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GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

VOLUME II: CONSTRUCTION

SECTION 2: SPECIAL TECHNICAL CONDITIONS

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University of Ljubljana
Faculty of Civil Engineering and Geodesy

DDC Consulting & Engineering Ltd.
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2.2.1 PREPARATORY WORKS

2.2.1.1 SURVEY WORKS

2.2.1.1.1 Description

Survey works comprise the following:

- setting out the alignment and other structures,
- all the measurements related to transferring the data from the drawings to the nature and vice versa, and
- maintaining setting out marks on the ground throughout the construction period, i.e. from the early beginning to the handing over of works.

The survey works also include taking into possession and maintaining all the fundamental surveying bases and drawings, as well as setting out in situ; the client shall submit those documents to the contractor at the beginning of works.

The supervising engineer is entitled to participate in all the measurements.

The extent of survey works shall entirely satisfy all the needs of construction, supervision, final account, and other issues providing conditions for the execution of works.

The survey works also comprise working out the technical documents, i.e. the as built-design, of a road and/or a bridge definitively set out and constructed. These documents shall be completed prior to technical inspection of the road and/or the bridge.

2.2.1.1.2 Method of execution

2.2.1.1.2.1 Handing over and taking over of alignment

The client is obliged to hand over the contractor the following:

- Road alignment set out in situ, regulations, and/or the set out bridge, including all the necessary information in writing.
- Only road, regulation, and/or bridge axis is set out at spacing directed by the ground characteristics, however not greater than 25 m. Access roads are generally set out along the edge of either decelerating or accelerating lane, or along the footway or the edge of the access road itself.
- Turning points set out in situ. The polygon shall relate to trigonometric points calculated according to Gauss-Krüger, with an admitted deviation in compliance with the rulebook of 1st order network of traverses.
- Height levels (benchmarks) determined at the location.
- Alignment drawing comprising the following constituent parts:
- Layout drawing at a scale of 1:1,000 containing the axis, the distance in kilometres, and an indication of alignment elements; in addition, the layout drawing also comprises sketches of how the principal points are connected to the polygon, including the required data for setting out;
- Calculation of principal points or, in case of an electronic calculation, the coordinates of the principal intermediate points including kilometre marking on the route;
- List of turning points including coordinates and topography of those points;
- List of benchmarks including their heights and topography.

For road accompanying structures of minor importance such as deviations, regulations, and similar, other surveying methods adapted to the type of structure and the ground can also be used, provided that the contractor will be able to carry out all the works without any disturbances.

On completion of the works, the contractor is obliged to renew the axis (layout and height) on the substructure formation, taking account of the sketch of turning point setting out. The supervising engineer shall check the correctness of the renewed axis. The axis shall also be renewed prior to placing the carriageway wearing course.

From the day of handing over on, the contractor is obliged to secure all the turning points and benchmarks. In case that certain in situ data (turning points, benchmarks) are lost or shifted, the contractor shall restore them at his expense. The supervising engineer shall check the correctness of the restored points.

2.2.1.1.2.2 Protection of set out axis

As soon as the contractor takes over the set out axis of the road or any other structure, he shall protect every profile both-sided (irrespective of the ground configuration) at such a distance from the fill or cut edge, that it remains undisturbed up to the completion of the works. Every point shall be protected with a triangle made of battens of 2.5/5 cm in cross-section. A protected point, i.e. a stake of 5/5 cm in cross-section, shall be equipped with a tack, and shall be painted above with red lead or other resistant paint. Each protection shall be levelled twice.

At a triangle, on the left and on the right, a board shall be placed, on which the profile number shall be written with larger ciphers, and the kilometre marking shall be indicated below. Red lead or any other suitable and durable paint shall be used.

2.2.1.1.2.3 Placing cross-sections

When the contractor is not satisfied with the submitted cross-sections from the main design, he has a right to resurvey individual cross-sections perpendicular to the road axis, by levelling or tacheometrically.

On fills and cut slopes, construction profiles shall be placed at inclinations as directed by drawn cross-sections. The section of the slopes with the ground shall be determined by calculation, taking account of the prescribed changes of slope inclinations.

The profiles (sections) shall be placed throughout the period of fill and/or cut construction, and shall be extended simultaneously with the work progress.

As a rule, construction profiles shall be made of battens of 2.5/5 cm, and stakes of 5/5 cm in cross-section. In high fills or cuts they shall be spaced at 50 m maximum. The supervising engineer has a right to order, as circumstances require, placing of additional intermediate construction profiles.

At slope inclinations, the fill or cut line is considered without topsoil and rounding off at the bottom or the top of the cut, or at the fill toe.

2.2.1.1.2.4 Setting out of structures

On the basis of data indicated in 2.2.1.1.4.1, the contractor shall set out all the structures according to his opinion and need; however, he is obliged to submit in advance to the engineer a setting out plan, which shall include al the required information according to 32.2.1.1.4.2 and 2.2.1.1.4.3. Placing cross-sections, protection of set out axis, and checking shall be carried out logically in the same way as it applies to the road alignment setting out, yet adjusted to the needs of a structure.

Setting out of a structure shall be double protected by means of cement concrete stakes placed on each side of the structure. The setting out drawing for major structures shall comprise a calculation of elements for checking the setting out in view of the layout, and for the pier construction including cross-sections.

2.2.1.1.3 Quality of execution

The accuracy of measurements shall comply with the geodesic norms for individual types of measurements, and with the required quality of individual works in accordance with the special technical conditions.

When the supervision engineer establishes that the survey does not ensure execution of works in compliance with the design, he may stop the survey works. The contractor is obliged either to take necessary arrangements for more accurate survey, or to carry out such measurements as directed by the engineer.

2.2.1.1.4 Quality control

Throughout the construction, the contractor shall check the set out alignment, and regularly renew al the ground marking, irrespective of who has caused the damage. In case of design modifications, the contractor is obliged to re-execute all the works indicated in 2.2.1.1.4.2. and 2.2.1.1.4.3. The contractor shall submit to the engineer all the information concerning setting out, and the engineer shall have a right to use all the marking for his purpose. When the engineer establishes by his own survey and checking the data that the survey performed by the contractor does not correspond, he is entitled to order all the survey works from an independent testing institution against contractor's account on the basis of actual expenses.

2.2.1.1.5 Measurement and taking over of works

2.2.1.1.5.1 Measurement

The survey works shall be measured as follows:

- setting out in kilometres of the road alignment set out
- placing profiles in pieces of both-sided placed profiles.

2.2.1.1.5.2 Taking over

On completion of works and prior to technical inspection, the contractor shall submit to the client/engineer the technical documents, i.e. the as-built design, of the set out and constructed road and/or bridge/structure in three copies. These documents shall also include the information on turning points and benchmarks according to 2.2.1.1.4.1. A record of taking over shall be made.

Prior to the technical inspection, the contractor shall repeatedly set out the axis or the edge of the carriageway, and mark the construction profiles with a durable paint.

2.2.1.1.6 Final account of works

The works executed shall be accounted on the basis of unit prices or lump sum prices in compliance with the contractual priced bill of quantities. The unit prices comprise all the work described in this section, including all the materials as well as external and internal transportations. The prices also comprehend all the additional measurements and setting out, including measurements at borrow pits and other similar cases, necessary to carry out the works. The contractor has no right to claim any extra payment for such works. The bases for a lump sum account shall be determined taking account of the percentage of the value of contractual works executed.

The price also includes the following:

- working out the technical documents (as-built design) of the set out and constructed road and/or bridge/structure; these documents shall be submitted to the client/engineer before or on the claim for the technical inspection of the road/structure/bridge;
- setting out of the axis or the edge of the carriageway, and
- marking construction profiles on the pavement surface.

In case that the contractor has performed inaccurate survey and provided unsuitable date, the client may order the survey works and checking the data from an independent testing institution against contractor's account.

2.2.1.2 CLEARING OF CONSTRUCTION SITE

2.2.1.2.1 Description

The clearing of construction site comprises the following:

- removal of shrubbery, trees, branches, and stumps,
- removal of traffic signs and equipment,
- demolishing and removal of pavement structures,
- demolishing and removal of structures.

2.2.1.2.1.1 Removal of shrubbery, trees, branches, and stumps

This work includes the following:

- felling and removal of shrubbery and trees,
- removal of branches of previously felled trees,
- removal of existing stumps as well as of those of newly felled trees,
- clearing or unearthing of surfaces including felling the shrubbery, trees, and branches, as well as digging out stumps and roots, separating stumps from the topsoil, removal of organic material, which could remain upon removal of shrubbery, trees, and branches, and transportation of all the abovementioned stuff to the appointed deposit areas out of the road alignment.

Areas to be cleared and/or unearthed shall be indicated in drawings, or specified by the engineer prior to commencement of the works.

2.2.1.2.1.2 Removal of traffic signs and equipment

This work includes the following:

- unearthing, dismantling, and displacement of traffic signs and informational boards,
- unearthing and dismantling of safety barriers and protective fences,
- unearthing and dismantling of delineators,
- removal of guard rails.

Traffic equipment intended for repeated use shall be indicated in the drawings. However, the engineer can also direct its repeated use.

2.2.1.2.1.3 Demolishing and removal of pavement structures

This work include the following:

- demolishing and removal of carriageway surfacing,
- milling, removal, and transportation of surfacing,
- cutting asphalt layers,
- demolishing and removal of kerbs.

All the works within the scope of demolition and removal of existing pavement structures shall be indicated in detail in the drawings. The engineer shall approve any deviation from the design.

2.2.1.2.1.4 Demolishing and removal of structures

This work includes the following:

- demolition and removal of culverts, sewage system, and shafts,
- demolition and removal of bridges,
- demolition and removal of buildings and walls.

Within the scope of demolition and removal all the structures shall be comprehended that could obstruct the works no matter how.

These works do not comprise removal of different installations in use such as high-voltage and low-voltage power cables, telecommunication installations, water supply, gas mains, and services to be displaced; however, those parts of the mentioned installations and services are included, which are considered as foundations or structural elements of massive material, that will be demolished after the mentioned installations and services are displaced.

2.2.1.2.2 Method of execution

2.2.1.2.2.1 Removal of shrubbery, trees, branches, and stumps

Shrubbery, trees, branches, and stumps shall be removed from all the areas indicated in drawings, and also from the individual places directed by the engineer (for individual tress and stumps).

The engineer has a right to appoint individual trees, which must remain untouched and undamaged. To prevent any damage to the trees appointed to stay at their places, other trees shall be felled very carefully. Where any damage to structures, other trees, or property has to be prevented, or when hazard is to be reduced or disturbance of property prevented, the trees shall be carefully felled from the top downwards.

All the stumps and roots shall be removed from the surfaces where excavation works for a new road alignment are planned, except from confined surfaces on slopes where they may be cut at the ground level. Stumps and roots shall be removed before the excavation of topsoil, turf, and/or fertile soil commences.

On the foundation soil surfaces from which layers of low bearing capacity have to be removed, or which are intended to be compacted, it is required to remove all the stumps and roots up to a depth of at least 20 cm below the foundation soil formation and/or at least 50 cm below the substructure formation.

When soils of low bearing capacity (of light-kneadable to viscid consistency) are excavated, roots and stumps shall be generally removed simultaneously with the soil excavation.

2.2.1.2.2.2 Other removals

Removals described in 2.2.1.2.1.2 to 2.2.1.2.1.4 shall be carried through from all the areas where clearing id required due to intended construction works, or due to aesthetical arrangement of the immediate road surroundings.

Traffic equipment shall be so unearthed and dismantled as to prevent damage to all the components, and to enable their repeated use. For this purpose, prior to dismantling, it shall be established in agreement with the engineer, which components need to be stored and protected from decaying, and which ones may be removed and cast off. The engineer shall appoint the location for storing the dismantled traffic equipment and signs, whilst the contractor shall store temporarily the dismantled components in his own storehouses being accessible to vehicles until they are taken over by the engineer. The latter shall appoint the date of taking over.

All the works related to demolishing and removal of pavement and different structures shall be so carried out as to ensure the smallest possible damage to adjoining structures, vegetation, and remaining roadway, and that the area of demolishing works shall be suitably functional for purposes foreseen by the design or directed by the engineer.

Removal of kerbs, demolition of bridges, buildings, and similar obstacles must be executed in such a way that those obstacles will be completely removed, that they will not represent any hindrance to proper work accomplishment, and that they will not affect the aesthetic appearance of both road and surroundings adversely. The contractor shall pay attention to preserve without any damage the components that are planned to be reused.

Parts of different services and installations to be displaced due to the road construction (such as foundations or massive structural members), and which cannot be dismantled or cut off, shall be removed in the same way as other installations within the scope of the site clearing.

The contractor shall select the method of demolishing and removing, taking account of all the regulations dealing with safety at work, and preventing any damage to and disturbance of other properties. The contractor is responsible for any damage due to the construction works.

The contractor has no right to claim any extra payment for such material. If the latter is suitable to contractual works, it can be reused.

2.2.1.2.3 Measurement and taking over of works

2.2.1.2.3.1 Measurement

The removal of shrubbery, trees, branches, and stumps of existing and newly felled trees, including all the works indicated in 2.2.1.2.1.1 and 2.2.1.2.4.1, is assessed according to the work actually performed.

The extent of other removals mentioned in 2.2.1.2.1.2 to 2.2.1.2.1.4, and in 2.2.1.2.4.2, shall be measured according to the work and quantity actually carried out, as well as to the corresponding unit.

2.2.1.2.3.2 Taking over

The executed works shall be taken over in compliance with the provisions of the general technical conditions, and of these special technical conditions.

2.2.1.2.4 Final account of works

All the quantities specified in 2.2.1.2.7.1 shall be accounted and paid according to unit prices indicated in the contractual priced bill of quantities.

A unit price represents a full compensation for all the working procedures indicated in 2.2.1.2.1 and 2.2.1.2.4, and/or necessary for a complete accomplishment of the works.

The work indicated in 2.2.1.2.4.1, 5th paragraph, shall be accounted in case of an excavation of soils of low bearing capacity.

2.2.1.3 OTHER PREPARATORY WORKS

2.2.1.3.1 Description

Other preparatory works comprise the following:

- traffic restriction,
- preparatory works for structures,
- reimbursements.

2.2.1.3.1.1 Traffic restriction

A public road contractor shall acquire in due time a permit by the relevant authority for all the works that might cause traffic restrictions.

To protect the traffic and the site during construction works, partial or complete traffic diversion or closure shall be carried out.

2.2.1.3.1.2 Preparatory works for structures

These works include particularly different provisional measures such as:

- placing temporary movable or fixed scaffoldings and structures,
- placing provisional fences,
- construction pit protection,
- provisional displacement of different installations/services.

The contractor shall execute all the works indicated in compliance with the design, and to acquire for these works a permit issued by the relevant authority or directorate.

2.2.1.3.1.3 Reimbursements

Reimbursements related to the construction works on national roads result particularly from the following:

- excessive use of municipal roads, and
- impediments, i.e. speed reductions and standstills in railway traffic.

For the works causing the abovementioned occurrences the contractor shall acquire a permit issued by the relevant authority or directorate.

2.2.1.3.2 Method of execution

2.2.1.3.2.1 Traffic restriction

Any traffic restriction on a public road shall be carried through in compliance with the Law of road traffic safety.

Site protection during construction works can be performed by a complete or a half traffic closure; in such cases the traffic shall be controlled by traffic lights or, exceptionally, manually.

Both type and location of a traffic closure shall be presented in detail by the traffic arrangement design; the closure shall be controlled throughout the works; as circumstances require, it shall also be supplemented or improved.

As soon as the traffic restriction becomes superfluous for the construction site protection, the contractor shall remove all the equipment that has been placed to restrict the traffic.

When traffic restriction is indispensable on a public road, it shall be executed to the smallest possible extent and to the shorter possible and professionally justified duration.

2.2.1.3.2.2 Preparatory works for structures

Within the scope of preparatory works for a structure, the contractor is obliged to arrange all the temporary diversions, bridging, stream diversions, as well as traffic protection below and at the structure, necessary for an undisturbed and safe execution of construction works, and traffic safety. All the works indicated shall be carried out in compliance with the design.

For all the provisional structures needed to build a bridge, the drawings shall be adjusted to the particularities of an individual structure.

The construction pit shall be sufficiently protected throughout the bridge construction to ensure a safe work. By pumping out the water it shall be made possible to execute all the required works in a dry construction pit.

All the temporary scaffoldings required to perform preparatory works within the scope of bridge construction shall be built of suitable materials to ensure the required stability and safety of such scaffolding throughout its use.

Where a provisional displacement of a power cable is indispensable within the scope of the bridge construction preparatory works, it shall be so carried through as to ensure an undisturbed electric energy supply throughout the preparatory works. An undisturbed supply shall also be ensured during provisional displacements of all other public utilities such as PTT cable, water main, sewage system, hot water conduit, gas main, and optical cable. All the required displacements within the scope of preparatory works for structures shall be carried out in accordance with the corresponding drawings. The planned permanent rearrangement shall be taken into account to the greatest possible extent.

2.2.1.3.2.3 Reimbursements

The contractor shall provide an adequate reimbursement on the basis of an objective evaluation of damage to existing roads due to loads imposed by heavy vehicles performing transport for the needs of construction works.

Suitable reimbursement shall also be ensured for all impediments (such as speed reductions and standstills) in railway traffic, when these result from the national road construction.

2.2.1.3.3 Quality of execution

All the preparatory works described in this chapter shall be executed in compliance with the quality requirements indicated in corresponding design documents, and in these special technical conditions, as well as in accordance with engineer's instructions.

In case that the supervising engineer finds out that the preparatory works indicated in 2.2.1.3.4.2 does not meet the quality requirements as directed by design documents, he is entitled to stop the works and to direct making good of the deficiencies established.

2.2.1.3.4 Measurement and taking over of works

2.2.1.3.4.1 Measurement

The extent of preparatory works mentioned in this chapter shall be specified in detail by the design. The engineer shall find out whether the intended works have actually been executed, or he shall determine the extent of the work actually carried out.

2.2.1.3.4.2 Taking over

Works performed to the extent indicated in 2.2.1.3.7.1 shall be taken over by the engineer in compliance with the provisions of these general and special technical conditions.

2.2.1.3.5 Final account of works

All the executed works indicated in 2.2.1.3.7.1, and taken over in compliance with 2.2.1.3.7.2, shall be accounted and paid according to the unit prices indicated in the contractual priced bill of quantities. Eventual additional works shall be accounted in accordance with the provisions of general technical (2.2.3.1.6.3).

2.2.1.4 PREPARATORY WORKS FOR STRUCTURAL REPAIR

2.2.1.4.1 Description

Preparatory works for structural repair comprise particularly the following:

- removal of precast members,
- demolition of monolithic members,
- removal of cement concrete and mortar,
- removal of expansion joint components,
- cutting of cement concrete,
- boring holes into cement concrete,
- removal of damaged parts and installations.

All the damaged surfaces of a structure that need to be repaired shall be precisely defined in the design documents, or shall be directed by the engineer on the basis of the actual condition of the structure prior to commencement of the works.

The unit price of the preparatory works mentioned above shall include all the activities required for a complete accomplishment of contractual obligations.

2.2.1.4.2 Method of execution

A detailed method of execution of abovementioned preparatory works for structural repair shall be defined in the design documents. In case that the engineer establishes some deviations of the actual conditions of the damaged structure from the foreseen ones, he has a right to direct a modification of the method, however within the scope of contractual provisions.

All the preparatory works for structural repair shall be so carried out as to ensure safety at work and to prevent damage to adjacent unaffected structural surfaces or to the environment.

Precast structural members and expansion joint components, which are not damaged, shall be so removed as to prevent damage to those elements, and to enable their reuse.

To demolish monolithic structural members, and to remove affected concrete, machine operations shall be introduced to the greatest possible extent. The engineer is entitled to modify the planned method and extent within the contractual priced bill of quantities, if he ascertains that the foreseen purpose would not be achieved by means of the planned method.

Where structural repair requires uncovering of reinforcement, the sound rebar cross-section must not be damaged.

Mortar shall be removed from joints of stone and brick walls to such an extent as to enable a required adhesion of the newly applied mortar to the cleaned stone or brick within the joint.

To cut non-reinforced or reinforced concrete and stone, suitable machine equipment (e.g. diamond saw or cord) shall be used enabling an accurate execution of the planned intervention. This shall be taken into account in boring holes as well.

Also all other required removals of elements of an existing bridge, such as arches, dewatering equipment, waterproofing, shall be carried out thoroughly and to the planned extent.

2.2.1.4.3 Quality of execution

All the preparatory works for structural repair indicated in 2.2.1.4.1 shall be executed in compliance with quality requirements, and shall be harmonized with regulations, with provisions and requirements of design documents, as well as in compliance with these technical conditions, and engineer’s instructions.

The contractor is obliged to draw engineer’s attention to all the problems occurring on execution of the aforementioned preparatory works, and affecting the quality of the works performed. When the contractor fails to draw engineer’s attention to such problems, he takes all the responsibility and all the costs of an eventual repair.

2.2.1.4.4 Quality control

The supervising engineer shall verify, whether the quality of the works performed complies with the provisions of the design. When the engineer ascertains that the preparatory works described in 2.2.1.4.1 have not been carried through in accordance with the design, he is entitled to stop the works and to request making good of defects established.

2.2.1.4.5 Measurement and taking over of works

Executed works shall be measured according to units indicated in the contractual priced bill of quantities. and in compliance with the item 2.1.6.1 of general technical conditions.

The extent of all the works performed shall generally comply with the planned extent of works.

Taking over of preparatory works executed for structural repair shall be carried out in accordance with item 2.1.6.2 of general technical conditions.

2.2.1.4.6 Final account of works

The executed preparatory works shall be accounted and paid according to unit prices indicated in the contractual priced bill of quantities. All the additional works approved by the engineer shall be accounted in compliance with provisions of item 2.1.6.3 of the general technical conditions.

2.2.1.5 GEOTECHNICAL CONTROL OF TUNNEL CONSTRUCTION

Geotechnical control of tunnel construction, which is described in detail in clause 2.2.9 of these technical conditions, comprises the following:

2.2.1.5.1 General:

- scope
- description of instruments to perform geotechnical measurements
- documentation

2.2.1.5.2 Materials:

- benchmarks
- anchors to measure convergence
- prisms or reflection targets
- theodolite
- accurate tape measure
- extensometer in the borehole
- inclinometer
- measuring anchors

2.2.1.5.3 Execution:

- general requirements
- reading, drawing, interpretation
- geological control and map work.

2.2.1.5.4 Measurement and Payment

In addition to requirements indicated in 2.2.8 of the technical conditions, the following conditions shall be considered for anchors for measuring convergence in the geotechnical control of the tunnel construction:

- an anchor for measuring convergence in the primary lining shall be manufactured of galvanized ribbed steel bar with a thread at the anchor head, onto which a tape measure or a measuring target will be fixed; the anchor diameter shall amount to at least 20 mm, and the anchor itself shall be firmly fixed to either rock or shot cement concrete. The measuring part of the anchor shall be protected from mechanical damage, and covered with a protective cap, which shall be clearly visible in the tunnel.
- an anchor for measuring convergence in the secondary lining shall be 20 cm long and made of a ribbed stainless steel bar, having a thread at the anchor head, onto which a tape measure or a measuring target shall be fixed; the anchor diameter shall amount to at least 20 mm, and the anchor itself shall be firmly fixed to the inner cement concrete lining. The measuring part of the anchor shall be protected from mechanical damage, and covered with a protective cap, which shall be clearly visible in the tunnel.

Besides the costs indicated in the technical conditions for the geotechnical control of tunnel construction, the unit prices should also include the following costs:

- for the execution of initial measurements (zero measurement)
- for difficulties due to excavation works
- for all the obstacles due to progress of construction works
- for purchasing and maintaining all the auxiliary means to carry out measurements, such as lighting, ladders, lifts, etc.
- for maintenance of measuring anchors as measuring targets, and their protection
- for maintenance of free lines of sight between standing-points and measuring profiles
- for establishing and securing fixed surveying reference points (benchmarks) both inside and outside the tunnel.

Boring works required for inserting anchors to measure convergences shall be taken into account in the price of placing convergence anchors, whereas boring works for placing extensometers shall be included in the price for the individual item.

2.2.1.6 PREPARATORY WORKS. - BILL OF WORKS

2.2.1.6.1 Survey works

Item	Unit	Description of work:
11 111	km	Renewal and protection of set out alignment axis of motorway and expressways on plain ground
11 112	km	Renewal and protection of set out alignment axis of motorway and expressways on hilly ground
11 113	km	Renewal and protection of set out alignment axis of motorway and expressways on mountainous ground
11 121	km	Renewal and protection of set out alignment axis of other public roads on plain ground
11 122	km	Renewal and protection of set out alignment axis of other public roads on hilly ground
11 123	km	Renewal and protection of set out alignment axis of other public roads on mountainous ground
11 211	pc	Placing and protection of cross-section of motorway and expressway on plain ground
11 212	pc	Placing and protection of cross-section of motorway and expressway on hilly ground
11 213	pc	Placing and protection of cross-section of motorway and expressway on mountainous ground
11 221	pc	Placing and protection of cross-section of other public roads on plain ground
11 222	pc	Placing and protection of cross-section of other public roads on hilly ground
11 223	pc	Placing and protection of cross-section of other public roads on mountainous ground
11 311	pc	Placing and protection of profiles for setting out a structure of an area up to 50 m^2
11 312	pc	Placing and protection of profiles for setting out a structure of an area between 51 m^2 and 100 m^2
11 313	pc	Placing and protection of profiles for setting out a structure of an area above 100 m^2
11 321	pc	Determination and checking situations, heights, and directions for construction of a structure of an area up to 200 m^2
11 322	pc	Determination and checking situations, heights, and directions for construction of a structure of an area between 201 $m^{2\text{ and}}$ 500 m^2
11 323	pc	Determination and checking situations, heights, and directions for construction of a structure of an area above 500 m^2
11 331	pc	Placing and protection of cross-section for noise barrier
11 411	km	Repeated setting out and protection of set out alignment of motorway and expressway during the works
11 412	km	Repeated setting out and protection of set out alignment of other public roads during the works
11 421	km	Renewal and protection of set out alignment of motorway or expressway – final setting out
11 422	km	Renewal and protection of set out alignment of other public works – final setting out
11 511	pc	Setting out as well as providing and checking heights and directions for repair and rehabilitation works of a structure of an area up to 200 m^2
11 512	pc	Setting out as well as providing and checking heights and directions for repair and rehabilitation works of a structure of an area between 201 m^2 and 500 m^2
11 513	pc	Setting out as well as providing and checking heights and directions for repair and rehabilitation works of a structure of an area above 500 m^2

Item	Unit	Description of work:
11 611	pc	Survey of heights of existing vertical alignment of asphalt on bridge and access ramps in three points of cross-section (cross-sections spaced at 5 m)
11 621	pc	Survey of heights of cement concrete of existing bridge carriageway slab (after removal of asphalt layer and waterproofing) in three points of cross-section (cross-sections spaced at 5 m)
11 631	pc	Survey of height and position of the reference point (benchmark) on ground/bridge (within the scope of monitoring of movements)
11 641	pc	Placing profiles and providing heights of bridge carriageway slab (profiles spaced at 5 m)

2.2.1.6.2 Clearing of construction site

2.2.1.6.2.1 Removal of shrubbery, trees, branches, and stumps

Item	Unit	Description of work
12 111	m^2	Removal of shrubbery from sparsely vegetated surface – manually
12 112	m^2	Removal of shrubbery from sparsely vegetated surface – with machines
12 121	m^2	Removal of shrubbery from densely vegetated surface – manually
12 122	m^2	Removal of shrubbery from densely vegetated surface – with machines
12 131	m^2	Removal of shrubbery and a tree of trunk of diameter up to 10 cm, and branches from sparsely vegetated surface – manually
12 132	m^2	Removal of shrubbery and a tree of trunk of diameter up to 10 cm, and branches from sparsely vegetated surface – with machines
12 141	m^2	Removal of shrubbery and a tree of trunk of diameter up to 10 cm, and branches from densely vegetated surface – manually
12 142	m^2	Removal of shrubbery and a tree of trunk of diameter up to 10 cm, and branches from densely vegetated surface – with machines
12 151	pc	Felling and removal of a tree of trunk of diameter between 11 cm and 30 cm, and removal of branches
12 152	pc	Felling and removal of a tree of trunk of diameter between 31 cm and 50 cm, and removal of branches
12 153	pc	Felling and removal of a tree of trunk of diameter above 50 cm, and removal of branches
12 161	pc	Removal of a stump of diameter between 11 cm and 30 cm, including transportation to deposit area
12 162	pc	Removal of a stump of diameter between 31 cm and 50 cm, including transportation to deposit area
12 163	pc	Removal of a stump of diameter above 50 cm, including transportation to deposit area
12 171	pc	Removal of a stump of diameter between 11 cm and 30 cm, including processing
12 172	pc	Removal of a stump of diameter between 31 cm and 50 cm, including processing
12 173	pc	Removal of a stump of diameter between above 50 cm, including processing

Item	Unit	Description of work
12 181	hr	Removal of branches of preliminarily felled trees

2.2.1.6.2.2 Removal of traffic signs and equipment

Item	Unit	Description of work
12 211	pc	Dismantling of traffic sign on one socle
12 212	pc	Dismantling of traffic sign on two socles
12 221	pc	Dismantling of informational board of an area up to 1 m^2
12 222	pc	Dismantling of informational board of an area between 1.1 m^2 and 3 m^2
12 223	pc	Dismantling of informational board of an area above 3 m^2
12 231	m^1	Dismantling of steel safety barrier
12 232	m^1	Dismantling of wooden safety barrier
12 233	m^1	Dismantling of cement concrete safety barrier (New Jersey)
12 234	m^1	Dismantling of .... safety barrier
12 241	m^2	Dismantling of metal noise barrier
12 242	m^2	Dismantling of wooden noise barrier
12 243	m^2	Dismantling of cement concrete noise barrier
12 244	m^2	Dismantling of transparent noise barrier
12 245	m^2	Dismantling of .... noise barrier
12 251	m^1	Dismantling of protective fence of height up to 1 m
12 252	m^1	Dismantling of protective fence of height between 1.1 m and 1.5 m
12 253	m^1	Dismantling of protective fence of height between 1.6 m and 2 m
12 254	m^1	Dismantling of protective fence of height above 2 m
12 261	pc	Dismantling of plastic delineator
12 262	pc	Dismantling of stone delineator
12 263	pc	Dismantling of cement concrete delineator
12 264	pc	Dismantling of .... delineator
12 271	pc	Displacement of traffic sign
12 272	pc	Displacement of informational board
12 281	m^2	Demolition and removal of guard rail made of wire mesh
12 282	m^2	Demolition and removal of guard rail made of wooden elements
12 283	m^2	Demolition and removal of guard rail made of steel elements
12 284	m^2	Demolition and removal of guard rail made of cement concrete elements
12 285	m^2	Demolition and removal of guard rail made of brick or hollow tile
12 286	m^2	Demolition and removal of guard rail made of ....
12 291	pc	Dismantling of pillars for meteorological equipment on the structure

2.2.1.6.2.3 Demolition and removal of pavement structures

Item	Unit	Description of work
12 311	m^2	Demolition and removal of macadam carriageway in a thickness up to 20 cm
12 312	m^2	Demolition and removal of macadam carriageway in a thickness above 20 cm
12 321	m^2	Demolition and removal of asphalt surfacing in a thickness up to 5 cm
12 322	m^2	Demolition and removal of asphalt surfacing in a thickness between 6 cm and 10 cm
12 323	m^2	Demolition and removal of asphalt surfacing in a thickness above 10 cm
12 331	m^2	Demolition and removal of cement concrete surfacing in a thickness up to 15 cm
12 332	m^2	Demolition and removal of cement concrete surfacing in a thickness between 16 cm and 22 cm
12 333	m^2	Demolition and removal of cement concrete surfacing in a thickness above 22 cm
12 341	m^2	Demolition and removal of carriageway paved with cubes of side up to 8 cm
12 342	m^2	Demolition and removal of carriageway paved with cubes of side between 9 cm and 12 cm
12 343	m^2	Demolition and removal of carriageway paved with cubes of side between 13 cm and 18 cm
12 344	m^2	Demolition and removal of carriageway paved with cubes of side above 18 cm
12 351	m^2	Demolition and removal of unbound pavement made of quarry stone, paving stones, and slabs in a thickness up to 12 cm
12 352	m^2	Demolition and removal of unbound pavement made of quarry stone, paving stones, and slabs in a thickness between 13 cm and 18 cm
12 353	m^2	Demolition and removal of unbound pavement made of quarry stone, paving stones, and slabs in a thickness above 18 cm
12 361	m^2	Demolition and removal of bound pavement in a thickness up to 12 cm
12 362	m^2	Demolition and removal of bound pavement in a thickness between 13 cm and 18 cm
12 363	m^2	Demolition and removal of bound pavement in a thickness above 18 cm
12 371	m^2	Milling and removal of asphalt surfacing in a thickness up to 3 cm
12 372	m^2	Milling and removal of asphalt surfacing in a thickness between 4 and 7 cm
12 373	m^2	Milling and removal of asphalt surfacing in a thickness between 8 and 10 cm
12 374		Milling and removal of asphalt surfacing in a thickness above 10 cm
12 381	m^1	Cutting asphalt layer with floor diamond saw in a thickness up to 5 cm
12 382	m^1	Cutting asphalt layer with floor diamond saw in a thickness between 6 cm and 10 cm
12 383	m^1	Cutting asphalt layer with floor diamond saw in a thickness between 11 cm and 15 cm
12 384	m^1	Cutting asphalt layer with floor diamond saw in a thickness between 16 cm and 20 cm
12 385	m^1	Cutting asphalt layer with floor diamond saw in a thickness above 20 cm
12 391	m^1	Demolition and removal of cement concrete kerb
12 392	m^1	Demolition and removal of stone kerb
12 393	m^1	Demolition and removal of kerb made of stone cubes
12 394	m^1	Demolition and removal of asphalt kerb

2.2.1.6.2.4 Demolition and removal of structures

Item	Unit	Description of work
12 411	m^1	Demolition and removal of culvert of diameter up to 60 cm
12 412	m^1	Demolition and removal of culvert of diameter between 61 cm and 100 cm
12 413	m^1	Demolition and removal of culvert of diameter above 100 cm
12 415	m^1	Demolition and removal of parabolic culvert of height up to 80 cm
12 416	m^1	Demolition and removal of parabolic culvert of height between 81 cm and 120 cm
12 417	m^1	Demolition and removal of parabolic culvert of height between 121 cm and 200 cm
12 418	m^1	Demolition and removal of parabolic culvert of height above 200 cm
12 421	m^1	Demolition and removal of sewage system of diameter up to 40 cm
12 422	m^1	Demolition and removal of sewage system of diameter between 41 cm and 80 cm
12 423	m^1	Demolition and removal of sewage system of diameter between 81 cm and 120 cm
12 424	m^1	Demolition and removal of sewage system of diameter above 120 cm
12 431	pc	Demolition and removal of shaft of side/diameter up to 60 cm
12 432	pc	Demolition and removal of shaft of side/diameter between 61 cm and 100 cm
12 433	pc	Demolition and removal of shaft of side/diameter above 100 cm
12 441	m^2	Demolition and removal of slab-top culvert made of cement concrete, of span up to 3 m
12 442	m^2	Demolition and removal of slab-top culvert made of cement concrete, of span above 3 m
12 451	m^2	Demolition and removal of reinforced cement concrete bridge of span above 5 m
12 452	m^2	Demolition and removal of wooden bridge of span above 5 m
12 453	m^2	Demolition and removal of stone bridge of span above 5 m
12 454	m^2	Demolition and removal of steel bridge of span above 5 m
12 455	m^2	Demolition and removal of composite steel-concrete bridge of span above 5 m
12 456	m^2	Demolition and removal of .... bridge of span above 5 m
12 461	m^2	Demolition and removal of prefabricated structure – shed
12 462	m^2	Demolition and removal of prefabricated structure – corn rack
12 463	m^2	Demolition and removal of prefabricated structure – barrack
12 471	m^3	Demolition and removal of brick wall in lime mortar
12 472	m^3	Demolition and removal of brick wall in cement mortar
12 473	m^3	Demolition and removal of stone wall in dry mortar
12 474	m^3	Demolition and removal of stone wall in cement-lime mortar
12 475	m^3	Demolition and removal of stone wall in cement mortar
12 476	m^3	Demolition and removal of cement concrete wall
12 477	m^3	Demolition and removal of reinforced cement concrete wall
12 481	m^2	Demolition and removal of building – wooden
12 482	m^2	Demolition and removal of building – of brick, of height up to 10 m
12 483	m^2	Demolition and removal of building – of brick, of height above 10 m
12 484	m^2	Demolition and removal of building – of stone
12 485	m^2	Demolition and removal of building – of ....
12 488	pc	Demolition and removal of building – sacral monument

Item	Unit	Description of work
12 489	pc	Demolition and removal of building – chapel
12 491	m^3	Demolition and removal of stone cribwork
12 492	m^3	Demolition and removal of gabion
12 493	m^3	Demolition and removal of packed rockfill

2.2.1.6.3 Other preparatory works

2.2.1.6.3.1 Traffic restrictions

Item	Unit	Description of work
13 111	day	Protection of site during construction by half traffic closure and traffic light control
13 112	day	Protection of site during construction by half traffic closure and manual control
13 113	day	Protection of site during construction by complete traffic closure
13 121	day	Protection of site during construction in railway traffic area by periodical traffic closure in compliance with traffic regulations
13 131	day	Placing, control, and removal of one-day traffic closure of type »A« or »B«, according to reviewed and approved traffic arrangement design
13 132	day	Placing, control, and removal of traffic closure of type »A« or »B« in duration of up to 10 days, according to reviewed and approved traffic arrangement design
13 133	day	Placing, control, and removal of traffic closure of type »A« or »B« in duration of more than 10 days, according to reviewed and approved traffic arrangement design
13 134	day	Placing, control, and removal of traffic closure of type »C« in duration of up to 10 days, according to reviewed and approved traffic arrangement design
13 135	day	Placing, control, and removal of traffic closure of type »C« in duration of more than 10 days, according to reviewed and approved traffic arrangement design
13 141	day	Traffic arrangement and diversion on one traffic lane by means of traffic lights and corresponding horizontal and vertical signs, according to reviewed and approved traffic arrangement design

2.2.1.6.3.2 Preparatory works for structures

Item	Unit	Description of work
13 211	KM	Preparatory works
13 221	pc	Arrangement of temporary bypass during construction according to design
13 222	pc	Arrangement of temporary bridging natural obstacle according to design
13 223	pc	Arrangement of temporary diversion of water stream according to design
13 224	pc	Arrangement of temporary artificial island for working field according to design
13 225	m^2	Arrangement of temporary traffic protection under bridge with fixed scaffolding of clear height of 4.75 m
13 226	m^1	Arrangement of temporary barrier of height of 1.5 m to protect the traffic on parallel traffic lane during removal of carriageway slab cement concrete

Item	Unit	Description of work
13 231	pc	Execution of all provisional structures for free cantilevering method
13 232	pc	Execution of all provisional structures for incremental launching method
13 233	pc	Execution of all provisional structures for construction on fixed falsework
13 234	pc	Execution of all provisional structures for .... construction method
13 241	pc	Protection of construction pit with sheet piles during construction
13 242	pc	Protection of construction pit with piles according to Jet Grouting system during construction
13 243	pc	Protection of construction pit with piles/pile wall during
13 244	pc	Protection of construction pit with .... during construction
13 251	hr	Pumping water to protect construction pit, up to 5 l/s
13 252	hr	Pumping water to protect construction pit, between to 6 l/s and 15 l/s
13 253	hr	Pumping water to protect construction pit, above 15 l/s
13 261	m^2	Movable scaffolding for works on lower side of superstructure, scaffolding height up to 5.0 m
13 262	m^2	Movable scaffolding for works on lower side of superstructure, scaffolding height between 5.1 m and 10.0 m
13 263	m^2	Movable scaffolding for works on lower side of superstructure, scaffolding height between 10.1 m and 15.0 m
13 264	m^2	Movable scaffolding for works on lower side of superstructure, scaffolding height above 15.0 m
13 271	m^2	Fixed scaffolding for works on lower side of superstructure, scaffolding height up to 5.0 m
13 272	m^2	Fixed scaffolding for works on lower side of superstructure, scaffolding height between 5.1 m and 10.0 m
13 273	m^2	Fixed scaffolding for works on lower side of superstructure, scaffolding height between 10.1 m and 15.0 m
13 274	m^2	Movable scaffolding for works on lower side of superstructure, scaffolding height above 15.0 m
13 281	m^2	Fixed scaffolding for works on piers, scaffolding height up to 5.0 m
13 282	m^2	Fixed scaffolding for works on piers, scaffolding height between 5.1 m and 10.0 m
13 283	m^2	Fixed scaffolding for works on piers, scaffolding height between 10.1 m and 15.0 m
13 284	m^2	Fixed scaffolding for works on piers, scaffolding height between 15.1 m and 20.0 m
13 285	m^2	Fixed scaffolding for works on piers, scaffolding height between 20.1 m and 30.0 m
13 286	m^2	Fixed scaffolding for works on piers, scaffolding height between 30.1 m and 40.0 m
13 287	m^2	Fixed scaffolding for works on piers, scaffolding height above 40.0 m
13 291	m^1	Temporary displacement of low voltage power cable installations in bridge area
13 292	m^1	Temporary displacement of high voltage power cable installations in bridge area
13 293	m^1	Temporary displacement of PTT cable installation in bridge area

Item	Unit	Description of work
13 294	m^1	Temporary displacement of water main of pipes of .... mm in diameter in bridge area
13 295	m^1	Temporary displacement of sewage system of pipes of .... mm in diameter in bridge area
13 296	m^1	Temporary displacement of hot water conduit of pipes of .... mm in diameter in bridge area
13 297	m^1	Temporary displacement of low pressure gas main of pipes of .... mm in diameter in bridge area
13 298	m^1	Temporary displacement of high pressure gas main of pipes of .... mm in diameter in bridge area
13 299	m^1	Temporary displacement of optical cables in pipes of .... mm in diameter in bridge area

2.2.1.6.3.3 Reimbursements

Item	Unit	Description of work
13 311	KM	Reimbursement for use of municipal road during national road construction or maintenance
13 312	KM	Reimbursement for excessive use of municipal road during national road construction or maintenance
13 321	KM	Reimbursement for speed reduction of railway traffic during national road construction or maintenance
13 322	KM	Reimbursement for closure of railway traffic during national road construction or maintenance
13 331	hr	Standstill of tunnel excavation lasting 2-12 hours due to inadmissible concentration of explosive gases
13 332	hr	Standstill of tunnel excavation lasting 12-24 hours due to inadmissible concentration of explosive gases
13 333	hr	Standstill of tunnel excavation lasting more than 24 hours due to inadmissible concentration of explosive gases
13 341	day	Standstill of the complete tunnel construction due to force majeure, or engineer's order, lasting more than 1 day

2.2.1.6.4 Preparatory works for structural repair

Item	Unit	Description of work
14 111	m^1	Removal of precast elements of walkway and edge beam of cross-section area up to 0.20 m^2
14 112	m^1	Removal of precast elements of walkway and edge beam of cross-section area between 0.21 m^2 and 0.30 m^2
14 113	m^1	Removal of precast elements of walkway and edge beam of cross-section area between 0.31 m^2 and 0.40 m^2
14 114	m^1	Removal of precast elements of walkway and edge beam of cross-section area between 0.41 m^2 and 0.50 m^2
14 115	m^1	Removal of precast elements of walkway and edge beam of cross-section area above 0.50 m^2
14 121	m^1	Demolition of monolitihic cement concrete of walkway and edge beam of

Item	Unit	Description of work
		cross-section area up to 0.20 m^2
14 122	m^1	Demolition of monolitihic cement concrete of walkway and edge beam of cross-section area between 0.21 m^2 and 0.30 m^2
14 123	m^1	Demolition of monolitihic cement concrete of walkway and edge beam of cross-section area between 0.31 m^2 and 0.40 m^2
14 124	m^1	Demolition of monolitihic cement concrete of walkway and edge beam of cross-section area between 0.41 m^2 and 0.50 m^2
14 125	m^1	Demolition of monolitihic cement concrete of walkway and edge beam of cross-section area above 0.50 m^2
14 131	m^1	*Removal of mortar or cement concrete without uncovering reinforcement, horizontal or inclined surface up to 20°, individual surface above 10 m^2, depth up to 10 mm*
14 133	m^1	Allowance for manual removal
14 134	m^1	Allowance for machine removal by chiselling
14 135	m^1	Allowance for machine removal with high-pressure water jet
14 136	m^1	Allowance for machine removal with milling machine
14 137	m^1	Allowance for inclined surface between 21˚and 70˚
14 138	m^1	Allowance for inclined surface between 71˚and 90˚
14 139	m^1	Allowance for overhead surface
14 140	m^1	Allowance for individual area of removal of up to 0.05 m^2
14 141	m^1	Allowance for individual area of removal between 0.051 m^2 and 0.20 m^2
14 142	m^1	Allowance for individual area of removal between 0.21 m^2 and 1.00 m^2
14 143	m^1	Allowance for individual area of removal between 1.1 m^2 and 10 m^2
14 144	m^1	Allowance for individual area of removal above 10 m^2
14 145	m^1	Allowance for depth of removal up to 10 mm
14 146	m^1	Allowance for depth of removal between 11 mm and 20 mm
14 147	m^1	Allowance for depth of removal between 21 mm and 30 mm
14 148	m^1	Allowance for depth of removal between 31 mm and 40 mm
14 149	m^1	Allowance for depth of removal above 40 mm
14 151	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth up to 10 mm
14 152	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 11 mm and 20 mm
14 153	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 21 mm and 30 mm
14 154	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm
14 155	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth above 40 mm
14 161	m^2	Removal of cement concrete by chiselling, manually or with machines,

Item	Unit	Description of work
		without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth up to 10 mm
14 162	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 11 mm and 20 mm
14 163	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 21 mm and 30 mm
14 164	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm
14 165	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth above 40 mm
14 171	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 10 mm
14 172	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 11 mm and 20 mm
14 173	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 21 mm and 30 mm
14 174	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 175	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 40 mm
14 181	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 10 mm
14 182	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 183	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 184	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 185	m^2	Removal of cement concrete by chiselling, manually or with machines,

Item	Unit	Description of work
		without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 40 mm
14 191	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 192	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 193	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm
14 194	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 195	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, horizontal or inclined surface up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 40 mm
14 201	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth up to 10 mm
14 202	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth between 11 mm and 20 mm
14 203	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth between 21 mm and 30 mm
14 204	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm
14 205	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth above 40 mm
14 211	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth up to 10 mm
14 212	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 11 mm and 20 mm
14 213	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 21 mm and 30 mm
14 214	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm

Item	Unit	Description of work
14 215	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth above 40 mm
14 221	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 10 mm
14 222	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 11 mm and 20 mm
14 223	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 21 mm and 30 mm
14 224	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 225	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 40 mm
14 231	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 10 mm
14 232	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 233	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 234	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 235	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 40 mm
14 241	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 242	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 243	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm

Item	Unit	Description of work
14 244	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 245	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, vertical or inclined surface up to 20° to vertical, individual cross-section area above 10.0 m^2, depth above 40 mm
14 251	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area up to 0.05 m^2, depth up to 10 mm
14 252	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area up to 0.05 m^2, depth between 11 mm and 20 mm
14 253	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area up to 0.05 m^2, depth between 21 mm and 30 mm
14 254	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm
14 255	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area up to 0.05 m^2, depth above 40 mm
14 261	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth up to 10 mm
14 262	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 11 mm and 20 mm
14 263	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 21 mm and 30 mm
14 264	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm
14 265	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth above 40 mm
14 271	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 10 mm
14 272	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 11 mm and 20 mm
14 273	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal,

Item	Unit	Description of work
		individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 21 mm and 30 mm
14 274	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 275	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 40 mm
14 281	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 10 mm
14 282	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 283	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 284	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 285	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 40 mm
14 291	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 292	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 293	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 21 mm and 20 mm
14 294	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 295	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, inclined surface by 20° to 70° to horizontal, individual cross-section area above 10.0 m^2, depth above 40 mm
14 301	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth up to 10 mm
14 302	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between

Item	Unit	Description of work
		11 mm and 20 mm
14 303	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 21 mm and 30 mm
14 304	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm
14 305	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth above 40 mm
14 311	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth up to 10 mm
14 312	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 11 mm and 20 mm
14 313	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 21 mm and 30 mm
14 314	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm
14 315	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth above 40 mm
14 321	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or surface by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 10 mm
14 322	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 11 mm and 20 mm
14 323	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 21 mm and 30 mm
14 324	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 325	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or surface by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 40 mm
14 331	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by

Item	Unit	Description of work
		20° to horizontal, individual cross-section area between 1.0 m^2 and 10.0 m^2, depth up to 10 mm
14 332	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.0 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 333	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.0 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 334	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.0 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 335	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.0 m^2 and 10.0 m^2, depth above 40 mm
14 341	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 342	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 343	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm
14 344	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 345	m^2	Removal of cement concrete by chiselling, manually or with machines, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 40 mm
14 351	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth up to 30 mm
14 352	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm
14 353	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 41 mm and 50 mm
14 354	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 0.05 m^2, depth above 50
14 361	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2,

Item	Unit	Description of work
		depth up to 30 mm
14 362	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm
14 363	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 41 mm and 50 mm
14 364	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth above 50 mm
14 371	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 30 mm
14 372	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 373	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 41 mm and 50 mm
14 374	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 50 mm
14 381	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 382	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 383	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 384	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm
14 391	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 392	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 393	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 41

Item	Unit	Description of work
		mm and 50 mm
14 394	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 50 mm
14 401	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth up to 30 mm
14 402	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm
14 403	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth between 41 mm and 50 mm
14 404	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 0.05 m^2, depth above 50 mm
14 411	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth up to 30 mm
14 412	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm
14 413	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 41 mm and 50 mm
14 414	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth above 50 mm
14 421	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 30 mm
14 422	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 423	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 41 mm and 50 mm
14 424	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 50 mm
14 431	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm

Item	Unit	Description of work
14 432	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 433	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 434	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm
14 441	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 442	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 443	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 41 mm and 50 mm
14 444	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth above 50 mm
14 451	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area up to 0.05 m^2, depth up to 30 mm
14 452	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm
14 453	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area up to 0.05 m^2, depth between 41 mm and 50 mm
14 454	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area up to 0.05 m^2, depth above 50 mm
14 461	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth up to 30 mm
14 462	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm
14 463	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 41 mm and 50 mm
14 464	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2,

Item	Unit	Description of work
		depth above 50 mm
14 471	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 30 mm
14 472	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 473	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 41 mm and 50 mm
14 474	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 50 mm
14 481	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 482	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 483	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 484	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm
14 491	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 492	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 493	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 41 mm and 50 mm
14 494	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, surface inclined between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth above 50 mm
14 501	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth up to 30 mm
14 502	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 31 mm and 40 mm

Item	Unit	Description of work
14 503	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth between 41 mm and 50 mm
14 504	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 0.05 m^2, depth above 50 mm
14 511	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth up to 30 mm
14 512	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 31 mm and 40 mm
14 513	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth between 41 mm and 50 mm
14 514	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.051 m^2 and 0.20 m^2, depth above 50 mm
14 521	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth up to 30 mm
14 522	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 31 mm and 40 mm
14 523	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth between 41 mm and 50 mm
14 524	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 0.21 m^2 and 1.0 m^2, depth above 50 mm
14 531	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 532	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 533	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 534	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm

Item	Unit	Description of work
14 541	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 542	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 543	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 544	m^2	Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm Removal of cement concrete by chiselling, manually or with machines, with uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 551	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area up to 10.0 m^2, depth up to 10 mm
14 552	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area up to 10.0 m^2, depth between 11 mm and 20 mm
14 553	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area up to 10.0 m^2, depth between 21 mm and 30 mm
14 554	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area up to 10.0 m^2, depth above 30 mm
14 561	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 562	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 563	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm
14 564	m^2	Milling of cement concrete, horizontal surfaces or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 30 mm
14 571	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth up to 10 mm
14 572	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 11 mm and 20 mm
14 573	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 21 mm and 30 mm
14 574	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth above 30 mm
14 581	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual

Item	Unit	Description of work
		cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 10 mm
14 582	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 583	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 584	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 30 mm
14 591	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 592	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 593	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm
14 594	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 30 mm
14 601	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth up to 10 mm
14 602	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth between 11 mm and 20 mm
14 603	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth between 21 mm and 30 mm
14 604	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth above 30 mm
14 611	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 10 mm
14 612	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 613	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 614	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 30 mm
14 621	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth up to 10 mm

Item	Unit	Description of work
14 622	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 623	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm
14 624	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth above 30 mm
14 631	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth up to 10 mm
14 632	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth between 11 mm and 20 mm
14 633	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth between 21 mm and 30 mm
14 634	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth above 30 mm
14 641	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 10 mm
14 642	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 643	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 644	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 30 mm
14 651	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 652	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 653	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm
14 654	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth above 30 mm
14 661	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 1.0 m^2, depth up to 10 mm
14 662	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 11 mm and 20 mm

Item	Unit	Description of work
14 663	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 21 mm and 30 mm
14 664	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area up to 1.0 m^2, depth above 30 mm, posamična površina prereza do 1,0 m^2, globina nad 30 mm
14 671	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 10 mm
14 672	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 11 mm and 20 mm
14 673	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 21 mm and 30 mm
14 674	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 30 mm
14 681	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 10 mm
14 682	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 11 mm and 20 mm
14 683	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 21 mm and 30 mm
14 684	m^2	Removal of cement concrete with high-pressure water jet, without uncovering reinforcement, overhead surface, horizontal or inclined by 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 30 mm
14 691	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth up to 30 mm
14 692	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 31 mm and 40 mm
14 693	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 41 mm and 50 mm
14 694	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth above 50 mm
14 701	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 702	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual

Item	Unit	Description of work
		cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 703	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 704	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm
14 711	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 712	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 713	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 41 mm and 50 mm
14 714	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, horizontal surface or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 50 mm
14 721	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth up to 30 mm
14 722	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth between 31 mm and 40 mm
14 723	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth between 41 mm and 50 mm
14 724	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area up to 1.0 m^2, depth above 50 mm
14 731	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 732	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 733	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 734	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm
14 741	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 742	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm

Item	Unit	Description of work
14 743	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth between 41 mm and 50 mm
14 744	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, vertical surface or inclined up to 20° to vertical, individual cross-section area above 10.0 m^2, depth above 50 mm
14 751	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth up to 30 mm
14 752	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth between 31 mm and 40 mm
14 753	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth between 41 mm and 50 mm
14 754	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area up to 1.0 m^2, depth above 50 mm
14 761	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 762	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 31 mm and 40 mm
14 763	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth between 41 mm and 50 mm
14 764	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth above 50 mm
14 771	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 772	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 773	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth between 41 mm and 50 mm
14 774	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, inclined surface between 20° and 70° to horizontal, individual cross-section area above 10.0 m^2, depth above 50 mm
14 781	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth up to 30 mm
14 782	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 31 mm and 40 mm
14 783	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 41 mm

Item	Unit	Description of work
		and 50 mm
14 784	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth above 50 mm
14 791	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area between 1.1 m^2 and 10.0 m^2, depth up to 30 mm
14 792	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 31 mm and 40 mm
14 793	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth between 41 mm and 50 mm
14 794	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area up to 1.0 m^2, depth above 50 mm
14 801	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth up to 30 mm
14 802	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 31 mm and 40 mm
14 803	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth between 41 mm and 50 mm
14 804	m^2	Removal of cement concrete with high-pressure water jet, with uncovering reinforcement, overhead surface, horizontal or inclined up to 20° to horizontal, individual cross-section area above 10.0 m^2, depth above 50 mm
14 811	m^1	Removal of cement concrete with high-pressure water jet using a gun, with uncovering reinforcement and tendons, cross-section area of removed concrete up to 0.04 m^2
14 812	m^1	Removal of cement concrete with high-pressure water jet using a gun, with uncovering reinforcement and tendons, cross-section area of removed concrete between 0.041 m^2 and 0.075 m^2
14 813	m^1	Removal of cement concrete with high-pressure water jet using a gun, with uncovering reinforcement and tendons, cross-section area of removed concrete between 0.076 m^2 and 0.1 m^2
14 814	m^1	Removal of cement concrete with high-pressure water jet using a gun, with uncovering reinforcement and tendons, cross-section area of removed concrete above 0.10 m^2
14 821	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area up to 0.25 m^2, thickness up to 10 cm
14 822	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area up to 0.25 m^2, thickness between 11 cm and 20 cm
14 823	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area up to 0.25 m^2, thickness above 20 cm

Item	Unit	Description of work
14 824	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area between 0.26 m^2 and 1.0 m^2, thickness up to 10 cm
14 825	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area between 0.26 m^2 and 1.0 m^2, thickness between 11 cm and 20 cm
14 826	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area between 0.26 m^2 and 1.0 m^2, thickness above 20 cm
14 827	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area between 1.1 m^2 and 5.0 m^2, thickness up to 10 cm
14 828	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area between 1.1 m^2 and 5.0 m^2, thickness between 11 cm and 20 cm
14 829	m^2	Removal of cement concrete with high-pressure water jet through entire thickness of member (local punching), individual cross-section area between 1.1 m^2 and 5.0 m^2, thickness above 20 cm
14 831	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width up to 1.0 m, and a thickness up to 10 cm
14 832	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width up to 1.0 m, and a thickness between 11 cm and 20 cm
14 833	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width up to 1.0 m, and a thickness above 20 cm
14 834	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width between 1.1 m and 1.5 m, and a thickness up to 10 cm
14 835	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width between 1.1 m and 1.5 m, and a thickness between 11 cm and 20 cm
14 836	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width between 1.1 m and 1.5 m, and a thickness above 20 cm
14 837	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width of ....m, and a thickness up to 10 cm
14 838	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width of ....m, and a thickness between 11 cm and 20 cm
14 839	m^3	Removal of cement concrete from superstructure cantilevers with high-pressure water jet, in a width of ....m, and a thickness above 20 cm
14 841	m^2	Removal of rubber expansion joints of movement capacity up to 160 mm
14 842	m^2	Removal of rubber expansion joints of movement capacity 161 mm – 320 mm
14 843	pc	Removal of rubber expansion joints of movement capacity above 320 mm
14 844	m^1	Removal of metal expansion joints of movement capacity up to 160 mm
14 845	m^1	Removal of metal expansion joints of movement capacity 161 mm – 320 mm
14 846	m^1	Removal of metal expansion joints of movement capacity above 320 mm

Item	Unit	Description of work
14 847	m^1	Removal of damaged seal from metal expansion joints, including cleaning and preparation for placing new seal
14 848	pc	Removal of steel plate at transition of expansion joint over concrete safety barrier and walkway, of dimensions .... mm
14 851	m^1	Manual or machine removal of mortar from joints of stone or brick walls, vertical surface or inclined up to 45° to vertical, depth up to 20 mm
14 852	m^1	Manual or machine removal of mortar from joints of stone or brick walls, vertical surface or inclined up to 45° to vertical, depth between 21 mm and 40 mm
14 853	m^1	Manual or machine removal of mortar from joints of stone or brick walls, vertical surface or inclined up to 45° to vertical, depth above 40 mm
14 855	m^1	Manual or machine removal of mortar from joints of stone or brick walls, overhead surface, horizontal, arched, or inclined up to 45° to vertical, depth up to 20 mm
14 856	m^1	Manual or machine removal of mortar from joints of stone or brick walls, overhead surface, horizontal, arched, or inclined up to 45° to vertical, depth between 21 mm and 40 mm
14 857	m^1	Manual or machine removal of mortar from joints of stone or brick walls, overhead surface, horizontal, arched, or inclined up to 45° to vertical, depth above 40 mm
14 861	m^1	Manual or machine removal of bituminous or plastic seals from hoints of depth up to 20 mm, joint width up to 10 mm
14 862	m^1	Manual or machine removal of bituminous or plastic seals from hoints of depth up to 20 mm, joint width between 11 mm and 20 mm
14 863	m^1	Manual or machine removal of bituminous or plastic seals from hoints of depth up to 20 mm, joint width above 20 mm
14 871	m^1	Cutting ordinary cement concrete or stone with floor diamond saw, thickness up to 10 cm
14 872	m^1	Cutting ordinary cement concrete or stone with floor diamond saw, thickness between 10.1 cm and 15.0 cm
14 873	m^1	Cutting ordinary cement concrete or stone with floor diamond saw, thickness between 15.1 cm and 20.0 cm
14 874	m^1	Cutting ordinary cement concrete or stone with floor diamond saw, thickness above 20.0 cm
14 876	m^1	Cutting reinforced cement concrete with floor diamond saw, thickness up to 10 cm
14 877	m^1	Cutting reinforced cement concrete with floor diamond saw, thickness between 10.1 cm and 15.0 cm
14 878	m^1	Cutting reinforced cement concrete with floor diamond saw, thickness between 15.1 cm and 20.0 cm
14 879	m^1	Cutting reinforced cement concrete with floor diamond saw, thickness above 20.0 cm
14 881	m^1	Cutting ordinary cement concrete or stone with wall diamond saw, thickness up to 10 cm
14 882	m^1	Cutting ordinary cement concrete or stone with wall diamond saw, thickness between 10.1 cm and 15.0 cm
14 883	m^1	Cutting ordinary cement concrete or stone with wall diamond saw, thickness between 15.1 cm and 20.0 cm
14 884	m^1	Cutting ordinary cement concrete or stone with wall diamond saw, thickness

Item	Unit	Description of work
		above 20.0 cm
14 886	m^1	Cutting reinforced cement concrete with wall diamond saw, thickness up to 10 cm
14 887	m^1	Cutting reinforced cement concrete with wall diamond saw, thickness between 10.1 cm and 15.0 cm
14 888	m^1	Cutting reinforced cement concrete with wall diamond saw, thickness between 15.1 cm and 20.0 cm
14 889	m^1	Cutting reinforced cement concrete with wall diamond saw, thickness above 20.0 cm
14 891	m^1	Cutting ordinary cement concrete or stone with diamond cord, thickness up to 10 cm
14 892	m^1	Cutting ordinary cement concrete or stone with diamond cord, thickness between 10.1 cm and 15.0 cm
14 893	m^1	Cutting ordinary cement concrete or stone with diamond cord, thickness between 15.1 cm and 20.0 cm
14 894	m^1	Cutting ordinary cement concrete or stone with diamond cord, thickness above 20.0 cm
14 896	m^1	Cutting reinforced cement concrete with diamond cord, thickness up to 10 cm
14 897	m^1	Cutting reinforced cement concrete with diamond cord, thickness between 10.1 cm and 15.0 cm
14 898	m^1	Cutting reinforced cement concrete with diamond cord, thickness between 15.1 cm and 20.0 cm
14 899	m^1	Cutting reinforced cement concrete with diamond cord, thickness above 20.0 cm
14 911	m^1	Boring holes into cement concrete or stone, horizontal surface or inclined up to 45°, diameter up to 30 mm
14 913	m^1	Allowance for boring holes into reinforced cement concrete
14 914	m^1	Allowance for surface inclined by 46°- 90°
14 915	m^1	Allowance for overhead surface
14 916	m^1	Allowance for borehole diameter 31 - 60 mm
14 917	m^1	Allowance for borehole diameter 61 - 100 mm
14 918	m^1	Allowance for borehole diameter 101 - 150 mm
14 919	m^1	Allowance for borehole diameter above 150 mm
14 921	m^1	Boring holes into ordinary cement concrete or stone, horizontal surface or inclined up to 45° to horizontal, diameter up to 30 mm
14 922	m^1	Boring holes into ordinary cement concrete or stone, horizontal surface or inclined up to 45° to horizontal, diameter 30 mm – 60 mm
14 923	m^1	Boring holes into ordinary cement concrete or stone, horizontal surface or inclined up to 45° to horizontal, diameter 61 mm – 100 mm
14 924	m^1	Boring holes into ordinary cement concrete or stone, horizontal surface or inclined up to 45° to horizontal, diameter 101 mm – 150 mm
14 925	m^1	Boring holes into ordinary cement concrete or stone, horizontal surface or inclined up to 45° to horizontal, diameter above 150 mm
14 931	m^1	Boring holes into ordinary cement concrete or stone, vertical surface or inclined up to 45° to vertical, diameter up to 30 mm
14 932	m^1	Boring holes into ordinary cement concrete or stone, vertical surface or

Item	Unit	Description of work
		inclined up to 45° to vertical, diameter 31 mm – 60 mm
14 933	m^1	Boring holes into ordinary cement concrete or stone, vertical surface or inclined up to 45° to vertical, diameter 61 mm – 100 mm
14 934	m^1	Boring holes into ordinary cement concrete or stone, vertical surface or inclined up to 45° to vertical, diameter 101 mm – 150 mm
14 935	m^1	Boring holes into ordinary cement concrete or stone, vertical surface or inclined up to 45° to vertical, diameter above 150 mm
14 941	m^1	Boring holes into ordinary cement concrete or stone, overhead horizontal surface, diameter up to 30 mm
14 942	m^1	Boring holes into ordinary cement concrete or stone, overhead horizontal surface, diameter 31 mm – 60 mm
14 943	m^1	Boring holes into ordinary cement concrete or stone, overhead horizontal surface, diameter 61 mm – 100 mm
14 944	m^1	Boring holes into ordinary cement concrete or stone, overhead horizontal surface, diameter 101 mm – 150 mm
14 945	m^1	Boring holes into ordinary cement concrete or stone, overhead horizontal surface, diameter above 150 mm
14 951	m^1	Boring holes into reinforced cement concrete, horizontal surface or inclined up to 45° to horizontal, diameter up to 30 mm
14 952	m^1	Boring holes into reinforced cement concrete, horizontal surface or inclined up to 45° to horizontal, diameter 30 mm – 60 mm
14 953	m^1	Boring holes into reinforced cement concrete, horizontal surface or inclined up to 45° to horizontal, diameter 61 mm – 100 mm
14 954	m^1	Boring holes into reinforced cement concrete, horizontal surface or inclined up to 45° to horizontal, diameter 101 mm – 150 mm
14 955	m^1	Boring holes into reinforced cement concrete, horizontal surface or inclined up to 45° to horizontal, diameter above 150 mm
14 961	m^1	Boring holes into reinforced cement concrete, vertical surface or inclined up to 45° to vertical, diameter up to 30 mm
14 962	m^1	Boring holes into reinforced cement concrete, vertical surface or inclined up to 45° to vertical, diameter 31 mm – 60 mm
14 963	m^1	Boring holes into reinforced cement concrete, vertical surface or inclined up to 45° to vertical, diameter 61 mm – 100 mm
14 964	m^1	Boring holes into reinforced cement concrete, vertical surface or inclined up to 45° to vertical, diameter 101 mm – 150 mm
14 965	m^1	Boring holes into reinforced cement concrete, vertical surface or inclined up to 45° to vertical, diameter above 150 mm
14 971	m^1	Boring holes into reinforced cement concrete, overhead horizontal surface, diameter up to 30 mm
14 972	m^1	Boring holes into reinforced cement concrete, overhead horizontal surface, diameter 31 mm – 60 mm
14 973	m^1	Boring holes into reinforced cement concrete, overhead horizontal surface, diameter 61 mm – 100 mm
14 974	m^1	Boring holes into reinforced cement concrete, overhead horizontal surface, diameter 101 mm – 150 mm
14 975	m^1	Boring holes into reinforced cement concrete, overhead horizontal surface, diameter above 150 mm
14 981	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, vertical surface or inclined up to 45° to vertical, thickness up to 40 cm
14 982	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, vertical surface or inclined up to 45° to vertical, thickness 41 cm – 60

Item	Unit	Description of work
		cm
14 983	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, vertical surface or inclined up to 45° to vertical, thickness above 60 cm
14 984	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, horizontal surface or inclined up to 45° to horizontal, thickness up to 40 cm
14 985	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, horizontal surface or inclined up to 45° to horizontal, thickness 41 cm – 60 cm
14 986	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, horizontal surface or inclined up to 45° to horizontal, thickness above 60 cm
14 987	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, overhead surface, thickness up to 40 cm
14 988	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, overhead surface, thickness 41 cm – 60 cm
14 989	m^2	Removal of damaged portion of walls or arches made of natural stone or brick, overhead surface, thickness above 60 cm
14 991	m^1	Removal of existing drainage pipes of diameter up to 200 mm, including bends, branches, and fixing elements
14 992	m^1	Removal of existing drainage pipes of diameter 250 mm – 400 mm, including bends, branches, and fixing elements
14 993	m^1	Removal of existing drainage pipes of diameter above 400 mm, including bends, branches, and fixing elements
14 994	pc	Removal of seepage water pipes
14 995	pc	Removal of gullies from carriageway slab
14 996	m^2	Manual removal of waterproofing from carriageway slab
14 997	m^2	Machine removal of bituminous or epoxy coating and waterproofing from carriageway slab by means of milling
14 999	pc	Removal of protective concrete cover from the stressing anchor head of prestressed tendon

2.2.1.6.5 Geotechnical control of tunnel construction

Item	Unit	Description of Work
15 111	pc	Supply and placing anchors of galvanized ribbed steel bars, of length 25 – 40 cm, into cement mortar, or welding on bends for measuring convergences with a tape, and for placing targets to carry out 3D measurements in the primary lining of the tunnel
15 112	pc	Supply and placing anchors of stainless steel, of length 20 cm, to cement mortar for measuring convergences with a tape, and for placing targets to carry out 3D measurements in the secondary lining of the tunnel
15 121	pc	Supply and placing bar-type triple-point extensometers (2, 4, and 6 m) with measuring heads for reading deformations
15 122	pc	Supply and placing bar-type triple-point extensometers (3, 6, and 9 m) with measuring heads for reading deformations
15 131	pc	Supply and placing measuring anchors of 250 kN bearing capacity, of 6 m

Item	Unit	Description of Work
		length, with measuring heads for reading anchor forces
15 132	pc	Supply and placing measuring anchors of 250 kN bearing capacity, of 9 m length, with measuring heads for reading anchor forces
15 136	pc	Supply and placing measuring anchors of 350 kN bearing capacity, of 6 m length, with measuring heads for reading anchor forces
15 137	pc	Supply and placing measuring anchors of 350 kN bearing capacity, of 9 m length, with measuring heads for reading anchor forces
15 141	pc	Supply and placing cells for measuring radial pressures between the rock and the tunnel primary lining
15 142	pc	Supply and placing cells for measuring tangential pressures between the rock and the tunnel primary lining
15 151	pc	Supply and placing measuring devices to assess specific deformations (strains) in the tunnel primary lining
15 152	pc	Supply and placing measuring devices to assess specific deformations (strains) in the tunnel secondary lining
15 161	pc	Execution of measurement in the tunnel in the measuring profile MS – I over the entire construction period, including graphical presentation of results, and an explanation
15 162	pc	Execution of measurement in the tunnel in the measuring profile MS – II over the entire construction period, including graphical presentation of results, and an explanation
15 163	pc	Execution of measurement in the tunnel in the measuring profile MS – III over the entire construction period, including graphical presentation of results, and an explanation
15 164	pc	Execution of measurement in the tunnel in the measuring profile MS – IV over the entire construction period, including graphical presentation of results, and an explanation
15 171	pc	Execution of measurements on structures above the tunnel, including supply and placing benchmarks, 3D measurements, and interpretation of measurements over the entire construction period
15 172	pc	Execution of measurements on the surface (roads, gas conduits, water mains, etc.) above the tunnel, including supply and placing benchmarks, 3D measurements, and interpretation of measurements over the entire construction period

GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

VOLUME II: CONSTRUCTION

SECTION 2: SPECIAL TECHNICAL CONDITIONS

Part 2: EARTH WORKS AND FOUNDATION

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CONTENTS

2.2.2 EARTH WORKS AND FOUNDATION

2.2.2.1 EXCAVATIONS

2.2.2.1.1 Description

Excavations include the following works:

- surface excavation of layers of fertile soil (topsoil) in an adequate thickness (up to a depth of 40 cm maximum), with pushing aside up to 50 m, or loading for transportation to deposit areas;
- all spread excavations of all the categories of soils and rocks, which are foreseen by the design, including pushing aside up to 50 m, or loading for transportation to fills, backfills, wedges and/or deposit areas, as appropriate; these works also comprise all the excavations for stairs, cuts, at borrow pits, and similar works, also on road deviations and stream regulations, as well as all the spread excavations for bridges and other structures;
- all the excavations for foundations of bridges and structures, as well as for sewerage and other trenches (for culverts, shafts, drainages) of all the categories of materials, and at all depths
  - of width up to 1.0 m,
  - of width above 1.0 m and up to 2.0 m.

These works also include the following activities:

- all the required measures to lift the excavated material to the specified height;
- all the excavations of construction pits for structures wider than 2.0 m, of all the material categories and at all the depths, including transportation of surplus material to deposit areas, or to locations where they will be used for fills, backfills, or wedges; this work also comprises lifting the surplus material to the required height;
- all the excavations for melioration and regulation channels, and similar works of all the categories of soils and rocks of different depths and widths; this work also includes deepening and widening of existing channels;
- all the excavations for drainage ditches and gutters along the road body, at made formation, or along the existing road, including shovelling away the excavated materials, and/or loading onto lorries, and transportation to deposit areas;
- all the excavations for paving and lining the surfaces, where such treatment is foreseen by the design, including shovelling away the material, and/or loading onto lorries and transportation to deposit areas, as well as arrangement of formation.

In addition, these works also include the following:

- all the necessary activities prescribed by the current regulations of safety at work, such as supporting (including drawing and design calculation), inclinations, widening, and similar;
- all the works needed to evacuate precipitation water, spring-water, and ground water during construction (including necessary pumping out), as to ensure a permanent and controlled drainage, and to prevent water accumulation and wetting of in-situ or raised materials; moreover, these works also comprise all the additional measures related to diverting ground water or spring-water streams;
- all the excavations, loading, and transportation of unsuitable or surplus material to deposit areas outside the construction site; the contractor shall provide depositing areas outside road alignment or structure, as well as all the necessary arrangements (spreading, seeding grass, drainage).

All the aforementioned works shall be included in the material excavation unit price, and the contractor has no right to claim any additional payment.

2.2.2.1.2 Basic materials

Basic materials won by excavating and/or from borrow pits to be used in construction works are soils and rocks.

2.2.2.1.3 Quality of materials

2.2.2.1.3.1 Description

All the types of soils and rocks for construction works are classified into the following nominal categories:

-	fertile soil	category 1
-	soil of low bearing capacity	category 2
-	cohesive soil and granular rock	category 3
-	soft rock	category 4
-	hard rock	category 5

The criterion to classify soils and rocks into categories is the characteristic properties affecting individual construction works. Taking account of the up-to-date mechanization, excavations, transportation, and placing belong to these works.

A description of soils and rocks, methods of their excavating and winning, as well as an assessment of their applicability are indicated in table 2.1 Classification of soils and rocks.

Where layers of soils and/or rock alternate within an excavation to such an extent that an accurate determination of category of an individual material would be difficult or impossible, an average type or category of the material may be assessed.

All the material having been won in surface and spread excavations, excavations for foundations and sewerage trenches, regulation and melioration channels, drainage ditches and gutters, as well as paving and linings, shall be classified in compliance with the bases indicated in this paragraph.

2.2.2.1.3.2 Quality

Prior to and during the works, on any change of the material quality, suitable samples shall be taken to test, whether the particular material is suitable to the intended use.

The contractor shall acquire a professional opinion of applicability of the material from every typical major cut or location, where it would be possible to win a local material for mineral aggregates to produce unbound and/or bound bearing and wearing courses, concrete mixes, and raising material, or material for preloading and overloading. When material won by excavation is foreseen for these purposes, the clayey weathered layer shall be removed prior to blasting, and used for fills or deposited onto suitable area to be proposed by the contractor, and approved by the engineer.

Table 2.1: Classification of soils and rocks

Ctg	Category designation	Description of material	Granulometric composition of material	Excavation method	Applicability assessment
1	fertile soil	located on ground surface: topsoil and turf, with admixtures of gravel, sand, silt, and/or clay	-	bulldozer, dredger	suitable only as a base for vegetation; neither load bearing nor stable, nor resistant to erosion
2	soil of low bearing capacity	of light-plasticity to liquid consistency ($I_c \leq 0.5$); it can contain organic material (peat, weathered material)	$>$ 15 % by m. $\Phi < 0.063$ mm	dredger, bulldozer	not applicable in natural condition
3	cohesive soil and granular rock	located below fertile soil of medium-plasticity to hard consistency (soil, weathered material) or in compacted condition (sand, gravel, rubble, rock waste)	$>$ 15 % by m. $\Phi > 0.063$ mm $<$ 15 % by m. $\Phi > 0.063$ mm $<$ 30 % by m. $\Phi > 63$ mm	bulldozer, dredger, bulldozer with crawler dozer (periodically)	in natural condition and suitable weather applicable to fills; bearing capacity and stability depend on outer impacts
4	soft rock	marl, flysch, slate, tuff, conglomerate, breccia, as well as cracked, crumbly, and weathered sandstone, dolomite, and limestone	$>$ 30 % by m. $\Phi > 63$ mm $\Phi < 300$ mm	bulldozer with crawler dozer, pin dredger, milling, blasting (periodically)	as a rule, of good bearing capacity and stability; where it is of an adequate granulometric composition, it is suitable to fills and substructure
5	hard rock (sedimentary origin [1])	limestone, hard dolomite, or material of more than 50 % by mass of pieces of $\Phi >$ 600 mm to be blasted	hard rock, $\Phi > 600$ mm	blasting, milling (exceptionally)	where it is of an adequate granulometric composition, its bearing capacity and stability are extremely good; it is suitable to fills and/or processing

[1] Silicate rocks of eruptive origin are not classified.

2.2.2.1.4 Method of execution

2.2.2.1.4.1 General

All the excavations shall be executed taking account of profiles, recorded levels, inclinations, and depths indicated in the design documents. Properties of individual material categories and required properties for the intended use of the excavated material shall be considered.

A surface excavation of fertile soil in a suitable thickness shall always be carried out, where subsequent excavation and/or preparation of subgrade are foreseen. The excavated fertile soil (topsoil) shall be removed in compliance with provisions of the design and these technical conditions. All the excavated material shall be deposited along the road alignment outside the intended excavation as to obstruct the works to the smallest possible extent. Raising, or pushing away the fertile soil to a deposit area shall be performed carefully to preserve the quality of the excavated fertile soil for subsequent arranging the slopes and green surfaces, and to prevent mixing of fertile soil with other unfertile materials.

Behind topsoil (fertile soil) deposit areas at excavations, a controlled drainage shall be ensured on the outer side as well; retaining of precipitation water and wetting of in-situ soil shall be prevented.

Where the works are carried through in soils of low bearing capacity, all the excavated material shall be transported and deposited onto special deposit areas outside construction areas (e.g. out of areas of lateral fills). Such deposit areas shall be suitably arranged throughout the works.

All the other material as well, for which it is established that it is useless for the road body construction, shall be removed. The contractor shall arrange an adequate deposit area for such materials, where the engineer directs so.

Unless specified otherwise, the surplus material shall be primarily used for widening the fills to win parking place and view points. The engineer shall appoint such areas, unless they are specified by the design.

2.2.2.1.4.2 Excavations

1. All the excavations shall be executed in compliance with designed or required cross-sections, foreseen height levels, as well as inclinations directed by the design or the engineer.

   Excavation works shall take account of all the provisions of current regulations dealing with safety at work (supporting, strutting, terraced excavations, etc.). The existing structures, communications, and devices shall be protected. Regular maintenance of used public areas and access public roads shall be ensured.

2. Surface and spread excavations, excavations for foundations and trenches, for construction pits, melioration and regulation ditches, drainage ditches and gutters, as well as for paving and lining, shall be, as a rule, carried out using mechanization and other means. Manual work shall be limited to minimum and only performed at locations where the specified quality cannot be attained with the machine equipment, or where this is required due to soil mechanical properties of soils or rocks.

3. Soils of low bearing capacity shall be excavated using an adequate mechanization, which specific loading corresponds to the ground bearing capacity. For grading the slopes and bottom, some manual work is indispensable, particularly to remove the strewn excavated soil. Pushing away the excavated soil of low bearing capacity is usually not feasible. Only fertile soil (topsoil) is suitable to intended application, for it can be used to protect slopes and lateral fills, and to sow grass on these surfaces.

4. Hard and sometimes soft rocks as well, shall be excavated by machine boring, depth, and ordinary blasting, and repeated blasting of large rocks, if such a procedure is requested by the intended use of the excavated hard rock. Where even slopes of cuts are designed, an adequate method of smooth blasting shall be introduced.

   To ensure uniformity of subgrade, a 25 to 30 cm thick upper (levelling) layer of the remaining solid rock shall be loosened by means of blasting.

5. The inclinations of excavated slopes depend on the soil category, moisture content, and stratification. These geotechnical properties are indicated in both design and geological – soil mechanical report. Weathered layers of soils occurring on excavation, including the weathered top and intermediate weathered zones, shall be used provided that adequate

conditions are present; otherwise, this material shall be treated in compliance with the design provisions and engineer's directions respectively.

This work also includes clearing of all the locations where protective measures are required, such as protection of weathered zones, pockets, caverns, water springs, etc., unless such works have already been foreseen elsewhere. During excavation, the engineer, contractor, and professional co-operators shall specify eventually required modifications of inclinations of cut slopes; this shall be done taking account of soil properties, geological ascertainment, and other phenomena, which might occur on excavation; the contractor shall consider all the aforementioned facts.

6. On slopes of inclinations of up to 20°, where fills will be constructed, 1.0 – 1.5 m wide steps shall be excavated in the subgrade. Front surfaces of those steps shall be excavated at an inclination of 2 : 1.

   On slopes inclined by 20° to 30°, 1.0 m wide interspaces shall be executed between the steps.

   On slopes, which inclinations exceed 30°, it is possible to construct steps without any interspaces.

   The inclination of steps in cohesive soils shall amount to 3% minimum towards the front surface, and at least 3% longitudinally to ensure a controlled drainage. In case that excavation of steps is not foreseen by the design, the contractor is obliged to execute them on the engineer's request, if the latter establishes that such steps are indispensable.

7. The bottom and the slopes of excavation in soil of low bearing capacity shall be even to ensure possibility of suitable placement of geotextiles and/or a layer of permeable stone material.

8. When performing excavation works, one shall pay attention not to cause undercutting of or damage to the cuts. The contractor shall remedy any such case in compliance with the engineer's instructions; however, the contractor will have no right to claim any reimbursement or additional payment for such unforeseen extra work.

   In case that an excessive excavation, which exceeds the specified profile, has been carried out by the contractor during construction works, the contractor is obliged to make all the remedy arrangements at his expense, and in accordance with the engineer's instructions.

9. The organization of excavation works shall be such that no major disturbances due to precipitation water or other water can occur. This particularly applies to soils. Special attention shall be paid to evacuate the water from excavations (in the shortest possible way), and to the fact that only such amount of soil can be excavated, which can be either removed or placed simultaneously, taking account of the capacity of machines and transportation means. Consequences that might occur due to non-considering this provision shall be born by the contractor, who will have no right to claim any neither reimbursement nor modification of the working method to the detriment of the client.

10. Excavation in soils of low bearing capacity shall generally not be open for a longer time: the excavation progress shall be mandatory harmonized with backfilling or arranging the slope. As circumstances require, the precipitation water shall be permanently pumped out until the fill surmounts the ground water level. Any eventual damage due to non-pumping the water shall be born by the contractor. Locally damaged slopes (slip) shall be cleared and filled up with suitable material at the contractor's expense.

    Due to the particularities of cohesive soils, the material excavated during construction must not be deposited into or at the excavation, but shall be loaded directly onto lorries during excavation works.

    When an excavation in a soil of low bearing capacity intersects a channel of a brook, a provisional culvert of suitable cross-section shall be constructed. If there is a possibility of diverting one water stream into another, this shall be carried through.

11. Where a slope is prone to slip or collapse, the works shall be carried out gradually to prevent such phenomena, or, particularly for greater heights, to introduce appropriate retaining measures.

12. In excavations where explosive is used, the contractor shall employ skilled and qualified labour. Where blasting or excavating works are carried out, all the impacts on traffic, humans, and environment shall be minimized, and all the required traffic and safety signs

shall be placed. Any disturbance arising from the abovementioned impacts shall be eliminated by the contractor at his expense.

In case that a rock slope has been damaged due to blasting, the contractor shall make it good at his expense.

13. Where excavations are executed next to traffic communications or structures, special safety precautions shall be taken.

    Where blasting is performed, or where the works are carried through next to power or telephone installations, all the relevant regulations shall be considered, and a permit shall be acquired from relevant authorities.

14. Construction pits shall be shaped and finished in accordance with the design (vertical walls as well as slopes and the bottom). The work also includes execution of drainages, ditches, and shafts during construction, as well as displacement of these structures, which are required to drain both precipitation water and spring-water.

    If required by soil mechanical properties of the ground, and by the geological conditions, retaining, and boarding up of pits shall be performed professionally. The method of retaining the excavated walls shall be selected by the contractor. The latter is obliged to submit to the engineer a suitable design of retaining works, including design static calculation, unless this has been foreseen by the original design, and is already under execution. In case that difference between actual condition and design occur, the contractor shall take immediate steps, and inform the engineer accordingly.

15. In excavations for melioration channels, the excavated material may be deposited provisionally at a suitable distance from the channel upper edge on both sides, if this is feasible in view of site conditions and other circumstances; if this is not the case, the material shall be deposited far enough from one upper edge of the channel only. Fertile soil (topsoil) shall be separated from other material.

    The works shall be so organized as to prevent any damage to the already executed works in case of stormy weather. Therefore, the contractor shall take permanent care of a suitable flowing away of all the water, including spring-water.

    When the approved design does not foresee the use of excavated material for some particular purposes, the material shall be transported to appointed deposit areas and spread in such a way that the topsoil is on the top.

    The works shall be carried out at the specified transverse and longitudinal fall in compliance with the design. On principle, the water must not stagnate at any place. All the roots, plants, and other obstacles shall be felled and removed without any additional payment.

16. Drainage ditches and gutters shall be excavated in accordance with the design. All the excavation surfaces shall be made even, and with required inclinations and rounding off to prevent stagnation of water, and damage to in-situ or already compacted soil.

    Weather or climatic changes, which might affect adversely the surfaces already excavated, shall be considered during the works. Therefore, the contractor shall organize the works in such a way, that they can be executed at the same time, or that they can be directly followed by the works on ditches and gutters. Eventual additional works, or works, which would later on become necessary due to non-performed drainage works, shall be executed by the contractor without any right to claim extra payment.

    Where construction works are carried out on soils of low bearing capacity where lateral fills are foreseen, lateral drainage ditches shall be executed along the outer edge of lateral fills already prior to the excavation, or simultaneously with the ground grading. After completion of the work, the drainage ditches shall be definitively finished and repaired respectively. Permanent lateral drainage ditches shall be connected to the existing regulated melioration ditches or other permanent drainage ditches.

17. Excavation for paving and lining shall be carried out in full compliance with the design documents, or with the engineer’s instructions.

    The subgrade formation, on which a pavement or other lining is foreseen, shall correspond to prescribed conditions, depending on the foreseen paving or lining.

2.2.2.1.4.3 Distribution of quantities

The material won by excavating works shall be used particularly to fulfil the contractual obligations (construction of fills, backfills, and wedges); the remaining surplus or unsuitable material shall be removed immediately either into backfills or to deposit areas in compliance with the design provisions. The costs of loading and unloading, or pushing away the surplus material shall be comprised in the excavation unit price. As circumstances require, the engineer will submit detailed instructions, when the applicability of excavated soils and/or rocks is not determined precisely by the design.

As a rule, the quantities shall be distributed in accordance with the design, or to the profile of quantities, which, however, is only a help to calculate the bid price, and does not oblige the client in case of eventual modifications.

2.2.2.1.4.4 Borrow pit (side cut)

1. When a borrow pit (side cut) is foreseen by the design, both contractor and engineer shall survey the land prior to commencement of taking material from the borrow pit (side cut), if this is related to the account of the works. The survey shall be bilaterally approved and signed, and will represent a basis to calculate the quantities.

   The contractor is obliged to:

   - prepare a proposal of rearranging the borrow pit (side cut) after the exploitation is completed;
   - obtain an approval for the proposed rearrangement by the engineer;
   - to rearrange the land of borrow pit in compliance with the approved proposal.

2. When no borrow pit has been foreseen by the design, but there is lack of material in the road alignment, the contractor shall provide a borrow pit location by himself. In such a case, the contractor is obliged, at his expense, to acquire a permit by the land proprietor, to prove both quality and quantity of the material to be taken from the borrow pit, and to submit to the engineer for approval the proposal of the borrow pit (including layout drawing and cross-sections).

   In the design layout the location shall be marked where fertile soil (topsoil) as well as surplus or unsuitable materials must be deposited. On the basis of such proposal and verified quality, the engineer will issue an exploitation permit.

3. For any subsequent modification (widening, deepening) of the borrow pit, the contractor is obliged to obtain an approval by the engineer in due time. All the costs for such works, which are not comprised by the design, shall be born by the contractor, including reimbursement for land exploitation, for crops, ground, and all other damage that might result from these works.

4. During exploiting borrow pits, an unimpeded drainage of both precipitation water and spring-water shall be ensured.

2.2.2.1.4.5 Openings

Openings, carried out by breaking through for trenches or gutters, the contractor can execute on condition that the construction method will not harm the performance of the works, and that the contractor will not claim any payment for additional works.

3.2.2.1.1.1 Obstacles

Where unforeseen obstacles occur during excavation works, such as installations, cables, channels, drainages, structural residues, major stones, boundary stones, etc., the contractor shall give notice to the engineer, and the latter will appoint measures to be taken by the contractor.

Irrespective of how the contractor intends to protect structures, installations, channels, drainages, cables, and similar, he is obliged to consider all the regulations, and instructions by the corresponding authorities. To installations, which have to be supported or suspended on special structures during the works, no loading must be applied.

2.2.2.1.4.6 Working space, bottom, slopes

2.2.2.1.4.6.1 Working space at excavation for foundations and construction pits

The maximum width of the working space, granted to the contractor, amounts to 50 cm between the structure and the construction pit wall. A normal working space width is defined as follows:

- in non-retained construction pits: the horizontal distance between the foot of the excavated slope and outer side of the wall, or outer side of the structural formwork;
- in retained construction pits: clear distance between the pit planking and outer side of the wall, or outer side of the structural formwork; no additional excavation for working space is granted in case where cement concrete is cast into the structure up to the excavation walls.

In excavations for trenches, the maximum required clear width of the working space (unless specified otherwise by the design) is the width of the outer diameter or the maximum width of the cross-section of the installation + 40 cm added to the outer diameter or to the maximum width of the pipe installation, however not less than 60 cm of the total excavation width for a trench depth up to 2.00 m, and not less than 80 cm for greater depths. As the clear width the bottom width is considered in non-retained trenches, and the planking spacing for retained trenches respectively.

2.2.2.1.4.6.2 Bottom

Both depth and width of the bottom are defined by the design and the required working space. The final depth of the bottom shall be defined by the design.

The excavation bottom for foundations shall be carried out horizontal, and terraced at different depths.

The bottom for trenches and drainages shall be executed exactly at the prescribed inclination, and in the design shape.

In the foundation area, the pit bottom must not be loosened. It shall be protected form damages due to transportation means, bulldozers, washing out, and frost. A damaged bottom of cohesive soils shall be excavated and replaced immediately prior to concreting or building. In granular rocks the bottom shall be repaired by means of suitable compaction.

The excavation bottom for foundation, construction pit, drainage ditch, or regulation/melioration ditch shall be shaped in full compliance with the design. Height deviations from the design vertical alignment must not exceed ± 2 cm, unless specified otherwise by the design. The evenness at a length of 4 m may deviate in any direction by 3 cm maximum.

In case that the contractor carries out a too deep excavation, he is obliged to perform at his expense all the repairs required by stability conditions, and directed by the engineer.

To achieve a faultless foundation in cohesive soils, the last excavated layer (of suitable thickness) shall be left as protection from damages, unless specified otherwise by the design. This layer may only be removed immediately prior to subsequent construction (casting, laying pipes, etc.).

The contractor may not proceed with the construction until the excavation is completed and taken over.

2.2.2.1.4.6.3 Slopes for non-retained construction pits

Slope inclinations depend on material properties and the period, in which the pit will have to be left open. In addition, all loads and vibrations due to the works either in or next to the pit shall be considered.

For materials subject to effects of drying up, water absorption, freezing, or sliding, suitable not steep slopes shall be performed, and all the arrangements to evacuate all the water shall be taken in order to prevent damage.

The contractor is free to select slope inclinations, unless directed otherwise by the design. However, an approval by the engineer is mandatory. The contractor shall be responsible for the safety and the slope maintenance during the works.

At the upper edge of the slope behind a non-retained construction pit, a free protective zone of a minimum width of 60 cm shall be maintained as a berm.

2.2.2.1.5 Quality of execution

Excavation works shall be carried out in a good quality, and shall be harmonized with regulations, design documents, as well as provisions and requirements of these technical conditions.

All the final surfaces of excavations shall be executed in compliance with the design requirements.

The evenness of the formation of the spread excavation bottom, measured with a 4 m straight edge, may deviate

- by up to 3 cm in soils,

- by up to 5 cm in rocks.

Excavations for drainage ditches and gutters, as well as melioration/regulation ditches shall be so arranged as to allow an undisturbed water outflow.

Excavations for drainage ditches and gutters, as well as regulation/melioration ditches, for which any lining or stabilization is foreseen, shall correspond to the design dimensions. Deviations to the detriment of the thickness of the lining or consolidation of the ditch are not admitted.

During excavation works, the contractor shall inform the engineer of all the problems, which could occur and affect the quality of the executed works, as specified by the present technical conditions. If the contractor fails to inform the engineer accordingly, he shall take all the responsibility and bear all the eventual repair costs.

The contractor is obliged to perform the internal control of the works in accordance with these technical conditions.

2.2.2.1.6 Measurement and taking over of works

2.2.2.1.6.1 Measuring of works

The executed works shall be measured in compliance with item 2.1.7.1 of general technical conditions, as well as with the following provisions:

- All the excavations (surface, spread, for foundations, trenches, construction pits, melioration/regulation ditches, drainage ditches and gutters, as well as paving and lining) shall be measured according to quantities actually executed, in cubic metres, in in-situ condition of different material categories according to item 2.2.2.1.3.1.
- To establish actually excavated quantities, cross-sections shall be used, which have been surveyed prior to and after the excavation. A suitable surface of the cross-section, measured from the excavation upper edge to the excavation bottom, represents – taking account of the thicknesses of individual layers, soil categories, and cross-section spacing – the actual accounting quantity, however only within the scope of the design, or modifications having been approved or ordered by the engineer.

The measurement shall also take account of the following:

- A surface excavation includes a layer of thickness up to 40 cm;
- In spread excavation, lenses, pockets, and caverns not exceeding 1 m^2 in cross-section are not deducted; if their size exceed 1 m^2 in cross-section, they shall be deducted from the individual material categories over the entire area;
- In excavations for foundations, trenches, and construction pits, the actually executed excavation is accounted in compliance with the provisions stated in 2.2.2.1.4.7.1. To determine the depths of those excavations, the mean level of the ground and excavation circumference shall be considered as a starting level;
- In excavations for drainage ditches, the starting level is the mean height level of the ground, and the mean height level of the excavation in the cross-section axis, representing a mean value of both height levels of in-situ materials in extreme points of the ditch.

All the excavated material used for other purposes than for fills, backfills, wedges, and substructure shall be deducted on determining the excavation quantities, unless the contractor has compensated such material from a borrow pit (without additional payment).

2.2.2.1.6.2 Taking over of works

The executed works shall be taken over in compliance with the provisions of item 1.1.6.2 of the general technical conditions, as well as of these special technical conditions.

2.2.2.1.7 Final account of works

The executed works shall be accounted in accordance with item 2.1.7.3 of the general technical conditions.

The quantities assessed in compliance with item 2.2.2.1.7.1 shall be accounted according to the contractual unit price per 1 m^3 of excavated material, separately by material categories, where the following is included in the unit prices:

- all the works related to excavation and pushing away to a specified location of placing or depositing, carried out in accordance with the design documents, and/or instructions by the engineer;

- all the works related to excavation and loading on lorries, carried out in accordance with the design documents, and/or instructions by the engineer;
- all the works related to transportation and dumping to a specified location of placing or depositing, carried out in accordance with the design documents, and/or instructions by the engineer;
- all the works related to spreading surplus material on the deposit area;
- all the works related to removal of roots and stumps, including excavation of soils of low bearing capacity, which are of light-plasticity to liquid consistency;
- all the works related to arrangement of permanent and provisional deposit areas for surplus or unsuitable materials;
- acquiring adequate areas for permanent and provisional deposit areas, including suitable reimbursements;
- grading all excavated and affected adjoining surfaces;
- clearing of site after completion of works, and removal of surplus material by lorries;
- removal of all obstacles which the contractor has been faced with, except those obstacles, which are of cultural/historical importance;
- maintaining executed works up to the final taking over.

In addition to the works mentioned above, the unit price also includes the following:

- in spread excavations:
  - arranging slopes, and removal of loose stone blocks and rubble from the slopes, and
  - excavation of steps foreseen in accordance with the design, or due to a need established subsequently.
- in excavations for foundations and trenches:
  - all the required retaining and planking of trenches for foundations or channels;
- in excavations for construction pits:
  - required permanent planking in construction pit;
  - re-establishing original condition of structures and ground affected by the construction works;
  - all the required retaining and planking the construction pit slopes;
- in excavations for melioration and regulation channels:
  - arrangement of formation for paving and lining in compliance with the design; this provision shall apply where paving or lining is carried out in existing channels.

In excavations for road tunnels, the unit price shall also include the following works and measures:

- safety measures of all kinds during the entire construction period, and special safety measures during the tunnel excavation
- staking-out and current control of the axis in the tunnel (by direction and level) during duration of the excavation, as well as the construction mileage marking, including placing and maintaining of fixed point of all the types
- cross-section survey in the tunnel during excavation and after application of shot cement concrete (arch and bench) for the clearance control (taking account of all the tolerances), as well as cross-section survey of the tunnel prior to placing the waterproofing, at spacing of 5 to 10 m
- difficulties with water, irrespective of excavating upwards or downwards, up to the limiting amount of 10 l/s; this applies to the arch of the main tunnel, emergency niches, and cross tunnels
- measurements of water quantity
- impediment of the excavation, and interruptions due to survey and geotechnical measurements in the tunnel; this also applies to control measurements executed by third parties
- evacuation of all the water from the tunnel up to the waste water treatment plant, including the plant itself, pumping the water up to the highest point in the tunnel at excavation downwards

- impediment of excavation by current elaboration of geological-geotechnical documents
- increase of excavation above the line 2 specified in the technical conditions for road tunnel construction
- increase of excavation due to anchor heads to be covered with shot cement concrete prior to placing the waterproofing
- transportations of material within the site (intermediate depositing areas, ramps, temporary invert, etc.) including loading and unloading, eventually repeated loading/unloading
- current working out technical documents for construction methods of all kinds (extent of execution of supporting measures, length of excavation step, inflows and breaking-in of water the front, crumbled material, damaged anchors, cracks in the shot cement concrete, particular difficulties in the excavation progress, etc.)
- execution of preliminary securing of structures on the surface in the area of shallow covers, if the contractor has not received any satisfactory documents from the client
- safety provisions during construction to protect the equipment and machinery at site until the tunnel is handed-over to the client; this requirement does not apply to working hours only, but also to periods of breaks, when the site is at a standstill
- damage to machines and equipment due to crumbling material and similar, as these items shall be specially insured by the contractor
- excessive profiles and excavations due to an unprofessional work; the contractor shall protect and fill these items with shot cement concrete or cement concrete without having the right to claim an extra payment; the surrounding of crumbled material shall be additionally secured by injecting as directed by the engineer; in addition, the contractor is responsible for the execution of reinforcements, which might be necessary due to the abovementioned facts; the contractor has no right to claim any additional payment for the damage, that he has caused to third parties
- all additional excavations, which are required by the working-technical site conditions, such as niches for transformers, side widening, etc., for which the contractor is obliged to acquire the client's approval; the client reserves the right to use niches, side widening, etc. for other purposes subsequently
- dry boring of holes for blasting, including reduced effects; the engineer shall approve the use of water for boring works
- all the required excessive profiles for excavation of individual niches, except emergency niches, difficulties related to removal of individual supporting means, and to the water inflow
- geological control of the tunnel face for each excavation step (map-work for tunnel face, and photo documentation), including a finally elaborated comparison between the predicted and actual geology
- difficulties due to removal of supporting means in areas where cross tunnels intersect the main tunnel, independently on the rock class, as well as surplus works associated with the water drainage (pumps etc.)
- eventual use of greater amounts of steel or truss arches upon excavation of the elephant foot in the arch, preparation of the elephant foot for subsequent extension of the arch to the bench, as well as a greater consumption of shot cement concrete and reinforcing steel.

Re-profiling of insufficient cross-section in a road tunnel due to radial deformations is only relevant, when it is evident that such an under-profile has not been caused by contractor's careless work. The unit price shall include:

- removal of excavated material, with transportation to a provisional depositing area, and subsequently to a permanent depositing area, including all the manipulation
- removal of reinforced shot cement concrete, with transportation to a provisional depositing area, and subsequently to a permanent depositing area, including all the manipulation
- removal of all steel elements reaching the clear excavated profile of the tunnel, taking account of all the tolerances, with transportation to a provisional depositing area, and subsequently to a permanent depositing area, including all the manipulation
- excavation of rock with over-profile (excessive cross-section) irrespective of the rock class

- repeated installation of anchor plates onto the anchors previously built-in
- all eventual additional difficulties, which might occur upon re-profiling works.

The unit price for rotary core boring including current taking borehole samples in all types of the ground, also in a light and heavy rock as well as in cement concrete (minimum borehole diameter 80 mm), shall include the geological control and preparation of colour photos of cores (size of photography 13 x 9 cm). The cores won by rotary boring in a light or heavy rock, as well as in a loose rock, shall be only paid to such a length, that the consistency of bored-through strata can be assessed on the basis of those cores, and a prognosis can be offered. However, the length of a core shall amount to at least 90% of the borehole length.

Preliminary boring for an early detection of methane shall not be extra paid as well. All the costs shall be included in the excavation unit price.

2.2.2.2 SUBGRADE FORMATION

2.2.2.2.1 Description

The execution of a subgrade formation includes the following works:

- preparation of subgrade for constructing fills, backfills, wedges, and/or substructure after completion of surface excavation of fertile soil (topsoil), or after spread excavation of soil or rock, which comprises the following:
- rough grading, and
- compaction of subgrade surface layer.
- at improvement, consolidation, and/or stabilization with binder the following as well:
    - delivery and spreading of binder,
    - moistening,
    - mixing, and
- maintaining subgrade formation up to subsequent construction works.

2.2.2.2.2 Basic materials

A formation of natural, improved, consolidated, or stabilized subgrade can be arranged in soils and rocks not containing materials, which would, due to chemical processes in the course of time, change their mechanical and physical properties to such an extent that the road body stability could be jeopardized.

Both soils and rocks in foundation ground shall make feasible such a compaction that the foundation ground will be able to take all the loading foreseen by the design.

To improve, consolidate, or stabilize the subgrade, particularly quicklime and hydrated lime, as well as pozzolanic or metallurgical cement shall be used. To improve the subgrade, suitable mineral aggregate can be used in certain cases.

2.2.2.2.3 Quality of materials

2.2.2.2.3.1 Soils and rocks

For foundation soils and rocks the classification according to item 2.2.2.1.3.1 applies logically. Both soils and rocks shall comply with the following conditions:

1. The moisture content in a cohesive soil or granular rock shall be such as to achieve the prescribed density on compaction. Where suitable moisture content in the material cannot be ensured either by consolidation or by stabilization, other appropriate technical methods shall be introduced.
2. The content of topsoil and organic admixtures shall not exceed the quantities specified by the engineer. The maximum admissible content of topsoil and/or organic admixtures determined by the test in accordance with the EN 1744-1 shall be such, that the sodium hydroxide solution is not darker than the reference colour.

2.2.2.2.3.1.1 Cohesive soil

The applicability of cohesive soils in the foundation ground shall be established by means of preliminary testing the characteristic samples. The following properties shall be verified:

- moisture content,
- optimum moisture content and maximum density according to standard Proctor method,
- consistency limits,
- content of topsoil and organic admixtures.

Medium and high plasticity clays (of liquid limit W_L > 35 %, and plasticity index I_p > 12 %) must not be left in the layer below the subgrade formation (up to maximum 0.5 m below the substructure formation level) unless their improvement, consolidation, or stabilization is planned.

The crucial criterion to assess whether the soil quality is suitable to consolidation or stabilization is the resistance of a consolidated or stabilized soil to weather impacts.

The engineer shall specify both type and number of tests.

2.2.2.2.3.1.2 Granular rocks

As a rule, all types of granular rocks are suitable to arrange a subgrade formation.

Where the granular rock composition is insufficient to ensure the required properties of the subgrade formation it can be improved by adding and mixing an adequate mineral aggregate.

In case of suspicion than a granular rock contains an excessive amount of topsoil and/or organic admixtures, appropriate tests shall be carried out on engineer's request.

2.2.2.2.3.2 Binders

To improve, consolidate, or stabilize the cohesive soil layer below the subgrade formation all types of binders are applicable, which ensure the required properties on an improved, consolidated, or stabilized soil.

The contractor shall submit suitable documents to prove that the binders are applicable. The following shall be verified:

- binding capacity (compressive strength), and
- binding commencement and completion.

2.2.2.2.4 Execution method

2.2.2.2.4.1 Rough grading

After completion of a surface excavation or a spread excavation, the subgrade formation shall be roughly graded to ensure an optimum drainage under existing ground conditions.

This works shall be carried out in compliance with the design and these technical conditions.

2.2.2.2.4.2 Improvement, consolidation, or stabilization of cohesive soil and granular rock in the foundation ground by means of binders

An improvement, consolidation, or stabilization of cohesive soil and granular rock with binders is required to ensure suitable moisture content and/or foundation ground stability.

Binders used for improvement, consolidation, or stabilization of cohesive soil or granular rock shall be spread onto a subgrade formation, which has been roughly graded preliminarily, to such amount and in such a way that the required uniformity of the added binder (dosing accuracy of ± 1 kg/m^2), and the required properties of the mix are ensured.

The spread binder shall be mixed with natural material by means of suitable machines in a layer, which shall generally be at least 20 cm thick, as to ensure a uniform mix of the natural material and the binder.

If required, an additional water quantity shall be adequately dosed to achieve uniform and optimum moisture content in the improved, consolidated, and/or stabilized cohesive soil and granular rock.

The uniformity of the mix of cohesive soil or granular rock and the binder containing water shall be ensured by means of mixing over the entire design thickness of the layer.

Improvement, consolidation, and stabilization of cohesive soil or granular rock in the foundation ground using binders is only feasible at temperatures above +3°C, and in a dry weather.

3.2.2.1.1.2 Compaction

After completion of grading and mixing, natural subgrade, as well as improved, consolidated, or chemically stabilized soils and granular rocks in the foundation ground shall be compacted over entire layer width by means of rollers with smooth and/or pneumatic wheels.

All places, which are inaccessible to rollers, shall be consolidated in accordance with the design by means of other compaction means or methods to be approved by the engineer, who also specifies the conditions, under which such means or methods shall be used.

Both serviceability of compacting machines and the compacting method shall be preliminarily tested in compliance with item 2.1.5.2 the general technical conditions.

Prior to commencement of compaction, any layer of natural, improved, consolidated, and stabilized subgrade or mixture shall contain such amount of water that it can be suitably compacted.

If required, the engineer may determine additional procedures to ensure adequate moisture content, and suitable placing of cohesive soil, granular rock, and/or mix.

When fills, backfills, or wedges are not constructed immediately after compacting and checking quality of the subgrade formation, but only after a longer period of different weather conditions, the layer density below the subgrade formation shall be rechecked prior to continuing the works. The latter can be carried out only in case that the established quality is sufficient.

2.2.2.2.4.3 Storage of binders

Binders for improvement, consolidation, and stabilization of cohesive soils and granular rocks shall generally be stored in adequate silos or tanks.

2.2.2.2.5 Quality of execution

2.2.2.2.5.1 Compaction

The contractor shall prove the compaction of cohesive soil or granular rock below the subgrade formation by test results within the scope of the internal control, as a rule by a non-destructive fast measuring method by means of an isotope gauge.

Layers of natural, improved, consolidated, and stabilized cohesive soils and granular rocks below the subgrade formation shall achieve the required compaction and load bearing values in accordance with table 2.2.

The required compaction values indicated in table 2.2 are mean values. The lower limiting value must not be by more than 3 % below the corresponding required mean value.

The compaction of cohesive soil or granular rock below the subgrade formation shall attain the lower limiting value at any measuring spot. The contractor is obliged to re-compact insufficiently compacted cohesive soils and/or granular rocks below the subgrade formation, taking account of provisions of these technical conditions, however without any right to claim additional payment.

When the engineer, on the basis of results of internal and/or external tests, subsequently establishes insufficiently compacted places on the subgrade formation, he may decide upon further measures autonomously.

2.2.2.2.5.2 Bearing capacity

The contractor shall prove the bearing capacity of the subgrade formation (unless he carried out compaction tests) by the results of internal bearing capacity tests measuring static and/or dynamical moduli of deformation (E_{v2} and E_{din}).

The required mean lower limiting values of static moduli of deformation E_{v2} on the subgrade formation are given in table 2.2.

Informative lower limiting values of dynamical moduli of deformation E_{vd} amount to approximately 50 % of the required lower limiting values of static moduli of deformation E_{v2}.

The ratio of static moduli of deformation E_{v2} : E_{v1} shall not exceed 2.2. If the measured value of the modulus E_{v1} exceeds 50 % of the required value of the modulus E_{v2}, the required ratio is not decisive to assess the bearing capacity of the made subgrade formation.

Table 2.2: Requirements in view of compaction and bearing capacity of the subgrade formation

Description of works	Required compaction with regard to the material density by SPP %	by MPP	Required bearing capacity E_{v2} MN/m²
Subgrade formation more than 2 m below the formation level of substructure made of			
- cohesive soils	92	-	-
- improved cohesive soils	92	-	-
- consolidated and stabilized cohesive soils	92	-	-
- granular rock	-	92	-
Subgrade formation less than 2 m below the formation level of substructure made of			
- cohesive soils	95	-	15
- improved cohesive soils	95	-	20
- consolidated and stabilized cohesive soils	95	-	30
- granular rock	-	95	60
Subgrade formation at the formation level of substructure made of			
- cohesive soils	98	-	20

- improved cohesive soils	98	-	25
- consolidated and stabilized cohesive soils	98	-	40
- granular rock	-	98	80

SPP – standard Proctor compaction test

MPP – modified Proctor compaction test

The required values indicated in table 2.2 represent the lower limiting values. The lower threshold value of an individual measurement (up to 5 % of the total number of measurements) may be by up to 20 % below the lower limiting value.

As a rule, the bearing capacity of a subgrade formation and of a consolidated or stabilized cohesive soil and granular rock can be checked only 7 days after completion of compaction.

When the engineer, on the basis of results of internal and/or external tests, subsequently establishes places of insufficient bearing capacity on the subgrade formation, he may decide upon further measures autonomously.

2.2.2.2.5.3 Consolidated and stabilized cohesive soils and/or granular rocks

The contractor shall prove the properties of consolidated and stabilized natural materials by results of the following tests within the scope of the internal control:

- compressive strength tested on seven days old specimens prepared according to conditions for preparation of specimens by a suitable Procotor test; the following values shall be achieved:
  - at least 0.4 MN/m^2 for cohesive soils,
  - at least 1.5 MN/m^2 for granular rocks;
- weather resistance of specimens prepared according to described conditions; it is determined by the ratio of compressive strengths of dry and soaked (for 24 hours) seven days old specimens, and shall amount to at least 0,70.

In case of necessity, the engineer may modify the abovementioned quality requirements for stabilized natural materials of the layers below the subgrade formation.

The required values of compressive strength of specimens represent mean values. The lower limiting value may be by 0.1 and 0.2 MN/m^2 respectively lower than the required value whilst the lower threshold value may by 0.2 and 0.5 MN/m^2 respectively lower.

2.2.2.2.5.4 Evenness and subgrade formation level

2.2.2.2.5.4.1 Evenness

The method of measuring evenness is defined in the General Technical Conditions.

The subgrade formation may deviate at a length of 4 m, in any direction with regard to the road axis, from the straight edge or plane by the following values:

- in natural, improved, consolidated and stabilized cohesive soils max. 30 mm
- in granular rocks max. 30 mm
- in rocks max. 50 mm

2.2.2.2.5.4.2 Level

A subgrade formation may deviate at any place from the design level by the following values:

- in natural, improved, consolidated and stabilized cohesive soils max. ± 25 mm
- in granular rocks max. ± 25 mm
- in rocks max. ± 40 mm

2.2.2.2.6 Execution quality control

2.2.2.2.6.1 Preliminary tests

Prior to commencement of consolidating the subgrade the contractor shall verify whether the characteristic properties of materials established by preliminary geotechnical investigations, correspond to the properties of material samples taken at the beginning of works.

By preliminary testing carried out on a suitable test area the contractor shall verify the characteristics indicated in table 2.3, taking account of the engineer’s instructions.

For each characteristic material type below the subgrade formation, adequate technology, type of compacting machine and its depth effect shall be specified prior to commencement of the works.

Table 2.3: Preliminary tests for subgrade preparation

Material property	Unit	Required value	Test method
- applicability of cohesive soil and/or granular rock:			
- natural moisture content:	% by m.	item 2.2.2.2.3.1/1	BAS
- Proctor compaction test:			EN 13286-2
- optimum moisture content	% by m.	-	
- maximum density	t/m^3	-	
- consistency limits:			
- liquid limit w_L	%	≤ 35	
- plasticity index I_p	%	≤ 12	
- portion of topsoil and/or organic admixtures	-	item 2.2.2.2.3.1/2	EN 1744-1
- applicability of binder:			
- binding capacity:	% by m.	item 2.2.2.2.3.1/1	
- compressive strength of mix:			EN 12390-2
- cohesive soils	MN/m^2	≥ 0,4	
- granular rock	MN/m^2	≥ 1,5	
- weather resistance	-	≥ 0,7	-
- commencement and completion of binding	h	-	EN 196-3

2.2.2.2.6.2 Consolidation control

2.2.2.2.6.2.1 Internal control

On the basis of preliminary tests the engineer specifies the internal control extent in consolidation the subgrade formation notwithstanding that such a control has already been determined by the programme of average control frequency.

The minimum frequency of internal control in consolidation of the subgrade formation, which includes

- testing of materials, and
- testing on placing,

is specified in tables 2.4 and 2.5 below.

Table 2.4: Minimum material testing frequency within the scope of internal control of consolidation of subgrade formation

Material property	Test method	Minimum testing frequency
- natural moisture content		per 40 m^1
- Proctor compaction test	EN 13286-2	per 400 m^1
- consistency limits of soils		per 400 m^1
- portion of topsoil and/or organic admixtures	EN 1744-1	per 400 m^1

When the engineer establishes that the results of the internal control tests significantly deviate from the results of preliminary testing, or from the properties specified in conformity certificates, he is entitled to modify the internal control extent. On the contrary, he may also reduce the internal control extent, when the testing results are homogeneous.

Table 2.5: Minimum placing control frequency within the scope of internal control of subgrade consolidation

Subgrade properties	Test method	Minimum testing frequency	Evaluation base
- moisture content and natural material density		20 m^1	item2.2.2.2.3.1.1
- quantity of spread binder		100 m^1	item 2.2.2.2.4.2
- mix:		100 m^1	
- moisture content and density		40 m^1	item 2.2.2.2.4.3
- compressive strength	EN 12390-3	100 m^1	item 2.2.2.2.5.3
- weather resistance		200 m^1	item 2.2.2.2.5.3
- subgrade formation:		100 m^1	
- compaction		20 m^1	item 2.2.2.2.5.1
- bearing capacity (E_{vd})		20 m^1	item 2.2.2.2.5.2
- evenness and level		20 m^1	item 2.2.2.2.5.4

2.2.2.2.6.2.2 External control

The ratio of the external control extent to be performed by the client, to the internal control extent, generally amounts to 1 : 4.

According to a statistical random pattern the engineer selects locations of taking samples for the external control, and places where evenness, levels, density, moisture content, and bearing capacity shall be measured.

2.2.2.2.7 Measurement and taking over of works

2.2.2.2.7.1 Measurement of works

The executed works shall be measured in compliance with item 2.1.7.1 of general technical conditions.

The quantities of all the works carried out on the subgrade formation shall be accounted in square metres.

All the quantities shall be measured according to the actually executed extent and type of works within the scope of the design documents.

The contractor shall submit suitable certificates for all the quantities of binders delivered to the site.

2.2.2.2.7.2 Taking over of works

The engineer shall take over the subgrade formation, taking account of the quality requirements indicated in these technical conditions, and in compliance with item 2.1.7.2 of the general technical conditions.

Prior to proceeding with the works, the contractor shall make good all the deficiencies established on the basis of these requirements.

All the costs associated with mending deficiencies shall be born by the contractor, including expenses for all the measurements and tests, which had shown an inappropriate quality if the executed works, as well as for additional tests, which have been performed after completion of the repair works to establish, whether the quality meets the requirements.

For all the works that do not comply with the requirements indicated in these technical conditions, and which have not been mended in accordance with the engineer’s instructions, the contractor has no right to claim any payment. In addition, the client is entitled to prolong the guarantee period (liability period) by at least 5 years for all the works that depend on the unrepaired works.

2.2.2.2.8 Final account of works

2.2.2.2.8.1 General

The executed works shall be accounted in accordance with item 2.1.7.3 of General Technical Conditions.

Quantities assessed according to item 2.2.2.2.7.1 shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a whole accomplishment of the works. The contractor shall not be entitled to claim any extra payment subsequently.

2.2.2.2.8.2 Deductions due to inadequate quality

2.2.2.2.8.2.1 Materials

As the quality of materials is clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.2.8.2.2 Binders

As the quality of binders used for improvement, consolidation, or stabilization of materials is clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.2.8.2.3 Compaction and bearing capacity

The lower limiting values of compaction and bearing capacity measurements, as well as individual values up to the lower threshold values of measurements (up to 5 % of the total number of measurements) represent a 100 % - value in accordance with the bid unit price. As the compaction and bearing capacity requirements are clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.2.8.2.4 Consolidated and stabilized materials

The lower limiting value of the quality specified in item 2.2.2.2.5.3 represents a 100 % - value in accordance with the bid unit price, whereas the lower threshold value a work without any value. Intermediate values shall be linearly interpolated.

2.2.2.2.8.2.5 Formation evenness

As the adequate evenness of the formation is clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.2.8.2.6 Formation level

As the design formation level is clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.3 SEPARATING, DRAINAGE, AND FILTER LAYERS; WORKING FIELD

2.2.2.3.1 Description

These works include both delivery and placing of the following:

- stone material for drainage and filer layers as well as working field and artificial islands,
- geotextiles for separating, drainage, and filter layers, and
- secondary materials for working field or artificial island in compliance with design or engineer's requirements, and with these technical conditions.

2.2.2.3.2 Basic materials

To construct drainage and filter layers as well as working field, natural, crushed, or mixed mineral aggregates are appropriate, provided that they comply with the provisions of these technical conditions. For working fields and artificial islands also such stone aggregates are applicable, which are produced of secondary materials.

In addition to stone materials, geotextiles can also be used to execute separating, drainage, and filter layers, on condition that they comply with these technical conditions.

2.2.2.3.3 Quality of materials

2.2.2.3.3.1 Stone materials

Stone materials for drainage and filter layers as well as working field can be won directly in excavations and/or borrow pits (gravel pits, quarries, etc.), and/or indirectly by crushing natural stones or secondary materials.

Mineral aggregates for drainage and filter layers as well as working field shall be composed of individual grain-groups in such proportions that the specified requirements are fulfilled in dependence on the intended purpose.

Mineral aggregates for drainage and filter layers as well as working field shall be suitable in view of

- particle size distribution,
- content of topsoil and organic admixtures, and
- durability of mineral grains.

A mineral mixture for drainage and filter layers shall fulfil the conditions of USBR specified by grading curve limiting values:

$$12 \langle \frac{d_{15F}}{d_{15Z}} \langle 40$$

$$12 \langle \frac{d_{50F}}{d_{50Z}} \langle 52$$

where:

d_{15F}/d_{50F} – particle diameter at 15 % by mass/50 % by mass passing sieve of aggregate for drainage in filter layers

d_{15Z}/d_{50Z} – particle diameter at 15 % by mass/50 % by mass passing sieve of soil, which access to adjacent and filter layers must be prevented

The diameter of the largest particle in mineral aggregates for drainage and filter layers must not be greater than 2/3 of the layer thickness; in mineral aggregates for working field the diameter must not exceed a half of the layer thickness.

Where geotextiles is laid as an intermediate layer between mineral aggregate drainage or filter layer, and a cohesive soil, the mineral aggregate particle size distribution is determined by both coefficient of granulometric composition non-uniformity U = d_{60}/d_{10} and coefficient of water permeability *k*.

The designation d_{60} signifies the diameter of mineral grains (sieve opening) at 60% by mass passing sieve of the aggregate, whereas d_{10} is the diameter of mineral grains at 10 % by mass passing sieve of the aggregate.

The quotient U of granulometric composition non-uniformity shall be greater than 8 for mineral aggregates for drainage and filter layers, when such a layer is placed without any intermediate layer of other material. However, where geotextiles is laid between the drainage or filter layer, and the cohesive soil, and where the mineral aggregate is composed of several basic grain-groups, the quotient U of granulometric composition non-uniformity shall be greater than 3. For a gap-graded aggregate (basic grain-group) the quotient U has no lower limiting value.

The portion of grains of up to 0.063 mm in size in an aggregate for a drainage or a filter layer shall, in case that such a layer is placed within the frost area, and that the quotient U amounts to ≥ 15, correspond (according to SIST EN 13242) to the following categories:

- category f_5 (up to 5 % by mass) on deposit areas, and
- category f_8 (up to 8 % by mass) in executed layer.

Where the quotient U amounts to ≤ 6, the portion of particles of up to 0.063 mm in the mineral aggregate of executed drainage or filter layer shall correspond to the category f_{15} (up to 15 % by mass).

Where coarse-grained mineral aggregate is used to execute a working field (granulometric composition 0/2500 mm or more), the admissible portion of grains of up to 0.063 mm shall correspond to the category f_{15} (up to 15 % by mass).

The coefficient of water permeability *k* of mineral aggregate for drainage and filter layers coated with geotextiles, as well as for working field shall amount to at 10^{-5} m/s. Suitable specimen shall be prepared according to the modified Proctor test.

The maximum admissible content of topsoil and/or organic admixtures in mineral aggregate determined by the test in accordance with the SIST EN 1744-1 shall be such, that the sodium hydroxide solution is not darker than the reference colour.

Mineral aggregates for drainage and filter layers shall not contain

- clayey, micaceous, and graphite slate,
- clayey and light-plasticity sandstone, and
- marl grains.

Both mechanical durability and volume constancy, as well as water and frost resistance shall be determined by macroscopic mineralogical – petrographical investigation (in accordance with EN 932-3), or by additional testing (in compliance with EN 1367-2).

When such mineral aggregates are used to construct a working field or an artificial island, which are, by their origin, secondary materials, their chemical inertness, and resistance to leaching respectively shall be verified.

Prior to commencement of works, the contractor shall inform the engineer on the location of winning mineral material for drainage and filter layers, as well as for a working field. Suitable certificates shall be submitted to the engineer, and the latter shall issue a permit to use these materials.

2.2.2.3.3.2 Geotextiles for separating, drainage, and filter layers

Geotextiles for separating, drainage, and filter layers shall generally meet the requirements specified by the design.

The required minimum requirements in view of properties of geotextiles for separating, drainage, and filter layers shall be harmonized with the conditions indicated in the geotechnical report, and with guidelines for planning and application of geotextiles for these types of layers in road construction.

The selected geotextiles for separating, drainage, and filter layers shall be specified by a general description of the following:

- material type, and
- dimensions.

As a rule, the geotechnical report shall define properties, which shall be verified for the execution. They are indicated in tables 2.6, and 2.7.

Table 2.6: Minimum requirements for separating geotextiles in common cases, where the selection has not been performed in compliance with the procedures indicated in guidelines or supplements, or by geotechnical design

Properties	Unit	Minimum requirements	Test method
Mechanical properties			
- tensile strength transversally - longitudinally	kN/m	> 14	EN ISO 10319
- elongation strain at failure	%	> 30	EN ISO 10319
- resistance to dynamic piercing	mm	< 30	EN 918
- resistance to piercing (CBR)	N	> 2000	EN ISO 12236
Hydraulic properties:			
- characteristic pore size	mm	$0{,}05 \le O_{90} < 0{,}5$	EN ISO 12956
- velocity index	m/s	3×10^{-3}	EN ISO 11058
- permeability index at 20 kPa	m/s	$> 10\ k_{soil}$	E-DIN 60 500-4

Table 2.7: Minimum requirements for filter geotextiles in common cases, where the selection has not been performed in compliance with the procedures indicated in guidelines or supplements, or by geotechnical design

Properties	Unit	Minimum requirements[1)]	Test method
Mechanical properties			
- tensile strength transversally - longitudinally	kN/m	> 14	EN ISO 10319
- elongation strain at failure	%	> 30[2)]	EN ISO 10319
- resistance to dynamic piercing	mm	< 35	EN 918
- resistance to piercing (CBR)	N	> 1500	EN ISO 12236
Hydraulic properties:			
- characteristic pore size	mm	$0{,}05 \le O_{90} < 0{,}2$	EN ISO 12956
- velocity index	m/s	3×10^{-3}	EN ISO 11058
- permeability index at 20 kPa	m/s	$> 10\ k_{soil}$	E-DIN 60 500-4

1) Recommended selection of filter geotextiles according to Guidelines

2) For wall drainages ≥ 10 %, for embedded vertical drainages ≥ 20 %

The minimum requirements for drainage geotextiles are the same as indicated in table 2.7.

The minimum required values for properties indicated in tables 2.6 and 2.7, shall be ensured by appropriate evidences to be submitted to the engineer prior to commencement of works.

The mechanical and hydraulic properties of drainage geotextiles, which shall be assessed by means of a design calculation, are indicated in table 2.8. Where compressible geotextiles are used for drainage layers, the effect of both external load and creep on reduction of their thickness, as well as reduction of conductivity in the course of time shall be calculated.

Table 2.8: Mechanical and hydraulic properties of drainage geotextiles to be assess by design calculation

Properties	Unit	Test method
Mechanical properties		
- tensile strength transversally - longitudinally	kN/m	EN ISO 10319
- elongation strain at failure	%	EN ISO 10319
- resistance to dynamic piercing	mm	EN 918
- resistance to piercing (CBR)	N	EN ISO 12236
Hydraulic properties:		
- characteristic pore size	mm	EN ISO 12956
- velocity index	m/s	EN ISO 11058
- permeability index at 20 kPa	m/s	E-DIN 60 500-4
- transmittance	m^2/s	EN ISO 125958

Where a geo-membrane, a rough foil, or a geo-mesh is foreseen for a separating, drainage, or filter layer, the requirements shall be defined in detail by the design.

Additional conditions for the application of geotextiles are presented in detail in the Guidelines for planning and application of geotextiles for separating, filter, and drainage layers in road construction.

2.2.2.3.3.3 Preliminary tests

No additional tests are generally required, provided that the contractor submits to the engineer in due time adequate evidences of quality of material for separating, drainage, and filter layers, as well as working field. However, in special cases, the engineer may request such tests, notwithstanding that suitable conformity certificate has been presented by the contractor.

The contractor shall submit all certificates proving that the material is suitable to the intended use unless such evidence has already been provided by the design or supplemental information.

The contractor has no right to claim any extra payment for additional tests.

2.2.2.3.4 Method of execution

2.2.2.3.4.1 Preparation of sub-base formation

A sub-base formation, onto which a drainage and/or a filter layer, or a working field of stone material will be placed according to the design, shall be prepared, prior to placing the material, in compliance with the design requirements and these technical conditions.

A sub-base formation, onto which geotextiles will be laid as a separating, drainage, and/or filter layer, shall be preliminarily so prepared as to comply with the special technical conditions.

2.2.2.3.4.2 Bringing stone material for execution of drainage and filter layers, and working field

Onto a suitably prepared sub-base formation (in accordance with item 2.2.2.3.4.1) stone material for drainage and filter layers, as well as for working field can be brought only after the formation has been taken over and approved by the engineer.

Mineral aggregates may only be brought to the working field over a mineral aggregate layer, which has already been spread previously. The stone aggregate must not be delivered over the subgrade formation, which has already been arranged and taken over.

Suitably equipped vehicles and/or spreading devices shall be used to enable the required distribution of material in uniform layers or zones. The layer thickness of the spread material shall comply with the value specified by the design.
In case of placing of several layers, each individual layer shall be adequately shaped and compacted prior to commencement of bringing material for the subsequent layer.

Vehicles bringing the material shall be distributed as uniform as possible over the entire width of the spread layer to prevent non-uniform compaction of the drainage layer and/or filter layer, or working field.

Vehicles which wheels and chassis are soiled must not drive on already spread or compacted stone material.

For formations of soils of very low bearing capacity (e.g. swamps or moors), where special methods for working field construction are foreseen by the design, the following provisions shall be generally applied as well, unless provided otherwise by additional technological conditions:

- mineral aggregate (according to 2.2.2.3.3.1) shall be spread onto previously laid geotextiles in compliance with the design and these technical conditions,
- on sections where vertical drainages are foreseen, the mineral aggregate for the working field shall be placed prior to execution of vertical drainages, whereas the specified aggregate for the drainage and/or filter layer shall be placed afterwards.

2.2.2.3.4.3 Spreading and profiling mineral aggregates for drainage and filter layers, and working field

After being spread, each layer shall be levelled to both profile and slope as provided by the design.

On a formation of soils of very low bearing capacity, where special methods for working field construction are foreseen by the design, the mineral aggregate shall be spread by means of a light bulldozer or motor grader.

2.2.2.3.4.4 Compaction of stone material for drainage and filter layers, and working field

After completion of spreading, the layer shall be compacted over entire layer width by means of rollers with smooth or pneumatic wheels.

As a rule, rolling shall be carried out from outer edges of the layer towards the middle, and/or from the lower edge towards the upper one. The number of required passages of rollers shall be determined by testing compaction during the works. Where the design layer compaction cannot be achieved, additional compaction shall be carried out as directed by the engineer.

All locations, which are inaccessible to rollers, shall be compacted by means of other compacting machines approved by the engineer who shall also specify the conditions under which such means must be used.

Applicability of compaction means, and the proposed compaction method shall be preliminarily tested according to item 2.1.5 of the general technical conditions.

Unless determined otherwise by the technological conditions, for soils of very low bearing capacity, where special conditions for execution of drainage and/or filter layers, and working field are provided by the design, only light rollers weighing up to 10 kN maximum may be used to compact mineral aggregates (only to shape the surface, and to prevent infiltration of fine particles from the subsequent layer).

2.2.2.3.4.5 Storing stone material and geotextiles

When the contractor, prior to placing, stores stone material and geotextiles for separating, drainage, and/or filter layers, and a working field, such place shall be preliminarily so prepared and cleaned as to prevent soiling the material. The space for storing geotextiles for separating, drainage, and/or filter layers shall also comply with provisions prescribed by the manufacturer.

2.2.2.3.4.6 Method of execution of separating, drainage, and filter layers using geotextiles

Geotextiles may only by laid onto sirfaces prepared in accordance with these technical conditions, i.e.:

- by sewing overlapping of approximately 10 cm in width,
- by thermal welding of overlapping of 10 – 15 cm in width,
- by unbound overlapping of 50 cm in width.

Laying geotextiles with unbound overlapping of 50 cm is only admitted, when weather conditions prevent sewing or welding.

As the laid geotextiles shall be, as a rule, covered within the same day with mineral material, it shall be laid in dependence on the work progress.

Coils of geotextiles shall be protected and stored in compliance with supplier's/producer's instructions.

Any passage of vehicles over the geotextiles is forbidden. Vehicles may only pass over a working field made of stone material of suitable thickness (at least 40 cm) frontally spread over the geotextiles.

2.2.2.3.5 Quality of execution

2.2.2.3.5.1 Compaction of working field

The compaction degree of mineral aggregate in a working field shall be, as a rule, assessed by a non-destructive fast measurement of density (and moisture content) by means of isotopic gauge.

The mean compaction degree of mineral aggregates of a working field shall amount to the following values related to the maximum density of aggregate determined by the modified Proctor compaction test:

- 95 %, when the working field is executed up to a depth of 1.5 m below the substructure bottom level, or
- 92 %, when the working field is executed deeper.

The lower limiting value of an individual result of compaction measurement may deviate by up to 5 % from the mean value.

2.2.2.3.5.2 Bearing capacity

The bearing capacity of the formation of a drainage and/or filter layer shall be assessed, if this is directed by the design. The requirements for such an assessment shall be specified in detail.

The bearing capacity of the working field formation shall be, as a rule, assessed by means of measuring static and dynamical moduli of deformation.

The static modulus of deformation E_{v2} on the working field formation shall amount to at least 50 MN/m^2, whereas the ratio of moduli $E_{v2} : E_{v1}$ must not exceed 3.0.

The dynamical modulus of deformation E_{vd} on the working field formation shall amount to minimum 25 MN/m^2.

The lower limiting value of an individual result of measurement of static or dynamical modulus of deformation may deviate by up to 20 % from the required value. The allowable number of such deviations must not exceed 10 % of the total number of measurements.

2.2.2.3.5.3 Formation evenness

The evenness of the formation of a drainage and/or filter layer, measured with a 4 m straight edge, may deviate in any direction with regard to the road axis by maximum 30 mm, whereas by maximum 50 mm for the working field formation.

The specified evenness must be attained. The contractor shall have no right to claim additional payment for eventual repair of the work already completed (to fulfil the abovementioned condition).

2.2.2.3.5.4 Formation level

At any place, the formation level of drainage and/or filter layer may deviate from the design level by maximum ± 30 mm, whereas the working field formation by maximum ± 50 mm.

The specified formation level of a drainage or filter layer as well as of the working field shall be attained. The contractor shall have no right to claim additional payment for eventual repair of the work already completed (to fulfil the abovementioned condition).

2.2.2.3.6 Execution quality control

Prior to the first placing of mineral aggregates and geotextiles for separating, drainage, and filter layer, as well as for working field, an independent external control institution shall verify the conformity certificates proving that the material properties comply with the requirements. In case of necessity, the independent institution shall also carry out identity tests specified by the engineer.

2.2.2.3.6.1 Preliminary tests

At the beginning of placing separating, drainage, and filter layers, as well as working field, the following shall be checked:

- granulometric composition of material, which access into upper or adjacent layers shall be prevented,
- granulometric composition of material foreseen for drainage and filter layers, as well as working field,
- properties of geotextiles.

On the basis of the aforementioned checking, the engineer may approve the proposed method of placing, or require a modification of the planned procedure/material, and the adjustment in view of the already placed or existing material.

If the contractor fails, in due time prior to commencement of placing, to submit to the engineer the required conformity certificates for mineral aggregate and/or geotextiles, planned for execution of separating, drainage, and filter layer, as well as of working field, it may be exceptionally allowed by the engineer to perform the required tests, in compliance with these technical conditions, at the beginning of the placing works. The engineer shall specify the number of tests in dependence of the material.

2.2.2.3.6.2 Verification of placing

2.2.2.3.6.2.1 Internal control

The contractor's internal control shall establish the conformity of properties of mineral aggregates in drainage and filter layers, as well as in a working field, and of properties of the placed layer with the requirements specified by both design documents and these technical conditions.

Both frequency and type of tests to be performed by the internal control are specified in the approved programme of the average control frequency. If this is not the case, the engineer shall direct both frequency and type of testing.

According to a statistical random pattern the engineer selects locations of taking samples and measurement spots.

During placing of mineral aggregate for drainage or filter layer, or working field, the laboratory shall take samples and verify the conformity, taking account of the frequency indicated in table 2.9.

Table 2.9: Minimum frequency of testing mineral aggregates within the scope of the internal control of placing drainage and filter layers, and working field

Properties of mineral aggregates	Test method	Minimum testing frequency	
		for drainage and filter layer	for working field
granulometric composition	EN 933-1	per 200 m^3	per 2000 m^3
portion of fines	EN 933-1	per 200 m^3	-
density by modified Proctor compaction test	EN 13286-2	per 400 m^3	per 8000 m^3
portion of topsoil and organic admix.	EN 1744-1	per 400 m^3	-

A minimum extent of tests within the scope of the internal control of drainage and filter layers, as well as of working field, made of mineral aggregates, is indicated in table 2.10.

Table 2.10: Minimum frequency of testing within the scope of the internal control of drainage and filter layers, as well as of working field, made of mineral aggregates

Property	Test method	Minimum testing frequency	
		for drainage and filter layer	for working field
moisture content and mineral aggregate density	BAS	per 20 m^1	per 40 m^1
layer bearing capacity – dynamical modulus of deformation E_{vd}	BAS	per 40 m^1	per 40 m^1
layer bearing capacity – static modulus of deformation E_{v2}	BAS	per 100 m^1	per 200 m^1
evenness and level of layer formation	BAS	per 20 m^1	per 40 m^1

2.2.2.3.6.2.2 External control

By the external control, the internal control is supervised, and the conformity of the produced and placed aggregate mixture and geotextiles in separating, drainage, and filter layer, as well as in working field, with requirements indicated in the design and these technical conditions is established.

A minimum testing frequency within the scope of the external control of placing aggregate mixtures for drainage and a filter layer as well as a working field is indicated in table 2.11.

Table 2.11: Minimum testing frequency within the scope of the external control of placing mineral aggregate for drainage and filter layers as well as working field

Properties of mineral aggregates	Test method	Minimum testing frequency	
		for drainage and filter layer	for working field
granulometric composition	EN 933-1	per 1000 m^3	per 8000 m^3
portion of fines	EN 933-1	per 1000 m^3	-
density by modified Proctor compaction test	EN 13286-2	per 400 m^3	per 16000 m^3
portion of topsoil and organic admix.	SIST EN 1744-1	per 4000 m^3	-

A minimum extent of tests within the scope of the external control of drainage and filter layers, as well as of working field, made of mineral aggregates, is indicated in table 2.12.

Table 2.12: Minimum frequency of testing within the scope of the external control of drainage and filter layers, as well as of working field, made of mineral aggregates

Property	Test method	Minimum testing frequency	
		for drainage and filter layer	for working field
moisture content and mineral aggregate density	BAS	per 100 m^1	per 200 m^1
layer bearing capacity – dynamical modulus of deformation E_{vd}	BAS	per 200 m^1	per 200 m^1
layer bearing capacity – static modulus of deformation E_{v2}	BAS	per 400 m^1	per 800 m^1

2.2.2.3.7 Measurement and taking over of works

2.2.2.3.7.1 Measurement of works

Executed works shall be measured in compliance with item 2.1.7.1 of general technical conditions and with the following provisions:

- the quantities of placed mineral aggregates for drainage and filter layers as well as the working field in cubic metres in compacted condition and in accordance with the works actually carried out within the scope of the design. The value indicated in the design documents shall be considered as the limiting (maximum) thickness of the constructed layer.
- the quantity of laid geotextiles in square metres in accordance with the measurement of works actually carried out; the specified overlapping shall not be measured extra.

The contractor shall submit to the engineer adequate evidence of the geotextiles quantity delivered to the site.

2.2.2.3.7.2 Taking over of works

Executed works shall be taken over in compliance with item 2.1.7.2 of the general technical conditions, and with the provisions of these special technical conditions.

The placed separating, drainage, and filter layers as well as the working field are subject to taking over by the engineer. The contractor shall submit in due time all the information and reports on conformity, as well as a final conformity certificate issued by an independent institution.

The engineer shall take over the separating, drainage, and filter layer, as well as working field in compliance with the requirements indicated in this technical specification, and with eventual additional requirements being a constituent part of the construction contract.

Where deficiencies and non-attaining minimum quality requirements are found out, the contractor shall mend the situation at his expense prior to continuation of works. This also applies to the costs associated with all the additional measurements and tests, which shall be performed after the deficiencies are made good.

For all the works, which do not meet the quality requirements in accordance with this technical specification, or which have not been carried out nor made good in compliance with the contractual design conditions, the contractor has no right to claim any extra payment.

In such a case, the contractor is entitled to extend the liability period by at least 5 years for all the works, which are dependent on the non-mended works.

2.2.2.3.8 Final account of works

2.2.2.3.8.1 General

Works shall be accounted in accordance with item 2.1.7.3 of the general technical conditions, and with the following provisions:

Quantities assessed in accordance with item 2.2.2.3.7.1 shall be accounted on the basis of the contractual unit price, where the latter shall include all the services related to delivery, transportation, placing, and all the other works, defined by both design and these technical conditions, which are necessary for a complete accomplishment of the works, thus the contractor has no right to claim any additional payment.

Mineral aggregates for drainage and filter layers as well as working field shall be accounted in cubic metres of the material placed.

Geotextiles for separating, drainage, and filter layers shall be accounted in square metres of the material laid.

When the contractor places such a material for separating, drainage, and filter layer, or working field, which does not comply with the minimum quality requirements, or when the bearing capacity of the working field formation is insufficient, the engineer shall decide upon the accounting method.

2.2.2.3.8.2 Deductions due to inadequate quality

2.2.2.3.8.2.1 Stone material

The quality of stone material for drainage and filter layers as well as working field specified in item 2.2.2.3.3.1 shall be ensured.

As the quality of stone material is clearly specified, there shall be no deductions upon final accounting of the works.

3.2.2.1.1.2.1 Geotextiles

Minimum requirements concerning geotextiles for separating, drainage, and filter layers, specified in both item 2.2.2.3.3.2 and design documents shall be ensured, thus no deductions upon final accounting shall be applicable.

2.2.2.3.8.2.2 Stone material compaction

Minimum requirements concerning compaction of the working field stone material specified in item 2.2.2.3.5.1 shall be fulfilled.

As the stone material compaction is clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.3.8.2.3 Bearing capacity

Bearing capacity of the working field formation specified in item 2.2.2.3.5.2 shall be ensured, thus no deductions upon final accounting shall be applicable.

2.2.2.3.8.2.4 Formation evenness

As the evenness of the drainage and filter layer formation as well as of the working field formation is clearly specified in item 2.2.2.3.5.3, there shall be no deductions upon final accounting of the works.

2.2.2.3.8.2.5 Formation level

As the suitable level of the drainage and filter layer formation as well as of the working field formation is clearly specified in item 2.2.2.3.5.4, there shall be no deductions upon final accounting of the works.

2.2.2.4 FILLS, BACKFILLS, WEDGES, SUBSTRUCTURE, AND PUDDLE LAYER

2.2.2.4.1 Description

The following works are included:

- machine spreading of materials for fills;
- machine and/or manual spreading of materials for backfilling the foundations, trenches, construction pits, melioration and regulation channels, as well as drainage ditches and gutters;
- machine and/or manual spreading of materials in wedges behind bridges, or at transitions from cuts to fills;
- machine and/or manual spreading of materials for substructure, all in compliance with the design or engineer's requirements, and in accordance with these technical conditions;
- moistening, mixing, rough grading, and compacting of materials in fills, backfills, and wedges of dimensions and quality specified by both design and these technical conditions;
- machine spreading of materials for preloading and overloading at locations where this is foreseen by the design, and complies with these technical conditions;
- construction of substructure of dimensions and quality specified by both design and these technical conditions;
- execution of puddle layer at locations where this is foreseen by the design, and complies with these technical conditions; delivery and placing of suitable cohesive soil is comprised;
- arrangement of formation of the top layer of fills, backfills, wedges, substructure, and puddle layer, as specified by the design and in compliance with these technical conditions.

2.2.2.4.2 Basic materials

2.2.2.4.2.1 Materials

For fills, backfills, wedges, and substructure, suitable cohesive soils, granular, soft, and hard rocks, fly ash from thermal power plants and heating plants, as well as secondary materials (slag, recycled construction materials) can be used in accordance with the design requirements.

Fertile soils (topsoil) or low bearing capacity soils and other materials, which would change their mechanical-physical properties due to biochemical processes in the course of time, shall not be used for backfills, wedges, and substructure.

Materials for fills, backfills, wedges, and substructure can be won by excavating in the road alignment, and/or from borrow pits.

For puddle layers, cohesive soils such as clays and silt clays are applicable. Perfect waterproofing can also be ensured by means of other materials such as plastic foil, multilayer (composite) foil, or plasticized fabric. To prevent mechanical damage to foils, each foil shall be protected on both sides with a layer of natural drainage materials, in a thickness of at least 20 cm, or with a layer of cohesive soil in a thickness of 30 cm minimum.

2.2.2.4.2.2 Binders for improvement, consolidation, or stabilization

For improvement, consolidation, or stabilization of natural materials in fills, backfills, substructure, and puddle layer it is possible to use particularly hydraulic binders such as fine quicklime or hydrated lime, pozzolanic or metalurgical cement, and fly ash, to which, depending on its composition, suitable amount of lime shall be added to stimulate and ensure binding (fly ash mortar).

2.2.2.4.3 Quality of materials

To construct fills, backfills, wedges, substructures, and puddle layers soils abd rocks classified in item 2.2.2.1.3.1 shall be logically used.

Materials for fills, backfills, wedges, substructures, and puddle layers shall fulfil the following conditions:

- the material moisture content shall be such that the specified density is achieved on compaction,
- the maximum admissible content of topsoil and/or organic admixtures determined by the test in accordance with the EN 1744-1 shall be such, that the sodium hydroxide solution is

not darker than the reference colour.

The contractor shall acquire and submit to the engineer a professional opinion of applicability of material from each characteristic major cut or location where in-situ material or secondary material could be won to execute fills, backfills, wedges, substructures, and puddle layers.

2.2.2.4.3.1 Cohesive soils

Applicability of cohesive soils shall be ascertained by means of preliminary testing characteristic soils from a cut and/or a borrow pit. The following properties shall be verified:

- moisture content,
- optimum moisture content and maximum density by standard Proctor compaction test,
- consistency limits, and
- portion of topsoil and organic admixtures.

Medium and high plasticity clays (of liquid limit W_L > 35 %, and plasticity index I_p > 12 %) must not be placed to the finishing layers unless their consolidation or stabilization with binder is planned. The decisive criterion to estimate the quality of the soil to be consolidated or stabilized with binder is the weather resistance.

For finishing layers of fills, backfills, and wedges no gap-grained silts and sands shall be used, as the latter can flow in presence of water.

Granulometric composition of cohesive soils for puddle layers shall be within the range indicated in table 2.13.

Table 2.13: Granulometric composition range of cohesive soils for puddle layers

Grain diameter mm	Limiting values of passing sieves % by mass
0.002	40 to 70
0.02	50 to 90
0.09	85 to100

Water permeability quotient for cohesive soils for puddle layers shall amount to: $k \leq 10^{-6}$ cm/s

Both type and number of tests of cohesive soils shall be specified by means of the programme of average control frequency. If this is not the case, the engineer shall decide upon both type and number of those tests.

2.2.2.4.3.2 Stones

Applicability of stones shall be established by preliminary tests of characteristic samples taken from a cut and/or a borrow pit. The following properties shall be verified:

- granulometric composition,
- optimum moisture content and maximum density by modified Proctor compaction test, and
- portion of topsoil and organic admixtures.

The coefficient of granulometric composition non-uniformity for stone material $U = d_{60}/d_{10}$ for fills, backfills, wedges, substructures, and levelling layers shall amount to at least 6; however, recommended values are in the range of $8 \leq U \leq 50$.

The largest grain in mineral aggregate for fills, backfills, and wedges must not be greater than 2/3 of the layer thickness (the layer thickness corresponds to 1.5 times the diameter of the largest grain), however not greater than 300 mm (10 % by mass of the total material amount may have a diameter of 300 - 400 mm), unless specified otherwise by the design.

The largest grain in mineral aggregate for substructure must not exceed one half of the thickness of the executed layer, however, as a rule, it shall not be greater than 125 mm.

Deviation from the abovementioned conditions is only admitted, if the required quantities of the stone material layer can be proven by means of demonstrative placing.

For stone materials containing grains of diameter above 30 mm, the following shall be established by preliminary testing:

- density of the layer of adequate thickness (by the substitutive method), which will be used as a base for subsequent measurements of compaction of placed materials on the top of the layer, and

- optimum moisture content.

Where granular rocks are used to execute fills, backfills, wedges, and substructure up to the critical frost depth h_{min} determined by the pavement design procedure, they may, in unfavourable hydrological conditions (high ground water level, possibility of capillary water lifting), contain the following:

- where U ≥ 15:
  - on deposit area up to 5 % by mass of grain size up to 0.063 mm (category f_5),
  - in executed layer up to 8 % by mass of grain size up to 0.063 mm (category f_s),
- where U ≤ 6:
  - up to 15 % by mass of grain size up to 0.063 mm (category f_{15})

Intermediate values shall be assesses by linear interpolation.

In the zone of frost penetration h_m (below critical frost depth h_{min}) the mixture of volume constant grains shall contain ≤ 15 % by mass of grain size up to 0.02 mm (according to USCS classification).

When rocks for fills, backfills, wedges, and substructures are not resistant to weathering, they shall be protected from weather action immediately after placing.

Pre-consolidated clays, marls, loamy stones, and other materials, which are prone to decay due to weather actions, shall be re-crushed and placed in such a way that the remaining impacts will not be harmful to them.

2.2.2.4.3.3 Fly ash

The characteristic properties of the fly ash are optimum moisture content and a maximum density, which shall be assessed by preliminary testing according to standard Proctor method. Both type and number of the tests shall be specified by the testing programme, or, if this is not the case, by the engineer.

To construction of fills, backfills, wedges, and substructures particularly those fly ashes are suitable, which have pozzolanic properties, and are also volume constant. In addition, aged and adequately crushed fly ashes are also applicable.

As the weight of fills, backfills, wedges, and substructures should be as small as possible in certain circumstances, a fly ash of the lowest possible volume mass is recommended.

2.2.2.4.3.4 Secondary materials

Where a secondary material is used to execute fills, backfills, wedges, and/or substructures, its chemical inertness or resistance to leaching shall be checked.

2.2.2.4.3.5 Binders

For improvement, consolidation, and/or stabilization of natural materials all the binders can be used, which fulfil the required properties indicated in item 2.2.2.4.2.2 for fills, backfills, wedges, and substructures.

For this purpose, by suitable certificates and preliminary testing, the applicability of each binder shall be proven, which is defined by the following:

- binder type,
- binding capacity (compressive strength), and
- commencement and completion of binding.

Both type and number of tests of a binder shall be specified by means of the programme of average control frequency. If this is not the case, the engineer shall specify the type and number of testing.

Binders for improvement, consolidation, and/or stabilization of natural materials shall be suitably stored prior to being used (in silos and/or tanks).

2.2.2.4.3.6 Preliminary material testing

Prior to commencement of constructing fills, backfills, wedges, substructures, and puddle layers all the specified properties of soils, rocks, fly ash, binders, and mixes shall be tested, if directed by the engineer.

For preliminary tests of specified properties of materials one sample of each materials is sufficient. In special cases the engineer may require additional samples.

The contractor shall provide or perform all the preliminary tests of applicability of soils, rocks, fly ash, secondary materials, binder, and mixes on request of the engineer, unless the test results are indicated in the design documents or additional information. For such tests the contractor shall have no right to claim additional payment.

2.2.2.4.3.7 Depositing soils and rocks

For a provisional depositing the substrate shall be suitable prepared. It shall be ensured that the preliminarily deposited material retains all its characteristics.

A permanent deposit area shall be prepared and arranged in compliance with the design. Its stability, drainage, and adaptation to environment shall be ensured.

2.2.2.4.4 Method of execution

2.2.2.4.4.1 Preparation of subgrade formation

Construction of fills, backfills, wedges, substructure, and puddle layer may commence after the underlay (subgrade) formation has been arranged in compliance with the design, and with these technical conditions (item 2.2.2.2), and/or a separating, drainage, or after a filter layer has been laid in accordance with item 2.2.2.3, and after the executed work has been taken over.

2.2.2.4.4.2 Bringing materials and binders

To a suitably prepared underlay formation (in compliance with item 2.2.2.4.4.1) material may be brought only after this is approved by the engineer. The latter has a right to stop the works, if there is a hazard of unfavourable weather conditions, and to determine an adequate protection of the works already carried out.

As a rule, materials for fills, backfills, wedges, and substructure must not be delivered over the underlay formation, bur only over the spread material layer. The delivered material shall be frontally or laterally turned over, and pushed away by means of machines to the location of placing.

Passages of vehicles, which bring the materials, shall be distributed over the entire width of the spread layer formation to the greatest possible extent.

Appropriate vehicles shall be used to deliver binders for improvement, consolidation, and/or stabilization of cohesive soils and/or granular rocks.

Vehicles which wheels and chassis are soiled must not drive on already spread or compacted stone material for the substructure.

2.2.2.4.4.3 Spreading and grading

Each individual material layer for fills, backfills, wedges, substructure, and puddle layer shall be spread and graded in the longitudinal direction at an inclination not exceeding the design road longitudinal fall.

In transverse direction each individual material layer shall be spread in one-sided or two-sided (roof) cross-fall, which shall amount for cohesive soils at least 3 %, whereas for granular rocks, fly ash, secondary materials, as well as consolidated and stabilized cohesive soils it shall be similar to the design carriageway surface cross-fall.

Where the cross-fall of a subgrade formation is, due to unfavourable ground conditions, insufficient for effective drainage (i.e. < 3 %), the minimum cross-fall shall be ensured by means of the first placed layers of fills, backfills, or wedges.

Each individual material layer shall be spread simultaneously and in such a width that after rough grading of the surface and compaction of the layer the specified quality is ensured up to the fill edge, i.e. up to the slopes.

The thickness of individual layers of spread and graded material shall be harmonized with depth effects of the foreseen compaction machines, and with material properties, which shall be verified by trial placing.

The thickness of a placed layer of cohesive soil for puddle layer shall amount to at least 30 cm; to this layer, a minimum 30 cm thick topsoil layer shall be laid, if the puddle layer is located at the road body, or a minimum 20 cm thick layer of topsoil, if the puddle layer is located below the road body.

Material shall not be spread and/or placed onto frozen surfaces, and the frozen material shall not be used to construct fills, backfills, substructures, and puddle layers.

2.2.2.4.4.4 Improvement, consolidation, and/or stabilization of materials

An improvement of materials, particularly cohesive soils, with binders is necessary to ensure an adequate placing of materials, which would be unsuitable without application of binders, for fills, backfills, wedges, and substructures.

Consolidation and stabilization of materials with binders shall ensure, that the gained improved properties of natural materials remain preserved in unfavourable weather conditions as well.

Binders for material improvement, consolidation, and/or stabilization shall be spread onto the previously suitably prepared formation of spread and graded material in a quantity according to the design and/or additional information, and in a method, which will ensure the required uniformity of the binder added (dosing accuracy ± 1 kg/m^2), and the attained material properties.

The spread binder shall be mixed with the material by means of suitable machines in a layer of at least 15 cm in thickness, as to ensure uniformity of the mix of the material with the binder.

To ensure uniform and optimum moisture content in the consolidated and stabilized material, additional water shall be dosed, if necessary. Uniformity of mix of material and water over the entire design layer thickness shall be ensured.

Improvement, consolidation, and/or stabilization of materials with binders are only feasible in a warm (temperatures above + 3 °C) and dry weather.

As the angle of internal friction is increased by consolidation and stabilization of natural materials, slope angles may be adequately increased in such cases.

2.2.2.4.4.5 Placing fly ash

As a rule, fly ash of optimum moisture content shall be placed. The optimum moisture content in the fly ash shall be attained by homogenization at the location of winning, or at the location of placing. The moisture content in the fly ash delivered with lorries can be lower (approx. 15 % by mass), and the required water difference is added at the location of placing.

The contractor is free to deliver dry fly ash in tanks, and the homogenization with water is carried out at the site. However, additional silos and homogenization devices are required in such cases.

2.2.2.4.4.6 Compaction

Stone materials, and cohesive soils consolidated and/or stabilized with binders shall be, after spreading and grading, compacted in adequately thick layers (in a full layer width) by means of rollers with smooth or pneumatic wheels, whereas natural and/or improved cohesive soils by means of sheep foot rollers, and of rollers with smooth wheels.

As a rule, the compaction shall be performed from the outer edge towards the middle of the surface, and from the lower edge of the layer towards the upper one. To ensure an adequate compaction and bearing capacity over the whole layer width, the latter shall be widened at each edge by the design layer thickness plus 10 cm.

The height of an individual spread material layer shall comply with the depth effect of used compaction machines, with fill material type, and with the required compaction of the fill material.

All places, which are inaccessible to rollers, shall be consolidated in accordance with the design by means of other compaction means or methods to be approved by the engineer, who also specifies the conditions, under which such means or methods shall be used.

The applicability of compaction means and method shall be preliminarily tested on a test area in compliance with item 2.1.5. The effect of a compaction mean shall be measured after each passage for each individual material layer.

After completion of compaction the following shall be carried through on the fill layer:

- to measure density and moisture content by a non-destructive method using an isotope gauge; to verify the results obtained, both density and moisture content shall also be measured by another approved method;
- to measure bearing capacity by assessing both static and dynamical module of deformation
- to take material samples from the test area to determine the optimum moisture content and the density by the Proctor standard compaction test (EN 13286-2).

On the basis of results obtained on the test area, both compaction method and machine type shall be specified in detail prior to commencement of the works.

In case that the density of the material placed is assessed by the method of continuous measurements, the system shall be calibrated on the test area.

Each material and/or mixture layer shall contain such an amount of water prior to commencement of compaction, that the used material type can be compacted to the specified density.

If required, the engineer may specify additional procedures to ensure suitable material moisture content and placing.

When the contractor does not continue with the works on the subsequent layer immediately after completion of compaction and quality control carried out on the previous layer, but only after a longer period of different weather conditions, the density of the placed material or mixture shall be rechecked prior to continuation of the works. Only after the quality meets the requirements, the works may go on.

Construction of fills, backfills, wedges, substructures, and puddle layers shall be interrupted, when the specified material density cannot be attained due to climatic conditions.

If the works have been stopped due to contractor's negligence, all the costs associated with the repeated measurements and eventual improvements shall be born by the contractor. Otherwise, these costs shall be born by the client.

Compaction of material consolidated and stabilized with binders shall be completed within the period specified by the approved method statement.

After being spread, the layer of cohesive soil to execute a puddle layer shall be compacted in a full profile width, in accordance with the design, by means of sheep foot rollers and rollers with smooth wheels. After the layer is adequately compacted, the planned excessive thickness of 10 cm of the puddle layer shall be cut off and removed, and the cohesive soil layer formation for the puddle layer shall be re-rolled by rollers with smooth wheels.

The contractor has a right to propose to the client a modification of the method statement. In such a case, he shall prove by the results of preliminary testing, which shall be carried out at his expense that the proposed modified solution is at least equivalent to the method foreseen originally.

2.2.2.4.4.7 Storing materials and binders

When the contractor, prior to placing, stores natural materials, fly ash, and/or secondary material for fills, backfills, substructures, and/or puddle layers, such place shall be preliminarily so prepared and cleaned as to prevent mixing of applicable materials with unsuitable ones.

Binders for improvement, consolidation, and/or stabilization of materials shall be, as a rule, stored in appropriate silos or tanks.

2.2.2.4.4.8 Arrangement of substructure formation

The arrangement of a substructure formation includes the following:

- grading of remaining peaks in rocks, and, in special cases, raising an up to 10 cm thick levelling course of mineral aggregate, and spreading, moistening, fine grading, and compacting the levelling course;
- fine grading of formation in soils, in improved, consolidated, and/or stabilized natural materials, and in fly ash.

Where a substructure formation cannot be suitably compacted due to excessive natural moisture content in the material, the engineer has a right to specify required measures to ensure the specified quality of the works executed.

2.2.2.4.4.9 Wedges

For the construction of wedges behind bridges, additional execution conditions shall be considered besides the mentioned ones.

The bridge contractor shall backfill the excavation for foundations up to the solid ground level. This shall be carried out in compliance with the provisions of these technical conditions for the works on fills on the road alignment in close vicinity, which shall be verified by measurement results.

Wedges behind bridges shall be so constructed (if necessary, by suitable terracing into the executed fill, or ground) as to provide the following:

- the slope, connected to the fill, shall be inclined by 1:4 from the top to a depth of 2 m below the substructure formation level;

- the slope, connected to the fill, shall be inclined by 1:3 on the upper half of the remaining height;
- the slope, connected to the fill, shall be inclined by 1:2 on the lower half of the remaining height;
- the slope, connected to the fill, is shifted from the abutment by at least 1 m at the abutment foundation.

Wedges behind bridges are generally the works above the in-situ ground.

Wedge areas below transition slabs shall be, prior to the transition slab construction, consolidated to the degree specified by the design.

Transition wedges between fills and excavatons shall be carried out in the excavation area

- in soils up to a depth of 1.0 m, and
- in rocks up to a depth of 0.3 m.

In case of a greater weather layer thickness, the transition wedges can be executed deeper as directed by the engineer, and in a longitudinal fall of 1:4, so that the weathered layer at the contact between the fill and the excavation is completely removed.

Transition wedges shall be constructed of similar materials as they have been used for the upper layer of the adjoining fill.

The connection of a transition wedge in excavations in rocks to the levelling layer of stone material shall be carried out in a thickness of 10 cm.

2.2.2.4.5 Quality of execution

2.2.2.4.5.1 Compaction

The contractor shall prove suitable compaction of each individual layer of fills, backfills, wedges, substructures, or puddle layer by results of internal control testing by non-destructive measurement of both density and moisture content by means of an isotope gauge.

For materials used for fills, backfills, wedges, and substructures, the required values of compaction are indicated in table 2.14. These values represent mean values. The lower limiting value of the individual measurement result must not be smaller by more than 3 % of the corresponding mean value. The admissible number of such deviations shall not exceed 10 % of the total number of measurements.

Table 2.14: Requirements for compaction and bearing capacity of fills, backfills, wedges, and substructures

Description of work	Required compaction with regard to the material density		Required bearing capacity
	by standard Proctor test	by modified Proctor test	
	%		MN/m^2
- Fills, backfills, and wedges more than 2 m below substructure formation of			
- cohesive soils	92	-	-
- improved materials	92	-	-
- consolidated and stabilized materials, and fly ash	92	-	-
- granular rock	-	92	-
- Fills, backfills, and wedges less than 2 m below substructure formation of			
- cohesive soils	95	-	15
- improved materials	95	-	20
- consolidated and stabilized materials, and fly ash	95	-	30
- granular rock	-	95	60

- Fills, backfills, and wedges at the level of substructure formation of			
- cohesive soils	98	-	20
- improved materials	98	-	25
- consolidated and stabilized materials, and fly ash	98	-	40
- granular rock	-	98	80

Cohesive soil in a puddle layer shall be compacted to 100 % on average with regard to the density according to the standard Proctor testing method. The lower limiting value must not be smaller than by more than 2 % of the required mean value.

The compaction of the material layers for fills, backfills, wedges, substructures, and puddle layer shall attain the lower limiting value at each measuring spot. The contractor shall re-compact unsuitably compacted layers in compliance with these technical conditions without any extra payment.

2.2.2.4.5.2 Bearing capacity

The contractor shall prove a suitable bearing capacity of materials placed for fills, backfills, and wedges by the internal conrol results, unless he performs compaction measurements.

In any case, the contractor shall prove the substructure formation bearing capacity by the internal control results.

As a rule, the load bearing capacity shall be assessed by measuring static and/or dynamical moduli of deformation.

Moduli of deformation shall be, as a rule, measured on the fill top layer formation, however at a depth not greater than 0.5 m below the substructure formation, as well as on the substructure formation.

The required lower limiting values of static moduli of deformation E_{v2} are indicated in table 2.14 for individual specified measuring spots. The threshold lower limiting value of any individual measurement (up to 5 % of the total number of measurements) may be smaller by up to 20 %.

The ratio of static moduli of deformation E_{v2}:E_{v1} for cohesive soils and granular rock may amount to 2.2 maximum. When the measured value of the static modulus of deformations E_{v1} exceeds 50 % of the required value of the static modulus of deformation E_{v2}, the abovementioned ratio is no more decisive to evaluate the bearing capacity of the material layer placed.

For layers of stone materials for fills, backfills, and wedges, the ratio of static moduli of deformation E_{v2}:E_{v1} shall not exceed 3.0.

The values of dynamical moduli of deformation E_{vd} shall amount to at least 50 % of the specified values of static moduli of deformation E_{v2}.

The bearing capacity of the fly ash layer formation, as well as of the consolidated and stabilized material can be, as a rule, controlled not before 7 days after completion of compaction of the mixture placed.

The engineer shall approve measurements of bearing capacity of materials for fills, backfills, wedges, and substructures as a taking over criterion instead of compaction measurements. The engineer shall also have a right to determine additional conditions for evaluation of results of bearing capacity measurements.

2.2.2.4.5.3 Consolidated and stabilized materials

The contractor shall prove the properties of materials consolidated and/or stabilized with binders (mixtures) by the results of the internal control of the following:

- compressive strength of specimens of consolidated or stabilized material, prepared in accordance with the conditions for preparation of specimens in compliance with the corresponding Proctor method, carried out on specimens, which have been maintained for 7 days, and which shall attain:
  - 0.5 MN/m^2 in cohesive soils, and
  - 2.0 MN/m^2 in granular rocks.
- weather resistance of specimens of consolidated or stabilized material, prepared in accordance with the described conditions, assessed by the ratio of compressive strengths

of dry specimens to compressive strengths of specimens soaked for 24 hours, measured after 7 days; the mentioned ratio shall amount to at least 0.70.

If necessary, the engineer may modify the abovementioned quality conditions for consolidated and stabilized materials for fills, backfills, wedges, and substructures.

The required values of compressive strengths of mixtures represent mean values.

The lower limiting value may be by up to 20 % smaller, whilst the threshold lower limiting value by up to 40 % smaller than the indicated required compressive strength values.

2.2.2.4.5.4 Layer evenness

The contractor shall execute each individual layer of fills, backfills, wedges, substructures, and puffle layer in accordance with the conditions indicated in item 2.2.2.4.4.

The top layer formation evenness – except for substructure – may deviate at a length of 4 m, in any direction with regard to the road axis, from the straight edge or plane by the following values:

- in puddle layer max. 20 mm
- in cohesive soils, in improved, consolidated and stabilized materials, in fly ash, and in secondary materials max. 30 mm
- in rocks max. 50 mm

When damage occur due to unsuitable evenness of placed material layers for fills, backfills, wedges, or puddle layers, the contractor shall carry out all the required repair works at his expense.

When such deviations from the specified evenness are established consecutively, the engineer shall decide upon how the repair work is to be carried out.

2.2.2.4.5.5 Substructure formation level and inclination

To prevent damage to a substructure formation due to vehicles and machines, which might impede a normal water outflow, no driving over the substructure formation is allowed.

A substructure formation may deviate at any spot from the design level by 20 mm maximum.

The substructure formation inclination shall be, as a rule, equal to both cross and longitudinal fall of the carriageway, however it may deviate from the design inclination by maximum ± 0,4 % of the absolute inclination value.

2.2.2.4.6 Execution quality control

For each individual material type used to construct fills, backfills, wedges, substructures, or puddle layers, a method statement, the compaction machine type, and its depth effect shall be determined prior to commencement of the works.

The confomity of executed works with the requirements indicated in the design and these technical conditions shall be verified by the following:

- preliminary testing of properties of materials foreseen to execute fills, backfills, wedges, substructures, and puddle layers, and
- verifying placing the material by both internal and external control.

2.2.2.4.6.1 Preliminary tests

Prior to commencement of placing cohesive soil and granular rock for fills, backfills, wedges, substructures, and puddle layer the contractor shall verify the material characteristics specified in table 2.15.

Table 2.15: Preliminary tests of material for fills, backfills, wedges, substructure, and puddle layer

Material property	Unit	Required value	Test method
- material applicability:			
- natural moisture content	% by m.	item 2.2.2.4.3	BAS
- Proctor test:			EN 13286-2
- optimum moisture content	% by m.	-	
- maximum density	t/m^3	-	

- consistency limits:			
- liquid limit w_L	%	≤ 35	
- plasticity index I_p	%	≤ 12	
- portion of topsoil and/or organic admixtures	-	item 2.2.2.4.3	EN 1744-1
- granulometric composition of stone material and cohesive soil for puddle layer	% by m.	item 2.2.2.4.3.2 item 2.2.2.4.3.1	EN 933-1
- binder applicability:			
- binding capacity:			
- compressive strength of mix:			EN 12390-3
- cohesive soils	MN/m^2	≥ 0,5	
- granular rocks	MN/m^2	≥ 2,0	
- weather resistance	-	≥ 0,7	-
- commencement and completion of binding	h	-	EN 196-3

2.2.2.4.6.2 Verification of placing

2.2.2.4.6.2.1 Internal control

During the work execution, the contractor’s internal control shall establish conformity of properties of all the materials used for fills, backfills, wedges, substructures, and puddle layers, with the requirements provided by the design and these technical conditions.

Both frequency and type of tests to be performed by the internal control are specified in the approved programme of the average control frequency. If this is not the case, the engineer shall direct both frequency and type of testing.

According to a statistical random pattern the engineer selects locations of taking samples and measurement spots.

During placing the material for fills, backfills, wedges, substructures, and puddle layers, the laboratory shall take samples and verify the conformity of properties, taking account of the frequency indicated in table 2.16.

Where the engineer establishes major deviations of internal control results form the preliminary testing results, he may modify the internal control extent; on the contrary, he may also reduce the internal control extent, when the testing results are homogeneous.

The minimum extent of internal control tests of construction of fills, backfills, wedges, substructures, and puddle layers is determined in table 2.17.

Table 2.16: Minimum frequency of material testing within the scope of the internal control of construction of fills, backfills, wedges, substructures, and puddle layers

Material property	Test method	Minimum testing frequency
- granulometric composition:		
- fine-grained rocks	EN 933-1	1,000 m^3
- cohesive soils for puddle layer		400 m^2
- natural moisture content		1,000 m^3
- Proctor test	EN 13286-2	4,000 m^3
- consistency limits of cohesive soil		4,000 m^3
- portion of topsoil and/or organic admixtures	EN 1744-1	4,000 m^3
- permeability coefficient of cohesive soils for puddle layer		400 m^2

Table 2.17: Minimum testing frequency within the scope of the internal control of construction of fills, backfills, wedges, substructures, and puddle layer

Material property	Test method	Minimum testing frequency	Base for evaluation
- moisture content and density of natural material	BAS	200 m^3/20 m^1	item 2.2.2.4.3.1
- quantity of spread binder		100 m^1	item 2.2.2.4.4.4
- mixture:			
- moisture content and density	BAS	200 m^3	item 2.2.2.4.4.4
- compressive strength	EN 12390-3	100 m^1	item 2.2.2.4.5.3
- weather resistance		200 m^1	item 2.2.2.4.5.3
- density of coarse-grained rock	BAS	4,000 m^3/200 m^1	item 2.2.2.4.5.1
- formation of fill, backfill, wedge, and substructure			
- bearing capacity:	BAS		item 2.2.2.4.5.2
- modulus of deformation E_{vd}		10 m^1	
- modulus of deformation E_{v2}		100 m^1	
- evenness	BAS	20 m^1	item 2.2.2.4.5.4
- level		20 m^1	item 2.2.2.4.5.5

If agreed with the engineer, the quality of placed layers can also be verified in accordance with other approved methods. In such a case, quality criteria as well as type and extent of the tests shall be agreed with the engineer.

2.2.2.4.6.2.2 External control

The ratio of the external control extent to be performed by the client or an independent institution, to the internal control extent, generally amounts to 1 : 4.

According to a statistical random pattern the engineer selects locations of taking samples for the external control, and places where evenness, levels, density, moisture content, and bearing capacity shall be measured.

2.2.2.4.7 Measurement and taking over of works

2.2.2.4.7.1 Measurement of works

Executed works shall be measured in compliance with item 2.1.7.1 of the general technical conditions, and with the following provisions:

- quantities of materials placed for fills, backfills, wedges, substructures, and puddle layers shall be accounted in cubic metres
- quantities of formation of placed materials shall be accounted in square metres.

All the quantities shall be measured according to the actually executed extent and type of works within the scope of the design.

For all the quantities of binders, fly ash, secondary materials, and other materials supplied to the site, the contractor shall submit suitable certificates.

2.2.2.4.7.2 Taking over of works

The engineer shall take over each individual layer of fills, backfills, wedges, substructure, and puddle layer, taking account of the quality requirements indicated in these technical conditions, and in compliance with item 2.1.7.2 of the general technical conditions.

Prior to proceeding with the works, the contractor shall make good all the deficiencies established on the basis of these requirements.

All the costs associated with mending deficiencies shall be born by the contractor, including expenses for all the measurements and tests, which had shown an inappropriate quality if the executed works, as well as for additional tests, which have been performed after completion of the repair works to establish, whether the quality meets the requirements.

For all the works that do not comply with the requirements indicated in these technical conditions, and which have not been mended in accordance with the engineer's instructions, the contractor has no right to claim any payment. In addition, the client is entitled to prolong the guarantee period (liability period) by at least 5 years for all the works that depend on the unrepaired works.

2.2.2.4.8 Final account of works

3.2.2.1.1.3 General

The executed works shall be accounted in accordance with item 2.1.7.3 of general technical conditions.

Quantities assessed according to item 2.2.2.4.7.1 shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a whole accomplishment of the works. The contractor shall not be entitled to claim any extra payment subsequently.

If necessary, the engineer shall determine a demarcation between the contractor for the road alignment earth works and the bridge contractor.

2.2.2.4.8.1 Deductions due to inadequate quality

2.2.2.4.8.1.1 Materials for fills, backfills, wedges, substructures, and puddle layers

As the material quality requirements are clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.4.8.1.2 Binders for improvement, consolidation, and stabilization of materials

As the binder quality requirements are clearly specified, there shall be no deductions upon final accounting of the works.

3.2.2.1.1.4 Compaction and bearing capacity

The lower limiting values of compaction and bearing capacity measurements, as well as individual values up to the lower threshold values of measurements (up to 5 % of the total number of measurements) represent a 100 % - value in accordance with the bid unit price. As the compaction and bearing capacity requirements are clearly specified, there shall be no deductions upon final accounting of the works.

2.2.2.4.8.1.3 Consolidated and stabilized materials

The lower limiting value of the quality specified in item 2.2.2.4.5.3 represents a 100 % - value in accordance with the bid unit price, whereas the lower threshold value a work without any value. Intermediate values shall be linearly interpolated.

2.2.2.4.8.1.4 Formation evenness

As the adequate evenness of the formation is clearly specified (item 2.2.2.4.5.4), there shall be no deductions upon final accounting of the works.

2.2.2.4.8.1.5 Formation level

As the design formation level is clearly specified (item 2.2.2.4.5.5), there shall be no deductions upon final accounting of works.

2.2.2.5 SLOPES AND GREEN SURFACES

2.2.2.5.1 Description

The works comprise arrangement and erosion protection of surfaces of natural slopes, embankments, cuts, fills, and green surfaces by the following:

- laying topsoil and sowing grass,
- bio shot cement concrete,
- wattle works
- planting decorative trees and shrubs,
- meshes,
- stone pitching,
- shot cement concrete, and
- prefabricated elements (cribwork, cement concrete hollow elements, turf slabs and pavers, and similar elements).

The following is included in this works:

- all the materials including loading, transportation, and unloading,
- substrate preparation,
- sowing and planting,
- placing and consolidating the materials.

2.2.2.5.2 Basic materials

To perform the works listed above, suitable materials for different methods of arrangement and protection of slopes and green surfaces shall be introduced.

2.2.2.5.2.1 Types of protection by vegetation

2.2.2.5.2.1.1 Topsoil

Active topsoil (humus) ensuring permanent vegetation shall be used.

2.2.2.5.2.1.2 Mulch

A mulch of straw or hay shall be applied in such a thickness as to ensure growth of grass and a durable protection, provided that adequate fertilizing and bituminous emulsion splash are carried out.

2.2.2.5.2.1.3 Wattle work

For wattle work, fresh and living willow switches (salix purpurea), of 0.5 – 3 cm in thickness, or other species approved by the engineer shall be used. Such switch types shall be used, which ensure vegetative reproduction.

It is also possible to use stronger and more stable dead anti-erosion wattle work of vegetative cuttings or plants. Props for wattle work shall be 70 – 80 cm long, and 2 – 3 cm thick.

2.2.2.5.2.1.4 Trees and shrubs

Types (species) of trees and shrubs shall correspond to biological conditions. Such plants shall be chosen as to ensure permanent growth. For locations exposed to wind such tree or shrub species shall be selected, which can defy the weather and snow avalanches.

2.2.2.5.2.1.5 Seeds for grassing

For grassing, seeds of such mixed grass and clover shall be selected, which comply with biological (ecological) conditions and ensure permanent vegetation. For temporary protection, certain corn seeds may also be used.

2.2.2.5.2.2 Other types of protection

2.2.2.5.2.2.1 Protection by meshes

Woven meshes of double-galvanized steel wire of 1.6 mm or 3.1 mm in diameter may be used. The thickness of the galvanized zinc layer shall be at least 0.07 mm. Mesh openings can be either rectangular or hexagonal of dimension 5 – 10 cm.

For fixing such meshes double-galvanized steel anchors with a corrosion protection layer thickness of 0.07 – 0.08 mm. For an additional fixing of meshes on slopes it is also possible to use double-galvanized steel pipes of 3/2" in diameter (outer diameter 48.25 mm, wall thickness 3.5 mm); the thickness of the galvanized zinc layer shall be at least 0.07 mm.

For stretching the protective woven meshes, cement concrete weights of suitable shape and size in accordance with the design can be used. The cement concrete of such weights shall comply with the current requirements for cement concrete (SIST EN206-1).

2.2.2.5.2.2.2 Stone pitching

Stone for pitching shall be sound and weather resistant.

Unfinished stone is used. Its thickness shall not exceed 30 cm.

2.2.2.5.2.2.3 Shot cement concrete

Adequate cement concrete and steel mesh reinforcement to protect slopes by means of shot cement concrete shall be used.

2.2.2.5.2.2.4 Protection by prefabricated elements

Prefabricated elements for slope protection shall comply with the current technical regulations; the same also applies to all the auxiliary material. Prefabricated elements shall be selected to suit the foreseen purpose, and in accordance with the manufacturer’s instructions.

2.2.2.5.3 Quality of materials

The quality of all the materials used shall comply with the general and special technical conditions and requirements specified for those materials.

Prior to commencement of the works, the contractor shall submit to the engineer appropriate evidence (certificates) of conformity of all the products to be used for slope protection.

2.2.2.5.4 Method of execution

2.2.2.5.4.1 Protection by vegetation

Protection by vegetation shall be executed at locations and in the way specified by both design and these technical conditions. The contractor shall perform the protection by vegetation is such a way, that the protected surfaces will be optimum overgrown in view of the required quality and conditions. In case that the contractor fails to perform these works properly, he shall mend them without any right for additional payment.

On slopes of smooth surfaces where landslides might occur, suitable roughness shall be ensured by means of approximately 15 cm wide horizontal cuts spaced at approximately 1.0 m.

Inclinations of excavations and fills shall be such as to ensure stability of the slope and its protection. When the instability of a slope is likely a consequence of the water, the slope shall be suitably drained.

The surface water of the slope inflow rear shall be evacuated in a controlled way.

Edges of cut slopes, and fill toes shall be rounded off in a radius of 3.0 m.

Tress swaying in the wind thus loosening the ground shall be felled in a width of 3 – 4 m from the edge.

Slopes of fills and particularly of cuts shall be roughly graded to ensure suitable roughness providing good adhesion of the protective vegetation to the slope.

The topsoil layer thickness on a roughly graded slope shall not exceed 10 cm on spreading.

Fill slopes of fly ash protecting the road body shall be preliminarily covered with filter material. The surface water shall be adequately led away from the fill formation.

Surfaces of lateral slopes can be treated by spreading up to 20 cm thick topsoil layer placed onto the levelling layer at locations where the thickness of the latter corresponds to the design lateral load. At locations where a 70 cm thick lateral fill is foreseen by the design, the filter layer shall be protected with 20 – 30 cm thick layer of mineral material, and the latter shall be covered with a topsoil layer. Grassing shall be carried out in the same way as it is foreseen for other slopes.

In cuts in decomposable and granular rocks, which are stable but prone to weathering on the surface, and which are very erosive (such as decomposable dolomite, marl, or flysch), approximately 15 cm wide cuts spaced at approximately 1 m shall be executed in the slope. When rocks or soils do not contain at least minimum amounts of active soils (5 % by mass or more), topsoil shall be placed onto the surface, and the latter shall be covered with a layer of active soil of

8 – 10 cm in thickness (which corresponds to approximately 6 cm after settling down).

Surfaces of such slopes shall be interlaced with wattle works spaced at approximately 5.0 m. Mulch (of approximately 60 kg of straw or hay per are), splashed with a bituminous emulsion (of approximately 80 kg per are), shall be grassed by sowing (approximately 0.5 kg of seed per are). Approximately 8.0 kg per are of fertilizer shall be added. One sapling per 2 m^2 of area shall be planted.

In granular rocks, weathered layers, alluvial deposits, cohesive soils (loam, clay), weathered marl and flysch, as well as other soils with prevailing clayey filling materials, the bottom substrate is usually sufficiently fertile, thus the slopes need not be covered with topsoil or turf; otherwise, the protection shall be executed in the same way as described.

In fills of rubble material, permeably to water, won by excavations in hard and semi-hard rocks, slope surfaces shall be covered with a 10 cm thick topsoil layer, interlaced with wattle works (approximately 0.2 m^1/ 11 m^2), and grassed by sowing in ditches (0.75 kg of seed per are). Approximately 8 kg of fertilizer per are shall be applied. 0.4 sapling of trees or plants of shrubs (or cuttings) per m^2 shall be planted.

In fills of alluvial materials, or materials won by excavating decomposable rocks, placing of topsoil onto slopes is not required on condition that the materials are sufficiently active, (more than 5 % by mass of active particles). The surface shall be interlaced with wattle works (0.2 m^1/m^2). Approximately 8 kg of fertilizer per are shall be applied. For stability, mulch (60 kg per are) of straw or hay shall be laid; the mulch shall be splashed with bituminous emulsion (80 kg per are). Into the mulch prepared in such a way, grass seed of 0.8 kg per are shall be sown. 0.4 sapling or cuttings per m^2 shall be planted.

Surfaces of fill slopes of cohesive soils such as loam or clay shall be interlaced with wattle works (0.2 m^1/m^2). Approximately 8 kg of fertilizer per are shall be applied. Plants/saplings of adequate species (0.4 pieces per m^2) shall be planted, and additional placing of topsoil shall be partly considered.

Grassing by sowing, either in mulch protected with bituminous emulsion, or on surfaces covered with topsoil, shall be performed in such a way that the surfaces will be fully overgrown with grassy vegetation, mainly without weeds.

Wattle works intended to prevent furrows due to storm water, i.e. to consolidate the material surface layer, shall be entirely placed in such a way that the upper edge of a wattle work matches the level of the definitively graded slope surface.

Shrubs and trees shall be planted in groups in pits covered with topsoil as not to impede excessively the protective vegetation of slopes, and not to reduce the sight distance to road users. Important groups of trees and shrubs shall therefore be located particularly on the convex side of the road. For a more efficient protection of material from erosion, trees and shrubs shall be planted in groups (approximately 1 plant per m^2 on 50 % of the total area), all in accordance with the engineer, as well in compliance with his instructions.

After completion of works the contractor shall clear the construction site, re-establish the original condition, and care for all the protective vegetations up to the final taking over of works, however not less than for a period of one year. The mentioned care includes supplemental sowing, regular fertilizing, removal of debris and weeds from the surface, as well as eventual watering of surface in case of drought.

2.2.2.5.4.2 Other types of protection

2.2.2.5.4.2.1 Protection by meshes

The engineer shall specify locations and type of protection by meshes in compliance with the design requirements and with these technical conditions. Prior to placing meshes the slope shall be prepared in accordance with the design and these technical conditions. All the stuff that might prevent adjusting of the mesh to the ground shall be removed. For protection from crumbling rock on steeper slopes (from 3 : 1 to 2 : 1), hanging meshes shall be used, which are weighted by cement concrete weights at their lower end, whereas they are fixed by means of anchors and pipes at the slope edge, as to enable crumbling rock to slide down up to the cut foot in a controlled way.

In less steep slopes meshes shall be fixed by means of anchors. The anchor spacing shall be selected with regard to the rock soil mechanical properties; generally, such spacing amounts to approximately 1.0 m. In rock where anchors cannot be rammed in directly, adequate holes shall be bored.

Individual meshes shall be interlaced by double-galvanized steel wire of 3.1 mm in diameter, and of the same quality as the mesh material.

2.2.2.5.4.2.2 Stone pitching

Stone pitching shall be performed in such a way that the stone is placed exactly in the fill profile as determined by the design and marked by construction profiles at site.

Each stone shall be safely placed down and fixed to prevent crumbling of the fill slope, which might occur due to instability of individual stones, or other reasons. The foot of the pitched slope shall be firmly built-in into a sound substrate, and so carried out as to prevent destruction of the pitched slope due to atmospheric and other adverse actions.

Stone pitching termination at the top of the slope shall be so executed as to prevent damage due to driving of shoulders and similar.

2.2.2.5.4.2.3 Shot cement concrete

Shot cement concrete for slope protection shall be applied under pressure to a suitably prepared slope.

Steel mesh reinforcement shall be fixed to the slope, and covered with at least 2 cm thick cement concrete layer.

2.2.2.5.4.2.4 Protection by prefabricated elements

When slopes are to be protected with prefabricated elements such as cribwork, cement concrete hollow elements, turf pavers and similar elements particularly producer’s instructions and design requirements shall be considered. For each individual purpose appropriate precast element shall be selected in compliance with the design or engineer’s instructions.

The slope surface to be faced with prefabricated elements shall be suitably prepared. When the subgrade is sandy, crushed stone of granulometric composition of up to 4 mm shall be used as underlay, which must be properly consolidated, and 2 to 5 cm thick in compacted condition, depending on the intended purpose.

Where the subgrade is of low bearing capacity, the underlay thickness shall be adequately increased. When additional erosive actions due to the precipitation or ground water on the lining, or higher loading are expected, the underlay shall be carried out as cement concrete blinding of suitable thickness in accordance with the design specification.

Precast elements shall be so placed as to be separated one from another by 3 to 5 mm wide joints. After being laid, hollow prefabricated elements shall be filled up with suitable material such as topsoil, sand, slag, etc. in dependence on both purpose and design requirements.

Where linings are intended for periodical traffic loading as well, the laid elements shall be adequately embedded.

2.2.2.5.5 Quality of execution

2.2.2.5.5.1 Protection by vegetation

For a correct selection of plant species and fertilizers the contractor shall keep records of controlling pedology properties for individual soil types. The results of the internal control analysis shall be submitted to the engineer for inspection.

Internal control of seed quality shall be performed in compliance with current regulations and commonly applicable methods respectively. Supplier’s certificates of seed adequacy shall be submitted to the engineer prior to commencement of the works.

2.2.2.5.5.2 Other types of protection

2.2.2.5.5.2.1 Protection by meshes

The contractor shall submit to the engineer the producer’s certificates of suitability of both meshes and anchors; the certificates shall contain adequate information on quality of both basic material and corrosion protection coating.

2.2.2.5.5.2.2 Stone pitching

The quality of stone to be used for pitching shall meet the requirements in view of weather resistance.

Concerning inclinations, slope surfaces of pitched fills shall comply with both current technical regulations and design.

Any deviation from the planned surface is only admissible within the visible accuracy limits, which apply to individual construction profiles in accordance with the design.

2.2.2.5.5.2.3 Shot cement concrete (shotcrete)

The quality of both cement concrete and steel mesh reinforcement shall meet the requirements indicated in these technical conditions.

Performed works shall comply with the current technical regulations and engineer's instructions respectively.

2.2.2.5.5.2.4 Protection by prefabricated elements

Only such prefabricated elements may be used, which ensure sufficient durability and weather resistance, and for which the contractor has submitted adequate conformity certificates.

The surface performance of precast elements shall comply with the design and engineer's requirements.

Forming of slope inclinations shall be specified by the design or by the engineer. Any deviation is only admissible within the visible accuracy limits, which apply to individual construction profiles in accordance with the design.

2.2.2.5.6 Execution quality control

2.2.2.5.6.1 Protection by vegetation

The engineer shall verify the selection and application of plant species and fertilizers on the basis of both design and contractor's internal control of penology properties of soil composition. In addition, the engineer shall check the seed quality taking account of the general regulations and common methods, either by control testing or by evaluating results of testing performed by the contractor, on the basis of conformity certificates submitted by the seed supplier.

Both engineer and contractor shall establish the final quality of works on taking over.

2.2.2.5.6.2 Other types of protection

2.2.2.5.6.2.1 Protection by meshes

The engineer shall verify conformity certificates of delivered meshes and anchors as well as of the protective coating. If, in is opinion, the used material as well as the submitted certificates do not ensure adequate quality, he has a right to claim additional evidence or to prescribe additional testing.

2.2.2.5.6.2.2 Stone pitching

The engineer shall check the quality of the supplied stone in view of the specified properties and requirements. If, in his opinion, the quality of both material and works is not ensured, he may prescribe additional tests.

2.2.2.5.6.2.3 Shot cement concrete

The engineer shall verify the quality of the delivered cement concrete, the certificates of steel mesh reinforcement, as well as their placing and conformity with the design provisions.

2.2.2.5.6.2.4 Protection by prefabricated elements

The engineer shall check the quality of the supplied prefabricated elements, their conformity with the design, their shape, and surface performance, as well as the quality of material, with which the precast elements will be filled up. Moreover, the engineer shall verify the quality of placing, the substrate compaction, and visual harmonization with the surroundings.

2.2.2.5.7 Measurement and taking over of works

2.2.2.5.7.1 Measurement of works

Executed works shall be measured in accordance with item 2.1.7.1 of the general technical conditions. Eventual additional provisions shall also be considered.

2.2.2.5.7.1.1 Protection by vegetation

Surfaces actually covered with topsoil and grass shall be measured in square metres and within the scope of the design.

Surfaces actually treated with bio shot cement concrete and with wattle works shall be measured in square metres and within the scope of the design.

Saplings of tress and shrubs shall be measured by pieces of actually planted items, which have taken roots, apart for each individual species.

2.2.2.5.7.1.2 Other types of protection

Actually laid meshes within the scope of the design shall be measured in square metres.

Actually stone pitched surfaces shall be measured in square metres within the scope of the design. Horizontal end surfaces on fills shall not be measured, as they are constituent part of the pitching termination.

Slope surfaces to which shot cement concrete is applied, or surfaces lined with precast elements shall be measured in square metres.

3.2.2.1.1.4.1 Taking over of works

The works shall be taken over in compliance with the provisions of item 2.1.7.2 of the general technical conditions, as well as of these special technical conditions.

All the costs associated with mending deficiencies shall be born by the contractor, including expenses for all the measurements and tests, which had shown an inappropriate quality if the executed works, as well as for additional tests, which have been performed after completion of the repair works to establish, whether the quality meets the requirements.

For all the works that do not comply with the requirements indicated in these technical conditions, and which have not been mended in accordance with the engineer's instructions, the contractor has no right to claim any payment. In addition, the client is entitled to prolong the guarantee period (liability period).

2.2.2.5.8 Final account of works

2.2.2.5.8.1 General

Executed works shall be accounted in accordance with item 2.1.7.3 of the general technical conditions.

All the quantities assessed in compliance with item 2.2.2.5.7.1 shall be accounted by the contract unit price.

The contract unit price shall comprise all the services necessary to complete the works. The contractor has no right to claim any additional payment subsequently.

In horticultural works final acceptance and account are only carried through after suitable, contractually defined period, after expiry of which a permanent growth and success of executed works are evident. During this period, the contractor shall, at his expense, replace any died away plant, and to repeat sowing grass until unanimous success can be proven.

2.2.2.5.8.2 Deductions

As the quality of individual works is clearly specified, there shall be no deduction on final accounting of the works.

2.2.2.6 REINFORCED SOILS

2.2.2.6.1 Description

Works related to reinforcing of soils include the following:

- supply and placing
    - cement concrete for foundations,
    - cement concrete lining elements,
    - wooden dowels and steel anchors,
    - stone material for drainage layer behind lining elements, and
    - strips for reinforcing of soils,
- supply and laying geotextiles, steel mesh, and other suitable materials to reinforce soil layers of fills, and
- spreading materials for reinforced fills and drainage layers behind reverting elements by means of machines (only allowance for aggravated works), all in accordance with the design, engineer's instructions, and these technical conditions.

2.2.2.6.2 Basic materials

All such soils and rocks are suitable to being reinforced, which are applicable to fills in compliance with item 2.2.2.4 of these technical conditions.

2.2.2.6.2.1 Cement concrete for foundations

Such types of cement concrete may be used, which ensure the foundation construction in compliance with the design, as well as the purpose and durability of foundation, and which comply with the provisions of these technical conditions.

2.2.2.6.2.2 Cement concrete lining elements

Lining elements are load bearing elements, which must take all the loading arising from normal components of earth pressures; lining elements are supported at the locations where strips for reinforcing of soils are fixed.

Both basic constructional materials and executed lining elements shall ensure reinforcing of soils and fill stability in compliance with the design and these technical conditions.

2.2.2.6.2.3 Dowels and anchors

Wooden dowels (made of hard timber), and steel anchors (made of reinforcing steel) shall ensure suitable interconnection and a perfect fitting of lining elements. Adequate surface protection shall be applied to these elements to ensure their durability.

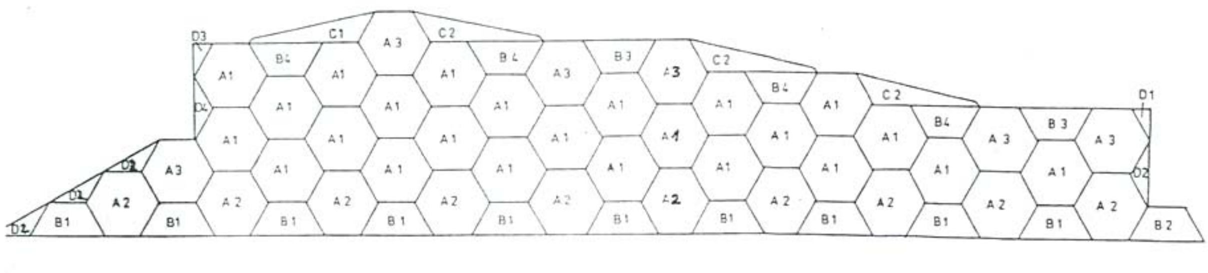


Figure 6.1: Cement concrete covering elements position

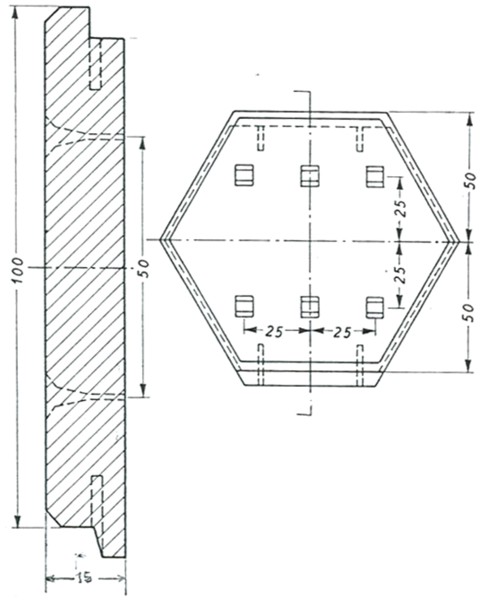


Figure 6.2: Element A1 - details

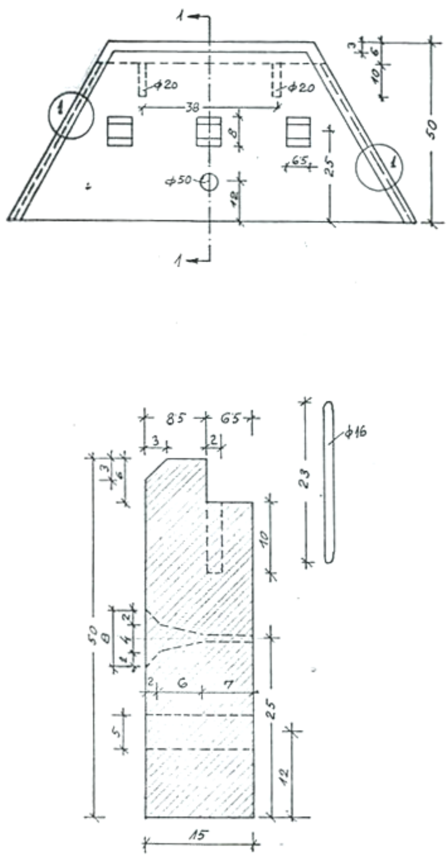


Figure 6.3: Element B1 - details

2.2.2.6.2.4 Stone material for drainage layer

For a drainage layer behind lining elements particularly natural and/or crushed mineral aggregates are applicable, which comply with these technical conditions related to stone material for drainage layers (item 2.2.2.3.3.1).

2.2.2.6.2.5 Strips for reinforcing of soils

Strips for reinforcing of soils, same as anchors, transfer earth pressure into the fill material. They can be made of:

- polyester laminate,
- corrosion protected or stainless steel plate, or
- other suitable materials.

Strips for reinforcing of soil shall meet the requirements of both design and these technical conditions.

3.2.2.1.1.5 Geotextiles

A soil reinforced with either geo-textiles or geo-mesh is particularly applicable as provisional structure.

Polypropylene felt resistant to micro-organisms and pests is recommendable. The felt shall meet all the design requirements, and shall comply with the provisions of these technical conditions.

3.2.2.1.1.6 Steel meshes

Steel meshes, which enable reinforcing of soils, and which comply with both design and these technical conditions may be used.

2.2.2.6.3 Quality of materials

2.2.2.6.3.1 General

The quality of cement concrete for foundations and lining elements, for dowels and anchors, as well as for stone material for the drainage layer behind the lining elements shall comply with the general and special technical conditions, and with the design specifications. In case that no technical regulation is available an individual material, engineer's instructions shall be decisive.

2.2.2.6.3.2 Strips for reinforcing of soils shall fulfil the following quality conditons:

- tensile strength minimum 3.3 kN per cm of strip width
- elongation at rupture maximum 1.5 %

Bending and impact strength (toughness) are, as a rule, determined by the reinforcing strip; therefore, information provided by the manufacturer shall be considered on evaluating these and some additional properties (strip dimensions, surface treatment, material composition). All the information provided by the manufacturer is constituent part of these technical conditions.

2.2.2.6.3.3 Geotextiles for reinforcing of soils shall, as a rule, fulfil the quality conditions specified in table 2.18.

Table 2.18: Required properties of geotextiles for reinforcing of soils

Property	Unit	Required value	Test method
- tensile strength – transversally, longitudinally	kN/cm	> 14	EN ISO 10319
- elongation	%	> 30	EN ISO 10319
- resistance to dynamic piercing	mm	< 30	EN 918

When, due to specific circumstances, other properties of geotextiles for reinforcing of soils are required, quality requirements indicated in the design, and/or engineer's requests shall be considered.

When evaluating mechanical and physical properties of geotextiles, information provided by the manufacturer shall be considered as well. Such information is constituent part of these special technical conditions.

Where geo-mesh of rough foil is foreseen to reinforce soils, the required properties shall be specified in detail by the design.

2.2.2.6.3.4 Steel meshes

Steel meshes shall comply with the design requirements dealing with reinforced soils.

2.2.2.6.4 Execution method

2.2.2.6.4.1 Preparation of subgrade formation

Subgrade formation, on which a fill made of reinforced soil will be constructed, shall be, prior to commencement of spreading the soil for reinforced fill, prepared in accordance with both design and these technical conditions.

As a rule, a subgrade formation shall be inclined towards the lining of the reinforced soil fill, and shall be suitably compacted. Unless this is specified by the design, the engineer shall decide upon the subgrade formation preparation.

2.2.2.6.4.2 Execution with reinforcing strips and lining elements

2.2.2.6.4.2.1 Execution of foundation

A foundation is relatively insignificantly loaded due to friction between lining elements and fills material. Therefore, a foundation is particularly an underlay element for the reinforced soil lining, which shall ensure suitable placing and stability of the first row of lining elements (without additional formwork).

2.2.2.6.4.2.2 Execution of fill made of reinforced soil

Cement concrete lining elements shall be structurally adjusted to the service conditions; therefore, they shall be built-in at adequate locations.

The first row of lining elements shall have appropriate openings for leading away eventual rear water.

The required inclination of the first row of the lining elements placed into a groove in the foundation shall be ensured with mortar suitably cast into the prepared groove.

Fill material shall be placed up to the level of openings in the first row of the lining elements. Onto the placed, isolated vertical steel anchors in the first row of the lining elements, the next row of the lining elements shall be put. By means of inclined wooden dowels, a stable supporting of lining elements shall be made feasible. All the lining elements shall be suitably inclined towards the fill.

Through the first row of the openings in the lining elements, reinforcing strips shall be pulled; then, they shall be adequately tensioned, followed by manual covering with a thin soil layer first (to protect the strips from mechanical damage), and, finally, by placing soil in the definitive thickness, i.e. up to the next row of openings in the lining elements. The procedure is repeated by placing the next row of lining elements.

An approximately 50 cm thick vertical layer between lining elements and fill soil shall be simultaneously executed using stone material for drainage layer, which needs not be compacted with a roller.

2.2.2.6.4.3 Execution with geotextiles, geo-mesh, and steel mesh

Fills reinforced with geotextiles, geo-mesh, and steel mesh can be built on a prepared subgrade formation in such a way: onto the material spread over a suitable area, a 30 cm thick and relatively pure gravel or gravel sand layer, ensuring perfect drainage, is placed. After this layer is adequately compacted, its outer side shall be wrapped with the extended part of the lower geotextiles, geo-mesh, or steel mesh layer. The required wrapping length shall be specified by the design.

The entire first, already placed fill layer (mineral material), shall be covered with the next layer of geotextiles, geo-mesh, or steel mesh, and the required length of the felt shall be left to wrap the next soil layer, which can be, in compacted condition, up to 50 cm thick. The soil shall be compacted up to 50 cm from the slope of reinforced soil, which shall be carried out at appropriate inclination (at least 4 %).

In case of higher fills, reinforced with geotextiles, geo-mesh, or steel mesh, the entire procedure shall be repeated.

2.2.2.6.5 Quality of execution

2.2.2.6.5.1 Subgrade formation

The required compaction or bearing capacity of a subgrade formation shall generally be specified by the design. The same applies to the inclination towards the fill slope made of reinforced soil, both in dependence on the subgrade material and the fill material properties.

2.2.2.6.5.2 Reinforced soil fill

Prior reinforcing strips are placed, each fill soil layer not thicker than 50 cm shall be compacted in compliance with item 2.2.2.6.4 of these technical conditions simultaneously up to 50 cm from the layer outer edge. A mean compaction rate of 95 % according to the modified Proctor compaction test shall be ensured. The lower limiting value, which shall be attained at any measuring spot, must not be lower than the required average value minus 3 %.

2.2.2.6.5.3 Reinforced soil fill formation

Where a reinforced soil fill is executed as a retaining structure, the load bearing capacity, i.e. the static modulus of deformation E_{v2} on the fill formation shall amount to at least 45 MN/m^2, and the ratio E_{v2} : E_{v1} must not exceed 2.2. When the measured value of the static modulus of deformation E_{v1} is greater than 50 % of the required value of the static modulus of deformation E_{v2}, the abovementioned ratio is no more decisive to evaluate the reinforced soil fill formation bearing capacity.

The minimum value of the dynamical modulus of deformation E_{vd} shall amount to minimum 20 MN/m^2.

The indicated bearing capacity value represents the lower limiting value, and shall be achieved at any measuring spot.

To ensure suitable dewatering of a reinforced soil fill formation, unevenness established by means of a 4 m long straight edge shall not exceed 25 mm.

A reinforced soil fill formation shall be executed at an inclination of at least 4 % towards the slope (lining).

2.2.2.6.6 Execution quality control

2.2.2.6.6.1 Preliminary tests

Prior to commencement of works within the scope of reinforcing of soils the contractor shall verify the material properties indicated in table 2.19.

Table 2.19: Preliminary tests of materials intended for a reinforced fill

Material property	Unit	Required value	Test method
- natural moisture content in the soil	% by mass	item 2.2.2.6.2	BAS
- Proctor test			EN 13286-2
- optimum moisture content	% by mass	-	
- maximum density	t/m^3	-	
- granulometric composition of material for drainage layer	% by mass	item 2.2.2.6.2.4	EN 933-1

Before starting the works on reinforcing of soils, the contractor shall submit to the engineer certificates for all the products he intends to use.

2.2.2.6.6.2 Execution control

2.2.2.6.6.3 Internal control

Both frequency and type of tests to be performed by the internal control are specified in the approved programme of the average control frequency. If this is not the case, the engineer shall direct both frequency and type of testing.

During carrying out soil reinforcing works, the laboratory shall take samples and verify the conformity, taking account of the frequency indicated in table 2.20.

Table 2.20: Minimum frequency of material testing within the scope of soil reinforcing works

Material properties	Test method	Minimum testing frequency
- soil moisture content		100 m^3
- Proctor test	EN 13286-2	400 m^3
- granulometric composition of material for drainage layer	EN 933-1	100 m^3
- compressive strength of cement concrete in lining elements (C 25/30)	EN 12390-3	1/100 elements

The engineer has a right to modify the extent of material testing within the scope of reinforcing of soils, if he establishes major deviations from the preliminary testing results.

The minimum frequency of testing within the scope of internal control of executing reinforced soils in indicated in table 2.21.

Table 2.21: Minimum frequency of testing of executing reinforced soils

Material property	Test method	Minimum testing frequency	Evaluation base
- soil moisture content and density	BAS	100 m^3/20m^1	item 2.2.2.6.5.2
- bearing capacity:			
- modulus of deformation E_{vd}	BAS	10 m^1	
- modulus of deformation E_{v2}	BAS	40 m^1	item 2.2.2.6.5.3
- measurements of evenness	BAS	20 m^1	item 2.2.2.6.5.3
- measurements of fill height	-	20 m^1	

Testing the quality of both materials and execution associated with reinforced soils can also be determined otherwise, provided that an approval by the engineer is obtained. In such cases, the engineer shall indicate criteria for the quality evaluation.

3.2.2.1.1.6.1 External control

The basic conditions related to the external control are specified in item 2.1.5.2.5 of the general technical conditions. The ratio of the external control extent to be performed by the client, to the internal control extent, generally amounts to 1 : 4. The external control results shall be indicated in the final report, and represent a basis for taking over and final accounting within the scope of the soil reinforcing works.

2.2.2.6.7 Measurement and taking over of works

2.2.2.6.7.1 Measurement of works

The executed works shall be measured in compliance with item 2.1.7.1 of the general technical conditions, and with the following provisions:

- surfaces of subgrade formation below the fills made of reinforced soils shall be measured in square metres according to actually executed quantities;
- foundation for slope lining, lining elements, anchors, dowels, and stone material for drainage layer shall be measured in average values for individual lining elements of certain type;
- strips for reinforcing of soils shall be measured according to actual quantities of built-in material in metres;
- additional payment for fill construction in the reinforcing strip areas due to aggravated work shall be approved on the basis of actually placed quantities in cubic metres;
- quantities of geotextiles, steel meshes, and other materials within the scope of reinforcing of soils are measured according to actually placed quantities in square metres, and shall be evaluated per quantity of actually reinforced soil in cubic metres.

The contractor is obliged to submit suitable conformity certificates for all the materials and all the quantities delivered to the site for execution of reinforced soils.

2.2.2.6.7.2 Taking over of works

Fills of reinforced soils shall be taken over in compliance with item 2.1.7.2 of the general technical conditions, quality requirements, and special technical conditions.

All the established deficiencies shall be made good prior to continuation of the works.

All the costs related to mending deficiencies shall be born by the contractor.

2.2.2.6.8 Final account of works

2.2.2.6.8.1 General

The executed works shall be accounted in accordance with item 2.1.7.3 of the general technical conditions.

Quantities assessed according to item 2.2.2.6.7.1 of these technical conditions shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a whole accomplishment of the works. The contractor shall not be entitled to claim any extra payment subsequently.

Arrangement of subgrade formation below the reinforced soil fills shall be, as a rule, accounted according to the provisions of item 2.2.2.2.8 of these technical conditions, whilst the fill construction, however without reinforcing, as per item 2.2.2.4.8.

2.2.2.6.8.2 Deductions due to inadequate quality

The quality of cement concrete of foundations and lining elements shall be financially evaluated according to conditions, which apply to cement concrete material and works (item 2.2.5.3.8).

The compaction of a reinforced soil fill shall be evaluated following item 2.2.2.6.5.2. The lower limiting value, which shall be ensured at any measuring spot, signifies a 100 % - value compared with the tender unit price, therefore no deductions will be imposed upon final accounting of the works executed.

The reinforced soil formation bearing capacity shall be evaluated following item 2.2.2.6.5.3. The lower limiting value signifies a 100 % - value compared with the tender unit price, therefore no deductions will be imposed upon final accounting of the works executed.

As the reinforced soil fill formation evenness is clearly specified (item 2.2.2.6.5.3), there shall be no deductions upon final account of the works carried out.

Properties of reinforcing strips specified in item 2.2.2.6.3.2, and properties of geotextiles specified in item 2.2.2.6.3.3 are lower limiting values signifying a 100 % - value compared with the tender unit price. The threshold limiting values can be by up to 10 % lower than the required limiting ones, and represent in individual properties of both reinforcing strip and geotextiles a material, and therefore an executed work without any value. Intermediate values shall be assessed by means of linear interpolation.

2.2.2.7 PILES AND WELLS

2.2.2.7.1 Description

Foundation on either piles or wells includes the following:

- delivery, installation, maintenance, disassembling, and removal of all the required machines and devices including accessories, and equipment for a complete execution of works, including all the necessary rooms;
- excavation and removal of excavated and/or bored cohesive soil and/or granular rock, as well as eventual pumping of water;
- supply and placing all the materials required for a perfect completion of works;
- all the works related to treatment of pile and well caps;
- all the works related to construction of external walls, bracing, barriers, and well cutting edges.

Pile or well foundation also includes all other works foreseen by the design, as well as all the works prescribed by current regulations dealing with safety at work.

All the aforementioned works shall be included in the unit price, thus the contractor shall have no right to claim any extra payment.

2.2.2.7.2 Basic materials

Only such materials may be used for pile and well construction, which comply with the design and these technical conditions.

As a rule, the following materials are used:

- for bored and driven piles, as well as for wells: cement concrete and reinforcing steel of standard composition;
- for wooden piles: suitable timber types;
- for mineral aggregate piles: suitable mixture of crushed mineral aggregate;
- for piles of stabilized soils: quicklime and hydrated lime, fly ash (if necessary, with suitable admixtures), and gypsum.

2.2.2.7.3 Quality of materials

Before commencement of the works, the contractor shall submit to the engineer conformity certificates for materials foreseen for execution of both piles and wells in accordance with the conditions indicated in items 2.1.5.1 and 2.1.5.2 of the general technical conditions.

The quality of all the materials shall meet the requirements of the design as well as both general and special technical conditions.

In absence of suitable technical regulations and/or manufacturers' instructions, the engineer's instructions shall be decisive.

The contractor shall perform or organize all the preliminary testing of specified properties or applicability of materials proposed. The contractor shall have no right to claim any additional payment for these services. As a rule, for preliminary tests one characteristic sample of each material is sufficient, but the engineer has a right to request a greater number of samples are special cases.

2.2.2.7.4 Method of execution

The contractor shall carry out all the works related to pile and well foundation in compliance with the design and these technical conditions.

The length of either piles or wells shall be in accordance with the conditions indicated in the soil mechanical report, including eventual foreseen fixing depth specified on the basis of the design analysis.

The work execution shall take account of the fundamental requirements of the selected pile or well construction method. Where the method of pile or well execution is insufficiently particularized, the engineer shall specify both conditions and method of construction.

2.2.2.7.5 Quality of execution

The quality of execution of piles and wells shall comply with the current technical regulations as well as with both general and special technical conditions that apply to the materials used, unless provided explicitly otherwise by the design quality requirements. By the internal control results the contractor shall prove the following:

- bearing capacity of the foundation soil at the pile or well foot;
- quality and uniformity of pile and well materials;
- fixing length and depth, or bearing capacity of piles and wells.

The abovementioned tests shall be carried through reasonably, taking account of the pile or well type.

2.2.2.7.6 Execution quality control

2.2.2.7.6.1 Internal control

Internal control of both material and placing quality shall be performed in accordance with the approved programme of the average testing frequency; the contractor shall prepare such a programme, and submit it to the engineer for approval.

Tests within the scope of the internal control shall be carried out in the same way as required for individual material types in accordance with these technical conditions, or they shall be logically adjusted.

As a rule, within the scope of the internal control, the following extent of testing shall be carried through:

- for reinforced concrete piles and wells:
  - bearing capacity of the foundation soil for each bored or sunk pile, or well;
  - compressive strength of cement concrete and filling cement concrete (for wells) for each pile and well;
  - reinforcing steel quality per each 5 tons of built-in reinforcement;
  - uniformity and continuity of cast cement concrete for each pile;
  - fixing length and depth for each pile or well.
- for steel piles and wells:
  - bearing capacity of the foundation soil for each bored or sunk pile, or well;
  - mechanical properties of steel per every 10 piles;
  - compressive strength of filling cement concrete for each well;
  - fixing length and depth for each pile or well.
- for wooden piles:
  - mechanical properties of timber per every 10 piles;
  - length of each pile.
- for piles made of mineral aggregates:
  - granulometric composition of mineral aggregates per every 10 piles;
  - length of each pile.
- for piles made of stabilized soils:
  - binder properties per every 50 tons of delivered material;
  - quantity of mixed-in binder (calculated) per every two piles;
  - compressive strength of stabilizing mixture for each pile;
  - resistance of stabilizing mixture to water per every 10 piles;
  - length of each pile.

In case that the engineer establishes major deviations of internal control results from the preliminary testing results, he is entitled to modify the internal control extent subsequently.

2.2.2.7.6.2 External control

Basic conditions for the external control during pile and well construction are logically specified in item 2.1.5.2.5 of the general technical conditions.

The ratio of the external control extent to be performed by the client, to the internal control extent, generally amounts to 1 : 4.

The external control results shall be presented in the final report.

2.2.2.7.7 Measurement and taking over of works

All the quantities of the works executed shall be measured in the following units:

- execution of piles and wells: in metres,
- extensions of piles and wells: in metres,
- cutting or shortening of piles and wells: in pieces,

all in dependence on the pile or well diameter.

When the executed works are measured, provisions of item 2.1.7.1 of the general technical conditions shall be considered.

The performed works shall be taken over in compliance with item 2.1.7.2 of the general technical conditions.

2.2.2.7.8 Final account of works

The executed works shall be accounted in accordance with the provisions of item 2.1.7.3 of the general technical conditions.

The quality specified by the design represents the lower limiting value, and signifies a 100 % - value compared with the tender unit price. As the quality determined by the design is, at the same time, also a threshold limiting value, the contractor shall have no right to claim any extra payment for the works not meeting the requirements. In addition, he shall bear all the costs resulting from any inadequate quality.

2.2.2.8 SHEET PILES

2.2.2.8.1 Description

The works include the following activities:

- delivery and placing sheet piling elements, angles and tie elements, supports, and all the accessories to secure a construction pit,
- maintenance of sheet piles during construction,
- pulling out the sheet piles,

all in compliance with the design, approved design static analysis, as well as these technical conditions, and current regulations dealing with safety at work.

All the abovementioned works are included in the unit price, and the contractor shall have no right to claim any extra payment.

3.2.2.1.2 Basic materials

For sheet piles only such materials may be used, which meet the requirements of both design and these technical conditions.

As a rule, steel and wooden elemements shall be used to execute sheet piling.

3.2.2.1.3 Quality of materials

Prior to commencement of the works, the contractor shall submit to the engineer conformity cetificates for all the products foreseen for the sheet piling execution, all in compliance with items 2.1.5.1 and 2.1.5.2 of the general technical conditions.

The quality of materials shall meet the requirements of the design as well as of both general and special technical conditions for those materials. In case that no adequate technical regulations and/or producers' instructions are available, engineer's opinion an instructions shall be decisive.

3.2.2.1.4 Method of execution

All the works related to execution of sheet piling shall be carried out in accordance with the design and the technical conditions.

When, for whatever reason, the method of execution of sheet piling is not sufficiently particularized, the engineer shall determine both conditions and method of execution.

3.2.2.1.5 Quality of execution

The quality of execution shall comply with the current technical regulations, the general and special technical conditions for material to be used, as well as the design quality requirements.

3.2.2.1.6 Execution quality control

In uncertain cases, the contractor shall, upon engineer's request, check the quality of the individual type of material and/or work during the construction.

3.2.2.1.7 Measurement and taking over of works

All the quantities of the works carried out shall be measured in square metres, as well as in accordance with the provisions of item 2.1.7.1 of the general technical conditions.

The works shall be taken over according to item 2.1.7.2 of the general technical conditions, and to the provisions of these special technical conditions.

2.2.2.8.2 Final account of works

The works carried out shall be accounted according to the provisions of item 2.1.7.3 of the general technical conditions.

2.2.2.9 SPREADING SURPLUS MATERIAL

2.2.2.9.1 General

Provisions of this chapter only comprise technical conditions for spreading surplus materials, and conditions of execution where the spreading works are included in unit prices for fills, backfills, wedges, substructures, and puddle layers.

2.2.2.9.2 Description

The work includes all types of spreading and placing surplus material from excavations of all types and categories, on both deposit areas and along the road alignment after completion of the works. Spreading and placing surplus material shall be carried out in compliance with the design, or as directed by the engineer. Appropriate aesthetical and technically correct forming the spread material, as well as correct bedding for individual soil types shall be considered.

2.2.2.9.3 Basic materials

All the materials shall be spread, which are not applicable and/or necessary to fills, backfills, wedges, substructure, and puddle layer according to item 2.2.2.4.2 of these technical conditions, or which are superfluous.

2.2.2.9.4 Quality of materials

There are no quality requirements applicable to surplus materials. In addition to the provisions of item 2.2.2.9.2, these materials can also be excessively dry, moist, soaked, or frozen.

2.2.2.9.5 Method of execution

The contractor is free to select the execution of works, method of organization, as well as machines and devices. Moreover, the contractor is free to acquire deposit areas out of the road alignment, as well as to arrange those areas. The contractor shall consider the design provisions related to proper distribution of the materials, to adequate adaptation to the ground and environment, to an effective drainage during spreading and afterwards, as well as to laying topsoil and grassing the surfaces after completion of spreading. The deposit area shall only be compacted to such extent as to prevent excessive non-uniform settlements.

2.2.2.9.6 Quality of execution

There are special quality requirements applicable to deposit areas; only general requirements related to an aesthetical performance, adjustment to surroundings, grassing, and draining surface, precipitation, spring, and ground water.
In no way the existing natural conditions of areas foreseen for spreading surplus material shall be adversely affected. On the contrary, it is wished-for, that the conditions will only ameliorate.

3.2.2.1.8 Execution quality control

The execution quality control shall only be carried out visually taking account of the following criteria:

- incorporation in the environment,
- suitability of placed layer,
- suitability of layer evenness,
- suitability of drainage,
- suitability of grassing,
- suitability of arrangement in compliance with the design and engineer's instructions.

2.2.2.9.7 Measurement and taking over of works

2.2.2.9.7.1 Measurement of works

Executed works shall not be measured, as these quantities are established within the scope of assessing categories of excavated materials in the sense of provisions of item 2.2.2.1.7.1.

2.2.2.9.7.2 Taking over of works

Executed works shall be taken over according to general requirements indicated in item 2.2.2.9.5.

2.2.2.9.8 Final account of works

Executed works shall be accounted in compliance with the provisions of item 2.1.7.3 of the general technical conditions, as well as by the contractual unit price per cubic metre of the spread surplus cohesive soil or granular rock.

2.2.2.10 EARTH WORKS - BILL OF WORKS

2.2.2.10.1 Excavations

Item	Unit	Description of work
21 111	m^3	Surface excavation of fertile soil (topsoil) – manually
21 112	m^3	Surface excavation of fertile soil (topsoil) – machine work including pushing away
21 113	m^3	Surface excavation of fertile soil (topsoil) – machine work including loading
21 211	m^3	Spread excavation of soil of low bearing capacity – manually
21 212	m^3	Spread excavation of soil of low bearing capacity – machine work including pushing away
21 213	m^3	Spread excavation of soil of low bearing capacity – machine work including loading
21 221	m^3	Spread excavation of cohesive soil – manually
21 222	m^3	Spread excavation of cohesive soil – machine work including pushing away
21 223	m^3	Spread excavation of cohesive soil – machine work including loading
21 225	m^3	Spread excavation of granular rock – manually
21 226	m^3	Spread excavation of granular rock – machine work including pushing away
21 227	m^3	Spread excavation of granular rock – machine work including loading
21 231	m^3	Spread excavation of soft rock including pushing away
21 232	m^3	Spread excavation of soft rock including loading
21 241	m^3	Spread excavation of hard rock including pushing away
21 242	m^3	Spread excavation of hard rock including loading
21 251	m^3	Allowance for cautious blasting of rock
21 311	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, up to 1.0 m in depth – manually, manual grading of bottom
21 312	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, up to 1.0 m in depth – machine work, manual grading of bottom
21 313	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, up to 1.0 m in depth – manually, manual grading of bottom
21 314	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, up to 1.0 m in depth – machine work, manual grading of bottom
21 315	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, up to 1.0 m in depth
21 316	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, up to 1.0 m in depth
21 321	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 1.1 – 2.0 m in depth – manually, manual grading of bottom
21 322	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 1.1 – 2.0 m in depth – machine work, manual grading of bottom
21 323	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 1.1 – 2.0 m in depth – manually, manual grading of bottom

Item	Unit	Description of work
21 324	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 1.1 – 2.0 m in depth – machine work, manual grading of bottom
21 325	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 1.1 – 2.0 m in depth
21 326	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 1.1 – 2.0 m in depth
21 331	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 2.1 – 4.0 m in depth – manually, manual grading of bottom
21 332	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 2.1 – 4.0 m in depth – machine work, manual grading of bottom
21 333	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 2.1 – 4.0 m in depth – manually, manual grading of bottom
21 334	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 2.1 – 4.0 m in depth – machine work, manual grading of bottom
21 335	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 2.1 – 4.0 m in depth
21 336	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, 2.1 – 4.0 m in depth
21 341	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, above 4.0 m in depth – manually, manual grading of bottom
21 342	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, above 4.0 m in depth – machine work, manual grading of bottom
21 343	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, above 4.0 m in depth – manually, manual grading of bottom
21 344	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, above 4.0 m in depth – machine work, manual grading of bottom
21 345	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, above 4.0 m in depth
21 346	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, up to 1.0 m in width, above 4.0 m in depth
21 351	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 - 2.0 m in width, up to 1.0 m in depth – manually, manual grading of bottom
21 352	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, up to 1.0 m in depth – machine work, manual grading of bottom
21 353	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, up to 1.0 m in depth – manually, manual grading of bottom
21 354	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, up to 1.0 m in depth – machine work, manual grading of bottom
21 355	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, up to 1.0 m in depth
21 356	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, up to 1.0 m in depth

Item	Unit	Description of work
21 361	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 - 2.0 m in width, 1.1 – 2.0 m in depth – manually, manual grading of bottom
21 362	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 1.1 – 2.0 m in depth – machine work, manual grading of bottom
21 363	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 1.1 – 2.0 m in depth – manually, manual grading of bottom
21 364	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 1.1 – 2.0 m in depth – machine work, manual grading of bottom
21 365	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 1.1 – 2.0 m in depth
21 366	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 1.1 – 2.0 m in depth
21 371	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 - 2.0 m in width, 2.1 – 4.0 m in depth – manually, manual grading of bottom
21 372	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 2.1 – 4.0 m in depth – machine work, manual grading of bottom
21 373	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 2.1 – 4.0 m in depth – manually, manual grading of bottom
21 374	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 2.1 – 4.0 m in depth – machine work, manual grading of bottom
21 375	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 2.1 – 4.0 m in depth
21 376	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, 2.1 – 4.0 m in depth
21 381	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 - 2.0 m in width, above 4.0 m in depth – manually, manual grading of bottom
21 382	m^3	Excavation of soil of low bearing capacity for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, above 4.0 m in depth – machine work, manual grading of bottom
21 383	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, above 4.0 m in depth – manually, manual grading of bottom
21 384	m^3	Excavation of cohesive soil/granular rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, above 4.0 m in depth – machine work, manual grading of bottom
21 385	m^3	Excavation of soft rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, above 4.0 m in depth
21 386	m^3	Excavation of hard rock for foundations, trenches, culverts, shafts, and drainages, 1.1 – 2.0 m in width, above 4.0 m in depth
21 411	m^3	Excavation of soil of low bearing capacity for construction pits for structures, up to 1.0 m in depth – manually, manual grading of bottom
21 412	m^3	Excavation of soil of low bearing capacity for construction pits for structures, up to 1.0 m in depth – machine work, manual grading of bottom
21 413	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, up to 1.0

Item	Unit	Description of work
		m in depth – manually, manual grading of bottom
21 414	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, up to 1.0 m in depth – machine work, manual grading of bottom
21 415	m^3	Excavation of soft rock for construction pits for structures, up to 1.0 m in depth
21 416	m^3	Excavation of hard rock for construction pits for structures, up to 1.0 m in depth
21 421	m^3	Excavation of soil of low bearing capacity for construction pits for structures, 1.1 – 2.0 m in depth – manually, manual grading of bottom
21 422	m^3	Excavation of soil of low bearing capacity for construction pits for structures, 1.1 – 2.0 m in depth – machine work, manual grading of bottom
21 423	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, 1.1 – 2.0 m in depth – manually, manual grading of bottom
21 424	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, 1.1 – 2.0 m in depth – machine work, manual grading of bottom
21 425	m^3	Excavation of soft rock for construction pits for structures, 1.1 – 2.0 m in depth
21 426	m^3	Excavation of hard rock for construction pits for structures, 1.1 – 2.0 m in depth
21 431	m^3	Excavation of soil of low bearing capacity for construction pits for structures, 2.1 – 4.0 m in depth – manually, manual grading of bottom
21 432	m^3	Excavation of soil of low bearing capacity for construction pits for structures, 2.1 – 4.0 m in depth – machine work, manual grading of bottom
21 433	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, 2.1 – 4.0 m in depth – manually, manual grading of bottom
21 434	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, 2.1 – 4.0 m in depth – machine work, manual grading of bottom
21 435	m^3	Excavation of soft rock for construction pits for structures, 2.1 – 4.0 m in depth
21 436	m^3	Excavation of hard rock for construction pits for structures, 2.1 – 4.0 m in depth
21 441	m^3	Excavation of soil of low bearing capacity for construction pits for structures, above 4.0 m in depth – manually, manual grading of bottom
21 442	m^3	Excavation of soil of low bearing capacity for construction pits for structures, above 4.0 m in depth – machine work, manual grading of bottom
21 443	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, above 4.0 m in depth – manually, manual grading of bottom
21 444	m^3	Excavation of cohesive soil/granular rock for construction pits for structures, above 4.0 m in depth – machine work, manual grading of bottom
21 445	m^3	Excavation of soft rock for construction pits for structures, above 4.0 m in depth
21 446	m^3	Excavation of hard rock for construction pits for structures, above 4.0 m in depth
21 511	m^3	Excavation of soil of low bearing capacity in wells of up to 3.0 m in diameter, and up to 6.0 m in depth
21 512	m^3	Excavation of cohesive soil/granular rock in wells of up to 3.0 m in diameter, and up to 6.0 m in depth
21 513	m^3	Excavation of soft rock in wells of up to 3.0 m in diameter, and up to 6.0 m in depth
21 514	m^3	Excavation of hard rock in wells of up to 3.0 m in diameter, and up to 6.0 m in depth
21 521	m^3	Excavation of soil of low bearing capacity in wells of up to 3.0 m in diameter, and above 6.0 m in depth
21 522	m^3	Excavation of cohesive soil/granular rock in wells of up to 3.0 m in diameter, and above 6.0 m in depth
21 523	m^3	Excavation of soft rock in wells of up to 3.0 m in diameter, and above 6.0 m in depth
21 524	m^3	Excavation of hard rock in wells of up to 3.0 m in diameter, and above 6.0 m in depth
21 531	m^3	Excavation of soil of low bearing capacity in wells of 3.1 – 6.0 m in diameter, and up

Item	Unit	Description of work
		to 6.0 m in depth
21 532	m^3	Excavation of cohesive soil/granular rock in wells of 3.1 – 6.0 m in diameter, and up to 6.0 m in depth
21 533	m^3	Excavation of soft rock in wells of 3.1 – 6.0 m in diameter, and up to 6.0 m in depth
21 534	m^3	Excavation of hard rock in wells of 3.1 – 6.0 m in diameter, and up to 6.0 m in depth
21 541	m^3	Excavation of soil of low bearing capacity in wells of 3.1 – 6.0 m in diameter, and above 6.0 m in depth
21 542	m^3	Excavation of cohesive soil/granular rock in wells of 3.1 – 6.0 m in diameter, and above 6.0 m in depth
21 543	m^3	Excavation of soft rock in wells of 3.1 – 6.0 m in diameter, and above 6.0 m in depth
21 544	m^3	Excavation of hard rock in wells of 3.1 – 6.0 m in diameter, and above 6.0 m in depth
21 551	m^3	Excavation of soil of low bearing capacity in wells above 6.0 m in diameter, and up to 6.0 m in depth
21 552	m^3	Excavation of cohesive soil/granular rock in wells above 6.0 m in diameter, and up to 6.0 m in depth
21 553	m^3	Excavation of soft rock in wells above 6.0 m in diameter, and up to 6.0 m in depth
21 554	m^3	Excavation of hard rock in wells above 6.0 m in diameter, and up to 6.0 m in depth
21 561	m^3	Excavation of soil of low bearing capacity in wells above 6.0 m in diameter, and above 6.0 m in depth
21 562	m^3	Excavation of cohesive soil/granular rock in wells above 6.0 m in diameter, and above 6.0 m in depth
21 563	m^3	Excavation of soft rock in wells above 6.0 m in diameter, and above 6.0 m in depth
21 564	m^3	Excavation of hard rock in wells above 6.0 m in diameter, and above 6.0 m in depth
21 611	m^3	Excavation of soil of low bearing capacity for foundations above 2.0 m in width, and of up to 1.0 m in depth
21 612	m^3	Excavation of cohesive soil/granular rock for foundations above 2.0 m in width, and of up to 1.0 m in depth
21 613	m^3	Excavation of soft rock for foundations above 2.0 m in width, and of up to 1.0 m in depth
21 614	m^3	Excavation of hard rock for foundations above 2.0 m in width, and of up to 1.0 m in depth
21 621	m^3	Excavation of soil of low bearing capacity for foundations above 2.0 m in width, and of 1.1 – 2.0 m in depth
21 622	m^3	Excavation of cohesive soil/granular rock for foundations above 2.0 m in width, and of 1.1 – 2.0 m in depth
21 623	m^3	Excavation of soft rock for foundations above 2.0 m in width, and of 1.1 – 2.0 m in depth
21 624	m^3	Excavation of hard rock for foundations above 2.0 m in width, and of 1.1 – 2.0 m in depth
21 631	m^3	Excavation of soil of low bearing capacity for foundations above 2.0 m in width, and of 2.1 – 4.0 m in depth
21 632	m^3	Excavation of cohesive soil/granular rock for foundations above 2.0 m in width, and of 2.1 – 4.0 m in depth
21 633	m^3	Excavation of soft rock for foundations above 2.0 m in width, and of 2.1 – 4.0 m in depth
21 634	m^3	Excavation of hard rock for foundations above 2.0 m in width, and of 2.1 – 4.0 m in depth
21 641	m^3	Excavation of soil of low bearing capacity for foundations above 2.0 m in width, and

Item	Unit	Description of work
		above 4.0 m in depth
21 642	m^3	Excavation of cohesive soil/granular rock for foundations above 2.0 m in width, and above 4.0 m in depth
21 643	m^3	Excavation of soft rock for foundations above 2.0 m in width, and above 4.0 m in depth
21 644	m^3	Excavation of hard rock for foundations above 2.0 m in width, and above 4.0 m in depth
21 711	m^3	Excavation of soil of low bearing capacity for melioration and regulation channels of up to 1.0 m in depth
21 712	m^3	Excavation of cohesive soil/granular rock for melioration and regulation channels of up to 1.0 m in depth
21 713	m^3	Excavation of soft rock for melioration and regulation channels of up to 1.0 m in depth
21 714	m^3	Excavation of hard rock for melioration and regulation channels of up to 1.0 m in depth
21 721	m^3	Excavation of soil of low bearing capacity for melioration and regulation channels of 1.1 – 2.0 m in depth
21 722	m^3	Excavation of cohesive soil/granular rock for melioration and regulation channels of 1.1 – 2.0 m in depth
21 723	m^3	Excavation of soft rock for melioration and regulation channels of 1.1 – 2.0 m in depth
21 724	m^3	Excavation of hard rock for melioration and regulation channels of 1.1 – 2.0 m in depth
21 731	m^3	Excavation of soil of low bearing capacity for melioration and regulation channels of 2.1 – 4.0 m in depth
21 732	m^3	Excavation of cohesive soil/granular rock for melioration and regulation channels of 2.1 – 4.0 m in depth
21 733	m^3	Excavation of soft rock for melioration and regulation channels of 2.1 – 4.0 m in depth
21 734	m^3	Excavation of hard rock for melioration and regulation channels of 2.1 – 4.0 m in depth
21 751	m^3	Excavation of soil of low bearing capacity for melioration and regulation channels above 4.0 m in depth
21 752	m^3	Excavation of cohesive soil/granular rock for melioration and regulation channels above 4.0 m in depth
21 753	m^3	Excavation of soft rock for melioration and regulation channels above 4.0 m in depth
21 754	m^3	Excavation of hard rock for melioration and regulation channels above 4.0 m in depth
21 761	m^3	Excavation of soil of low bearing capacity for drainage ditches and gutters
21 762	m^3	Excavation of cohesive soil/granular rock for drainage ditches and gutters
21 763	m^3	Excavation of soft rock for drainage ditches and gutters
21 764	m^3	Excavation of hard rock for drainage ditches and gutters
21 771	m^3	Excavation of soil of low bearing capacity for paving and lining
21 772	m^3	Excavation of cohesive soil/granular rock for paving and lining
21 773	m^3	Excavation of soft rock for paving and lining
21 774	m^3	Excavation of hard rock for paving and lining

21 811	m^3	Excavation of tunnel arch upwards in the rock class PC (Portal Class)
21 812	m^3	Excavation of tunnel arch upwards in the rock class A1
21 813	m^3	Excavation of tunnel arch upwards in the rock class A2
21 814	m^3	Excavation of tunnel arch upwards in the rock class B1
21 815	m^3	Excavation of tunnel arch upwards in the rock class B2
21 816	m^3	Excavation of tunnel arch upwards in the rock class B3
21 821	m^3	Excavation of tunnel arch upwards in the rock class C1
21 822	m^3	Excavation of tunnel arch upwards in the rock class C2
21 823	m^3	Excavation of tunnel arch upwards in the rock class C3
21 824	m^3	Excavation of tunnel arch upwards in the rock class C4
21 825	m^3	Excavation of tunnel arch upwards in the rock class C5
21 827	m^3	Excavation of tunnel arch upwards in the rock class SCC (Shallow Cover Class)
21 828	m^3	Excavation of tunnel arch upwards in the rock class CA (Concrete Arch)
21 829	m^3	Excavation of tunnel arch upwards for emergeny niche irrespective of the rock class
21 831	m^3	Excavation of tunnel arch downwards in the rock class PC (Portal Class)
21 832	m^3	Excavation of tunnel arch downwards in the rock class A1
21 833	m^3	Excavation of tunnel arch downwards in the rock class A2
21 834	m^3	Excavation of tunnel arch downwards in the rock class B1
21 835	m^3	Excavation of tunnel arch downwards in the rock class B2
21 836	m^3	Excavation of tunnel arch downwards in the rock class B3
21 841	m^3	Excavation of tunnel arch downwards in the rock class C1
21 842	m^3	Excavation of tunnel arch downwards in the rock class C2
21 843	m^3	Excavation of tunnel arch downwards in the rock class C3
21 844	m^3	Excavation of tunnel arch downwards in the rock class C4
21 845	m^3	Excavation of tunnel arch downwards in the rock class C5
21 847	m^3	Excavation of tunnel arch downwards in the rock class SCC (Shallow Cover Class)
21 848	m^3	Excavation of tunnel arch downwards in the rock class CA (Concrete Arch)
21 849	m^3	Excavation of tunnel arch downwards for emergeny niche irrespective of the rock class
21 851	m^3	Excavation of tunnel bench upwards in the rock class PC (Portal Class)
21 852	m^3	Excavation of tunnel bench upwards in the rock class A1
21 853	m^3	Excavation of tunnel bench upwards in the rock class A2
21 854	m^3	Excavation of tunnel bench upwards in the rock class B1
21 855	m^3	Excavation of tunnel bench upwards in the rock class B2
21 856	m^3	Excavation of tunnel bench upwards in the rock class B3
21 861	m^3	Excavation of tunnel bench upwards in the rock class C1
21 862	m^3	Excavation of tunnel bench upwards in the rock class C2
21 863	m^3	Excavation of tunnel bench upwards in the rock class C3
21 864	m^3	Excavation of tunnel bench upwards in the rock class C4
21 865	m^3	Excavation of tunnel bench upwards in the rock class C5

21 867	m^3	Excavation of tunnel bench upwards in the rock class SCC (Shallow Cover Class)
21 868	m^3	Excavation of tunnel bench upwards in the rock class CA (Concrete Bench)
21 869	m^3	Excavation of tunnel bench upwards for emergeny niche irrespective of the rock class
21 871	m^3	Excavation of tunnel bench downwards in the rock class PC (Portal Class)
21 872	m^3	Excavation of tunnel bench downwards in the rock class A1
21 873	m^3	Excavation of tunnel bench downwards in the rock class A2
21 874	m^3	Excavation of tunnel bench downwards in the rock class B1
21 875	m^3	Excavation of tunnel bench downwards in the rock class B2
21 876	m^3	Excavation of tunnel bench downwards in the rock class B3
21 881	m^3	Excavation of tunnel bench downwards in the rock class C1
21 882	m^3	Excavation of tunnel bench downwards in the rock class C2
21 883	m^3	Excavation of tunnel bench downwards in the rock class C3
21 884	m^3	Excavation of tunnel bench downwards in the rock class C4
21 885	m^3	Excavation of tunnel bench downwards in the rock class C5
21 887	m^3	Excavation of tunnel bench downwards in the rock class SCC (Shallow Cover Class)
21 888	m^3	Excavation of tunnel bench downwards in the rock class CA (Concrete Bench)
21 889	m^3	Excavation of tunnel bench downwards for emergeny niche irrespective of the rock class
21 911	m^3	Excavation for invert (a half) upwards, max. segment length 12 m
21 912	m^3	Excavation for invert in emergency niche (a half) upwards, max. segment length 12 m
21 916	m^3	Excavation for invert (a half) downwards, max. segment length 12 m
21 917	m^3	Excavation for invert in emergency niche (a half) downwards, max. segment length 12 m
21 921	m^3	Excavation for invert (total width) upwards, max. segment length 12 m
21 922	m^3	Excavation for invert in emergency niche (total width) upwards, max. segment length 12 m
21 926	m^3	Excavation for invert (total width) downwards, max. segment length 12 m
21 927	m^3	Excavation for invert in emergency niche (total width) downwards, max. segment length 12 m
21 931	m^3	Excavation for invert of shot cement concrete, upwards
21 933	m^3	Excavation for invert of shot cement concrete, downwards
21 935	m^3	Excavation for temporary invert of shot cement concrete in the arch
21 937	m^3	Excavation for widening of foot in the arch, of minimum width of 50 cm
21 941	m^3	Excavation of arch and bench in cross-tunnels

21 951	m^3	Excavation for invert in cross-tunnels
21 952	m^3	Excavation for niches
21 953	m^3	Excavation for re-profiling the tunnel due to unexpectedly substantial deformations, including shot cement concrete and all steel elements reaching the clear profile area of the primary substructure, with loading and transportation of all the material to a permanent depositing area
21 961	m^3	Additional payment for excavation in the arch due to impediment caused by water inflow of 10 l/s to 20 l/s
21 962	m^3	Additional payment for excavation in the arch due to impediment caused by water inflow of 20 l/s to 50 l/s
21 963	m^3	Additional payment for excavation in the arch due to impediment caused by water inflow greater than 50 l/s
21 971	m^3	Additional payment for excavation in the bench due to impediment caused by water inflow of 10 l/s to 20 l/s
21 972	m^3	Additional payment for excavation in the bench due to impediment caused by water inflow of 20 l/s to 50 l/s
21 973	m^3	Additional payment for excavation in the bench due to impediment caused by water inflow greater than 50 l/s
21 981	m^3	Additional payment for excavation in the invert due to impediment caused by water inflow of 10 l/s to 20 l/s
21 982	m^3	Additional payment for excavation in the invert due to impediment caused by water inflow of 20 l/s to 50 l/s
21 983	m^3	Additional payment for excavation in the invert due to impediment caused by water inflow greater than 50 l/s
21 991	m^3	Provisional pumping of water at excavation downwards in all the categories, with a pump of capacity of 5 to 10 l/s
21 992	m^3	Provisional pumping of water at excavation downwards in all the categories, with a pump of capacity of 10 to 15 l/s

2.2.2.10.2 *Subgrade formation*

Item	Unit	Description of work
22 111	m^2	Arrangement of subgrade formation of low bearing capacity soil
22 112	m^2	Arrangement of subgrade formation of cohesive soil
22 113	m^2	Arrangement of subgrade formation of granular rock
22 114	m^2	Arrangement of subgrade formation of soft rock
21 115	m^2	Arrangement of subgrade formation of hard rock
22 211	m^2	Improvement of subgrade of low bearing capacity soil in thickness up to 20 cm with lime admixture of 3% by mass
22 212	m^2	Improvement of subgrade of low bearing capacity soil in thickness up to 20 cm with lime admixture of 4% by mass
22 213	m^2	Improvement of subgrade of low bearing capacity soil in thickness up to 20 cm with lime admixture of 5% by mass
22 214	m^2	Improvement of subgrade of low bearing capacity soil in thickness up to 20 cm with lime admixture of 6% by mass
22 215	m^2	Improvement of subgrade of low bearing capacity soil in thickness up to 20 cm with lime admixture of 7% by mass
22 216	m^2	Improvement of subgrade of low bearing capacity soil in thickness up to 20 cm with lime admixture of ...% by mass
22 221	m^2	Improvement of subgrade of low bearing capacity soil in thickness 21 - 30 cm with lime admixture of 3% by mass
22 222	m^2	Improvement of subgrade of low bearing capacity soil in thickness 21 - 30 cm with lime admixture of 4% by mass
22 223	m^2	Improvement of subgrade of low bearing capacity soil in thickness 21 - 30 cm with lime admixture of 5% by mass
22 224	m^2	Improvement of subgrade of low bearing capacity soil in thickness 21 - 30 cm with lime admixture of 6% by mass
22 225	m^2	Improvement of subgrade of low bearing capacity soil in thickness 21 - 30 cm with lime admixture of 7% by mass
22 226	m^2	Improvement of subgrade of low bearing capacity soil in thickness 21 - 30 cm with lime admixture of ...% by mass
22 231	m^2	Improvement of subgrade of cohesive soil in thickness up to 20 cm with lime admixture of 3% by mass
22 232	m^2	Improvement of subgrade of cohesive soil in thickness up to 20 cm with lime admixture of 4% by mass
22 233	m^2	Improvement of subgrade of cohesive soil in thickness up to 20 cm with lime admixture of 4% by mass
22 234	m^2	Improvement of subgrade of cohesive soil in thickness up to 20 cm with lime admixture of 4% by mass
22 235	m^2	Improvement of subgrade of cohesive soil in thickness up to 20 cm with lime admixture of 4% by mass
22 241	m^2	Improvement of subgrade of cohesive soil in thickness 21 - 30 cm with lime admixture of 3% by mass
22 242	m^2	Improvement of subgrade of cohesive soil in thickness 21 - 30 cm with lime admixture of 4% by mass
22 243	m^2	Improvement of subgrade of cohesive soil in thickness 21 - 30 cm with lime admixture of 5% by mass
22 244	m^2	Improvement of subgrade of cohesive soil in thickness 21 - 30 cm with lime

Item	Unit	Description of work
		admixture of 6% by mass
22 245	m^2	Improvement of subgrade of cohesive soil in thickness 21 - 30 cm with lime admixture of 7% by mass
22 251	m^2	Improvement of subgrade of cohesive soil in thickness 31 - 40 cm with lime admixture of 3% by mass
22 252	m^2	Improvement of subgrade of cohesive soil in thickness 31 - 40 cm with lime admixture of 4% by mass
22 253	m^2	Improvement of subgrade of cohesive soil in thickness 31 - 40 cm with lime admixture of 5% by mass
22 254	m^2	Improvement of subgrade of cohesive soil in thickness 31 - 40 cm with lime admixture of 6% by mass
22 255	m^2	Improvement of subgrade of cohesive soil in thickness 31 - 40 cm with lime admixture of 7% by mass
22 261	m^2	Improvement of subgrade of low bearing capacity soil by adding FA 6% by mass
22 262	m^2	Improvement of subgrade of low bearing capacity soil by adding FA 8% by mass
22 263	m^2	Improvement of subgrade of low bearing capacity soil by adding FA 10% by mass
22 264	m^2	Improvement of subgrade of low bearing capacity soil by adding FA 12% by mass
22 265	m^2	Improvement of subgrade of low bearing capacity soil by adding FA 14% by mass
22 266	m^2	Improvement of subgrade of low bearing capacity soil by adding FA 16% by mass
22 271	m^2	Improvement of subgrade of cohesive soil by adding FA 6% by mass
22 272	m^2	Improvement of subgrade of cohesive soil by adding FA 8% by mass
22 273	m^2	Improvement of subgrade of cohesive soil by adding FA 10% by mass
22 274	m^2	Improvement of subgrade of cohesive soil by adding FA 12% by mass
22 275	m^2	Improvement of subgrade of cohesive soil by adding FA .... by mass
22 281	m^2	Improvement of subgrade of granular rock in thickness up to 20 cm by adding FA 3% by mass
22 282	m^2	Improvement of subgrade of granular rock in thickness up to 20 cm by adding FA 4% by mass
22 283	m^2	Improvement of subgrade of granular rock in thickness up to 20 cm by adding FA 5% by mass
22 284	m^2	Improvement of subgrade of granular rock in thickness up to 20 cm by adding FA ....% by mass
22 291	m^2	Improvement of subgrade of granular rock in thickness 21 - 30 cm by adding FA 3% by mass
22 292	m^2	Improvement of subgrade of granular rock in thickness 21 - 30 cm by adding FA 4% by mass
22 293	m^2	Improvement of subgrade of granular rock in thickness 21 - 30 cm by adding FA 5% by mass
22 294	m^2	Improvement of subgrade of granular rock in thickness 21 - 30 cm by adding FA ....% by mass

Item	Unit	Description of work
22 311	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness up to 20 cm by adding lime 5% by mass
22 312	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness up to 20 cm by adding lime 6% by mass
22 313	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness up to 20 cm by adding lime 7% by mass
22 314	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness up to 20 cm by adding lime .... % by mass
22 321	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness 21 - 30 cm by adding lime 5% by mass
22 322	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness 21 - 30 cm by adding lime 6% by mass
22 323	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness 21 - 30 cm by adding lime 7% by mass
22 324	m^2	Consolidation or stabilization of subgrade of low bearing capacity soil in thickness 21 - 30 cm by adding lime .... % by mass
22 331	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness up to 20 cm by adding lime 5% by mass
22 332	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness up to 20 cm by adding lime 6% by mass
22 333	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness up to 20 cm by adding lime 7% by mass
22 334	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness up to 20 cm by adding lime .... % by mass
22 341	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness 21 - 30 cm by adding lime 5% by mass
22 342	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness 21 - 30 cm by adding lime 6% by mass
22 343	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness 21 - 30 cm by adding lime 7% by mass
22 344	m^2	Consolidation or stabilization of subgrade of cohesive soil in thickness 21 - 30cm by adding lime .... % by mass
22 351	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding lime 4% by mass
22 352	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding lime 5% by mass
22 353	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding lime 6% by mass
22 354	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding lime .... % by mass
22 361	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding lime 4% by mass
22 362	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding lime 5% by mass
22 363	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding lime 6% by mass
22 364	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding lime .... % by mass

Item	Unit	Description of work
22 371	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding cement 3% by mass
22 372	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding cement 4% by mass
22 373	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding cement 5% by mass
22 374	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding cement 6% by mass
22 375	m^2	Consolidation or stabilization of subgrade of granular rock in thickness up to 20 cm by adding cement ... % by mass
22 381	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding cement 3% by mass
22 382	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding cement 4% by mass
22 383	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding cement 5% by mass
22 384	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding cement 6% by mass
22 385	m^2	Consolidation or stabilization of subgrade of granular rock in thickness 21 - 30 cm by adding cement ... % by mass

2.2.2.10.3 Separating, drainage, and filer layers; working field

Šifra	Enota mere	Opis dela
23 111	m^2	Placing drainage layer of stone material in thickness up to 20 cm
23 112	m^2	Placing drainage layer of stone material in thickness 21 – 30 cm
23 113	m^2	Placing drainage layer of stone material in thickness 31 – 40 cm
23 114	m^2	Placing drainage layer of stone material in thickness 41 – 50 cm
23 115	m^2	Placing drainage layer of stone material in thickness above 50 cm
23 211	m^2	Placing filter layer of stone material in thickness up to 20 cm
23 212	m^2	Placing filter layer of stone material in thickness 21 – 30 cm
23 213	m^2	Placing filter layer of stone material in thickness 31 – 40 cm
23 214	m^2	Placing filter layer of stone material in thickness 41 – 50 cm
23 215	m^2	Placing filter layer of stone material in thickness above 50 cm
23 311	m^2	Laying geotextiles for separating layer – mass up to 50 g/m^2
23 312	m^2	Laying geotextiles for separating layer – mass 51 - 100 g/m^2
23 313	m^2	Laying geotextiles for separating layer – mass 101 - 150 g/m^2
23 314	m^2	Laying geotextiles for separating layer – mass 151 - 200 g/m^2
23 315	m^2	Laying geotextiles for separating layer – mass 201 - 250 g/m^2
23 316	m^2	Laying geotextiles for separating layer – mass 251 - 300 g/m^2
23 317	m^2	Laying geotextiles for separating layer – mass 351 - 400 g/m^2
23 318	m^2	Laying geotextiles for separating layer – mass 451 - 500 g/m^2
23 319	m^2	Laying geotextiles for separating layer – mass above 500 g/m^2
23 321	m^2	Laying geotextiles for filter layer – mass up to 50 g/m^2
23 322	m^2	Laying geotextiles for filter layer – mass 51 - 100 g/m^2
23 323	m^2	Laying geotextiles for filter layer – mass 101 - 150 g/m^2
23 324	m^2	Laying geotextiles for filter layer – mass 151 - 200 g/m^2
23 325	m^2	Laying geotextiles for filter layer – mass 201 - 250 g/m^2
23 326	m^2	Laying geotextiles for filter layer – mass 251 - 300 g/m^2
23 327	m^2	Laying geotextiles for filter layer – mass 351 - 400 g/m^2
23 328	m^2	Laying geotextiles for filter layer – mass 451 - 500 g/m^2
23 329	m^2	Laying geotextiles for filter layer – mass above 500 g/m^2
23 331	m^2	Laying geotextiles for drainage layer – mass up to 50 g/m^2
23 332	m^2	Laying geotextiles for drainage layer – mass 51 - 100 g/m^2
23 333	m^2	Laying geotextiles for drainage layer – mass 101 - 150 g/m^2
23 334	m^2	Laying geotextiles for drainage layer – mass 151 - 200 g/m^2
23 335	m^2	Laying geotextiles for drainage layer – mass 201 - 250 g/m^2
23 336	m^2	Laying geotextiles for drainage layer – mass 251 - 300 g/m^2
23 337	m^2	Laying geotextiles for drainage layer – mass 351 - 400 g/m^2
23 338	m^2	Laying geotextiles for drainage layer – mass 451 - 500 g/m^2
23 339	m^2	Laying geotextiles for separating layer – mass above 500 g/m^2
23 341	m^2	Placing geo-membrane
23 351	m^2	Placing rough foil
23 361	m^2	Placing geo-mesh

Šifra	Enota mere	Opis dela
23 411	m^2	Construction of working field of quarry rock waste in thickness up to 30 cm
23 412	m^2	Construction of working field of quarry rock waste in thickness 31 - 40 cm
23 413	m^2	Construction of working field of quarry rock waste in thickness 41 - 50 cm
23 414	m^2	Construction of working field of quarry rock waste in thickness 51 - 60 cm
23 415	m^3	Construction of working field of quarry rock waste in thickness above 60 cm
23 421	m^2	Construction of working field of gravel material in thickness up to 30 cm
23 422	m^2	Construction of working field of gravel material in thickness 31 - 40 cm
23 423	m^2	Construction of working field of gravel material in thickness 41 - 50 cm
23 424	m^2	Construction of working field of gravel material in thickness 51 - 60 cm
23 425	m^3	Construction of working field of gravel material in thickness above 60 cm
23 431	m^2	Construction of working field of crushed stone material in thickness up to 30 cm
23 432	m^2	Construction of working field of crushed stone material in thickness 31 - 40 cm
23 433	m^2	Construction of working field of crushed stone material in thickness 41 - 50 cm
23 434	m^2	Construction of working field of crushed stone material in thickness 51 - 60 cm
23 435	m^3	Construction of working field of crushed stone material in thickness above 60 cm
23 441	m^2	Construction of working field of secondary materials in thickness up to 30 cm
23 442	m^2	Construction of working field of secondary materials in thickness 31 - 40 cm
23 443	m^2	Construction of working field of secondary materials in thickness 41 - 50 cm
23 444	m^2	Construction of working field of secondary materials in thickness 51 60 cm
23 445	m^3	Construction of working field of secondary materials in thickness above 60 cm
23 511	m^3	Construction of artificial island for execution of pile or well foundations for a bridge, and its removal after completion of works

2.2.2.10.4 Fills, backfills, wedges, substructure, and puddle layer

Item	Unit	Descripiton of work
24 111	m^3	Execution of fill of cohesive soil
24 112	m^3	Execution of fill of granular rock
24 113	m^3	Execution of fill of soft rock
24 114	m^3	Execution of fill of hard rock
24 115	m^3	Execution of fill of secondary materials
24 116	m^3	Execution of fill of ……………………….
24 121	m^3	Execution of fill of fly ash (FA)
24 122	m^3	Execution of fill of FA sandwich 20 + 10 cm
24 123	m^3	Execution of fill of FA sandwich 30 + 10 cm
24 124	m^3	Execution of fill of FA sandwich 40 + 10 cm
24 125	m^3	Execution of fill of FA sandwich ... + ... cm
24 131	m^3	Execution of fill of improved cohesive soil with lime admixture of 3 % by mass in thickness up to 20 cm
24 132	m^3	Execution of fill of improved cohesive soil with lime admixture of 3 % by mass in thickness above 20 cm
24 133	m^3	Execution of fill of improved cohesive soil with lime admixture of 4 % by mass in thickness up to 20 cm
24 134	m^3	Execution of fill of improved cohesive soil with lime admixture of 4 % by mass in thickness above 20 cm
24 135	m^3	Execution of fill of improved cohesive soil with lime admixture of 5 % by mass in thickness up to 20 cm
24 136	m^3	Execution of fill of improved cohesive soil with lime admixture of 5 % by mass in thickness above 20 cm
24 137	m^3	Execution of fill of improved cohesive soil with lime admixture of more than 5 % by mass in thickness up to 20 cm
24 138	m^3	Execution of fill of improved cohesive soil with lime admixture of more than 5 % by mass in thickness above 20 cm
24 141	m^3	Execution of fill of improved cohesive soil with FA admixture of 6 % by mass in thickness up to 20 cm
24 142	m^3	Execution of fill of improved cohesive soil with FA admixture of 6 % by mass in thickness above 20 cm
24 143	m^3	Execution of fill of improved cohesive soil with FA admixture of 8 % by mass in thickness up to 20 cm
24 144	m^3	Execution of fill of improved cohesive soil with FA admixture of 8 % by mass in thickness above 20 cm
24 145	m^3	Execution of fill of improved cohesive soil with FA admixture of 10 % by mass in thickness up to 20 cm
24 146	m^3	Execution of fill of improved cohesive soil with FA admixture of 10 % by mass in thickness above 20 cm
24 147	m^3	Execution of fill of improved cohesive soil with FA admixture of more than 10 % by mass in thickness up to 20 cm
24 148	m^3	Execution of fill of improved cohesive soil with FA admixture of more than 10 % by mass in thickness above 20 cm
24 151	m^3	Execution of fill of improved granular rock with lime admixture of 3 % by mass in thickness up to 20 cm

Item	Unit	Descripiton of work
24 152	m^3	Execution of fill of improved granular rock with lime admixture of 3 % by mass in thickness above 20 cm
24 153	m^3	Execution of fill of improved granular rock with lime admixture of 4 % by mass in thickness up to 20 cm
24 154	m^3	Execution of fill of improved granular rock with lime admixture of 4 % by mass in thickness above 20 cm
24 155	m^3	Execution of fill of improved granular rock with lime admixture of 5 % by mass in thickness up to 20 cm
24 156	m^3	Execution of fill of improved granular rock with lime admixture of 5 % by mass in thickness above 20 cm
24 157	m^3	Execution of fill of improved granular rock with lime admixture of more than 5 % by mass in thickness up to 20 cm
24 158	m^3	Execution of fill of improved granular rock with lime admixture of more than 5 % by mass in thickness above 20 cm
24 161	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of 5 % by mass in thickness up to 20 cm
24 162	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of 5 % by mass in thickness above 20 cm
24 163	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of 6 % by mass in thickness up to 20 cm
24 164	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of 6 % by mass in thickness above 20 cm
24 165	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of 7 % by mass in thickness up to 20 cm
24 166	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of 7 % by mass in thickness above 20 cm
24 167	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of more than 7 % by mass in thickness up to 20 cm
24 168	m^3	Execution of fill of consolidated/stabilized cohesive soil with lime admixture of more than 7 % by mass in thickness above 20 cm
24 171	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of 5 % by mass in thickness up to 20 cm
24 172	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of 5 % by mass in thickness above 20 cm
24 173	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of 6 % by mass in thickness up to 20 cm
24 174	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of 6 % by mass in thickness above 20 cm
24 175	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of 7 % by mass in thickness up to 20 cm
24 176	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of 7 % by mass in thickness above 20 cm
24 177	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of more than 7 % by mass in thickness up to 20 cm
24 178	m^3	Execution of fill of consolidated/stabilized granular rock with lime admixture of more than 7 % by mass in thickness above 20 cm
24 181	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of 3 % by mass in thickness up to 20 cm
24 182	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of 3 % by mass in thickness above 20 cm

Item	Unit	Descripiton of work
24 183	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of 4 % by mass in thickness up to 20 cm
24 184	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of 4 % by mass in thickness above 20 cm
24 185	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of 5 % by mass in thickness up to 20 cm
24 186	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of 5 % by mass in thickness above 20 cm
24 187	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of more than 5 % by mass in thickness up to 20 cm
24 188	m^3	Execution of fill of consolidated/stabilized granular rock with cement admixture of more than 5 % by mass in thickness above 20 cm
24 191	m^3	Placing of crushed stone blinding below bridge foundation in thickness up to 30 cm
24 192	m^3	Placing of crushed stone blinding below bridge foundation in thickness above 30 cm
24 193	m^3	Placing of gravel blinding below bridge foundation in thickness up to 30 cm
24 194	m^3	Placing of gravel blinding below bridge foundation in thickness up to 30 cm
24 196	m^3	Consolidation of fill toe with quarry stone – pieces $> 0.1\ m^3$
24 211	m^3	Backfill with cohesive soil – manually
24 212	m^3	Backfill with cohesive soil – with machines
24 213	m^3	Backfill with granular rock – manually
24 214	m^3	Backfill with granular rock – with machines
24 215	m^3	Backfill with soft rock
24 216	m^3	Backfill with hard rock
24 221	m^3	Backfill with fly ash (FA) – manually
24 222	m^3	Backfill with fly ash (FA) – with machines
24 225	m^3	Backfill with secondary material – manually
24 226	m^3	Backfill with secondary material – with machines
24 229	m^3	Backfill of cables and pipes with sand
24 231	m^3	Backfill with improved cohesive soil with lime admixture of 3 % by mass
24 232	m^3	Backfill with improved cohesive soil with lime admixture of 4 % by mass
24 233	m^3	Backfill with improved cohesive soil with lime admixture of 5 % by mass
24 234	m^3	Backfill with improved cohesive soil with lime admixture of more than 5 % by mass
24 241	m^3	Backfill with improved granular rock with lime admixture of 3 % by mass
24 242	m^3	Backfill with improved granular rock with lime admixture of 4 % by mass
24 243	m^3	Backfill with improved granular rock with lime admixture of 5 % by mass
24 244	m^3	Backfill with improved granular rock with lime admixture of more than 5 % by mass
24 251	m^3	Backfill with consolidated/stabilized cohesive soil with lime admixture of 5 %

Item	Unit	Descripiton of work
		by mass
24 252	m^3	Backfill with consolidated/stabilized cohesive soil with lime admixture of 6 % by mass
24 253	m^3	Backfill with consolidated/stabilized cohesive soil with lime admixture of 7 % by mass
24 254	m^3	Backfill with consolidated/stabilized cohesive soil with lime admixture of more than 7 % by mass
24 261	m^3	Backfill with consolidated/stabilized granular rock with lime admixture of 5 % by mass
24 262	m^3	Backfill with consolidated/stabilized granular rock with lime admixture of 6 % by mass
24 263	m^3	Backfill with consolidated/stabilized granular rock with lime admixture of 7 % by mass
24 264	m^3	Backfill with consolidated/stabilized granular rock with lime admixture of more than 7 % by mass
24 271	m^3	Backfill with consolidated/stabilized granular rock with cement admixture of 3 % by mass
24 272	m^3	Backfill with consolidated/stabilized granular rock with cement admixture of 4 % by mass
24 273	m^3	Backfill with consolidated/stabilized granular rock with cement admixture of 5 % by mass
24 274	m^3	Backfill with consolidated/stabilized granular rock with cement admixture of more than 5 % by mass
24 311	m^3	Execution of wedge of cohesive soil
24 312	m^3	Execution of wedge of granular rock
24 313	m^3	Execution of wedge of soft rock
24 314	m^3	Execution of wedge of hard rock
24 321	m^3	Execution of wedge of fly ash (FA)
24 325	m^3	Execution of wedge of secondary material
24 331	m^3	Execution of wedge with improved cohesive soil with lime admixture of 3 % by mass
24 332	m^3	Execution of wedge with improved cohesive soil with lime admixture of 4 % by mass
24 333	m^3	Execution of wedge with improved cohesive soil with lime admixture of 5 % by mass
24 334	m^3	Execution of wedge with improved cohesive soil with lime admixture of more than 5 % by mass
24 341	m^3	Execution of wedge with improved granular rock with lime admixture of 3 % by mass
24 342	m^3	Execution of wedge with improved granular rock with lime admixture of 4 % by mass
24 343	m^3	Execution of wedge with improved granular rock with lime admixture of 5 % by mass
24 344	m^3	Execution of wedge with improved granular rock with lime admixture of more than 5 % by mass
24 351	m^3	Execution of wedge with consolidated/stabilized cohesive soil with lime

Item	Unit	Descripiton of work
		admixture of 5 % by mass
24 352	m^3	Execution of wedge with consolidated/stabilized cohesive soil with lime admixture of 6 % by mass
24 353	m^3	Execution of wedge with consolidated/stabilized cohesive soil with lime admixture of 7 % by mass
24 354	m^3	Execution of wedge with consolidated/stabilized cohesive soil with lime admixture of more than 7 % by mass
24 361	m^3	Execution of wedge with consolidated/stabilized granular rock with lime admixture of 5 % by mass
24 362	m^3	Execution of wedge with consolidated/stabilized granular rock with lime admixture of 6 % by mass
24 363	m^3	Execution of wedge with consolidated/stabilized granular rock with lime admixture of 7 % by mass
24 364	m^3	Execution of wedge with consolidated/stabilized granular rock with lime admixture of more than 7 % by mass
24 371	m^3	Execution of wedge with consolidated/stabilized granular rock with cement admixture of 3 % by mass
24 372	m^3	Execution of wedge with consolidated/stabilized granular rock with cement admixture of 4 % by mass
24 373	m^3	Execution of wedge with consolidated/stabilized granular rock with cement admixture of 5 % by mass
24 374	m^3	Execution of wedge with consolidated/stabilized granular rock with cement admixture of more than 5 % by mass
24 411	m^2	Execution of substructure in thickness up to 30 cm of cohesive soil
24 413	m^2	Execution of substructure in thickness up to 30 cm of improved cohesive soil with lime admixture of 3 % by mass
24 414	m^2	Execution of substructure in thickness up to 30 cm of improved cohesive soil with lime admixture of 4 % by mass
24 415	m^2	Execution of substructure in thickness up to 30 cm of improved cohesive soil with lime admixture of 5 % by mass
24 417	m^2	Execution of substructure in thickness up to 30 cm of consolidated/stabilized cohesive soil with lime admixture of 4 % by mass
24 418	m^2	Execution of substructure in thickness up to 30 cm of consolidated/stabilized cohesive soil with lime admixture of 5 % by mass
24 419	m^2	Execution of substructure in thickness up to 30 cm of consolidated/stabilized cohesive soil with lime admixture of 6 % by mass
24 421	m^2	Execution of substructure in thickness up to 30 cm of granular rock
24 423	m^2	Execution of substructure in thickness up to 30 cm of improved granular rock with lime admixture of 4 % by mass
24 424	m^2	Execution of substructure in thickness up to 30 cm of improved granular rock with lime admixture of 5 % by mass
24 425	m^2	Execution of substructure in thickness up to 30 cm of improved granular rock with lime admixture of 6 % by mass
24 427	m^2	Execution of substructure in thickness up to 30 cm of consolidated/stabilized granular rock with cement admixture of 3 % by mass

Item	Unit	Descripiton of work
24 428	m^2	Execution of substructure in thickness up to 30 cm of consolidated/stabilized granular rock with cement admixture of 4 % by mass
24 429	m^2	Execution of substructure in thickness up to 30 cm of consolidated/stabilized granular rock with cement admixture of 5 % by mass
24 431	m^2	Execution of substructure in thickness of 31 - 40 cm of cohesive soil
24 433	m^2	Execution of substructure in thickness of 31 - 40 cm of improved cohesive soil with lime admixture of 3 % by mass
24 434	m^2	Execution of substructure in thickness of 31 - 40 cm of improved cohesive soil with lime admixture of 4 % by mass
24 435	m^2	Execution of substructure in thickness of 31 - 40 cm of improved cohesive soil with lime admixture of 5 % by mass
24 437	m^2	Execution of substructure in thickness of 31 - 40 cm of consolidated/stabilized cohesive soil with lime admixture of 4 % by mass
24 438	m^2	Execution of substructure in thickness of 31 - 40 cm of consolidated/stabilized cohesive soil with lime admixture of 5 % by mass
24 439	m^2	Execution of substructure in thickness of 31 - 40 cm of consolidated/stabilized cohesive soil with lime admixture of 6 % by mass
24 441	m^2	Execution of substructure in thickness of 31 - 40 cm of granular rock
24 443	m^2	Execution of substructure in thickness of 31 - 40 cm of improved granular rock with lime admixture of 4 % by mass
24 444	m^2	Execution of substructure in thickness of 31 - 40 cm of improved granular rock with lime admixture of 5 % by mass
24 445	m^2	Execution of substructure in thickness of 31 - 40 cm of improved granular rock with lime admixture of 6 % by mass
24 447	m^2	Execution of substructure in thickness of 31 - 40 cm of consolidated/stabilized granular rock with cement admixture of 3 % by mass
24 448	m^2	Execution of substructure in thickness of 31 - 40 cm of consolidated/stabilized granular rock with cement admixture of 4 % by mass
24 449	m^2	Execution of substructure in thickness of 31 - 40 cm of consolidated/stabilized granular rock with cement admixture of 5 % by mass
24 451	m^2	Execution of substructure in thickness of 41 - 50 cm of cohesive soil
24 453	m^2	Execution of substructure in thickness of 41 - 50 cm of improved cohesive soil with lime admixture of 3 % by mass
24 454	m^2	Execution of substructure in thickness of 41 - 50 cm of improved cohesive soil with lime admixture of 4 % by mass
24 455	m^2	Execution of substructure in thickness of 41 - 50 cm of improved cohesive soil with lime admixture of 5 % by mass
24 457	m^2	Execution of substructure in thickness of 41 - 50 cm of consolidated/stabilized cohesive soil with lime admixture of 4 % by mass
24 458	m^2	Execution of substructure in thickness of 41 - 50 cm of consolidated/stabilized cohesive soil with lime admixture of 5 % by mass
24 459	m^2	Execution of substructure in thickness of 41 - 50 cm of consolidated/stabilized cohesive soil with lime admixture of 6 % by mass

Item	Unit	Descripiton of work
24 461	m^2	Execution of substructure in thickness of 41 - 50 cm of granular rock
24 463	m^2	Execution of substructure in thickness of 41 - 50 cm of improved granular rock with lime admixture of 4 % by mass
24 464	m^2	Execution of substructure in thickness of 41 - 50 cm of improved granular rock with lime admixture of 5 % by mass
24 465	m^2	Execution of substructure in thickness of 41 - 50 cm of improved granular rock with lime admixture of 6 % by mass
24 467	m^2	Execution of substructure in thickness of 41 - 50 cm of consolidated/stabilized granular rock with cement admixture of 3 % by mass
24 468	m^2	Execution of substructure in thickness of 41 - 50 cm of consolidated/stabilized granular rock with cement admixture of 4 % by mass
24 469	m^2	Execution of substructure in thickness of 41 - 50 cm of consolidated/stabilized granular rock with cement admixture of 5 % by mass
24 471	m^2	Execution of substructure of crushed mineral aggregate in thickness up to 15 cm
24 472	m^2	Execution of substructure of crushed mineral aggregate in thickness of 16 - 20 cm
24 473	m^2	Execution of substructure of crushed mineral aggregate in thickness of 21 - 25 cm
24 474	m^2	Execution of substructure of crushed mineral aggregate in thickness of 26 - 30 cm
24 475	m^2	Execution of substructure of crushed mineral aggregate in thickness of 31 - 40 cm
24 476	m^2	Execution of substructure of crushed mineral aggregate in thickness of 41 - 50 cm
24 477	m^2	Execution of substructure of crushed mineral aggregate in thickness of .... cm
24 481	m^2	Execution of substructure of mixed mineral aggregate in thickness up to 15 cm
24 482	m^2	Execution of substructure of mixed mineral aggregate in thickness of 16 - 20 cm
24 483	m^2	Execution of substructure of mixed mineral aggregate in thickness of 21 - 25 cm
24 484	m^2	Execution of substructure of mixed mineral aggregate in thickness of 26 - 30 cm
24 485	m^2	Execution of substructure of mixed mineral aggregate in thickness of 31 - 40 cm
24 486	m^2	Execution of substructure of mixed mineral aggregate in thickness of 41 - 50 cm
24 487	m^2	Execution of substructure of mixed mineral aggregate in thickness of .... cm
24 491	m^2	Execution of substructure of secondary materials in thickness up to 30 cm
24 492	m^2	Execution of substructure of secondary materials in thickness of 31 - 40 cm
24 493	m^2	Execution of substructure of secondary materials in thickness of 41 - 50 cm
24 494	m^2	Execution of substructure of secondary materials in thickness above 50 cm

Item	Unit	Descripiton of work
24 511	m^2	Execution of puddle layer in thickness up to 15 cm
24 512	m^2	Execution of puddle layer in thickness of 16 - 30 cm
24 513	m^2	Execution of puddle layer in thickness of 31 - 50 cm
24 514	m^2	Execution of puddle layer in thickness above 50 cm
24 611	m^2	Execution of formation of fill, backfill, wedge, or substructure of cohesive soil
24 612	m^2	Execution of formation of fill, backfill, wedge, or substructure of granular rock
24 621	m^2	Execution of formation of improved cohesive soil
24 622	m^2	Execution of formation of improved granular rock
24 631	m^2	Execution of formation of consolidated/stabilized cohesive soil
24 632	m^2	Execution of formation of consolidated/stabilized granular rock
24 641	m^2	Execution of formation of puddle layer

2.2.2.10.5 Slopes and green surfaces

Item	Unit	Description of work
25 111	m^2	Application of topsoil to slope without rolling in thickness up to 15 cm – manually
25 112	m^2	Application of topsoil to slope without rolling in thickness up to 15 cm – with machines
25 116	m^2	Application of topsoil to slope without rolling in thickness above 15 cm – manually
25 117	m^2	Application of topsoil to slope without rolling in thickness above 15 cm – with machines
25 121	m^2	Application of topsoil to slope with rolling in thickness up to 15 cm – manually
25 122	m^2	Application of topsoil to slope with rolling in thickness up to 15 cm – with machines
25 126	m^2	Application of topsoil to slope with rolling in thickness above 15 cm – manually
25 127	m^2	Application of topsoil to slope with rolling in thickness above 15 cm – with machines
25 131	m^2	Application of topsoil to green surface without rolling in thickness up to 15 cm – manually
25 132	m^2	Application of topsoil to green surface without rolling in thickness up to 15 cm – with machines
25 136	m^2	Application of topsoil to green surface without rolling in thickness above 15 cm – manually
25 137	m^2	Application of topsoil to green surface without rolling in thickness above 15 cm – with machines
25 141	m^2	Application of topsoil to green surface with rolling in thickness up to 15 cm – manually
25 142	m^2	Application of topsoil to green surface with rolling in thickness up to 15 cm – with machines
25 146	m^2	Application of topsoil to green surface with rolling in thickness above 15 cm – manually
25 147	m^2	Application of topsoil to green surface with rolling in thickness above 15 cm – with machines
25 151	m^2	Allowance for grassing
25 161	m^2	Bio shot cement concrete with mulching on slopes
25 166	m^2	Bio shot cement concrete with mulching on green surfaces
25 171	m^2	Wattle works on slope – willows with props
25 176	m^2	Wattle work on slope – willow – 30 cm in height
25 177	m^2	Wattle work on slope – willow – 60 cm in height

Item	Unit	Description of work
25 178	m^2	Wattle work on slope – willow – above 60 cm in height
25 181	pc	Planting different tree and shrub species on slope
25 186	pc	Planting different tree and shrub species on green surface
25 211	m^2	Protection of slope with mesh – galvanized steel wire of 1.6 mm in diameter
25 212	m^2	Protection of slope with mesh – galvanized steel wire of 3.1 mm in diameter
25 214	m^2	Protection of slope with mesh – Palvis 5 x 5 cm
25 215	m^2	Protection of slope with mesh – Palvis 10 x 10 cm
25 216	m^2	Protection of slope with mesh – Netlon
25 218	m^2	Protection of slope with geo-mesh
25 221	m^2	Protection of slope with stone pitching in thickness up to 30 cm
25 222	m^2	Protection of slope with stone pitching in thickness above 30 cm
25 231	m^2	Protection of slope with shot cement concrete
25 232	m^2	Protection of slope with shot cement concrete and mesh
25 241	m^3	Protection of slope with prefabricated cement concrete cribwork filled up with crushed stone
25 242	m^3	Protection of slope with prefabricated cement concrete cribwork filled up with quarry stone
25 243	m^3	Protection of slope with prefabricated cement concrete cribwork filled up with balls
25 251	m^2	Protection of slope with prefabricated cement concrete elements of type .... filled up with topsoil
25 252	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with sand
25 253	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with gravel
25 254	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with crushed stone
25 255	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with other materials
25 261	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with topsoil
25 262	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with sand
25 263	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with gravel
25 264	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with crushed stone
25 265	m^2	Proteciton of slope with prefabricated cement concrete elements of type .... filled up with ....
25 271	m^2	Protection of slope with cement concrete slabs placed to sand

Item	Unit	Description of work
25 272	m^2	Protection of slope with turf pavers placed to sand
25 273	m^2	Protection of slope with cement concrete pavers placed to sand
25 274	m^2	Protection of slope with quarry stone placed to sand
25 275	m^2	Protection of slope with .... placed to …………….
25 281	m^3	Protection of slope with packed rockfill
25 291	m^3	Execution of cement concrete toe to support slope protection
25 296	m^3	Execution of cement concrete sill to confine slope protection

2.2.2.10.6 Reinforced soils

Item	Unit	Description of work
26 111	pc	Reinforcing of soil with cement concrete elements, type A (incl. dowels and anchors)
26 112	pc	Reinforcing of soil with cement concrete elements, type B (incl. dowels and anchors)
26 113	pc	Reinforcing of soil with cement concrete elements, type C (incl. dowels and anchors)
26 114	pc	Reinforcing of soil with cement concrete elements, type D (incl. dowels and anchors)
26 115	pc	Reinforcing of soil with cement concrete elements, type E (incl. dowels and anchors)
26 116	pc	Reinforcing of soil with elements of type .... (incl. all additional materials)
26 121	m^1	Strip of polyester laminate for reinforcing of soils
26 122	m^1	Strip of galvanized steel for reinforcing of soils
26 123	m^1	Strip for differently protected steel for reinforcing of soils
26 124	m^1	Strip for reinforcing of soils - ....
26 131	m^3	Allowance for placing reinforced soil into fills in reinforcing strip areas
26 132	m^3	Allowance for placing granular rock into fills in reinforcing strip areas
26 133	m^3	Allowance for placing fly ash into fills in reinforcing strip areas
26 211	m^3	Reinforcing of soil with geotextiles of mass of 300 g in fill layers of 20 cm thickness
26 212	m^3	Reinforcing of soil with geotextiles of mass of 300 g in fill layers of 30 cm thickness
26 213	m^3	Reinforcing of soil with geotextiles of mass of 300 g in fill layers of 40 cm thickness
26 221	m^3	Reinforcing of soil with geotextiles of mass of 400 g in fill layers of 20 cm thickness
26 222	m^3	Reinforcing of soil with geotextiles of mass of 400 g in fill layers of 30 cm thickness
26 223	m^3	Reinforcing of soil with geotextiles of mass of 400 g in fill layers of 40 cm thickness
26 231	m^3	Reinforcing of soil with geotextiles of mass of 500 g in fill layers of 20 cm thickness
26 232	m^3	Reinforcing of soil with geotextiles of mass of 500 g in fill layers of 30 cm thickness
26 233	m^3	Reinforcing of soil with geotextiles of mass of 500 g in fill layers of 40 cm thickness
26 241	m^3	Reinforcing of soil with steel mesh in fill layers of 20 cm thickness
26 242	m^3	Reinforcing of soil with steel mesh in fill layers of 30 cm thickness
26 243	m^3	Reinforcing of soil with steel mesh in fill layers of 40 cm thickness
26 243	m^3	Reinforcing of soil with steel mesh in fill layers of 50 cm thickness
26 251	m^3	Reinforcing of soil with geo-mesh
26 261	m^3	Reinforcing of soils with rough foil
26 311	m^3	Construction of foundation for reinforced soil

2.2.2.10.7 Piles and wells

Item	Unit	Description of work
27 111	m^1	Construction of cement concrete bored piles of Benotto system, 60 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 112	m^1	Construction of cement concrete bored piles of Benotto system, 80 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 113	m^1	Construction of cement concrete bored piles of Benotto system, 100 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 114	m^1	Construction of cement concrete bored piles of Benotto system, 118 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 115	m^1	Construction of cement concrete bored piles of Benotto system, 120 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 116	m^1	Construction of cement concrete bored piles of Benotto system, 125 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 117	m^1	Construction of cement concrete bored piles of Benotto system, 150 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 118	m^1	Construction of cement concrete bored piles of Benotto system, 200 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 119	m^1	Construction of cement concrete bored piles of Benotto system, above 200 cm in diameter, excavation in cohesive soil/granular rock, of length up to 10 m
27 121	m^1	Construction of cement concrete bored piles of Benotto system, 60 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 122	m^1	Construction of cement concrete bored piles of Benotto system, 80 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 123	m^1	Construction of cement concrete bored piles of Benotto system, 100 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 124	m^1	Construction of cement concrete bored piles of Benotto system, 118 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 125	m^1	Construction of cement concrete bored piles of Benotto system, 120 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 126	m^1	Construction of cement concrete bored piles of Benotto system, 125 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 127	m^1	Construction of cement concrete bored piles of Benotto system, 150 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 128	m^1	Construction of cement concrete bored piles of Benotto system, 200 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 129	m^1	Construction of cement concrete bored piles of Benotto system, above 200 cm in diameter, excavation in cohesive soil/granular rock, of length 10 - 20 m
27 131	m^1	Construction of cement concrete bored piles of Benotto system, 60 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 132	m^1	Construction of cement concrete bored piles of Benotto system, 80 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 133	m^1	Construction of cement concrete bored piles of Benotto system, 100 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 134	m^1	Construction of cement concrete bored piles of Benotto system, 118 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 135	m^1	Construction of cement concrete bored piles of Benotto system, 120 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 136	m^1	Construction of cement concrete bored piles of Benotto system, 125 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m

Item	Unit	Description of work
27 137	m^1	Construction of cement concrete bored piles of Benotto system, 150 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 138	m^1	Construction of cement concrete bored piles of Benotto system, 200 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 139	m^1	Construction of cement concrete bored piles of Benotto system, above 200 cm in diameter, excavation in cohesive soil/granular rock, of length above 20 m
27 141	m^1	Construction of bored grouted piles of Benotto system, 60 cm in diameter, excavation in cohesive soil/granular rock
27 142	m^1	Construction of bored grouted piles of Benotto system, 80 cm in diameter, excavation in cohesive soil/granular rock
27 143	m^1	Construction of bored grouted piles of Benotto system, 100 cm in diameter, excavation in cohesive soil/granular rock
27 144	m^1	Construction of bored grouted piles of Benotto system, 118 cm in diameter, excavation in cohesive soil/granular rock
27 145	m^1	Construction of bored grouted piles of Benotto system, 120 cm in diameter, excavation in cohesive soil/granular rock
27 146	m^1	Construction of bored grouted piles of Benotto system, 125 cm in diameter, excavation in cohesive soil/granular rock
27 147	m^1	Construction of bored grouted piles of Benotto system, 150 cm in diameter, excavation in cohesive soil/granular rock
27 148	m^1	Construction of bored grouted piles of Benotto system, 200 cm in diameter, excavation in cohesive soil/granular rock
27 149	m^1	Construction of bored grouted piles of Benotto system, above 200 cm in diameter, excavation in cohesive soil/granular rock
27 151	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 60 cm in diameter
27 152	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 80 cm in diameter
27 153	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 100 cm in diameter
27 154	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 118 cm in diameter
27 155	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 120 cm in diameter
27 156	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 125 cm in diameter
27 157	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 150 cm in diameter
27 158	m^1	Execution of extensions of cement concrete bored piles, above the ground level, 200 cm in diameter
27 159	m^1	Execution of extensions of cement concrete bored piles, above the ground level, above 200 cm in diameter
27 161	pc	Cutting (shortening) cement concrete bored piles, 60 cm in diameter
27 162	pc	Cutting (shortening) cement concrete bored piles, 80 cm in diameter
27 163	pc	Cutting (shortening) cement concrete bored piles, 100 cm in diameter
27 164	pc	Cutting (shortening) cement concrete bored piles, 118 cm in diameter
27 165	pc	Cutting (shortening) cement concrete bored piles, 120 cm in diameter
27 166	pc	Cutting (shortening) cement concrete bored piles, 125 cm in diameter
27 167	pc	Cutting (shortening) cement concrete bored piles, 150 cm in diameter

Item	Unit	Description of work
27 168	pc	Cutting (shortening) cement concrete bored piles, 200 cm in diameter
27 169	pc	Cutting (shortening) cement concrete bored piles, above 200 cm in diameter
27 171	m^1	Additional excavation for bored piles in soft rock
27 172	m^1	Additional excavation for bored piles in hard rock
27 181	m^1	Allowance for execution of inclined bored piles
27 182	m^1	Allowance for execution of inclined bored grouted piles
27 183	m^1	Allowance for execution of bored piles from pontoon above water
27 191	m^1	Application of protective steel lining to piles in accordance with design, pile diameter ...., steel lining thickness .... mm
27 196	m^3	Execution of widening bored pile foot to increase bearing capacity below pile foot in accordance with design, pile diameter ..../ foot diameter ...…
27 211	m^1	Execution of driven vertical cement concrete piles of 36/36 cm in section
27 212	m^1	Execution of driven vertical cement concrete piles of ..../.... cm in section
27 216	m^1	Execution of driven inclined cement concrete piles of 36/36 cm in section
27 217	m^1	Execution of driven cement concrete piles of ..../.... cm in section
27 221	m^1	Execution of extensions of driven cement concrete piles of 36/36 cm in section
27 222	m^1	Execution of extensions of driven cement concrete piles of ..../.... cm in section
27 226	pc	Cutting (shortening) of driven cement concrete piles of 36/36 cm in section
27 227	pc	Cutting (shortening) of driven cement concrete piles of .../... cm in section
27 231	m^1	Execution of prestressed driven vertical cement concrete piles of 60 cm in diameter
27 232	m^1	Execution of prestressed driven vertical cement concrete piles of 70 cm in diameter
27 233	m^1	Execution of prestressed driven vertical cement concrete piles above 60 cm in diameter
27 236	m^1	Execution of prestressed driven vertical cement concrete piles of 40/40 cm in section
27 237	m^1	Execution of prestressed driven vertical cement concrete piles of ..../.... cm in section
27 241	m^1	Execution of prestressed driven inclined cement concrete piles of 60 cm in diameter
27 242	m^1	Execution of prestressed driven inclined cement concrete piles of 70 cm in diameter
27 243	m^1	Execution of prestressed driven inclined cement concrete piles above 60 cm in diameter
27 246	m^1	Execution of prestressed driven inclined cement concrete piles of 40/40 cm in section

Item	Unit	Description of work
27 247	m^1	Execution of prestressed driven inclined cement concrete piles of ..../.... cm in section
27 251	m^1	Execution of sunk vertical wells of cement concrete elements of 100 cm in diameter
27 252	m^1	Execution of sunk vertical wells of cement concrete elements of 125 cm in diameter
27 253	m^1	Execution of sunk vertical wells of cement concrete elements of 150 cm in diameter
27 254	m^1	Execution of sunk vertical wells of cement concrete elements of 175 cm in diameter
27 255	m^1	Execution of sunk vertical wells of cement concrete elements of 200 cm in diameter
27 256	m^1	Execution of sunk vertical wells of cement concrete elements of 250 cm in diameter
27 257	m^1	Execution of sunk vertical wells of cement concrete elements of .... cm in diameter
27 258	m^1	Execution of sunk vertical wells of cement concrete elements of .... cm in diameter
27 261	m^1	Execution of extensions of prestressed driven cement concrete piles of 60 cm in diameter
27 262	m^1	Execution of extensions of prestressed driven cement concrete piles of 70 cm in diameter
27 263	m^1	Execution of extensions of prestressed driven cement concrete piles of .... cm in diameter
27 264	m^1	Execution of extensions of prestressed driven cement concrete piles of 40/40 cm in section
27 265	m^1	Execution of extensions of prestressed driven cement concrete piles of .../... cm in section
27 266	pc	Cutting (shortening) driven cement concrete piles of 60 - 70 cm in diameter
27 267	pc	Cutting (shortening) driven cement concrete piles of ..... cm in diameter
27 268	pc	Cutting (shortening) driven cement concrete piles of 40/40 cm in section
27 269	pc	Cutting (shortening) driven cement concrete piles of .../... cm in section
27 311	m^1	Execution of steel driven vertical piles of 300 mm in diameter
27 312	m^1	Execution of steel driven vertical piles of 400 mm in diameter
27 313	m^1	Execution of steel driven vertical piles of 500 mm in diameter
27 314	m^1	Execution of steel driven vertical piles of 600 mm in diameter
27 315	m^1	Execution of steel driven vertical piles of 700 mm in diameter
27 316	m^1	Execution of steel driven vertical piles above 700 mm in diameter
27 321	m^1	Execution of steel driven inclined piles of 300 mm in diameter
27 322	m^1	Execution of steel driven inclined piles of 400 mm in diameter
27 323	m^1	Execution of steel driven inclined piles of 500 mm in diameter
27 324	m^1	Execution of steel driven inclined piles of 600 mm in diameter
27 325	m^1	Execution of steel driven inclined piles of 700 mm in diameter
27 326	m^1	Execution of steel driven inclined piles above 700 mm in diameter
27 331	m^1	Execution of extensions of steel driven piles of 300 mm in diameter
27 332	m^1	Execution of extensions of steel driven piles of 400 mm in diameter

Item	Unit	Description of work
27 333	m^1	Execution of extensions of steel driven piles of 500 mm in diameter
27 334	m^1	Execution of extensions of steel driven piles of 600 mm in diameter
27 335	m^1	Execution of extensions of steel driven piles of 700 mm in diameter
27 336	m^1	Execution of extensions of steel driven piles above 700 mm in diameter
27 341	pc	Shortening steel driven piles of 300 mm in diameter
27 342	pc	Shortening steel driven piles of 400 mm in diameter
27 343	pc	Shortening steel driven piles of 500 mm in diameter
27 344	pc	Shortening steel driven piles of 600 mm in diameter
27 345	pc	Shortening steel driven piles of 700 mm in diameter
27 346	pc	Shortening steel driven piles above 700 mm in diameter
27 411	m^1	Execution of sunk vertical cement concrete piles, with protective pipes - wells of 100 cm in diameter
27 412	m^1	Execution of sunk vertical cement concrete piles, with protective pipes - wells of 120 cm in diameter
27 413	m^1	Execution of sunk vertical cement concrete piles, with protective pipes - wells of 140 cm in diameter
27 414	m^1	Execution of sunk vertical cement concrete piles, with protective pipes - wells of 160 cm in diameter
27 415	m^1	Execution of sunk vertical cement concrete piles, with protective pipes - wells of 180 cm in diameter
27 416	m^1	Execution of sunk vertical cement concrete piles, with protective pipes - wells of 200 cm in diameter
27 417	m^1	Execution of sunk vertical cement concrete piles, with protective pipes - wells above 200 cm in diameter
27 418	m^1	Execution of sunk vertical cement concrete piles - wells of box cross section of one or more openings, of dimensions .... according to design
27 421	m^1	Execution of sunk inclined cement concrete piles, with protective pipes - wells of 100 cm in diameter
27 422	m^1	Execution of sunk inclined cement concrete piles, with protective pipes - wells of 120 cm in diameter
27 423	m^1	Execution of sunk inclined cement concrete piles, with protective pipes - wells of 140 cm in diameter
27 424	m^1	Execution of sunk inclined cement concrete piles, with protective pipes - wells of 160 cm in diameter
27 425	m^1	Execution of sunk inclined cement concrete piles, with protective pipes - wells of 180 cm in diameter
27 426	m^1	Execution of sunk inclined cement concrete piles, with protective pipes - wells of 200 cm in diameter
27 427	m^1	Execution of sunk inclined cement concrete piles, with protective pipes - wells above 200 cm in diameter
27 428	m^1	Execution of sunk inclined cement concrete piles - wells of box cross section of one or more openings, of dimensions .... according to design
27 431	m^1	Execution of extensions of sunk cement concrete piles, with protective pipes – wells of 100 cm in diameter
27 432	m^1	Execution of extensions of sunk cement concrete piles, with protective pipes – wells of 120 cm in diameter
27 433	m^1	Execution of extensions of sunk cement concrete piles, with protective pipes – wells of 140 cm in diameter

Item	Unit	Description of work
27 434	m^1	Execution of extensions of sunk cement concrete piles, with protective pipes – wells of 160 cm in diameter
27 435	m^1	Execution of extensions of sunk cement concrete piles, with protective pipes – wells of 180 cm in diameter
27 436	m^1	Execution of extensions of sunk cement concrete piles, with protective pipes – wells of 200 cm in diameter
27 437	m^1	Execution of extensions of sunk cement concrete piles, with protective pipes – wells above 200 cm in diameter
27 438	m^1	Execution of extensions of sunk cement concrete piles – wells of box cross section of one or more openings, of dimensions .... according to design
27 441	pc	Cutting (shortening) sunk cement concrete piles, with protective pipes – wells of 100 cm in diameter
27 442	pc	Cutting (shortening) sunk cement concrete piles, with protective pipes – wells of 120 cm in diameter
27 443	pc	Cutting (shortening) sunk cement concrete piles, with protective pipes – wells of 140 cm in diameter
27 444	pc	Cutting (shortening) sunk cement concrete piles, with protective pipes – wells of 160 cm in diameter
27 445	pc	Cutting (shortening) sunk cement concrete piles, with protective pipes – wells of 180 cm in diameter
27 446	pc	Cutting (shortening) sunk cement concrete piles, with protective pipes – wells of 200 cm in diameter
27 447	pc	Cutting (shortening) sunk cement concrete piles, with protective pipes – wells above 200 cm in diameter
27 448	pc	Cutting (shortening) sunk cement concrete piles – wells of box cross section of one or more openings, of dimensions ....according to design
27 511	m^1	Execution of steel sunk vertical piles – wells of 1,000 mm in diameter
27 512	m^1	Execution of steel sunk vertical piles – wells of 1,250 mm in diameter
27 513	m^1	Execution of steel sunk vertical piles – wells of 1,500 mm in diameter
27 514	m^1	Execution of steel sunk vertical piles – wells of 1,750 mm in diameter
27 515	m^1	Execution of steel sunk vertical piles – wells of 2,000 mm in diameter
27 516	m^1	Execution of steel sunk vertical piles – wells of .... mm in diameter
27 517	m^1	Execution of steel sunk vertical piles – wells of .... mm in diameter
27 521	m^1	Execution of steel sunk inclined piles – wells of 1,000 mm in diameter
27 522	m^1	Execution of steel sunk inclined piles – wells of 1,250 mm in diameter
27 523	m^1	Execution of steel sunk inclined piles – wells of 1,500 mm in diameter
27 524	m^1	Execution of steel sunk inclined piles – wells of 1,750 mm in diameter
27 525	m^1	Execution of steel sunk inclined piles – wells of 2,000 mm in diameter
27 526	m^1	Execution of steel sunk inclined piles – wells of .... mm in diameter
27 527	m^1	Execution of steel sunk inclined piles – wells of .... mm in diameter
27 531	m^1	Execution of extensions of steel sunk piles – wells of 1,000 mm in diameter
27 532	m^1	Execution of extensions of steel sunk piles – wells of 1,250 mm in diameter
27 533	m^1	Execution of extensions of steel sunk piles – wells of 1,500 mm in diameter
27 534	m^1	Execution of extensions of steel sunk piles – wells of 1,750 mm in diameter
27 535	m^1	Execution of extensions of steel sunk piles – wells of 2,000 mm in diameter
27 536	m^1	Execution of extensions of steel sunk piles – wells of ...... mm in diameter
27 537	m^1	Execution of extensions of steel sunk piles – wells of .... mm in diameter

Item	Unit	Description of work
27 541	pc	Cutting (shortening) steel sunk piles of 1,000 mm in diameter
27 542	pc	Cutting (shortening) steel sunk piles of 1,250 mm in diameter
27 543	pc	Cutting (shortening) steel sunk piles of 1,500 mm in diameter
27 544	pc	Cutting (shortening) steel sunk piles of 1,750 mm in diameter
27 545	pc	Cutting (shortening) steel sunk piles of 2,000 mm in diameter
27 546	pc	Cutting (shortening) steel sunk piles of .... mm in diameter
27 547	pc	Cutting (shortening) steel sunk piles of .... mm in diameter
27 611	m^1	Execution of wooden vertical piles of 25 cm in diameter
27 612	m^1	Execution of wooden vertical piles of 30 cm in diameter
27 613	m^1	Execution of wooden vertical piles of 35 cm in diameter
27 614	m^1	Execution of wooden vertical piles of 40 cm in diameter
27 615	m^1	Execution of wooden vertical piles above 40 cm in diameter
27 616	m^1	Fixing wooden semi-beams
27 621	m^1	Execution of wooden inclined piles of 25 cm in diameter
27 622	m^1	Execution of wooden inclined piles of 30 cm in diameter
27 623	m^1	Execution of wooden inclined piles of 35 cm in diameter
27 624	m^1	Execution of wooden inclined piles of 40 cm in diameter
27 625	m^1	Execution of wooden inclined piles above 40 cm in diameter
27 631	pc	Cutting (shortening) wooden piles of 25 cm in diameter
27 632	pc	Cutting (shortening) wooden piles of 30 cm in diameter
27 633	pc	Cutting (shortening) wooden piles of 35 cm in diameter
27 634	pc	Cutting (shortening) wooden piles of 40 cm in diameter
27 635	pc	Cutting (shortening) wooden piles above 40 cm in diameter
27 711	m^1	Execution of piles of mineral aggregate of 40 cm in diameter
27 712	m^1	Execution of piles of mineral aggregate of 50 cm in diameter
27 713	m^1	Execution of piles of mineral aggregate of 60 cm in diameter
27 714	m^1	Execution of piles of mineral aggregate of 70 cm in diameter
27 715	m^1	Execution of piles of mineral aggregate above 70 cm in diameter
27 811	m^1	Execution of vertical piles of "Jet Grouting" system of 40 cm in diameter
27 812	m^1	Execution of vertical piles of "Jet Grouting" system of 50 cm in diameter
27 813	m^1	Execution of vertical piles of "Jet Grouting" system of 60 cm in diameter
27 814	m^1	Execution of vertical piles of "Jet Grouting" system of 70 cm in diameter
27 815	m^1	Execution of vertical piles of "Jet Grouting" system of 80 cm in diameter
27 816	m^1	Execution of vertical piles of "Jet Grouting" system above 80 cm in diameter

2.2.2.10.8 Sheet piles

Item	Unit	Description of work
28 111	m^2	Placing and maintenance of steel sheet pile
28 112	m^2	Placing and maintenance of wooden sheet pile
28 113	m^2	Placing and maintenance of anchored sheet pile
28 114	m^2	Placing and maintenance of sheet piling boards with grooves
28 115	m^2	Placing and maintenance of sheet piling of reinforced cement concrete elements
28 116	m^2	Placing and maintenance of sheet piling of ......………
28 121	m^2	Pulling out steel sheet pile, including dismantling works
28 122	m^2	Pulling out wooden sheet pile, including dismantling works
28 123	m^2	Pulling out anchored sheet pile, including dismantling works
28 124	m^2	Pulling out sheet piling boards with grooves, including dismantling works
28 125	m^2	Pulling out sheet piling of reinforced cement concrete elements, including dismantling works
28 126	m^2	Pulling out sheet piling of ...., including dismantling all the coupling elements

2.2.2.10.9 Transportation and spreading of surplus material

Item	Unit	Description of work
29 111	m^3	Transportation of excavated material to a distance of up to 100 m
29 112	m^3	Transportation of excavated material to a distance of 100 - 500 m
29 113	m^3	Transportation of excavated material to a distance of 500 - 1,000 m
29 114	m^3	Transportation of excavated material to a distance of 1,000 - 2,000 m
29 115	m^3	Transportation of excavated material to a distance of 2,000 - 3,000 m
29 116	m^3	Transportation of excavated material to a distance of 3,000 - 4,000 m
29 117	m^3	Transportation of excavated material to a distance of 4,000 - 5,000 m
29 118	m^3	Transportation of excavated material to a distance above 5,000
29 121	m^3	Spreading surplus fertile soil (topsoil)
29 122	m^3	Spreading surplus soil of low bearing capacity
29 123	m^3	Spreading surplus cohesive soil
29 124	m^3	Spreading surplus granular rock
29 125	m^3	Spreading surplus soft/hard rock
29 126	m^3	Spreading surplus secondary material
29 127	m^3	Spreading surplus other material

GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

VOLUME II: CONSTRUCTION

SECTION 2: SPECIAL TECHNICAL CONDITIONS

Part 3: PAVEMENT STRUCTURES

Sarajevo/Banja Luka
2005

CONTENTS

2.2.3 PAVEMENT STRUCTURES

2.2.3.1 ROADBASES

General

Roadbases are parts of pavement structures between the wearing course and substructure.

Roadbases are unbound, or bound with hydraulic or organic binders. They shall be placed in dimensions specified by the design and by these Technical conditions.

2.2.3.1.1 UNBOUND ROADBASES

The technical conditions and procedures for construction of unbound roadbases are indicated in detail in the TSC 06.200 Unbound bearing and wearing courses.

2.2.3.1.1.1 Description

The construction of unbound (mechanically stabilized, pavement base) roadbases includes the supply and placing of a corresponding mixture of granules for the unbound roadbases at sites specified by the design.

This work has to be executed in weather when the temperature is above 2°C and without precipitations.

Unbound roadbases (URB) can be placed into the pavement structure for all groups of traffic loads, generally between the substructure foundation and the bound roadbase.

2.2.3.1.1.2 Basic Materials

Basic materials for URB are aggregates from natural, crushed, and/or mixed grains.

Mixtures of natural grains contain particles of more or less rounded edges, which occur during the natural crushing of massive stones.

Mixtures of crushed grains contain particles produced by crushing natural stones, artificial stones or natural grains.

Mixed mixtures of grains contain mixes of natural and crushed particles.

In these special technical conditions the terms used for the mixtures of grains are specified in Table 3.1 and indicated in Fig. 3.1.

2.2.3.1.1.3 Quality of Materials

The required quality of mixtures of mineral aggregates for URBs is indicated in detail in the EN 13242 Aggregates for unbound materials, and for materials bound with hydraulic binders for civil engineering and pavement structures.

2.2.3.1.1.3.1 Mineral Aggregate Mixtures

Mixtures of natural or crushed grains, as well as mixtures of mixed mineral grains shall consist of coarse gravel and well graded crushed stone, or of crushed gravel, sand, and filler, to ensure such a mix composition as specified in Figures 3.2, 3.3, and 3.4. The method of assessing the composition is specified in EN 933-1.

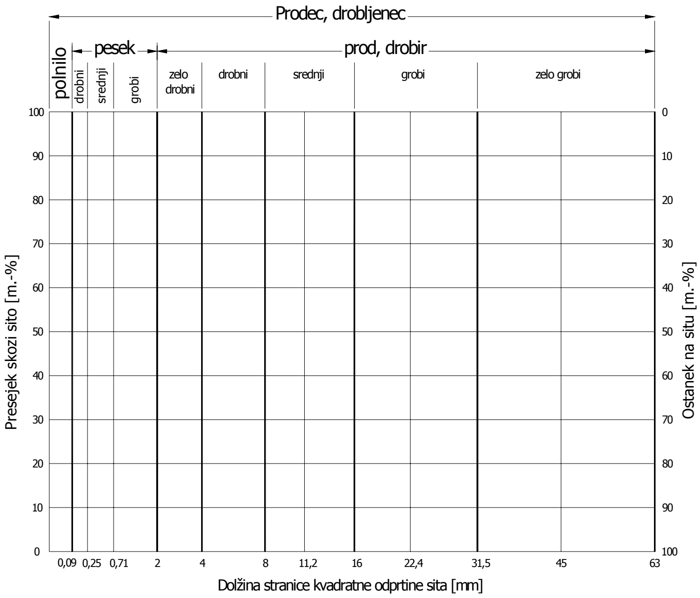
The portion of crushed grains in a mixture for an unbound bearing course shall be specified (in accordance with the EN 933-5) within the scope of the pavement structure design in view of the classification as provided by the EN 13242 (category $C_{90/3}$ or $C_{50/10}$).

Table 3.1

Nominal grain-group	Grain size		Mineral aggregate
mm	from mm	to mm	mixture
0/1*	0	2	
0/2	0	4	sand
0/4	0	4	
1/4*	0,5	8	
0/8	0	11.2	
0/11*	0	16	
0/16	0	22.4	
0/22*	0	31.5	gravel, crushed stone
0/32	0	45	
0/45*	0	63	
0/63	0	125	
2/4*	1	8	
4/8	2	11.2	
8/11*	4	16	
8/16	4	22	
11/16*	8	22	
16/22*	11.2	31.5	coarse gravel, crushed gravel
16/32	11.2	45	
22/32*	16	45	
32/45*	22.4	63	
32/63	22.4	125	
45/63*	31.5	125	

** Intermediate granulometric composition, intermediate grain size*

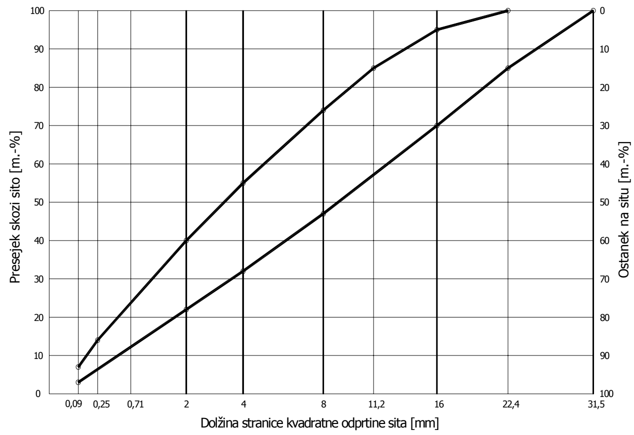
Fig. 3.1 Diagram of granulometric composition of mineral aggregate mixtures



translation: presejek skozi sito = passing sieve; prodec = gravel; drobljenec = crushed stone; ostanek na situ = remaining on sieve; prod = coarse gravel; drobir = crushed gravel; dolžina stranice kvadratne odprtine sita = length of side of sieve square opening; polnilo = filler; zelo drobni = very fine; drobni = fine; srednji = medium; grob = coarse; zelo grob = very coarse.

The mineral aggregate mixture composition for the URB shall be specified in the design in dependence on the foreseen traffic loading and the raw material properties. If this is not the case, for heavier traffic loading coarse graded mineral mixtures shall be foreseen. The minimum layer thickness shall amount to at least 2.5 times the diameter of the maximum grain in the mixture.

The contractor is free to introduce different mineral aggregate mixture provided that the suitability of such a mixture is approved by both relevant institution and client's engineer.



terms are translated in figure 3.1

Fig. 3.2: Grading curve limits of mineral aggregate granulometric composition of 0/22 mm for unbound bearing courses

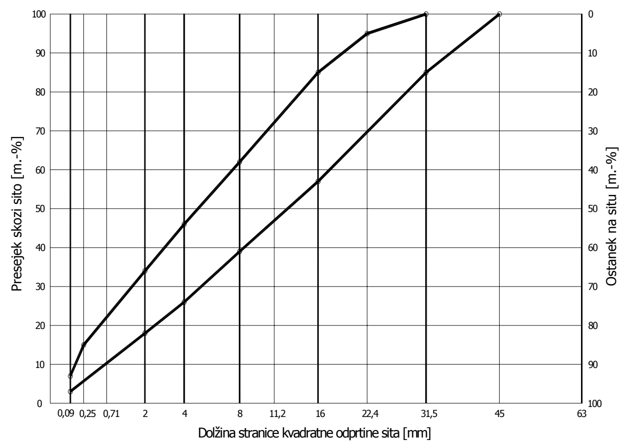


Fig. 3.3: Limit curves of mineral aggregate granulometric composition of 0/32 mm for unbound bearing courses

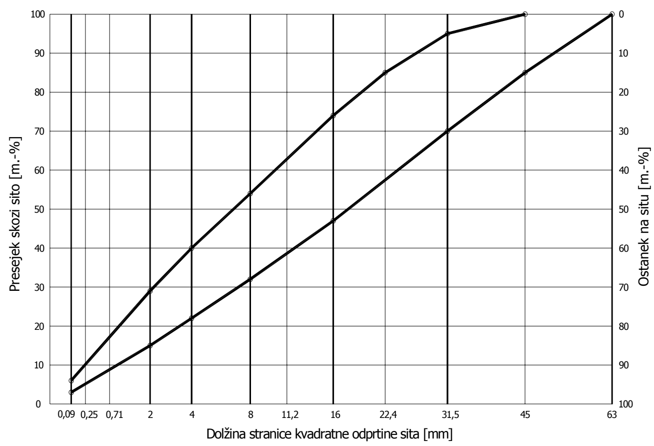


Fig. 3.4: Grading curve limits of mineral aggregate granulometric composition of 0/45 mm for unbound bearing courses

The mixture of mineral grains for URB may contain the following portion of grains of up to 0.063 mm (in compliance with EN 13242):

- in storage piles, no more than 5% by mass (category f_5),
- after placing into URB, no more than 8% by mass (category f_8).

Individual results (maximum 5% of the total number) of testing specimens taken from storage piles may exceed the indicated value by no more than 10%.

The content of stone particles of up to 0.02 mm in mixtures must not be greater then 3% by mass. Individual results of testing may exceed the indicated value by no more than 15%. The quotient of uneven particle size distribution $U = d_{60}/d_{10}$ shall be equal for mixtures of

- natural grains 15 to 100,
- crushed and mixed grains 8 to 50.

In case that the engineer, on the basis of the results of testing placement a mixture of the quotient of unevenness U < 6, allows the use of such mixture, the latter may contain up to 15% by mass of grains of size up to 0.063 mm. Intermediate values shall be assessed by linear interpolation.

For unbound roadbases, the equivalent of sand specified (in accordance with the EN 933-8) for a mixture of mineral particles of up to 4 mm in size shall amount to the following:

roads with heavy or very heavy traffic loading: at least 60% (category SE_{60}),

roads with average or light traffic loading: at least 50 % (category SE_{50}).

2.2.3.1.1.3.2 Mechanical Properties

The resistance of granules against crushing defined as the amount passing through a sieve by the Los Angeles method (according to EN 1097-2) on roads, is allowed to amount to the following values:

- medium or heavy traffic loading: maximum 30 % (category LA_{30}),
- light traffic loading: maximum 35 % (category LA_{35}).

The resistance of mineral grains against freezing action is determined (according to EN 1367-2) by means of a test with magnesium sulphate, and expressed by the percentage of chipped particles of the original mass sample is allowed to amount to 25% by mass (category MS_{25}).

No more than 20% by mass of grains which shape does not satisfy the condition l:d ≤ 3:1 (testing in compliance with the EN 933-4, category SI_{20}) is allowed in a mixture.

Organic compounds in mixtures of mineral grains may colour a 3% solution of sodium hydroxide darker than the reference colour (according to the EN 1744-1).

A mixture of mineral grains for a URB must not contain harmful and/or brittle grains or admixtures (testing in accordance with the EN 1744-1). Mixtures may contain individual weathered or brittle stone particles only to such an amount, that the whole corresponds to the prescribed requirements.

The load bearing capacity of stone grains determined at laboratory by the CBR method shall amount to

- for mixtures of natural grains and mixed mixtures of grains in which there are less than 50% of crushed particles: at least 40 %,
- for mixtures of crushed grains and mixed mixtures of grains in which there are more than 50% of crushed particles: at least 80 %.

2.2.3.1.1.4 Method of Execution

2.2.3.1.1.4.1 Winning of Mineral Aggregate Mixtures

The site of acquiring mineral aggregate mixtures for URB shall be reported by the contractor to the supervising engineer in due time prior to beginning the exploitation. The contractor shall also submit an evidence on the quality of the mixture as specified in the section 2.2.3.1.1.3 of these technical conditions, and get approval for use from the supervising engineer.

A mineral aggregate mixture shall be acquired in such a way that its permanent quality and uniformity are ensured.

Borrow pits of mineral aggregate mixtures and quarries shall be previously suitably cleaned.

2.2.3.1.1.4.2 Preliminary Testing

At the beginning of works the following shall be tested:

- mineral aggregate mixture composition (according to section 2.2.3.1.1.3.1),
- mechanical properties (according to section 2.2.3.1.1.3.2), and
- optimum moisture content and density by Proctor (according to EN 13286-2),

to establish conformity of the characteristic properties of the particular mixture with properties assessed by the preliminary testing of samples taken for the production internal control; in addition, the following shall be measured:

- density and moisture content of placed layer (according to section 2.2.3.1.1.5.1) and of mineral aggregate mixture,
- load bearing capacity of the placed layer (according to section 2.2.3.1.1.5.2), and
- evenness and level of the placed layer formation (according to section 2.2.3.1.1.5.3).

Prior to commencement of the works, for each type of mineral aggregate mixtures the technology, compaction means, and their depth effect shall be specified. For this purpose, the effect of the foreseen compacting machines shall be measured on a test area after each passage of such machines. After completion of compaction, both density and moisture content of the placed mineral aggregate mixture shall be measured on the URB formation.

2.2.3.1.1.4.3 Preparation of Substructure (Subgrade) Formation

Prior to commencement of placing mineral aggregate mixtures into the URB, the subgrade (substructure) formation shall be prepared as provided by the section 2.2.2.4.5 of these technical conditions.

Construction of the URB may start after the subgrade has been accepted in accordance with the requirements indicated in section 2.2.2.4.5 of these technical conditions. The contractor is obliged to maintain the substrate after acceptance till commencement of placing subsequent layers in a constant condition. All damages shall be made good in due time, and a report shall be submitted to the engineer.

2.2.3.1.1.4.4 Depositing of Mineral Aggregate Mixtures

If the contractor intends to deposit provisionally a mineral aggregate mixture before placing it into the URB, an adequate deposit area (levelled, consolidated, drained) shall be prepared in advance.

A temporary deposit area shall be, if feasible, of rectangular shape, with side lengths of up to 50 m. The level shall not exceed 3 m. Mineral aggregate mixture shall be spread in layers, which shall be homogenized and suitably moistened. The slope of such provisional storage pile shall amount up to 1 : 2.

Appropriate access road (ramp) shall be constructed to reach the provisional deposit pile.

The provisional deposit area (pile) shall be suitably marked (location/number, dimension, acceptance stage). After such a temporary storage pile is accepted, no additional aggregate mixtures must be delivered to it until it is completely exploited.

2.2.3.1.1.4.5 Bringing Mineral Aggregate Mixtures

A mineral aggregate mixture for the URB may be brought to a suitably prepared subgrade formation only when this is allowed by the engineer.

Bringing must generally not be executed over the prepared and taken-over subgrade formation but over an already spread layer of mixture of mineral aggregate. Vehicles transporting the material must be emptied by tilting to the side or backwards. If, due to mechanical spreading or placing, the mixture is partly brought over the subgrade formation, then the method of bringing shall be approved by the engineer.

A suitably equipped vehicle shall be used for the conveyance of mineral aggregate mixtures, and for spreading, equipment which achieves the required even distribution of the mixture shall be introduced. The thickness of the distributed mixture of grains shall comply with the specified thickness of the layer of the compacted mixture of mineral grains as defined in the design.

Each individual layer shall be suitably formed and compacted before brining the mixture for the next layer begins, where several layers of mineral aggregate mixtures are foreseen.

If mineral aggregate mixtures are spread over non-compacted layers, vehicles shall be equally distributed over hte whole width of the spread mixture.

Vehicles with muddy wheels or undercarriages are prohibited to drive over already spread or compacted mixtures of stone aggregate for the URB.

2.2.3.1.1.4.6 Placing Mineral Aggregate Mixtures

Placing mineral aggregate mixtures into the URB shall generally be done mechanically. Manual spreading is only admitted in places which cannot be reached with machines and where manual spreading is permitted by the engineer.

Mineral aggregate mixtures for URB shall generally be delivered in a suitable composition to the site. Any correction of a deficient composition of a mixture at the site or place of distribution shall be permitted by the engineer on the basis of the corresponding results of preliminary testing.

The required amount of water to ensure an optimum moisture of the mineral aggregate mix for compacting has usually to be equally distributed in the mixture already at the site of exploitation.

If water has to be added to the mineral aggregate mixture at the place of spreading, then this shall be dine by sprinkling, so as to avoid washing out fine grains. During compacting, the moisture content of the mixture may deviate from the optimum value by $\pm$ 2% by mass. Ensuring such a moisture content is especially important if the mixture of stone grains is spread by graders, so that the mixture remains as uniform as possible.

Spreading of mineral aggregate mixtures for URB shall be carried out with a suitable machine, usually with a finisher, with the permission of the supervising engineer also with a grader or exceptionally with a bulldozer. Usually, spreading shall be performed on the same day as moistening.

A uniform mineral aggregate mixture levelled to the required profile must be compacted with suitable machinery over the whole width of the layer. To achieve a correct compaction and bearing capacity over the entire design width of the carriageway, the width of the layer for the designed layer thickness shall be increased by +10 cm, if this has not been already foreseen by the design.

Layers shall be compacted from the lower layer towards the higher one. The number of passages of suitable compacting means determined by preliminary testing shall be checked by routine tests of density and compaction of the placed mineral aggregate mixture.

All irregularities discovered during compaction shall be made good as directed by the engineer.

All places inaccessible to machines shall be compacted to the specified compaction degree by means of other machinery, which shall be preliminarily approved by the engineer. He shall also specify conditions in which these machines may be used.

Besides the compaction degree, the load bearing capacity of the executed URB shall be ascertained prior to final compaction as well.

If the design values are not achieved, then the contractor shall ensure that the quality of the executed URB is attained by additional measures.

2.2.3.1.1.5 Quality of Execution

Before the machines and equipment from which the quality of the executed work depends begin to operate, their capacity for ensuring a uniform quality in accordance with the requirements of these technical conditions shall be verified.

All the equipment and machines shall be certified and shall satisfy the demands of the design in view of capacity.

2.2.3.1.1.5.1 Compaction

Compaction of the mineral aggregate mixtures in the URB determined in view of the compaction of the mixture by the modified Proctor Method, shall amount to an average of 98 %. The lower limiting value of compaction must not be smaller than the average value by more than 3 %.

The density of the placed mixture must usually be determined with a non-destructive method of measurement with an isotope gauge (nuclear densitometer) in compliance with TSC 06.711.

2.2.3.1.1.5.2 Load Bearing Capacity

The load bearing capacity of the URB determined by the static modulus of deformation E_{v2} and the dynamic modulus of deformation E_{vd} (according to TSC 06.720), shall comply with the requirements indicated in Table 3.2 .

Table 3.2: Required values of moduli of deformation on the URB formation

Type of mineral aggregate mixture	Traffic load very heavy or heavy specified value			medium or light		
	E_{v2} MN/m^2	E_{v2}/E_{v1}	E_{vd} MN/m^2	E_{v2} MN/m^2	E_{v2}/E_{v1}	E_{vd} MN/m^2
- natural	≥ 100	≤ 2.2	≥ 45	≥ 90	≤ 2.4	≥ 40
- crushed or mixed	≥ 120	≤ 2.0	≥ 55	≥ 100	≤ 2.2	≥ 45

The ratio of moduli of deformation E_{v2}/E_{v1} is not decisive to estimate the bearing capacity of layers of unbound mixtures of mineral grains, if the value of the modulus of deformation E_{v1} is greater than 50 % of the required value of E_{v2}.

The lower limiting value of the modulus of deformation may be up to 20 % smaller than the value specified in Table 3.2 (up to 10 % of the total number of measurements).

If the contractor fails to reach the specified ration of the moduli of deformation E_{v2}/E_{v1}, the engineer decides on the further work.

2.2.3.1.1.5.3 Evenness, Level, Slope

The unevenness of the URB shall be determined as a deviation under a 4 m long straight-edge placed in any optional direction with regard to the road axis (according to TSC 06.610). The formation of the URB is admitted to deviate from the straight-edge by no more than 20 mm (upper limiting value). If such deviations follow one another, the supervising engineer decides on the method of correction.

The level of individual measurement points on the URB formation shall be determined by levelling. The formation of the URB may deviate at any optional point by no more than +10 mm or – 15 mm (upper limiting value) from the designed level.

The slope of the URB formation must be equal to the transversal and longitudinal fall of the carriageway. The allowed deviations are defined by the admitted unevenness and the deviation from the URB formation level, but they must not be greater than ± 0.4 % of the absolute value of the slope (threshold limiting value).

2.2.3.1.1.6 Quality Control of Execution

For each characteristic type of mineral aggregate mixture foreseen to be placed into URB conformity with design requirements and these technical conditions shall be established

by preliminary testing of properties at the beginning of placing, and

within the scope of both internal and external control during placing.

2.2.3.1.1.6.1 Preliminary Testing

Preliminary testing to verify conformity of properties of mineral aggregate mixtures defined in 2.2.3.1.1.3 for are indicated in Table 3.3.

The results of preliminary testing shall comply with the evidence on properties of delivered mineral aggregate mixtures. Such an evidence shall be submitted by the contractor.

Table 3.3: Required properties of mineral aggregate mixtures for URB at preliminary testing

Properties	Unit measure	Required value	Test method
- mineral aggregate mixture composition	% by mass	section 2.2.3.1.1.3	EN 933-1
- portion of grains of up to 0.063 mm	% by mass	f_5/f_8	EN 933-1
- portion of crushed grains	% by mass	$C_{90/3}$ / $C_{50/10}$	EN 933-5
- shape of coarse grains	% by mass	SI_{20}	EN 933-4
- quotient U	-	section 2.2.3.1.1.3	-

- sand equivalent	%	SE_{60}/SE_{50}	EN 933-8
- resistance to crushing – quotient LA	%	LA_{30}/LA_{35}	EN 1097-2
- portion of organic admixtures	-	section 2.2.3.1.1.3.2	EN 1744-1
- bearing capacity – CBR method	%	40/80	TP BF-StB, B7.1
- modified Proctor test:			EN 13286-2
- optimum moisture content	% by mass	-	
- maximum density	t/m^3	-	
- measurements of placed aggregate mixture:			
- moisture content	% by mass	-	BAS
- compaction	%	section 2.2.3.1.1.5.1	BAS
- bearing capacity:		section 2.2.3.1.1.5.2	BAS
- dynamical modulus of deformation E_{vd}	MN/m^2		
- static modulus of deformation E_{v2}	MN/m^2		
- evenness, level, slope	-	section 2.2.3.1.1.5.3	BAS

2.2.3.1.1.6.2 Internal Control

Contractor's internal control to be carried out by an independent laboratory shall, during placing mineral aggregate mixtures into URB, establish conformity of the mixture with the design and these technical conditions.

Both type and frequency of testing within the scope of the internal control of placing mineral aggregate grains into the URB shall be determined and approved by the programme of the average frequency of the control. If this is not the case, it shall be specified by the engineer, who shall also determine locations of taking specimens, as well as locations of measurements, all in accordance with a random statistical pattern.

During placing mineral aggregate mixtures the laboratory shall take samples and verify the conformity. The frequency of these activities is specified in Table 3.4.

Samples of mineral aggregate mixtures shall generally be taken in the provisional deposit area (a portion of two thirds), and from the placed URB (a portion of one third).

Table 3.4: Minimum frequency of testing mineral aggregate mixtures upon internal control of placing into URB

Properties	Test method	Minimum testing frequency
- granulometric composition of mineral aggregate mixture	EN 933-1	$4{,}000m^2/1{,}000m^3$
- portion of grains of up to 0.063 mm	EN 933-1	$4{,}000m^2/1{,}000m^3$
- moisture content and density by Proctor	EN 13286-2	$4{,}000m^2/1{,}000m^3$
- portion of organic admixtures	EN 1744-1	$8{,}000m^2/2{,}000m^3$

The minimum testing frequency upon internal control of the placed mineral aggregate mixture in the URB is specified in Table 3.5.

Table 3.5: Minimum frequency of internal control testing of mineral aggregate mixture placed into URB

Properties	Test method	Minimum testing frequency
- moisture content and density	BAS	200 m^2
- bearing capacity:		
- dynamical modulus of deformation E_{vd}	BAS	400 m^2
- static modulus of deformation E_{v2}	-	2,000 m^2
- layer formation:		
- evenness	BAS	20 m^1
- level and slope	-	20 m^1

In agreement with the engineer the quality of mineral aggregate mixture placed into the URB may also be defined in compliance with other approved methods. In such a case, criteria for testing the quality of placed mixture as well as the mode and frequency of testing shall be indicated in the agreement.

2.2.3.1.1.6.3 External Control

The extent of the external control tests to be carried out by a third party institution employed by the client is usually in a ratio of 1:4 with the internal control testing.

Locations of taking samples of mineral aggregate mixes from both provisional deposit area and placed URB to carry out the tests within the scope of the external control of conformity shall be specified by the engineer by the statistical random selection method.

Taking samples for the external control, as well as testing and measurements at site shall be generally performed in the presence of both contractor and engineer.

2.2.3.1.1.7 Measurement and Take-Over of Works

2.2.3.1.1.7.1 Measurement of Works

Executed works shall generally be measured in accordance with section 2.1.7.1 of the general technical conditions, and calculated in cubic metres.

All the quantities shall be measured by the actually executed extent and type of works in compliance with the design.

2.2.3.1.1.7.2 Take-Over of Works

The executed URB shall be taken-over by the engineer after receiving information in writing on completion of the works, all in accordance with the quality requirements indicated in these technical conditions, and with the section 2.1.7.2 of the general technical conditions.

The contractor shall submit in due time to the engineer all the data and reports on the internal control, as well as a final conformity assessment issued by a third party institution.

All deficiencies found out shall be made good by the contractor prior to continuation of the works.

2.2.3.1.1.8 Final Account of Works

2.2.3.1.1.8.1 General

The executed works shall be accounted in compliance with section 2.1.7.3 of the general technical conditions.

Quantities defined in section 2.2.3.1.1.7.1 shall be accounted by the contract unit price.

The contract unit price shall include all services necessary to complete the works. The contractor has no right to claim any additional payment unless provided otherwise by the contract.

2.2.3.1.1.8.2 Deductions Due to Insufficient Quality

Mineral aggregate mixture

Due to unambiguously defined quality of mineral aggregate mixture for URB there are no deductions when accounting the quantities.

If the contractor places a mixture into the URB which does not comply with the requirements indicated in 2.2.3.1.1.3 of these technical conditions, the method of accounting shall be determined by the engineer.

- Quality of execution

The lower limiting value for

- compaction according to 2.2.3.1.1.5.1,
- bearing capacity according to 2.2.3.1.1.5.2,
- evenness and level according to 2.2.3.1.1.5.3

means a 100 % value of the offered unit price.

Due to unambiguously defined lower limiting value of quality of execution no deductions are practicable.

If the contractor fails to ensure the required quality of execution as specified in 2.2.1.1.5, the engineer shall decide on the method of accounting.

2.2.3.1.2 BOUND SUB-BASES

2.2.3.1.2.1 Description

The construction of sub-bases bound with binders includes the supply of corresponding mineral aggregate mixtures and binders, the production and placing of the mixture or asphalt mixture, and the maintenance of the mixtures in the bound roadbases at sites specified by the design.

This work shall be performed in dry weather, and the substrate and air temperature (at still weather without precipitations) during placing shall amount to

- 5°C to 25°C for mixtures
- above 0 °C for asphalt mixtures.

Bound (with binders) sub-bases are aimed above all for placing into pavement structures for heavier traffic loads, generally between the unbound roadbase (URB) and the bound roadbase (BRB). For lighter traffic loads, such a bound bound course of mineral aggregate mixtures can be the only bound roadbase in the pavement structure.

The type of the mixture or the asphalt mixture for SSB is generally specified by the design. If this is not the case, it shall be determined by the engineer.

2.2.3.1.2.2 Basic Materials

2.2.3.1.2.2.1 Mineral Aggregate Mixtures

For SSB all mixtures of natural, crushed and/or mixed stone grains are used. They are defined in section 3.2.3.1.1.2 of these technical conditions, and are compatible with the foreseen binders.

2.2.3.1.2.2.2 Binders

The following binders are applicable to SSB:

- hydraulic binders: Portland cement with additives of granulated furnace slag (CEM II/B-S), and/or pozzolans (CEM II/B-P),
- bituminous binders: bitumen B 50/70 and B 70/100,
- combined binders: cement and fly ash.

Unless provided by the pavement structure design, the type of bitumen in asphalt mixtures for SSB shall be specified by the engineer with regard to the binder quality, traffic load, and climatic conditions.

The contractor may, with permission of the engineer, use other binders, if he proves their use for bound sub-bases.

2.2.3.1.2.3 Quality of Materials

2.2.3.1.2.3.1 Granulometric Composition of Mineral Aggregate Mixtures

The quality of mineral aggregate mixtures for SSB is defined in detail in the following codes:

- EN 13242 Aggregates for unbound and bound (with hydraulic binders) materials used in civil engineering and pavement structures, and
- EN 13043 Aggregates for asphalt mixtures and surfacing for roads, airports, and other traffic surfaces.

For sub-bases bound with hydraulic binders and combined binders, mineral aggregate mixtures specified in section 2.2.3.1.1.3 of these technical conditions can be used. The size stone grains in the mixture is limited to 32 mm.

For sub-bases bound with bituminous binders, the composition of the used mineral aggregate mixture shall comply with the requirements indicated in Figures 3.5 and 3.6. If the percentage of grains of size up to 0.09 mm exceeds 10% by mass, such a mixture may be used on condition the the sand equivalent in the fraction 0/4 mm is greater than 50%.

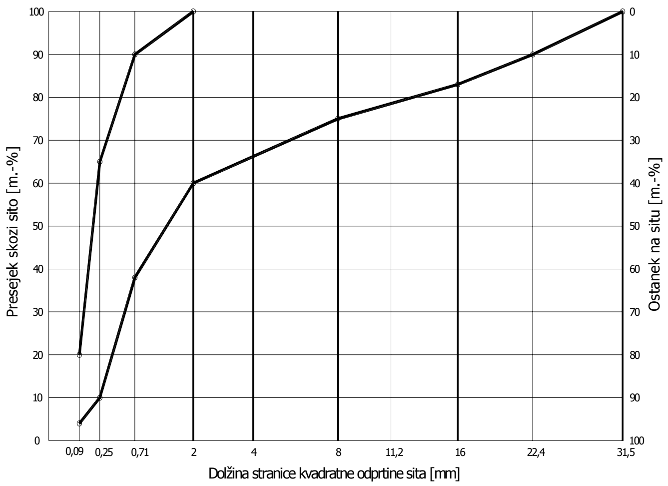


Fig. 3.5: Limit curves of granulometric composition of mineral aggregate mixtures of grains 0/22 mm for bound asphalt sub-bases *(translation of terms: see figure 3.1)*

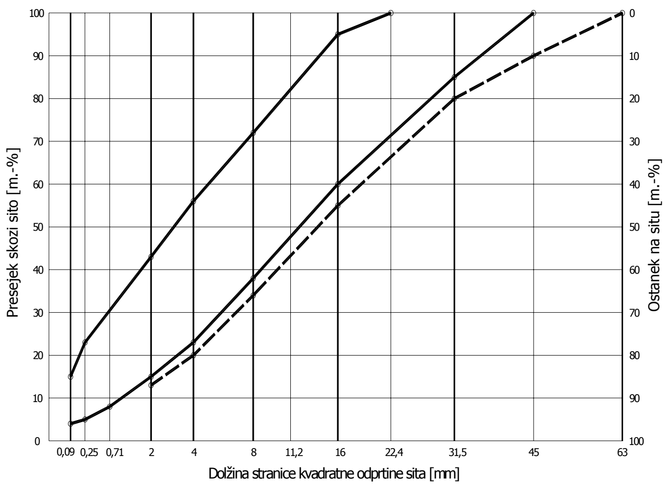


Fig. 3.6: Limit curves of granulometric composition of mineral aggregate mixtures of grains 0/32 mm and 0/45 mm for bound asphalt sub-bases *(translation of terms: see figure 3.1)*

The composition of mineral aggregate mixtures for SSB is specified in the design. If this is not the case, then a coarser granulometric composition of stone mixture shall be used for thicker bound courses, in the sense of and within the scope of these technical conditions.

The contractor is free to apply other granulometric compositions of mineral aggregate mixtures for SSB, provided that the suitability of such mixtures in specific conditions has been proven by an independent institution, and that its use has been approved by the engineer.

2.2.3.1.2.3.2 Properties of Mineral Aggregate Mixtures

Mineral aggregate mixtures for SSB shall have the following mechanical properties:

- resistance of stone grains to crushing specified as passing through sieve by the Los Angeles method (specified in the EN 1097-2) is admitted to amount to on roads
- with very heavy or heavy traffic loading no more than 30% (category LA_{30}),
- with medium or light traffic loading no more than 35% (category LA_{35}),
- resistance of mixtures to freezing defined (according to EN 1367-2) by the magnesium sulphate test, and expressed in terms of percentage of chipped particles from the original mass of the sample: the loss is allowed to be no more than 25 % by mass (category MS_{25}),
- no more than 20% by mass of grains which form (defined by the EN 933-4) does not correspond to the condition l : d ≤ 3 : 1 is admitted in the mixture (category SI_{20}),
- organic and other harmful admixtures in the mixture must still allow the production of a bound mixture or asphalt mixture in the specified quality (test according to EN 1744-1),
- the adhesion of grains to bituminous binder shall be such, that the surface of the specimen prepared according to the prescribed method is coated with bitumen at least by 90/70% as provided by the EN 12697-11.

Before beginning of works, each mixture of grains expected to be used in the SSB shall be tested in compliance with provisions indicated in sections 3.2.3.1.2.3.1 and 3.2.3.1.2.3.2 of these technical conditions. The number of specimens shall be directed by the engineer.

If the engineer has already permitted the contractor to use the same mineral aggregate mixture for placing into an URB or SSB, it is not necessary to repeat the testing of the mixture.

2.2.3.1.2.3.3 Properties of Binders

The required basic properties of binders for SSB are defined

- for hydraulic binder – cement in Table 3.6 (according to EN 196)
- for bituminous binders in Table 3.7 (according to EN 12591).

Table 3.6: Required cement properties for stabilizing mineral aggregate mixtures for SSB

Properties of cement	Unit measure	Required value	Test method
- fineness of grind (remainins on sieve 0.09 mm), maximum	% by m.	10	EN 196-6
- binding time			
- beginning, not before	h	1	EN 196-3
- end, not later	h	10	
- necessary water for standard consistency, max.	% by m.	31	EN 196-3

Table 3.7: Required bitumen properties for stabilizing mineral aggregate mixtures for SSB

Lastnosti bitumna	Unit measure	Type of bitumen B 70/100 Required value	B 50/70	Test method
- penetration at 25 °C	mm/10	70 to 100	50 to 70	EN 1426
- softening point by PK	°C	43 to 51	46 to 54	EN 1427
- breaking point by Fraass, max.	°C	- 11	- 8	EN 12593
- change after heating:				
- preserved penetration, min.	%	46	50	EN 1426
- softening, min	°C	45	48	EN 1427

The properties of combined binders shall ensure such properties of mixtures as specified by the design. As a rule, the requirements are the same as it applies to the mixtures bound with cement.

2.2.3.1.2.3.4 Water

For the preparation of mixtures for SSB made of mineral aggregate grains and hydraulic binder, only such natural or suitably processed standstill or running water may be used which properties comply with the requirements provided by the EN 1008, and in the Table 3.8.

Table 3.8: Required properties of water for stabilizing mineral aggregate mixtures for SSB

Properties of water	Unit measure	Required value	Test method
- pH value, minimum	-	6	EN 1008
- content of sulphates (SO_4^{2-}), maximum	mg/l	2,700	EN 196-2
- content of chlorides (Cl^-), maximum	mg/l	300	EN 196-21
- salt content (dry residue), maximum	mg/l	500	EN 1008

2.2.3.1.2.4 Method of Execution

2.2.3.1.2.4.1 Winning of Mineral Aggregate Mixtures and Binders

The contractor shall inform the engineer, in due time prior to commencement of the works, on the location of acquiring mineral aggregate mixtures and binders.

Evidences on conformity of mineral aggregate mixtures according to the requirements indicated in 2.2.3.1.2.3.1 and 2.2.3.1.2.3.2, as well as of binders according to the requirements indicated in 2.2.3.1.2.3.3 shall be submitted to the engineer in due time.

2.2.3.1.2.4.2 Preparation of Base Formation

As a base for SSB the following may be used:

- the formation of an URB, which shall be prepared in accordance with section 2.2.3.1.1.5 of these technical conditions, or
- the formation of a substructure (subgrade), which shall be prepared in compliance with section 2.4.5 of these technical conditions.

The construction of the SSB may begin when the supervising engineer takes-over the formation of the base under the specified requirements.

The contractor is obliged to maintain the formation of the base up to the beginning of placing the SSB in the same condition as it has been upon taking-over. All deficiencies shall be corrected subsequently, and evidence of this shall be submitted to the engineer.

2.2.3.1.2.4.3 Depositing of Mineral Aggregate Mixtures and Binders

If the contractor temporarily depostis mineral aggregate mixtures prior to placing them into the SSB, suitable location shall be prepared in advance. Such an area shall be protected from precipitations.

The equipment foreseen to store the cement shall be such as to prevent exposure of the cement to air humidity.

Storage tanks for bitumen shall be equipped with indirect heating and a thermometer. The maximum admitted temperature of the bitumen in the tank amounts to:

- for bitumen B 70/100 140 °C to maximum 160 °C,
- for bitumen B 50/70 150 °C to maximum 170 °C.

Stocks of mixtures of mineral aggregates and binders for SSB at depositing areas shall be available in such amounts as to ensure a continuous production of mixtures and asphalt mixtures for the SSB.

2.2.3.1.2.4.4 Production of Mixes and Asphalt Mixtures

The production of mixes of mineral aggregate mixtures, binders and water, and of asphalt mixtures shall be carried out mechanically at an adequate plant based on batch production, or exceptionally on continuous production.

Dosing facilities shall ensure the corresponding quantity of components in the mixture, and of bituminous compound by weight. Volumetric dosing is only admitted if approved by the engineer.

Mixtures can also be produced at the location of placing provided that a conformity certificate is submitted in advance. The engineer shall preliminarily approve such a production type.

Duration of mixing and other factors affecting the quality of coating of grains with the binder shall be so adjusted as to ensure a uniform mix or asphalt mixture.

Asphalt mixtures for SSB shall be produced by the hot process. The temperature of the produced asphalt mixture for SSB depends on the type of used bitumen. Upon leaving the mixer, the mixture temperature shall amount to

- 150 ± 10 °C to maximum 175 °C for bitumen B 70/100
- 160 ± 10 °C to maximum 180 °C for bitumen B 50/70

The produced mixture shall be transported to the construction site as soon as possible.

2.2.3.1.2.4.5 Bringing of Mixes and Asphalt Mixtures

Mixes or asphalt mixtures for the SSB may be brought to a suitably prepared base formation, which must not be frozen, only when this is approved by the supervising engineer.

Suitable vehicles shall be used for the transport – a tipper equipped for tipping backwards (into the surface finisher), and with a tarpaulin for protection of the load from drying, precipitations, cooling, and dust.

Internal surfaces (sides and bottom) of the metal tipping body shall be sprayed with water prior to loading mixes, whilst before loading asphalt mixtures it shall be sprayed with a solution to prevent sticking.

The number of vehicles for the transport of the mix or asphalt mixture to the construction site shall be adapted to the conditions for an even spreading, the capacity of the production machines, and the transport distance.

2.2.3.1.2.4.6 Placing Mixes and Asphalt Mixtures

The surface of the base onto which a mixture of mineral aggregate, hydraulic binder and water will be placed as a SSB, shall be moistened evenly with water in due time before beginning of spreading.

The surface of bound course in the existing base to which a asphalt mixture will be applied as a SSB shall be evenly sprayed with a cationic bituminous emulsion (0.2 – 0.4 kg/m^2) or another adequate binder in due time prior to commencement of spreading. The used binder shall be dry before spreading starts. If the base is an URB, spraying is not necessary.

Placing of the mixture or asphalt mixture into the SSB must be mechanical with a surface finisher. Exceptionally, manual spreading is permitted, if the use of machines is not feasible due to limited space. Manual spreading shall be approved by the engineer.

The minimum temperature of asphalt mixtures at the location of placing depends on the type of used bitumen, and amounts to:

- 120 °C for B 70/100
- 130°C for B 50/70

The optimum temperature for placing is by maximum 10°C to 30°C higher than the temperatures indicated above.

If permitted by the work conditions, placing of the SSB shall be performed at the same time over the whole width of the carriageway. If two surface finishers are introduced for spreading, one after the other, there shall be no difference in quality in the joint area.

When placing is carried out in several layers, longitudinal joints shall be shifted one to the other by at least 20 cm, whereas the transverse joints by at least 50 cm.

Any break in work shall be performed along the whole carriageway or traffic lane width, usually perpendicularly to the road axis and vertically. Deviations are only allowed with the consent of the engineer. Before continuing placing, the surface of the transverse joint shall be coated with bituminous emulsion or with cut-back bitumen, and the area of the transverse joint of the asphalt mixtures shall be pre-heated by indirect heating.

The spreading effect of the surface finisher in spreading the mix or asphalt mixture shall ensure compaction of at least 85%.

To ensure the required properties of the placed mixture, the water content may be greater by no more than 1.5% by mass than the optimum value by the modified Proctor method.

The whole procedure of production, transportation, placing, and compaction of the mixture is not allowed to last more than 2 hours.

The selected type of rollers and the method of compaction must ensure the greatest possible uniformity of the density or compaction of the mix or asphalt mixture over all the entire design width of the carriageway. Thus the layer width shall be increased by the design thickness plus 5 cm, unless this has already been foreseen by the design.

The placed mix or asphalt mixture shall be compacted from the edge towards the centre of the course, and from the lower to the upper edge of the course. Any stoppage of the roller on the spread course has to be prevented.

All places inaccessible to machines shall be compacted to the specified density by other means. The supervising engineer shall approve such means and direct conditions in which such means shall be used.

If a mix of mineral aggregates, hydraulic binder, and/or pozzolan and water is placed into the SSB, the traffic at the construction site can be admitted or the next course of the pavement structure can be placed only after the agent for protection of the layer surface has set. If a asphalt mixture is placed into the SSB, the traffic can be admitted or the next layer placed only after the mixture in the middle of the layer has dropped to approximately 30 °C.

The supervising engineer can specify other conditions to be fulfilled prior to admitting the traffic onto the SSB.

The placed layer of the mixture shall generally be after-treated at least 3 days by wetting, or by means of other suitable method to ensure protection from drying (spray application of a cationic emulsion of 0.8 kg/m^2, cover, overlay).

If a SSB is made of a mineral aggregate mixture, hydraulic binder, and water, then the required compressive strength and weather resistance shall be reached before freezing, or it shall be protected against cold weather by an adequate overlay. The supervising engineer shall decide on the need and method of protection.

2.2.3.1.2.5 Quality of Execution

At least 7 days in advance prior to starting placing a mixture or bituminous mixture for the SSB, the contractor shall submit to the engineer for approval a method statement, which shall include particularly the following:

- Preliminary composition of the mixture or asphalt mixture,
- Evidence of conformity of all the materials to be used,
- Programme of average frequency of both internal and external control,
- Description of work methods, and
- Information on the mechanization to be introduced.

Before the machines and equipment, on which the quality of the executed work depends, begin to operate, their ability to ensure a uniform quality in accordance with these technical conditions shall be ascertained.

All the machinery and equipment shall be certified and shall satisfy the design requirements as well as these technical conditions.

2.2.3.1.2.5.1 Preliminary (Laboratory) Composition

The contractor shall submit to the engineer a preliminary (laboratory) composition of the

- Mix of hydraulic or combined binder, mineral aggregate grains, and water, or
- Mix of bituminous binder and mineral aggregate grains, which are planned to be placed as a bound mixture if grains into the SSB.

The preliminary investigation shall include:

- Types and quantities of individual nominal grain-groups of mineral aggregate mixtures (in % by mass),
- Water quantity (for mixtures, in % by mass),
- Mechanical properties of mixes or asphalt mixtures.
- The preliminary composition of a asphalt mixture shall be specified in accordance with the TSC 06.730.

Besides the abovementioned preliminary composition (resulting from the preliminary laboratory investigation), the contractor shall also submit to the engineer. Suitable evidence of the source and suitable quality of all the materials used in the preliminary composition shall be submitted as well.

By the preliminary composition the contractor shall prove that the foreseen composition of mineral grains, binders, and water can achieve the quality of the mix or asphalt mixture as required by these technical conditions.

The preliminary composition of the asphalt mixture shall be given for the selected composition of mixtures of stone grains, and for at least five different quantities of added binder with a suitable increase of the percentage (0.3 to 0.4 % by mass), so that the mean composition is the closest to the proposed one. The properties of specimens of these asphalt mixtures shall be indicated for all 5 of the investigated compositions.

The contractor is prohibited to begin placing before getting approval from the engineer in view of the preliminary composition of the mix or asphalt mixture.

If the contractor has already placed a SSB last year with the same compositions of mineral grains and binders, then the preliminary composition may be taken from the already performed composition determined by internal testing. However, final decision shall be made by the engineer.

2.2.3.1.2.5.2 Properties of Test Specimens

Within the scope of the preliminary investigation of the composition of test specimens of mixes and asphalt mixtures, properties (indicated in Table 3.9) of basic materials, mixes, and asphalt mixtures for SSB shall be tested.

2.2.3.1.2.5.3 Demonstrative Production and Placing

The contractor shall test and prove suitability of the preliminary composition of the mixture or asphalt mixture by demonstrative production and placing into SSB after this has been approved by the engineer.

The location of demonstrative placing, generally on the contractual works, shall be approved by the engineer.

The average compaction of the placed mixture shall amount to at least 97% of the density determined on the preliminary composition of the mixture. The threshold limiting value of compaction is 94%.

The percentage of the binder in the mixture can be (relatively) by up to 8% greater or by up to 5% smaller than the optimum quantity assessed by the preliminary investigation.

The water content in the placed mix can be by up to 1.5% (by mass) greater than the optimum one, determined within the scope of the preliminary investigation.

The average compressive strength of test specimens of the placed mix after 7 days shall amount to at least 3.5 MN/m^2, whereas the lowest individual value shall be 2.5 MN/m^2, and the highest value shall not exceed 4.5 MN/m^2.

Resistance of the mix to freezing and thawing shall be assessed by the ratio of the average compressive strengths of the specimens exposed to freezing and thawing, to those of specimens maintained in normal conditions. The coefficient of resistance shall amount to 0.7 minimum.

The placed layer of a mix shall be protected from drying by spray application of a cationic emulsion (0.8 to 1.0 kg/m^2), which also ensures adhesion between the base and the overlaid course.

The thickness of the placed layer of a mixture and asphalt mixture may deviate from the design value by no more than -10%, whilst an individual value, exceptionally, by -30 mm maximum.

The level of formation of the placed SSB may deviate from the designed one by up to +10/- 15 mm, the evenness under a 4 m – straight edge by 15 mm maximum, and the fall by no more than ± 0,4% of the absolute value of the fall.

Production of a asphalt mixture for SSB can be considered as adequate, if:

- The composition of extracted mineral aggregate mixture is within the range defined by the preliminary investigation,
- The percentage of the bituminous binder is within the range of 0.5% by mass of the asphalt mixture with regard to the preliminary composition.

The average compaction of the placed asphalt mixture shall amount to at least 97% of the density determined on the preliminary composition of the mixture. The threshold limiting value of compaction is 94%.

The void content in the placed asphalt mixture may amount to no more than 12% by volume, whereas filling-up of voids in a mix of mineral grains with bituminous binder to no more than 40%.

Properties of mixtures or asphalt mixtures, which shall be re-tested upon demonstrative placing, are indicated in Table 3.10.

During production, transport, and placing of a asphalt mixture the bituminous binder may harden by up to 2 degrees.

If the contractor has already constructed a SSB in similar conditions with similar mixtures or asphalt mixtures within the period of no more than a year ago, the results of the executed composition can be adopted as the demonstrative production and placing. Final decision shall be made by the engineer.

The engineer shall approve contractor to perform regular production and working composition only after he examines the results indicated in the report on the demonstrative production and placing. The permit for a continuous production also includes the required properties of mixtures and asphalt mixtures, as well as requirements to be met by the internal production control foreseen in these technical conditions.

If any change occurs during production or placing the SSB, the contractor shall submit in writing his proposal of this modification to the engineer for approval.

Table 3.9: Required values of properties of basic materials, mixtures, and asphalt mixtures in the preliminary composition for SSB

Properties	Unit measure	Required value	Test method
- mineral aggregate mixture:			
- composition	% by m.	Section 2.1.2.3.1	EN 933-1
- resistance to crushing – Los Angeles quotient			EN 1097-2
- for heavy loading	%	LA_{30}	
- for lighter loading	%	LA_{35}	
- resistance to freezing	% by m.	MS_{25}	EN 1367-2
- shape of coarse grains	% by m.	SI_{20}	EN 933-4
- content of organic admixtures	-	Section 2.1.2.3.2	EN 1744-1
- adhesion to bituminous binder	%	90/70	EN 12697-11
- binders:			
- cement	-	Table 3.6	EN 196
- bitumen	-	Table 3.7	EN 12591
- water:	-	Table 3.8	EN 1008
- mixture:			
- percentage of binder (informatively)	% by m.	2	-
- test of density and moisture content by Proctor			EN 13286-2
- compressive strength after 7 days			EN 12390-2
(cylinders: D=15 cm, h=15 cm):			
- on average	MN/m^2	3.5	
- maximum/minimum	MN/m^2	4.5/2.5	
- resistance to freezing	-	0.7	-
- bitumininous mixtures:			
- stability	kN	5 – 4 – 3	EN 12697-34
- stiffness, minimum	kN/mm	1.5 – 1.2	EN 12697-34
- total void content, maximum	% by V.	10	EN 12697-8
- filling-up of voids with bitumen, minimum	%	45	-

Table 3.10: Required properties of mixtures and asphalt mixtures placed into SSB

Properties	Unit measure	Required value	Test method
mixture:			
- compaction	%	≥ 97	BAS
- water content [1)]	% by m.	< 1,5	BAS
- compressive strength (on average)	MN/m^2	3,5	EN 12390-2
- resistance to freezing		≥ 0,7	-
- layer thickness	mm	± 10	-
formation of layer [1)]:			
- level	mm	± 15	-
- evenness	mm	15	BAS
- slope (fall)	%	± 0,4	-
bitumininous mixture:			
- composition of mineral aggregate mixture[1)]	% by m.	Section 2.1.2.5.3	EN 933-1
- percentage of bituminous binder [1)]	% by m.	± 0.5	EN 12697-1
- compaction	%	≥ 97	BAS
- void content	% by V.	≤ 12	EN 12697-8
- filling-up of voids	%	> 40	EN 12697-8
- layer thickness [1)]	%	- 10	-
formation of layer [1)]:			
- level	mm	+10/-15	-
- evenness	mm	15	BAS
- slope (fall)	%	± 0.4	-

[1)] Deviation from requirements in the design or in the preliminary composition

2.2.3.1.2.6 Quality Control of Execution

2.2.3.1.2.6.1 Internal Control

Contractor's internal control shall, during placing SSB, establish conformity of the basic materials, as well as produced and placed mixtures and asphalt mixtures with the contract, design and these technical conditions.

Both type and frequency of testing within the scope of the internal control of the execution of SSB shall be determined and approved by the programme of the average frequency of the control. If this is not the case, it shall be specified by the engineer, who shall also determine locations of taking specimens, as well as locations of measurements, all in accordance with a random statistical pattern.

During placing mixtures and asphalt mixtures into SSB, the laboratory performing the internal control shall take test specimens and verify the conformity. The frequency of these activities is specified in Table 3.11.

Cores of asphalt mixtures for the internal control of conformity with the requirements shall be taken at locations of taking specimens of the mix produced by the hot method. Locations where cores have been taken shall be immediately after taking filled-up with a hot asphalt mixture of similar composition.

2.2.3.1.2.6.2 External Control

External control, which shall be carried out by an independent institution authorized by the client, comprises the following:

- Establishing conformity of the produced and placed mixture or asphalt mixture in comparison with the requirements provided by the design and these technical conditions, and
- Supervision of the internal control.

The extent of the external control testing generally amounts to one fifth of the tests performed within the scope of the internal control.

Properties of mixtures and asphalt mixtures for SSB, which conformity with the design requirements as well as the requirements indicated in these technical conditions shall be verified, have to be defined in an approved programme of the average frequency of the control. If this is not the case, they shall be specified by the engineer.

Test specimens for the external control of mixtures and asphalt mixtures shall generally be taken at the location of placing. Such locations shall be defined by the engineer.

Taking specimens for the external control as well as testing and measurements at site shall be, as a rule, carried out in the presence of both contractor and engineer.

Statistical analyses and comparisons of results of testing within the scope of both internal and external control represent a base for assessment of conformity of the executed works with the requirements, and for eventually necessary measures to make good any deficiencies.

The independent institution that performs the external control of conformity of mixtures and asphalt mixtures with the specified requirements, shall prepare an assessment of the conformity, and such a report shall be submitted to the engineer.

Table 3.11: Minimum frequency of testing of mixtures and asphalt mixtures within the scope of the internal control of placing into SSB

Properties	Test method	Minimum testing frequency
mineral aggregate mixture:		
- composition	EN 933-1	3,000 t
- properties – Table 3.9	EN 13043	15,000 t
- binder:		
- cement – Table 3.6	EN 196	300 t
- bitumen – Table 3.7	EN 12591	750 t
- water – Table 3.8	EN 1008	As necessary
mixture:		
- optimum moisture content and density	EN 13286-2	10,000 m^2
- percentage of binder – section 2.1.2.5.3	-	5,000 m^2
- compressive strength	EN 12390-2	5,000 m^2
- resistance to freezing		20,000 m^2
- density and moisture content	BAS	150 m^2
- layer thickness – section 2.1.2.5.3	-	200 m^2
- evenness, level, slope	BAS	200 m^2
produced asphalt mixture:		
- temperature	EN 12697-13	Three times a day
- mechanical and volume properties:		1,000 t
- percentage of binder – section 2.1.2.5.3	EN 12697-1	or at least once a day
- composition of extracted grain mix	EN 12697-2	
- volume mass (at 25 °C)	EN 12697-5	
- stability and stiffness (at 60 °C)	EN 12697-34	
- void content	EN 12697-8	
- filling-up of voids with bitumen	EN 12697-8	
placed asphalt mixture:		
core:		1,000 t
- void content	EN 12697-8	or at least once a day
- density/compaction	EN 12697-5	
- layer thickness	EN 12697-36	

- layer adhesion layers: - density - evenness - level, slope (fall)	BAS BAS BAS -	250 m^2

2.2.3.1.2.7 Measurement and Take-Over of Works

2.2.3.1.2.7.1 Measurement of Works

The executed works shall generally be measured in compliance with section 2.1.7.1 of the general technical conditions, and calculated in either square metres or cubic metres.

All the quantities shall be measured by the actually executed extent and type of work within the scope of the design. All the measurements shall be immediately recorded.

2.2.3.1.2.7.2 Take-Over of Works

The executed SSB shall be taken-over by the engineer after receiving information in writing on completion of the works, all in accordance with the quality requirements indicated in these technical conditions, and with the section 2.1.7.2 of the general technical conditions.

All deficiencies found out shall be made good by the contractor prior to continuation of the works, otherwise deductions for unsuitable quality of the executed work will be charged.

2.2.3.1.2.8 Final Account of Works

2.2.3.1.2.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in accordance with section 2.2.3.1.2.7.1 and taken-over according to section 2.2.3.1.2.7.2 shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment unless provided otherwise by the contract.

If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.1.2.8.2 Deductions Due to Unsuitable Quality

2.2.3.1.2.8.2.1 Quality of Materials

The quality of basic materials specified in 2.2.3.1.2.3 and Table 3.9 shall be ensured.

Due to unambiguously defined quality of materials for SSB there are no deductions when accounting the quantities.

If the contractor places into SSB such material, which does not comply with the requirement indicated in these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.1.2.8.2.2 Quality of Execution

For the assessment of the quality of execution and for the calculation of deductions due to unsuitable quality the necessary bases are indicated in 2.2.3.1.2.5.3 and Table 3.10.

If the contractor fails to ensure the required quality of execution, the engineer shall make a decision on the calculation method. If he establishes

- in the placed mixture an insufficient
  - content of hydraulic binder,
  - compaction of placed mixture,
  - compressive strength,
  - layer thickness, and
- in the placed asphalt mixture
  - an unsuitable filling of voids in mineral aggregate mixture with the binder,
  - an inadequate void content,

- an insufficient compaction,
- an insufficient layer thickness,

he has the right to put into force financial deductions, which shall be specified on the following bases:

for an insufficient content of hydraulic binder in the mix, where the optimum value assessed on the basis of the preliminary investigation is (relatively) exceeded by more than 8%, or if it is too low (relatively) by more than 5% (limiting values), the following equation shall apply:

$$FO = \frac{p^2}{100} \times 0{,}5 \times C \times PD$$

where:

FO - financial deduction (SIT)

p - deviation above the limiting values in % (relatively), however, taking into account individual values, by maximum 15% for excessive quantities, and by maximum 10% for insufficient quantities (relatively)

C - unit price of the executed work

PD - extent of the work carried out inadequately (m^2)

The deduction shall be assessed on the basis of the average value for the executed work.

Calculation of deduction: $FO' = p^2 \times 0{,}5$ (%)

p %	1	2	3	4	5	6	7	8	9	10
FO' (%)	0.5	2	4.5	8	12.5	18	24.5	32	40.5	50

for an insufficient compaction of the placed mixture (less than 97% by Proctor's modified test), the following equation shall apply:

$$FO = \frac{1}{100} \times (11p - 4{,}5) \times C \times PD$$

where:

p - % (absolute) of compaction below the required value (97 %)

Calculation of deduction: $FO' = 11p - 4{,}5$ (%)

p %	0.5	1	1.5	2	2.5	3
FO' (%)	1	6.5	12	17.5	23	28.5

for insufficient compressive strength of the mix, the following equation shall apply:

$$FO = \frac{p}{100} \times 2 \times C \times PD$$

where:

$$p = \frac{\sigma_z - \sigma_d}{\sigma_z} \times 100(\%)$$

σ_z - *required compressive strength (MN/m^2)*

σ_d - *attained compressive strength (MN/m^2)*

The deduction can be assessed on the basis of the average value of all the attained compressive strengths, or on the basis of the sum of deductions for individual test specimens. The higher value of the deduction is decisive.

Calculation of deduction: $FO' = p \times 2$ (%)

p %	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25
FO' (%)	5	10	15	20	25	30	35	40	45	50

for an insufficient filling up of voids in the mineral aggregate mixture with bituminous binder, if the achieved filling up of voids deviates from the optimum value assessed by the preliminary investigation of the asphalt mixture, the following equation shall apply:

$$FO = \frac{p^2}{100} \times C \times PD$$

where:

FO - financial deduction (SIT)

p - deviation from the optimum value, assessed by the preliminary investigation of the asphalt mix, however by no more than ± 5 % (relatively), i.e. up to the threshold values (%)

C - unit price of the work executed (SIT/m²)

PD - extent of the work carried out inadequately (m²)

Calculation of deduction: $FO' = p^2$ (%)

p %	0.50	1	1.50	2	2.50	3	3.50	4	4.50	5
FO' (%)	0,25	1	2.25	4	6.25	9	12.25	16	20.25	25

for an unsuitable void content in the asphalt mixture placed, if the optimum value assessed on the basis of the preliminary composition is exceeded, the following equation shall apply:

$$FO = \frac{p^2}{100} \times 6 \times C \times PD$$

where:

p - deviation from the optimum value assessed by the preliminary investigation of the asphalt mixture, however by maximum ± 2 % (relatively), i.e. up to the threshold values

Calculation of deduction: $FO' = p^2 \times 6$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
FO' (%)	0.24	0.96	2.16	3.84	6.0	8.64	11.76	15.36	19.44	24.0

for an insufficient compaction of the placed asphalt mixture compared to the test specimen by Marshall, the following equation shall apply:

$$FO = \frac{p^2}{100} \times 3 \times C \times PD$$

where:

p - deviation of the compaction of the laid asphalt mixture from the lower limiting value, however by no more than 3% (absolute), i.e. up to the lower threshold value

Calculation of deduction: $FO' = p^2 \times 3$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
FO' (%)	0.12	0.48	1.08	1.92	3.0	4.32	5.88	7.68	9.72	12.0	14.52	17.28	20.28	23.52	27.0

for an insufficient thickness of the placed mixture layer or asphalt mixture layer:

$$FO = \frac{p}{100} \times 3{,}75 \times C \times PD$$

where:

p - % of insufficient layer thickness exceeding the lower limiting value – 10% (with regard to the contractual layer thickness)

Calculation of deduction: $FO' = p \times 3{,}75$ (%)

p %	2	4	6	8	10	12	14	16	18	20
FO' (%)	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75

The deduction can be assessed on the basis of the average value of all the established layer thicknesses, or on the basis of the sum of deductions for individual established insufficient thicknesses. The higher value of the deduction is decisive.

A deduction for an average thickness, that is lower than the contractual thickness, up to the lower limiting value shall be accounted separately by reducing the unit price proportionally to the actually placed average thickness and contractual thickness of the layer.

Deviation of the placed SSB in the level and evenness shall be made good by suitable measures, where the design bearing capacity of the pavement structure must not be diminished. If such a situation cannot be settled adequately, the client has the right to reject the works.

If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations and performance liabilities remain valid and unchanged.

Other properties of mixtures and bituminous mixes, which exceed the defined limiting values, shall be ensured by the contractor without having the right to claim an extra payment.

2.2.3.1.3 BOUND ASPHALT BASE-BEARING AND BASE-WEARING COURSES

Technical conditions and procedures for the execution of bound asphalt base-bearing and base-wearing courses are described in detail in the TSC 06.310 Bound pavement base-bearing and base-wearing courses with bituminous binders.

2.2.3.1.3.1 Description

The execution of a bound pavement base-bearing course (BPBB) and a bound pavement base-wearing course (BPBW) includes the supply of suitable mixtures of stone aggregates and binder, as well as the production and placing of an adequate asphalt mixture at locations specified by the design.

These works shall only be carried out when no precipitations occur during placing, and when the air and substrate temperature is above 5°C. Exceptionally, asphalt mixtures may be placed at temperature of 0°C, provided that the substrate is dry and not frozen, and that there is no wind during placing.

For BPBB courses the following asphalt mixtures produced by hot procedure are applicable:

- bituminous gravel (BG),
- bituminous crushed gravel (BCG),
- bituminous crushed stone (BCS).

In view of the largest grains in an asphalt mixture, the following asphalt mixtures are generally used for asphalt bound pavement base-bearing (BPBB) and base-wearing (BPBW) courses:

- BPBB 16 and BPBB 16S
- BPBB 22 and BPBB 22S

- BPBB 32 and BPBB 32S
- BPBW 16

The design thicknesses of both BPBB and BPBW courses are indicated in Table 3.12.

Table 3.12: Limiting design thicknesses of asphalt mixture layers

Design thickness of layer	Unit measure	Asphalt mixture type			
		BPBB 16 BPBB 16M	BPBB 22 BPBB 22M	BPBB 32 BPBB 32M	BPBW 16
minimum	mm	50	60	80	50
maximum	mm	70	100	140	80

BPBB courses are intended, depending on the type of the mixture of mineral aggregate and binder, for construction of pavement structures for all the traffic loading types, generally between the unbound or bound subbase and bound base wearing course. Asphalt mixtures designated with "S" (skeletal, i.e. coarse-grained composition of mineral aggregate mixture) are intended particularly for roads with heavy traffic loading. They can be placed in one or two layers. For light traffic loading, one BPBB or BPBW course of suitable asphalt mix is sufficient.

The type of asphalt mixtures for both BPBB and BPBW courses shall generally be specified by the design. If this is not the case, the engineer shall make final decision.

2.2.3.1.3.2 Basic Materials

2.2.3.1.3.2.1 Mineral Aggregate Mixtures

Mineral aggregates applicable to BPBB and BPBW courses are indicated in Table 3.13.

Table 3.13: Applicability of mineral aggregate mixtures for BPBB and BPBW courses

Type of mineral aggregate	Group of traffic loading					
	EH	VH	H	M	L	VL
- crushed stone	+*1)	+*1)	+*1)	+	+	+
- crushed gravel	-	-	-	+	+	+
- gravel	-	-	-	-	+	+

Coarse-grained composition of mineral aggregate

The granulometric composition of mineral grains for BPBB and BPBW courses shall be specified by the engineer taking account of the traffic loading, layer thickness, and climatic conditions unless this is defined in the design.

The assessment of the group of traffic loading is defined in the TSC 06.511 Design, Traffic loading.

2.2.3.1.3.2.2 Bituminous Binders

Bituminous binders applicable to both BPBB and BPBW courses are indicated in Table 3.14.

Table 3.14: Applicability of bituminous binders for BPBB and BPBW courses

Group of traffic loading	Type of asphalt mixture	Type of bituminous binder								
		B 160/220	B 100/150	B,SB 1) 70/100	B,CB 1) 50/70	B,CB 1) 35/50	B,CB 1) 20/30	PmB2) 3	PmB2) 4	PmB2) 5
exceptionally heavy (EH)	BPBB »S«				+	+	+	+	+	+
very heavy (VH)	BPBB »S«				+	+	+	+	+	+
heavy (H)	BPBB »S«				+	+				
medium (M)	BPBB,			+	+	+				
	BPBB »S«			+	+	+				
light (L)	BPBB 16,22			+	+					
	BPBW	+	+	+	+					
very light (VL)	BPBB 16, 22			+	+					
	BPBW	+	+	+	+					

1) composite bitumen

2) polymer bitumen

The type of bituminous binder for BPBB and BPBW courses shall be specified in the design with regard to the binder quality, traffic loading, and climatic conditions. It shall be based on the results of the preliminary investigation of the asphalt mix.

If approved by the engineer, the contractor may also use other bituminous binders provided that suitable conformity certificates prove their application for BPBB and BPBW courses.

2.2.3.1.3.3 Quality of Materials

2.2.3.1.3.3.1 Granulometric Composition and Properties of Mineral Aggregate Mixtures

The quality of mineral aggregate mixtures for BPBB and BPBW courses is described in detail in the EN 13043 Aggregates for asphalt mixtures and surfacing for roads, airports, and other traffic surfaces.

Stone aggregates for asphalt mixtures of BPBB and BPBW courses shall generally be composed of grains of:

- stone dust,
- sand, and
- crushed stone, gravel, and crushed gravel.

For BPBB and BPBW courses a combined mineral aggregate mixture won by crushing, or a natural composition of gravel mixture can be used, if appropriate and approved by the engineer.

2.2.3.1.3.3.1.1 Sand

Sand is a mixture of natural and/or crushed mineral grains.

Requirements in view of the nominal granulometric composition of sand are indicated in Table 3.15.

Table 3.15: Required granulometric composition of sand

Length of sieve square opening side (mm)	Nominal sand fractions fine 0/2 mm	coarse 0/4 mm	Test method
	passing sieve (% by mass)		
0.09	maximum 10	maximum 10	EN 933-1
0.25	15 – 35	12 – 25	
0.71	40 – 85	33 – 70	
2	minimum 90	minimum 65	
4	100	minimum 90	
8	-	100	

The required properties of sand particle mixtures are indicated in Table 3.16.

Table 3.16: Required properties of sand particle mixtures

Properties of sand particle mixture	Unit measure	Required value natural sand	crushed sand	Test method
Content of particles up to 0.09 mm, maximum	% my m.	f_3 [1)]	f_{10} [1)]	EN 933-1
Sand equivalent, minimum	%	$SE_4 70$	$SE_4 60$	EN 933-8
Content of organic admixtures[2)]	% by m.	-	-	EN 1744-1

[1)] The content of larger particles is admitted, if a suitable value of the sand equivalent is ensured.

[2)] The colour of the NaOH solution must not be darker than the reference colour.

Crushed stone grains used for production of crushed sand shall be resistant to crushing and wearing by the Los Angeles method to the same extent as it is required for the mixture of crushed stone grains for the corresponding group of traffic loading.

2.2.3.1.3.3.1.2 Crushed Aggregate and Gravel

Required nominal granulometric compositions of crushed aggregate and gravel are indicated in Table 3.17.

Table 3.17: Required composition of grains of crushed aggregate and gravel

Length of sieve square opening side (mm)	Basic nominal fractions 2/4 mm	4/8 mm	8/16 mm	16/32 mm	Test method
	passing sieve (% by mass)				
0.09	max. 3	max. 1	max. 1	max. 1	EN 933-1
2	max. 15	max. 5	-	-	
4	min. 90	max. 15	max. 5	-	
8	100	min. 90	max. 15	max. 5	
16	-	100	min. 90	max. 15	
31.5	-	-	100	min. 90	
45	-	-	-	100	

The required properties of mixtures of grains of crushed aggregate or gravel for BPBB and BPBW courses are indicated in Table 3.18.

Table 3.18: Required properties of mixtures of crushed aggregate and gravel grains

Properties of mixtures of crushed aggregate and gravel grains	Unit measure	Required value	Test method
resistance of grains to crushing by Los Angeles test: passing sieve may amount to on roads with			EN 1097-2
- heavy traffic loading (crushed aggregate)	%	LA_{30}	
- other traffic loading (crushed aggregate and gravel)	%	LA_{35}	
resistance of grains to freezing (magnesium sulphate test)	% by m.	$MS_{25}2$	EN 1367-2
water absorption (on grain group of 4/8 mm)	% by m.	WA_{24}	EN 1097-6
coarse grain form	% by m.	SI_{20}	EN 933-4
portion of grain area coated with bitumen B100/150, minimum	%	90/70	EN 12697-11
content of organic admixtures[1)]	-	-	EN 1744-1

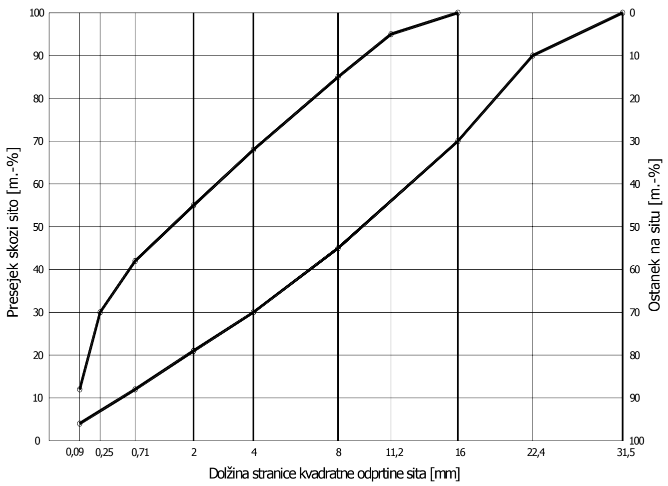
[1)] The colour of the NaOH solution must not be darker than the reference colour.

2.2.3.1.3.3.1.3 Total Granulometric Composition

For BPBB courses, asphalt mixtures composed of nominal fractions of stone particles of 0/16 mm, 0/22 mm, 0/32 mm, and exceptionally 0/45 mm may be used.

The defined ranges of the granulometric composition, i.e. grading curve limits, for mixtures of mineral grains for asphalt mixes are indicated in the figures below:

- Fig. 3.7 for BPBB 22
- Fig. 3.8 for BPBB 22S
- Fig. 3.9 for BPBB 32
- Fig. 3.10 for BPBB 32S
- Fig. 3.11 for BPBB 45
- Fig. 3.12 for BPBW 16



translation: presejek skozi sito = particles passing sieve, ostanek na situ = particles remaining on sieve

dolžina kvadratne odprtine sita = sieve square opening side length

Fig 3.7: Grading curve limits for mixtures of stone grains for BPBB 22

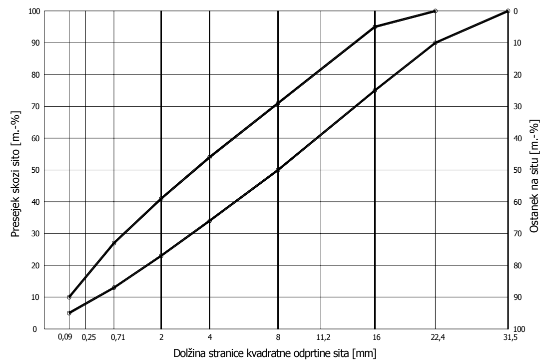


Fig. 3.8: Grading curve limits for mixtures of stone grains for BPBB 22S

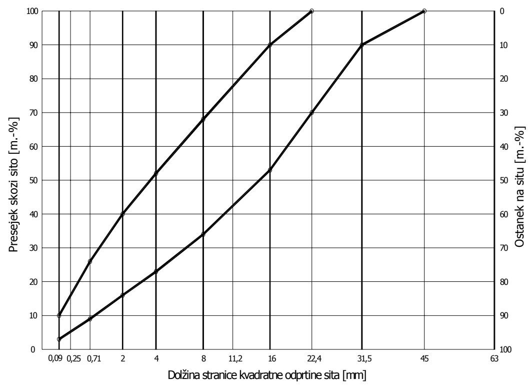


Fig. 3.9: Grading curve limits for mixtures of stone grains for BPBB 32

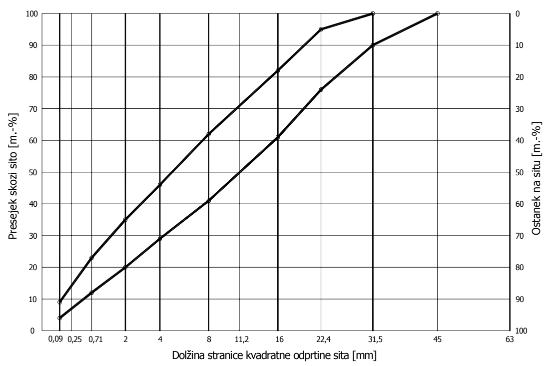


Fig. 3.10: Grading curve limits for mixtures of stone grains for BPBB 32S

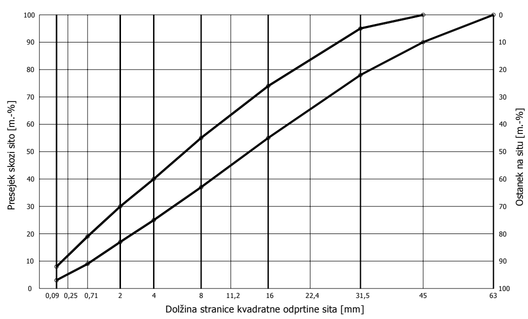


Fig. 3.11: Grading curve limits for mixtures of stone grains for BPBB 45

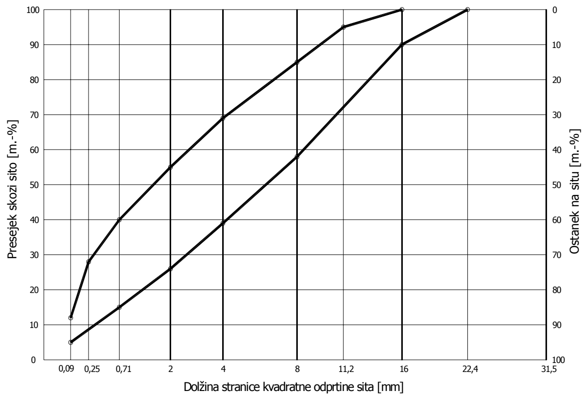


Fig. 3.12: Grading curve limits for mixtures of stone grains for BPBW16

efore commencing the works, the conformity of each mineral aggregate mixture, foreseen for BPBB and BPBW courses, with the design requirements and with the provisions of these technical conditions shall be tested in compliance with section 2.2.3.1.3.3.1 of these technical conditions.

In case that the engineer has already approved the use of identical mineral aggregate mixtures for execution of both BPBB and BPBW courses, re-testing of conformity is not necessary.

2.2.3.1.3.3.2 Binders

The quality of binders for BPBB and BPBW courses is defined in

- EN 12591 Bitumen and bituminous binders – Specifications for road bitumen, and
- EN 14023 Bitumen and bituminous binders – Specifications for bitumen modified with polymers.

The required basic properties of binders for asphalt mixtures for both BPBB and BPBW courses are indicated in Table 3.19.

Table 3.19: Required properties of road bitumen

Properties of bitumen	Unit measure	Type of bituminous binder						Test method
		B 160/220	B 100/150	B 70/100	B 50/70	B 35/50	B 20/30	
		required value						
penetration at 25 ˚C	mm/10	160-220	100-150	70-100	50-70	35-50	20-30	EN 1426
softening point	°C	35-43	39-47	43-51	46-54	50-58	55-63	EN 1427
breaking point by Fraass	°C	-15	-13	-11	-8	-6	-	EN 12593
change after heating to163 ˚C								
- penetration, minimum	%	37	43	46	50	53	55	EN 1426
- softening point, minimum	°C	37	41	45	48	52	57	EN 1427

In due time prior to commencement of the works the contractor shall submit suitable evidence of the conformity of bituminous binder to be used for either BPBB or BPBW courses, all in compliance with the section 2.2.3.1.3.3.2 of these technical conditions.

The engineer has the right to specify another binder, in particular if this is justified by traffic loading and climatic conditions. In such a case the engineer shall also define quality requirements for such binder.

2.2.3.1.3.3.3 Agents Ensuring Adhesion of Layers

Agents ensuring adhesion of an asphalt mixture in either BPBB or BPBW course to the underlay (bound roadbase or similar) shall be such as to provide a perfect and uniform bond of both layers.

An asphalt mixture underlay shall be sprayed with such an agent only where the traffic has removed the binder from the grains located on the top of that layer.

As a rule, to ensure mutual adhesion of layers, a cationic (polymer) bitumen emulsion containing at least 55% by mass of bitumen shall be used.

2.2.3.1.3.4 Method of Execution

2.2.3.1.3.4.1 Winning of Mineral Aggregates and Binders

In due time prior to commencement of works, the contractor is obliged to inform the engineer of the location and method of winning both mineral aggregate and binder for BPBB and BPBW courses.

The method of acquiring both mineral aggregate and binder shall be such as to ensure their constant and traceable quality.

The contractor shall submit to the engineer evidences of conformity of mineral aggregates and binders with requirements indicated in 2.2.3.1.3.3.1 for the aggregate, and 2.2.3.1.3.3.2 for the binder.

2.2.3.1.3.4.2 Preparation of Substrate Formation

The following can be used as a base for either BPBB or BPBW course:

- formation of bound roadbase (a mixture stabilized with bitumen), which shall be prepared in accordance with section 2.2.3.1.2.5.3 of these technical conditions,
- formation of unbound roadbase, which shall be prepared in compliance with section 2.2.3.1.1.5 of these technical conditions, or
- formation of mineral aggregate subgrade, which shall be prepared in accordance with section 2.2.2.4.5 of these technical conditions.

The contractor may commence to execute BPBB or BPBW course only after the engineer has taken-over the substrate formation in accordance with the specified requirements.

All the time up to the beginning of placing BPBB or BPBW course, the contractor is obliged to maintain the substrate formation in such a condition as it has been upon taking-over. All damage (including spray application to the substrate) shall be made good in due time, and an adequate evidence of the performed work shall be submitted to the engineer.

2.2.3.1.3.4.3 Depositing of Mineral Aggregates and Binders

When the contractor, prior to placing asphalt mixtures for either BPBB or BPBW course, provisionally deposits mineral aggregates, the foreseen location shall be suitably arranged and protected from precipitations in advance.

Stone dust shall be stored in a dry and closed space.

Tanks for storing bituminous binder shall be equipped with devices for an indirect heating, and with thermometers. The maximum admissible temperature of bitumen in the tank amounts to:

- for B 160/220 130 °C to maximum 150 °C
- for B 100/150 135 °C to maximum 155 °C
- for B 70/100 140 °C to maximum 160 °C
- for B 50/70 150 °C to maximum 170 °C
- for B 30/45 160 °C to maximum 180 °C
- for B 20/30 170 °C to maximum 190 °C

The optimum temperature of the bitumen in tanks is by 10 °C to 15 °C below the maximum admitted temperature.

Stocks of mineral aggregates and binders at deposit areas shall be such as to ensure a continuous production of asphalt mixes for BPBB or BPBW courses.

2.2.3.1.3.4.4 Production of Asphalt Mixtures

The production of asphalt mixtures shall be carried out mechanically at suitable plant for preparation of asphalt mixtures by means of batch mixers.

Dosing devices shall ensure an adequate quantity of components in the asphalt mixtures by mass. Dosing the components by volume may be carried out upon the engineer's consent.

The mixing time and other factors influencing the quality of coating aggregate grains with the binder shall be so adjusted as to ensure a homogenous asphalt mixture.

Asphalt mixtures for BPBB abd BPBW courses shall be produced by the hot procedure. At the moment when the asphalt mixture leaves the mixer, its temperature shall amount to:

- for B 160/220 130 °C to 150 °C, maximum 165 °C
- for B 100/150 135 °C to 155 °C, maximum 170 °C
- for B 70/100 140 °C to 160 °C, maximum 175 °C
- for B 50/70 150 °C to 170 °C, maximum 180 °C
- for B 35/50 160 °C to 180 °C, maximum 190 °C
- for B 20/30 170 °C to 190 °C, maximum 195 °C

The produced asphalt mixture may be, however only for a short period, stored in suitable silos at the asphalt base, or shall be immediately delivered to the location of placing BPBB or BPBW courses. From the beginning of production up to the placing, the bitumen shall not harden by more than 2 degrees of hardness.

2.2.3.1.3.4.5 Bringing Asphalt Mixtures

To a suitably prepared substrate formation, which must be neither dusty nor damp, asphalt mixture for bound pavement base-bearing and base-wearing courses can be brought after the engineer has approved the substrate appropriateness.

Asphalt mixtures shall be transported by means of suitable vehicles (dumper trucks) enabling an adequate protection of the asphalt mixture from precipitations, cooling, and pollution. Prior to loading an asphalt mixture, internal surfaces of metal caissons on lorries shall be sprayed with such an agent to prevent sticking together that does not affect the asphalt mixture harmfully.

When the asphalt mix is transported in a heated container, the distance of transport is limited to maximum 100 km, or the time of transport to maximum 2 hours. If this is not the case, the distance is limited to 70 km, and the time to 1.5 hours.

The number of vehicles to transport the asphalt mixture to the site shall be so adjusted as to ensure a uniform placing taking into consideration the duration of the transportation.

2.2.3.1.3.4.6 Placing Asphalt Mixtures

In due time prior to placing asphalt mixtures the surface of a clean substrate, to which an asphalt mixture will be placed as BPBB or BPBW course, shall be evenly sprayed with a cationic bituminous emulsion (0.3 to 0.5 kg/m2) or with another suitable binder to achieve adhering together of layers, if it has not been sprayed at all, or if the traffic has removed the bituminous film from the substrate surface. The sprayed-on agent for sticking the layers together shall be dry prior to placing the asphalt mix.

Placing of asphalt mixtures for BPBB or BPBW courses shall generally be performed mechanically by means of a finisher. Exceptionally, manual placing is allowed as well, if mechanical placing is not feasible for limited space. The engineer shall approve the manual placing.

Taking account of the type of the bitumen used in production, the following optimum temperatures of the bituminous mix at location of placing is recommended:

- for B 160/220 120°C to maximum 140 °C, not less than 110°C
- for B 100/150 125°C to maximum 145 °C, not less than 115°C
- for B 70/100 130°C to maximum 150 °C, not less than 120°C
- for B 50/70 140°C to maximum 160 °C, not less than 130°C
- for B 35/50 150°C to maximum 170 °C, not less than 140°C
- for B 20/30 160°C to maximum 180 °C, not less than 150°C

In windy weather the lowest temperature of the asphalt mixture for BPBB and BPBW courses shall not be less than by 10°C higher than the abovementioned temperature for the particular bitumen type. In case of manual placing, the temperature shall be by at least 20°C higher than the abovementioned values.

If work conditions permit, BPBB and BPBW courses shall be placed over the whole width of the carriageway at the same time. If two finishers situated one after another are used for spreading, the difference in quality of the placed layer of the asphalt mixture in the joint area must not be visible.

When placing asphalt mixtures for base-bearing courses in more layers, the longitudinal joints shall be dislocated one from another by at least 20 cm, whilst the transverse ones by minimum 50 cm.

Any interruption of work shall be executed perpendicularly to the road axis and vertically over the entire width of the carriageway or traffic lane. Any deviation from this is only allowed upon the engineer's consent. Before the continuation of placing, the surface of the transverse joint shall be coated with bituminous emulsion or with cut-back bitumen (at least 0.5 kg/m^2), and the area of the transverse joint shall be indirectly heated. A 15 cm wide zone in the joint area, and the inclined outer edge of the layer shall be coated as well.

The spreading effect of the finisher must ensure a compaction of at least 85% of the distributed asphalt mixture.

The selected type of rollers and the compaction method shall ensure the required density (compaction) as evenly as possible over the whole design width. Therefore, the width of the layer shall be increased by the design layer thickness unless provided otherwise by the design.

An asphalt layer of a BPBB or BPBW course shall be compacted from the edge towards the centre of the layer, and from the lower edge to the upper edge of the layer. Individual passages of rollers shall always overlap by 15 – 20 cm. Any staying of rollers on the placed layer, as well as sudden braking and accelerating, and change of direction of the roller shall be avoided.

All places inaccessible to machines shall be compacted to the required degree by other means, the use of which shall be approved by the engineer, who also specifies the conditions in which such means have to be used.

Traffic, or the beginning of placing the next layer, is allowed over the BPBB and BPBW course only after the asphalt mixture in the middle of the layer has cooled down to approximately 30°C. The engineer has the right to specify other conditions to be fulfilled prior to allowing the traffic over BPBB or BPBW course.

2.2.3.1.3.5 Quality of Execution

At least seven days prior to commencement of placing asphalt mixture for base-bearing or base-wearing course, the contractor shall submit to the engineer for approval a method statement, which shall comprise the following information:

- the preliminary composition of the asphalt mixture
- conformity certificates for all materials to be used
- a programme of average internal and external control
- a description of foreseen working procedures;
- an information on the mechanization;

Prior to commencement of the operation of machines and devices, which directly affect the quality of the works, their suitability to ensure a uniform quality in compliance with these technical conditions shall be verified.

All the equipment and machines shall be certified, and their capacity shall meet the requirements of both design and these technical conditions.

2.2.3.1.3.5.1 Preliminary (Laboratory) Composition of Asphalt Mixture

The contractor shall submit to the engineer a preliminary (laboratory) composition of the mixture of the bituminous binder and mineral aggregate, which he intends to place as an asphalt mixture for either BPBB or BPBW course.

The preliminary investigation of a asphalt mixture carried out as directed by the TSC 06.730 shall provide the following results:

- types and quyntities of individual nominal fractions of mineral aggregates (in % by mass),
- type and quantity of binder (in % by mass),
- type and quantity of bitumen additives,
- mechanical properties of the asphalt mixture.

Besides the preliminary composition, the contractor shall also submit an evidence of the source and suitable quality of all the materials used to prepare the preliminary composition.

The contractor shall demonstrate with the preliminary investigation (composition) that the foreseen mixture of mineral aggregates and binders can achieve the required quality of an asphalt mixture as specified in these technical conditions.

In case of foreseen periodical (seasonal, transient) increases of traffic loading, which can under certain climatic and ground conditions affect the performance of asphalt mixtures in the BPBB or BPBW courses, the conditions applying to the composition of the asphalt mixture shall be adjusted by classifying the road into the subsequent class of traffic loading.

The preliminary investigation shall be carried out with the selected composition of mineral aggregate grains, and at least five different quantities of added binder with a corresponding increase of the percentage (0.3 to 0.4% by mass) in such a way, that the mean composition is the closest to the proposed one. The properties of the asphalt mixture shall be indicated for all the five tested compositions.

The contractor must not begin placing until he has received an approval by the engineer for the preliminary composition of the asphalt mixture.

If the contractor has already placed a BPBB or BPBW last year with compositions of mineral grains and binders of the same properties, then the preliminary composition may be taken from the already performed composition determined by internal testing. However, final decision shall be made by the engineer.

2.2.3.1.3.5.2 Properties of Test Specimens

The required quality of mineral aggregates and bituminous binder for asphalt mixtures for both BPBB and BPBW courses is specified in detail in 2.2.3.1.3.3.

The required properties of test specimens of asphalt mixtures for both BPBB and BPBW courses are indicated in table 3.20.

Table 3.20: Required mechanical and volume properties (limiting values) of asphalt mixtures for a preliminary (laboratory) composition for BPBB and BPBW courses

Property of asphalt mixture	Unit measure	Required value for particular traffic loading					Test method
		extraordinarily heavy	very heavy and heavy	medium	light and very light BPBB	light and very light BPBW	
- stability at 60°C	kN	$S_{min12.5}$	S_{min10}	$S_{min7.5}$	S_{min5}	S_{min5}	EN 12697-34
- stiffness at 60°C	kN/m	Q_{min3}	Q_{min3}	$Q_{min2.5}$	Q_{min2}	$Q_{min2.5}$	EN 12697-34
- total void content	% by vol.	$V_{min5} – V_{max9}$	$V_{min4} – V_{max9}$	$V_{min4} – V_{max8}$	$V_{min3} – V_{max7}$	$V_{min1.5} – V_{max3.5}$	EN 12697-8
- void content in stone aggregate	% by vol.	to be tested					EN 12697-8
- filling up of voids in stone aggregate with bitumen	%	$VFB_{45} – VFB_{57}$	$VFB_{45} – VFB_{65}$	$VFB_{50} – VFB_{70}$	$VFB_{55} – VFB_{75}$	$VFB_{78} – VFB_{89}$	EN 12697-8

Test specimens of asphalt mixtures for BPBB courses on roads with a heavy traffic loading shall be prepared by 2 times 75 hammering blows.

The required value of the stability of the test specimen by Marshall is the lower limiting value.

The value of the Marshall-flow of the test specimen is indirectly assessed by the specified stiffness of the asphalt mixture.

The total void content in an asphalt mixture, and the filling-up of voids in a mixture of mineral aggregate with bitumen shall be within the range of the specified limiting values.

For roads with a heavy traffic loading and special climatic action, it is necessary, within the scope of the preliminary investigation of an asphalt mixture for BPBB courses, to verify the resistance to formation of ruts, which shall be carried out in accordance with the procedure defined in the EN 12697-22. The WTR or R_D category defined in the EN 13108-1 shall be assessed in dependence on the traffic loading specified in the design.

2.2.3.1.3.5.3 Demonstrative Production and Placing

The contractor shall verify the preliminary (laboratory) composition of the asphalt mixture at a suitable asphalt production plant, the transportation to the site, and placing for either BPBB or BPBW course after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and asphalt plant for production of asphalt mixtures for pavement base-bearing and base-wearing courses,
- establish suitability of transportation method and equipment for placing asphalt layers,
- take a specimen of the asphalt mixture at the location of placing to perform a conformity test,
- follow the process of thickenning of the asphalt mixture by means of a non-destructive test (with isotope gauge according to TSC 06.711),
- take cores at the location where asphalt mixture specimens have been taken,
- measure the density of the asphalt mixture placed at 30 locations.

The threshold values of mechanical and volume properties in compositions of asphalt mixtures for pavement base-bearing and base-wearing courses are indicated in table 3.21.

During production, transport, and placing of asphalt mixture the bituminous binder may harden by up to 2 grades.

If the contractor has already placed a BPBB or BPBW last year with compositions of mineral grains and binders of the similar properties and under similar conditions, then the preliminary investigation results may be taken as a demonstrative production and placing. However, the engineer shall make final decision.

In case that some changes occur in view of the mechanization used for placing, the demonstrative placing of the asphalt mixture shall be repeated. The engineer shall make final decision.

Table 3.21: Admissible threshold values of mechanical and volume properties of asphalt mixtures for

BPBB and BPBW courses

Property of asphalt mixture	Unit measure	Required value for particular traffic loading					Testing method
		extraordinarily heavy	very heavy and heavy	medium	light and very light		
					BPBB	BPBW	
- stability at 60°C	kN	S_{min10}	$S_{min7.5}$	S_{min5}	S_{min5}	S_{min5}	EN 12697-34
- stiffness at 60°C	kN/m	Q_{min3}	$Q_{min2.5}$	Q_{min2}	$Q_{min1.5}$	$Q_{min1.5}$	EN 12697-34
- total void content	% by vol.	$V_{min3.5} – V_{max10.5}$	$V_{min2.5}$ -$V_{max10..5}$	$V_{min2.5} – V_{max9.5}$	$V_{min1.5} – V_{max8.5}$	$V_{min0.5}– V_{max5.0}$	EN 12697-8
- void content in stone aggregate	% by vol.	to be tested					EN 12697-8
- filling up of voids in stone aggregate with bitumen	%	VFB_{min40} – VFB_{max62}	VFB_{min40} – VFB_{max70}	VFB_{min45} – VFB_{max75}	VFB_{min50} – VFB_{max80}	VFB_{min73} – VFB_{max94}	EN 12697-8

2.2.3.1.3.5.4 Routine Production and Placing

The engineer shall approve a routine production and a working composition not until the contractor has submitted the results of the demonstrative production and placing. The permission for a routine production also includes requirements for the asphalt mixture properties and for the control foreseen by these technical conditons.

The permission for a routine production and placing of an asphalt mixture for pavement base-bearing and base-wearing courses shall also comprise detailed requirements for an eventual additional spray application of an adhesive agent to the underlay surface according to section 2.1.3.4.6 of these technical conditions.

In case of any modification in production and placing of an asphalt mixture for base-bearing and base-wearing courses, the contractor shall submit to the engineer in writing his proposal for the particular modification. Such a modification shall only be implemented after being approved by the engineer.

The required limiting values of the compaction and void content for asphalt mixtures of both BPBB and BPBW courses are indicated in Table 3.22.

Table 3.22: Required limiting values of placed asphalt mixtures

Property of placed asphalt mixture	Unit measure	Required value for particular traffic loading					Test method
		exceptionally heavy	very heavy and heavy	medium	light and very light		
					BPBB	BPBW	
- layer compaction	%	≥ 98	≥ 98	≥ 98	≥ 97	≥ 96	BAS
- layer void content	V.-%	$V_{min5} – V_{max9}$	$V_{min4} – V_{max9}$	$V_{min4} – V_{max8}$	$V_{min3} – V_{max7}$	$V_{min1,5} – V_{max3,5}$	EN 12697-8

2.2.3.1.3.5.5 Layer Thickness

Limiting design thicknesses of asphalt mixtures for BPBB and BPBW courses are indicated in Table 3.12.

Average thickness of an asphalt mixture may be by up to 10% below the design thickness, whereas individual measured values by up to 25% below the design thickness (threshold value).

An individual measured thickness of an ahspalt mixture for BPBB abd BPBw courses is admitted to be by up to 10% greater than the design thickness.

2.2.3.1.3.5.6 Evenness, Level, and Slope of Formation

An unevenness of the formation of the asphalt bound pavement base-bearing and base-wearing course shall be established, in any direction with regard to the road axis, as a deviation below a 4 m long straight edge. The formation of the asphalt base-bearing or base-wearing course may deviate from the straight edge by maximum the following limiting value:

- on carriageways subjected to exceptionally heavy, very heavy and heavy traffic loading
  - - for machine placing in one layer ≤ 8 mm
  - for machine placing in two layers
  - on a lower layer ≤ 10 mm
- on carriageways subjected to other traffic loading types
  - - for machine placing ≤ 10 mm
  - - for manual placing ≤ 15 mm

The level of the individual measuring points on the formation of the base-bearing and base-bearing course shall be determined by levelling. In any place, the course formation may deviate from the design level by maximum +10 mm or – 15 mm (limiting values).

The slope of the formation of the asphalt base-bearing and base-wearing course shall be, as a rule, equal to both transverse and longitudinal fall of the carriageway. The allowable slope tolerances are defined by the admitted unevenness and deviation from the particular layer formation level. However, the allowable tolerances shall not exceed the design slope by more than ±0.4% (threshold value).

2.2.3.1.3.6 Quality Control of Execution

The quality of performed works and the conformity with the contractual requirements as well as the requirements provided by these technical conditions shall be checked by

- the internal control, and
- the external control.

2.2.3.1.3.6.1 Internal Control

Both type and frequency of testing within the scope of the internal control of asphalt mixtures in BPBB and NPBW courses shall be determined and approved by the programme of the average frequency of the control. If this is not the case, it shall be specified by the engineer, who shall also determine locations of taking specimens, as well as locations of measurements, all in accordance with a random statistical pattern.

During placing asphalt mixtures for BPBB and BPBW courses, the laboratory shall take test specimens and check the conformity of the properties to such a frequency as specified in Table 3.23.

Cores for testing the placed asphalt mixture shall be, as a rule, taken at locations where specimens of the hot produced asphalt mix have been taken. Immediately after taking a core, the borehole shall be filled-up with a hot asphalt mixture of similar composition.

The contractor shall regularly inform both engineer and/or institution authorized for the external control on the internal testing results. In case of any deviations from the required quality, the contractor shall take an adequate and prompt action.

2.2.3.1.3.6.2 External Control

The external control of the execution of BPBB and BPBW layers, which has to be performed by a third party institution authorized by the client, includes the following activities:

establishing conformity of the produced and placed asphalt mixture with the requirements provided by both design and these technical conditions, and

supervision of the internal control.

As a rule, the extent of the external control testing of produced and placed asphalt mixtures shall be in a proportion of 1:5 with regard to the internal control testing extent.

The approved programme of the average frequency of the external control shall define properties of asphalt mixtures, which conformity with the requirements is tested.

Test specimens for the external control of asphalt mixtures shall be generally taken at the location of placing, which shall be appointed by the engineer.

Taking test specimens for the external control, as well as the tests and measurements at the site shall be generally carried out in the presence of both contractor and engineer.

Table 3.23: Minimum frequency of testing asphalt mixtures upon internal control of placing for BPBB and BPBW courses

Property	Test method	Minimum testing frequency
- mineral aggregate mixture:		
- composition – Tables 3.30 and 3.31	EN 933-1	10,000 m^2
- properties – Tables 3.32 to 3.35	EN 13043	10,000 t
- bituminous binder:		
- bitumen properties – Tables 3.36 and 3.37	EN 12591	25 t 1)
- bitumen emulsion properties		15,000 m^2
- produced asphalt mixture:		
- temperature	EN 12697-3	3 times a day
- mechanical and volume properties:		750 t 2)
- bituminous binder content	EN 12697-1	
- composition of extracted mixture	EN 12697-2	
- volume mass (at 25° C)	EN 12697-5	
- stability and stiffness (at 60° C)	EN 12697-34	
- volume mass of specimens by Marshall (at 25 ° C)	EN 12697-6	
- void content	EN 12697-8	
- filling-up of voids with bitumen	EN 12697-8	
- resistance to re-shaping	EN 12697-22	2,000 t

- placed asphalt mixture:		750 t 2)
- core:		
- void content	EN 12 697-8	
- density/compaction	EN 12697-5	
- layer thickness	EN 12697-36	
- adhesion of layers	BAS	
- layer:		100 m^2
- density	BAS	
- evenness	BAS	
- level, slope	-	

1) Each tank lorry from a different source or at least once a day

2) Or at least once a day.

Statistical analyses and comparisons of testing results within the scope of both internal and external control represent a base for evaluation of conformity of executed works with the requirements, and for eventual necessary measures to mend the deficiencies.

The third party institution authorized to perform the external control of conformity of asphalt mixtures for BPBB and BPBW courses with the requirements shall prepare a written conformity assessment, which shall be submitted to the engineer.

2.2.3.1.3.7 Measurement and Take-Over of Works

2.2.3.1.3.7.1 Measurement of Works

The executed works shall be measured in accordance with section 2.1.7.1 of the general technical conditions and calculated in square metres.

All the quantities shall be measured by the actually performed extent and type of works within the scope of the design. The measurements shall be recorded in due time.

2.2.3.1.3.7.2 Take-Over of Works

The engineer shall take-over the placed BPBB and BPBW course after receiving a written notice from the contractor, all in accordance with the quality requirements indicated in these technical conditions, as well as with section 2.1.7.2 of the general technical conditions. The contractor shall make good any deficiencies established, prior to continuing the works, otherwise deductions for unsuitable performance of the works will be charged to him.

2.2.3.1.3.8 Final Account of Works

2.2.3.1.3.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in compliance with section 3.2.3.1.3.7.1 and taken-over according to section 3.2.3.1.3.7.2 of these technical conditions shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment unless provided otherwise by the contract.

If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.1.3.8.2 Deductions Due to Unsuitable Quality

2.2.3.1.3.8.2.1 Quality of Materials

The quality of basic materials defined in section 3.2.3.1.3.3 shall be ensured.

Due to unambiguously defined quality of materials for BPBB and BPBW courses there are no deductions when accounting the quantities.

If the contractor places into BPBB and BPBW courses such material, which does not comply with the requirement indicated in 3.2.3.1.3.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.1.3.8.2.2 Quality of Execution

Necessary bases to assess the quality of execution and to calculate deductions due to unsuitable quality of the asphalt mixture placed for BPBB and BPBW courses, are indicated in section 2.2.3.1.3.5.3 and in Tables 3.20, 3.21, and 3.22.

If the contractor fails to ensure the required quality of placed BPBB and BPBW courses, the engineer shall decide upon the method of accouting. When the engineer establishes deficiencies such as

- insufficient filling up of voids in stone aggregate with a binder,
- unsuitable void content in the asphalt mixture placed,
- insufficient compaction of the asphalt mixture placed,
- insufficient thickness of the layer laid, or
- unsuitable level and evenness of the formation of the course placed,

he is entitled to put into effect deductions, which shall be evaluated on the following bases:

For an insufficient filling up of voids in the stone aggregate with a bituminous binder,

Where the achieved filling up of voids deviates from the optimum value specified in Table 3.20, the following equation shall apply:

$$FO = \frac{p^2}{100} \times C \times PD$$

where:

FO = *financial deduction (SIT)*

p = *deviation above the limiting value, however by maximum* $\pm 5\%$ *(threshold value)*

C = *unit price of the work executed (SIT/m²)*

PD = *extent of the work carried out inadequately (m²).*

Calculation of deduction: $FO^{'} = p^2$ (%)

p %	0.50	1	1.50	2	2.50	3	3.50	4	4.50	5
FO' (%)	0.25	1	2.25	4	6.25	9	12.25	16	20.25	25

For an unsuitable void content in the asphalt mixture placed, if the void content specified by the preliminary investigation of the asphalt mixture (Table 3.22) is exceeded, the following equation shall apply:

$$FO = \frac{p^2}{100} \times 6 \times C \times PD$$

where:

p - deviation above the limiting value, however by maximum $\pm$ *2% (threshold value)*

Calculation of deduction: $FO^{'} = p^2 \times 6$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
FO' (%)	0.24	0.96	2.16	3.84	6.0	8.64	11.76	15.36	19.44	24.0

For an unsuitable compaction of the asphalt mixture placed (compared to the specimen by Marshall – Table 3.22), the following equation shall apply:

$$FO = \frac{p^2}{100} \times 3 \times C \times PD$$

where:

p - deviation of compaction of the placed asphalt mixture from the lower limiting value, however by maximum 3% (absolute value), (lower threshold value)

Calculation of deduction: $FO^{'} = p^2 \times 3$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
FO' (%)	0.12	0.48	1.08	1.92	3.0	4.32	5.88	7.68	9.72	12.0	14.52	17.28	20.28	23.52	27.0

For insufficient thickness of the asphalt layer placed:

- for a deviation of the average or individual thicknesses from the contractual value (Table 3.12) by up to 10%, the contract price shall be cut down linearly;
- - for a deviation of individual thicknesses by > 10% to 25%, an additional contract price reduction shall be carried out applying the following equation:

$$FO = \frac{p}{100} \times 3{,}75 \times C \times PD$$

where:

p - percentage of the insufficient individual layer thickness (above -10% to - 25% of the design/contract thickness)

Calculation of deduction: $FO^{'} = p \times 3{,}75$ (%)

p %	2	4	6	8	10	12	14	16	18	20
FO' (%)	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75

For unsuitable formation evenness of the base-wearing course, the following equation shall apply:

$$FO = \sum \left(p_i^2 \times A_i\right) \times 0{,}6 \times C$$

where:

p_i *= deviation of the evenness above the limit value specified in section 3.2.3.1.3.5.6 (mm)*

A_i *= corresponding zone width of an uneven formation (m)*

The contractor shall make good any excessive deviation of the formation evenness of a base-wearing course. He shall introduce such measures as not to reduce the pavement design bearing capacity. In case that the contractor fails to mend the established effects, the client/engineer is entitled to reject the work executed.

The contractor shall ensure other properties of asphalt mixtures, which exceed the limiting values indicated in these technical conditions, without having the right to claim any extra payment for such works.

2.2.3.2 WEARING AND SEALING COURSES

General

Wearing and sealing courses are constituent parts of the pavement structure located above the bearing courses to the pavement surface.

Wearing courses are either unbound, or bound with organic or hydraulic binders. They shall be placed in dimensions specified by the design, and in compliance with these technical conditions.

3.2.3.1.1 UNBOUND WEARING COURSES

Technical conditions and methods of construction of unbound wearing courses are described in detail in the TSC 06.200 Unbound bearing and wearing courses.

2.2.3.2.1.1 Description

The execution of an unbound (mechanically stabilized, macadam) wearing course (UWC) comprises supply and placing of suitable mineral aggregate mixture at locations specified by the design.

This work shall be carried out in weather without precipitations and with air temperature above 2°C.

As a rule, UWC can only be used for pavements for a very light traffic load or as a provisional stabilization of the pavement surface.

2.2.3.2.1.2 Basic Materials

Basic materials for UWC are mixtures of crushed and naturally crushed mineral grains, gravel, mixed stone grains, and grains of secondary materials. Granulometric compositions of 0/22 mm, 0/32 mm, and 0/45 mm as the basic ones, and of 0/8 mm for pinning are applicable.

2.2.3.2.1.3 Quality of Materials

2.2.3.2.1.3.1 Granulometric Composition of Mineral Aggregate Mixtures

Mixtures of crushed or natural mineral grains, mixed mineral aggregates, and mixtures of secondary materials for an UWC shall be composed of

- basic granulometric composition, which shall be as coarse-grained as possible, and
- granulometric composition for pinning.

The required basic coarse-grained granulometric compositions for UWC are indicated in Figures 3.2, 3.3, and 3.4. The curve of the composition of mineral aggregate mixtures shall be as close as possible to the corresponding lower grading limit curve.

The adequate range of the granulometric composition of mineral aggregate mixtures for pinning is specified by the limit curves indicated in Fig. 3.13. As a rule, mixtures of crushed mineral grains shall be used for pinning. Naturally crushed mineral grains may be used exceptionally only.

The remaining properties of the mineral aggregate for the basic coarse-grained composition are specified in section 3.2.3.1.1.3.1 of these technical conditions.

For pinning, the required value of the sand equivalent shall amount to at least 40%.

2.2.3.2.1.3.2 Properties of Mineral Aggregate Mixtures

Mechanical properties of mineral aggregate mixtures for the basic UWC structure are defined in section 3.2.3.1.1.3.2.

The following mechanical properties are required for mineral aggregate mixtures for pinning:

- the resistance of mineral grains against freezing action is determined (according to EN 1367-2) by means of a test with magnesium sulphate, and expressed by the percentage of chipped particles of the original mass sample is allowed to amount to 25% by mass (category MS_{25}).
- Organic compounds in mixtures of mineral grains may colour a 3% solution of sodium hydroxide darker than the reference colour (according to the EN 1744-1).

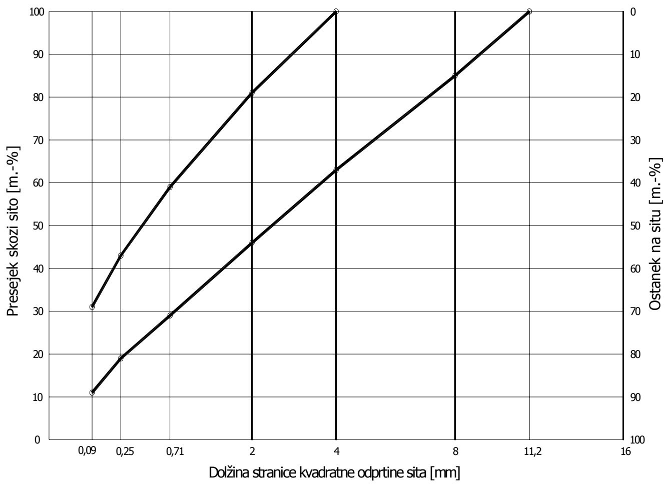


Figure 3.13: Grading curve limits for mineral aggregate grains of 0/8 mm for pinning unbound wearing courses

2.2.3.2.1.4 Method of Execution

2.2.3.2.1.4.1 Winning of Mineral Aggregate Mixtures

Conditions for winning mineral aggregate mixtures for the basic skeleton (coarse-grained structure), and for pinning of UWC are defined in section 2.2.3.1.1.4.1 of these technical conditions.

2.2.3.2.1.4.2 Preliminary Testing

Requirements for preliminary technological testing of mineral aggregate mixtures for UWC are the same as indicated in section 2.2.3.1.1.4.2.

2.2.3.2.1.4.3 Preparation of Substrate Formation

Provisions indicated in section 2.2.3.1.1.4.3 shall apply as appropriate.

2.2.3.2.1.4.4 Depositing of Mineral Aggregate Mixtures

To depositing mineral aggregate mixtures for UWC, provisions indicated in section 2.2.3.1.1.4.4 apply as appropriate.

2.2.3.2.1.4.5 Bringing Mineral Aggregate Mixtures

Basic coarse-grained (skeleton) aggregate mixture and mineral aggregate mixture for pinning shall be brought apart. To all other issues, provisions indicated in section 2.2.3.1.1.4.5 apply as appropriate.

2.2.3.2.1.4.6 Placing Mineral Aggregate Mixtures

To placing skeleton (coarse-grained) base of mineral aggregate mixture, provisions indicated in section 2.2.3.1.1.4.6 apply as appropriate.

Stone aggregate mixtures for pinning shall be distributed over the already constructed layer of the coarse-grained (skeleton) basic mineral aggregate mixture, in such a quantity which is necessary for a complete filling of voids on the layer surface, and for covering. The necessary quantity of water for rinsing the mineral aggregate mixture into the surface of the coarse-grained (skeleton) basic mixture for UWC shall be evenly added by sprinkling. Lighter static rollers shall be introduced to final compaction. A 15 cm layer is a condition for an adequate execution of work during placing UWC.

2.2.3.2.1.5 Quality of Execution

Before the machines and equipment from which the quality of the executed work depends begin to operate, their capacity for ensuring a uniform quality in accordance with the requirements of these technical conditions shall be verified.

All the equipment and machines shall be certified and shall satisfy the demands of the design in view of capacity.

2.2.3.2.1.5.1 Compaction

To the compaction of mineral aggregate mixtures placed into UWC, provisions indicated in section 2.2.3.1.1.5.1 shall apply.

2.2.3.2.1.5.2 Bearing Capacity

The load bearing capacity of the UWC determined by the static modulus of deformation E_{v2} and the dynamic modulus of deformation E_{vd} shall comply with the requirements indicated in Table 3.24 .

Table 3.24: Required values of moduli of deformation on UWC formation

Type of basic mineral aggregate mixture	Required value		
	E_{v2} MN/m^2	E_{v2}/E_{v1}	E_{vd} MN/m^2
- crushed, naturally crushed	≥ 100	≤ 1.8	≥ 45
- natural rounded off	≥ 80	≤ 2.2	≥ 35
- mixed, of secondary materials	≥ 90	≤ 2.0	≥ 40

To other issues, provisions indicated in section 2.2.3.1.1.5.2 apply.

2.2.3.2.1.5.3 Evenness, Level, and Slope of Formation

To these characteristics of the UWC formation, requirements indicated in section 3.2.3.1.1.5.3 shall apply.

2.2.3.2.1.6 Quality Control of Execution

2.2.3.2.1.6.1 Internal Control

Specifications indicated in section 2.2.3.1.1.6.2 apply to the internal control of skeleton (coarse-grained) basic mineral aggregate mixes.

The minimum internal control tests of mineral aggregate mixes for pinning include the following:

- composition of mineral aggregate mixtures every 4,000 m^2
- resistance of grains to freezing action every 8,000 m^2
- organic additive content every 8,000 m^2

The minimum internal control testing shall be executed for both mixtures of stone grains simultaneously. The requirements for the extent of both testing are stated in section 2.2.3.1.1.6.2.

2.2.3.2.1.6.2 External Control

To the external control of the UWC, provisions indicated in item 2.2.3.1.1.6.3 shall apply.

2.2.3.2.1.7 Measurement and Take-Over of Works

For measuring and taking-over the executed works within the scope of the UWC, all the requirements indicated in sections 2.2.3.1.1.7.1 and 2.2.3.1.1.7.2 apply.

2.2.3.2.1.8 Final Account of Works

To the final account of works, requirements indicated in section 2.2.3.1.1.8 apply.

2.2.3.2.2 BOUND ASPHALT WEARING AND SEALING COURSES – BITUMINOUS CONCRETE

Technical conditions and methods of construction of bound asphalt wearing and sealing courses of bituminous concrete are described in detail in the TSC 06.411.

2.2.3.2.2.1 Description

The construction of bound asphalt wearing and sealing course (BWSC) made of bituminous concrete includes the supply of corresponding mineral aggregate mixtures and bituminous binder, the production and placing of asphalt mixture at locations specified in the design.

This work shall be carried out in weather when there is no precipitation, the weather is still, and the temperature of the substrate and air is above 5°C. Exceptionally, a bituminous concrete BWSC may be placed onto a dry and non-frozen substrate at still weather at temperature of 3°C, if the asphalt layer thickness is in the upper range of the specified technological (design) thickness, as provided by the Table 3.27 or 3.28, on condition that this is approved by the engineer.

In view of the size of the largest stone grains in the bituminous concrete mix, as well as of their origin, the following asphalt mixtures are applicable to BWSC:

- bituminous concrete BC 4k, BC 4ks, BC 4sk, BC 4s
- bituminous concrete BC 8k, BC 8ks, BC 8sk, BC 8s
- bituminous concrete BC 11k, BC 11ks, BC 11sk, BC 11s

Bituminous concrete mixtures

- designated with »k« contain grains of carbonate stone of sedimentary origin only,
- designated with »ks« contain grains of sand of carbonate stone, and grains of crushed silicate stone of eruptive origin,
- designated with »sk« contain grains of sand of silicate stone, and grains of crushed carbonate stone
- designated with »s« contain grains of sand, and crushed silicate stone.

BWSC of bituminous concrete mixtures are intended, depending on the mineral aggregate and binder type, for pavement structure wearing and sealing course, or sealing course below the wearing course of an asphalt mixture of open composition for all traffic loading groups.

The use of bituminous concrete mixtures for BWSC for characteristic traffic loading groups is indicated in Table 3.25, whereas for characteristic traffic densities in Table 3.26.

The method of how to assess the traffic loading in defined in detail in the TSC 06.511 Design, Traffic loading.

Table 3.25: Fields of application of bituminous concrete mixtures for wearing and sealing courses in dependence on the average annual daily traffic loading

Group of traffic loading	AADT loading (nominal axle load 82 kN)	Vrsta bituminizirane zmesi							
		BB 4k	BB 4ks BB 4sk BB 4s	BB 8k	BB 8ks BB 8sk	BB 8s	BB 11k	BB 11ks BB 11sk	BB 11s
exceptionally heavy (EH)	> 3,000	-	-	-	-	+	-	-	+
very heavy (VH)	> 800 to 3,000	-	-	-	-	+	-	-	+
heavy (H)	> 300tdo 800	-	-	-	-	+	-	-	+
medium (M)	> 80tdo 300	-	+	-	+	+	-	+	+
light (L)	> 30 to 80	-	+	+	+	-	+	+	-
very light (VL)	≤ 30	+	+	+	+	-	+	-	-
footways, cycle tracks, parking places, and emergency lanes on motorways	-	+	-	+	-	-	+	-	-

Table 3.26: Fields of application of bituminous concrete mixtures for wearing and sealing courses in dependence on the average annual daily traffic volume

Traffic volume group	AADT volume	Type of asphalt mixture								
		BC 4			BC 8			BC 11		
		Type of stone [1]								
		k	ks sk	s	k	ks sk	s	k	ks sk	s
exceptionally high	> 20,000	-	-	-	-	-	+	-	-	+
very high	> 10,000 to 20,000	-	-	-	-	-	+	-	-	+
high	> 5,000 to 10,000	-	-	-	-	-	+	-	-	+
medium	> 2,000 to 5,000	-	+	+	-	+	+	-	+	+
low	> 1,000 to 2,000	-	+	+	-	+	+	-	+	-
very low	≤ 1,000	+	+	-	+	+	-	+	+	-

[1] When selecting the type of grains in the asphalt mixture, such stone is preferential, which is more resistant to smoothing.

The design (technological) layer thicknesses of bituminous concrete for BWSC for new road construction are indicated in Table 3.27, whilst for the works on existing roads in Table 3.28.

Table 3.27: Limiting design layer thicknesses of bituminous concrete mixtures for BWSC in new road construction

Design thickness plasti	Unit measure	Type of asphalt mixture		
		BC 4	BC 8	BC 11
- minimum	mm	20	30	35
- maximum	mm	30	45	50

Table 3.28: Limiting design layer thicknesses of bituminous concrete mixtures for BWSC for works on existing roads

Design thickness plasti	Unit measure	Type of asphalt mixture		
		BC 4	BC 8	BC 11
- minimum	mm	20	25	30
- maximum	mm	30	45	50

As a rule, the type of the asphalt mixture for BWSC shall be specified by the design. If this is not the case, the engineer shall make a final decision.

2.2.3.2.2.2 Basic Materials

2.2.3.2.2.2.1 Mineral Aggregate Mixtures

For bituminous concrete for BWSC particularly mixtures of crushed mineral aggregates shall be used. Only for a very light traffic loading, mixtures of natural stone grains may be used.

If the type of mineral aggregate mixture is not specified by the design, the engineer shall specify it in view of the traffic loading and traffic volume, as well as of climatic conditions and layer thickness.

2.2.3.2.2.2.2 Bituminous Binders

As a binder for bituminous concrete for BWSC, standard road bitumen (B) or polymer bitumen (PmB) of adequate properties in view of the foreseen traffic and climatic conditions, as well as of production and placing shall be used.

The applicability of types of standard bituminous binders is indicated in Table 3.29.

Table 3.29: Applicability of types of road and polymer bitumen for mixtures of bituminous concrete for BWSC in dependence on the traffic loading

Traffic Loading group	Type of bituminous concrete								
	B 160/220	B 100/150	B 70/100	B 50/70	B 30/45	PmB 2	PmB 3	Pm B 4	PmB 5
Exceptionally heavy EH	-	-	-	+	+	+	+	+	-
Very heavy VH	-	-	-	+	+	+	+	+	-
Heavy H	-	-	-	+	+	-	+	+	-
Medium M	-	-	+	+	+	-	+	+	+
Light L	+	+	+	-	-	-	-	+	+
Very light L and footways, cycle tracks, etc.	+	+	+	-	-	-	-	-	+

If the type of the bituminous binder is not specified by the design, the engineer shall specify it taking account of the foreseen application conditions. The engineer has also the right to direct a change of the bituminous binder type, if this is justified by both traffic loading and climatic conditions.

After receiving the engineer's approval, the contractor can use other types of bitumen as well, on condition that he proves their applicability by suitable evidence.

2.2.3.2.2.3 Quality of Materials

2.2.3.2.2.3.1 Mineral Aggregate Mixtures

Mineral aggregates for mixtures of bituminous concrete for BWSC shall be composed of grains of

stone dust,

sand, and

crushed stone and/or gravel.

The quality of mineral aggregate mixtures for BWSC is defined in detail in the EN 13043 Aggregates for asphalt mixtures and surfacing for roads, airports, and other traffic surfaces.

2.2.3.2.2.3.1.1 Stone Dust

For mixtures of bituminous concrete for BWSC for roads with medium or heavy loading, stone dust of the quality class I produced of carbonate stone shall be used as a rule.

Recovered stone dusts won during the production of asphalt mixtures by de-dusting silicate grains must not be used as added (foreign) stone dust.

Properties of stone dust used to produce bituminous concrete mixtures shall meet the requirements indicated in Table 3.30.

Table 3.30: Required properties of stone dust

Properties of stone dust		Quality class I	Quality class II	Test method
		Passing sieve (% by mass)		
- granulometric com. (length of side of sieve square opening (mm)	0.063	60 to 85	50 dt 85	EN 933-1
	0.09	80 to 95	65 to 95	
	0.25	95 to 100	95 to 100	
	0.71	100	100	
- void content in filler in dry-compacted condition (% by vol.)		$V_{28/38}$		EN 1097-4
- index of bitumen hardening		To be indicated		EN 13179-1

3.2.3.1.1.1.1.1 Sand

Crushed and natural sand of GF_{85} category may be used for bituminous concrete mixtures for BWSC.

For roads with heavy traffic loading and high traffic volume, silicate stone sand of granulometric composition of 0/2 mm shall be used.

The required composition of sand grain mixtures for bituminous concrete mixes for BWSC is indicated in Table 3.31.

Table 3.31: Requirements for composition of sand grain mixtures

Length of side of sieve squatre opening (mm)	Natural and crushed sand fine 0/2 mm	Natural and crushed sand Coarse 0/4 mm	Test method
	Passing sieve (% by mass)		
0.09	0 – 10[1)]	0 – 10	EN 933-1
0.25	15 – 35	12 – 25	
0.71	40 – 85	33 – 70	
2	90 – 100	65 – 100	
4	100	90 – 100	
8		100	

1) For sand won by crushing silicate stone the maximum admissible amount of passing sieve is 5% by mass.

Fine crushed sand is applicable to bituminous concrete mixtures for BWSC on roads with all types of traffic loading, whereas coarse sand only on roads with medium and light traffic loading.

Natural sand is suitable to bituminous concrete mixtures on roads with light traffic loading, as well as on footways and cycle tracks.

The required properties of sand grain mixtures for bituminous concrete for BWSC are indicated in Table 3.32.

Table 3.32: Required properties of sand grain mixtures

Property of sand grain mixture	Unit measure	Required value for sand natural	Required value for sand crushed	Test method
- portion of grains below 0.063 mm	% by m.	f_3[1)]	f_{10}[1)]	EN 933-1
- equivalent of sand	%	$SE_4 70$	$SE_4 60$	EN 933-8
- portion of organic admixtures[2)]	-	-	-	EN 1744-1

1) For sand of limestone, dolomite, or carbonate-silicate stone a greater portion of grains smaller than 0.063 is admitted, on condition that an adequate value of the equivalent of sand is ensured, however up to the value of f_{15} only.

2) The colour of the NaOH solution must not be darker than the reference colour.

Broken stone and crushed gravel grains used to produce crushed sand shall be equally resistant to crushing and wear by the Los Angeles testing method as required for crushed stone mixture for the corresponding traffic loading group indicated in Table 3.33.

2.2.3.2.2.3.1.2 Crushed Stone

For bituminous concrete mixtures basic fractions and intermediate fractions of crushed stone grains, which meet the requirements indicated in the EN 13043, are recommended.

Requirements for resistance of stone grains for bituminous concrete mixtures

to crushing and wear assessed by the Los Angeles testing method (according to EN 1097-2), and

to polishing (PSV coefficient according to EN 1097-8),

are indicated in Table 3.33 for the traffic loading groups, while the other requirements for properties of crushed stone grain mixtures are stated in Table 3.34.

Table 3.33: Requirements for resistance of crushed stone grain mixtures to crushing and wear

Traffic loading group	Traffic volume group	Los Angeles coefficient (%)		Coefficient of resistance to polishing (PSV)	
		Silicate stone	Carbontate or carbonate-silicate stone	Silicate stone	Carbontate or carbonate-silicate stone
- exceptionally and very heavy	very low	LA_{16}	-	PSV_{50}	-
- heavy	very low	LA_{18}	-	PSV_{50}	-
- medium	very low	LA_{22}	LA_{28}	PSV_{50}	PSV_{30}
- light	low	LA_{22}	LA_{30}	PSV_{45}	PSV_{30}
- very light	low	LA_{22}	LA_{35}	PSV_{45}	-

Table 3.34: Requirements for properties of crushed stone grain mixtures

Property of crushed stone grain mixture	Unit measure	Required value	Test method
- portion of coating of grain surface with bitumen B 100/150, minimum	%	100/90	EN 12697-11
- resistance of grains to frost (magnesium sulphate test)	% by mass	MS_{25} 1)	EN 1367-2
- water absorption at fraction 4/8 mm	% by mass	$WA_{24}2$	EN 1097-6
- modulus of shape of coarse grains	% by mass	SI_{20}	EN 933-4
- portion of organic admixtures 2)	-	-	EN 1744-1

1) *Silicate stone grains maximum* MS_{18}

2) *The colour of the NaOH solution must not be darker than the reference colour.*

For bituminous concrete mixtures for BWSC on roads with heavy traffic loading, only perfectly crushed stone grains may be used.

Where the required percentage of coating of stone grain surface with bitumen B 100/150 is not ensured, suitable additive shall be introduced to improve the coating.

2.2.3.2.2.3.1.3 Gravel

The properties of mixtures of natural or partly broken gravel grains for BWSC shall meet the requirements indicated in Table 3.35.

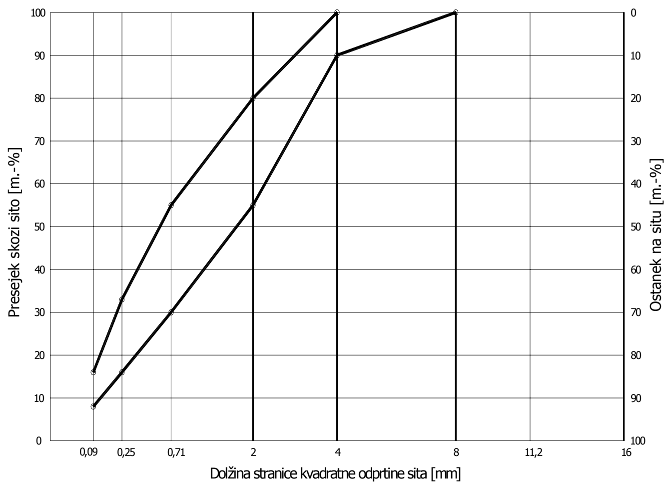
Table 3.35: Required properties of mixtures of natural gravel grains

Property of gravel grain mixture	Unit measure	Required value	Test method
- portion of coating of grain surface with bitumen B 100/150, minimum	%	90/80	EN 12697-11
resistance of grains to frost:magnesium sulphate test)	% by m.	MS_{25}	EN 1367-2
natriumium sulphate test)	% by m	5	
- water absorption at fraction 4/8 mm	% by m.	$WA_{24}2$	EN 1097-6
- portion of organic admixtures[2)]	-	-	EN 1744-1

2.2.3.2.2.3.1.4 Collective Granulometric Composition

Ranges of mineral aggregates passing sieve for BWSC basic asphalt mixtures are determined by grading curve limits indicated in Figs. 3.14 to 3.19.

The method of testing mineral aggregate mixtures is defined in the EN 933-1, whereas the composition of mineral aggregate mixtures is specified in the EN 13108-1.



translation of terms: see Figure 3.1

Fig. 3.14: Grading curve limits for mineral aggregate mixtures for bituminous concrete BC 4k, BC 4ks, and BC 4sk

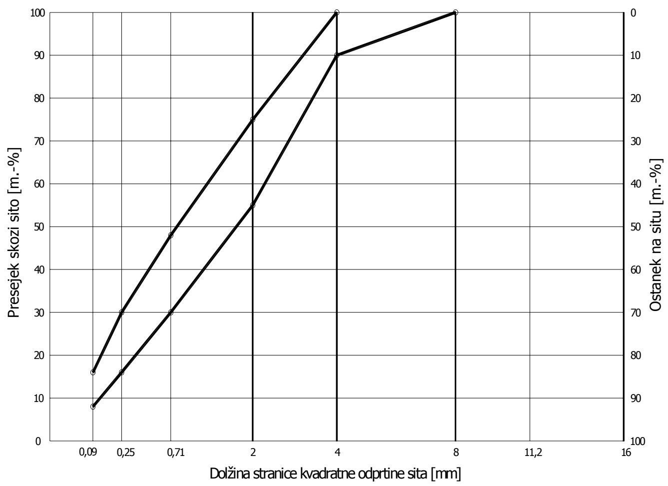


Fig. 3.15: Grading curve limits for mineral aggregate mixtures for bituminous concrete BC 4s

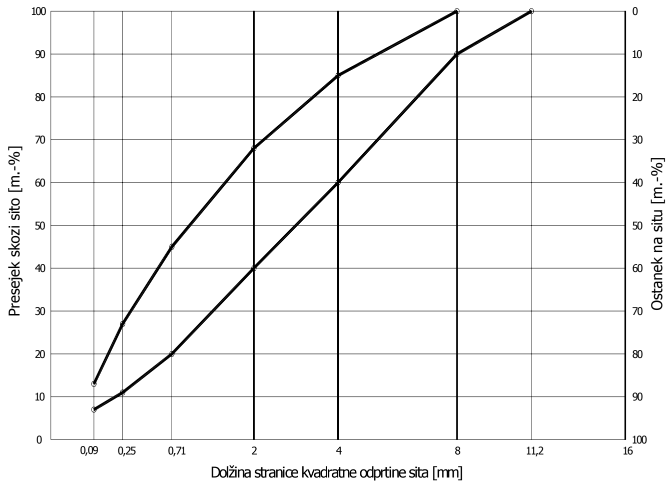


Fig 3.16: Grading curve limits for mineral aggregate mixtures for bituminous concrete for bituminous concrete BC 8k, BC 8ks, and BC 8sk

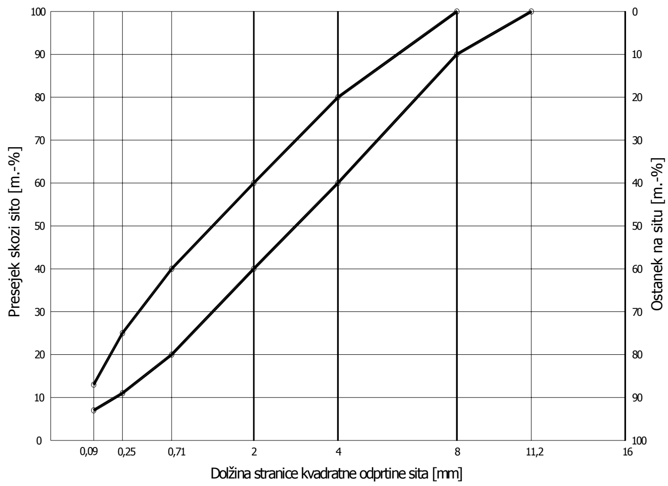


Fig. 3.17: Grading curve limits for mineral aggregate mixtures for bituminous concrete BC 8s

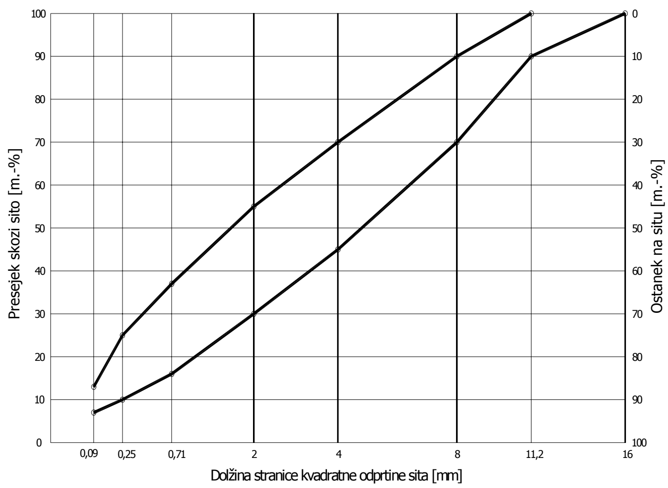


Fig. 3.18: Grading curve limits for mineral aggregate mixtures for bituminous concrete BC 11k, BC 11ks, and BC 11sk

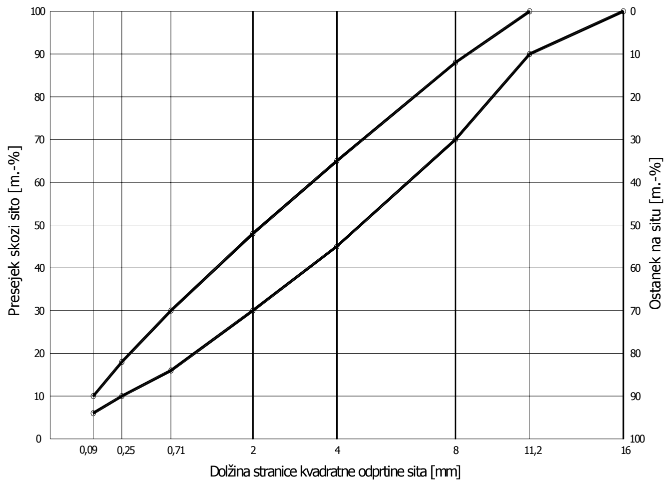


Fig 3.19: Grading curve limits for mineral aggregate mixtures for bituminous concrete BC 11s

Prior to commencement of the works, conformity of each mineral aggregate mixture foreseen for the use in a bituminous concrete mixture for BWSC, with the requirements indicated in these technical conditions shall be verified.

If the engineer has already given approval to the contractor to use similar mineral aggregate mixture for BWSC, it is not necessary to repeat the conformity verification.

2.2.3.2.2.3.2 Bituminous Binders

The quality of bituminous binders used for production of bituminous concrete mixtures for BWSC is defined in the

- EN 12591 Bitumen and bituminous binders – Specifications for road bitumen, and
- EN 14023 Bitumen and bituminous binders – Specifications for polymer modified bitumen.

The required properties of road bitumen for bituminous concrete mixtures for BWSC are indicated in Table 3.36, and of polymer bitumen in Table 3.37.

Climatic conditions and traffic loading shall be considered when selecting the type of bitumen.

Polymer bitumen may only be used in case of an adequate technological preparation, and when the conformity with the requirements indicated in these technical conditions is verified.

The engineer may require other binders than those specified by the design, and/or by the preliminary investigation. In such a case he shall also define the quality requirements.

Table 3.36: Required properties of road bitumen

Properties of road bitumen	Unit measure	Type of bituminous binder						Test method
		B 160/220	B 100/150	B 70/100	B 50/70	B 35/50	B 20/30	
		Required value						
- penetration at 25 °C	mm/10	160-220	100-150	70-100	50-70	35-50	20-30	EN 1426
- softening point	°C	35-43	39-47	43-51	46-54	50-58	55-63	EN 1427
- breaking point by Fraass	°C	-15	-13	-11	-8	-6	- __	EN 12593
- change after heating to 163 °C:								
- preserved penetration, minimum	%	37	43	46	50	53	55	EN 1426
- softening point, minimum	°C	37	41	45	48	52	57	EN 1427

Table 3.37: Required properties of polymer bitumen

Properties of road bitumen	Unit measure	Type of polymer bitumen / Required value				Test method
		PmB2	PmB3	PmB4	PmB5	
- penetration at 25 °C	mm/10	10-40	25-55	45-80	40-100	EN 1426
- softening point, minimum	°C	80	75	70	65	EN 1427
- breaking point by Fraass	°C	0	-5	-7	-10	EN 12593
- change after heating to 163 °C:						
- preserved penetration, minimum	%	35	40	45	50	EN 1426
- increase of softening point, maximum	°C	8	10	12	-	EN 1427
- elastic return: at 25 °C	%	70	60	50	-	EN 13398

2.2.3.2.2.3.3 Agents Ensuring Adhesion of Layers

Agents ensuring adhesion of a bituminous concrete to the underlay shall be such as to provide a perfect and uniform bond of both layers.

A asphalt mixture underlay shall be sprayed with such an agent only where the traffic has removed the binder from the grains located on the top of that layer.

As a rule, to ensure mutual adhesion of layers, a cationic (polymer) bitumen emulsion containing at least 55% by mass of bitumen shall be used.

2.2.3.2.2.4 Method of Execution

2.2.3.2.2.4.1 Winning of Mineral Aggregates and Binders

In due time prior to commencement of works, the contractor is obliged to inform the engineer of the location and method of winning both mineral aggregate and binder for bituminous concrete for BWSC.

The method of acquiring both mineral aggregate and binder shall be such as to ensure their constant and traceable quality.

The contractor shall submit to the engineer evidences of conformity of mineral aggregates and binders with requirements indicated in 2.2.3.2.2.3.1 for the aggregate, and 2.2.3.2.2.3.2 for the binder.

2.2.3.2.2.4.2 Depositing of Mineral Aggregates and Bituminous Binders

When the contractor, prior to the further use, provisionally deposits mineral aggregates, the foreseen location shall be suitably arranged and protected from precipitations in advance.

Stone dust shall be stored in a dry and closed space.

Tanks for storing bituminous binder shall be equipped with devices for an indirect heating, and with thermometers. The recommended and maximum temperature of road bitumen are indicated in Table 3.38.

Table 3.38: Recommended and maximum temperatures of road bitumen during storing

Type of bitumen	Recommended temperature °C	Maximum temperature °C
B 160/200	130	150
B 100/150	135	155
B 70/100	140	160
B 50/70	150	170
B 35/50	160	180
B 20/30	170	190

For storing polymer bitumen, temperatures as specified by the producer of the binder shall be considered.

Stocks of mineral aggregates and binders at deposit areas shall be such as to ensure a continuous production of bituminous concrete for BWSC.

2.2.3.2.2.4.3 Preparation of Substrate Formation

As a base of the BWSC of bituminous concrete mixture, a bound roadbase of a mixture of bituminous crushed stone, crushed gravel, or gravel prepared in compliance with section 2.2.3.1.3.5.6 of these technical conditions is suitable.

Unless provided otherwise by the design, a bound sub-base corresponding to section 2.2.3.1.2.5.3, or an unbound roadbase corresponding to section 2.2.3.1.1.5 of these technical conditions can be used as a base for the bituminous concrete BWSC, on condition that the engineer approves this.

All the time from the beginning of placing bituminous concrete BWSC, the contractor is obliged to maintain the substrate formation in such a condition as it has been during take-over. All damage, deviations, and other deficiencies shall be made good and suitable evidence shall be submitted to the engineer prior to continuation of placing BWSC.

To ensure proper adhesion of the bituminous concrete BWSC to the substrate, the latter shall be sprayed with a cationic polymer emulsion (approximately 0.3 to 0.5 kg/m^2), if the traffic running on the substrate has removed the bituminous binder from the grains on the bound roadbase surface. The amount of the material applied by spraying depends on the substrate condition.

The contractor may start placing the bituminous concrete for BWSC only after the engineer has taken-over the substrate formation in compliance with the specified requirements.

2.2.3.2.2.4.4 Production of Bituminous Concrete

The production of bituminous concrete mixtures shall be carried out mechanically at suitable plant for preparation of asphalt mixtures by means of batch mixers.

Dosing devices shall ensure an adequate quantity of components in the bituminous concrete by mass. Dosing the components by volume may be carried out upon the engineer's consent.

The mixing time and other factors influencing the quality shall be so adjusted as to ensure a homogenous bituminous concrete mixture.

Bituminous concrete mixture for BWSC shall be produced by the hot procedure as a rule. At the moment when the mixture leaves the mixer, its temperature shall amount to the values indicated in Table 3.39.

Table 3.39: Recommended and maximum temperature of produced bituminous concrete mixture

Type of bitumen	Recommended temperature range °C	Maximum temperature °C
B 160/200	130 to 150	165
B 100/150	135 to 155	170
B 70/100	140 to 160	175
B 50/70	150 to 170	180
B 35/50	160 to 180	190
B 20/30	170 to 190	195

Production capacities of the mixer, transportation means, and placing equipment shall be mutually harmonized.

The produced bituminous concrete mixture may be stored in non-heated silos, however for a short period only.

2.2.3.2.2.4.5 Bringing Bituminous Concrete Mixture

To a suitably prepared substrate formation, which must be neither dusty nor damp, bituminous concrete mixture for BWSC can be brought after the engineer has approved the substrate appropriateness.

Asphalt mixtures shall be transported by means of suitable vehicles (tippers with a thermo-caisson, equipped for tipping backwards into finishers, and covered with a tarpaulin enabling an adequate protection of the mixture from precipitations, cooling, and pollution. Prior to loading a asphalt mixture, internal surfaces of metal caissons on lorries shall be sprayed with such an agent to prevent sticking together that does not affect the asphalt mixture harmfully.

When the asphalt mixture is transported in a heated container, the distance of transport is limited to maximum 100 km, or the time of transport to maximum 2 hours. If this is not the case, the distance is limited to 70 km, and the time to 1.5 hours.

The number of vehicles to transport the bituminous concrete mixture to the site shall be so adjusted as to ensure a uniform placing.

2.2.3.2.2.4.6 Placing Bituminous Concrete Mixture

Placing of bituminous concrete mixtures for BWSC shall generally be performed mechanically by means of a finisher. The spreading effect of the finisher must ensure a compaction of at least 85% of the distributed mixture.

Exceptionally, manual placing is allowed as well, if mechanical placing is not feasible for limited space. The engineer shall approve the manual placing.

Taking account of the type of the road bitumen used in production, the recommended and the minimum temperatures of the bituminous concrete mix upon placing are indicated in Table 3.40.

Table 3.40: Recommended and minimum temperature of bituminous concrete mixture upon placing

Type of bitumen	Recommended temperature range °C	Minimum temperature °C
B 160/200	120 to 140	110
B 100/150	125 to 145	115
B 70/100	130 to 150	120
B 50/70	140 to 160	130
B 35/50	150 to 170	140
B 20/30	160 to 180	150

The temperature of a hot bituminous concrete mixture shall be measured in accordance with the EN 12697-13.

In windy weather the lowest temperature of the bituminous concrete mixture for BWSC shall not be less than by 10°C higher than the abovementioned temperature for the particular road bitumen type. In case of manual placing, the temperature shall be by at least 20°C higher than the abovementioned values.

If work conditions permit, BWSC shall be placed over the whole width of the carriageway at the same time. If two finishers situated one after another are used for spreading, the difference in quality of the placed layer of the asphalt mixture in the joint area must not be visible.

When placing asphalt mixtures for base-bearing courses in more layers, the longitudinal joints shall be dislocated one from another by at least 20 cm, whilst the transverse ones by minimum 50 cm.

Any interruption of work shall be executed perpendicularly to the road axis and vertically over the entire width of the carriageway or traffic lane. Any deviation from this is only allowed upon the engineer's consent. Before the continuation of placing, the surface of the transverse joint shall be coated with bituminous emulsion or with cut-back bitumen (at least 0.5 kg/m^2), and the area of the transverse joint shall be indirectly heated. A 15 cm wide zone in the joint area and the inclined outer edge of the layer shall be coated as well.

The selected type of rollers and the compaction method shall ensure the required density (compaction) of the bituminous concrete as evenly as possible over the whole design width. Therefore, the width of the layer shall be increased by the design layer thickness unless provided otherwise by the design.

A BWSC bituminous concrete mixture shall be compacted from the edge towards the centre of the layer, and from the lower edge to the upper edge of the layer. Individual passages of rollers shall always overlap by 15 – 20 cm. Any staying of rollers on the placed layer, as well as sudden braking and accelerating, and change of direction of the roller shall be avoided.

All places inaccessible to machines shall be compacted to the required degree by other means, the use of which shall be approved by the engineer, who also specifies the conditions in which such means have to be used.

Traffic, or the beginning of placing the next layer, is allowed over the BWSC only after the bituminous concrete mixture in the middle of the layer has cooled down to approximately 30°C. The engineer has the right to specify other conditions to be fulfilled prior to allowing the traffic over the BWSC (e.g. spreading crushed stone of granulometric composition of /4 mm onto a partly compacted bituminous concrete course).

2.2.3.2.2.5 Quality of Execution

At least seven days prior to commencement of placing bituminous concrete mixture for BWSC, the contractor shall submit to the engineer for approval a method statement, which shall comprise the following information:

- the preliminary composition of the asphalt mixture
- conformity certificates for all materials to be used
- a programme of average internal and external control
- a description of foreseen working procedures;
- an information on the mechanization;

Prior to commencement of the operation of machines and devices, which directly affect the quality of the works, their suitability to ensure a uniform quality in compliance with these technical conditions shall be verified.

All the equipment and machines shall be certified, and their capacity shall meet the requirements of the design and these technical conditions.

2.2.3.2.2.5.1 Preliminary (Laboratory) Composition of Asphalt mixture

The contractor shall submit to the engineer a preliminary (laboratory) composition of the mixture of the bituminous binder and mineral aggregate, which he intends to place as a bituminous concrete mixture for BWSC.

The preliminary investigation of a asphalt mixture carried out as directed by the TSC 06.730 shall provide the following results:

- types and quyntities of individual nominal fractions of mineral aggregates (in % by mass),
- type and quantity of binder (in % by mass),
- type and quantity of bitumen additives,
- mechanical properties of the asphalt mixture.

Besides the preliminary composition, the contractor shall also submit an evidence of the source and suitable quality of all the materials used to prepare the preliminary composition.

The contractor shall demonstrate with the preliminary investigation (composition) that the foreseen mixture of mineral aggregates and binders can achieve the required quality of a asphalt mixture as specified in these technical conditions.

In case of foreseen periodical (seasonal, transient) increases of traffic loading, which can under certain climatic and ground conditions affect the performance of asphalt mixtures in the BWSC, the conditions applying to the composition of the asphalt mixture shall be adjusted by classifying the road into the subsequent class of traffic loading.

The preliminary investigation shall be carried out with the selected composition of mineral aggregate grains, and at least five different quantities of added binder with a corresponding increase of the percentage (0.3 to 0.4% by mass) in such a way, that the mean composition is the closest to the proposed one. The properties of the asphalt mixture shall be indicated for all the five tested compositions.

The contractor must not begin placing until he has received an approval by the engineer for the preliminary composition of the asphalt mixture.

If the contractor has already placed a BWSC last year with compositions of mineral grains and binders of the same properties, then the preliminary composition may be taken from the already performed composition determined by internal testing. However, final decision shall be made by the engineer.

2.2.3.2.2.5.2 Properties of Test Specimens

The required quality of mineral aggregates and bituminous binder for bituminous concrete BWSC is specified in detail in 2.2.3.2.2.3.1 and 2.2.3.2.2.3.2.

Test specimens of bituminous concrete mixtures for BWSC on roads with an exceptionally heavy and very heavy loading shall be prepared by 2 times 75 hammering blows.

The required properties of test specimens of bituminous concrete mixtures for BWSC are indicated in table 3.41.

Table 3.41: Required mechanical and volume properties (limiting values) of bituminous concrete mixtures for a preliminary (laboratory) composition for BWSC

Property of asphalt mixture	Unit measure	Required value for traffic loading					Test method
		Except. heavy	Very heavy and heavy	Medium	Light	Very light	
- stability at 60 °C	kN	S_{min10}	S_{min8}	S_{min8}	S_{min7}	S_{min6}	EN 12697-34
- stiffness at 60 °C	kN/mm	Q_{min2}	Q_{min2}	$Q_{min1,7}$	$Q_{min1,5}$	$Q_{min1,5}$	EN 12697-34
- total void content	% by vol.	$V_{min3,5}$ – $V_{max6,5}$	V_{min3} – $V_{max6,5}$	V_{min3} – V_{max6}	V_{min2} – V_{max5}	$V_{min1,5}$ – V_{max4}	EN 12697-8
- void content in mineral aggregate	% by vol.	To be tested					EN 12697-8
- filling of voids in mineral aggregate with bitumen	%	VFB_{65} – VFB_{78}	VFB_{65} – VFB_{80}	VFB_{69} – VFB_{85}	VFB_{73} – VFB_{88}	VFB_{75} – VFB_{90}	EN 12697-8

The required value of the stability of the test specimen by Marshall in Table 3.41 is the lower limiting value.

The value of the Marshall-flow of the test specimen is indirectly assessed by the specified stiffness of the asphalt mixture.

The total void content in a asphalt mixture and the filling-up of voids in a mixture of mineral aggregate with bitumen shall be within the range of the specified limiting values.

For roads with a heavy traffic loading and special climatic action, it is necessary, within the scope of the preliminary investigation of a asphalt mixture, to verify the resistance to formation of ruts, which shall be carried out in accordance with the procedure defined in the EN 12697-22. The WTR or RD category defined in the EN 13108-1 shall be assessed in dependence on the traffic loading specified in the design.

2.2.3.2.2.5.3 Demonstrative Production and Placing

The contractor shall verify the preliminary (laboratory) composition of the asphalt mixture at a suitable asphalt production plant, the transportation to the site, and placing for BWSC after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and asphalt plant for production of asphalt mixtures for BWSC,
- establish suitability of transportation method and equipment for placing bituminous layers,
- take a specimen of the asphalt mixture at the location of placing to perform a conformity test,

- follow the process of thickenning of the asphalt mixture by means of a non-destructive test
- take cores at the location where asphalt mixture specimens have been taken,
- measure the density of the asphalt mixture placed at 30 locations.

The threshold values of mechanical and volume properties in compositions of asphalt mixtures for BWSC are indicated in table 3.42.

Table 3.42: Admissible threshold values of mechanical and volume properties of asphalt mixtures for BWSC

Property of asphalt mixture	Unit measure	Required value for traffic loading: Except. heavy	Very heavy and heavy	Meduim	Light	Very light	Test method
- stability at 60 °C	kN	S_{min8}	S_{min6}	S_{min6}	S_{min5}	S_{min5}	EN 12697-34
- stiffness at 60 °C	kN/mm	Q_{min2}	Q_{min2}	$Q_{min1,7}$	$Q_{min1,5}$	$Q_{min1,5}$	EN 12697-34
- total void content	% by vol.	V_{min3} - V_{max7}	$V_{min2,5}$ - V_{max7}	V_{min2} – V_{max7}	V_{min1} – V_{max6}	V_{min1} – V_{max5}	EN 12697-8
- void content in mineral aggregate	% by vol.	se preskusi					EN 12697-8
- filling of voids in mineral aggregate with bitumen	%	VFB_{min62} - VFB_{max81}	VFB_{min62} - VFB_{max83}	VFB_{min66} - VFB_{max88}	VFB_{min70} - VFB_{max91}	VFB_{min72} - VFB_{max93}	EN 12697-8

During production, transport, and placing of asphalt mixture the bituminous binder may harden by up to 2 grades.

If the contractor has already placed a BWSC last year with compositions of mineral grains and binders of the similar properties and under similar conditions, then the preliminary investigation results may be taken as a demonstrative production and placing. However, the engineer shall make final decision.

In case that some changes occur in view of the mechanization used for placing, the demonstrative placing of the asphalt mixture shall be repeated. The engineer shall make final decision.

2.2.3.2.2.5.4 Routine Production and Placing

The engineer shall approve a routine production and a working composition not until the contractor has submitted the results of the demonstrative production and placing. The permission for a routine production also includes requirements for the asphalt mixture properties and for the control foreseen by these technical conditons.

The permission for a routine production and placing of a asphalt mixture for BWSC shall also comprise detailed requirements for an eventual additional spray application of an adhesive agent to the underlay surface according to section 2.2.3.2.2.4.3 of these technical conditions.

In case of any modification in production and placing of a asphalt mixture for BWSC, the contractor shall submit to the engineer in writing his proposal for the particular modification. Such a modification shall only be implemented after being approved by the engineer.

The required limiting values of the compaction and void content for asphalt mixtures for BWSC are indicated in Table 3.43.

Table 3.43: Required limiting values of placed bituminous concrete mixture for BWSC

Property of placed asphalt mixture	Unit measure	Required value for particular traffic loading					Test method
		Exceptionally heavy	Very heavy and heavy	Medium	Light	Very light	
- layer compaction	%	≥ 98	≥ 98	≥ 97	≥ 96	≥ 96	BAS
- layer void content	V.-%	$V_{min2,5}$ – $V_{max8,5}$	V_{min2} – $V_{max8,5}$	V_{min2} – V_{max8}	V_{min1} – V_{max7}	V_{min1} – $V_{max6,5}$	EN 12697-8

2.2.3.2.2.5.5 Layer Thickness

Limiting design thicknesses of asphalt mixtures for BWSC are indicated in Tables 3.27 and 3.28.

Average thickness of a asphalt mixture may be by up to 10% below the design thickness (however, no more than 10% of the total test number), whereas individual measured values by up to 25% below the design thickness (threshold value).

When assessing the average thickness of a placed layer, the maximum thickness is limited to the upper limiting design thickness + 5 mm (according to Table 3.27).

2.2.3.2.2.5.6 Evenness, Level, and Slope of Formation

An unevenness of the formation of the BWSC shall be established, in any direction with regard to the road axis, as a deviation below a 4 m long straight edge. The formation of the BWSC may deviate from the straight edge by maximum the following limiting value:

- on carriageways subjected to exceptionally heavy, very heavy and heavy traffic loading
  - for machine placing in one layer ≤ 4 mm
  - for machine placing in two layers on a lower layer ≤ 6 mm
- on carriageways subjected to other traffic loading types
  - for machine placing ≤ 6 mm
  - for manual placing ≤ 10 mm

The level of the individual measuring points on the formation of the BWSC shall be determined by levelling. In any place, the BWSC formation may deviate from the design level by maximum $\pm$10 mm (limiting values).

The slope of the formation of the BWSC shall be, as a rule, equal to both transverse and longitudinal fall of the carriageway. The allowable slope tolerances are defined by the admitted unevenness and deviation from the particular layer formation level. However, the allowable tolerances shall not exceed the design slope by more than ±0.4% (threshold value).

2.2.3.2.2.6 Quality Control of Execution

The quality of performed works and the conformity with the contractual requirements as well as the requirements provided by these technical conditions shall be checked by

- the internal control, and
- the external control.

2.2.3.2.2.6.1 Internal Control

Both type and frequency of testing within the scope of the internal control of asphalt mixtures in BWSC shall be determined and approved by the programme of the average frequency of the control. If this is not the case, it shall be specified by the engineer, who shall also determine locations of taking specimens, as well as locations of measurements, all in accordance with a random statistical pattern.

During placing asphalt mixtures for BWSC, the laboratory shall take test specimens and check the conformity of the properties to such a frequency as specified in Table 3.44.

Cores for testing the placed asphalt mixture shall be, as a rule, taken at locations where specimens of the hot produced mix have been taken. Immediately after taking a core, the borehole shall be filled-up with a hot asphalt mixture of similar composition.

The contractor shall regularly inform both engineer and/or institution authorized for the external control on the internal testing results. In case of any deviations from the required quality, the contractor shall take an adequate and prompt action.

2.2.3.2.2.6.2 External Control

The external control of the execution of BWSC, which has to be performed by a third party institution authorized by the client, includes the following activities:

- establishing conformity of the produced and placed asphalt mixture with the requirements provided by both design and these technical conditions, and
- supervision of the internal control.

As a rule, the extent of the external control testing of produced and placed asphalt mixtures shall be in a proportion of 1:5 with regard to the internal control testing extent.

The approved programme of the average frequency of the external control shall define properties of asphalt mixtures, which conformity with the requirements is tested.

Test specimens for the external control of asphalt mixtures shall be generally taken at the location of placing, which shall be appointed by the engineer.

Taking test specimens for the external control, as well as the tests and measurements at the site shall be generally carried out in the presence of both contractor and engineer.

Statistical analyses and comparisons of testing results within the scope of both internal and external control represent a base for evaluation of conformity of executed works with the requirements, and for eventual necessary measures to mend the deficiencies.

The third party institution authorized to perform the external control of conformity of asphalt mixtures for BWSC with the requirements shall prepare a written conformity assessment, which shall be submitted to the engineer.

Table 3.44: Minimum frequency of testing asphalt mixtures upon internal control of placing for BWSC

Property	Test method	Minimum testing frequency
- mineral aggregate mixture:		
- composition – Tables 3.30 and 3.31, Figs. 3.14 to 3.19	EN 933-10,-1	2,000 t
- properties – Tables 3.32 to 3.35		10,000 t
- bituminous binder:		
- bitumen properties – Tables 3.36 and 3.37		25 t [1)]
- bitumen emulsion properties		15,000 m^2
- produced asphalt mixture:		
- temperature	EN 12697-3	3 times a day
- mechanical and volume properties:		500 t [2)]
- bituminous binder content	EN 12697-1	
- composition of extracted mixture	EN 12697-2	
- volume mass (at 25° C)	EN 12697-5	
- stability and stiffness (at 60° C)	EN 12697-34	
- volume mass of specimens by Marshall (at 25 ° C)	EN 12697-6	
- void content	EN 12697-8	
- filling-up of voids with bitumen	EN 12697-8	
- resistance to re-shaping	EN 12697-22	2,000 t
- placed asphalt mixture:		500 t [2)]
- core:		
- void content	EN 12 697-8	
- density/compaction	EN 12697-5	
- layer thickness	EN 12697-36	
- adhesion of layers	BAS	
- layer:		100 m^2
- density	BAS	
- evenness	BAS	
- level, slope	-	

[1)] *Each tank lorry from a different source or at least once a day*

[2)] *Or at least once a day.*

2.2.3.2.2.7 Measurement and Take-Over of Works

2.2.3.2.2.7.1 Measurement of Works

The executed works shall be measured in accordance with section 2.1.7.1 of the general technical conditions and calculated in square metres.

All the quantities shall be measured by the actually performed extent and type of works within the scope of the design. The measurements shall be recorded in due time.

2.2.3.2.2.7.2 Take-Over of Works

The engineer shall take-over the placed BWSC after receiving a written notice from the contractor, all in accordance with the quality requirements indicated in these technical conditions, as well as with section 2.1.7.2 of the general technical conditions. The contractor shall make good any deficiencies established, prior to continuing the works, otherwise deductions for unsuitable performance of the works will be charged to him.

2.2.3.2.2.8 Final Account of Works

2.2.3.2.2.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in compliance with section 2.2.3.2.2.7.1 and taken-over according to section 2.2.3.2.2.7.2 of these technical conditions shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment unless provided otherwise by the contract.

If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.2.2.8.2 Deductions Due to Unsuitable Quality

2.2.3.2.2.8.2.1 Quality of Materials

The quality of basic materials defined in section 2.2.3.2.2.3 shall be ensured.

Due to unambiguously defined quality of materials for BWSC there are no deductions when accounting the quantities.

If the contractor places into BWSC such material, which does not comply with the requirement indicated in 2.2.3.2.2.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.2.2.8.2.2 Quality of Execution

Necessary bases to assess the quality of execution and to calculate deductions due to unsuitable quality of the asphalt mixture placed for BWSC, are indicated in section 3.2.3.2.2.5.

If the contractor fails to ensure the required quality of placed BWSC, the engineer shall decide upon the method of accouting. When the engineer establishes deficiencies such as

- insufficient filling up of voids in stone aggregate with a bituminous binder,
- unsuitable void content in the asphalt mixture placed,
- insufficient compaction of the asphalt mixture placed,
- insufficient thickness of the layer laid, or
- unsuitable level and evenness of the formation of the BWSC placed,

he is entitled to put into effect deductions, which shall be evaluated on the following bases:

- For an insufficient filling up of voids in the stone aggregate with a bituminous binder, where the achieved filling up of voids deviates from the optimum value specified by the preliminary investigation (Table 3.41), the following equation shall apply:

$$FO = \frac{p^2}{100} \times C \times PD$$

where:

FO = *financial deduction (SIT)*
p = *deviation above the limiting value, however by maximum* $\pm$ *5% (threshold value)*
C = *unit price of the work executed (SIT/m*^{2}*)*
PD = *extent of the work carried out inadequately (m*^{2}*).*

Calculation of deduction: $FO^{'} = p^2$ (%)

p %	0.50	1	1.50	2	2.50	3	3.50	4	4.50	5
FO' (%)	0.25	1	2.25	4	6.25	9	12.25	16	20.25	25

- For an unsuitable void content in the asphalt mixture placed, if the void content specified by the preliminary investigation of the asphalt mixture (Table 3.43) is exceeded, the following equation shall apply:

$$FO = \frac{p^2}{100} \times 6 \times C \times PD$$

where:
p - deviation above the limiting value, however by maximum ± 2% (threshold value)

Calculation of deduction: $FO^{'} = p^2 \times 6$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
FO' (%)	0.24	0.96	2.16	3.84	6.0	8.64	11.76	15.36	19.44	24.0

For an unsuitable compaction of the asphalt mixture placed (compared to the specimen by Marshall – Table 3.43), the following equation shall apply:

$$FO = \frac{p^2}{100} \times 3 \times C \times PD$$

where:
p - deviation of compaction of the placed asphalt mixture from the lower limiting value, however by maximum 3% (absolute value), (lower threshold value)

Calculation of deduction: $\mathrm{FO}^{'} = p^2 \times 3$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
FO' (%)	0.12	0.48	1.08	1.92	3.0	4.32	5.88	7.68	9.72	12.0	14.52	17.28	20.28	23.52	27.0

For insufficient thickness of the bituminous layer placed:

- for a deviation of the average or individual thicknesses from the contractual value (Table 3.27 and 3.28 respectively) by up to 10%, the contract price shall be cut down linearly;
- for a deviation of individual thicknesses by > 10% to 25%, an additional contract price reduction shall be carried out applying the following equation:

$$FO = \frac{p}{100} \times 3{,}75 \times C \times PD$$

where:
p - percentage of the insufficient individual layer thickness (above -10% to - 25% of the design/contract thickness)

Calculation of deduction: $\mathrm{FO}^{'} = p \times 3{,}75$ (%)

p %	2	4	6	8	10	12	14	16	18	20
FO' (%)	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75

For unsuitable formation evenness of the course, the following equation shall apply:

$$FO = \sum \left(p_i^2 \times A_i\right) \times 0{,}6 \times C$$

where:
p_i = deviation of the evenness above the limit value specified in section 2.2.3.2.2.5.6 (mm)
A_i = corresponding zone width of an uneven formation (m)

The contractor shall make good any excessive deviation of the formation evenness of the BWSC. He shall introduce such measures as not to reduce the pavement design bearing capacity. In case that the contractor fails to mend the established effects, the client/engineer is entitled to reject the work executed.

The contractor shall ensure other properties of asphalt mixtures, which exceed the limiting values indicated in these technical conditions, without having the right to claim any extra payment for such works.

2.2.3.2.3 BOUND ASPHALT BEARING AND SEALING COURSES – POURED ASPHALT

2.2.3.2.3.1 Description

The construction of bound asphalt wearing and sealing course (BWSC) made of a mixture of poured asphalt includes the supply of corresponding mineral aggregate mixtures and bituminous binder, the production and placing of asphalt mixture at locations specified in the design.

This work shall be carried out in weather when there is no precipitation, the weather is still, and the temperature of the substrate and air is above 0°C.

BWSC of poured asphalt are intended, depending on the mineral aggregate and binder type, for placing into pavement structure for all traffic loading groups. As a rule, a BWSC of poured asphalt is used as the upper wearing course particularly for very heavy and heavy traffic loading, or as the sealing course below the open wearing course. Layers of poured asphalt are also intended for protective courses in case of bridge waterproofing.

The type of the asphalt mixture of poured asphalt for BWSC is generally defined by the design. If this is not the case, the engineer shall make a final decision.

In view of the size of the largest mineral grains in a mixture of poured asphalt, as well as of their composition, the following asphalt mixtures are applicable to BWSC:

- poured asphalt PA 4
- poured asphalt PA8 and PA 8S
- poured asphalt PA 11 and PA 11S.

Asphalt mixtures of poured asphalt designated with "S" (skeletal, i.e. coarse-grained composition of mineral aggregate mixture) are intended particularly for roads with heavy traffic loading.

The quantity of the binder (road bitumen and natural asphalt) in the poured asphalt mixture shall be such as to ensure filling of all the voids in the mineral aggregate mixture with the binder, and certain surplus amount of binder shall remain as well. Such a asphalt mixture can be spread and smoothed without any compaction. The poured asphalt BWSC surface shall be spread with crushed stone immediately after placing.

Types of poured asphalt mixtures are indicated in Table 3.45 with regard to the traffic loading.

Table 3.45: Fields of application of poured asphalt mixture in dependence on the traffic loading

Type of poured asphalt	Traffic loading group						
	EH	VH	H	M	L	VL	footways, parking places
PA 4	-	-	-	-	-	+	+
PA 8	-	-	-	-	+	+	+
PA 8s	-	+	+	+	-	-	-
PA 11	-	-	-	-	+	+	+
PA 11s	+	+	+	+	-	-	-

Design thicknesses of poured asphalt BWSC are indicated in Table 3.46.

Table 3.46: Limiting design thicknesses of poured asphalt layers

Design layer thickness	Unit measure	Type of asphalt mixture PA 4	PA 8	PA 8S	PA 11	PA 11S
- minimum	mm	15	20	20	30	30
- maximum	mm	30	35	35	40	40

2.2.3.2.3.2 Basic Materials

2.2.3.2.3.2.1 Mineral Aggregate Mixtures

Mixtures of crushed and natural mineral grains are applicable to poured asphalt BWSC.

2.2.3.2.3.2.2 Binders

Road bitumen B 35/50 or a mixture of bitumen and natural asphalt having the same characteristics as B 50/70 are suitable to poured asphalt BWSC.

Bituminous binder B 50/70 or B 20/30 can also be used for poured asphalt BWSC provided that the engineer approves this.

2.2.3.2.3.3 Quality of Materials

2.2.3.2.3.3.1 Mineral Aggregate Granulometric Composition

Bases for assessment of quality of mineral aggregate mixtures for asphalt mixtures for BWSC poured asphalt are defined in detail in the EN 13043.

A mixture of mineral aggregate grains for poured asphalt BWSC shall be composed of grains of

- stone dust,
- sand, and
- crushed stone.

2.2.3.2.3.3.1.1 Stone Dust

For poured asphalt BWSC stone dust of quality I produced of carbonate stone shall be used. Requirements for the composition and properties of the stone dust mix are indicated in Table 3.30.

2.2.3.2.3.3.1.2 Sand

For poured asphalt BWSC, sand of natural and/or crushed grains shall be used.

Natural sand allows an easier placing of poured asphalt mixture.

Requirements for the composition and properties of sand grain mixtures are indicated in Tables 3.31 and 3.32.

2.2.3.2.3.3.1.3 Crushed Stone

For poured asphalt BWSC a grain mixture of crushed stone shall be used. The particle size shall be up to 11 mm.

To make a poured asphalt BWSC surface rough, a mixture of very fine crushed stone made of silicate stone shall be spread onto it. The particle size shall be 2/4 and 4/8 mm.

The required properties of mixtures of crushed stone for poured asphalt BWSC are indicated in Table 3.34. The requirements for resistance of these mixtures to crushing and wear are indicated in Table 3.47.

2.2.3.2.3.3.1.4 Collective Granulomertric Composition

For BWSC, mixtures of poured asphalt composed of nominal fractions 0/4, 0/8, and 0/11 mm shall be used.

Ranges of granulometric composition of these asphalt mixtures are indicated:

- for poured asphalt PA 4 in Fig. 3.20,
- for poured asphalt PA 8 and PA 8s in Figs. 3.21 and 3.22, and
- for poured asphalt PA 11 and PA 11s in Figs. 3.23 and 3.24.

Table 3.47: Requirements for resistance of mineral aggregates to crushing and wear, and for resistance of spread crushed stone to polishing (PSV coefficient).

Group of traffic loading	Group of traffic volume	Los Angeles coefficient (%)	Coefficient of resistance of spreading crushed stone grains to polishing (PSV)
- exceptionally heavy and very heavy: EH, VH	very high	LA_{22}	PSV_{50}
- heavy: H	very high	LA_{22}	PSV_{50}
- medium: M	very high	LA_{25}	PSV_{40}
- light: L	low	LA_{25}	PSV_{40}
- very light: VL	low	LA_{30}	PSV_{40}

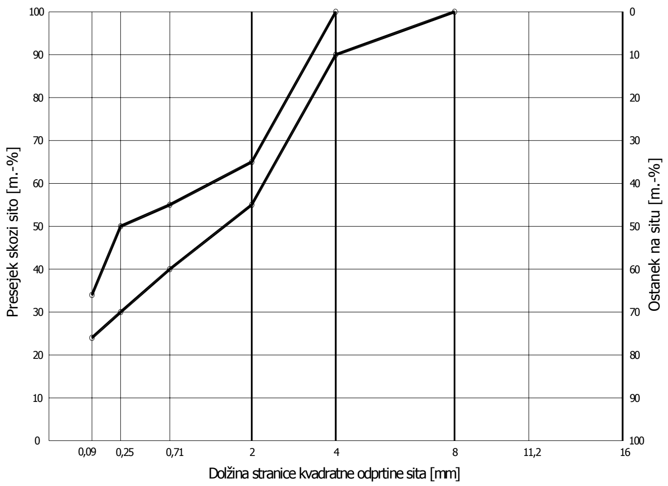


Fig. 3.20: Grading curve limits for mineral aggregates for PA 4 poured asphalt BWSC

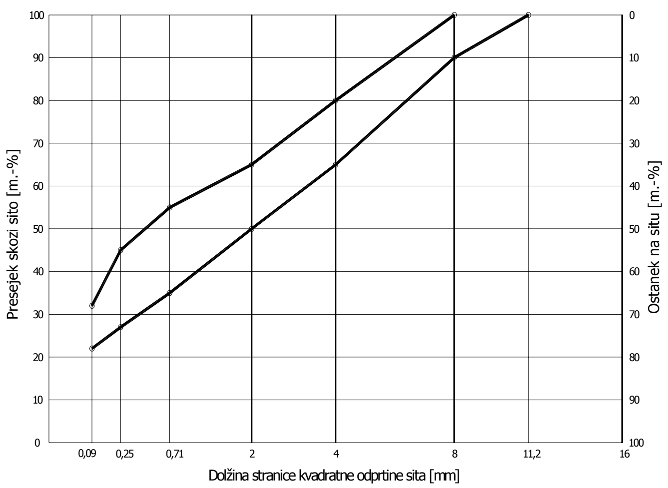


Fig. 3.21: Grading curve limits for mineral aggregates for PA 8 poured asphalt BWSC

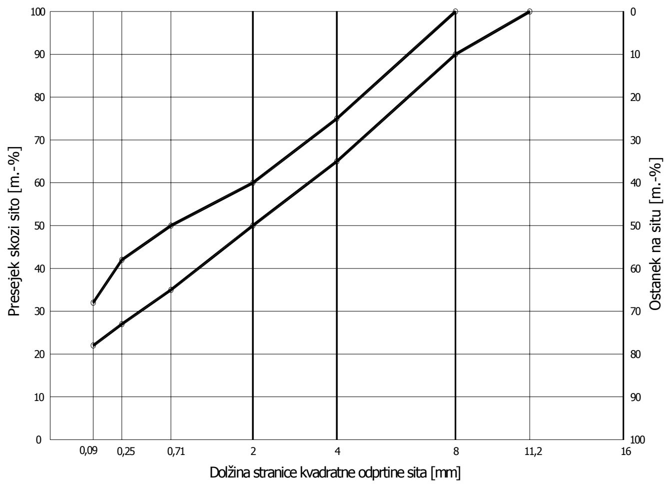


Fig. 3.22: Grading curve limits for mineral aggregates for PA 8S poured asphalt BWSC

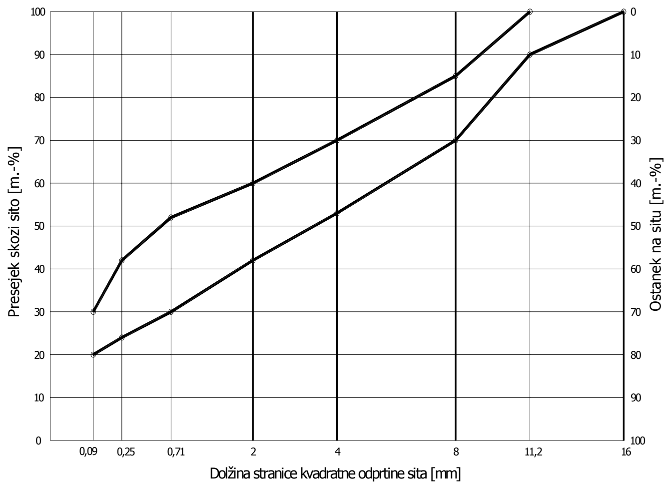


Fig. 3.23: Grading curve limits for mineral aggregates for PA 11 poured asphalt BWSC

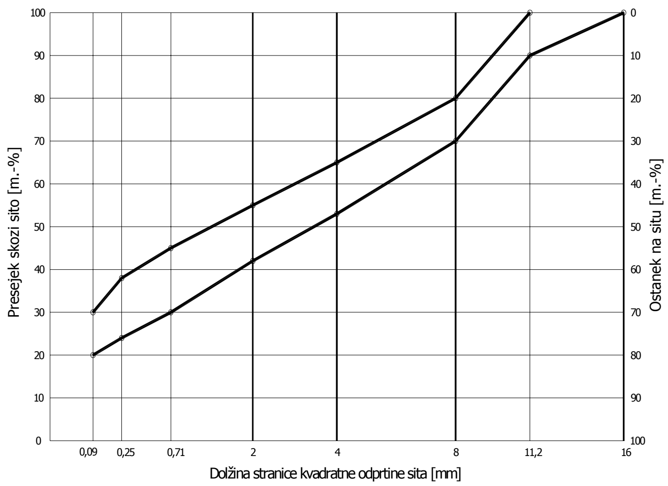


Fig. 3.24: Grading curve limits for mineral aggregates for PA 11S poured asphalt BWSC

2.2.3.2.3.3.2 Properties of Binders

The quality of bituminous binders used for production of poured asphalt mixtures for BWSC is defined in the

- EN 12591 Bitumen and bituminous binders – Specifications for road bitumen, and
- EN 14023 Bitumen and bituminous binders – Specifications for polymer modified bitumen.

The required properties of road bitumen for poured asphalt mixtures for BWSC are indicated in Table 3.36, and of polymer bitumen in Table 3.37.

Climatic conditions and traffic loading shall be considered when selecting the type of bitumen.

Polymer bitumen may only be used in case of an adequate technological preparation, and when the conformity with the requirements indicated in these technical conditions is verified.

Properties of natural asphalt, which may be used to improve the characteristics of the road bitumen (for composite bitumen) for BWSC poured asphalt mixtures, shall be tested as directed by the engineer.

The engineer may require other binders than those specified by the design, and/or by the preliminary investigation. In such a case he shall also define the quality requirements.

The contractor shall in due time prior to commencement of the works submit adequate evidence of conformity of the binder he intends to use for poured asphalt BWSC.

2.2.3.2.3.4 Method of Execution

2.2.3.2.3.4.1 Winning of Mineral Aggregates and Binders

To winning mineral aggregates and binders for poured asphalt BWSC, requirements indicated in section 2.2.3.2.2.4.1 of these technical conditions shall apply as appropriate.

2.2.3.2.3.4.2 Depositing of Mineral Aggregates and Binders

To this works, requirements indicated in section 2.2.3.2.2.4.2 of these technical conditions shall čogically apply.

The maximum admitted temperature of road bitumen in the tank lorry amounts to:

- for B 50/70 170 °C
- for B 35/50 180 °C
- for B 20/30 190 °C

For storing polymer bitumen, instructions by the manufacturers of binders shall be considered.

2.2.3.2.3.4.3 Preparation of Substrate Formation

For these works, provisions indicated in section 3.2.3.2.2.4.3 of these technical conditions shall apply as appropriate.

2.2.3.2.3.4.4 Production of Poured Asphalt Mixtures

The production of poured asphalt mixtures shall be mechanical, in an adequate plant for preparation of asphalt mixtures or in suitable motor cookers – mixers for poured asphalt, both by a batch method of work.

Dosing equipment shall ensure a suitable amount of asphalt mixture components by mass. Dosing by volume is allowed only if approved by the engineer.

The mixing time and other impacts on the quality of coating of grains with binder, or distributing the binder within the mixture shall be so adjusted as to ensure a uniform mixture of poured asphalt.

A mixture of poured asphalt for BWSC shall be produced by the hot procedure. The temperature of the produced poured asphalt mix shall amount to 200°C to 250°C, depending on the type of bituminous binder introduced.

Poured asphalt mixture cannot be stored for its liquid consistency, as continuous mixing is required to ensure a uniform composition of the hot poured asphalt mix.

A mixture of grains of 2/4 mm or 4/8 mm to be spread onto the poured asphalt BWSC layer to make it rough shall be uniformly coated with B 160/220 bitumen by hot procedure. The quantity of that bitumen shall be such that the coated mixture of grains for spreading remains loose after being stored.

2.2.3.2.3.4.5 Bringing Poured Asphalt Mixture

Onto suitably prepared substrate formation, which shall not be dusty, moist, or frozen, a mixture of poured asphalt for BWSC can be brought only this has been approved by the engineer.

For the transportation of poured asphalt mix motor cookers – mixers shall be used. Their number shall be adjusted to production conditions, to uniform placing, and to the transportation distance.

2.2.3.2.3.4.6 Placing Poured Asphalt Mixture

Placing of poured asphalt mixtures for BWSC shall be carried out mechanically by means of a finisher. If mechanical placing is not feasible, the poured asphalt can be placed manually as well, however on conditions that the engineer approves such a method.

At the location of placing, the temperature of the poured asphalt shall amount to 190°C to 250°C, depending on the type of the bituminous binder used.

If a poured asphalt mixture has to be kept in the cooker – mixer for a longer period (over 6 hours), its temperature must not exceed 230°C during this time.

If permitted by the work conditions, a poured asphalt mixture for BWSC shall be placed simultaneously over the entire carriageway width.

Longitudinal and transverse joints of the overlaying layers of asphalt mixtures shall be shifted by at least 20 cm one to the other. The joint shall be straight and vertical as much as possible. They can be executed either as sealed or welded joints. With the latter, the cold side of the joint shall be preliminarily heated.

All the joints between the poured asphalt layer and kerbs or other items in the carriageway area shall be carried out as sealed joints.

The thickness of the placed poured asphalt layer defined in Table 3.46 shall be as uniform as possible over the whole cross-section.

The poured asphalt BWSC surface shall be mechanically or manually spread with a mix of coated (glazed) grains of crushed stone to achieve an adequate roughness. This shall be performed when the asphalt surface is still hot. The quantity of the mixture of coated grains for spreading shall amount to:

- in fraction 2/4 mm 5 to 8 kg/m^2,
- in fraction 4/8 mm 13 to 16 kg/m^2.

Coated grains of crushed stone spread onto the BWSC shall be immediately rolled into the poured asphalt layer by means of rollers with a smooth metal or toothed cylinder. The engineer shall determine the method of rolling-in of spread grains.

Traffic is allowed over the placed poured asphalt BWSC layer only after the bituminous compound in the middle of the layer has cooled down to approximately 30°C. The engineer is free to specify different conditions for giving admission to traffic to enter the layer of poured asphalt.

The crushed stone grains spread onto the hot protective layer of poured asphalt (2 to 3 kg/m^2) shall be slightly pressed-in by means of a light roller.

2.2.3.2.3.5 Quality of Execution

Before the machines and equipment from which the quality of the executed work depends begin to operate, their capacity for ensuring a uniform quality in accordance with the requirements of these technical conditions shall be verified.

All the equipment and machines shall be certified and shall satisfy the demands of the design in view of capacity.

2.2.3.2.3.5.1 Preliminary Composition (Investigation)

To the preliminary composition (investigation) of BWSC poured asphalt mixtures all the requirements indicated in section 3.2.3.2.2.5.1 shall apply.

2.2.3.2.3.5.2 Required Properties of Test Specimens

For mixtures of poured asphalt the required mechanical property is the depth of impression with a seal (5 cm^2, 40 °C, 30 minut, 525 N), specified in Table 3.48.

Table 3.48: Required mechanical and volume properties of poured asphalt mixtures for the preliminary investigation (composition) for BWSC

Property of asphalt mixture	Unit measure	Type of asphalt mixture PA 4	PA 8	PA 8S	PA 11	PA 11S	Test method
- depth of impressing with seal 5 cm^2 on standard cube at 40 °C							
- after 30 min	mm	≤ 10	1 - 6	1 - 3,5	1 - 5	1 – 3	DIN 1966-7
- increase of impression depth after additional 30 min of loading	mm	≤ 0.8	≤ 0.6	≤ 0.4	≤ 0.5	≤ 0.4	
- volume mass of standard cube	mg/m^3	to be tested					

During the production and placing a poured asphalt mix, the bituminous binder may harden by two degrees, but the softening point by PK

- for B 35/50 must not exceed 70 °C,
- for B 20/30 must not exceed 73 °C.

The required values of the depth of impression after 30 minutes of loading are limiting values. The threshold values are by 1 mm greater.

2.2.3.2.3.5.3 Demonstrative Production and Placing

The contractor shall verify the preliminary (laboratory) composition of the asphalt mixture at a suitable asphalt production plant, the transportation to the site, and placing for BWSC after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and asphalt plant or cookers - mixers for production of poured asphalt for BWSC,
- establish suitability of transportation method and equipment for placing poured asphalt layers,
- take two specimens of the poured asphalt mixture at the location of placing to perform a full conformity test.

If the contractor has already executed a BWSC with similar poured asphalt mixtures last year, the results of testing of the applied mixture may be adopted instead of a demonstrative production and placing. However, the engineer shall make final decision.

2.2.3.2.3.5.4 Routine Production and Placing

To the routine production and placing poured asphalt BWSC the requirements indicated in section 2.2.3.2.2.5.4 shall apply as appropriate.

2.2.3.2.3.5.5 Layer Thickness

Limiting design thicknesses of poured apshalt BWSC are indicated in Table 3.46.

Average thickness of an asphalt mixture may be by up to 10% below the design thickness, whereas individual measured values by up to 25% below the design thickness (threshold value).

2.2.3.2.3.5.6 Evenness, Level, and Slope of Formation

To the evenness, level, and slope of formation of poured asphalt BWSC, the requirements indicated in section 2.2.3.2.2.5.6 shall apply as appropriate.

The vertical alignment of manually placed poured asphalt BWSC may deviate from the design value by no more than ± 15 mm.

2.2.3.2.3.6 Quality Control of Execution

2.2.3.2.3.6.1 Internal Control

Both type and frequency of testing within the scope of the internal control of asphalt mixtures in BWSC shall be determined and approved by the programme of the average frequency of the control. If this is not the case, it shall be specified by the engineer, who shall also determine locations of taking specimens, as well as locations of measurements, all in accordance with a random statistical pattern.

During placing poured asphalt mixtures for BWSC, the laboratory shall take test specimens and check the conformity of the properties to such a frequency as specified in Table 3.49.

Cores for testing the placed asphalt mixture shall be, as a rule, taken at locations where specimens of the hot produced mix have been taken. Immediately after taking a core, the borehole shall be filled-up with a hot asphalt mixture of similar composition.

The contractor shall regularly inform both engineer and/or institution authorized for the external control on the internal testing results. In case of any deviations from the required quality, the contractor shall take an adequate and prompt action.

Table 3.49: Minimum frequency of testing poured asphalt mixtures upon internal control of placing for BWSC

Property	Test method	Minimum testing frequency
- mineral aggregate mixture:		
- composition – Tables 3.30 and 3.31 and Figs. 3.20 to 3.24	EN 933-10,-1	1,000 t
- properties – Tables 3.32, 3.34 and 3.47	-	10,000 t
- bituminous binder:		25 t [1)]
- properties of road and polymer bitumen – Tables 3.36 and 3.37	-	
- properties of composite bitumen	-	
- produced asphalt mixture:		
- temperature	EN 12697-3	each filling
- mechanical and volume properties - Table 3.48		200 t [2)]
- bituminous binder content	EN 12697-1	
- composition of extracted mixture of grains	EN 12697-2	
- placed asphalt mixture:		500 t [2)]
- core:		2,000 m^2
- layer thickness	EN 12697-36	
- adhesion of layers	BAS	
- layer:		100 m^2
- evenness	BAS	
- level, slope	-	

1) Each tank lorry from a different source or at least once a day

2) Uninterrupted procedure at production plant or each filling

2.2.3.2.3.6.2 External Control

To the external control of execution of poured asphalt BWSC, the requirements indicated in section 2.2.3.2.2.6.2 of these technical conditions shall apply as appropriate.

2.2.3.2.3.7 Measurement and Take-Over of Works

2.2.3.2.3.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of general technical conditions by the actually extent and type of works performed within the scope of the design specifications, and calculated in square metres.

2.2.3.2.3.7.2 Take-Over of Works

Poured asphalt BWSC shall be taken-over in accordance with section 2.1.7.2 of general technical conditions. Provisions of section 2.2.3.2.2.7.2 of these technical conditions shall apply as appropriate.

2.2.3.2.3.8 Final Account of Works

2.2.3.2.3.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in compliance with section 2.2.3.2.3.7.1 and taken-over according to section 2.2.3.2.3.7.2 of these technical conditions shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment unless provided otherwise by the contract. If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.2.3.8.2 Deductions Due to Unsuitable Quality

2.2.3.2.3.8.2.1 Quality of Materials

Due to unambiguously defined quality of materials for poured asphalt BWSC there are no deductions when accounting the quantities.

If the contractor places into poured asphalt BWSC such material, which does not comply with the requirements indicated in 2.2.3.2.3.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.2.3.8.2.2 Quality of Execution

Necessary bases to assess the quality of execution and to calculate deductions due to unsuitable quality are indicated in section 2.2.3.2.3.5.

When the engineer establishes deficiencies such as

- inadequate value of depth of impression with a seal,
- inadequate value of increase of depth of impression with a seal, and
- insufficient thickness of the layer laid,

he is entitled to put into effect deductions, which shall be evaluated on the following bases:

- for inadequate value of depth of impression with a seal, if an individual value exceeds by up to 30% (1 mm) the upper limiting value, the following equation shall apply:

$$FO = \frac{p^2}{1000} \times C \times PD$$

where:

FO = *financial deduction (SIT)*
p = *deviation above the limiting value (in %)*
C = *unit price of the work executed (SIT)*
PD = *extent of the work carried out inadequately (m^2).*

Calculation of deduction: $FO' = \frac{p^2}{1000}$

p (%)	3	6	9	12	15	18	21	24	27	30
FO' (%)	0.01	0.04	0.08	0.14	0.23	0.32	0.44	0.58	0.73	0.90

for inadequate value of increase of the depth of impression with a seal, if the established individual value exceeds the upper limiting value of the increase by up to 50%, the following equation shall apply:

$$FO = \frac{p^2}{1000} \times C \times PD$$

where:

FO = *financial deduction (SIT)*
p = *deviation above the limiting value (in %)*
C = *unit price of the work executed (SIT)*
PD = *extent of the work carried out inadequately (m^2).*

Calculation of deduction: $FO^{'} = \frac{p^2}{1000}$

p (%/10)	2	4	6	8	10	12	14	16	18	20
FO' (%)	0.01	0.02	0.04	0.06	0.10	0.14	0.20	0.26	0.33	0.40

for insufficient thickness of the executed layer, the following equation shall apply:

$$FO = \frac{p}{100} \times 3{,}75 \times C \times PD$$

where:

p - % of too low value of average layer thickness over the lower limiting value, i.e. up to a value, which is by 10% below the contractual layer thickness

Calculation of deduction: $FO^{'} = \frac{p}{100} \times 3{,}75(\%)$

p %	2	4	6	8	10	12	14	16	18	20
FO' (%)	0.075	0.15	0.225	0.30	0.375	0.45	0.525	0.60	0.675	0.75

For unsuitable formation evenness of the course: if the evenness exceeds the required criteria, the following equation shall apply to calculate the deduction:

$$FO = 0{,}6 \times C \times \sum \left(p_i^2 \times A_i\right)$$

where:

p_i *= deviation of the evenness above the limit value specified in section 3.2.3.2.3.5.6 (mm)*

A_i *= corresponding zone width of an uneven formation (m)*

2.2.3.2.4 BOUND ASPHALT WEARING AND SEALING COURSES – SURFACE DRESSING

2.2.3.2.4.1 Description

Execution of bound asphalt wearing and sealing course (BWSC) – carriageway surface dressing comprises the supply of suitable mineral aggregate mixtures and binders, as well as the placing at locations specified by the design.

This work shall be carried out in weather without precipitations and wind. The substrate and air temperature shall amount to at least 15°C.

A carriageway surface dressing is a thin layer executed on a suitable substrate by one or several successive spray or other applications of an adequate binder, alternately with spreading mineral grains, and – in most cases – by applying one or several layers of uncoated or with bitumen coated, or appropriately painted grains of crushed stone or sand.

With regard to the types of mineral aggregates and binders, surface dressing is intended for the BWSC

- for a light and very light traffic loading in new pavement structures; the substrate can be either an unbound roadbase, or bound sub-base or bound roadbase;
- for all the traffic loading types in the existing pavement maintenance;
- on traffic surfaces for cyclists and pedestrians.

The type of surface dressing for BWSC is generally specified by the design. If this is not the case, the engineer shall make final decision. It can be executed by both hot and cold procedure as

- one-layer with a single or double spreading of mineral material grains,
- two-layer with a single or double spreading of mineral grains,
- inverse two-layer,
- sandwich, and
- with final bituminous slurry.

2.2.3.2.4.2 Basic Materials

2.2.3.2.4.2.1 Mineral Aggregate Mixtures

To surface dressing on traffic surfaces crushed stone grains are applicable, whereas to cyclist and pedestrian surfaces natural grains are applicable as well.

2.2.3.2.4.2.2 Binders

To BWSC – surface dressing the following bituminous binders are applicable:

- road bitumen (B 160/220),
- road bitumen modified with polymers (PmB8, PmB9, and PmB10),
- emulsion of road bitumen (EB),
- emulsion of road bitumen modified with polymers (EPmB).

The engineer may also allow the use of other suitable binders, e.g. two-component permanently elastic binders based on synthetic resins – epoxy resins. The contractor is obliged to submit adequate conformity certificates for such alternative material.

2.2.3.2.4.3 Quality of Materials

2.2.3.2.4.3.1 Granulometric Composition and Properties of Mineral Aggregate Mixtures

For BWSC – surface dressing nominal fractions of up to 16 mm of crushed stone, and fractions of natural quartz sand of 0.7/1.2 mm can be used.

The requirements for the granulometric composition of crushed stone mixtures are indicated in Table 3.50. The method of testing the composition of mineral aggregate grains is defined in the EN 933-1 (G_c90/15 category).

Table 3.50: Requirements for granulometric composition of crushed stone grains

Length of side of sieve square opening (mm)	Nominal fraction 2/4 mm	4/8 mm	8/11 mm	11/16 mm
	passing sieve (% by mass)			
0.063[1)]	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5
0.09[1)]	≤ 1	≤ 1	≤ 1	≤ 1
2	≤ 15	≤ 5	-	-
4	≥ 90	≤ 15	≤ 5	-
8	100	≥ 90	≤ 15	≤ 5
11.2	-	100	≥ 90	≤ 15
16	-	-	100	≥ 90
22.4	-	-	-	100

[1)] *Wet procedure of sieve-analysis*

Fractions of crushed stone grains for surface dressing on roads with medium or heavy loading, or with medium or higher traffic volume shall be produced of silicate stone of eruptive origin.

The required properties of crushed stone grain fractions for surface dressing are indicated in Table 3.51.

Table 3.51: Requirements for properties of crushed stone grain fractions

Properties of crushed stone grains	Unit measure	Traffic loading/volume medium or heavy/high	light/low	Test method
- resistance to crushing	%	LA_{18}	LA_{30}	EN 1097-2
- resistance to polishing	-	PSV_{50}	PSV_{30}	EN 1097-8
- resistance to frost	% by m.	MS_{18}	MS_{25}	EN 1367-2
- water absorption (on fraction 4/8 mm)	% by m.	$WA_{24}2$	$WA_{24}2$	EN 1097-6
- modulus of shape of coarse grains	% by m.	SI_{15}	SI_{20}	EN 933-4
- content of organic admixtures	% by m.	$m_{LPC}0.1$	$m_{LPC}0.1$	EN 1744-1
- percentage of coating with bitumen B 100/150, minimum	%	100/90	100/90	EN 12697-11

For BWSC – surface dressing with road bitumen as binder it is also possible to use crushed stone coated (glazed) with bitumen (0.6 to 0.8 % by mass of road bitumen B 35/50 or corresponding amount of 55%-bitumen emulsion). In such a case an additive to improve the adhesion of the bitumen to the crushed stone shall be introduced.

The composition of grains of natural quartz sand for spreading is defined by the limiting values of passing sieve of undersized grains of up to 5% by mass, and of oversized grains of up to 10% by mass (to the next grain size).

The properties of grains of natural quartz sand mixture to produce an epoxy resin mortar are defined in Table 3.32.

Prior to commencement of the works each mineral aggregate mixture foreseen to be used in a surface dressing shall be tested as specified by these technical conditions.

For BWSC – surface dressing with an epoxy binder it is possible to use quartz sand grains to be spread onto the surface. Those grains shall be painted with suitable paint.

2.2.3.2.4.3.2 Properties of Binders

The types of binders for surface dressing are indicated in Table 3.52.with regard to the traffic loading.

Table 3.52: Fields of application of bituminous binders for surface dressing in dependence on the traffic loading

Type of bituminous binder	Group of traffic loading EH	VH	H	M	L	VL
- B 160/220	-	-	-	-	+	+
- PmB8, PmB9, PmB10	+	+	+	+	+	+
- EB		-	-	-	+	+
- EPmB		+	+	+	+	+

The required basic properties of the road bitumen B 160/220 for surface dressing are indicated in Table 3.36, whilst the basic properties of polymer bitumen in Table 3.53.

Table 3.53: Required basic properties of polymer bitumen

Properties of bituminous binder	Unit measure	Type of polymer bitumen PmB8	PmB9	PmB10
		Required value		
- penetration at 25 °C	mm/10	90-150	120-200	200-300
- softening point by PK, minimum	°C	50	45	40

The basic properties of bituminous emulsions for surface dressing shall be indicated in detail by the manufacturer.

In due time prior to commencement of the works the contractor shall submit adequate evidence of the quality of the bituminous binder he intends to use for the surface dressing. Provisions indicated in these technical conditions shall be fully considered.

To improve adhesion of the bitumen to crushed stone particles it is generally necessary to foresee an adequate additive. The type, amount, and method of adding shall be approved by the engineer.

2.2.3.2.4.4 Method of Execution

2.2.3.2.4.4.1 Winning of Mineral Aggregate Mixtures and Binders

In due time prior to commencement of works, the contractor is obliged to inform the engineer of the location and method of winning mineral aggregate for surface dressing.

The contractor shall submit to the engineer evidences of conformity of mineral aggregates and binders with requirements indicated in 2.2.3.2.4.3 of these technical conditions.

2.2.3.2.4.4.2 Depositing of Mineral Aggregate Mixtures and Bituminous Binders

To these works the requirements indicated in section 2.2.3.2.2.4.2 of these technical conditions shall apply as appropriate.

2.2.3.2.4.4.3 Preparation of Substrate Formation

The following can be used as a base for surface dressing:

- formation of unbound roadbase which shall be prepared in accordance with section 2.2.3.1.1.5 of these technical conditions,
- formation of bound sub-base, which shall be prepared in compliance with section 2.2.3.1.2.5.3 of these technical conditions,
- formation of bound roadbase, which shall be prepared in accordance with section 2.2.3.1.3.5.6 of these technical conditions.

For construction of a surface dressing as a measure of maintaining an existing carriageway, a cleaned surface of the existing wearing or sealing course may be used as substrate, however only after being adequately levelled, if necessary. The contractor may commence to execute the surface dressing only after the engineer has taken-over the substrate formation in accordance with the specified requirements.

All the time up to the beginning of placing the surface dressing, the contractor is obliged to maintain the substrate formation in such a condition as it has been upon taking-over. Any damage shall be made good in due time, and an adequate evidence of the performed work shall be submitted to the engineer.

2.2.3.2.4.4.4 Production of Coated Crushed Stone

Crushed stone grains can be coated by hot, warm, or cold method, depending on the type of the binder used. Preliminary heating and de-dusting of crushed stone grain mixture shall be carried out at the asphalt mixture production plant. The binder amount for coating the grains shall be such as to allow the coated mix to remain loose after being stored.

2.2.3.2.4.4.5 Execution of Surface Dressing

As a rule, a BWSC surface dressing shall be placed mechanically over the whole traffic lane width at the same time. Any deviation from these requirements shall be approved by the engineer.

The execution of a surface dressing consists of the following three stages:

- spray application of binder to the substrate,
- spreading crushed stone, and
- rolling-in the crushed stone.

2.2.3.2.4.4.5.1 Spray Application of Binder

Both type and quantity of the binder to be sprayed onto a BWSC surface dressing shall be assessed on the basis of preliminary testing in view of the type and amount of crushed stone, substrate condition, traffic loading, and climatic conditions.

Informative necessary amounts of the bituminous binder to be sprayed-on are indicated in Table 3.54.

To spread the binder it is recommended to use suitable self-propelling spraying device equipped to be able to heat and pump the binder. Arrangement of spraying nozzles shall be such as to ensure a uniform amount of the applied binder (a deviation of up to 10% by mass for hot bituminous binder, and of up to 15% by mass for cold bituminous binder is admitted).

Manual spray equipment is only allowed for the application of surface dressing to minor surfaces. However, this shall be preliminarily approved by the engineer.

2.2.3.2.4.4.5.2 Spreading With Crushed Stone

Suitable vehicles and spreaders shall be used to scatter crushed stone.

The quantity and nominal fractions of crushed stone to be spread shall be assessed on the basis of preliminary testing in view of the substrate condition, traffic loading, climatic conditions, and type of the binder used.

The quantity of the spread crushed stone may deviate by no more than 10% by mass from the quantity foreseen on the basis of preliminary testing.

2.2.3.2.4.4.5.3 Rolling

For pressing-in crushed stone grains into the binder it is generally required to introduce rollers with rubber tyre wheels with air pressure 0.6 to 0.8 MPa, and of total weight of 14 – 18 tons.

Rollers with smooth metal circumference (up to a total weight of 12 tons) may only be used for final rolling, however on condition that the mineral grains are not crushed.

Immediately after being spread over the substrate sprayed with the binder, the crushed stone grains shall be rolled-in to a half or two thirds into the binder layer.

Onto the executed BWSC – surface dressing, traffic may be allowed immediately after final rolling, however with a reduced speed (2 to 3 days maximum 30 to 40 km/h). The engineer shall specify the duration of the speed limitation.

Table 3.54: Informative quantities of crushed stone grains and bituminous binders for surface dressing

Type of surface dressing	Mineral aggregate mixture fraction (mm)	quantity (kg/m^2)	Bituminous binder cold * (kg/m^2)	hot (kg/m^2)
one-layer with single spreading of mineral grains	2/4 4/8 8/11	7 to 12 10 to 18 15 to 20	1.2 to 1.6 1.5 to 2.0 1.8 to 2.3	0.8 to 1.1 1.1 to 1.4 1.3 to 1.6
two-layer with double spreading of mineral grains 1st working stage 2nd working stage or 1st working stage 2nd working stage	 8/11 2/4 11/16 4/8	 11 to 16 3 to 8 15 to 20 4 to 8	 1,8 do 2,2 2,0 do 2,6	 1,2 do 1,5 1,4 do 1,8
two-layer 1st working stage 2nd working stage or 1st working stage 2nd working stage	 8/11 4/8 or 2/4 11/16 4/8	 11 to 18 10 to 15 8 to 12 15 to 20 4 to 8	 1.4 to 2.1 1.2 to 1.8 1.0 to 1.4 2.0 to 2.4 1.3 to 1.7	 1.0 to 1.5 0.9 to 1.3 0.7 to 1.0 1.4 to 1.7 0.9 to 1.2
reverse two-layer 1st working stage 2nd working stage or 1st working stage 2nd working stage	 2/4 4/8 or 8/11 4/8 11/16	 7 to 12 10 to 18 15 to 20 10 to 18 15 to 22	 1.2 to 1.6 1.5 to 2.0 1.2 to 1.5 1.5 to 2.0 1.2 to 1.5	 0.8 to 1.0 1.0 to 1.3 0.8 to 1.0 1.0 to 1.3 0.8 to 1.0

Type of surface dressing	Mineral aggregate mixture fraction (mm)	Mineral aggregate mixture quantity (kg/m^2)	Bituminous binder cold * (kg/m^2)	Bituminous binder hot (kg/m^2)
sandwich				
1st working stage	8/11	11 to 16	1.7 to 2.1	1.1 to 1.4
2nd working stage	2/4	3 to 8		
or			1.8 to 2.2	1.2 to 2.4
1st working stage	8/11	11 to 16		
2nd working stage	4/8	4 to 8	1.9 to 2.5	1.2 to 1.6
or				
1st working stage	11/16	15 to 20		
2nd working stage	4/8	4 to 8		

1) Values for the cold binder refer to a 65% - bituminous emulsion

Spread crushed stone grains, which are not perfectly bound to the substrate, shall be removed from the carriageway by means of sweeping or vacuum cleaning, prior to cessation of the speed restriction.

2.2.3.2.4.5 Quality of Execution

Before the machines and equipment from which the quality of the executed work depends begin to operate, their capacity for ensuring a uniform quality in accordance with the requirements of these technical conditions shall be verified. All the equipment and machines shall be certified and shall satisfy the demands of the design in view of capacity.

2.2.3.2.4.5.1 Method Statement

At least 7 days in advance prior to starting placing a surface dressing for BWSC, the contractor shall submit to the engineer for approval a method statement, which shall include particularly the following:

- Preliminary composition for the surface dressing,
- Evidence of conformity of all the materials to be used,
- Programme of both internal and external control,
- Information on the mechanization to be introduced,
- Site organization and traffic regulation plan,
- Information on labour and responsible employees at the site.

The preliminary investigation shall provide the following results:

- type and quantity of individual crushed stone fractions (in l/m^2 or kg/m^2),
- type and quantity of the binder (in l/m^2 or kg/m^2),
- type and quantity of additives for adhesion.

Besides the preliminary composition, the contractor shall also submit an evidence of the source and suitable quality of all the materials used to prepare the preliminary composition for surface dressing.

The contractor shall demonstrate with the preliminary investigation (composition) that the foreseen mixture of crushed stone and binders can achieve the required quality of a surface dressing as specified in these technical conditions.

The contractor must not begin placing until he has received an approval by the engineer for the preliminary composition of the surface dressing.

If the contractor has already placed a surface dressing last year with compositions of mineral grains and binders of the same properties, then the preliminary composition may be taken from the already performed composition determined by internal testing. However, final decision shall be made by the engineer.

2.2.3.2.4.5.2 Demonstrative Production and Placing

The contractor shall prove the conformity of the preliminary (laboratory) composition of the surface dressing by placing for BWSC at the site after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and asphalt plant for production of coated crushed stone grains, as well as suitability of transportation method and equipment for placing, all in compliance with these technical conditions,
- take two specimen of the sprayed-on binder and spread crushed stone at the location of placing to perform a complete conformity test.

If the contractor has already placed a surface dressing in similar conditions last year, then results of the executed composition may be considered as the demonstrative production and placing. However, the engineer shall make final decision.

2.2.3.2.4.5.3 Routine Production and Placing

The engineer shall approve a routine production and placing of a surface dressing not until the contractor has submitted the results of the demonstrative production and placing. The permission for a continuous production also includes requirements for the internal control foreseen by these technical conditons.

The permission for a routine production and placing of the surface dressing for BWSC shall also comprise detailed requirements for an eventual additional levelling of the underlay according to section 2.2.3.2.4.4.3 of these technical conditions, as well as eventual additional requirements and conditions for the internal control as specified by these technical conditions.

In case of any modification in production or placing of a surface dressing, the contractor shall submit to the engineer in writing his proposal for the particular modification. Such a modification shall only be implemented after being approved by the engineer.

2.2.3.2.4.5.4 Evenness, Level, Slope

As the application of surface dressing does not essentially change the evenness of the substrate or the existing carriageway, there are no special requirements related to that pavement characteristic.

The same consideration also applies to both level and slope of the BWSC – surface dressing.

2.2.3.2.4.6 Quality Control of Execution

2.2.3.2.4.6.1 Internal Control

The engineer shall specify the extent of the internal control of placing BWSC – surface dressing on the basis of the results of preliminary technological tests (preliminary composition as well as demonstrative production and placing). The minimum tests to carried out by the contractor comprise the following:

- mineral aggregate mixture:	- granulometric composition	every 8,000 m^2
	- properties	every 20,000 m^2
	- quantity of spread grains	every 2,000 m^2
- binder:	- quantity of sprayed-on binder	every 2,000 m^2

In case that the engineer, within the scope of the internal control, establishes substantial deviations of results from the preliminary technological tests, he is entitled to increase the minimum extent of the internal control subsequently.

2.2.3.2.4.6.2 External Control

The conditions for the external control to be carried through by an authorized third party institution are defined as appropriate in section 2.2.3.2.2.6.2.

2.2.3.2.4.7 Measurement and Take-Over of Works

2.2.3.2.4.7.1 Measurement of Works

The executed works shall be measured in accordance with the section 2.1.7.1 of the general technical conditions, and calculated in square metres.

All the quantities shall be measured by the actually executed extent and type of works within the scope of the design.

2.2.3.2.4.7.2 Take-Over of Works

To the take-over of a BWSC surface dressing the conditions indicated in section 2.2.3.2.2.7.2 of these technical conditions shall apply as appropriate.

3.2.3.1.1.2Final Account of Works

3.2.3.1.1.2.1 General

To the final account of executed surface dressing the conditions indicated in section 2.2.3.2.2.8.1 shall apply as appropriate.

2.2.3.2.4.7.3 Deductions Due to Unsuitable Quality

2.2.3.2.4.7.3.1 Quality of Materials

Due to unambiguously defined quality of materials for surface dressing there are no deductions when accounting the quantities.

If the contractor places into a BWSC surface dressing such material, which does not comply with the requirement indicated in 2.2.3.2.4.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.2.4.7.3.2 Quality of Execution

If the contractor fails to ensure the specified quality of the executed surface dressing as provided by the section 2.2.3.2.4.4 of these technical conditions, the engineer shall make a final decision on the accounting method. He has the right to order the removal of all the materials placed, if the traffic safety is endangered due to unsuitable quality of the surface dressing. All the costs for the removal shall be born by the contractor.

2.2.3.2.5 BOUND ASPHALT WEARING COURSES – DRAINAGE ASPHALT

2.2.3.2.5.1 Description

The execution of a bound wearing course (BWC) of drainage asphalt comprises the supply of suitable mineral aggregate mixtures and bituminous binder, as well as the production and placing at locations specified by the design.

In view of the size of the largest stone grains in the drainage asphalt mixture, and of their origin, the following mixtures are applicable to BWC:

- drainage asphalt DA 8s and DA 8,
- drainage asphalt DA 11s and DA 11,
- drainage asphalt DA 11.

Mixtures of drainage asphalt designated with »s« shall contain grains of sand and crushed stone of silicate stone of eruptive origin.

With regard to the type of mineral aggregate and binder, drainage asphalt BWC is intended for pavements for all groups of traffic loading. As a rule, they are introduced as pavement wearing courses on carriageways of minimum slopes. The layer below the drainage asphalt course shall be perfectly waterproof to prevent water to seep into the pavement structure.

For typical groups of traffic loading the use of drainage asphalt mixes for BWC is indicated in Table 3.55, whereas for characteristic groups of traffic volume it is given in the Table 3.56.

The method of assessing the traffic loading is defined in detail in the TSC 06.511 Design, Traffic loading.

Table 3.55: Fields of application of drainage asphalt mixtures for BWC in dependence on the average annual daily traffic loading

Traffic loading group	AADT loading (nominal axle load 82 kN)	Type of asphalt mix				
		DA 8	DA 8s	DA 11	DA 11S	DA 16
- exceptionally heavy	> 3,000	-	+	-	+	-
- very heavy	> 800 to 3,000	-	+	-	+	-
- heavy	> 300 to 800	-	+	-	+	-
- medium	> 80 to 300	-	+	-	+	-
- light	> 30 to 80	+	-	+	-	-
- very light	≤ 30	+	-	+	-	-
- footways, cycle tracks, parking places, and emergency lanes on motorways	-	+	-	+	-	+ [1)]

[1)] Base on sports fields

Table 3.56: Fields of application of drainage asphalt mixtures for BWC in dependence on the average annual daily traffic volume

Traffic volume group	AADT volume	Type of asphalt mix				
		DA 8	DA 8s	DA 11	DA 11s	DA 16k
- exceptionally high	> 20,000	-	-	-	+	-
- very high	> 10,000 to 20,000	-	+	-	+	-
- high	> 5,000 to 10,000	-	+	-	+	-
- medium	> 2,000 to 5,000	-	+	-	+	-
- low	> 1,000 to 2,000	+	+	+	-	+
- very low	≤ 1,000	+	+	+	+	+

For new road construction, the design (technological) layer thicknesses of drainage asphalt for BWC are indicated in Table 3.57

Table 3.57: Limiting design layer thicknesses of drainage asphalt mixtures for BWC

Design layer thickness	Unit measure	Type of asphalt mix		
		DA 8, DA 8s	DA 11, DA 11s	
- minimum	mm	30	40	45
- maximum	mm	40	50	60

As a rule, the type of the drainage asphalt mix for BWC shall be specified by the design. If this is not the case, the engineer shall make final decision.

2.2.3.2.5.2 Basic Materials

For preparation of drainage asphalt mixtures the following materials are required:

- mineral aggregate mixtures,
- bituminous binders, and
- stabilizing additives.

2.2.3.2.5.2.1 Mineral Aggregate Mixtures

Only crushed grains of silicate and carbonate stone are applicable to execution of drainage asphalt BWC.

3.2.3.1.1.2.2 Bituminous Binders

For drainage asphalt BWC, road bitumen or a mixture of bitumen and additives such as polymer bitumen or tar having properties as specified for these asphalt mixtures shall be used.

Exceptionally, and if approved by the engineer, for drainage asphalt BWC a binder of characteristics B 100/150 may also be used, generally for light and very light traffic loading, and in severe climatic conditions.

2.2.3.2.5.2.2 Stabilizing Additives

Stabilizing additives for drainage asphalt mixtures for BWC are generally of inorganic origin (fibres, granules, dust).

2.2.3.2.5.3 Quality of Materials

2.2.3.2.5.3.1 Granulometric Composition and Properties of Mineral Aggregate Mixtures

Mineral aggregate mixtures for drainage asphalt BWC are composed of grains of

- stone dust,
- sand, and
- crushed stone.

The quality of mineral grain mixtures for drainage asphalt BWC is basically defined in detail in the EN 13043.

2.2.3.2.5.3.1.1 Stone Dust

For drainage asphalt BWC, stone dust of quality I produced of carbonate stone shall be used. The requirements for the composition and properties of stone dust grain mixtures are indicated in Table 3.30.

2.2.3.2.5.3.1.2 Sand

For drainage asphalt BWC, crushed particles of fine sand may be used (granulometric composition 0/2 mm, GF_{85} category).

The requirements for the composition and properties of grain mixtures of crushed fine sand are indicated in Tables 3.31 and 3.32.

2.2.3.2.5.3.1.3 Crushed Stone

For drainage asphalt BWC, fractions of crushed stone grains of size up to 16 mm and of $C_{100/0}$ category shall be used.

The requirements for the quality of crushed stone mixtures are indicated in Tables 3.33 and 3.34 of these technical conditions.

In case that the required degree of coating of mineral grain surface with bituminous binder is not ensured, suitable additive shall be used to improve coating of grains.

2.2.3.2.5.3.1.4 Collective Granulometric Composition

For BWC, mixtures of drainage asphalt composed of nominal fractions 0/8 mm, 0/11 mm, and 0/16 mm shall be used.

Ranges of the granulometric composition of these asphalt mixtures are indicated in terms of grading curve limits for

- drainage asphalt DA 8 and DA 8s in Fig. 3.25,
- drainage asphalt DA 11 and DA 11s in Fig. 3.26, and for
- drainage asphalt DA 16 in Fig. 3.27.

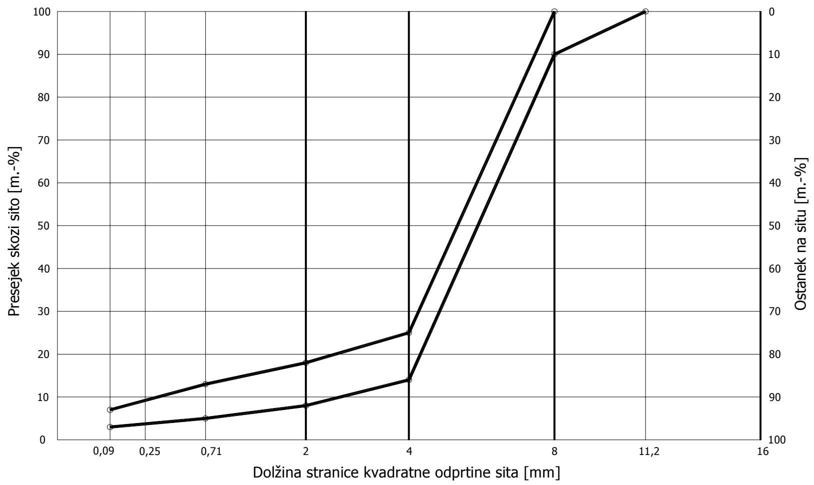


Fig. 3.25: Grading curve limits for mineral aggregate mixtures for drainage asphalt DA 8 and DA 8s

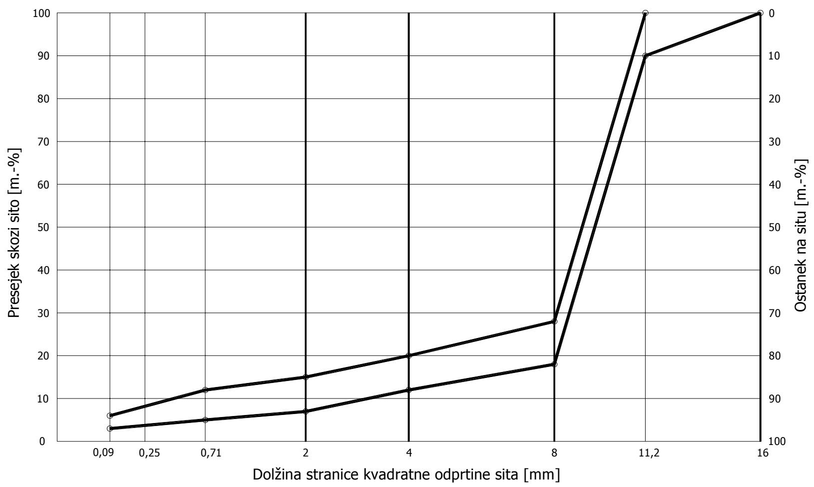


Fig. 3.26: Grading curve limits for mineral aggregate mixtures for drainage asphalt DA 11 and DA 11s

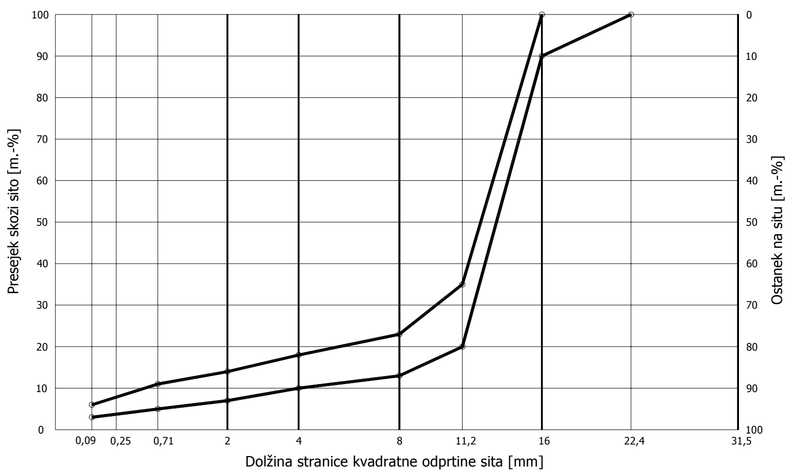


Fig. 3.27: Grading curve limits for mineral aggregate mixtures for drainage asphalt DA 16

2.2.3.2.5.3.2 Properties of Bituminous Binders

The properties of bituminous binders for drainage asphalts are defined

- for road bitumen in Table 3.36, and
- for polymer bitumen in Table 3.37.

Traffic loading and climatic conditions shall be considered when selecting the type of the bituminous binder.

If the engineer directs the use of a bituminous binder other than the binder specified by the design and/or preliminary investigation, he shall specify the quality conditions as well.

2.2.3.2.5.4 Method of Execution

2.2.3.2.5.4.1 Winning of Mineral Aggregate Mixtures and Binders

To winning mineral aggregate mixtures and bituminous binders for drainage asphalt BWC the requirements indicated in section 2.2.3.2.2.4.1 of these technical conditions shall apply as appropriate.

2.2.3.2.5.4.2 Depositing of Mineral Aggregate Mixtures and Binders

To these works the requirements indicated in section 2.2.3.2.2.4.2 of these technical conditions shall apply as appropriate.

2.2.3.2.5.4.3 Preparation of Substrate Formation

To this work the requirements indicated in section 2.2.3.2.2.4.3 of these technical conditions shall apply as appropriate.

2.2.3.2.5.4.4 Production of Asphalt mixture

To production of drainage asphalt mix the requirements indicated in section 2.2.3.2.2.4.4 of these technical conditions shall apply as appropriate.

2.2.3.2.5.4.5 Bringing Asphalt mixture

General conditions for bringing asphalt mixture for BWC drainage asphalt are indicated in section 3.2.3.2.2.4.5 of these technical conditions.

2.2.3.2.5.4.6 Placing Asphalt mixture

In due time prior to placing asphalt mixtures the surface of a clean substrate, to which a drained asphalt mixture will be placed as BWC, shall be evenly sprayed with a cationic bituminous emulsion (0.3 to 0.5 kg/m^2) or with another suitable binder to achieve adhering together of layers, if it has not been sprayed at all, or if the traffic has removed the bituminous film from the substrate surface. The sprayed-on agent for sticking the layers together shall be dry prior to placing the asphalt mix.

Placing of asphalt mixture of drainage asphalt for BWC shall generally be performed mechanically by means of a finisher to ensure a uniform composition of the spread mix. Exceptionally, manual placing is allowed as well, if mechanical placing is not feasible for limited space. The engineer shall approve the manual placing.

A bituminous mix of drainage asphalt may only be placed in favourable weather conditions. Both air and substrate temperature shall amount to at least 10°C. Exceptionally, and if approved by the engineer, the drainage asphalt mix may be placed at 5°C to a dry and non-frozen substrate in a still weather, on condition that the asphalt layer thickness is in the upper range of the design thickness specified in Table 3.57.

In windy weather the lowest temperature of the asphalt mixture for BWC shall not be less than by 10°C higher than the established lower limiting value for the particular bitumen type. In case of manual placing, the temperature shall be by at least 20°C higher than the lower limiting value.

If work conditions permit, drainage asphalt for BWC shall be placed over the whole width of the carriageway at the same time. If two finishers situated one after another are used for spreading, the difference in quality of the placed layer of the asphalt mixture in the joint area must not be visible.

Any interruption of work shall be executed perpendicularly to the road axis and vertically over the entire width of the carriageway or traffic lane. Any deviation from this is only allowed upon the engineer's consent. Before the continuation of placing, the surface of the transverse joint shall be indirectly heated. The spreading effect of the finisher must ensure a compaction of at least 85% of the distributed asphalt mixture.

The selected type of rollers and the compaction method (generally by static moving of rollers) shall ensure the required density or compaction as evenly as possible over the whole carriageway design width. Therefore, the width of the layer shall be increased by the design layer thickness unless provided otherwise by the design.

An asphalt layer of a BWC shall be compacted from the edge towards the centre of the layer, and from the lower edge to the upper edge of the layer. Individual passages of rollers shall always overlap. Any staying of rollers on the placed layer shall be avoided.

All places inaccessible to machines shall be compacted to the required degree by other means, the use of which shall be approved by the engineer, who also specifies the conditions in which such means have to be used.

Traffic is allowed over the executed layer of drainage asphalt only after the mixture in the middle of the layer has cooled down to approximately 30°C. The engineer has the right to specify other conditions to be fulfilled prior to allowing the traffic over the BWC.

2.2.3.2.5.5 Quality of Execution

At least 7 days in advance prior to starting placing a drainage asphalt layer, the contractor shall submit to the engineer for approval a method statement, which shall include particularly the following:

- Preliminary composition of the asphalt mixture,
- Evidence of conformity of all the materials to be used,
- Programme of average frequency of both internal and external control,
- Description of work methods, and
- Information on the mechanization to be introduced.

Before the machines and equipment, on which the quality of the executed work depends, begin to operate, their ability to ensure a uniform quality in accordance with these technical conditions shall be ascertained.

All the machinery and equipment shall be certified and shall satisfy the design requirements as well as these technical conditions for the quality of the placed layer of drainage asphalt.

2.2.3.2.5.5.1 Preliminary (Laboratory) Composition of Asphalt mixture

To the preliminary investigation (composition) of the drainage asphalt mixture for BWC all the requirements indicated in section 2.2.3.2.2.5.1 shall apply as appropriate.

2.2.3.2.5.5.2 Properties of Test Specimens

The required properties of test specimens of asphalt mixtures of drainage asphalt for BWC are indicated in Table 3.58. To the other properties of test specimens the requirements indicated in section 2.2.3.2.2.5.2 shall apply as appropriate.

Table 3.58: Required mechanical and volume properties (limiting values) of mixtures of drainage asphalt for a preliminary (laboratory) composition for BWC

Property of asphalt mixture	Unit measure	Required value for traffic loading			Test method
		DA 8	DA 11	DA 16	
- total void content	% by vol.	V_{min16} – V_{max27}			EN 12697-8
- void content in mineral aggregate mixture	% by vol.	to be tested			EN 12697-8
- filling of voids in mineral aggregate mixture with bitumen	%	VFB_{25}–VFB_{45}	VFB_{23} – VFB_{43}	VFB_{20} – VFB_{40}	EN 12697-8

2.2.3.2.5.5.3 Demonstrative Production and Placing

To the demonstrative production and placing of asphalt mixture of drainage asphalt the requirements indicated in section 2.2.3.2.2.5.3 shall apply as appropriate.

The threshold values of mechanical and volume properties of drainage asphalt mixes are indicated in Table 3.59.

2.2.3.2.5.5.4 Routine Production and Placing

To the routine production and placing of drainage asphalt mixtures the requirements indicated in section 2.2.3.2.2.5.4 shall apply as appropriate.

Table 3.59: Threshold values of mechanical and volume properties of produced drainage asphalt mixes for BWC

Property of asphalt mixture	Unit measure	Required value			Test method
		DA 8	DA 11	DA 16	
- total void content	% by vol.	$V_{min13} - V_{max30}$			EN 12697-8
- void content in mineral aggregate mixture	% by vol.	to be tested			EN 12697-8
- filling of voids in mineral aggregate mixture with bitumen	%	$VFB_{20} - VFB_{50}$	$VFB_{18} - VFB_{48}$	$VFB_{15} - VFB_{45}$	EN 12697-8

The required limiting values of compaction and void content for drainage asphalt mixtures for BWC are indicated in Table 3.60.

Table 3.60: Required limiting values of placed mixture of drainage asphalt for BWC

Property of placed asphalt mixture	Unit measure	Required value			Test method
		DA 8	DA 11	DA 16	
- layer compaction	% by vol.	≥ 97			BAS
- layer void content	% by vol.	$V_{min15} - V_{max28}$			EN 12697-8

2.2.3.2.5.5.5 Layer Thickness

Limiting design thicknesses of drainage asphalt mixtures for BWC are indicated in Table 3.57.

Average thickness of an asphalt mixture may be by up to 10% below the design thickness, whereas individual measured values (however maximum 10% of the total number of tests) by up to 25% below the design thickness (threshold value).

An individual measured thickness of an ahspalt mixture for BPBB abd BPBw courses is admitted to be by up to 10% greater than the design thickness.

When assessing the average thickness of a placed layer, the maximum thickness is limited to the upper limiting design thickness + 5 mm (according to Table 3.57).

3.2.3.1.1.2.3 Evenness, Level, and Slope of Formation

To the evenness, level, and slope of formation of a placed layer of drainage asphalt for BWC, the requirements indicated in section 3.2.3.2.2.5.6 shall apply as appropriate.

2.2.3.2.5.6 Quality Control of Execution

2.2.3.2.5.6.1 Internal Control

To the internal control within the scope of execution of drainage asphalt mix for BWC the conditions indicated in section 2.2.3.2.2.6.1 shall apply as appropriate.

3.2.3.1.1.2.4 External Control

To the external control within the scope of execution of drainage asphalt mix for BWC the conditions indicated in section 2.2.3.2.2.6.2 shall apply as appropriate.

2.2.3.2.5.7 Measurement and Take-Over of Works

2.2.3.2.5.7.1 Measurement of Works

The executed works shall be measured in accordance with section 2.1.7.1 of the general technical conditions and calculated in square metres.

All the quantities shall be measured by the actually performed extent and type of works within the scope of the design. The measurements shall be recorded in due time.

3.2.3.1.1.2.5 Take-Over of Works

To taking-over of constructed drainage asphalt layers for BWC the conditions indicated in section 2.2.3.2.2.7.2 of these technical conditions shall apply as appropriate.

2.2.3.2.5.8 Final Account of Works

2.2.3.2.5.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in compliance with section 2.2.3.2.5.7.1 and taken-over according to section 2.2.3.2.5.7.2 of these technical conditions shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment unless provided otherwise by the contract.

If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.2.5.8.2 Deductions Due to Unsuitable Quality

2.2.3.2.5.8.2.1 Quality of Materials

Due to unambiguously defined quality of materials for drainage asphalt BWC there are no deductions when accounting the quantities.

If the contractor places such material for BWC, which does not comply with the requirement indicated in 2.2.3.2.5.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.2.5.8.2.2 Quality of Execution

Necessary bases to assess the quality of execution and to calculate deductions due to unsuitable quality are indicated in section 2.2.3.2.5.5.

If the contractor fails to ensure the required quality of placed drainage asphalt BWC the engineer shall decide upon the method of accouting. When the engineer establishes deficiencies such as

- unsuitable void content in the asphalt mixture placed,
- insufficient compaction of the asphalt mixture placed,
- insufficient thickness of the layer laid, or
- unsuitable evenness of the formation,

he is entitled to put into effect deductions, which shall be evaluated on the following bases:

- For an unsuitable void content in the asphalt mixture placed, if the void content specified by the preliminary investigation of the asphalt mixture is exceeded, the following equation shall apply:

$$FO = \frac{p^2}{100} \times 6 \times C \times PD$$

where:

FO = financial deduction (SIT)

p = deviation above the limiting value, however by maximum ± 5% (threshold value)

C = unit price of the work executed (SIT/m²)

PD = extent of the work carried out inadequately (m²).

Calculation of deduction: $FO' = p^2 \times 6$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
FO' (%)	0.24	0.96	2.16	3.84	6.0	8.64	11.76	15.36	19.44	24.0

For an unsuitable compaction of the asphalt mixture placed (compared to the specimen by Marshall), the following equation shall apply:

$$FO = \frac{p^2}{100} \times 3 \times C \times PD$$

where:

p - deviation of compaction of the placed asphalt mixture from the lower limiting value, however by maximum 3% (absolute value), i.e. up to the lower threshold value

Calculation of deduction: $FO' = p^2 \times 3$ (%)

p %	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
FO' (%)	0.12	0.48	1.08	1.92	3.0	4.32	5.88	7.68	9.72	12.0	14.52	17.28	20.28	23.52	27.0

For insufficient thickness of the bituminous layer placed:

- for a deviation of the average or individual thicknesses from the contractual value by up to 10%, the contract price shall be cut down linearly;
- for a deviation of individual thicknesses by > 10% to 25%, an additional contract price reduction shall be carried out applying the following equation:

$$FO = \frac{p}{100} \times 3{,}75 \times C \times PD$$

where:

p - percentage of the insufficient individual layer thickness (above -10% to - 25% of the design/contract thickness)

Calculation of deduction: $FO' = p \times 3{,}75$ (%)

p %	2	4	6	8	10	12	14	16	18	20
FO' (%)	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75

For unsuitable formation evenness of the course, the following equation shall apply:

$$FO = \sum \left(p_i^2 \times A_i \right) \times 0{,}6 \times C$$

where:

p_i = deviation of the evenness above the limit value specified in section 3.2.3.2.2.5.6 (mm)

A_i = corresponding zone width of an uneven formation (m)

2.2.3.2.6 BOUND ASPHALT WEARING AND SEALING COURSES – STONE MASTIC ASPHALT

2.2.3.2.6.1 Description

The execution of a bound wearing and sealing course (BWSC) of a mixture of stone mastic asphalt (SMA) comprises the supply or suitable mineral aggregate mixtures and binder, as well as the production, transport, and placing the asphalt mix at locations specified by the design.

This work shall be carried out in still weather without precipitations, and at both substrate and air temperatures of at least 5°C. Exceptionally, and if approved by the engineer, a BWSC of SMA may be placed onto a dry and non-frozen substrate at temperature 3°C in still weather, on condition that the asphalt layer thickness is in the upper range of the required technological (design) thickness.

In view of the size of the largest grains in a stone mastic asphalt mixture as well as their origin, the following asphalt mixtures are applicable to BWSC:

- stone mastic asphalt SMA 4,

- stone mastic asphalt SMA 8 and SMA 8s, and
- stone mastic asphalt SMA 11 and SMA 11s.

Mixtures of stone mastic asphalt designated with »s« shall contain grains of sand and crushed stone of silicate stone of eruptive origin.

In dependence on the type of both mineral aggregate mixture and binder, BWSC made of stone mastic asphalt are placed as wearing and sealing course for all the traffic loading groups.

The use of mixture of stone mastic asphalt for BWSC is indicated in Table 3.61.for the characteristic traffic loading groups, whilst for the characteristic traffic volume groups it is indicated in Table 3.62.

The method of assessing the traffic loading is described in detail in the TSC 06.511 Design, Traffic loading.

Table 3.61: Fields of application of mixtures of SMA for wearing and sealing courses in dependence in the average annual daily traffic loading

Traffic loading group	AADT loading (nominal axle load 82 kN)	Type of asphalt mixture				
		SMA 4	SMA 8	SMA 8s	SMA 11	SMA 11s
- exceptionally heavy (EH)	> 3,000	-	-	+	-	+
- very heavy (VH)	> 800 to 3,000	-	-	+	-	+
- heavy (H)	> 300 to 800	-	-	+	-	+
- medium (M)	> 80 to 300	-	+	+	+	+
- light (L)	> 30 to 80	+	+	-	+	-
- very light (VL)	≤ 30	+	+	-	+	-
- footways, cycle tracks, parking places, and emergency lanes on motorways	-	+	+	-	-	-

Table 3.62: Fields of application of mixtures of SMA for wearing and sealing courses in dependence on the average annual daily traffic volume

Traffic volume group	AADT volume	Type of asphalt mixture				
		SMA 4	SMA 8	SMA 8s	SMA 11	SMA 11s
- exceptionally high	> 20,000	-	-	+	-	+
- very high	> 10,000 to 20,000	-	-	+	-	+
- high	> 5,000 to 10,000	-	-	+	-	+
- medium	> 2,000 to 5,000	-	+	+	+	+
- low	> 1,000 to 2,000	+	+	-	+	-
- very low	≤ 1,000	+	+	-	+	-

[1)] *When selecting type of mineral grains such stone shall prevail which is more resistant to* smoothening.

The required limiting design layer thicknesses of SMA for BWSC are indicated in Table 3.63.

Table 3.63: Limiting layer thicknesses of SMA for BWSC

Design layer thickness	Unit measure	Type of asphalt mixture				
		SMA 4	SMA 8	SMA 8s	SMA 11	SMA 11s
- minimum	mm	1.5	2	2.5	2.5	3
- maximum	mm	3.5	4	4.5	4.5	5

As a rule, the type of the SMA mixture for BWSC shall be specified by the design. If this is not the case, the engineer shall make a final decision.

2.2.3.2.6.2 Basic Materials

2.2.3.2.6.2.1 Mineral Aggregate Mixtures

For SMA mixtures to be placed as BWSC only mixtures of crushed stone grains may be used.

If the type of the mineral aggregate mixture is not specified by the design, it shall be determined by the engineer with regard to the traffic loading and volume, as well as to climatic conditions and layer thickness.

2.2.3.2.6.2.2 Bituminous Binders

For SMA mixtures for BWSC, standard road bitumen (B) of polymer bitumen (PmB) can be used, on condition that their properties meet the requirements for the foreseen traffic and climatic loading, as well as for production and placing.

The applicability of types of bituminous binders is indicated in Table 3.64.

Table 3.64: Applicability of types of road bitumen and polymer bitumen for SMA mixtures for BWSC in dependence on the traffic loading

Traffic loading group	Type of bituminous binder					
	B 70/100	B 50/70	B 35/50	PmB 2	PmB 3	PmB 4
exceptionally heavy	-	+	+	+	+	+
very heavy	-	+	+	+	+	+
heavy	-	+	+	-	+	+
medium	+	+	+	-	+	+
light	+	-	-	-	-	+
very light, and footways, cycle tracks, etc.	+	-	-	-	-	-

If the type of the bituminous binder is not specified by the design, the engineer shall specify taking account of the foreseen conditions of application. The engineer has also the right to request a change of the bituminous binder type, if this is required due to the traffic loading and climatic conditions.

The contractor may also use other binders provided that he can prove their conformity and that the engineer approves such a modification.

2.2.3.2.6.2.3 Stabilizing Additives

Stabilizing additives for SMA mixtures for BWC are generally of inorganic origin (fibres, granules, dust).

2.2.3.2.6.3 Quality of Materials

2.2.3.2.6.3.1 Mineral Aggregate Mixtures

Mineral aggregate mixtures for SMA mixes for BWSC shall be composed of

- stone dust,
- sand, and
- crushed stone.

The quality of mineral aggregate mixtures for BWSC is basically defined in detail in the EN 13043 Aggregates for asphalt mixtures and surface dressing for roads, airports, and other traffic surfaces.

2.2.3.2.6.3.1.1 Stone Dust

For mixtures of SMA for BWSC for roads with medium or heavy loading, stone dust of the quality class I produced of carbonate stone shall be used as a rule.

Recovered stone dusts won during the production of asphalt mixtures by de-dusting silicate grains must not be used as added (foreign) stone dust.

Properties of stone dust used to produce SMA mixtures shall meet the requirements indicated in Table 3.20 in these technical conditions.

2.2.3.2.6.3.1.2 Sand

For SMA for BWSC, only fine crushed sand of GF_{85} category shall be used.

The required composition of fine crushed sand mixture for SMA mixes for BWSC is indicated in Table 3.31.

For roads with a heavy traffic loading and high traffic density, fine crushed sand of silicate stone shall be used.

The required properties of sand grains for SMA mix for BWSC are indicated in Table 3.32.

Mineral grains used to produce crushed sand shall have same resistance to both crushing and wear when tested by the Los Angeles method as it is required for the crushed stone mixture for the corresponding traffic loading type indicated in Table 3.33.

2.2.3.2.6.3.1.3 Crushed Aggregate

For SMA mixtures basic fractions and intermediate fractions of crushed stone grains, which meet the requirements indicated in the EN 13043, are recommended.

Requirements for resistance of stone grains for SMA mixtures

- to crushing and wear assessed by the Los Angeles testing method (according to EN 1097-2), and
- to polishing (PSV coefficient according to EN 1097-8),

are indicated in Table 3.33 for the traffic loading groups, while the other requirements for properties of crushed stone grain mixtures are stated in Table 3.34 in these technical conditions.

For SMA mixtures for BWSC on roads with heavy traffic loading it is only allowed to use completely crushed stone grains ($C_{100/0}$ category assessed in accordance with the EN 933-5.

In case that the percentage of coating of mineral grain surface with the bitumen B 100/150 is not ensured, suitable additive shall be introduced to improve the coating rate.

2.2.3.2.6.3.1.4 Collective Granulometric Composition

Ranges of mineral aggregates passing sieve for SMA mixes are determined for the basic types of asphalt mixtures by grading curve limits indicated in Figs. 3.28 to 3.32.

The method of testing mineral aggregate mixtures is defined in the EN 933-1, whereas the composition of mineral aggregate mixtures is specified in the EN 13108-1.

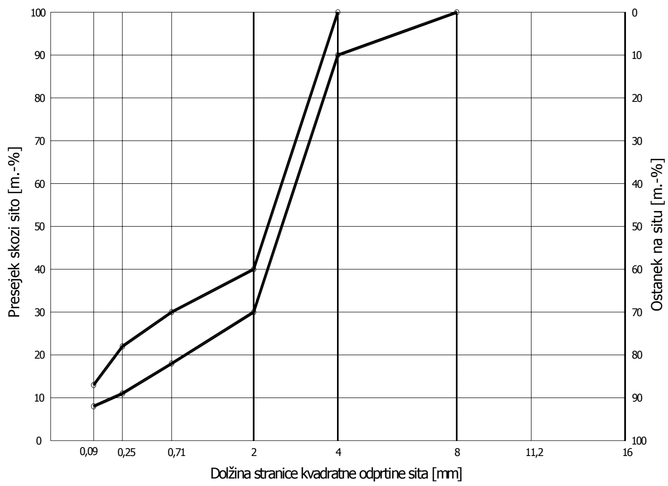


Fig. 3.28: Grading curve limits for mineral aggregate mixtures for stone mastic asphalt SMA 4

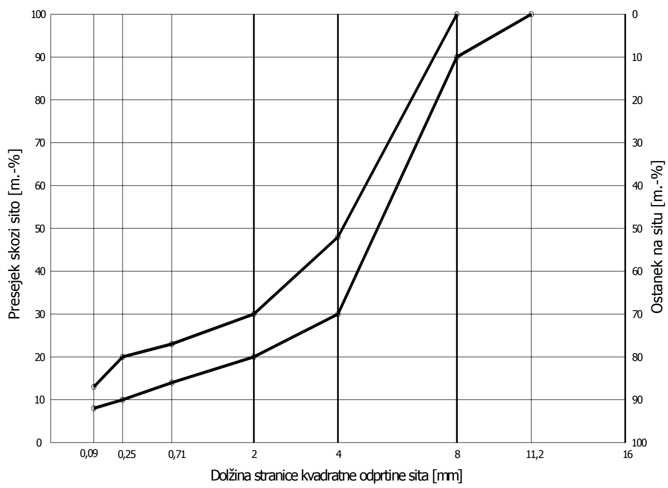


Fig. 3.29: Grading curve limits for mineral aggregate mixtures for stone mastic asphalt SMA 8

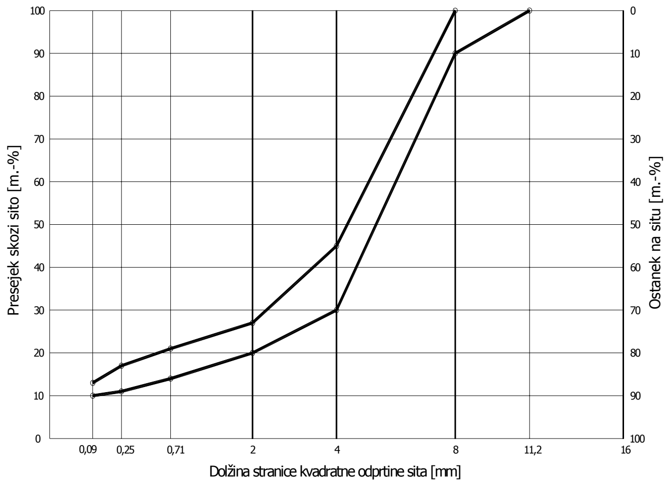


Fig. 3.30: Grading curve limits for mineral aggregate mixtures for stone mastic asphalt SMA 8s

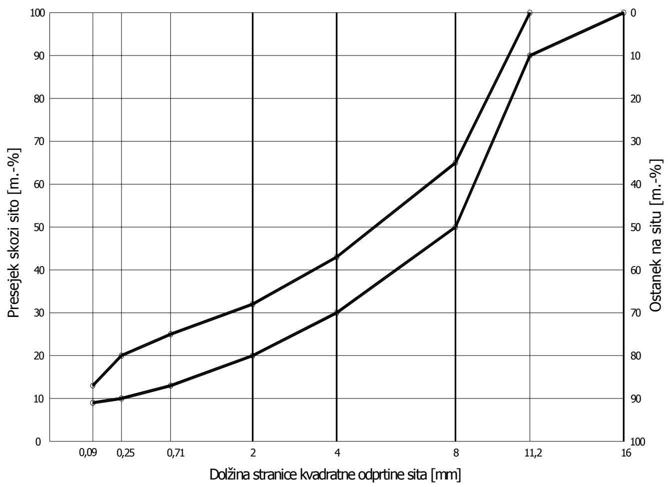


Fig. 3.31: Grading curve limits for mineral aggregate mixtures for stone mastic asphalt SMA 11

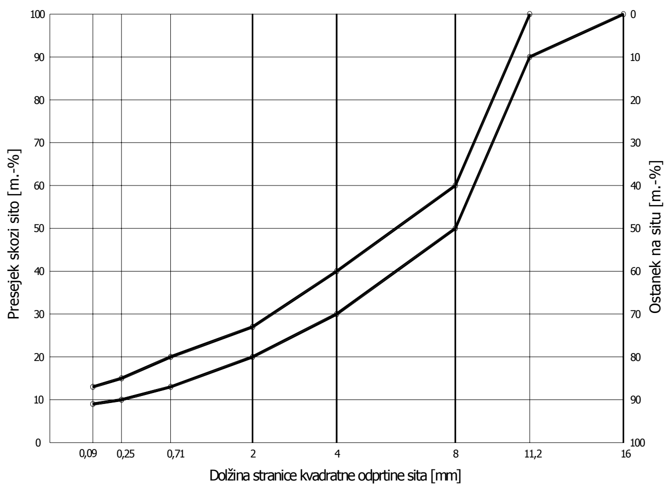


Fig. 3.32: Grading curve limits for mineral aggregate mixtures for stone mastic asphalt SMA 11s

Before commencing the works, the conformity of each mineral aggregate mixture, foreseen for SMA, with the design requirements and with the provisions of these technical conditions shall be tested in compliance with the requirements indicated in these technical conditions.

In case that the engineer has already approved the use of identical mineral aggregate mixtures for execution of SMA, re-testing of conformity is not necessary.

2.2.3.2.6.3.2 Bituminous Binders

The quality of bituminous binders used for production of SMA for BWSC is defined in the

- EN 12591 Bitumen and bituminous binders – Specifications for road bitumen, and
- EN 14023 Bitumen and bituminous binders – Specifications for polymer modified bitumen.

The required properties of road bitumen for SMA mixtures for BWSC are indicated in Table 3.36, and of polymer bitumen in Table 3.37 in these technical conditions.

Climatic conditions and traffic loading shall be considered when selecting the type of bitumen.

Polymer bitumen may only be used in case of an adequate technological preparation, and when the conformity with the requirements indicated in these technical conditions is verified.

The engineer may require other binders than those specified by the design, and/or by the preliminary investigation. In such a case he shall also define the quality requirements.

2.2.3.2.6.3.3 Agents Ensuring Adhesion of Layers

Agents ensuring adhesion of a AMA layer to the bituminous mix in the underay shall be such as to provide a perfect and uniform bond of both layers.

An asphalt mixture underlay shall be sprayed with such an agent only where the traffic has removed the binder from the grains located on the top of that layer.

As a rule, to ensure mutual adhesion of layers, a cationic polymer bitumen emulsion containing at least 55% by mass of bitumen shall be used.

2.2.3.2.6.3.4 Stabilizing Additives

The portion of a stabilizing additive to prevent flowing away of bituminous binder from the surface of mineral grains in the SMA mixture may amount to 0.3 – 1.5% by mass of the asphalt mixture.

2.2.3.2.6.4 Method of Execution

2.2.3.2.6.4.1 Winning of Mineral Aggregate Mixtures and Binders

In due time prior to commencement of works, the contractor is obliged to inform the engineer of the location and method of winning both mineral aggregate and binder for stone mastic asphalt mixtures for BWSC.

The method of acquiring both mineral aggregate and binder shall be such as to ensure their constant and traceable quality.

The contractor shall submit to the engineer evidences of conformity of mineral aggregates and binders with requirements indicated in 2.2.3.2.6.3.1 for the aggregate, and 2.2.3.2.6.3.2 for the binder.

2.2.3.2.6.4.2 Depositing of Mineral Aggregate Mixtures and Binders

When the contractor, prior to the further use, provisionally deposits mineral aggregates, the foreseen location shall be suitably arranged and protected from precipitations in advance.

Stone dust shall be stored in a dry and closed space.

Tanks for storing bituminous binder shall be equipped with devices for an indirect heating, and with thermometers. The recommended and maximum temperature of road bitumen are indicated in Table 3.65.

Table 3.65: Recommended and maximum temperatures of road bitumen during storing

Type of bitumen	Recommended temperature °C	Maximum temperature °C
B 70/100	140	160
B 50/70	150	170
B 35/50	160	180

For storing polymer bitumen such temperatures shall be considered as specified by the manufacturer of the binder.

Stocks of mineral aggregates and binders, and/or the current supply to the asphalt plant shall be such as to ensure a continuous production of SMA mix for BWSC.

2.2.3.2.6.4.3 Preparation of Substrate Formation

As a base of the SMA mixture for BWSC, a bound roadbase of bituminous crushed stone prepared in compliance with section 2.2.3.1.3.5.6 of these technical conditions is suitable.

Unless provided otherwise by the design, a bound sub-base corresponding to section 2.2.3.1.2.5.3, of these technical conditions can be used as a base for the SMA for BWSC, on condition that the engineer approves this.

All the time from the beginning of placing the SMA for BWSC, the contractor is obliged to maintain the substrate formation in such a condition as it has been during take-over. All damage, deviations, and other deficiencies shall be made good and suitable evidence shall be submitted to the engineer prior to continuation of placing BWSC.

To ensure proper adhesion of the SMA to the substrate, the latter shall be sprayed with a cationic polymer emulsion (approximately 0.3 to 0.5 kg/m^2), if the traffic running on the substrate has removed the bituminous binder from the grains on the bound roadbase surface. The amount of the material applied by spraying depends on the substrate condition.

The contractor may start placing the SMA for BWSC only after the engineer has taken-over the substrate formation in compliance with the specified requirements.

2.2.3.2.6.4.4 Production of Stone Mastic Asphalt

The production of SMA shall be carried out mechanically at a mixing plant by a batch method of work.

Dosing equipment shall ensure a suitable amount of SMA components by mass. Dosing by volume is allowed only if approved by the engineer.

The mixing time and other impacts on the quality of coating of grains with binder, or distributing the binder within the mixture shall be so adjusted as to ensure a uniform mixture of SMA.

A mixture of SMA for BWSC shall generally be produced by the hot procedure. The temperature of the produced SMA mix upon leaving the mixer is indicated in Table 3.66.

Table 3.66: Recommended and maximum temperature of produced SMA mixture

Type of bitumen	Recommended temperature range °C	Maximum temperature °C
B 70/100	140 to 160	175
B 50/70	150 to 170	180
B 35/50	160 to 180	190

The production capacities of the mixer, transportation means, and equipment for placing shall be mutually harmonized.

The produced SMA mix may be stored in non-heated silos for shorter periods.

2.2.3.2.6.4.5 Bringing Stone Mastic Asphalt Mixtures

To bringing SMA mixtures the conditions indicated in section 2.2.3.2.2.4.5 of these technical conditions shall apply as appropriate.

2.2.3.2.6.4.6 Placing Stone Asphalt Mastic Mixtures

Placing SMA mixtures for BWSC shall generally be performed mechanically by means of a finisher - spreader. The spreading effect of the finisher must ensure a compaction of at least 85% of the distributed mixture with regard to the reference density of the laboratory test specimen.

Exceptionally, manual placing is allowed as well, if mechanical placing is not feasible for limited space. The engineer shall approve the manual placing.

Taking account of the type of the road bitumen used in production of SMA, the recommended and the minimum temperature of the mixture upon placing are indicated in Table 3.67. In case that polymer bitumen is used, the manufacturer's recommendations shall be considered.

Table 3.67: Recommended and minimum temperature of SMA mixture upon placing

Type of bitumen	Recommended temperature range °C	Minimum temperature °C
B 70/100	130 to 120	120
B 50/70	140 to 130	130
B 35/50	150 to 140	140

The temperature of a hot mixture of SMA shall be measured in compliance with the EN 12697-13.

In windy weather the lowest temperature of the SMA mixture, when placed mechanically, shall not be less than by 10°C higher than the abovementioned temperature for the particular road bitumen type. In case of manual placing, the temperature shall be by at least 20°C higher than the abovementioned values.

If work conditions permit, the SMA mixture for BWSC shall be placed over the whole width of the carriageway at the same time. If two finishers situated one after another are used for spreading, the difference in quality of the placed layer of the asphalt mixture in the joint area must not be visible.

Any interruption of work shall be executed perpendicularly to the road axis and vertically over the entire width of the carriageway or traffic lane. Any deviation from this is only allowed upon the engineer's consent. Before the continuation of placing, the surface of the transverse joint shall be coated with bituminous emulsion or with cut-back bitumen (at least 0.5 kg/m^2), and the area of the transverse joint shall be indirectly heated. A 15 cm wide zone in the joint area shall be coated as well.

The selected type of rollers and the compaction method shall ensure the required density (compaction) as evenly as possible over the whole design width. Therefore, the width of the layer shall be increased by the design layer thickness unless provided otherwise by the design.

The placed SMA mixture shall be compacted from the edge towards the centre of the layer, and from the lower edge to the upper edge of the layer. Individual passages of rollers shall always overlap by 15 – 20 cm. Any staying of rollers on the placed layer, as well as sudden braking and accelerating, and change of direction of the roller shall be avoided.

All places inaccessible to machines shall be compacted to the required degree by other means, the use of which shall be approved by the engineer, who also specifies the conditions in which such means have to be used.

Traffic is allowed over the placed SMA mixture only after the asphalt mixture in the middle of the layer has cooled down to approximately 30°C. The engineer has the right to specify other conditions to be fulfilled prior to allowing the traffic over the BWSC.

2.2.3.2.6.5 Quality of Execution

At least 7 days in advance prior to starting placing a SMA layer, the contractor shall submit to the engineer for approval a method statement, which shall include particularly the following:

- Preliminary composition of the asphalt mixture,
- Evidence of conformity of all the materials to be used,
- Programme of average frequency of both internal and external control,
- Description of work methods, and
- Information on the mechanization to be introduced.

Before the machines and equipment, on which the quality of the executed work depends, begin to operate, their ability to ensure a uniform quality in accordance with these technical conditions shall be ascertained.

All the machinery and equipment shall be certified and shall satisfy the design requirements as well as these technical conditions for the quality of the placed layer.

2.2.3.2.6.5.1 Preliminary (Laboratory) Composition of Asphalt Mixture

To the preliminary (laboratory) composition (investigation) of a stone mastic asphalt mixture the conditions indicated in section 2.2.3.2.2.5.1 of these technical conditions shall apply as appropriate.

2.2.3.2.6.5.2 Properties of Test Specimens

The required quality of mineral aggregates and bituminous binder for SMA mixtures for BWSC is specified in detail in sections 2.2.3.2.2.3.1 and 2.2.3.2.2.3.2 of these technical conditions.

The required properties of test specimens of SMA mixtures are indicated in table 3.68.

Test specimens of SMA mixtures on roads with exceptionally heavy and very heavy traffic loading shall be prepared by 2 times 75 hammering blows.

The total void content in an asphalt mixture, and the filling-up of voids in a mixture of mineral aggregate with bitumen shall be within the range of the specified limiting values.

For roads with a heavy traffic loading and special climatic action, it is necessary, within the scope of the preliminary investigation of an asphalt mixture for BPBB courses, to verify the resistance to formation of ruts, which shall be carried out in accordance with the procedure defined in the EN 12697-22. The WTR or R_D category defined in the EN 13108-1 shall be assessed in dependence on the traffic loading specified in the design.

Table 3.68: Required mechanical and volume properties (limiting values) of SMA mixtures for a preliminary (laboratory) composition for BWSC

Property of asphalt mixture	Unit measure	Required value for traffic loading: heavy	Required value for traffic loading: medium and light	Test method
- total void content	% by vol.	$V_{min2,5} – V_{max4,5}$	$V_{min2} – V_{max4}$	EN 12697-8
- void content in mineral aggregate mixture	% by vol.	to be tested		EN 12697-8
- filling of voids in mineral aggregate mixture with bitumen	%	$VFB_{75} – VFB_{90}$	$VFB_{80} – VFB_{90}$	EN 12697-8
- minimum void content	% by m.	6.5	7.0	EN 12697-1

2.2.3.2.6.5.3 Demonstrative Production and Placing

The contractor shall verify the preliminary (laboratory) composition of the asphalt mixture at a suitable asphalt production plant, the transportation to the site, and placing for BWSC after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and asphalt plant for production of asphalt mixtures for BWSC,
- establish suitability of transportation method and equipment for placing bituminous layers,
- take a specimen of the asphalt mixture at the location of placing to perform a conformity test,
- follow the process of thickenning of the asphalt mixture by means of a non-destructive test (with isotope gauge according to TSC 06.711),
- take cores at the location where asphalt mixture specimens have been taken,
- measure the density of the asphalt mixture placed at 30 locations.

The threshold values of mechanical and volume properties in compositions of SMA mixtures for BWSC are indicated in table 3.69.

Table 3.69: Threshold values of mechanical and volume properties of produced SMA mixture for BWSC

Property of	Unit	Required value for traffic loading	Test

asphalt mixture	measure	heavy	medium and light	method
- total void content	% by vol.	$V_{min1} – V_{max6}$	$V_{min1} – V_{max5}$	EN 12697-8
- void content in mineral aggregate mixture	% by vol.	to be tested		EN 12697-8
- filling of voids in mineral aggregate mixture with bitumen	%	$VFB_{70} – VFB_{95}$	$VFB_{75} – VFB_{95}$	EN 12697-8

During production, transport, and placing of asphalt mixture the bituminous binder may harden by up to 2 grades.

If the contractor has already placed a BWSC last year with compositions of mineral grains and binders of the similar properties and under similar conditions, then the preliminary investigation results may be taken as a demonstrative production and placing. However, the engineer shall make final decision.

In case that some changes occur in view of the mechanization used for placing, the demonstrative placing of the asphalt mixture shall be repeated. The engineer shall make final decision.

2.2.3.2.6.5.4 Routine Production and Placing

The engineer shall approve a routine production and a working composition not until the contractor has submitted the results of the demonstrative production and placing. The permission for a routine production also includes requirements for the SMA mixture properties and for the control foreseen by these technical conditons.

The permission for a routine production and placing of a SMA mixture for BWSC shall also comprise detailed requirements for an eventual additional spray application of an adhesive agent to the underlay surface according to section 2.2.3.2.6.4.3 of these technical conditions.

In case of any modification in production and placing of the asphalt mixture, the contractor shall submit to the engineer in writing his proposal for the particular modification. Such a modification shall only be implemented after being approved by the engineer.

The required limiting values of the compaction and void content for SMA mixtures placed as BWSC are indicated in Table 3.70.

Table 3.70: Required limiting values of placed SMA mixture for BWSC

Property of placed asphalt mixture	Unit measure	Required value for traffic loading		Test method
		exceptionally heavy	very heavy and heavy	
- layer compaction	%	≥ 97	≥ 97	BAS
- layer void content	% by v.	$V_{min3} – V_{max6}$	$V_{min2} – V_{max5}$	EN 12697-8

2.2.3.2.6.5.5 Layer Thickness

Limiting design thicknesses of SMA mixtures for BWSC are indicated in Table 3.63.

Average thickness of an asphalt mixture may be by up to 10% below the design thickness, whereas individual measured values (however no more than 10% of the total number) by up to 25% below the design thickness (threshold value).

When assessing the average thickness of a placed layer, the maximum thickness is limited to the upper limiting design thickness + 5 mm (according to Table 3.63).

2.2.3.2.6.5.6 Evenness, Level, and Slope of Formation

Any unevenness of the formation of the SMA layer placed as BWSC shall be established, in any direction with regard to the road axis, as a deviation below a 4 m long straight edge. The formation of the BWSC may deviate from the straight edge by maximum the following limiting value:

- on carriageways subjected to exceptionally heavy, very heavy and heavy traffic loading
    - - for machine placing in one layer ≤ 4 mm
    - for machine placing in two layers
    - on a lower layer ≤ 6 mm

- on carriageways subjected to other traffic loading types
  - - for machine placing $\leq$ 6 mm
  - - for manual placing $\leq$ 10 mm

The level of the individual measuring points on the formation of the BWSC shall be determined by levelling. In any place, the BWSC formation may deviate from the design level by maximum $\pm$10 mm (limiting values).

The slope of the formation of the BWSC shall be, as a rule, equal to both transverse and longitudinal fall of the carriageway. The allowable slope tolerances are defined by the admitted unevenness and deviation from the particular layer formation level. However, the allowable tolerances shall not exceed the design slope by more than $\pm$ 0.4% (threshold value).

2.2.3.2.6.6 Quality Control of Execution

To checking the quality of placed stone mastic asphalt layer the provisions of section 2.2.3.2.2.6 of these technical conditions shall apply as appropriate.

Statistic analyses and comparisons of results within the scope of both internal and external control represent a base to evaluate conformity of the executed works with the requirements, and to carry through eventually necessary measures for mending the deficiencies.

A third party institution performing the external control of conformity of asphalt mixtures for BWSC with the requirements indicated in both design and these technical conditions shall prepare a written conformity evaluation, and a report shall be submitted to the engineer.

2.2.3.2.6.7 Measurement and Take-Over of Works

To the measurement and take-over of SMA layers the conditions indicated in section 2.2.3.2.2.7 of these technical conditions shall apply as appropriate.

2.2.3.2.6.8 Final Account of Works

The final account of the works carried out within the scope of construction of BWSC made of SMA shall be performed on the basis of provisions of section 2.2.3.2.2.8 of these technical conditions.

2.2.3.2.7 BOUND ASPHALT WEARING AND SEALING COURSES – THIN OVERLAYS

Technical conditions and methods for construction of bound asphalt wearing and sealing courses of thin overlays are described in detail in the TSC 06.416.

2.2.3.2.7.1 Description

The execution of a bound asphalt wearing and sealing course (BWSC) in the form of a thin overlay includes the supply of suitable mineral aggregate mixtures and bituminous binder, as well as the production (by either cold or hot procedure), transportation, and placing asphalt mixture at locations specified by the design.

This work shall be carried out in still weather without precipitations, and at both substrate and air temperatures of at least 10°C for cold procedure, and at least 5°C for hot procedure. Exceptionally, and if approved by the engineer, a thin overlay may be placed onto a dry and non-frozen substrate at temperature 3°C in still weather, on condition that the thickness of the asphalt mix is in the upper range of the design thickness indicated in Table 3, and that the engineer approves this.

In view of the size of the largest stone grains in the asphalt mixture for a thin overlay, and of their origin, the following asphalt mixtures are applicable to BWSC:

- thin overlays TPh 2k,
- thin overlays TPh 4k, TPh 4s, TPv 4k, TPv 4s
- thin overlays TPh 6k, TPh 6s
- thin overlays TPh 8k, TPh 8s, TPv 8k, TPv 8s
- thin overlays TPh 11k, TPh 11s

avtor naj definira kratice oz. simbole, ki so po njegovem mnenju najustreznejši (morda P = O, k = c ipd.)

Asphalt mixtures for thin overlays

- designated with »k« contain carbonate grains of sediment origin only,
- designated with »s« contain grains of silicate sand and crushed aggregate of eruptive origin, or of suitable secondary raw materials.

In dependence on the type of mineral aggregate grains and binder as well as on the execution method, thin overlays are intended for placing into pavement structures as wearing and sealing course, or as a sealing course below the wearing course of an asphalt mixture of open composition for all traffic loading groups.

The use of thin overlays for the characteristic traffic loading groups is indicated in Table 3.71, and for the characteristic traffic volume groups in Table 3.72.

The method of assessing the traffic loading is described in detail in the TSC 06.511 Design, Traffic Loading.

Table 3.71: Fields of application of thin overlays for wearing and sealing courses in dependence on the average annual daily traffic loading

Group of traffic loading	AADT loading (nominal axle load 82 kN)	Type of asphalt mixture						
		cold				hot		
		TPh 2k	TPh 4k TPH 8k	TPh 4s TPh 6s	TPh 8s	TPv 4k TPv 8k TPv 11k	TPv 4s	TPv 8s TPv 11s
- exceptionally heavy (EH)	> 3,000	-	-	-	-	-	-	+
- very heavy (VH)	> 800 to 3,000	-	-	-	-	-	-	+
- heavy (H)	> 300 to 800	-	-	+	+	-	+	+
- medium (M)	> 80 to 300	-	-	+	+	-	+	+
- light (L)	> 30 to 80	-	+	+	+	+	-	-
- very light (VL)	≤ 30	+	+	+	-	+	-	-
- footways, cycle tracks, parking, emergency lanes on motorways	-	+	+	+	-	+	-	-

Table 3.72: Fields of application of thin overlays for wearing and sealing courses in dependence on the average annual daily traffic volume

Group of traffic loading	AADT volume (nominal axle load 82 kN)	Type of asphalt mixture							
		cold					hot		
		TPh 2k	TPh 4k TPH 8k	TPh 4s	TPh 6s	TP 8s	TPv 4k TPv 8k TPv 11k	TPv 4s	TPv 82 TPv 11s
- exceptionally high	> 20,000	-	-	-	-	+	-	-	+
- very high	> 10,000 to 20,000	-	-	-	+	+	-	+	+
- high	> 5,000 to 10,000	-	-	+	+	+	-	+	+
- medium	> 2,000 to 5,000	-	-	+	+	+	-	+	+
- low	> 1,000 to 2,000	-	+	-	-	-	+	-	-
- very low	≤ 1,000	+	+	-	-	-	+	-	-

1) When selecting the type of grains in the asphalt mixture, such stone is preferential, which is more resistant to smoothing.

The design thicknesses of thin overlays for BWSC are indicated in Table 3.73.

Table 3.73: Limiting design thicknesses of thin overlays for BWSC

Design thickness of thin overlay	Unit measure	Type of asphalt mixture				
		TP 2[1)]	TP 4[2)]	TP 6[1)]	TP 8[2)]	TP 11[2)]
		Limiting value				
- clod method:						
- minimum	mm	2	4	6	8	-
- maximum	mm	4	8	12	16	-
- hot method:						
- minimum	mm	-	12	-	16	20
- maximum	mm	-	16	-	20	25

1) placing: one-layer or two-layer

2) placing: two-layer

The type of asphalt mixture for BWSC shall be specified by the design. If not, the engineer shall make final decision.

2.2.3.2.7.2 Basic Materials

The following basic materials are necessary to produce thin overlays:

- mineral aggregates,
- bituminous (or special) binders, and
- additives.

2.2.3.2.7.2.1 Mineral Aggregate Mixtures

As a rule, mixtures of crushed grains of stone or secondary materials (e.g. slag) shall be used for thin layers.

Unless defined by the design, the engineer shall specify the type of mineral aggregate mixture with regard to the traffic loading, traffic volume, climatic conditions, and layer thickness.

2.2.3.2.7.2.2 Binders

For thin overlays, the following binders may be used: standard road bitumen (B) or bituminous emulsions (BE), polymer bitumen (PmB), and polymer bituminous emulsions (PmBE) of adequate characteristics required for the foreseen traffic and climatic conditions, as well as for production and placing. Special binders such as epoxy resins are applicable as well.

The engineer shall specify the type of bituminous binder with regard to the foreseen conditions of use, unless this has already been provided by the design. The engineer has also the right to direct a change of the bituminous binder type if this is justified by the traffic loading and climatic conditions.

The contractor is free to introduce other binders provided that he proves their suitability, and the engineer approves such a modification.

2.2.3.2.7.2.3 Additives

Additives for thin overlays produced by the cold method shall ensure suitable placeability of the asphalt mixture (water), and enable controlling the process of decomposition of the emulsion (cement, lime). The manufacturer of the bituminous binder shall specify the required amount and quality of the additive.

2.2.3.2.7.3 Quality of Materials

2.2.3.2.7.3.1 Mineral Aggregate Mixtures

Mineral aggregate mixtures for thin overlays for BWSC shall be composed of grains of

- sand and
- crushed gravel

If a thin overlay is produced by the hot method, its mix shall also contain stone dust.

The quality of mineral aggregate mixtures for BWSC is basically defined in detail in the EN 13043 Aggregates for bituminous mixtures and surface dressing for roads, airports, and other traffic surfaces.

Mixtures of grains produced of secondary materials shall logically meet all the requirements specified for mineral aggregates made of natural stone.

2.2.3.2.7.3.1.1 Stone Dust

For thin overlays for roads with medium or heavy loading, stone dust of the quality class I produced of carbonate stone shall be used as a rule.

For asphalt mixes containing washed sand of silicate stone, stone dust of quality class II may also be used.

Recovered stone dusts won during the production of asphalt mixtures by de-dusting silicate grains must not be used as added (foreign) stone dust.

Properties of stone dust used to produce thin overlays shall meet the requirements indicated in Table 3.30.

2.2.3.2.7.3.2 Sand

Crushed sand of GF_{85} category may only be used for thin overlays for BWSC.

For roads with heavy traffic loading and high traffic volume, silicate stone sand of granulometric composition of 0/2 mm shall be used.

The required composition of sand grain mixtures for thin overlays is indicated in Table 3.31.

The required properties of mixtures of sand grains for thin overlays are indicated in Table 3.32.

Crushed stone and gravel used for production of crushed sand shall have the same resistance to crushing and wear (Los Angeles test) as it is required for the mixtures of crushed stone grains for the corresponding traffic loading group indicated in Table 3.33.

2.2.3.2.7.3.2.1 Crushed Gravel

For asphalt mixtures for thin overlays basic fractions and intermediate fractions of crushed gravel grains are recommended, which logically meet the requirements indicated in section 2.2.3.2.2.3.1.3.

2.2.3.2.7.3.2.2 Collective Granulometric Composition

Ranges of mineral grains passing sieve for asphalt mixes for thin overlays are defined by grading curve limits shown in Figures 3.33 to 3.39.

The test method to applied to mineral aggregate mixtures is determined in the EN 933-1.

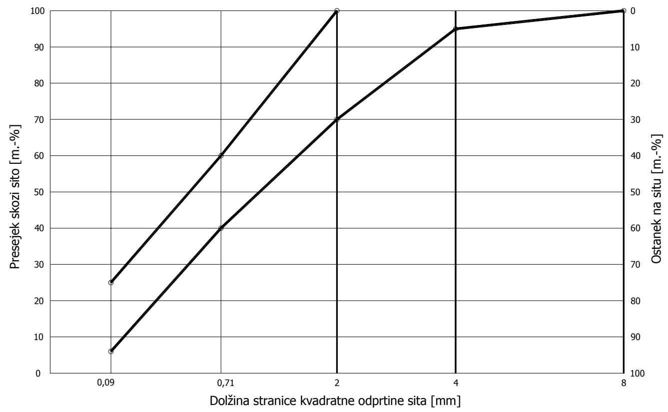


Fig. 3.33: Grading curve limits for mineral aggregate for asphalt mixtures for thin overlays TP 2h

Fig. 3.34: Grading curve limits for mineral aggregate for asphalt mixtures for thin overlays TP 4h

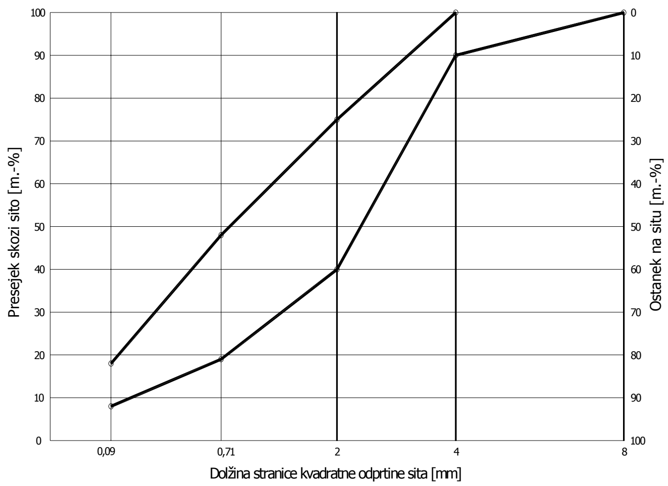


Fig. 3.35: Grading curve limits for mineral aggregate for asphalt mixtures for thin overlays TP 4v

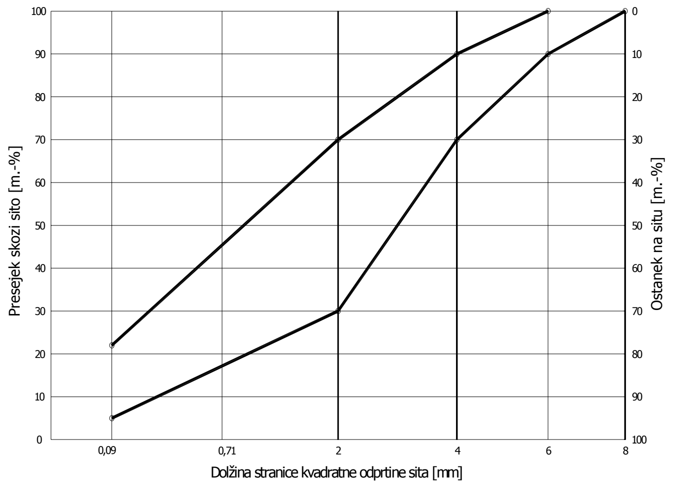


Fig. 3.36: Grading curve limits for mineral aggregate for asphalt mixtures for thin overlays TP 6h

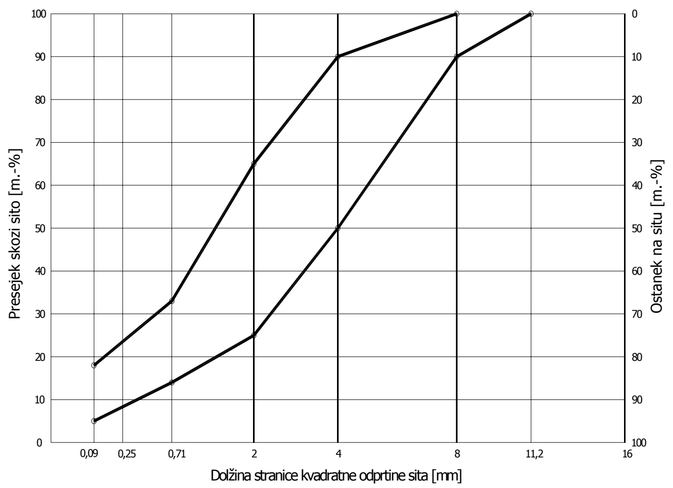


Fig. 3.37: Grading curve limits for mineral aggregate for asphalt mixtures for thin overlays TP 8h

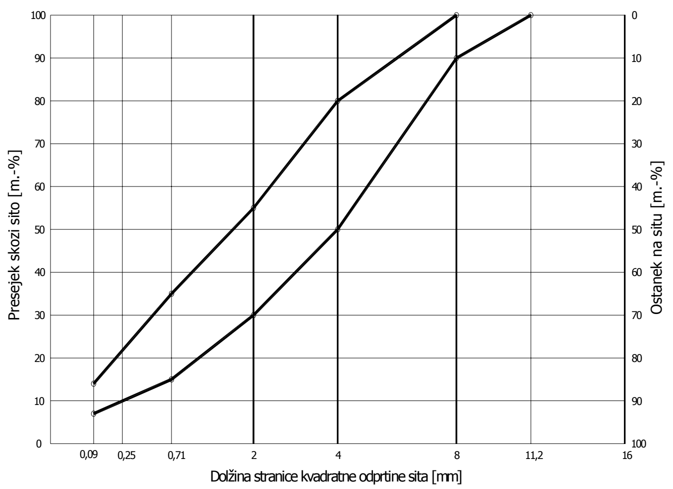


Fig. 3.38: Grading curve limits for mineral aggregate for asphalt mixtures for thin overlays TP 8v

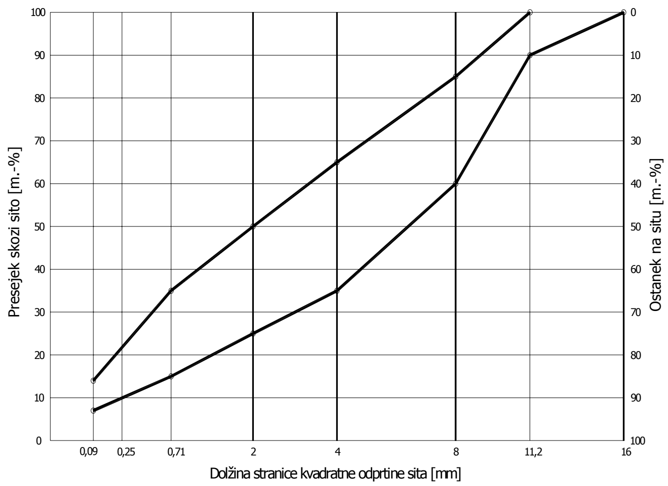


Fig. 3.39: Grading curve limits for mineral aggregate for asphalt mixtures for thin overlays TP 11v

Prior to commencement of works, the conformity of each individual mineral aggregate mixture foreseen for the asphalt mix for BWSC thin overlay with the requirements indicated in these technical conditions shall be tested.

If the engineer has already approved the same mineral aggregate mixture for a BWSC thin overlay, retesting of conformity is not mandatory.

2.2.3.2.7.3.3 Binders

The quality of bituminous binders for BWSC thin overlays is defined by

- EN 12591 Bitumen and bituminous binders – Specifications for road bitumen, and
- EN 14023 Bitumen and bituminous binders – Specifications for bitumen modified with polymers.

The required basic properties of road bitumen are indicated in Table 3.36, whereas of polymer bitumen in Table 3.37.

The required properties of polymer bituminous emulsions are indicated in Table 3.74 (according to TL PmBE-DSK).

Table 3.74: Required properties of polymer bituminous emulsions

Property of bituminous emulsion	Unit measure	Requirement
- type of ionic load	–	cationic
- outer appearance	-	brown, liquid, homogeneous
- bitumen content	% by m.	≥ 58
- residue on sieve	% by m.	≤ 0.5
- constancy after 4 weeks of storing	% by m.	≤ 0.5
- stability	g	≥ 150
- viscosity (viscosity for tar, 4 mm)	s	1)
- coating	%	≥ 90
Bitumen separated from the emulsion:		
- softening point by PK	°C	≥ 50
- breaking point by Fraass	°C	≤ -15
- elastic strain (30 min., 25 °C)	%	≥ 40

1) as indicated by the manufacturer

Climatic conditions and traffic loading shall be considered when selecting the type of bituminous binder.

Polymer bitumen may only be used in case of suitable technological preparation and proven conformity with the requirements indicated in these technical conditions.

The required properties of special binders for thin overlays shall be assessed on the basis of testing the preliminary composition of the asphalt mix for thin overlays, and of the conditions provided by the manufacturer of the binder.

If the engineer directs the use of a binder, which differs from the binder foreseen by either design or preliminary investigation, he shall also define the quality conditions.

2.2.3.2.7.3.4 Additives

The quality of additives to ensure the specified properties of asphalt mixtures for BWSC thin overlays shall be defined on the basis of testing the preliminary composition, and specified by the producer of the particular additive.

2.2.3.2.7.4 Method of Execution

2.2.3.2.7.4.1 Winning of Mineral Aggregate Mixtures and Binders

In due time prior to commencement of works, the contractor is obliged to inform the engineer of the location and method of winning both mineral aggregate and binder for thin overlays for BWSC.

The method of acquiring both mineral aggregate and binder shall be such as to ensure their constant and traceable quality.

The contractor shall submit to the engineer evidences of conformity of mineral aggregates and binders with requirements indicated in 2.2.3.2.7.3.1 for the aggregate, and 2.2.3.2.7.3.2 for the binder.

2.2.3.2.7.4.2 Deposting of Mineral Aggregate Mixtures and Bituminous Binders

To depositing mineral aggregate mixtures and bituminous binders the conditions indicated in section 2.2.3.2.2.3.2 of these technical conditions shall apply as appropriate.

For storing special binders the conditions provided by the manufacturer of the particular binder shall be considered.

2.2.3.2.7.4.3 Preparation of Substrate Formation

As a base for thin overlays for BWSC, a bound roadbase of bituminous crushed stone, and only exceptionally of bituminous crushed gravel or gravel, prepared in compliance with section 2.2.3.1.3.5.6 of these technical conditions is suitable.

All the time from the beginning of placing the thin overlay, the contractor is obliged to maintain the substrate formation in such a condition as it has been during take-over. All damage, deviations, and other deficiencies shall be made good and suitable evidence shall be submitted to the engineer prior to continuation of placing BWSC.

Where the unevenness of the substrate formation for a thin overlay for BWSC, measured below a 4 m straight gauge, exceeds 6 mm, it shall be reduced to an admissible value by suitable procedure such as an additional layer for leveling or by milling-off.

At any location, the level of the substrate formation for a thin overlay may deviate from the design level by no more than ± 15 mm, whilst the slope by maximum ± 0,4 % (absolute values).

Carriageway marking shall be removed prior to placing the thin overlay.

Cracks on the substrate wider than 6 mm shall be suitably sealed prior to placing thin overlays.

The substrate formation for thin overlays placed by the cold method may be moist, whereas it shall be dry and coated by spraying for overlays placed by the hot method.

To ensure proper adhesion of the thin overlay to the substrate, the latter shall be sprayed with a cationic polymer emulsion (approximately 0.3 to 0.5 kg/m^2), if the traffic running on the substrate has removed the bituminous binder from the grains on the bound roadbase surface. The amount of the material applied by spraying depends on the substrate condition.

The contractor may start placing the thin overlay for BWSC only after the engineer has taken-over the substrate formation in compliance with the specified requirements.

2.2.3.2.7.4.4 Production of Asphalt Mixture

The production of asphalt mixtures for thin overlays (by both cold and hot method) shall be carried out mechanically.

Dosing devices shall ensure an adequate quantity of components in the asphalt mixtures by mass. Dosing the components by volume may be carried out upon the engineer’s consent.

The mixing time and other factors influencing the quality shall be so adjusted as to ensure a homogenous asphalt mixture for a thin overlay.

When an asphalt mix for a thin overlay is produced by the hot method, the temperature of the asphalt mix upon leaving the mixer shall be as indicated in Table 3.39.

Production capacities of the mixer, transport means, and placing equipment shall be mutually harmonized.

A thin overlay produced by the hot method may be stored in non-heated silos for shorter periods.

2.2.3.2.7.4.5 Bringing of Asphalt mixture

To a suitably prepared substrate formation asphalt mixture may be brought only after the engineer has approved the substrate appropriateness.

Asphalt mixtures shall be transported by means of suitable vehicles - dumper trucks with thermo-caissons equipped for tipping backwards into finishers, and covered with a tarpaulin enabling an adequate protection of the mixture from precipitations, cooling, and pollution. Prior to loading an asphalt mixture, internal surfaces of metal caissons on lorries shall be sprayed with such an agent to prevent sticking together that does not affect the asphalt mixture harmfully.

When the asphalt mix is transported in a heated container, the distance of transport is limited to maximum 100 km, or the time of transport to maximum 2 hours on condition that a dumper truck with a thermo-caisson is used. If this is not the case, the distance is limited to 70 km, and the time to 1.5 hours.

The number of vehicles to transport the asphalt mixture to the site shall be so adjusted as to ensure a uniform placing.

2.2.3.2.7.4.6 Placing of Asphalt mixture

Cold Method

A placed asphalt mix made in a self-propelling mechanical device with a spreader attached shall only be compacted (by means of rubber-tyre roller) where the traffic is not allowed onto the placed layer after decomposition of the bituminous emulsion (approximately 30 minutes after spreading).

Hot Method

To placing hot asphalt mix for thin overlays the conditions indicated in section 2.2.3.2.2.4.6 shall apply as appropriate.

2.2.3.2.7.5 Quality of Execution

At least seven days prior to commencement of placing asphalt mixture for thin overlay the contractor shall submit to the engineer for approval a method statement, which shall comprise the following information:

- the preliminary composition of the asphalt mixture
- conformity certificates for all materials to be used
- a programme of average internal and external control
- a description of foreseen working procedures;
- an information on the mechanization;

Prior to commencement of the operation of machines and devices, which directly affect the quality of the works, their suitability to ensure a uniform quality in compliance with these technical conditions shall be verified.

All the equipment and machines shall be certified, and their capacity shall meet the requirements of the design and these technical conditions.

2.2.3.2.7.5.1 Preliminary (Laboratory) Composition of Asphalt Mixture

To the preliminary (laboratory) composition (investigation) of asphalt mixtures for thin overlays the requirements indicated in section 2.2.3.2.2.5.1 of these technical conditions shall apply as appropriate.

2.2.3.2.7.5.2 Properties of Test Specimens

The required quality of mineral aggregates and bituminous binder for asphalt mixtures for thin overlays is specified in detail in 2.2.3.2.7.3.1 and 2.2.3.2.7.3.2.

The properties of asphalt mixtures for thin overlays produced by the cold method shall be determined on the basis of the results of testing the preliminary composition. The following shall be defined:

- mineral aggregate composition,
- type, portion, and properties of the bituminous binder,
- type and portion of additives, and
- apparent specific density.

The required properties of test specimens of asphalt mixtures for thin overlays produced by the hot method are indicated in table 3.75.

Table 3.75: Required mechanical and volume properties (limiting values) of asphalt mixtures for a preliminary (laboratory) composition for BWSC thin overlays made by hot method

Property of asphalt mixture	Unit measure	Traffic loading heavy and medium Type of asphalt mixture			light		Test method
		TP 4	TP 8	TP 11	TP 4	TP 8	
- stability at 60 °C	kN	S_{min8}	S_{min10}	S_{min12}	S_{min6}	S_{min8}	EN 12697-34
- stiffness at 60 °C	kN/mm	$Q_{min2,5}$	Q_{min3}	$Q_{min3,5}$	$Q_{min1,6}$	Q_{min2}	EN 12697-34
- total void content	% by vol.	$V_{min3,5}$ – $V_{max4,5}$	V_{min4} – V_{max5}	$V_{min4,5}$ – $V_{max5,5}$	V_{min2} – V_{ma3x}	$V_{min2,5}$ $V_{max3,5}$	EN 12697-8
- void content in mineral aggregate mixture	% by vol.	to be tested					EN 12697-8
- filling of voids in mineral aggregate with bitumen	%	VFB_{72} – VFB_{84}	VFB_{70} – VFB_{82}	VFB_{68} – VFB_{78}	VFB_{75} – VFB_{85}	VFB_{78} – VFB_{88}	EN 12697-8

The value of the Marshall-flow of the test specimen is indirectly assessed by the specified stiffness of the asphalt mixture.

The total void content in an asphalt mixture, and the filling-up of voids in a mixture of mineral aggregate with bitumen shall be within the range of the specified limiting values.

2.2.3.2.7.5.3 Demonstrative Production and Placing

The contractor shall verify the preliminary (laboratory) composition of the asphalt mixture at a suitable asphalt production plant, the transportation to the site, and placing BWSC thin overlay after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and asphalt plant for production of asphalt mixtures for BWSC,
- establish suitability of transportation method and equipment for placing bituminous layers, all in compliance with these technical conditions
- take a specimen of the asphalt mixture at the location of placing to perform a conformity test,
- follow the process of thickenning of the asphalt mixture by means of a non-destructive test (with isotope gauge according to TSC 06.711),
- take cores at the location where asphalt mixture specimens have been taken,

- measure the density of the asphalt mixture placed by the hot method (at 30 locations).

The threshold values of mechanical and volume properties in compositions of asphalt mixtures for BWSC thin overlays are indicated in table 3.76.

During production, transport, and placing of asphalt mixture the bituminous binder may harden by up to 2 grades.

If the contractor has already placed a BWSC last year with asphalt properties and under similar conditions, then the preliminary investigation results may be taken as a demonstrative production and placing. However, the engineer shall make final decision.

In case that some changes occur in view of the mechanization used for placing, the demonstrative placing of the asphalt mixture shall be repeated. The engineer shall make final decision.

Table 3.76: Admissible threshold values of mechanical and volume properties of asphalt mixtures for thin overlays (produced by hot method)

Property of asphalt mixture	Unit measure	Traffic loading: heavy and medium – Type of asphalt mixture			Traffic loading: light		Test method
		TP 4	TP 8	TP 11	TP 4	TP 8	
- stability at 60 °C	kN	S_{min7}	S_{min9}	S_{min11}	S_{min5}	S_{min7}	EN 12697-34
- stiffness at 60 °C	kN/mm	Q_{min2}	$Q_{min2,5}$	Q_{min3}	$Q_{min1,2}$	$Q_{min1,5}$	EN 12697-34
- total void content	% by vol.	V_{min3} V_{max5}	$V_{min3,5}$ $V_{max5,5}$	V_{min4} V_{max6}	$V_{min1,5}$ $V_{max3,5}$	V_{min2} V_{max4}	EN 12697-8
- void content in mineral aggregate mixture	% by vol.	to be tested					EN 12697-8
- filling of voids in mineral aggregate with bitumen	%	VFB_{min68} VFB_{max88}	VFB_{min66} VFB_{max86}	VFB_{min64} VFB_{max82}	VFB_{min71} VFB_{max89}	VFB_{min74} VFB_{max92}	EN 12697-8

2.2.3.2.7.5.4 Routine Production and Placing of Asphalt Mixtures

Basic conditions for a routine production of asphalt mixtures and for placing as BWSC thin overlays are defined in section 2.2.3.2.2.5.4 of these technical conditions as appropriate.

The required limiting values of compaction and void content of asphalt mixes for thin overlays are indicated in Table 3.77.

Table 3.77: Required limiting values of asphalt mixture placed as thin overlay

Property of asphalt mixture	Unit measure	Traffic loading: heavy and light – Type of asphalt mixture			Traffic loading: light		Test method
		TP 4	TP 8	TP 11	TP 4	TP 8	
- layer compaction	%	≥ 97	≥ 98	≥ 97	≥ 96	≥ 96	BAS
- layer void content	% by vol.	V_{min3} – V_{max8}	V_{min3} – V_{max8}	V_{min3} – V_{max8}	V_{min2} – V_{max7}	$V_{min1,5}$ – $V_{max6,5}$	EN 12697-8

2.2.3.2.7.5.5 Layer Thickness

Limiting design thicknesses of asphalt mixtures for BWSC thin overlays are indicated in Table 3.73.

Average thickness of an asphalt mixture may be by up to 10% below the design thickness, whereas individual measured values by up to 25% below the design thickness (threshold value).

2.2.3.2.7.5.6 Evenness, Level, and Slope of Formation

An unevenness of the formation of a thin overlay shall be established, in any direction with regard to the road axis, as a deviation below a 4 m long straight edge. The formation of the BWSC may deviate from the straight edge by maximum the following limiting value:

- up to 6 mm, if unevenness of formation is more than 6 mm, and
- up to 4 mm, of unevenness of formation is less than 6 mm.

The level of the individual measuring points on the formation of the BWSC shall be determined by levelling. In any place, the BWSC formation may deviate from the design level by maximum ±10 mm (limiting values).

The slope of the formation of the BWSC shall be, as a rule, equal to both transverse and longitudinal fall of the carriageway. The allowable slope tolerances are defined by the admitted unevenness and deviation from the particular layer formation level. However, the allowable tolerances shall not exceed the design slope by more than ±0.4% (threshold value).

2.2.3.2.7.6 Quality Control of Execution

To the quality control of placed thin overlay the provisions indicated in section 2.2.3.2.2.6 of these technical shall apply as appropriate.

Statistical analyses and comparisons of the results within the scope of both internal and external control represent a base for evaluation of conformity of the executed works with the requirements, and for eventually required measures to make good the deficiencies established.

The third party institution performing the external control of conformity of asphalt mixtures for BWSC with the requirements indicated in both design and these technical conditions shall prepare a written conformity assessment and submit it to both engineer and client.

2.2.3.2.7.7 Measurement and Take-Over of Works

To both measurement and take-over of thin overlays the provisions indicated in section 2.2.3.2.2.7 of these technical conditions shall apply as appropriate.

2.2.3.2.7.8 Final Account of Works

The final account of the works executed within the scope of construction of a thin overlay shall be carried out in compliance with the provisions indicated in section 2.2.3.2.2.8 of these technical conditions as appropriate.

2.2.3.3 BOUND BEARING AND WEARING COURSES – CEMENT CONCRETE

2.2.3.3.1 Description

Bound bearing and wearing courses of cement concrete are constituent parts of pavement structures above the bearing courses up to the carriageway surface.

They shall be placed in a way, dimensions, and quality as provided by the design, and in compliance with these technical conditions to ensure the design bearing capacity and durability.

The execution of a bound bearing and wearing course (BBWC) of cement concrete mix comprises the supply and preparation of suitable mineral aggregate mixtures, cement, water, and chemical additives, as well as the production, transportation, and placing a fresh mixture at locations specified by the design. It also includes all the works related to the execution of joints and protection the cement concrete BBWC surface after placing, and, if necessary, all the works associated with reinforcing the cement concrete.

Both bearing and wearing course can be produced of cement concrete of the same composition, i.e. simultaneously in one layer, or of different cement concrete mixtures, i.e. each layer separately. However, in the latter case, both courses shall be compatible.

Unless provided otherwise by the design, a BWSC shall be constructed of a C 30/37 cement concrete mix. On roads with medium and heavy traffic loading, C 35/45 cement concrete mix made of silicate grain mixtures shall be used for the wearing course.

In view of the size of the largest grains in the cement concrete mixture, and of their origin, the following cement concrete mixtures are applicable to BWSC:

- CC 16 and CB 16s, and
- CC 32.

As a rule, placing shall be carried out in weather without precipitations, and the cement concrete mix temperature shall be within the range of 5 °C to 30 °C. In case that the temperature is periodically out of this range, special measures shall be introduced.

In dependence on the type of the cement concrete mix, such BBWC are intended for execution of the pavement top layer for all the traffic loading groups. In particular, cement concrete BBWC are suitable to pavement structures with significant traffic and climatic loading (high axle loads, substantial longitudinal falls of the carriageway, canalized and controlled traffic, significant temperature ranges, long lasting high and low temperatures).

Depending on the traffic loading the following minimum thicknesses of cement concrete BBWC are required, unless otherwise specified by the design:

- for exceptionally heavy and very heavy traffic loading, minimum 260 mm,
- for heavy traffic loading, minimum 240 mm,
- for other traffic loading, minimum 200 mm,
- for cycle tracks and footways, minimum 100 mm.

If a cement concrete BBWC is constructed in two layers, the wearing course shall be 5 to 8 cm thick.

As a rule, the type of the cement concrete mix for BBWC shall be specified in the design. If this is not the case, the engineer shall make final decision.

2.2.3.3.2 Basic Materials

Basic materials for production of cement concrete for BBWC are

- mineral aggregate mixtures,
- cement,
- water,
- chemical additives, and
- mineral additives.

In certain conditions the following materials are also required for the execution of cement concrete BBWC:

- steel (dowels, anchors, welded mesh reinforcement),
- protective means, and

- material for sealing the joints.

2.2.3.3.2.1 Mineral Aggregate Mixtures

Basic properties of mineral aggregate mixtures for cement concrete BBWC are specified in the EN 12620.

With regard to the required cement concrete grade, traffic loading, as well as the method and conditions of the transportation, the engineer shall approve the composition of mineral grain mixture (up to 16 mm or up to 32 mm) for cement concrete mix for BBWC, notwithstanding that the composition is already defined by the design.

2.2.3.3.2.2 Cement

For cement concrete BBWC the following cement binders shall be used:

- Portland cement CEM I, and
- Portland cement with added granulated furnace slag CEM II/A-S and CEM II/B-S, which meet the requirements indicated in the EN 197-1.

The type of cement for cement concrete PPWC shall be specified by the design. If not, the engineer shall specify it taking account of the cement grade, traffic loading, and climatic conditions. The engineer has also the right to claim a change of the cement type foreseen by the design, if justified reasons such as traffic loading and/or climatic conditions exist.

The contractor is free to use different hydraulic binders, such as binders based on the Portland cement clinker on condition that he can prove their applicability and that the engineer approves such a modification.

2.2.3.3.2.3 Water

The water for cement concrete can be natural or suitably processed. In any case it shall comply with the conditions indicated in the EN 1008.

As a rule, the water from the public waterworks is suitable to preparation of the cement concrete for BBWC as well.

2.2.3.3.2.4 Chemical Additives

To improve certain properties of the cement concrete mix for BBWC, different chemical additives may be used for plasticizing, aeration, and other modifications of properties, e.g. retardation of setting. All the additives shall comply with the provisions of the EN 934-2.

The engineer shall approve the use of chemical additives.

2.2.3.3.2.5 Mineral Additives

To ensure adequate properties of cement concrete mixes for BBWC, mineral additives may be introduced, which shall comply with the provisions of the EN 13263.

2.2.3.3.2.6 Steel

To reinforce the BBWC cement concrete, suitable welded mesh reinforcement shall generally be used. For dowels and anchors appropriate bars of smooth and deformed (ribbed) rolled steel shall be foreseen, as specified by the design or directed by the engineer.

Steel shall meet the requirements indicated in the EN 10080.

2.2.3.3.2.7 Protective Means

For protection of the cement concrete on the BBWC surface from drying up and/or soaking, different liquid chemical agents forming a uniform waterproof film on the surface, or suitable covers such as felt, foil, straw mat, etc.

2.2.3.3.2.8 Materials for Sealing the Joints

For sealing the joints between BBWC cement concrete slabs the following can be used:

- sealing insertions,
- strips to fill up the joint lower part,
- materials for priming coat applied to the joint upper part, and
- bituminous elastic compounds for sealing the joints.

2.2.3.3.3 Quality of Materials

2.2.3.3.3.1 Mineral Aggreegate Mixtures

Mineral aggregate mixtures for BBWC cement concrete are generally composed of grains of

- sand, and
- gravel and/or crushed gravel.

Mineral aggregate mixtures shall meet the requirements indicated in the EN 12620, and shall be chemically inert, washed or dedusted, and fractionized.

The largest mineral grain in a BBWC cement concrete mix shall not be greater than one fourth the design layer thickness.

2.2.3.3.3.1.1 Sand

The sand for BBWC cement concrete may be of natural grains, or of a mixture of natural and crushed grains.

The requirements for the sand granulometric composition are indicated in Table 3.31, whereas for the properties of sand grains in Table 3.32 in these technical conditions.

2.2.3.3.3.1.2 Gravel and Crushed Gravel

To BBWC cement concrete a mixture of gravel and crushed gravel grains of size up to 32 mm ($GC_{90/15}$ category) is suitable and predominantly applied.

2.2.3.3.3.1.3 Collective Granulometric Composition

To BBWC cement concrete, mixtures of mineral grains of nominal granulometric composition of 0/32 mm, exceptionally also of 0/16 mm (informative category GA_{90}), are suitable.

Ranges of mineral aggregate granulometric composition for cement concrete mixes are indicated in Fig. 3.40 (CS 16 and CS 16s cement concrete) and Fig. 3.41 (CS 32 cement concrete).

For cement concrete mixtures designated with »s«, gravel and crushed gravel grains of silicate origin shall be used.

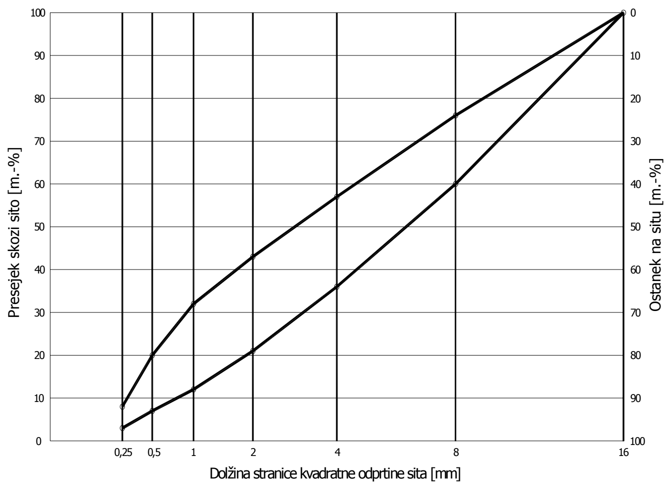


Fig. 3.40: Grading curve limits for mineral aggregate mixtures for BBWC made of CB 16 and CB 16s concrete mixes

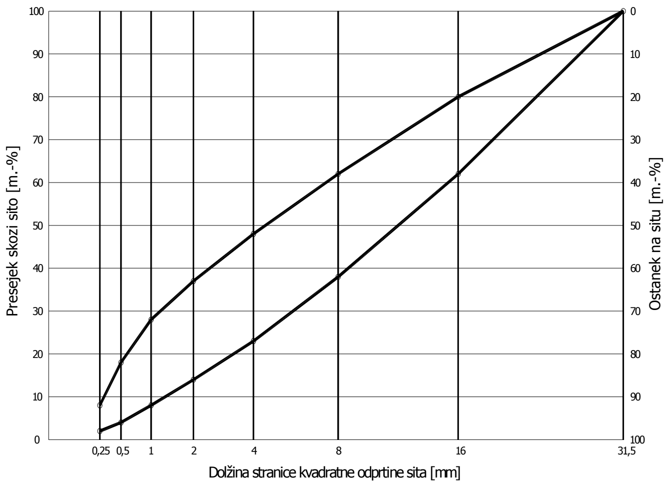


Fig. 3.41: Grading curve limits for mineral aggregate mixtures for BBWC made of CB 32 concrete mixes

The contractor has the right to use a different mineral aggregate mixture for the production of BBWC cement concrete mix provided that suitable evidence is submitted to the engineer proving that the mechanical properties of such a cement concrete mix meet the requirements indicated in both design and these technical conditions.

Mineral aggregate mixtures for cement concrete BBWC shall have properties as indicated in Table 3.78. The quotients of resistance to polishing shall comply with the values indicated in Table 3.33.

In fractions above 4 mm, mineral aggregate mixtures for BBWC cement concrete mixtures shall contain

- at least 90% by mass of crushed grains on roads with heavy traffic loading,
- at least 50% by mass of crushed grains on roads with medium and light traffic loading.

Prior to commencement of the works, the conformity of each mineral aggregate mixture, foreseen for BBWC cement concrete, with the requirements in these technical conditions shall be tested. If the engineer has already approved the use of the same mineral aggregate mixture for the BBWC construction, re-testing of conformity of those mineral grain mixtures is not required.

The required properties of mineral aggregate mixtures shall be ensured (threshold values).

Table 3.78: Required properties of mineral aggregate mixtures for BBWC cement concrete mixes

Properties of mineral aggregate mixtures	Unit measure	Required value	Test method
- compressive strength of mineral grains, minimum			EN 1926
- for wearing courses:			
- for VH and H traffic loading	MN/m^2	160	
- for other traffic loading	MN/m^2	140	
- for bearing courses	MN/m^2	100	
- resistance of mineral grains to crushing assessed by the Los Angeles method shall amount to			N 1097-2
- for wearing courses:			
- for VH and H traffic loading	% by m.	LA_{20}	
- for other traffic loading	% by m.	LA_{25}	
- for bearing courses	% by m.	LA_{30}	
- resistance of mineral grains to frost (magnesium sulphate test)			EN 1367-2

- for wearing courses	% by m.	MS_{18}	
- for bearing courses	% by m.	MS_{25}	
- modulus of shape of coarse grains	% by m.	SI20	EN 933-4
- water absorption	% by m.	$W_{cm}0.5$	EN 1097-6

2.2.3.3.3.2 Cement

Basic properties of cement for BBWC cement concrete mixes are defined in the EN 197-1. The following cement types are particularly suitable to cement concrete mixtures:

- CEM I of strength class 32, and, in special cases
- CEM II/A-S and CEM II/B-S of strength class 42.5.

For the cement used for BBWC cement concrete mixes, the following restrictions shall be considered.

- beginning of setting at 20 °C not before after 1 hour,
- beginning of setting at 30 °C not before after 45 minutes,
- completion of setting within 10 hours.

The required basic properties of the cement shall be ensured (threshold values).

For BBWC cement concrete of the same cross-section, cement of equal properties and produced of equal primary materials shall be used (cement of uniform quality).

In due time prior to commencement of the works the contractor shall submit to the engineer suitable certificates proving the quality of the cement he intends to use to produce BBWC cement concrete mixes, all in compliance with these technical conditions.

The engineer has the right to direct or approve a cement of other properties as well.

2.2.3.3.3.3 Water

The properties of the water to be used for the preparation of BBWC cement concrete mixes are defined in the EN 1008. The required water properties are indicated in Table 3.79.

Table 3.79: Required properties of water used for production of BBWC cement concrete mixes

Properties	Unit measure	Required value	Test method
- pH value, minimum	-	6.5	EN 1008
- chloride content (Cl), maximum	mg/l	300	EN 196-21
- sulphate content (SO_4), maximum	mg/l	400	EN 196-2

The required properties of the water for the production of BBWC cement concrete shall be ensured (threshold values).

Drinking water may be used without proving its suitability to production of cement concrete for BBWC.

2.2.3.3.3.4 Chemical Additives

The properties of cement concrete chemical additives are specified in the EN 934-2.

The chemical additives used shall ensure the improved properties of the cement concrete mix in certain states (fresh, setting, hardened cement concrete). This shall be preliminarily tested with such a mineral aggregate mixture that is intended for the cement concrete production.

Conformity certificates of cement concrete chemical additives, which prove that an additive meets the requirements indicated in both design and these technical conditions, shall be submitted to the engineer in due course before commencement of the works.

2.2.3.3.3.5 Steel

The properties of the reinforcing steel, as well as of dowels and anchors used to construct cement concrete BBWC are defined in the EN 10080.

Steel used for welded mesh reinforcement shall be in accordance with the specified quality class (grade).

Steel, i.e. smooth bars for dowels to reinforce transverse joints in the cement concrete BBWC, shall be of B 235 grade.

Ribbed (deformed) steel, i.e. bars for anchors for transverse connection of BBWC cement concrete at longitudinal joints shall be of B 400 grade.

The required properties of steel for meshes and bars shall be ensured (threshold values). The contractor shall submit to the engineer an evidence of the conformity of those steels with the requirements mentioned in both design and these technical conditions.

The engineer may approve certain deviations from those requirements on conditions that the contractor submits him suitable evidence (certificates).

2.2.3.3.3.6 Protective Agents

The properties of liquid chemical protective agents to be applied to the BBWC cement concrete surface are defined in manufacturer's technical conditions and application instructions. They shall ensure conditions for suitable hydratation of the cement and protection from adverse weather actions.

The applied film shall adequately protect the BBWC cement concrete surface for at least 7 or 10 day depending on the cement hydratation progress. Any adverse effect on cement setting process and on the surface of the executed BBWC shall be avoided.

Quality certificates of protective agents to be applied to BBWC cement concrete surfaces, as well as eventual supplementary instructions shall be issued by an authorized institution.

In due time prior to application of the protective agent, the contractor shall get approval by the engineer.

2.2.3.3.3.7 Materials for Sealing the Joints

The quality of sealing insertions and strips to fill the lower part of joints between cement concrete slabs placed as BBWC shall be determined by the manufacturer's technical conditions and application instructions.

The quality of materials for priming the walls of the upper part of the joints is determined with regard to the properties of the elastic compound for sealing the joints. The producer of the sealing compound shall provide technical conditions and application instructions for the priming material.

The properties of bituminous elastic compounds for sealing the joints are indicated in the EN 52132.

On the basis of submitted the certificates proving the conformity with the provisions of the design and these technical conditions, the engineer shall preliminarily approve all the material for sealing the joints in the BBWC cement concrete.

2.2.3.3.4 Method of Execution

General technical requirements for the composition of cement concrete mixes for BBWC construction, for their production, properties of both fresh and hardened cement concrete, as well as for establishing conformity of the produced cement concrete are indicated in the v EN 206-1. They shall be adjusted to the traffic loading as well as environment and construction conditions.

2.2.3.3.4.1 Winning of Materials

In due time prior to commencement of works, the contractor is obliged to inform the engineer of the location and method of winning mineral aggregate for production of cement concrete mixes.

The contractor shall submit to the engineer evidences of conformity of mineral aggregates with requirements indicated in 2.2.3.3.3.1. These evidences shall be issued by an authorized institution.

In due course prior to commencement of the use, the contractor shall submit to the engineer certificates of all other materials he intends to introduce to cement concrete BBWC construction (cement, water, steel, protective agents, and material for sealing the joints).

2.2.3.3.4.2 Depositing of Materials

If the contractor intends to deposit provisionally a mineral aggregate mixture for BBWC cement concrete production, an adequate deposit area shall be prepared in advance.

Cement shall be stored in suitable silos.

In case that for the production of cement concrete mixtures the water is not directly taken from the waterworks, than it shall be stored in adequate tanks.

Chemical additives shall be stored as directed by the manufacturers.

Steel bars and meshes for reinforcing the cement concrete shall be shielded from precipitations if stored at provisional deposit areas. The dowels, however, need not be shielded, unless they are not protected from moisture.

Protective agents for after-treatment and maintenance of fresh or young cement concrete, as well as the material for sealing the joints in the BBWC cement concrete shall be stored in accordance with makers' instructions.

The stocks of all the materials at deposit areas shall be such as to ensure a continuous production of cement concrete mix for BBWC.

2.2.3.3.4.3 Preparation of Substrate Formation

As a base for cement concrete BBWC the formation of bound bearing and bound wearing course of asphalt mixture can be used. It shall be prepared in compliance with section 2.2.3.1.3.5.6 of these technical conditions.

Unless specified otherwise by the design, the engineer may approve the formation of the bound sub-base prepared in compliance with section 2.2.3.1.2.5.3, or the formation of unbound roadbase prepared in compliance with section 2.2.3.1.1.5 of these technical conditions.

BBWC cement concrete must not be placed onto a frozen or excessively moist or soiled substrate.

Where the substrate material absorbs the water, it shall be, prior to commencement of placing BBWC cement concrete,

- covered with suitable impermeable material such as PVC foil,
- coated by spraying an adequate bituminous emulsion, or
- moistened with water.

The engineer shall approve the method of substrate preparation.

The contractor may commence placing cement concrete for BBWC after the engineer has taken-over the substrate in accordance with the abovementioned requirements.

All the time up to the beginning of placing BBWC the contractor is obliged to maintain the formation of the base in a condition as it has been at the time of taking-over. All damage shall be suitably made good in due time and corresponding evidence of repairing works shall be submitted to the engineer.

2.2.3.3.4.4 Production of Fresh Cement Concrete Mix

The production of fresh cement concrete mix shall be mechanical at suitable plant by batching method of work. The production capacities of the plant shall be certified.

The plant for production of cement concrete mixes shall be protected from atmospheric action. Possibility of permanent visual control of dosing individual components shall be ensured.

Dosing devices shall be such as to provide adequate amounts of all the components by mass.

Mixing time and other factors influencing the quality shall be so adjusted as to ensure a uniform cement concrete mix.

To allow production at low temperatures as well, the cement concrete production plant shall be equipped with heating facilities, so that the temperature of the produced cement concrete mix is within the limits of 5 – 30°C.

The capacity of the cement concrete production plant shall be such as to ensure the required quantity for uniform spreading with the finisher.

As a rule, the produced cement concrete mix shall be immediately brought to the location of placing for BBWC.

2.2.3.3.4.5 Bringing Cement Concrete Mix

Cement concrete for BBWC may be brought onto suitably prepared substrate formation only after the engineer has approved this.

For bringing cement concrete suitable vehicles – mixers or tippers adjusted to tipping into a finisher and equipped with a tarpaulin to protect the cement concrete mix from precipitations, drying up and dust shall be used. During transportation the cement concrete mix shall remain uniform, and the properties of the fresh cement concrete must no change as well.

The number of vehicles transporting the material to the site shall be adjusted to conditions of uniform spreading, taking account of capacity of production plant, transport distance, and capability for placing.

Any intervention in the cement concrete composition during transportation or prior to placing is only admitted if it is foreseen by the cement concrete design.

2.2.3.3.4.6 Placing Fresh Cement Concrete Mix

Placing cement concrete mixtures for BBWC shall generally be done mechanically by means of a finisher. Manual spreading is only admitted in places which cannot be reached with machines. Graders or bulldozers may only be used to spread a fresh cement concrete mix for the bearing course. This shall be approved by the engineer.

A fresh cement concrete mix can be placed between roller beams or by means of a finisher with sliding formwork. A uniformly spread cement concrete mix for BBWC shall be evenly compacted. As a rule, pervibrators uniformly distributed over the entire finisher width shall be used for compaction. Such pervibrators allow a uniform and perfect compaction over the whole BBWC cross-section. For the compaction of cement concrete spread on minor areas, different mechanical equipment may also be used.

Daily interruptions of placing shall be treated as transverse compressed joint perpendicularly to the road axis.

In cement concrete BBWC reinforced with welded steel meshes (at least 3 kg/m^2), the latter shall perfectly fit. The overlapping of mesh reinforcement shall amount to

- at least 2 meshes in longitudinal direction,
- at least 1 mesh in transverse direction.

A BBWC can also be reinforced with micro-reinforcement. Conditions for such an execution shall be specified in the design.

Before a bridge, the cement concrete BBWC shall be terminated at least 15 m before the abutment. The final slab shall be reinforced with not less than 10 kg/m^2 of smooth steel bars of minimum diameter of 16 mm.

Due to induction apparatus of the automatic toll system and to the traffic counting system, cement concrete BBWC shall not be reinforced with welded steel meshes at toll stations.

The engineer shall specify the method and conditions of using devices for compaction of the BBWC cement concrete mixes.

Spreading and cpmpacting the lower (bearing) and the upper (wearing) course of a cement concrete BBWC shall be harmonized in view of time.

The time of placing BBWC cement concrete must not exceed

- one hour at air temperatures up to 30°C,
- half an hour at air temperatures above 30°C.

The engineer may approve longer placing times, when the contractor submits evidence that the specified quality of the BBWC cement concrete is ensured anyway.

For finishing BBWC cement concrete surfaces, mechanical smoothers and brushers shall be introduced, which shall ensure the required evenness and friction of the BBWC traffic surface. If this is not ensured, additional quantities of cement concrete shall be placed. Any adding of cement, water, or cement mortar is not admitted.

The cement concrete temperature upon placing shall not be

- lower than 10°C at air temperature 0 °C,
- lower than 20°C at air temperature -3 °C,
- higher than 30°C at air temperatures above 25 °C.

In case that the air temperature drops down below -3°C and, at high air humidity, below 0°C respectively, or that the cement concrete temperature is less than 5°C, placing of BBWC cement concrete shall be interrupted, and the executed BBWC suitably protected.

Placing the cement concrete mix for BBWC shall also be interrupted, if the fresh cement concrete temperature rises to a value greater than 30°C.

Interruptions of placing BBWC cement concrete shall be planned at transverse joints, which shall be executed as compressed (construction) joints.

The surface of a placed BBWC shall be protected to prevent the temperature of placed cement concrete to drop down below 5°C until the concrete has reached at least 50% of the design compressive strength.

Light site traffic is allowed onto the cement concrete BBWC after the latter has reached 50% of the required compressive strength. For heavier site traffic this value amounts to 70%, whilst for the public traffic it shall be equal to the design compressive strength.

2.2.3.3.4.7 Protection of Fresh Cement Concrete

Cement concrete BBWC shall be protected from weather conditions. When the cement concrete mix is placed between roller beams it is possible to introduce trolleys with a clear tent for one-day protection, whereas for a long-lasting protection chemical agents of light colour shall be used. In case that the cement concrete mix is placed by means of finishers with sliding formwork, only chemical protective agents (sprayed foil) may be used.

Suitable protection of cement concrete shall be ensured immediately after compaction of the wearing course.

When using chemical protective material, manufacturer’s technical conditions, and, if necessary, supplementary application instructions by an authorized institution shall be considered.

Wetting a fresh cement concrete BBWC surface with water is generally only allowed as additional provision to the chemical protection at very high temperatures. However, such wetting may last no longer than 3 days, exceptionally up to 7 days.

An excessive and quick cooling of BBWC cement concrete, which is at the setting stage, shall be prevented by covering the surface with straw mat, felt, foil, etc., until the cement concrete reaches at least 50% of the specified compressive strength. Cement concrete BBWC constructed in autumn shall be adequately impregnated to achieve reliable protection against de-icing salt used in winter.

The duration of BBWC cement concrete after-treatment is informatively indicated in the EN 206-1.

2.2.3.3.4.8 Execution of Joints

The method of joint construction shall be such as to ensure that the quality of the cement concrete at the joints is the same as that at other locations on the BBWC.

Both location and method of execution of joints shall be defined by the design. If not, the engineer shall make the final decision. As a rule, the joints shall be adapted to the position of inductive apparatus: the joints shall not intersect them, and the dowels and anchors shall be placed at least 50 cm away from the inductive apparatus.

2.2.3.3.4.8.1 Dummy Joints

Grooves for transverse and longitudinal dummy joints (contraction joints) shall be carried out in due time to prevent an uncontrolled cracking of BBWC cement concrte slabs due to shrinkage during setting. The depth of a groove shall amount to approximately 25 to 30% of the BBWC thickness ,whilst its width shall be 3 – 4 mm.

The required depths and widths of subsequently widened grooves, i.e. cuts of dummy joints, are indicated in Table 3.79.

Table 3.79: Required depths and widths of cuts of BBWC dummy joints

Type of dummy joint	Crack width below cut (mm)	Dimension of cut	
		depth (mm)	width (mm)
- transverse	up to 1	25	8
	1 to 2	30	12
	above 2	35	15
- longitudinal	-	15	6

Where a BBWC is executed in all the carriageway width at one time thus a longitudinal dummy joint is required, the depth of the cut shall amount to 25 mm, while its width to 8 mm.

2.2.3.3.4.8.2 Compressed Joints

Compressed joints may be carried out as construction joints separating cement concrete slabs over the entire BBWC depth. By means of compressed joints new cement concrete slabs are attached to the already hardened ones.

In transverse compressed construction joints the vertical cement concrete surface shall be coated with suitable bituminous binder (0,8 do 1 kg/m^2) prior to continuation of placing BBWC. In longitudinal compressed construction joints the vertical cement concrete surface shall be first coated with a primer, and after the primer has dried, with suitable bituminous binder (1.0 to 1.5 kg/m^2).

The depths of cuts of compressed joints shall amount to 35 mm, while the widths to 10 mm.

2.2.3.3.4.8.3 Expansion Joints

Expansion joints shall separate a cement concrete BBWC over the entire thickness. Insertions in the expansion joints shall fit perfectly and may be covered by maximum 50 mm of cement concrete.

The groove depth in expansion joints shall amount to at least 30 mm (approximately 1.5 times the width), whilst the groove width shall be up to 20 mm and by at least 2 mm less than the insertion thickness.

Expansion joints shall be cut 2 – 3 days after placing cement concrete.

2.2.3.3.4.8.4 Cutting the Joints

Grooves and cuts shall be carried out in due course, mechanically, straight, and with sharp edges.

The depth of cuts shall be adapted to the type of material for sealing the joints.

2.2.3.3.4.8.5 Sealing the Joints

Prior to sealing the joints their surfaces shall be dried and the cuts shall be adequately cleaned. After the priming coat applied to walls of the cut has dried, suitable joint sealing materials shall be built-in. The engineer shall approve the proposed method of sealing the joints.

2.2.3.3.4.8.6 Placing Dowels and Anchors

Into transverse dummy (contraction) and compressed joints as well as into expansion joints dowels shall be inserted, whereas into longitudinal dummy (contraction) and compressed joints anchors shall be built-in.

Dowels, which are 500 mm long and isolated over their total length shall be made of smooth bars of diameter 20 – 25 mm. Anchors are 800 mm long and isolated in the middle in a length of 200 mm only. They shall be made of ribbed (deformed) steel bars.

As a rule, dowels shall be pressed by vibrating into the middle of already compacted cement concrete mix for BBWC, so that they are orientated in the carriageway direction. When, however, the dowels are placed prior to spreading the cement concrete, it shall be ensured that they remain suitably orientated in the centre of the slabs during placing BBWC cement concrete.

Anchors shall be inserted perpendicularly to traffic flow direction in the carriageway slope

- in longitudinal dummy joints in a height of one third the BBWC thickness measured from the lower edge,
- in longitudinal compressed joints in the centre of the BBWC cross-section.

The arrangement of dowels and anchors in the cement concrete BBWC shall be specified in detail by the design. If this is not the case, the engineer shall specify it.

2.2.3.3.4.9 Inductive Loops of Systems for Toll and Counting of Traffic

Inductive loops of the automatic system for toll and counting of traffic shall be installed into grooves, which must be cut after the BBWC cement has already attained its design compressive strength.

The method of installing inductive loops shall be described in detail in the design.

2.2.3.3.5 Quality of Execution

At least 7 days in advance prior to starting placing BBWC cement concrete, the contractor shall submit to the engineer for approval a method statement, which shall include the following:

- Design of cement concrete
- Evidence of conformity of all the materials to be used,
- Programme of average frequency of both internal and external control,
- Description of work methods, and
- Information on the mechanization to be introduced.

Before the machines and equipment, on which the quality of the executed work depends, begin to operate, their ability to ensure a uniform quality in accordance with these technical conditions shall be ascertained.

All the machinery and equipment shall be certified and shall satisfy the design requirements as well as these technical conditions.

2.2.3.3.5.1 Initial Test of Cement Concrete Mix

2.2.3.3.5.1.1 Composition of Cement Concrete Mix

The contractor shall submit to the engineer the results of the initial testing of the cement concrete mix he intends to place as a BBWC.

The following information of the mix shall be provided:

- types and quantities of individual fractions of mineral grains (kg/m^3)
- type and quantity of the binder (kg/m^3)
- water amount (l/m^3)
- types and quantities of chemical additives (% of the cement quantity or kg/m^3 of cement concrete).

The contractor must not begin placing until he has received an approval by the engineer for the proposed composition of cement concrete.

If the contractor has already placed BBWC last year with similar cement concrete mixes, then the preliminary composition may be taken from the already performed composition determined by the internal testing. However, final decision shall be made by the engineer.

2.2.3.3.5.1.2 Cement Concrete Properties

By the proposed composition of the cement concrete mix the contractor shall demonstrate that the properties of the cement concrete defined in the EN 206-1 can be achieved using the foreseen mineral aggregate mixture, cement, water, and chemical additives, all in accordance with the design and these technical conditions.

The required properties of mixes of fresh cement concrete for BBWC are indicated in Table 3.80.

Table 3.80: Required limiting values of properties of fresh cement concrete

Properties	Unit measure	Required value	Test method
- content of micro-pores:			EN 12350-7
- for CC 16	% by v.	5 to 7	
- for CC 32	% by v.	3 to 5	
- content of cement and mineral grains (up to 0.25 mm):			-
- if cement quantity ≤ 300 kg/m^3	kg/m^3	400	
- if cement quantity ≥ 350 kg/m^3	kg/m^3	450+(C-350)	

The admitted deviation of content of micro-pores amounts to -1 % or + 2 % (absolute value).

The required properties of hardened cement concrete for BBWC are indicated in Table 3.81 in dependence on the foreseen traffic loading.

Values of pore content are threshold values.

Values of content of cement and content of mineral grains of up to 0.25 mm are upper limiting values.

Values of compressive strength and tensile strength at bending are lower limiting values.

Resistance to freezing and thawing is specified as lower limiting value.

Resistance to water penetration is a threshold value.

Table 3.81: Required properties of hardened cement concrete

Properties	Unit measure	Required value	Test method
- class of compressive strength:			EN 12390-3
- for exceptionally heavy and very heavy traffic loading:			
- for bearing course	class	C 30/37	
- for wearing course	class	C 35/45	
- for heavy and light traffic loading:			
- for bound bearing and wearing courses	class	C 30/37	
- tensile strength at bending			EN 12390-5
- for exceptionally heavy and very heavy traffic loading	MN/m^2	≥ 5.5	
- for heavy and light traffic loading	MN/m^2	≥ 5.0	
- resistance to freezing/thawing – grade XF4, 50 cycles	mg/mm^2	≤ 0.40	EN 12390-8
- resistance to water penetration – grade PV-II	mm	≤ 30	1026

2.2.3.3.5.2 Demonstrative Production and Placing / Test Area

The contractor shall verify the initial (laboratory) composition of the cement concrete mix at suitable plant, the transportation to the site, and placing for BBWC after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and plant for production of fresh cement concrete, and establish suitability of transportation method and equipment for placing, all in compliance with the provisions of these technical conditions,
- take a specimen of fresh and hardened cement concrete at the location of placing to perform a conformity test,
- establish suitability of finishing the BBWC cement concrete surface,
- establish the execution of joints in BBWC,
- establish the protection of the surface of BBWC cement concrete
- establish thethickness, evenness, level, slope, and direction of the BBWC.

If the contractor has already placed a BBWC last year with cement concrete mixes of similar properties and under similar conditions, then the preliminary investigation results may be taken as a demonstrative production and placing. However, the engineer shall make final decision.

2.2.3.3.5.3 Routine Production and Placing

The engineer shall approve a routine production or composition of a cement concrete mix not until the contractor has submitted the results of the demonstrative production and placing. The permission for a continuous production also includes requirements for the internal control foreseen by these technical conditions and the contract.

The permission for a routine production and placing of the fresh cement concrete mixes for BBWC shall also comprise detailed requirements for an eventual additional preparation of the underlay according to section 2.2.3.3.4.3 of these technical conditions.

In case of any modification in production or placing of a fresh cement concrete mix, the contractor shall submit to the engineer in writing his proposal for the particular modification. Such a modification shall only be implemented after being approved by the engineer.

2.2.3.3.5.4 Thickness of BBWC

Limiting thicknesses of cement concrete BBWC are specified in section 2.2.3.3.1 of these technical conditions.

The average thickness of BBWC may be by up to 5 % below the specified limiting value, whereas individual measured values by up to 10% (threshold value).

2.2.3.3.5.5 Evenness, Level, and Slope of BBWC Formation

Any unevenness of the formation of the BBWC shall be established, in any direction with regard to the road axis, as a deviation below a 4 m long straight edge. The BBWC formation may deviate from the straight edge by maximum the following upper limiting value:

- on carriageways subjected to very heavy and heavy traffic loading:
  - for machine placing - 4 mm
  - for manual placing - 6 mm
- on carriageways subjected to other traffic loading types:
  - for machine placing - 6 mm
  - for manual placing -10 mm

In case that such deviatons are successive, the engineer shall shall make final decision.

The level of the individual measuring points on the formation of the BBWC shall be determined by levelling. In any place, the BBWC formation may deviate from the design level by maximum $\pm$10 mm (upper limiting value).

The slope of the formation of the BBWC shall be, as a rule, equal to both transverse and longitudinal fall of the carriageway. The allowable slope tolerances are defined by the admitted unevenness and deviation from the particular layer formation level. However, the allowable tolerances shall not exceed the design slope by more than $\pm$ 0.3% (threshold value).

The edges of the placed cement concrete BBWC may deviate from the carriageway direction (upper threshold value)

on carriageways for very heavy and heavy traffic loading maximum 30 mm,

on carriageways for medium and light traffic loading maximum 50 mm

2.2.3.3.6 Quality Control of Execution

2.2.3.3.6.1 Internal Control

Both type and frequency of testing BBWC cement concrete within the scope of the internal control to be carried out by the contractor's laboratory shall be determined and approved by the programme of the average frequency of the control. If this is not the case, it shall be specified by the engineer, who shall also determine locations of taking specimens, as well as locations of measurements, all in accordance with a random statistical pattern.

During placing BBWC cement concrete, the laboratory shall take test specimens and check the conformity of the properties to such a frequency as specified in Table 3.82.

Table 3.82: Minimum frequency of testing cement concrete within the scope of the internal control of placing

Properties	Test method	Minimum testing frequency
- content of micro-pores in the mix	EN 12350-7	100 m^3
- compressive strength of specimens	EN 12390-3	400 m^3
- tensile strength at bending	EN 12390-5	800 m^3
- resistance to freezing/thawing	EN 12390-8	1,600 m^3
- resistance to water penetration	1026	1,600 m^3

The contractor is obliged to submit regularly the internal control results to both engineer and performer of the external control. In case that the contractor establishes any deviation from the specified quality, he shall inform the engineer and take adequate steps immediately.

The evenness, level, and slope of cement concrete BBWC formation shall be tested every 200 m^2, whereas the direction of the executed carriageway every 20 m^1.

The conformity of the constructed cement concrete BBWC with all the requirements indicated in the design and these technical conditions shall be evaluated by considering particularly the conformity criteria provided by the EN 206-1 and section 2.2.3.3.5.6 of these technical conditions.

2.2.3.3.6.2 External Control

The external control of the execution of cement concrete BBWC, which has to be performed by a third party institution authorized by the client, includes the following activities:

establishing conformity of the produced and placed BBWC cement concrete mixture with the requirements provided by both design and these technical conditions, and

supervision of the internal control.

As a rule, the extent of the external control testing of produced and placed cement concrete mixes shall be in a proportion of 1:5 with regard to the internal control testing extent. The engineer, however, has the right to direct different frequency of external control testing.

The approved programme of the average frequency of the external control shall define properties of cement concrete mixes, which conformity with the requirements is tested.

Test specimens for the external control of cement concrete mixtures shall be generally taken at the location of placing, which shall be appointed by the engineer.

Taking test specimens for the external control, as well as the tests and measurements at the site shall be generally carried out in the presence of both contractor and engineer.

The third party institution authorized to perform the external control of conformity of cement mixes for BBWC shall prepare a written report on routine inspection of the internal control, including an evaluation of results. The report shall be submitted to the engineer.

2.2.3.3.7 Measurement and Take-Over of Works

2.2.3.3.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions, and calculated in square metres.

All the quantities shall be measured by the actually executed extent and type of works within the scope of the design. An adequate report on the measured quantities shall be worked out in due time.

3.2.3.1.1.3Take-Over of Works

The executed cement concrete BBWC shall be taken-over by the engineer in compliance with the quality requirements indicated in these technical conditions, and with section 2.1.7.2 of the general technical conditions. Prior to continuing the work, the contractor shall mend all the deficiencies established, otherwise deductions will be charged to him for an inappropriate quality of the work carried out.

2.2.3.3.8 Final Account of Works

2.2.3.3.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in compliance with section 2.2.3.3.7.1 and taken-over according to section 2.2.3.1.3.7.2 of these technical conditions shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment.

If the contractor has failed to achieve the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.3.8.2 Deductions Due to Unsuitable Quality

2.2.3.3.8.2.1 Quality of Materials

Due to unambiguously defined quality of materials for cement concrete BBWC there are no deductions when accounting the quantities.

If the contractor places into BBWC such material, which does not comply with the requirement indicated in 2.2.3.3.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.3.8.2.2 Quality of Execution

Necessary bases to assess the quality of execution and to calculate deductions due to unsuitable quality of the BBWC cement concrete are indicated inTables 3.80 and 3.81.

If the contractor fails to ensure the required quality of placed cement concrete BBWC the engineer shall decide upon the method of accouting. When the engineer establishes deficiencies such as

- insufficient compressive strength,

- insufficient tensile strength at bending,
- insufficient thickness of BBWC, or
- unsuitable evenness of the BBWC formation,

he is entitled to put into effect deductions, which shall be evaluated on the following bases:

for insufficient compressive strength of BBWC cement concrete the following equation shall apply:

$$FO = \frac{0}{100} \times 3 \times C \times PD$$

where:

0 – *deviation from the limiting value (%) assessed by the equation* $0 = \frac{f_{ck} - f_{ckd}}{f_{ck}} \times 100$

f_{ck} – *prescribed (characteristic) compressive strength (MN/m²)*

f_{ckd} – *attained (established) compressive strength (MN/m²)*

C – *unit price of the work executed (SIT)*

PD – *extent of the work executed unsatisfactorily (m²)*

The assessment of financial deduction for each individual unsuitable result of testing cement concrete compressive strength shall be based on the required limiting value specified by the design (in Table 3.81), and on the determined corresponding threshold value f_{cksm}.

for insufficient tensile strength at bending of BBWC cement concrete the following equation shall apply:

$$FO = \frac{0}{100} \times 5 \times C \times PD$$

where:

0 – *deviation from the limiting value (%) assessed by the equation* $0 = \frac{f_{fk} - f_{fkd}}{f_{fk}} \times 100$

f_{fk} – *prescribed (characteristic) tensile strength at bending (MN/m²)*

f_{fkd} – *attained (established) tensile strength at bending (MN/m²)*

The assessment of financila deduction for each individual unsuitable result of testing cement concrete tensile strength at bending shall be based on the required limiting value specified by the design (in Table 3.81), and on the determined corresponding threshold value f_{fksm}

for insufficient thickness of BBWC the follng equation shall apply:

$$FO = 0 \times C \times PD$$

where:

0 – quotient of deduction in dependence on the value f (%) $f = \frac{h_n - h_{adm} - h_u}{h_n} \times 100$

h_n – design thickness of BBWC (cm)

h_{adm} – admissible deviation of thickness of BBWC (cm) (popraviti tudi v enačbi!), za h_n predlagam h_d , za

h_u pa h_e

h_u – established thickness of BBWC (cm)

The value of the quotient 0 shall be assessed on the basis if the value f in compliance with Table 3.83.

Table 3.83: Assessment of quotient of deduction 0 (D)

f (%)	2	4	6	8	10	12	14	16	18	20

0 (D)	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75

for unsuitable evenness of the BBWC formation the following equation shall apply:

$$FO = \sum \left(p_i^2 \times A \right) \times 0{,}6 \times C$$

where:

p_i – deviation of evenness above the limiting value specified in section 2.2.3.3.5.6 (mm)

A_i – corresponding width of zone of uneven formation (m)

The contractor shall make good any excessive deviation of the formation evenness of cement concrete BBWC. He shall introduce such measures as not to reduce the pavement design bearing capacity. In case that the contractor fails to mend the established effects, the client/engineer is entitled to reject the work executed.

The contractor shall ensure other properties of BBWC cement concrete, which exceed the limiting values indicated in these technical conditions, without having the right to claim any extra payment for such works.

2.2.3.4 PAVED WEARING COURSES

General

Paved wearing courses are constituent parts of pavements above roadbases and below the carriageway surface.

The method, dimensions, and quality of placing paved wearing courses shall be in accordance with the design and these technical conditions to ensure the design traffic surface and durability.

2.2.3.4.1 Description

Paved wearing courses (PWC) consist of pavers and underlay. In view of the traffic loading they can be placed as wearing courses onto unbound or bound roadbases.

PWC are intended for pavements for all groups of lighter traffic loading, particularly for a slow and standstill traffic.

The construction of a PWC comprises the supply of suitable materials and placing at locations specified by the design, including execution of joints.

The underlay can be made of an unbound mineral aggregate mixture (sand) and cement or lime mortar.

Along the edges, a PWC shall be protected against pushing away by means of suitable border elements.

The type of PWC and pavement structure shall generally be specified by the design. If this is not the case, the engineer shall make final decision.

2.2.3.4.2 Basic Materials

2.2.3.4.2.1 Stone Pavers

For PWC for traffic surfaces particularly small and big stone pavers made of silicate stone are recommended. In certain conditions small pavers can also be used for pedestrian surfaces.

2.2.3.4.2.2 Pavers and Turf Pavers of Cement Concrete

Pavers and turf pavers of cement concrete are applicable to PWC for standstill traffic surfaces and for pedestrian surfaces.

2.2.3.4.2.3 Slabs

Slabs made of roughened and sealed, or washed cement concrete, exceptionally of natural stone, are applicable particularly to paved surfaces intended for pedestrians.

2.2.3.4.2.4 Mineral Aggregate Mixtures

Mineral aggregate mixtures for unbound underlay for PWC shall contain particularly natural and crushed grains of sand. In exceptional cases they may also contain very fine grains of gravel and/or crushed stone. For filling the joints between pavers, only mixtures of stone grains of sand are recommended.

Mineral aggregate mixtures for unbound underlay for PWC shall meet the requirements indicated in the EN 12620.

2.2.3.4.2.5 Cement Mortar and Lime Mortar

Cement mortar and lime mortar for bound underlay for PWC or for filling the joints between pavers shall be composed of a mixture of sand, cement or mortar, and water.

The sand for cement mortar and lime mortar can consist of natural and/or crushed grains.

For cement mortars for bound underlay for PWC, or for filling the joints between pavers, the following binders shall be used:

Portland cement CEM I, and

Portland cement with an admixture of granulated furnace slag or pozzolans CEM II/A-S and CEM II/B-S, which meet the requirements defined in the EN 197-1.

For lime mortars hydrated lime shall be used.

The water for both cement mortar and lime mortar can be natural or suitably processed. In any case it shall comply with the conditions indicated in the EN 1008.

2.2.3.4.2.6 Compounds for Sealing the Joints

For sealing the joints between pavers, special sealing compounds on bituminous bases with additives to increase elasticity and/or plasticity shall be used.

2.2.3.4.3 Quality of Materials

2.2.3.4.3.1 Stone Pavers

Stone pavers for PWC intended for motor traffic shall be made of tough and uniform silicate stone resistant to frost and salt actions. Pavers for standstill traffic and pedestrian surfaces may also be of solid and tough carbonate stone.

Basic dimensions of pavers of natural stone are indicated in Table 3.84.

Table 3.84: Basic dimensions of stone pavers

Type of stone pavers	Dimensions of pavers length	width	height
	mm		
- small pavers (cubes)	80	80	80
	90	90	90
	100	100	100
- big pavers	120 to 180	120	130
	140 to 200	140	150
	160 to 220	160	160

A deviation from the basic dimensions indicated in Table 3.84 shall not exceed ± 10 %.

As pavers are placed for PWC predominantly in a curved shape, pavers of trapezoidal and oblong form are required as well. The latter are also necessary to carry out linking.

The engineer has the right to approve the use of stone pavers of other dimensions.

2.2.3.4.3.2 Pavers and Turf Pavers of Cement Concrete

Pavers and turf pavers for PWC shall be made of compact cement concrete without any cracks. Their dimensions shall comply with those indicated in Table 3.85.

The engineer has the right to approve the use of pavers and turf pavers of cement concrete of other properties as well.

Where pavers or turf pavers are produced of two cement concrete types (composite pavers of basic concrete and face mix), a perfect bond between both concrete types shall be ensured.

Table 3.85: Required properties of cement concrete pavers and slabs

Properties	Unit measure	Required value
- dimensional deviation:		
- length and width, maximum	mm	± 3
- height, maximum	mm	± 5
- convexity of paver sides:		
- of height up to 80 mm, maximum	mm	2
- of height above 80 mm, maximum	mm	3
- cement concrete compressive strength:		
- average, minimum	MN/m^2	35/45
- individual, minimum	MN/m^2	30/37
- resistance to freezing/thawing	mg/mm^2	≤ 0.40

2.2.3.4.3.3 Mineral Aggregate Mixtures

Mineral aggregate mixtures for the underlay for PWC may be composed of grains of

- medium sand 0/2 mm,
- coarse sand 0/4 mm,
- sand and very fine crushed stone and/or gravel 0/4 mm.

Mineral aggregate mixtures for filling the joints between pavers shall consist of crushed or natural grains of sand 0/2 mm.

The content of grains up to 0.063 mm in the particular mineral aggregate mix shall not exceed 5 by mass.

To other characteristics of sand grain mixtures the requirements indicated in Tables 3.31 and 3.32 shall apply. To the properties of crushed stone and gravel mixtures the requirements in Tables 3.33 and 3.34 are relevant.

2.2.3.4.3.4 Cement Mortar and Lime Mortar

Requirements to be met by the sand for the cement mortar for bound underlying courses and for sealing the joints between pavers are indicated in section 2.2.3.4.3.4 as appropriate.

Requirements for cement are specified in section 2.2.3.3.3.2.

The required properties of hydrated lime for lime mortar for the underlay below slabs are indicated in Table 3.86.

Table 3.86: Required properties of hydrated lime

Properties	Unit measure	Required value
- CO_2 content, maximum	% by m.	7
- content of active CaO + MgO, minimum	% by m.	85
only MgO in CaO + MgO, maximum	% by m.	8
- fineness of grinding:		
- residue on sieve 0.5 mm, maximum	% by m.	0.5
- residue on sieve 0.09 mm, maximum	% by m.	10

The required properties of water for both cement mortar and lime mortar are specified in section 2.2.3.3.3.3.

2.2.3.4.3.5 Compounds for Sealing the Joints

The required properties of bitumen based joint sealing compounds for PWC are defined in section 2.2.3.3.3.7.

On the basis of submitted conformity certificates for particular purposes, the engineer shall preliminarily approve the use of all the materials for sealing the joints between pavers or slabs.

2.2.3.4.4 Method of Execution

2.2.3.4.4.1 Winning of Materials

In due time prior to commencement of works, the contractor is obliged to inform the engineer of the types of all the materials he intends to use for PWC. Suitable conformity certificates shall be submitted.

All the required material properties indicated in section 2.2.3.4.3 shall be ensured (threshold values).

2.2.3.4.4.2 Depositing of Materials

If the contractor provisionally deposits the materials prior to use them for PWC, he shall ensure and arrange adequate space. Producer’s and engineer’s instructions shall be fully considered.

Stocks of all the materials at deposit areas shall be such as to ensure a continuous construction of PWC.

2.2.3.4.4.3 Preparation of Substrate Formation

The following can be used as a base for PWC:

- formation of unbound roadbase which shall be prepared in accordance with section 2.2.3.1.1.5 of these technical conditions,
- formation of bound sub-base, which shall be prepared in compliance with section 2.2.3.1.2.5.3 of these technical conditions,
- formation of bound roadbase, which shall be prepared in accordance with section 2.2.3.1.3.5.6 of these technical conditions.

The void content on the layers below the PWC, as well as the slope of se layers shall ensure a perfect evacuation of water, which could sink through the PWC.

In certain conditions a asphalt mixture for a bound wearing course may be used as a base for the PWC. However, the engineer shall give an approval in such a case.

The contractor may commence to execute the PWC only after the engineer has taken-over the substrate formation in accordance with the specified requirements. All the time up to the beginning of placing the PWC, the contractor is obliged to maintain the substrate formation in such a condition as it has been upon taking-over. Any damage shall be made good in due time, and an adequate evidence of the performed work shall be submitted to the engineer.

2.2.3.4.4.4 Production of Cement Mortar and Lime Mortar

The production of cement mortar and lime mortar shall be carried out mechanically at suitable plant for preparation of mortar by means of batch mixers.

Dosing devices shall ensure an adequate quantity of components in the mortars by mass.

The mixing time and other factors influencing the quality shall be so adjusted as to ensure a homogenous cement mortar or lime mortar.

As a rule, the produced mortar shall be immediately delivered to the location of placing for PWC.

2.2.3.4.4.5 Bringing Mineral Aggregate Mixtures and Mortar

For bringing unbound mineral aggregate mixtures for the underlay below pavers, suitable vehicles – tippers shall be used. The material must not be brought until this is approved by the engineer.

Cement mortar or lime mortar for the underlay below pavers or slabs may be brought onto suitably prepared substrate formation for PWC only after the engineer has approved this. Adequate vehicles – mixers or tippers shall be used for the transportation.

The number of vehicles transporting the material to the site shall be adjusted to conditions of uniform spreading, taking account of capacity of production plant, transport distance, and capability for placing.

2.2.3.4.4.6 Placing

2.2.3.4.4.6.1 Underlay

A uniformly thick layer of suitable unbound mineral aggregate mixture intended for the underlay shall be placed in such a thickness that, after compaction or stabilization of PWC, this underlay is 3 – 6 cm thick, i.e. thinner for the small pavers and thicker for the big ones.

Where a substantial loading of the PWC is expected it is useful to add cement or lime to the mineral aggregate mix; this is by all means required when the joints between pavers are sealed with cement mortar.

The cement mortar as the underlay below pavers or slabs shall be spread in a uniform thickness as well. In such a case the base for the PWC to be placed, i.e. the cement concrete bearing course, must still not set.

When slabs are foreseen for the PWC, the underlay shall be executed of at least 3 cm thick layer of sand mixture covered with a 2 cm thick layer of lime mortar.

All the underlay types shall be placed mechanically. Manual work is only allowed where the space for mechanical placing is restricted. The engineer shall approve the method of spreading the material for the underlay.

2.2.3.4.4.6.2 Pavers and Slabs

The method of arranging the pavers shall be specified by the design: in a shape of segments, in rectangular rows or diagonally to the road axis, mechanically or manually.

Paving slabs can be arranged in rows or diagonally, and manually as a rule.

When the joints are filled with rinsed-in mixture of sand grains, the paver or slab spacing shall amount to 3 – 5 mm. If the joints are sealed with cement mortar or bituminous compound, the pavers or slabs shall be spaced at least by 8 mm.

If the joints between pavers or slabs are filled-up with cement mortar, the pavers and slabs shall be moistened prior to being distributed onto the underlay.

Voids in turf pavers shall be filled with topsoil and grassed (0.5 to 0.8 kg of seed, and 8 kg of fertilizer per are.

2.2.3.4.4.6.3 Joints

When executing PWC with joints filled with unbound mineral aggregate mixture, the whole surface of pavers or slabs already placed shall be covered with a layer of sand, and wetted. After vibrating, the surplus sand shall be swept away from the PWC surface.

When executing PWC with joints sealed with cement mortar or bituminous compound, sand shall be removed from the joints to a depth of at least 30 mm.

Joints shall be sealed with either cement mortar or bituminous compound particularly in cases where substantial impacts of water, oil, or fuel are expected.

During the application of cement mortar to joints the pavers or slabs shall be moist, whereas during the application of bituminous sealing compound they shall be dry, and, if feasible, coated with an adequate material such as bituminous emulsion or cut-back bitumen in the joint area.

Joints between pavers or slabs shall be filled-up simultaneously with the work progress.

Bituminous sealing compounds shall be placed particularly to those joints where substantial movements of the PWC due to a rigid connection (by means of cement mortar) are expected (at spacing of up to 8 m at connections to structures).

When using bituminous compounds to seal the joints between pavers or slabs for PWC, manufacturer's instructions shall be fully considered.

Cement mortar shall be applied at air temperatures higher than 10°C. The temperature of the mortar itself shall be in the range of 10°C to 30°C.

A PWC surface with joints sealed with cement mortar shall be kept moist by at least 7 days. During this period the PWC must not be burdened with heavy vehicles.

2.2.3.4.5 Quality of Execution

At least 7 days in advance prior to starting placing a PWC, the contractor shall submit to the engineer for approval a method statement, which shall include the following:

- Evidence of conformity of all the materials to be used,
- Composition of the mineral aggregate mixture,
- Preliminary composition of mortar,
- Programme of average frequency of both internal and external control,
- Description of work methods, and
- Information on the mechanization to be introduced.

Before the machines and equipment, on which the quality of the executed work depends, begin to operate, their ability to ensure a uniform quality in accordance with these technical conditions shall be ascertained.

All the machinery and equipment shall be certified and shall satisfy the design requirements as well as these technical conditions.

2.2.3.4.5.1 Preliminary Composition of Mortar

The preliminary composition (investigation) of the mortar foreseen for PWC shall include the following information:

- types and quantities of individual fractions of mineral aggregate mixtures (in kg/m^3)
- type and amount of binder (in kg/m^3)
- quantity of water and additives (in kg/m^3 or in % by mass in terms of the cement quantity)
- characteristics of fresh mortar:
  - composition analysis (in kg/m^3)

- consistency (cone settlement) (in cm)
- characteristics of hardened mortar:
  - compressive strength (in MN/m^2)
  - tensile strength at bending (in MN/m^2)
  - resistance to frost and salt actions.

By the preliminary investigation (composition) the contractor shall demonstrate that such a quality of mortar can be achieved using the foreseen mineral aggregate mixture and binders, which is in compliance with the design and these technical conditions.

The contractor must not begin placing until he has received an approval by the engineer for the preliminary composition of the mortar.

If the contractor has already placed a PWC last year with compositions of mineral grains and binders of the same properties, then the preliminary composition may be taken from the already performed composition determined by the internal testing testing. However, final decision shall be made by the engineer.

2.2.3.4.5.2 Required Properties of Cement Mortar

The required properties of the cement mortar for PWC are indicated in Table 3.87.

Table 3.87: Required properties of cement mortar for PWC

Properties	Unit measure	Required value for underlay	Required value for sealing of joints	Test method
- cement content, minimum	kg/m^3	270	500	-
- compressive strength, minimum	MN/m^2	C8/10	C 30/37	EN 12390-3
- tensile strength at bending, minimum	MN/m^2	-	≥ 5.5	EN 12390-5
- resistance to freezing/thawing – grade XF4, 50 cycles	mg/mm^2	-	60,40	EN 12390-8

The required cement content is the lower limiting value.

The values of compressive strength and tensile strength at bending are the lower limiting values.

The required resistance to freezing/thawing is determined as the lower limiting value.

2.2.3.4.5.3 Demonstrative Production and Placing

The contractor shall verify the preliminary (laboratory) composition of the cement mortar at suitable plant, the transportation to the site, and placing for PWC after he has obtained an approval by the engineer.

As a rule, the engineer shall approve the location of the demonstrative placing at the construction site after he has checked the suitability of the prepared substrate formation.

Within the scope of the demonstrative production and placing several tests shall be carried out by an authorized third party to be engaged by the contractor in order to

- establish adequateness of deposit areas and plant for production of mortar,
- establish suitability of transportation method and equipment for placing,
- take a specimen of the hardenend cement mortar at the location of placing to perform a conformity test,
- establish the execution of joints between pavers or slabs,
- establish the evenness, level, and slope of the PWC.

If the contractor has already placed a PWC last year with mortars of similar properties and under similar conditions, then the preliminary investigation results may be taken as a demonstrative production and placing. However, the engineer shall make final decision.

2.2.3.4.5.4 Routine Production and Placing

The engineer shall approve a routine production and a working composition not until the contractor has submitted the results of the demonstrative production and placing. The permission for a routine production also includes requirements for the mortar properties and for the control foreseen by these technical conditions and design.

In case of any modification in production and placing of the mortar the contractor shall submit to the engineer in writing his proposal for the particular modification. Such a modification shall only be implemented after being approved by the engineer.

2.2.3.4.5.5 Evenness, Level, and Slope of Formation

Any unevenness of the formation of a PWC shall be established, in any direction with regard to the road axis, as a deviation below a 4 m long straight edge. The formation of the PWC may deviate from the straight edge by maximum – 10 mm (upper limiting value). If such deviations are established in succession, the engineer shall make a final decision.

The level of the individual measuring points on the formation of the PWC shall be determined by levelling. In any place, the PWC formation may deviate from the design level by maximum $\pm$10 mm (upper limiting value).

The slope of the formation of the PWC shall be, as a rule, equal to both transverse and longitudinal fall of the carriageway. The allowable slope tolerances are defined by the admitted unevenness and deviation from the PWC formation level. However, the allowable tolerances shall not exceed the design slope by more than $\pm$ 0.4% (threshold value).

2.2.3.4.6 Quality Control of Execution

2.2.3.4.6.1 Internal Control

Both type and frequency of testing within the scope of the internal control of PWC to be carried out by the contractor's laboratory shall be determined and approved by the programme of the average frequency of the control. If this is not the case, it shall be specified by the engineer, who shall also determine locations of taking specimens, as well as locations of measurements, all in accordance with a random statistical pattern.

During placing PWC, the laboratory shall take test specimens and check the conformity of the properties to such a frequency as specified in Table 3.88.

Table 3.88: Minimum frequency of internal control testing of placing paved wearing courses (PWC)

Properties	Test method	Minimum testing frequency
- pavers and slabs:		
- dimensions	-	400 m^2
- compressive strength of cement concrete	EN 12390-3	800 m^2
- mineral aggregate mixture:		
- composition	EN 933-1	800 m^2
- characteristics	EN 12620	2,000 m^2
- fresh cement mortar:		
- granulometric composition	EN 933-1	800 m^2
- cement content	-	800 m^2
- hardened cement mortar:		
- compressive strength	EN 12390-3	800 m^2
- tensile strength at bending	EN 12390-5	2,000 m^2
- resistance to freezing/thawing	EN 12390-8	200 m^2
- bituminous joint sealing compound	-	800 m^2
- evenness, level, and slope of formation	-	200 m^2

The engineer shall specify the extent and types of testing lime mortar for PWC unless this is defined in the design.

By agreement with the engineer the quality of placed PWC can also be assessed by other approved methods. In such a case the criteria for quality of placing as well as the method and extent of testing shall also be specified.

2.2.3.4.6.2 External Control

The extent of the external control tests to be carried out by a third party institution employed by the client is usually in a ratio of 1:5 with the internal control testing.

Locations of taking samples and measuring places for both internal and external control of the quality of PWC shall be specified by the engineer by the statistical random selection method.

An independent institution shall prepare a written report on the regular surveillance of the internal control, including an evaluation of results of control testing. Such a report shall be submitted to both contractor and engineer.

2.2.3.4.7 Measurement and Take-Over of Works

2.2.3.4.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions, and calculated in square metres.

All the quantities shall be measured by the actually executed extent and type of works within the scope of the design. An adequate report on the measured quantities shall be worked out in due time.

2.2.3.4.7.2 Take-Over of Works

The executed PWC shall be taken-over by the engineer in compliance with the quality requirements indicated in these technical conditions, and with section 2.1.7.2 of the general technical conditions. Prior to continuing the work, the contractor shall mend all the deficiencies established, otherwise deductions will be charged to him for an inappropriate quality of the work carried out.

2.2.3.4.8 Final Account of Works

2.2.3.4.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in compliance with section 2.2.3.4.7.1 and taken-over according to section 2.2.3.1.4.7.2 of these technical conditions shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment unless provided otherwise by the contract.

If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.4.8.2 Deductions Due to Unsuitable Quality

2.2.3.4.8.2.1 Quality of Materials

Due to unambiguously defined quality of materials for PWC there are no deductions when accounting the quantities.

If the contractor places into PWC such material, which does not comply with the requirement indicated in 2.2.3.4.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.4.8.2.2 Quality of Execution

Due to unambiguously defined quality of execution of PWC there are no deductions when accounting the quantities.

If the contractor fails to ensure the required quality of PWC, the engineer shall make a decision on the final account method.

2.2.3.5 CARRIAGEWAY EDGE ELEMENTS

General

Carriageway edge elements are longitudinal elements to stabilize and confine the outer edge of the traffic lanes.

They shall be constructed in dimensions as provided by the design, and in compliance with these technical conditions.

2.2.3.5.1 Description

Carriageway edge elements are extrawidths, kerbs, borders, and concrete safety barrier elements. They are intended for protection of pavement edges and increasing of the traffic safety on all types of roads.

The construction of carriageway edge elements (CEE) comprises the following activities:

- the supply of suitable prefabricated elements and their placing, or
- the supply of all the necessary basic materials, their processing, and placing into CEE,

both in places as specified by the design.

The CEE construction also includes all the necessary works associated with the preparation of foundation for the CEE, execution of joints, and the required protection of the surface after completion of works, as well as all the works related to reinforcing these elements.

This works shall be carried out in a dry and still weather, and when the substrate temperature amounts to 5°C to 25°C. If the temperature is out of these limits, special arrangements shall be taken during the works.

The type of the CEE shall generally be specified by the design. If this is not the case, the engineer shall make a final decision.

2.2.3.5.2 Basic Materials

The basic materials to be used for the production of cement concrete mixes for CEE are indicated in section 2.2.3.3.2 of these technical conditions.

Basic materials to be used for production of a bituminous concrete mixes for kerbs are indicated in section 2.2.3.2.2.2.

Stone kerbs and pavers for borders can be made of silicate or carbonate stones.

2.2.3.5.3 Quality of Materials

Prior to commencement of placing the contractor shall submit to the engineer the required conformity certificates for all the products he intends to use for the EEC construction.

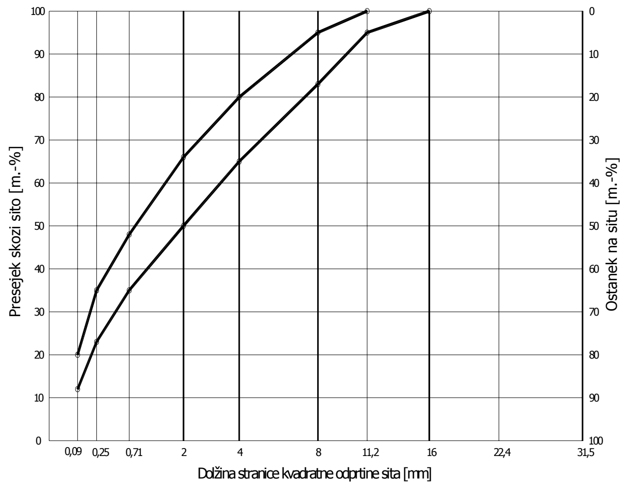
The quality of materials for cement concrete mixes, and of all other materials to be used for the EEC construction is specified in detail in section 2.2.3.3.3.

The quality of materials for asphalt mixes is defined in detail in section 2.2.3.2.2.3. The range of the defined granulometric composition of mineral aggregate grains for bituminous concrete mixes for kerbs is indicated:

In Fig. 3.42 for bitumionus concrete for kerbs BC 11k

In Fig. 3.43 for bituminous concrete for kerbs BC 16k

Fig 3.42: Limiting curves for mineral aggregate mixtures for bituminous concrete mix for kerbs BC 11k



presejek skozi sito = passing through sieve; ostanek na situ = remaining on sieve; dolžina stranice kvadratne odprtine sita = length of side of sieve square opening;

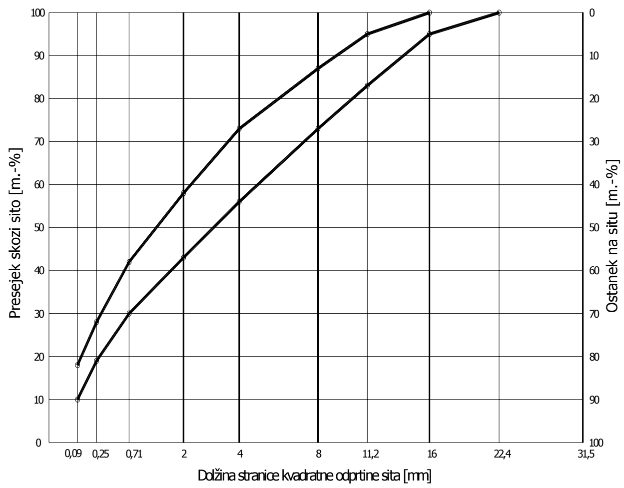


Fig. 3.43: Limiting curves for mineral aggregate mixtures for bituminous concrete mix for kerbs BC 16k

During production the granulometric composition of mineral aggregate mixtures may deviate from the limiting curve ranges by up to 3% by mass.

The mineral aggregate mixture shall contain crushed grains only. Exceptionally, natural sand of 0/2 mm is admitted, however in the ratio of no more than 1 to 1 to the crushed sand only.

Bitumen B 50/70 shall be used for the preparation of mixtures of bituminous concrete for kerbs.

Stone kerbs and pavers for borders shall be made durable, uniform, as well as frost and salt resistant stone. Exposed surfaces shall be specially finished.

Allowed deviations of dimensions of stone kerbs from the design values amount to:

- for width ± 3 mm,
- for level ± 10 mm.

The allowed deviation of dimensions of stone pavers from the specified size amounts to ± 10 %.

Precast kerbs, pavers, and concrete safety barriers shall meet the requirements indicated in section 2.2.3.3.5.2 (Table 3.81).

The admitted conical shape of kerbs in the longitudinal direction may amount to 5 mm, and in the transverse direction to 2 mm. Deviation of evenness in the longitudinal direction shall not exceed 5 mm at a length of 1,000 mm.

The required properties of cement concrete pavers are defined in section 2.2.3.4.3.2 (Table 3.83).

For construction of safety barriers by means of a sliding formwork, only mixture of crushed grains may be used. Precast concrete safety barrier elements my deviate from the design dimensions by up to ± 10 mm.

2.2.3.5.4 Method of Execution

2.2.3.5.4.1 Winning Materials

The requirements indicated in 2.2.3.3.4.1 and 2.2.3.4.4.1 shall apply as appropriate to winning materials for CEE.

2.2.3.5.4.2 Preparation of Base

The base for edge strips (extrawidths) made of cement concrete can be:

- the formation of an unbound roadbase prepared in accordance with 2.2.3.1.1.5., and
- the formation of a bound roadbase prepared in accordance with 2.2.3.1.2.5.3.

As a base for foundations of stone kerbs and cement concrete kerbs as well as of borders can generally be the formation of an unbound roadbase, exceptionally also the subgrade formation prepared in compliance with 2.2.2.4.5. For kerbs made of bituminous concrete and for safety fences the following may be used as a base:

the formation of a bound bearing and wearing course of asphalt mixture prepared in accordance with 2.2.3.1.3.5.6, and

the formation of a bound wearing and sealing course of bituminous concrete prepared in accordance with 2.2.3.2.2.5.6.

The contractor may start to execute the CEE after the engineer has taken-over the formation of the base in compliance with the indicated requirements. All the time up to the beginning of placing CEE the contractor is obliged to maintain the formation of the base in a condition as it has been at the time of taking-over. All damage shall be suitably made good in due time and corresponding evidence of repairing works shall be submitted to the engineer.

2.2.3.5.4.3 Depositing of Mineral Aggregate Mixtures, Binders, and Precast Elements

To depositing mineral aggregate mixtures, binders, and precast elements foreseen for placing in CEE, the requirements indicated in 2.2.3.2.2.4.2 and 2.2.3.3.4.2 shall apply as appropriate.

2.2.3.5.4.4 Production of Cement Concrete, Cement Mortar, and Bituminous Mix

2.2.3.5.4.4.1 Production of Cement Concrete Mixes

To the production of all types of cement concrete for CEE, the requirements indicated in 2.2.3.3.4.4 shall apply as appropriate.

2.2.3.5.4.4.2 Production of Cement Mortar

To the production of cement mortar used for filling-up the joints occurring at kerbs, borders, and safety barriers, the requirements indicated in 2.2.3.4.4.4 shall apply.

2.2.3.5.4.4.3 Production of Bituminous Mix

To the production of bituminous mix for kerbs, the requirements indicated in 2.2.3.2.2.4.4 shall apply.

2.2.3.5.4.5 Bringing Mixes

The following shall be considered when bringing mixtures and mixes:

- requirements indicated in 2.2.3.3.4.5 for cement concrete mixes
- requirements indicated in 2.2.3.4.4.5 for cement mortars, and
- requirements indicated in 2.2.3.2.2.4.5 for bituminous mixes.

2.2.3.5.4.6 Placing

2.2.3.5.4.6.1 Placing Cement Concrete Mixes

Placing cement concrete mixes for execution of CEE as well as for foundation for precast elements for CEE is specified in detail in section 2.2.3.3.4.6.

2.2.3.5.4.6.2 Placing Bituminous Mixes for Kerbs

When placing kerbs made of bituminous concrete, the following requirements shall be considered in addition to those indicated in section 2.2.2.4.6:

For placing kerbs made of bituminous mix, suitable machines ensuring the design shape of the kerbs shall be introduced.

The substrate temperature and the air temperature shall amount to at least 10°C. The substrate shall be preliminarily adequately sprayed.

The maximum temperature deviation of the bituminous mix upon placing from the optimum temperature determined by the demonstrative production and placing may amount to ± 10 °C.

The external edge of the kerb made of bituminous concrete shall be shifted from the outer edge of the underlay of the bituminous mix by at least 5 cm.

A kerb shall not be burdened until the bituminous mix has cooled to the temperature of the surroundings.

2.2.3.5.4.6.3 Placing Kerbs and Borders

Stone and prefabricated kerbs and borders shall generally be placed onto a suitably shaped underlay of C 15/18 cement concrete in compliance with the design.

The underlay thickness shall amount to at least

- 15 cm below kerbs, and
- 10 cm below borders.

Joints between successive kerbs or pavers for a border shall be 10 – 15 mm wide. These joints shall be on the front and pper side filled up with cement mortar to a depth of at least 30 mm, whereas on the remaining part adequate sand may be placed into the joint. The surface of the cement mortar in the joint shall be appropriately formed.

In exceptional cases kerbs and borders may also be placed onto an unbound base course. The engineer shall make a final decision.

2.2.3.5.4.7 Protection of Cement Concrete

The required protection of the cement concrete upon preparation of precast elements and execution of CEE is described in 2.2.3.3.4.7.

3.2.3.1.1.4Placing

All the necessary works related to the CEE joints are indicated as appropriate in 2.2.3.3.4.8.

2.2.3.5.5 Quality of Execution

At least 7 days in advance prior to starting producing and placing CEE, the contractor shall submit to the engineer for approval a method statement, which shall include particularly the following:

- Evidence of conformity of all the materials to be used,
- Programme of average frequency of both internal and external control,
- Description of work methods, and
- Information on the mechanization to be introduced.

2.2.3.5.5.1 Cement Concrete

Conditions to be considered to achieve a proper quality of the cement concrete for CEE are indicated in detail in section 2.2.3.3.5. In addition to these requirements it shall also be considered that the protective concrete cover to the steel reinforcement in safety barriers shall not be less than 4 cm.

Where the cement concrete quality requirements for individual CEE are not specified by the design, the engineer shall specify them in the sense of the requirements for similar works in these technical conditions.

2.2.3.5.5.2 Bitumininous Mix

Basic conditions for the quality of the execution of bituminous concrete kerbs are indicated in section 2.2.3.2.2.5. However, some special properties of the bituminous mix for kerbs shall be additionally considered. They are indicated in Table 3.89.

Table 3.89: Required properties of bituminous mix for bituminous concrete for kerbs

Properties	Unit measure	Required value	Test method
Test specimen by Marshall:			
- stability at 60°C, at least	kN	$S_{min7,5}$	EN 12697-34
- flow at 60 °C, at least	mm	Q_{min4}	EN 12697-34
- total void content	% by vol.	V_{min1} to $V_{max2,5}$	EN 12697-8
- filling of voids in mineral grains with bitumen	%	VFB_{86} to VFB_{93}	EN 12697-8
Core or cut-out:			
- total void content, maximum	% by vol.	V_{max6}	EN 12697-8
- compaction, at least	%	96	

2.2.3.5.5.3 Cement Mortar

Condition to be fulfilled to achieve proper quality of cement mortar indicated in 2.2.3.4.5.2 shall apply as appropriate to the cement mortar used for filling joints of kerbs, borders, and safety barriers.

2.2.3.5.6 Quality of Execution

2.2.3.5.6.1 Internal Control

The extent of the internal control upon placing CEE shall be specified by the engineer on the basis of results of preliminary technological testing.

The minimum internal control to be carried out at the contractor's laboratory shall include the following:

- For extrawidths all the feasible tests indicated in 2.2.3.3.6.1,
- For stone and precast kerbs and pavers for borders all the feasible tests indicated in 2.2.3.4.6.1 per 100 m^1,
- For kerbs placed by means of a sliding formwork all the tests indicated in 2.2.3.3.6.1 per 100 m^1,
- For kerbs made of bituminous concrete all the feasible tests indicated in 2.2.3.2.2.6.1,
- For safety barriers all the feasible tests indicated in section 2.2.3.3.6.1 per 100 m^1.

By agreement with the engineer, the quality of placed CEE can also be assessed by other approved methods. In such a case, the acceptance criteria as well as the mode and extent of testing shall also be agreed.

3.2.3.1.1.5External Control

The extent of the external control tests to be carried out by a third party institution employed by the client is usually in a ratio of 1:5 with the internal control testing.

Locations of taking samples and measuring places for both internal and external control of the quality of CEE shall be specified by the engineer by the statistical random selection method.

An independent institution shall prepare a written report on the regular surveillance of the internal control, including an evaluation of results of control testing. Such a report shall be submitted to both contractor and engineer.

2.2.3.5.7 Measurement and Take-Over of Works

2.2.3.5.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions, and calculated in adequate units.

All the quantities shall be measured by the actually executed extent and type of works within the scope of the design. An adequate report on the measured quantities shall be worked out in due time.

2.2.3.5.7.2 Take-Over of Works

The executed CEE shall be taken-over by the engineer in compliance with the quality requirements indicated in these technical conditions, and with section 2.1.7.2 of the general technical conditions. Prior to continuing the work, the contractor shall mend all the deficiencies established, otherwise deductions will be charged to him for an inappropriate quality of the work carried out.

2.2.3.5.8 Final Account of Works

2.2.3.5.8.1 General

The executed works shall be accounted in accordance with section 2.1.7.3 of the general technical conditions.

Quantities determined in compliance with section 2.2.3.5.7.1 and taken-over according to section 2.2.3.1.5.7.2 of these technical conditions shall be accounted by the contract unit price.

All services necessary for a complete finalization of the works shall be included in the contract price. The contractor shall have no right to claim any extra payment unless provided otherwise by the contract.

If the contractor has not achieved the contractual quality, and, consequently, he has been charged for deductions, all the contractual obligations remain valid and unchanged.

2.2.3.5.8.2 Deductions Due to Unsuitable Quality

2.2.3.5.8.2.1 Quality of Materials

Due to unambiguously defined quality of materials for CEE there are no deductions when accounting the quantities.

If the contractor places into CEE such material, which does not comply with the requirement indicated in 2.2.3.5.3 of these technical conditions, the engineer shall decide on the method of accounting. The engineer has also the right to reject the complete executed work.

2.2.3.5.8.2.2 Quality of Execution

For the assessment of the quality of execution and for the calculation of deductions due to unsuitable quality the following necessary bases are indicated:

- For extrawidths, kerbs, and safety barriers in Table 3.81 and in section 2.2.3.3.8.2.2,
- For stone and precast kerbs and pavers in Table 3.84 and in section 2.2.3.5.3,
- For kerbs made of bituminous concrete in Table 3.89 of these technical conditions.

If the contractor fails to ensure the required quality of CEE as directed by section 2.2.3.5.5, the engineer shall make a decision on the final account method.

2.2.3.6 SHOULDERS

General

Shoulders are longitudinal zones at outer carriageway edges. They are not intended for the traffic, but only ensure that the carriageway serves its purpose as a whole.

Shoulders shall be constructed in dimensions as provided by the design, and in compliance with these technical conditions.

2.2.3.6.1 Description

Construction of shoulders comprises supply and placing all the suitable material for shoulder structure at locations as specified by the design.

The structure of a shoulder is composed of one or more layers of material foreseen by the design.

This work shall be carried out when the air temperature is above 2°C, and in the absence of precipitations.

2.2.3.6.2 Basic Materials

Basic materials for shoulder construction are particularly mineral aggregate mixtures. For upper layers, topsoil, turf pavers (made of cement concrete), and asphalt mixtures of mineral grains are also used.

2.2.3.6.3 Quality of Material

The required quality of mineral aggregate mixtures for shoulders is specified in section 2.2.3.1.1.3 of these technical conditions.

Topsoil material shall be active to ensure a permanent growth.

The quality of turf pavers is indicated in section 2.2.3.4.3.2.

The quality of the asphalt mixture shall meet the same requirements as they apply to the asphalt courses of the adjacent traffic lane (sections 2.2.3.2.3.5 or 2.2.3.1.3.5).

2.2.3.6.4 Method of Execution

For the shoulder construction the conditions indicated in 2.2.3.1.1.4 and 2.2.3.4.4 of these technical conditions shall apply as appropriate.

A base for the shoulder construction can be:

- Subgrade (substructure) formation prepared according to section 2.2.2.4.5, or
- Formation of an unbound roadbase prepared according to section 2.2.3.1.1.5.

Materials placed into a shoulder structures shall be so interconnected and compacted as to minimize the erosion as much as possible.

The thickness of the stone material layer in the shoulder structure shall amount to at least 30 cm.

Shoulders with topsoil shall have a base course of mineral aggregate mixture at least 20 cm thick, whilst the thickness of the topsoil upper layer shall not exceed 10 cm.

A shoulder structure with turf pavers shall be executed of at least 20 cm thick base course of adequate mineral aggregate mixture, and at least a 5 cm thick underlay of sand grain mixture. The type of turf pavers shall be approved by the engineer.

Shoulders stabilized with crushed stone filled up with topsoil shall be made of a basic layer of mineral aggregate mixture measuring at least 20 cm in thickness, and of an at least 10 cm thick layer of well graded crushed stone of coarse-grained composition, which is filled up with an average 5 cm thick layer of topsoil, that has to be rinsed-in into the crushed stone layer and sown with grass.

A shoulder with an asphalt wearing course shall be constructed up to no more than 10 cm away from the steel safety barrier. The thickness of the shoulder structures shall be the same as the thickness of the adjoining traffic lane. However, an unbound roadbase is placed instead of a bound one.

On a fill, the shoulder shall extend by at least 50 cm behind the steel safety barrier post.

2.2.3.6.5 Quality of Execution

The quality of execution of shoulder structures made of mineral aggregate mixtures shall comply with the section 2.2.3.1.1.5 of these technical conditions.

The quality of execution of shoulder structures with turf pavers shall comply with sections 2.2.3.4.4.6.2 and 2.2.3.4.5.5 of these technical conditions.

Other types of shoulder structures shall, in view of their quality, comply as appropriate with the requirements indicated in these technical conditions.

The formation of a shoulder shall be carried out with a slope going outwards by at least 4%, and at least 1 cm below the level of the edge of the nearby carriageway. However, this condition does not apply to shoulder with an asphalt wearing course.

2.2.3.6.6 Quality Control of Execution

The conditions, which apply to the extent of the testing of quality of shoulder construction, are defined as appropriate in sections 2.2.3.1.1.6 and 2.2.3.4.6 of these technical conditions.

The conditions, which apply to the extent of the testing of quality of shoulders executed with an asphalt wearing course, are defined as appropriate in sections 2.2.3.2.2.6 and 2.2.3.1.3.6 of these technical conditions.

2.2.3.6.7 Measurement and Take-Over of Works

The method of measuring and taking-over the executed shoulders shall be taken as appropriate from sections 2.2.3.1.1.7 and 2.2.3.4.7 of these technical conditions.

3.2.3.1.2 Accounting of Works

Conditions indicated in sections 2.2.3.1.1.8 and 2.2.3.4.8 apply as appropriate to accounting of the shoulder construction works.

2.2.3.7 PAVEMENT STRUCTURES – BILL OF WORKS

2.2.3.7.1 Roadbases

2.2.3.7.1.1 Unbound Roadbases

Item	Unit Measure	Description of Work
31 111	m^3	Execution of unbound roadbase of natural gravel in a thickness of up to 20 cm
31 112	m^3	Execution of unbound roadbase of natural gravel in a thickness of 21 - 30 cm
31 113	m^3	Execution of unbound roadbase of natural gravel in a thickness of 31 – 40 cm
31 114	m^3	Execution of unbound roadbase of natural gravel in a thickness of 41 to 50 cm
31 121	m^3	Execution of unbound roadbase of gravel in a thickness of up to 20 cm
31 122	m^3	Execution of unbound roadbase of gravel in a thickness of 21 - 30 cm
31 123	m^3	Execution of unbound roadbase of gravel in a thickness of 31 – 40 cm
31 124	m^3	Execution of unbound roadbase of gravel in a thickness of 41 to 50 cm
31 131	m^3	Execution of unbound roadbase of uniformly graded crushed stone in a thickness of up to 20 cm
31 132	m^3	Execution of unbound roadbase of uniformly graded crushed stone in a thickness of 21 - 30 cm
31 133	m^3	Execution of unbound roadbase of uniformly graded crushed stone in a thickness of 31 – 40 cm
31 134	m^3	Execution of unbound roadbase of unifomly graded cruhsed stone in a thickness above 40 cm
31 141	m^3	Execution of unbound roadbase of gap-grained crushed stone in a thickness of up to 20 cm
31 142	m^3	Execution of unbound roadbase of gap-grained crushed stone in a thickness of 21 - 30 cm
31 143	m^3	Execution of unbound roadbase of gap-grained crushed stone in a thickness of 31 – 40 cm
31 144	m^3	Execution of unbound roadbase of gap-grained cruhsed stone in a thickness above 40 cm
31 151	m^3	Execution of unbound roadbase of uniformly graded crushed stone made of slag in a thickness of up to 20 cm
31 152	m^3	Execution of unbound roadbase of uniformly graded crushed stone made of slag in a thickness of 21 - 30 cm
31 153	m^3	Execution of unbound roadbase of uniformly graded crushed stone made of slag in a thickness of 31 – 40 cm
31 154	m^3	Execution of unbound roadbase of unifomly graded cruhsed stone made of slag in a thickness above 40 cm
31 161	m^3	Execution of unbound roadbase of gap-grained crushed stone made of slag in a thickness of up to 20 cm
31 162	m^3	Execution of unbound roadbase of gap-grained crushed stone made of slag in a thickness of 21 - 30 cm
31 163	m^3	Execution of unbound roadbase of gap-grained crushed stone made of slag in a thickness of 31 – 40 cm
31 164	m^3	Execution of unbound roadbase of gap-grained cruhsed stone made of

Item	Unit Measure	Description of Work
		slag in a thickness above 40 cm
31 171	m^3	Execution of unbound roadbase of gap-grained crushed stone made of secondary material in a thickness of up to 20 cm
31 172	m^3	Execution of unbound roadbase of gap-grained crushed stone made of secondary material in a thickness of 21 - 30 cm
31 173	m^3	Execution of unbound roadbase of gap-grained crushed stone made of secondary material in a thickness of 31 – 40 cm
31 174	m^3	Execution of unbound roadbase of gap-grained cruhsed stone made of secondary material in a thickness above 40 cm

2.2.3.7.1.2 Bound Subbases (with Hydraulic and Bituminous Binders)

Item	Unit Measure	Description of Work
31 211	m^2	Execution of cement bound (stabilized) sub-base of natural gravel in a thickness of 15 cm
31 212	m^2	Execution of cement bound (stabilized) sub-base of natural gravel in a thickness of 18 cm
31 213	m^2	Execution of cement bound (stabilized) sub-base of natural gravel in a thickness of 20 cm
31 214	m^3	Execution of cement bound (stabilized) sub-base of natural gravel in a thickness above 20 cm
31 216	m^2	Execution of cement bound (stabilized) sub-base of naturally crushed stone material in a thickness of 15 cm
31 217	m^2	Execution of cement bound (stabilized) sub-base of naturally crushed stone material in a thickness of 18 cm
31 218	m^2	Execution of cement bound (stabilized) sub-base of naturally crushed stone material in a thickness of 20 cm
31 219	m^3	Execution of cement bound (stabilized) sub-base of naturally crushed stone material in a thickness above 20 cm
31 221	m^2	Execution of cement bound (stabilized) sub-base of gravel in a thickness of 15 cm
31 222	m^2	Execution of cement bound (stabilized) sub-base of gravel in a thickness of 18 cm
31 223	m^2	Execution of cement bound (stabilized) sub-base of gravel in a thickness of 20 cm
31 224	m^3	Execution of cement bound (stabilized) sub-base of gravel in a thickness above 20 cm
31 226	m^2	Execution of cement bound (stabilized) sub-base of crushed stone in a thickness of 15 cm
31 227	m^2	Execution of cement bound (stabilized) sub-base of crushed stonel in a thickness of 18 cm
31 228	m^2	Execution of cement bound (stabilized) sub-base of crushed-stone in a thickness of 20 cm
31 229	m^3	Execution of cement bound (stabilized) sub-base of crushed stone in a thickness above 20 cm
31 231	m^2	Execution of cement bound (stabilized) sub-base of recycled material in a thickness of 15 cm

Item	Unit Measure	Description of Work
31 232	m^2	Execution of cement bound (stabilized) sub-base of recycled material in a thickness of 18 cm
31 233	m^2	Execution of cement bound (stabilized) sub-base of recycled material in a thickness of 20 cm
31 234	m^3	Execution of cement bound (stabilized) sub-base of recycled material in a thickness above 20 cm
31 236	m^2	Execution of cement bound (stabilized) sub-base of mixed stone material in a thickness of 15 cm
31 237	m^2	Execution of cement bound (stabilized) sub-base of mixed stone material in a thickness of 18 cm
31 238	m^2	Execution of cement bound (stabilized) sub-base of mixed stone material in a thickness of 20 cm
31 239	m^3	Execution of cement bound (stabilized) sub-base of mixed stone material in a thickness above 20 cm
31 241	m^2	Execution of subbase bound (stabilized) with composite binder, of natural gravel or naturally crushed stone in a thickness of 15 cm
31 242	m^2	Execution of subbase bound (stabilized) with composite binder, of natural gravel or naturally crushed stone in a thickness of 18 cm
31 243	m^2	Execution of subbase bound (stabilized) with composite binder, of natural gravel or naturally crushed stone in a thickness of 20 cm
31 244	m^3	Execution of subbase bound (stabilized) with composite binder, of natural gravel or naturally crushed stone material in a thickness above 20 cm
31 246	m^2	Execution of subbase bound (stabilized) with composite binder, of gravel or crushed stone in a thickness of 15 cm
31 247	m^2	Execution of subbase bound (stabilized) with composite binder, of gravel or crushed stone in a thickness of 18 cm
31 248	m^2	Execution of subbase bound (stabilized) with composite binder, of gravel or crushed stone in a thickness of 20 cm
31 249	m^3	Execution of subbase bound (stabilized) with composite binder, of gravel or crushed stone in a thickness above 20 cm
31 251	m^2	Execution of bitumen bound sub-base of gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 8 cm
31 252	m^2	Execution of bitumen bound sub-base of gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 10 cm
31 253	m^2	Execution of bitumen bound sub-base of gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 12 cm
31 254	m^2	Execution of bitumen bound sub-base of gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 14 cm
31 261	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 8 cm
31 262	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 10 cm
31 263	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 12 cm
31 264	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 14 cm
31 265	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric

Item	Unit Measure	Description of Work
		composition 0/16 or 0/22 mm in a thickness of 16 cm
31 271	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 10 cm
31 272	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 12 cm
31 273	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 14 cm
31 274	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 16 cm
31 275	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 18 cm
31 281	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/32 mm in a thickness of 10 cm
31 282	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 12 cm
31 283	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 14 cm
31 284	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 16 cm
31 285	m^2	Execution of bitumen bound sub-base of crushed gravel of granulometric composition 0/16 or 0/22 mm in a thickness of 18 cm
31 291	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/32 mm in a thickness of 10 cm
31 292	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 12 cm
31 293	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 14 cm
31 294	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 16 cm
31 295	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 18 cm
31 296	m^2	Execution of bitumen bound sub-base of crushed stone of granulometric composition 0/16 or 0/22 mm in a thickness of 20

2.2.3.7.1.3 Bound Asphalt Base-Bearing and Base-Wearing Courses

Item	Unit measure	Description of Work
31 311	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 4 cm
31 312	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 5 cm
31 313	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 6 cm
31 314	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 7 cm
31 315	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 8 cm
31 316	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 9 cm

Item	Unit measure	Description of Work
31 317	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 10 cm
31 321	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/32 mm in a thickness of 7 cm
31 322	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/32 mm in a thickness of 8 cm
31 323	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/32 mm in a thickness of 9 cm
31 324	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/32 mm in a thickness of 10 cm
31 325	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/32 mm in a thickness of 11 cm
31 326	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/32 mm in a thickness of 12 cm
31 327	m^2	Execution of base-bearing course of asphalt mixture of bituminous gravel of granulometric composition of 0/32 mm in a thickness of 14 cm
31 331	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 or 0/16S mm in a thickness of 4 cm
31 332	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 or 0/16S mm in a thickness of 5 cm
31 333	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 or 0/16S mm in a thickness of 6 cm
31 334	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 or 0/16S mm in a thickness of 7 cm
31 336	t	Levelling of asphalt substrate with bituminous well graded crushed stone of granulometric composition of 0/16 mm
31 341	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 5 cm
31 342	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 6 cm
31 343	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 7 cm
31 344	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 8 cm
31 345	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 9 cm
31 346	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 10 cm
31 347	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a

Item	Unit measure	Description of Work
		thickness of 11 cm
31 348	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 12 cm
31 349	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22 or 0/32 mm in a thickness of 14cm
31 351	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 5 cm
31 352	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 6 cm
31 353	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 7 cm
31 354	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 8 cm
31 355	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 9 cm
31 356	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 10 cm
31 357	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 11 cm
31 358	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 12 cm
31 359	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with road bitumen in a thickness of 14 cm
31 361	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 5 cm
31 362	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 6 cm
31 363	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 7 cm
31 364	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 8 cm
31 365	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 9 cm
31 366	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 10 cm
31 367	m^2	Execution of base-bearing course of asphalt mixture of bituminous well

Item	Unit measure	Description of Work
		graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 11 cm
31 368	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 12 cm
31 369	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with composite bitumen binder in a thickness of 14 cm
31 371	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 5 cm
31 372	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 6 cm
31 373	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 7 cm
31 374	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 8 cm
31 375	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 9 cm
31 376	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 10 cm
31 377	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 11 cm
31 378	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 12 cm
31 379	m^2	Execution of base-bearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/22S or 0/32S mm with polymer bitumen binder in a thickness 14 cm
31 381	m^2	Execution of base-bearing course of asphalt mixture of bituminous crushed gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 4 cm
31 382	m^2	Execution of base-bearing course of asphalt mixture of bituminous crushed gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 5 cm
31 383	m^2	Execution of base-bearing course of asphalt mixture of bituminous crushed gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 6 cm
31 384	m^2	Execution of base-bearing course of asphalt mixture of bituminous crushed gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 7 cm
31 385	m^2	Execution of base-bearing course of asphalt mixture of bituminous crushed gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 8 cm
31 386	m^2	Execution of base-bearing course of asphalt mixture of bituminous crushed gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 9 cm

Item	Unit measure	Description of Work
31 387	m^2	Execution of base-bearing course of asphalt mixture of bituminous crushed gravel of granulometric composition of 0/16 or 0/22 mm in a thickness of 10 cm
31 391	m^2	Execution of base-wearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 mm in a thickness of 4 cm
31 392	m^2	Execution of base-wearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 mm in a thickness of 5 cm
31 393	m^2	Execution of base-wearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 mm in a thickness of 6 cm
31 394	m^2	Execution of base-wearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 mm in a thickness of 7 cm
31 395	m^2	Execution of base-wearing course of asphalt mixture of bituminous well graded crushed stone of granulometric composition of 0/16 mm in a thickness of 8 cm
31 397	t	Supply of polymer bituminous binder, adding of binder to asphalt mixture
31 398	t	Supply of natural bituminous binder (Selenica, Trinidad, Uintate), adding of binder to asphalt mixture

2.2.3.7.2 Wearing Courses

2.2.3.7.2.1 3.2.1 Unbound Wearing Courses

Item	Unit measure	Description of Work
32 111	m^2	Execution of unbound (mechanically stabilized) wearing course of crushed stone grain mixture in a thickness of up to 15 cm
32 112	m^2	Execution of unbound (mechanically stabilized) wearing course of crushed stone grain mixture in a thickness of 16 - 20 cm
32 113	m^2	Execution of unbound (mechanically stabilized) wearing course of crushed stone grain mixture in a thickness of 21 – 25 cm
32 114	m^2	Execution of unbound (mechanically stabilized) wearing course of crushed stone grain mixture in a thickness of 26 - 30 cm
32 115	m^2	Execution of unbound (mechanically stabilized) wearing course of crushed stone grain mixture in a thickness above 30 cm
32 121	m^2	Execution of unbound (mechanically stabilized) wearing course of natural crushed stone grain mixture in a thickness of up to 15 cm
32 122	m^2	Execution of unbound (mechanically stabilized) wearing course of natural crushed stone grain mixture in a thickness of 16 - 20 cm
32 123	m^2	Execution of unbound (mechanically stabilized) wearing course of natural crushed stone grain mixture in a thickness of 21 – 25 cm
32 124	m^2	Execution of unbound (mechanically stabilized) wearing course of natural crushed stone grain mixture in a thickness of 26 - 30 cm
32 125	m^2	Execution of unbound (mechanically stabilized) wearing course of natural crushed stone grain mixture in a thickness above 30 cm
32 131	m^2	Execution of unbound (mechanically stabilized) wearing course of gravel grain mixture in a thickness of up to 15 cm
32 132	m^2	Execution of unbound (mechanically stabilized) wearing course of gravel grain mixture in a thickness of 16 - 20 cm
32 133	m^2	Execution of unbound (mechanically stabilized) wearing course of gravel grain mixture in a thickness of 21 – 25 cm
32 134	m^2	Execution of unbound (mechanically stabilized) wearing course of gravel grain mixture in a thickness of 26 - 30 cm
32 135	m^2	Execution of unbound (mechanically stabilized) wearing course of gravel grain mixture in a thickness above 30 cm
32 141	m^2	Execution of unbound (mechanically stabilized) wearing course of mixed grain mixture in a thickness of up to 15 cm
32 142	m^2	Execution of unbound (mechanically stabilized) wearing course of mixed grain mixture in a thickness of 16 - 20 cm
32 143	m^2	Execution of unbound (mechanically stabilized) wearing course of mixed grain mixture in a thickness of 21 – 25 cm
32 144	m^2	Execution of unbound (mechanically stabilized) wearing course of mixed grain mixture in a thickness of 26 - 30 cm
32 145	m^2	Execution of unbound (mechanically stabilized) wearing course of mixed grain mixture in a thickness above 30 cm
32 151	m^2	Execution of unbound (mechanically stabilized) wearing course of secondary material grain mixture in a thickness of up to 15 cm
32 152	m^2	Execution of unbound (mechanically stabilized) wearing course of secondary material grain mixture in a thickness of 16 - 20 cm
32 153	m^2	Execution of unbound (mechanically stabilized) wearing course of secondary material mixture in a thickness of 21 – 25 cm

Item	Unit measure	Description of Work
32 154	m^2	Execution of unbound (mechanically stabilized) wearing course of secondary material mixture in a thickness of 26 - 30 cm
32 155	m^2	Execution of unbound (mechanically stabilized) wearing course of secondary material mixture in a thickness above 30 cm
32 161	m^2	Placing mixtures of crushed grains for pinning unbound wearing course
32 162	m^2	Placing mixtures of naturally rounded stone grains for pinning unbound wearing course

2.2.3.7.2.2 Bound Asphalt Wearing and Sealing Courses – Bituminous Concrete

Item	Unit measure	Description of Work
32 211	m^2	Execution of wearing and sealing course of bituminous concrete BC 4k of a mixture of carbonate stone grains and road bitumen in a thickness of 20 mm
32 212	m^2	Execution of wearing and sealing course of bituminous concrete BC 4k of a mixture of carbonate stone grains and road bitumen in a thickness of 25 mm
32 213	m^2	Execution of wearing and sealing course of bituminous concrete BC 4k of a mixture of carbonate stone grains and road bitumen in a thickness of 30 mm
32 214	m^2	Execution of wearing and sealing course of bituminous concrete BC 4ks of a mixture of carbonate stone grains, silicate stone crushed stone, and road bitumen in a thickness of 20 mm
32 215	m^2	Execution of wearing and sealing course of bituminous concrete BC 4ks of a mixture of carbonate stone grains, silicate stone crushed stone, and road bitumen in a thickness of 25 mm
32 216	m^2	Execution of wearing and sealing course of bituminous concrete BC 4ks of a mixture of carbonate stone grains, silicate stone crushed stone, and road bitumen in a thickness of 30 mm
32 217	m^2	Execution of wearing and sealing course of bituminous concrete BC 4sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 20 mm
32 218	m^2	Execution of wearing and sealing course of bituminous concrete BC 4sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 25 mm
32 219	m^2	Execution of wearing and sealing course of bituminous concrete BC 4sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 30 mm
32 221	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and road bitumen in a thickness of 20 mm.
32 222	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and road bitumen in a thickness of 25 mm.
32 223	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and road bitumen in a thickness of 30 mm.
32 224	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and road bitumen in a thickness of ...

Item	Unit measure	Description of Work
		mm.
32 226	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and polymer bitumen in a thickness of 20 mm
32 227	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and polymer bitumen in a thickness of 25 mm
32 228	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and polymer bitumen in a thickness of 30 mm
32 229	m^2	Execution of wearing and sealing course of bituminous concrete BC 4s of a mixture of silicate stone grains and polymer bitumen in a thickness of ... mm
32 231	m^2	Execution of wearing and sealing or protective course of bituminous concrete BC 8k of a mixture of carbonate stone grains and road bitumen in a thickness of 25 mm
32 232	m^2	Execution of wearing and sealing or protective course of bituminous concrete BC 8k of a mixture of carbonate stone grains and road bitumen in a thickness of 30 mm
32 233	m^2	Execution of wearing and sealing or protective course of bituminous concrete BC 8k of a mixture of carbonate stone grains and road bitumen in a thickness of 35 mm
32 234	m^2	Execution of wearing and sealing or protective course of bituminous concrete BC 8k of a mixture of carbonate stone grains and road bitumen in a thickness of 40 mm
32 235	m^2	Execution of wearing and sealing or protective course of bituminous concrete BC 8k of a mixture of carbonate stone grains and road bitumen in a thickness of ... mm
32 236	m^2	Execution of wearing and sealing course of bituminous concrete BC 8ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 25 mm
32 237	m^2	Execution of wearing and sealing course of bituminous concrete BC 8ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 30 mm
32 238	m^2	Execution of wearing and sealing course of bituminous concrete BC 8ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 35 mm
32 239	m^2	Execution of wearing and sealing course of bituminous concrete BC 8ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 40 mm
32 241	m^2	Execution of wearing and sealing course of bituminous concrete BC 8sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 25 mm
32 242	m^2	Execution of wearing and sealing course of bituminous concrete BC 8sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 30 mm
32 243	m^2	Execution of wearing and sealing course of bituminous concrete BC 8sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 35 mm
32 244	m^2	Execution of wearing and sealing course of bituminous concrete BC 8sk of

Item	Unit measure	Description of Work
		a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 40 mm
32 245	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture silicate stone grains and road bitumen in a thickness of 25 mm
32 246	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture silicate stone grains and road bitumen in a thickness of 30 mm
32 247	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture silicate stone grains and road bitumen in a thickness of 35 mm
32 248	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture silicate stone grains and road bitumen in a thickness of 40 mm
32 249	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture silicate stone grains and road bitumen in a thickness of 45 mm
32 251	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture of silicate stone grains and polymer bitumen in a thickness of 25 mm.
32 252	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture of silicate stone grains and polymer bitumen in a thickness of 30 mm.
32 253	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture of silicate stone grains and polymer bitumen in a thickness of 35 mm.
32 254	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture of silicate stone grains and polymer bitumen in a thickness of 40 mm.
32 255	m^2	Execution of wearing and sealing course of bituminous concrete BC 8s of a mixture of silicate stone grains and polymer bitumen in a thickness of 45 mm.
32 261	m^2	Execution of wearing and sealing course of bituminous concrete BC 11k of a mixture of carbonate stone grains and road bitumen in a thickness of 30 mm
32 262	m^2	Execution of wearing and sealing course of bituminous concrete BC 11k of a mixture of carbonate stone grains and road bitumen in a thickness of 35 mm
32 263	m^2	Execution of wearing and sealing course of bituminous concrete BC 11k of a mixture of carbonate stone grains and road bitumen in a thickness of 40 mm
32 264	m^2	Execution of wearing and sealing course of bituminous concrete BC 11k of a mixture of carbonate stone grains and road bitumen in a thickness of 45 mm
32 265	m^2	Execution of wearing and sealing course of bituminous concrete BC 11k of a mixture of carbonate stone grains and road bitumen in a thickness of 50 mm
32 266	m^2	Execution of levelling layer of bituminous concrete BC 11k of a mixture of carbonate stone grains and road bitumen
32 271	m^2	Execution of wearing and sealing course of bituminous concrete BC 11ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 30 mm
32 272	m^2	Execution of wearing and sealing course of bituminous concrete BC 11ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 35 mm

Item	Unit measure	Description of Work
32 273	m^2	Execution of wearing and sealing course of bituminous concrete BC 11ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 40 mm
32 274	m^2	Execution of wearing and sealing course of bituminous concrete BC 11ks of a mixture of carbonate stone sand, silicate stone crushed stone, and road bitumen in a thickness of 45 mm
32 275	m^2	Execution of wearing and sealing course of bituminous concrete BC 11sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 30 mm
32 276	m^2	Execution of wearing and sealing course of bituminous concrete BC 11sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 35 mm
32 277	m^2	Execution of wearing and sealing course of bituminous concrete BC 11sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 40 mm
32 278	m^2	Execution of wearing and sealing course of bituminous concrete BC 11sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 45 mm
32 279	m^2	Execution of wearing and sealing course of bituminous concrete BC 11sk of a mixture of silicate stone sand, carbonate stone crushed stone, and road bitumen in a thickness of 50 mm
32 281	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and road bitumen in a thickness of 30 mm
32 282	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and road bitumen in a thickness of 35 mm
32 283	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and road bitumen in a thickness of 40 mm
32 284	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and road bitumen in a thickness of 45 mm
32 285	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and road bitumen in a thickness of 50 mm
32 291	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and polymer bitumen in a thickness of 30 mm
32 292	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and polymer bitumen in a thickness of 35 mm
32 293	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and polymer bitumen in a thickness of 40 mm
32 294	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and polymer bitumen in a thickness of 45 mm
32 295	m^2	Execution of wearing and sealing course of bituminous concrete BC 11s of a mixture of silicate stone grains and polymer bitumen in a thickness of 50 mm

Item	Unit measure	Description of Work
32 297	m^2	Spreading of crushed stone of 2/4 mm granulometric composition onto wearing and sealing course of bituminous concrete

2.2.3.7.2.3 3.2.3 Bound Asphalt Wearing and Sealing Courses – Poured Asphalt

Item	Unit measure	Description of Work
32 311	m^2	Execution of wearing and sealing course of poured asphalt PA 4, thickness 15 mm
32 312	m^2	Execution of wearing and sealing course of poured asphalt PA 4, thickness 20 mm
32 313	m^2	Execution of wearing and sealing course of poured asphalt PA 4, thickness 25 mm
32 314	m^2	Execution of wearing and sealing course of poured asphalt PA 4, thickness 30 mm
32 321	m^2	Execution of wearing and sealing course of poured asphalt PA 8, thickness 20 mm
32 322	m^2	Execution of wearing and sealing course of poured asphalt PA 8, thickness 25 mm
32 323	m^2	Execution of wearing and sealing course of poured asphalt PA 8, thickness 30 mm
32 324	m^2	Execution of wearing and sealing course of poured asphalt PA 8, thickness 35 mm
32 331	m^2	Execution of wearing and sealing course of poured asphalt PA 8s, thickness 20 mm
32 332	m^2	Execution of wearing and sealing course of poured asphalt PA 8s, thickness 25 mm
32 333	m^2	Execution of wearing and sealing course of poured asphalt PA 8s, thickness 30 mm
32 334	m^2	Execution of wearing and sealing course of poured asphalt PA 8s, thickness 35 mm
32 341	m^2	Execution of wearing and sealing course of poured asphalt PA 11, thickness 30 mm
32 342	m^2	Execution of wearing and sealing course of poured asphalt PA 11, thickness 35 mm
32 343	m^2	Execution of wearing and sealing course of poured asphalt PA 11, thickness 40 mm
32 351	m^2	Execution of wearing and sealing course of poured asphalt PA11s, thickness 30 mm
32 352	m^2	Execution of wearing and sealing course of poured asphalt PA11s, thickness 35 mm
32 353	m^2	Execution of wearing and sealing course of poured asphalt PA11s, thickness 40 mm
32 361	m^2	Spreading silicate stone crushed stone grains onto poured asphalt wearing course, rolling of grains into the course
32 362	m^2	Spreading carbonate stone crushed stone grains onto poured asphalt sealing course

2.2.3.7.2.4 Bound Asphalt Wearing and Sealing Courses – Surface Dressing

Item	Unit measure	Description of Work
32 411	m^2	Execution of one-layer surface dressing with a single spreading of crushed stone of granulometric composition of 2/4 mm, and with
	m^2	- road bitumen
32 412	m^2	- polymer bitumen
32 413	m^2	- polymer bitumen emulsion
32 414	m^2	Execution of one-layer surface dressing with a single spreading of crushed stone of granulometric composition of 4/8 mm, and with
	m^2	- road bitumen
32 415	m^2	- polymer bitumen
32 416	m^2	- polymer bitumen emulsion
32 417	m^2	Execution of one-layer surface dressing with a single spreading of crushed stone of granulometric composition of 8/11 mm, and with
	m^2	- road bitumen
32 418	m^2	- polymer bitumen
32 419	m^2	- polymer bitumen emulsion
32 421	m^2	Execution of one-layer surface dressing with a single spreading of coated crushed stone of granulometric composition of 2/4 mm, and with
	m^2	- road bitumen
32 422	m^2	- polymer bitumen
32 423	m^2	- polymer bitumen emulsion
32 424	m^2	Execution of one-layer surface dressing with a single spreading of coated crushed stone of granulometric composition of 4/8 mm, and with
	m^2	- road bitumen
32 425	m^2	- polymer bitumen
32 426	m^2	- polymer bitumen emulsion
32 427	m^2	Execution of one-layer surface dressing with a single spreading of coated crushed stone of granulometric composition of 8/11 mm, and with
	m^2	- road bitumen
32 428	m^2	- polymer bitumen
32 429	m^2	- polymer bitumen emulsion
32 431	m^2	Execution of one-layer surface dressing with a double spreading of crushed stone of granulometric composition 8/11 and 2/4 mm, and with
	m^2	- road bitumen
32 432	m^2	- polymer bitumen
32 433	m^2	- polymer bitumen emulsion
32 435	m^2	Execution of one-layer surface dressing with a double spreading of crushed stone of granulometric composition 11/16 and 4/8 mm, and with
	m^2	- road bitumen
32 436	m^2	- polymer bitumen
32 437	m^2	- polymer bitumen emulsion

Item	Unit measure	Description of Work
32 441	m^2	Execution of one-layer surface dressing with a double spreading of coated crushed stone of granulometric composition 8/11 and 2/4 mm, and with
	m^2	- road bitumen
32 442	m^2	- polymer bitumen
32 443	m^2	- polymer bitumen emulsion
32 445	m^2	Execution of one-layer surface dressing with a double spreading of coated crushed stone of granulometric composition 11/16 and 4/8 mm, and with
	m^2	- road bitumen
32 446	m^2	- polymer bitumen
32 447	m^2	- polymer bitumen emulsion
32 451	m^2	Execution of two-layer or inverse two-layer surface dressing with spreading of crushed stone of granulometric composition of 8/11 and 4/8 mm, and with
	m^2	- road bitumen
32 452	m^2	- polymer bitumen
32 453	m^2	- polymer bitumen emulsion
32 455	m^2	Execution of two-layer or inverse two-layer surface dressing with spreading of crushed stone of granulometric composition of 11/16 and 4/8 mm, and with
	m^2	- road bitumen
32 456	m^2	- polymer bitumen
32 457	m^2	- polymer bitumen emulsion
32 461	m^2	Execution of two-layer or inverse two-layer surface dressing with spreading of coated crushed stone of granulometric composition of 8/11 and 4/8 mm, and with
	m^2	- road bitumen
32 462	m^2	- polymer bitumen
32 463	m^2	- polymer bitumen emulsion
32 465	m^2	Execution of two-layer or inverse two-layer surface dressing with spreading of coated crushed stone of granulometric composition of 11/16 and 4/8 mm, and with
	m^2	- road bitumen
32 466	m^2	- polymer bitumen
32 467	m^2	- polymer bitumen emulsion
32 471	m^2	Execution of sandwich system of surface dressing with spreading crushed stone of granulometric composition of 8/11 and 2/4 mm, and with
	m^2	- road bitumen
32 472	m^2	- polymer bitumen
32 473	m^2	- polymer bitumen emulsion
32 474	m^2	Execution of sandwich system of surface dressing with spreading crushed stone of granulometric composition of 8/11 and 4/8 mm, and with

Item	Unit measure	Description of Work
	m^2	- road bitumen
32 475	m^2	- polymer bitumen
32 476	m^2	- polymer bitumen emulsion
32 477	m^2	Execution of sandwich system of surface dressing with spreading crushed stone of granulometric composition of 11/16 and 4/8 mm, and with
	m^2	- road bitumen
32 478	m^2	- polymer bitumen
32 479	m^2	- polymer bitumen emulsion
32 481	m^2	Execution of surface dressing with bituminous slurry of up to 3 kg/m^2
32 482	m^2	Execution of surface dressing with bituminous slurry 3 - 5 kg/m^2
32 483	m^2	Execution of surface dressing with bituminous slurry of 5 - 8 kg/m^2
32 484	m^2	Execution of surface dressing with bituminous slurry of 8 - 12 kg/m^2
32 486	m^2	Execution of surface dressing with epoxy binder, and spreading with painted quartz sand
32 487	m^2	Execution of surface dressing with a mixture of epoxy resin and quartz sand as a binder, and spreading with painted quartz sand
32 491	m^2	Spraying instable cationic emulsion of up to 0.30 kg/m^2
32 492	m^2	Spraying instable cationic emulsion of 0.31 – 0.50 kg/m^2
32 493	m^2	Spraying instable cationic emulsion above 0.50 kg/m^2
32 494	m^2	Spaying instable anionic bituminous emulsion of up to 0.30 kg/m^2
32 495	m^2	Spaying instable anionic bituminous emulsion above 0.50 kg/m^2
32 496	m^2	Spraying polymer bituminous emulsion of up to 0.30 kg/m^2
32 497	m^2	Spraying polymer bituminous emulsion of 0.31 – 0.50 kg/m^2
32 498	m^2	Spraying polymer bituminous emulsion above 0.50 kg/m^2

2.2.3.7.2.5 3.2.5 Bound Asphalt Wearing Courses – Drainage Asphalt

Item	Unit measure	Description of Work
32 511	m^2	Execution of wearing course of drainage asphalt DA 8s of silicate stone grain mixture and polymer bitumen in a thickness of 30 mm
32 512	m^2	Execution of wearing course of drainage asphalt DA 8s of silicate stone grain mixture and polymer bitumen in a thickness of 35 mm
32 513	m^2	Execution of wearing course of drainage asphalt DA 8s of silicate stone grain mixture and polymer bitumen in a thickness of 40 mm
32 514	m^2	Execution of wearing course of drainage asphalt DA 8s of silicate stone grain mixture and polymer bitumen in a thickness of 45 mm
32 521	m^2	Execution of wearing course of drainage asphalt DA 8k of carbonate stone grain mixture and polymer bitumen in a thickness of 30 mm
32 522	m^2	Execution of wearing course of drainage asphalt DA 8k of carbonate stone grain mixture and polymer bitumen in a thickness of 35 mm
32 523	m^2	Execution of wearing course of drainage asphalt DA 8k of carbonate stone

Item	Unit measure	Description of Work
		grain mixture and polymer bitumen in a thickness of 40 mm
32 524	m^2	Execution of wearing course of drainage asphalt DA 8k of carbonate stone grain mixture and polymer bitumen in a thickness of 45 mm
32 531	m^2	Execution of wearing course of drainage asphalt DA 11s of silicate stone grain mixture and polymer bitumen in a thickness of 35 mm
32 532	m^2	Execution of wearing course of drainage asphalt DA 11s of silicate stone grain mixture and polymer bitumen in a thickness of 40 mm
32 533	m^2	Execution of wearing course of drainage asphalt DA 11s of silicate stone grain mixture and polymer bitumen in a thickness of 45 mm
32 534	m^2	Execution of wearing course of drainage asphalt DA 11s of silicate stone grain mixture and polymer bitumen in a thickness of 50 mm
32 541	m^2	Execution of wearing course of drainage asphalt DA 11k of carbonate stone grain mixture and polymer bitumen in a thickness of 30 mm
32 542	m^2	Execution of wearing course of drainage asphalt DA 11k of carbonate stone grain mixture and polymer bitumen in a thickness of 35 mm
32 543	m^2	Execution of wearing course of drainage asphalt DA 11k of carbonate stone grain mixture and polymer bitumen in a thickness of 40 mm
32 544	m^2	Execution of wearing course of drainage asphalt DA 11k of carbonate stone grain mixture and polymer bitumen in a thickness of 45 mm
32 551	m^2	Execution of wearing course of drainage asphalt DA 16k of carbonate stone grain mixture and polymer bitumen in a thickness of 45 mm
32 552	m^2	Execution of wearing course of drainage asphalt DA 16k of carbonate stone grain mixture and polymer bitumen in a thickness of 50 mm
32 553	m^2	Execution of wearing course of drainage asphalt DA 16k of carbonate stone grain mixture and polymer bitumen in a thickness of 55 mm
32 554	m^2	Execution of wearing course of drainage asphalt DA 16k of carbonate stone grain mixture and polymer bitumen in a thickness of 60 mm
32 561	m^2	Spray application of bituminous emulsion to substrate 0.2 kg/m^2
32 562	m^2	Spray application of bituminous emulsion to substrate 0.4 kg/m^2
32 563	m^2	Spray application of bituminous emulsion to substrate 0.6 kg/m^2
32 564	m^2	Spray application of bituminous emulsion to substrate 0.8 kg/m^2
32 565	m^2	Spray application of bituminous emulsion to substrate 1.0 kg/m^2
32 566	m^2	Spray application of bituminous emulsion to substrate ... kg/m^2
32 571	m^2	Spray application of road bitumen to substrate 0.7 kg/m^2
32 572	m^2	Spray application of road bitumen to substrate 1.0 kg/m^2
32 573	m^2	Spray application of road bitumen to substrate … kg/m^2
32 581	m^2	Spray application of polymer bitumen to substrate 0.7 kg/m^2
32 582	m^2	Spray application of polymer bitumen to substrate 1.0 kg/m^2
32 583	m^2	Spray application of polymer bitumen to substrate … kg/m^2

2.2.3.7.2.6 Bound Wearing and Sealing Courses – Stone Mastic Asphalt

Item	Unit measure	Descripton of Work
32 611	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and road bitumen in thickness 2.0 cm
32 612	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and road bitumen in thickness 2.5 cm

Item	Unit measure	Descripton of Work
32 613	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and road bitumen in thickness 3.0 cm
32 614	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and road bitumen in thickness 3.5 cm
32 615	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and road bitumen in thickness 4.0 cm
32 621	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and polymer bitumen in thickness 2.0 cm
32 622	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and polymer bitumen in thickness 2.5 cm
32 623	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and polymer bitumen in thickness 3.0 cm
32 624	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and polymer bitumen in thickness 3.5 cm
32 625	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8s of silicate stone grains and polymer bitumen in thickness 4.0 cm
32 631	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and road bitumen in thickness 2.5 cm
32 632	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and road bitumen in thickness 3.0 cm
32 633	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and road bitumen in thickness 3.5 cm
32 634	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and road bitumen in thickness 4.0 cm
32 635	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and road bitumen in thickness 4.5 cm
32 636	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and road bitumen in thickness 5.0 cm
32 641	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and polymer bitumen in thickness 2.5 cm
32 642	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and polymer bitumen in thickness 3.0 cm
32 643	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and polymer bitumen in thickness 3.5 cm
32 644	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and polymer bitumen in thickness 4.0 cm
32 645	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and polymer bitumen in thickness 4.5 cm
32 646	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11s of silicate stone grains and polymer bitumen in thickness 5.0 cm
32 651	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and road bitumen in thickness 2.0 cm
32 652	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and road bitumen in thickness 2.5 cm
32 653	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and road bitumen in thickness 3.0 cm
32 654	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and road bitumen in thickness 3.5 cm

Item	Unit measure	Descripton of Work
32 655	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and road bitumen in thickness 4.0 cm
32 661	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and polymer bitumen in thickness 2.0 cm
32 662	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and polymer bitumen in thickness 2.5 cm
32 663	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and polymer bitumen in thickness 3.0 cm
32 664	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and polymer bitumen in thickness 3.5 cm
32 665	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 8k of carbonate stone grains and polymer bitumen in thickness 4.0 cm
32 671	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and road bitumen in thickness 2.5 cm
32 672	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and road bitumen in thickness 3.0 cm
32 673	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and road bitumen in thickness 3.5 cm
32 674	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and road bitumen in thickness 4.0 cm
32 675	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and road bitumen in thickness 4.5 cm
32 681	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and polymer bitumen in thickness 2.5 cm
32 682	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and polymer bitumen in thickness 3.0 cm
32 683	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and polymer bitumen in thickness 3.5 cm
32 684	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and polymer bitumen in thickness 4.0 cm
32 685	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 11k of carbonate stone grains and polymer bitumen in thickness 4.5 cm
32 691	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 4k of carbonate stone grains and road bitumen in thickness 1.5 cm
32 692	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 4k of carbonate stone grains and road bitumen in thickness 2.0 cm
32 693	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 4k of carbonate stone grains and road bitumen in thickness 2.5 cm
32 695	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 4k of carbonate stone grains and polymer bitumen in thickness 1.5 cm
32 696	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 4k of carbonate stone grains and polymer bitumen in thickness 2.0 cm
32 697	m^2	Execution of wearing and sealing course of stone mastic asphalt SMA 4k of carbonate stone grains and polymer bitumen in thickness 2.5 cm
32 699	m^2	Spreading of coated sand grains or very fine crushed stone grains onto the wearing and sealing course of stone mastic asphalt

2.2.3.7.2.7 Bound Asphalt Wearing and Sealing Courses – Thin Overlays

Item	Unit measure	Description of Works
32 711	m^2	Execution of thin overlay TPh 2k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 2 mm
32 712	m^2	Execution of thin overlay TPh 2k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 3 mm
32 713	m^2	Execution of thin overlay TPh 2k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 4 mm
32 721	m^2	Execution of thin overlay TPh 4k, TPh 6k, and TPh 8k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 4 mm
32 722	m^2	Execution of thin overlay TPh 4k, TPh 6k, and TPh 8k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 6 mm
32 723	m^2	Execution of thin overlay TPh 4k, TPh 6k, and TPh 8k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 8 mm
32 724	m^2	Execution of thin overlay TPh 4k, TPh 6k, and TPh 8k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 10 mm
32 725	m^2	Execution of thin overlay TPh 4k, TPh 6k, and TPh 8k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 12 mm
32 726	m^2	Execution of thin overlay TPh 4k, TPh 6k, and TPh 8k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 14 mm
32 727	m^2	Execution of thin overlay TPh 4k, TPh 6k, and TPh 8k by cold method of carbonate mineral grain mixture and polymer bituminous emulsion in a thickness of 16 mm
32 731	m^2	Execution of thin overlay TPh 4s, TPh 6s, and TPh 8s by cold method of silicate mineral grain mixture and polymer bituminous emulsion in a thickness of 4 mm
32 732	m^2	Execution of thin overlay TPh 4s, TPh 6s, and TPh 8s by cold method of silicate mineral grain mixture and polymer bituminous emulsion in a thickness of 6 mm
32 733	m^2	Execution of thin overlay TPh 4s, TPh 6s, and TPh 8s by cold method of silicate mineral grain mixture and polymer bituminous emulsion in a thickness of 8 mm
32 734	m^2	Execution of thin overlay TPh 4s, TPh 6s, and TPh 8s by cold method of silicate mineral grain mixture and polymer bituminous emulsion in a thickness of 10 mm
32 735	m^2	Execution of thin overlay TPh 4s, TPh 6s, and TPh 8s by cold method of silicate mineral grain mixture and polymer bituminous emulsion in a thickness of 12 mm
32 736	m^2	Execution of thin overlay TPh 4s, TPh 6s, and TPh 8s by cold method of silicate mineral grain mixture and polymer bituminous emulsion in a thickness of 14 mm
32 737	m^2	Execution of thin overlay TPh 4s, TPh 6s, and TPh 8s by cold method of silicate mineral grain mixture and polymer bituminous emulsion in a thickness of 16 mm
32 741	m^2	Execution of thin overlay TPv 4k by hot method of carbonate mineral grain

Item	Unit measure	Description of Works
		mixture and road bitumen in a thickness of 10 mm
32 742	m^2	Execution of thin overlay TPv 4k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 12 mm
32 743	m^2	Execution of thin overlay TPv 4k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 16 mm
32 744	m^2	Execution of thin overlay TPv 4k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 20 mm
32 746	m^2	Execution of thin overlay TPv 8k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 12 mm
32 747	m^2	Execution of thin overlay TPv 8k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 16 mm
32 748	m^2	Execution of thin overlay TPv 8k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 20 mm
32 749	m^2	Execution of thin overlay TPv 8k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 24 mm
32 751	m^2	Execution of thin overlay TPv 11k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 15 mm
32 752	m^2	Execution of thin overlay TPv 11k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 20 mm
32 753	m^2	Execution of thin overlay TPv 11k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 25 mm
32 754	m^2	Execution of thin overlay TPv 11k by hot method of carbonate mineral grain mixture and road bitumen in a thickness of 30 mm
32 761	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 10 mm
32 762	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 12 mm
32 763	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 16 mm
32 764	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 20 mm
32 766	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 12 mm
32 767	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 16 mm
32 768	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 20 mm
32 769	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 24 mm
32 771	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 15 mm
32 772	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 20 mm
32 773	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 25 mm
32 774	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and road bitumen in a thickness of 30 mm

Item	Unit measure	Description of Works
32 781	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 10 mm
32 782	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 12 mm
32 783	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 16 mm
32 784	m^2	Execution of thin overlay TPv 4s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 20 mm
32 786	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 12 mm
32 787	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 16 mm
32 788	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 20 mm
32 789	m^2	Execution of thin overlay TPv 8s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 24 mm
32 791	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 15 mm
32 792	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 20 mm
32 793	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 25 mm
32 794	m^2	Execution of thin overlay TPv 11s by hot method of silicate mineral grain mixture and polymer bitumen in a thickness of 30 mm

2.2.3.7.3 Bound Bearing and Wearing Courses – Cement Concrete

Unit	Unit measure	Description of Works
33 111	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 5 cm
33 112	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 10 cm
33 113	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 12 cm
33 114	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 14 cm
33 115	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 16 cm
33 116	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 18 cm
33 117	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 20 cm
33 118	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 22 cm
33 119	m^2	Execution of bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of .. cm
33 121	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 10 cm
33 122	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 12 cm
33 123	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 14 cm
33 124	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 16 cm
33 125	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 18 cm
33 126	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 20 cm
33 127	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 22 cm
33 128	m^2	Execution of reinforced bearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of .. cm
33 211	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 5 cm
33 212	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 6 cm
33 213	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 7 cm
33 214	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 8 cm
33 215	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of .. cm
33 221	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 5 cm
33 222	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 6 cm
33 223	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of

Unit	Unit measure	Description of Works
		silicate grains in a thickness of 7 cm
33 224	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 8 cm
33 225	m^2	Execution of wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of .. cm
33 231	m^2	Execution of wearing course of cement concrete C 35/45 of mixture of silicate grains in a thickness of 5 cm
33 232	m^2	Execution of wearing course of cement concrete C 35/45 of mixture of silicate grains in a thickness of 6 cm
33 233	m^2	Execution of wearing course of cement concrete C 35/45 of mixture of silicate grains in a thickness of 7 cm
33 234	m^2	Execution of wearing course of cement concrete C 35/45 of mixture of silicate grains in a thickness of 8 cm
33 235	m^2	Execution of wearing course of cement concrete C 35/45 of mixture of silicate grains in a thickness of .. cm
33 311	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 5 cm
33 312	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 10 cm
33 313	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 15 cm
33 314	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 18 cm
33 315	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 20 cm
33 316	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 22 cm
33 317	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 24 cm
33 318	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of 26 cm
33 319	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of carbonate grains in a thickness of .. cm
33 321	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 10 cm
33 322	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 15 cm
33 323	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 18 cm
33 324	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 20 cm
33 325	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 22 cm
33 326	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 24 cm
33 327	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 26 cm
33 328	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of 28 cm
33 329	m^2	Execution of bearing and wearing course of reinforced cement concrete C 30/37 of mixture of carbonate grains in a thickness of .. cm

Unit	Unit measure	Description of Works
33 331	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 10 cm
33 332	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 15 cm
33 333	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 18 cm
33 334	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 20 cm
33 335	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 22 cm
33 336	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 24 cm
33 337	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 26 cm
33 338	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of 28 cm
33 339	m^2	Execution of bearing and wearing course of cement concrete C 30/37 of mixture of silicate grains in a thickness of .. cm

2.2.3.7.4 Paved Wearing Courses

Item	Unit measure	Description of Work
34 111	m^2	Execution of wearing course of small pavers of silicate stone, dim. 8 cm/8 cm/8 cm, joints filled with sand
34 112	m^2	Execution of wearing course of small pavers of silicate stone, dim. 8 cm/8 cm/8 cm, joints sealed with cement mortar
34 113	m^2	Execution of wearing course of small pavers of silicate stone, dim. 8 cm/8 cm/8 cm, joints sealed with bituminous compound
34 114	m^2	Execution of wearing course of small pavers of silicate stone, dim. 8 cm/8 cm/8 cm, joints sealed with elastic compound
34 121	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 8 cm/8 cm/8 cm, joints filled with sand
34 122	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 8 cm/8 cm/8 cm, joints sealed with cement mortar
34 123	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 8 cm/8 cm/8 cm, joints sealed with bituminous compound
34 124	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 8 cm/8 cm/8 cm, joints sealed with elastic compound
34 131	m^2	Execution of wearing course of small pavers of silicate stone, dim. 9 cm/9 cm/9 cm, joints filled with sand
34 132	m^2	Execution of wearing course of small pavers of silicate stone, dim. 9 cm/9 cm/9 cm, joints sealed with cement mortar
34 133	m^2	Execution of wearing course of small pavers of silicate stone, dim. 9 cm/9 cm/9 cm, joints sealed with bituminous compound
34 134	m^2	Execution of wearing course of small pavers of silicate stone, dim. 9 cm/9 cm/9 cm, joints sealed with elastic compound
34 141	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 9 cm/9 cm/9 cm, joints filled with sand
34 142	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 9 cm/9 cm/9 cm, joints sealed with cement mortar
34 143	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 9 cm/9 cm/9 cm, joints sealed with bituminous compound
34 144	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 9 cm/9 cm/9 cm, joints sealed with elastic compound
34 151	m^2	Execution of wearing course of small pavers of silicate stone, dim. 10 cm/10 cm/10 cm, joints filled with sand
34 152	m^2	Execution of wearing course of small pavers of silicate stone, dim. 10 cm/10 cm/10 cm, joints sealed with cement mortar
34 153	m^2	Execution of wearing course of small pavers of silicate stone, dim. 10 cm/10 cm/10 cm, joints sealed with bituminous compound
34 154	m^2	Execution of wearing course of small pavers of silicate stone, dim. 10 cm/10 cm/10 cm, joints sealed with elastic compound
34 161	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 10 cm/10 cm/10 cm, joints filled with sand
34 162	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 10 cm/10 cm/10 cm, joints sealed with cement mortar
34 163	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 10

Item	Unit measure	Description of Work
		cm/10 cm/10 cm, joints sealed with bituminous compound
34 164	m^2	Execution of wearing course of small pavers of carbonate stone, dim. 10 cm/10 cm/10 cm, joints sealed with elastic compound
34 171	m^2	Execution of wearing course of small pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints filled with sand
34 172	m^2	Execution of wearing course of small pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints sealed with cement mortar
34 173	m^2	Execution of wearing course of small pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints sealed with bituminous compound
34 174	m^2	Execution of wearing course of small pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints sealed with elastic compound
34 181	m^2	Execution of wearing course of small pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints filled with sand
34 182	m^2	Execution of wearing course of small pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints sealed with cement mortar
34 183	m^2	Execution of wearing course of small pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints sealed with bituminous compound
34 184	m^2	Execution of wearing course of small pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints sealed with elastic compound
34 211	m^2	Execution of wearing course of big pavers of silicate stone, dim. 12 cm/12 cm/12 cm, joints filled with sand
34 212	m^2	Execution of wearing course of big pavers of silicate stone, dim. 12 cm/12 cm/12 cm, joints sealed with cement mortar
34 213	m^2	Execution of wearing course of big pavers of silicate stone, dim. 12 cm/12 cm/12 cm, joints sealed with bituminous compound
34 214	m^2	Execution of wearing course of big pavers of silicate stone, dim. 12 cm/12 cm/12 cm, joints sealed with elastic compound
34 221	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 12 cm/12 cm/12 cm, joints filled with sand
34 222	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 12 cm/12 cm/12 cm, joints sealed with cement mortar
34 223	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 12 cm/12 cm/12 cm, joints sealed with bituminous compound
34 224	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 12 cm/12 cm/12 cm, joints sealed with elastic compound
34 231	m^2	Execution of wearing course of big pavers of silicate stone, dim. 14 cm/14 cm/14 cm, joints filled with sand
34 232	m^2	Execution of wearing course of big pavers of silicate stone, dim. 14 cm/14 cm/14 cm, joints sealed with cement mortar
34 233	m^2	Execution of wearing course of big pavers of silicate stone, dim. 14 cm/14 cm/14 cm, joints sealed with bituminous compound
34 234	m^2	Execution of wearing course of big pavers of silicate stone, dim. 14 cm/14 cm/14 cm, joints sealed with elastic compound
34 241	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 14 cm/14 cm/14 cm, joints filled with sand
34 242	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 14

Item	Unit measure	Description of Work
		cm/14 cm/14 cm, joints sealed with cement mortar
34 243	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 14 cm/14 cm/14 cm, joints sealed with bituminous compound
34 244	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 14 cm/14 cm/14 cm, joints sealed with elastic compound
34 251	m^2	Execution of wearing course of big pavers of silicate stone, dim. 16 cm/16 cm/16 cm, joints filled with sand
34 252	m^2	Execution of wearing course of big pavers of silicate stone, dim. 16 cm/16 cm/16 cm, joints sealed with cement mortar
34 253	m^2	Execution of wearing course of big pavers of silicate stone, dim. 16 cm/16 cm/16 cm, joints sealed with bituminous compound
34 254	m^2	Execution of wearing course of big pavers of silicate stone, dim. 16 cm/16 cm/16 cm, joints sealed with elastic compound
34 261	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 16 cm/16 cm/16 cm, joints filled with sand
34 262	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 16 cm/16 cm/16 cm, joints sealed with cement mortar
34 262	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 16 cm/16 cm/16 cm, joints sealed with bituminous compound
34 264	m^2	Execution of wearing course of big pavers of carbonate stone, dim. 16 cm/16 cm/16 cm, joints sealed with elastic compound
34 271	m^2	Execution of wearing course of big pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints filled with sand
34 272	m^2	Execution of wearing course of big pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints sealed with cement mortar
34 273	m^2	Execution of wearing course of big pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints sealed with bituminous compound
34 274	m^2	Execution of wearing course of big pavers of silicate stone, dim. .. cm/.. cm/.. cm, joints sealed with elastic compound
34 281	m^2	Execution of wearing course of big pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints filled with sand
34 282	m^2	Execution of wearing course of big pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints sealed with cement mortar
34 283	m^2	Execution of wearing course of big pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints sealed with bituminous compound
34 284	m^2	Execution of wearing course of big pavers of carbonate stone, dim. .. cm/.. cm/.. cm, joints sealed with elastic compound
34 311	m^2	Execution of wearing course of cement concrete pavers, dim. .. cm /.. cm /.. cm, joints filled with sand
34 312	m^2	Execution of wearing course of cement concrete pavers, dim. .. cm /.. cm /.. cm, joints sealed with cement mortar
34 313	m^2	Execution of wearing course of cement concrete pavers, dim. .. cm /.. cm /.. cm, joints sealed with bituminous compound
34 314	m^2	Execution of wearing course of cement concrete pavers, dim. .. cm /.. cm

Item	Unit measure	Description of Work
		/.. cm, joints sealed with elastic compound
34 411	m^2	Execution of wearing course of cement concrete turf pavers, dim. .. cm /.. cm /.. cm, joints filled with sand
34 412	m^2	Execution of wearing course of cement concrete turf pavers, dim. .. cm /.. cm /.. cm, joints sealed with cement mortar
34 413	m^2	Execution of wearing course of cement concrete turf pavers, dim. .. cm /.. cm /.. cm, joints sealed with bituminous compound
34 414	m^2	Execution of wearing course of cement concrete turf pavers, dim. .. cm /.. cm /.. cm, joints sealed with elastic compound
34 511	m^2	Execution of wearing course of …………….. slabs, dim. .. cm /.. cm /.. cm, joints filled with sand
34 512	m^2	Execution of wearing course of …………….. slabs, dim. .. cm /.. cm /.. cm, joints sealed with cement mortar
34 513	m^2	Execution of wearing course of …………….. slabs, dim. .. cm /.. cm /.. cm, joints sealed with bituminous compound
34 514	m^2	Execution of wearing course of …………….. slabs, dim. .. cm /.. cm /.. cm, joints sealed with elastic compound
34 611	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 30 cm /30 cm /4 cm, joints filled with sand
34 612	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 30 cm /30 cm/4 cm, joints filled with cement mortar
34 613	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 30 cm /30 cm/4 cm, joints filled with bituminous compound
34 614	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 30 cm /30 cm/4 cm, joints filled with elastic compound
34 621	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 40 cm /40 cm /4 cm, joints filled with sand
34 622	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with cement mortar
34 623	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with bituminous compound
34 624	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with elastic compound
34 631	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 50 cm /50 cm /4 cm, joints filled with sand
34 632	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 50 cm /50 cm/4 cm, joints filled with cement mortar
34 633	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 50 cm /50 cm/4 cm, joints filled with bituminous compound
34 634	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. 50 cm /50 cm/4 cm, joints filled with elastic compound

Item	Unit measure	Description of Work
34 641	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. .. cm /.. cm /4 cm, joints filled with sand
34 642	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with cement mortar
34 643	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with bituminous compound
34 644	m^2	Execution of wearing course of roughened and sealed cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with elastic compound
34 711	m^2	Execution of wearing course of washed cement concrete slabs, dim. 30 cm /30 cm /4 cm, joints filled with sand
34 712	m^2	Execution of wearing course of washed cement concrete slabs, dim. 30 cm /30 cm/4 cm, joints filled with cement mortar
34 713	m^2	Execution of wearing course of washed cement concrete slabs, dim. 30 cm /30 cm/4 cm, joints filled with bituminous compound
34 714	m^2	Execution of wearing course of washed cement concrete slabs, dim. 30 cm /30 cm/4 cm, joints filled with elastic compound
34 721	m^2	Execution of wearing course of washed cement concrete slabs, dim. 40 cm /40 cm /4 cm, joints filled with sand
34 722	m^2	Execution of wearing course of washed cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with cement mortar
34 723	m^2	Execution of wearing course of washed cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with bituminous compound
34 724	m^2	Execution of wearing course of washed cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with elastic compound
34 731	m^2	Execution of wearing course of washed cement concrete slabs, dim. 50 cm /50 cm /4 cm, joints filled with sand
34 732	m^2	Execution of wearing course of washed cement concrete slabs, dim. 50 cm /50 cm/4 cm, joints filled with cement mortar
34 733	m^2	Execution of wearing course of washed cement concrete slabs, dim. 50 cm /50 cm/4 cm, joints filled with bituminous compound
34 734	m^2	Execution of wearing course of washed cement concrete slabs, dim. 50 cm /50 cm/4 cm, joints filled with elastic compound
34 741	m^2	Execution of wearing course of washed cement concrete slabs, dim. .. cm /.. cm /4 cm, joints filled with sand
34 742	m^2	Execution of wearing course of washed cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with cement mortar
34 743	m^2	Execution of wearing course of washed cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with bituminous compound
34 744	m^2	Execution of wearing course of washed cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with elastic compound
34 811	m^2	Execution of wearing course of cement concrete slabs, dim. 40 cm /40 cm /4 cm, joints filled with sand
34 812	m^2	Execution of wearing course of cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with cement mortar
34 813	m^2	Execution of wearing course of cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with bituminous compound

Item	Unit measure	Description of Work
34 814	m^2	Execution of wearing course of cement concrete slabs, dim. 40 cm /40 cm/4 cm, joints filled with elastic compound
34 821	m^2	Execution of wearing course of cement concrete slabs, dim. .. cm /.. cm /4 cm, joints filled with sand
34 822	m^2	Execution of wearing course of cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with cement mortar
34 823	m^2	Execution of wearing course of cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with bituminous compound
34 824	m^2	Execution of wearing course of cement concrete slabs, dim. .. cm /.. cm/4 cm, joints filled with elastic compound
34 911	m2	Execution of unbound mineral grain mixture (sand) underlay for paved wearing course
34 912	m2	Execution of cement mortar underlay for paved wearing course
34 913	m2	Execution of lime mortar underlay for paved wearing course

2.2.3.7.5 Carriageway Edge Elements

2.2.3.7.5.1 Extrawidths

Item	Unit Measure	Description of Work
35 111	m^1	Execution of double-layered extrawidth of 50 cm width, of cement concrete of 6 cm thick silicate mixture wearing course and 10 cm thick carbonate mixture bearing course
35 112	m^1	Execution of double-layered extrawidth of 50 cm width, of cement concrete of 6 cm thick silicate mixture wearing course and 12 cm thick carbonate mixture bearing course
35 113	m^1	Execution of double-layered extrawidth of 50 cm width, of cement concrete of 6 cm thick silicate mixture wearing course and 14 cm thick carbonate mixture bearing course
35 114	m^1	Execution of double-layered extrawidth of 50 cm width, of cement concrete of 6 cm thick silicate mixture wearing course and 16 cm thick carbonate mixture bearing course
35 115	m^1	Execution of double-layered extrawidth of 50 cm width, of cement concrete of 6 cm thick silicate mixture wearing course and 18 cm thick carbonate mixture bearing course
35 116	m^1	Execution of double-layered extrawidth of 50 cm width, of cement concrete of 6 cm thick silicate mixture wearing course and 20 cm thick carbonate mixture bearing course
35 117	m^1	Execution of double-layered extrawidth of 50 cm width, of cement concrete of 6 cm thick silicate mixture wearing course and .. cm thick carbonate mixture bearing course
35 121	m^1	Execution of single-layer extrawidth of 50 cm width, of cement concrete of 16 cm thick carbonate mixture
35 122	m^1	Execution of single-layer extrawidth of 50 cm width, of cement concrete of 18 cm thick carbonate mixture
35 123	m^1	Execution of single-layer extrawidth of 50 cm width, of cement concrete of 20 cm thick carbonate mixture
35 124	m^1	Execution of single-layer extrawidth of 50 cm width, of cement concrete of 22 cm thick carbonate mixture
35 125	m^1	Execution of single-layer extrawidth of 50 cm width, of cement concrete of 24 cm thick carbonate mixture
35 126	m^1	Execution of single-layer extrawidth of 50 cm width, of cement concrete of 26 cm thick carbonate mixture
35 127	m^1	Execution of single-layer extrawidth of 50 cm width, of cement concrete of .. cm thick carbonate mixture
35 131	m^1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement concrete of 8 cm thick carbonate mixture
35 132	m^1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement concrete of 10 cm thick carbonate mixture
35 133	m^1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement concrete of 12 cm thick carbonate mixture
35 134	m^1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement concrete of 14 cm thick carbonate mixture
35 135	m^1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement concrete of 16 cm thick carbonate mixture
35 136	m^1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement concrete of 18 cm thick carbonate mixture
35 137	m^1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement

		concrete of 20 cm thick carbonate mixture
35 138	m1	Execution of single-layer reinforced extrawidth of 50 cm width, of cement concrete of .. cm thick carbonate mixture

2.2.3.7.5.2 Kerbs

Item	Unit Measure	Description of Work
35 211	m^1	Execution of precast cement concrete raised kerb of section 8/12 cm
35 212	m^1	Execution of precast cement concrete raised kerb of section 15/25 cm
35 213	m^1	Execution of precast cement concrete raised kerb of section 15/30 cm
35 214	m^1	Execution of precast cement concrete raised kerb of section 18/30 cm
35 215	m^1	Execution of precast cement concrete raised kerb of section../.. cm
35 221	m^1	Execution of cement concrete raised kerb of section 15/25 cm
35 222	m^1	Execution of cement concrete raised kerb of section 15/30 cm
35 223	m^1	Execution of cement concrete raised kerb of section 18/30 cm
35 224	m^1	Execution of cement concrete raised kerb of section../.. cm
35 231	m^1	Execution of precast cement concrete deep kerb of section 10/20 cm
35 232	m^1	Execution of precast cement concrete deep kerb of section 12/20 cm
35 233	m^1	Execution of precast cement concrete deep kerb of section 12/25 cm
35 234	m^1	Execution of precast cement concrete deep kerb of section 15/25 cm
35 235	m^1	Execution of precast cement concrete deep kerb of section../.. cm
35 241	m^1	Execution of cement concrete deep kerb of section 10/20 cm
35 242	m^1	Execution of cement concrete deep kerb of section 12/20 cm
35 243	m^1	Execution of cement concrete deep kerb of section 12/25 cm
35 244	m^1	Execution of cement concrete deep kerb of section 15/25 cm
35 245	m^1	Execution of cement concrete deep kerb of section../.. cm
35 251	m^1	Execution of raised kerb of natural stone of section 10/15 cm
35 252	m^1	Execution of raised kerb of natural stone of section 18/24 cm
35 253	m^1	Execution of raised kerb of natural stone of section ../.. cm
35 254	m^1	Execution of raised kerb of roughened natural stone of section 10/15 cm
35 255	m^1	Execution of raised kerb of roughened natural stone of section 18/24 cm
35 256	m^1	Execution of raised kerb of roughened natural stone of section ../.. cm
35 257	m^1	Execution of raised kerb made of natural stone by splitting, of section 10/15 cm
35 258	m^1	Execution of raised kerb made of natural stone by splitting, of section 18/24 cm
35 259	m^1	Execution of raised kerb made of natural stone by splitting, of section ../.. cm
35 261	m^1	Execution of deep kerb of natural stone of section 10/15 cm
35 262	m^1	Execution of deep kerb of natural stone of section ../.. cm
35 264	m^1	Execution of deep kerb of roughened natural stone of section 10/15 cm
35 265	m^1	Execution of deep kerb of roughened natural stone of section ../.. cm

Item	Unit Measure	Description of Work
35 267	m^1	Execution of deep kerb made of natural by splitting stone of section 10/15 cm
35 268	m^1	Execution of deep kerb made of natural stone by splitting, of section ../.. cm
35 271	m^1	Execution of raised inlet kerb of natural stone of section 10/15 cm
35 272	m^1	Execution of raised inlet kerb of roughened natural stone of section 10/15 cm
35 273	m^1	Execution of raised inlet kerb made of natural stone by splitting, of section 10/15 cm
35 274	m^1	Execution of raised inlet kerb of ………………….. of section ../.. cm.
35 276	m^1	Execution of deep inlet kerb of natural stone of section 10/15 cm
35 277	m^1	Execution of deep inlet kerb of roughened natural stone of section 10/15 cm
35 278	m^1	Execution of deep inlet kerb made of natural stone by splitting, of section 10/15 cm
35 279	m^1	Execution of deep inlet kerb of ………………….. of section ../.. cm.
35 281	m^1	Execution of kerb of natural stone on bridge, of section 13/20 cm
35 282	m^1	Execution of kerb of natural stone on bridge, of section 20/23 cm
35 283	m^1	Execution of kerb of natural stone on bridge, of section ../.. cm
35 285	m^1	Execution of kerb of natural stone at transition from bridge to fill, of section 13/20 cm
35 286	m^1	Execution of kerb of natural stone at transition from bridge to fill, of section 20/23 cm
35 287	m^1	Execution of kerb of natural stone at transition from bridge to fill, of section ../.. cm
35 291	m^1	Execution of kerb of asphalt mixture according to design detail, of section ../.. cm
35 292	m^1	Execution of kerb of asphalt mixture according to design detail, of section ../.. cm
35 295	m^1	Execution of asphalt expansion joint by the Thorma Joint method

2.2.3.7.5.3 Borders

Item	Unit measure	Description of Work
35 311	m^2	Execution of borders made of small pavers of natural stone of dimensions 8 cm/8 cm /8 cm
35 312	m^2	Execution of borders made of small pavers of natural stone of dimensions 9 cm/9 cm /9 cm
35 313	m^2	Execution of borders made of small pavers of natural stone of dimensions 10 cm/ 10 cm /10 cm
35 314	m^2	Execution of borders made of small pavers of natural stone of dimensions ... cm/ ... cm /... cm

35 321	m^2	Execution of borders made of small pavers of cement concrete of dimensions 8 cm/8 cm /8 cm
35 322	m^2	Execution of borders made of small pavers of cement concrete of dimensions 9 cm/9 cm /9 cm
35 323	m^2	Execution of borders made of small pavers of cement concrete of dimensions 10 cm/ 10 cm /10 cm
35 324	m^2	Execution of borders made of small pavers of cement concrete of dimensions ... cm/ ... cm /... cm

2.2.3.7.5.4 Safety Barriers

Item	Unit measure	Description of Work
35 411	m^1	Execution of safety barrier of New Jersey type of cement concrete, of 80 cm height, without foundation
35 412	m^1	Execution of safety barrier of New Jersey type of cement concrete, of 110 cm height, without foundation
35 413	m^1	Execution of safety barrier of New Jersey type of cement concrete, of ..... cm height, without foundation
35 421	m^1	Execution of safety barrier of New Jersey type of precast cement concrete elements, of 80 cm height, without foundation
35 422	m^1	Execution of safety barrier of New Jersey type of precast cement concrete elements, of 110 cm height, without foundation
35 423	m^1	Execution of safety barrier of New Jersey type of precast cement concrete elements, of ..... cm height, without foundation
35 431	m^1	Execution of impact safety barrier of New Jersey type of precast cement concrete elements, of 80 cm height, without connection to steel safety barrier
35 432	m^1	Execution of impact safety barrier of New Jersey type of precast cement concrete elements, of 110 cm height, without connection to steel safety barrier
35 433	m^1	Execution of impact safety barrier of New Jersey type of precast cement concrete elements, of ...... cm height, without connection to steel safety barrier
35 436	m^1	Execution of impact safety barrier of New Jersey type of precast cement concrete elements, of 80 cm height, with connection to steel safety barrier
35 437	m^1	Execution of impact safety barrier of New Jersey type of precast cement concrete elements, of 110 cm height, with connection to steel safety barrier
35 438	m^1	Execution of impact safety barrier of New Jersey type of precast cement concrete elements, of ...... cm height, with connection to steel safety barrier
35 441	m^1	Execution of outer precast concrete safety barrier on a bridge, of 80 cm height
35 442	m^1	Execution of outer precast concrete safety barrier on a bridge, of 100 cm height
35 443	m1	Execution of outer precast concrete safety barrier on a bridge, of ..... cm height
35 451	m^1	Execution of outer semi-precast concrete safety barrier on a bridge, of 80 cm height
35 452	m^1	Execution of outer semi-precast concrete safety barrier on a bridge, of 110 cm height
35 453	m^1	Execution of outer semi-precast concrete safety barrier on a bridge, of ..... cm height

Item	Unit measure	Description of Work
35 461	m^1	Execution of outer concrete safety barrier on a bridge, of 80 cm height
35 462	m^1	Execution of outer concrete safety barrier on a bridge, of 110 cm height
35 463	m^1	Execution of outer concrete safety barrier on a bridge as specified by the design detail, of ..... cm height
35 471	m^1	Execution of inner precast concreete safety barrier on a bridge, of 80 cm height
35 472	m^1	Execution of inner precast concreete safety barrier on a bridge as specified by the design detail, of ..... cm height
35 481	m^1	Execution of inner semi-precast concrete safety barrier on a bridge, of 80 cm height
35 482	m^1	Execution of inner semi-precast concrete safety barrier as specified by the design detail, of ...... cm height
35 491	m^1	Execution of outer concrete safety byrrier on a bridge, of 80 cm height
35 492	m^1	Execution of outer concrete safety barrier on a bridge as specified by the design detail, of .... cm height.

2.2.3.7.6 Shoulders

Item	Unit measure	Description of Work
36 111	m^1	Execution of shoulder of natural gravel or naturally crushed stone material, of width up to 0.50 m
36 112	m^1	Execution of shoulder of natural gravel or naturally crushed stone material, of width 0.51 – 0.75 m
36 113	m^1	Execution of shoulder of natural gravel or naturally crushed stone material, of width 0.76 – 1.00 m
36 114	m^2	Execution of shoulder of natural gravel or naturally crushed stone material, of width above 1.00 m
36 121	m^1	Execution of shoulder of gravel, of width up to 0.50 m
36 122	m^1	Execution of shoulder of gravel, of width 0.51 – 0.75 m
36 123	m^1	Execution of shoulder of gravel, of width 0.76 – 1.00 m
36 124	m^2	Execution of shoulder of gravel, of width above 1.00 m
36 131	m^1	Execution of shoulder of crushed stone, of width up to 0.50 m
36 132	m^1	Execution of shoulder of crushed stone, of width 0.51 – 0.75 m
36 133	m^1	Execution of shoulder of crushed stone, of width 0.76 – 1.00 m
36 134	m^2	Execution of shoulder of crushed stone, of width above 1.00 m
36 211	m^1	Execution of shoulder of topsoil, of width up to 0.50 m
36 212	m^1	Execution of shoulder of topsoil, of width 0.51 – 0.75 m
36 213	m^1	Execution of shoulder of topsoil, of width 0.76 – 1.00 m
36 214	m^2	Execution of shoulder of topsoil, of width above 1.00 m
36 311	m^1	Execution of shoulder stabilized with turf pavers, of width up to 0.50 m
36 312	m^1	Execution of shoulder stabilized with turf pavers, of width 0.51 – 0.75 m
36 313	m^1	Execution of shoulder stabilized with turf pavers, of width 0.76 – 1.00 m
36 314	m^2	Execution of shoulder stabilized with turf pavers, of width above 1.00 m

Item	Unit measure	Description of Work
36 411	m^1	Execution of shoulder stabilized with crushed stone, and filled with topsoil, of width up to 0,50 m
36 412	m^1	Execution of shoulder stabilized with crushed stone, and filled with topsoil, of width 0,51 – 0.75 m
36 413	m^1	Execution of shoulder stabilized with crushed stone, and filled with topsoil, of width 0,76 – 1.00 m
36 414	m^2	Execution of shoulder stabilized with crushed stone, and filled with topsoil, of width above 1.00 m
36 511	m^2	Execution of shoulder of a mixture of bituminous crushed stone 16, of thickness 40 mm
36 512	m^2	Execution of shoulder of a mixture of bituminous crushed stone 16, of thickness 50 mm
36 513	m^2	Execution of shoulder of a mixture of bituminous crushed stone 16, of thickness 60 mm
36 521	m^2	Execution of shoulder of a mixture of bituminous concrete 8 or 11, of thickness 25 mm
36 522	m^2	Execution of shoulder of a mixture of bituminous concrete 8 or 11, of thickness 30 mm
36 523	m^2	Execution of shoulder of a mixture of bituminous concrete 8 or 11, of thickness 35 mm
36 524	m^2	Execution of shoulder of a mixture of bituminous concrete 8 or 11, of thickness 40 mm
36 525	m^2	Execution of shoulder of a mixture of bituminous concrete 8 or 11, of thickness 50 mm
36 526	m^2	Execution of shoulder of a mixture of bituminous concrete 8 or 11, of thickness 60 mm

GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

VOLUME II: CONSTRUCTION

SECTION 2: SPECIAL TECHNICAL CONDITIONS

Part 4: DRAINAGE SYSTEM

Sarajevo/Banja Luka
2005

CONTENTS:

2.2.4 DRAINAGE SYSTEM

2.2.4.1 MATERIALS

General

For various drainage works similar materials can be used. The characteristics of such materials are defined in detail.

All the considered materials shall be applied in accordance with the requirements in the design and these technical conditions. Selection and any alteration of material shall be previously approved by the engineer.

2.2.4.1.1 Description

Materials predominantly used for the drainage works are the following:

- mineral aggregates for underlaid courses
- cement concrete mixtures for underlaid courses and for drainage elements, and
- cement mortars.

2.2.4.1.2 Basic Materials

2.2.4.1.2.1 Mineral Aggregates

Mineral aggregates for underlaid courses of drainage systems can be composed of natural and/or crushed stone grains.

2.2.4.1.2.2 Cement Concrete

2.2.4.1.2.2.1 Mineral Aggregates

Mineral aggregates for cement concrete mixtures for underlaid courses and for prefabricated elements of drainage systems may be composed of natural and/or crushed stone grains. In case natural and crushed grains are mixed together, the portion of crushed grains shall amount to at least 50 % by mass for cement concrete of strength class C 30/37 or higher.

2.2.4.1.2.2.2 Binders

To cement concrete mixtures of strength class C 30/37 or higher in compliance with the EN 206-1 the following binders are applicable:

- Portland cements, and
- Portland cements with admixtures of granulated furnace slag.

To cement concrete mixtures for underlaid courses, Portland cements with pozzolan admixtures are applicable as well.

The cement type shall be specified with regard to the cement grade and conditions of application of cement concrete, and shall comply with the provisions indicated in both design and these technical conditions.

Uppon the apporval by the engineer, the contractor is allowed to apply other hydraulic binders based on the Portland cement as well provided that their suitability is proven by adequate tests and certificates.

2.2.4.1.2.2.3 Water

For the preparation of cement concrete mixtures used for drainage works it is admitted to use natural or treated water provided that its suitability is proven.

Drinking water is allowed to be applied also without any proof on its appropriateness for the preparation of cement concrete.

2.2.4.1.2.2.4 Chemical Admixtures

In order to improve certain properties of fresh and/or hardened cement concrete mixtures, various admixtures for plasticization, aeration, and other modifications of the cement concrete properties can be used.

The engineer shall approve any application of such admixtures.

When applying admixtures it is compulsory to take account of the provisions indicated in the EN 206-1, as well as of the maker's instructions.

2.2.4.1.2.2.5 Protective Agents

For protection and/or impregnation of the surface of fresh and/or hardened cement concrete against drying and/or wetting, various liquid chemical agents can be used ensuring a uniform and watertight film on the cement concrete surface.

The engineer shall approve any application of such admixtures.

When applying protective agents it is compulsory to take account of the provisions indicated in the EN 206-1, as well as of the maker's instructions.

2.2.4.1.2.3 Cement Mortar

Cement mortar to be used for drainage works shall be composed of sand grains, cement, and water.

As a rule, a mixture of rough sand of 0/4 granulometric composition shall be used, which may be composed of natural and/or crushed grains.

For cement mortars, Portland cements indicated in 2.2.4.1.2.2.2 can be used as binders.

To the water to be used for cement mortar, the provisions indicated in 2.2.4.1.2.2.3 shall apply as appropriate.

2.2.4.1.3 Quality of Materials

2.2.4.1.3.1 Mineral Aggregates

2.2.4.1.3.1.1 Composition

The mineral aggregate mixtures for underlaid courses of the drainage works shall consist of gravel or crushed stone grains, or of shingle or chippings, sand, and filler in order to ensure such a composition of mixtures that lies between the grading curve limits indicated in Figures 4.1, 4.2, and 4.3.

In case that the mineral aggregate composition for the underlaid course is not defined in the design, the course thickness shall then amount to at least 2.5 times the diameter of the largest grain in the mixture.

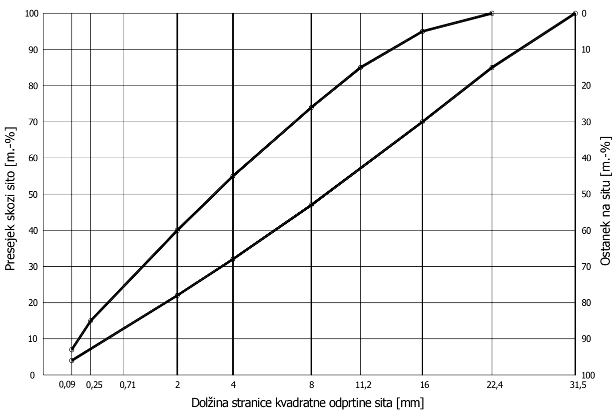
The portion of mineral grains of size up to 0.063 mm is admitted to be in the mixture

- at deposit area maximum 5% by mass
- after placing maximum 8% by mass

The quotient of uneven granulometric composition $U = d_{60}/d_{10}$ shall amount for the mixtures of

- natural grains to 15 - 100
- crushed and mixed grains to to 8 - 50.

The engineer shall approve the granulometric composition of mineral aggregates for underlaid courses.



presejek skozi sito = passing sieve; ostanek na situ = remaining on sieve;

dolžina stranice kvadratne odprtine sita = length of side of sieve square opening;

Fig. 4.1: Grading curve limits for mineral aggregate mixtures of 0/22 mm for underlaid courses

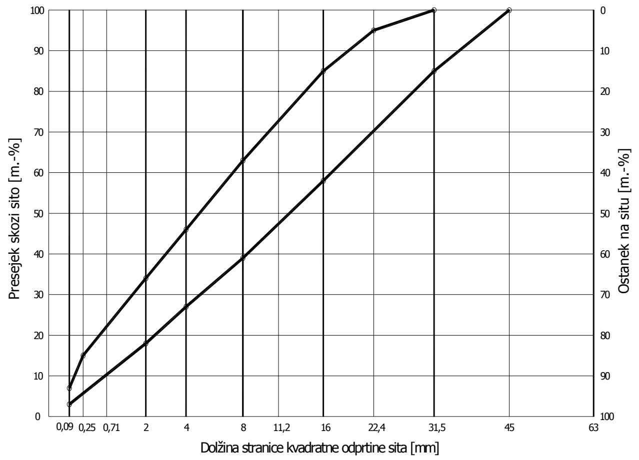


Fig. 4.2: Grading curve limits for mineral aggregate mixtures of 0/32 mm for underlaid courses

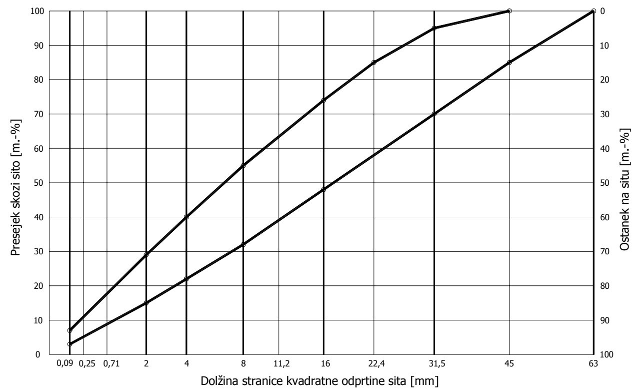


Fig. 4.3: Grading curve limits for mineral aggregate mixtures of 0/45 mm for underlaid courses

2.2.4.1.3.1.2 Mechanical Properties

Resistance of grains to freezing determined by the magnesium sulphate test shall comply with the MS_{25} category according to the EN 1367-2.

The organic admixtures present in the mixture must not colour the solution of sodium hydroxide darker than the reference colour according to the EN 1744-1.

Resistance of stone grains to crushing assessed by the Los Angeles test shall comply with the LA_{30} category according to the EN 1097-2.

Each mineral aggregate mix foreseen to be applied to the underlaid course for the drainage works shall be tested pursuant to the requirements given in these technical conditions prior to placing.

2.2.4.1.3.2 Cement Concrete

2.2.4.1.3.2.1 Mineral Aggregates

2.2.4.1.3.2.1.1 Composition

For cement concrete to be applied within the scope of drainage works mineral aggregate mixtures of 0/32 mm, exceptionally also 0/16 mm, can be used (informative category GA_{90} according to the EN 12620). Granulometric composition ranges are indicated in Fig. 4.4 (CC 16) and Fig. 4.5 (CC 32). The size of the largest grain in the mixture shall not exceed 1/3 of the cement concrete layer thickness.

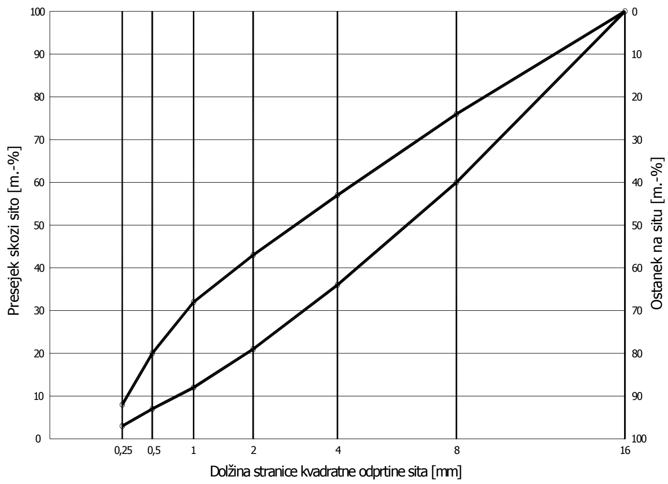


Fig 4.4: Grading curve limits for mineral aggregate grains for CC 16 cement concrete mixtures

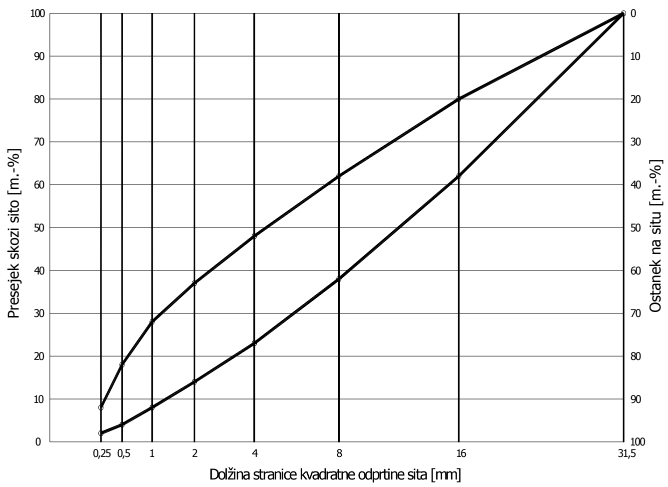


Fig. 4.5: Grading curve limits for mineral aggregate grains for CC 32 cement concrete mixtures

Subject to previous approval by the engineer it is also possible, for the preparation of cement concrete up to the strength class of C 16/20, to use a natural composition of mineral aggregates.

The organic admixtures present in the mixture must not colour the solution of sodium hydroxide darker than the reference colour.

Mineral grains shall be washed or de-dusted and fractionized.

The contractor is free to use other composition of mineral aggregates for preparation of cement concrete mixtures provided that he submits to the engineer suitable documents proving that the mechanical properties of such cement concrete mixture meet the requirements provided by these technical conditions and the design.

2.2.4.1.3.2.1.2 Properties

Mineral aggregate mixtures foreseen for the preparation of cement concrete mixes shall have the properties set out in Table 4.1.

Table 4.1: Required properties of mineral aggregate mixtures for cement concrete mixes

Properties of mineral aggregates	Unit measure	Required value	Test method
- resistance of mineral grains to freezing (magnesium sulphate test)	% by m.	MS_{25}	EN 1367-2
- content of poorly formed grains	% by m.	SI_{20}	EN 933-4

Prior the commencement of works it is necessary to test every mineral aggregate mixture foreseen for the preparation of cement concrete pursuant to these technical conditions. In case the engineer has already approved the application of equal mineral aggregate mixture, the tests need not be repeated.

The required properties of mineral aggregate mixtures shall be ensured in terms of the threshold values.

2.2.4.1.3.2.2 Binders

Cements for cement concrete mixtures, foreseen for drainage works, shall meet the requirements provided by the EN 197-1. The following cement types are particularly suitable to such purposes:

- cement type CEM I of 32.5 strength class, and
- cement type CEM II/A-S and CEM II/B-S of 42.5 strength class.

For cements used for production of cement concrete mixtures for drainage works the following limitations shall be considered:

- start of concrete setting at 20 °C not earlier than after one hour,
- start of concrete setting at 30 °C not earlier than after 45 minutes,
- completion of concrete setting after 10 hours.

The required properties of cement shall be ensured in terms of the threshold values.

2.2.4.1.3.2.3 Water

The required water properties for the preparation of cement concrete mixtures used for drainage works are specified in Table 4.2.

The required water properties shall be ensured in terms of the threshold values.

The engineer shall specify the test to be carried out on the water proposed to be used for the cement concrete production.

Table 4.2: Required properties of water for cement concrete mixtures

Water property	Unit measure	Required value	Test method
- pH value	-	4.5 to 9.5	EN 1008
- chloride (Cl^-) content, maximum	mg/l	300	EN 196-21
- sulphate (SO_4^{2-}) content, maximum	mg/l	400	EN 196-2

2.2.4.1.3.2.4 Chemical Admixtures

The required properties of chemical admixtures to cement concrete are specified in the EN 934-2.

When preparing cement concrete, chemical admixtures are permitted to be applied in order to assure the required improvements of cement concrete properties. The contractor shall previously test the mineral aggregate mixture, the binders, and the water foreseen for the production of cement concrete, and submit adequate evidence to the engineer in due time prior to commencement of the works.

The evidence on the conformity of the chemical admixture to cement concrete with the requirements provided by both design and these technical conditions should be issued by an authorized institute.

The engineer shall approve the use of chemical admixture to the cement concrete.

2.2.4.1.3.2.5 Protective Agents

Properties of liquid chemical protective agents to be applied to the cement concrete surface are defined in the instructions and technical conditions issued by the producers of such agents.

The film of the chemical protective agents shall adequately protect the cement concrete surface and it should not affect harmfully either the cement setting process or the surface of the placed cement concrete mixture.

An authorized institute shall issue evidence on the quality of the protective agent for the cement concrete surface.

2.2.4.1.3.3 Cement Mortar

Mineral aggregate mixtures for cement mortar used to fill-up the joints may be composed of sand of 0/2 mm or 0/4 mm.

The required composition and properties of sand grains are defined in Tables 4.3 and 4.4.

Table 4.3: Required composition of sand grain mixtures for cement mortar (test according to the EN 933-1)

Length of side sieve square opening mm	Natural or crushed sand passing sieve (% by mass) 0/2 mm	0/4 mm
0.09	maximum 10	maximum 10
2	minimum 90	minimum 65
4	100	minimum 90
8	-	100

Table 4.4: Required properties of sand grain mixtures for cement mortar

Properties of sand grain mixtures	Unit measure	Required value		Test method
		Natural sand	Crushed sand	
- portion of grains up to max. 0.09 mm	% by m.	10	10	EN 933-1
- sand equivalent, min.	%	SE_{60}	SE_{60}	EN 933-8
- content of organic admixtures [1]	-	-	-	EN 1744-1

[1] *A sodium hydroxide solution must not be coloured darker than the reference colour.*

The required properties of other materials for cement mortars used for filling-up the joints (binders, water, admixtures) are the same as indicated in 2.2.4.1.3.2.

2.2.4.1.4 Method of Execution

2.2.4.1.4.1 Winning the Materials

In due time prior to commencement of the drainage works, the contractor shall inform the engineer of all the materials he intends to use for execution of underlaid courses or cement concrete and cement mortar, submit adequate evidence on the conformity, and obtain an approval by the engineer for the application of these materials.

All material properties specified in 2.2.4.1.3 shall be ensured. The material not meeting the specified requirements shall be eliminated and extra marked by the contractor.

3.2.4.0.1.1Depositing the Materials

In case the contractor, prior to execution of drainage works, temporarily deposits the materials required for this work, he shall assure and arrange adequate space. Thereby, he shall take account of the instructions issued by the producer of the particular material in view of its storing, as well instructions given by the engineer.

Zaloge vseh materialov na deponijah morajo biti tolikšne, da je zagotovljeno neprekinjeno izvajanje del.

2.2.4.1.4.2 Production of Cement Concrete and Cement Mortar Mixtures

The production of cement concrete and cement concrete mortar mixtures shall be mechanical and carried out at suitable plant where batch-based production is provided. Production capacities of the production plant shall be certified.

Dosing devices shall be such as to ensure an appropriate amount of all the components in the particular mixture by mass.

Mixing time and other impacts on the quality shall be so adjusted as to ensure a uniform mixture of cement concrete or cement mortar.

For the work at lower temperatures (up to -3 °C), a possibility of heating the mixtures of grains and/or water up to an adequate temperature shall be ensured, so that the temperature of the fresh cement concrete and cement mortar amounts to 10 – 30°C.

The plant for production of cement concrete and cement mortar shall be protected from atmospheric actions.

A possibility of permanent visual checking the dosing of quantities of individual materials for production of cement concrete and cement mortar mixtures shall be given at the plant.

The produced cement concrete and cement mortar mixture may be, upon previous approval by the engineer, put at stock in adequate silos within the plant for shorter period, or it shall be immediately transported to the application place.

2.2.4.1.5 Quality of Execution

Not later than 7 days prior to commencement of the works, the contractor shall submit to the engineer a detailed method statement comprising all the information as required by these technical conditions, which is the following:

- a design of cement concrete and cement mortar,
- conformity certificates for materials to be used,
- a programme of average frequency of both internal and external control, and
- a description of working methods.

Before the commencement of the operation of machines and facilities, of which the quality of cement concrete and cement mortar depends, it is mandatory to test their adequacy for ensuring uniform quality according to the requirements provided by these technical conditions. All the equipment and machinery shall be tested and shall, in view of their capacity, satisfy the requirements provided by both design and these technical conditions.

2.2.4.1.5.1 Cement Concrete

2.2.4.1.5.1.1 Composition of Mixture

The composition of the cement concrete mixture for drainage works, which shall be carried out within the scope of the preliminary testing and submitted to the engineer, must comprise the following:

- types and quantities of individual fractions and the overall mineral aggregate mixture (kg/m^3)
- type and quantity of the binder (kg/m^3)
- water quantity (l/m^3)
- types and quantities of admixtures (in % by mass of cement or in kg/m^3 of cement concrete)

With the composition of the mixture the contractor shall prove that it is possible, with the foreseen composition of the mineral aggregate, binder, water, and admixtures, to obtain such quality of cement concrete as required by these technical conditions and the design.

The contractor is not allowed to commence to place the cement concrete mixture until the engineer issues an approval in writing on the proposed composition.

In case the contractor already performed the work with similar cement concrete mixtures during the past year, it is possible to consider the results of the executed composition, which were established upon the internal production control, as an adequate composition of the cement concrete. The engineer shall make the final decision.

2.2.4.1.5.1.2 Cement Concrete Properties

The quality of mixtures of fresh cement concrete to be used for the drainage works shall meet the requirements indicated in Table 4.5.

Table 4.5: Required properties of fresh cement concrete for drainage works

Properties of fresh cement concrete	Unit measure	Required value for underlaid courses	Required value for other cement concrete	Test method
- content of micro-pores[1)]				EN 12350-7
- for CC 16	% by v.	-	5 to 7	
- for CC 32	% by v.	-	3 to 5	
- content of cement and grain mixtures up to 0.25 mm:				-
- if cement ≤ 300 kg/m^3	kg/m^3	400	400	
- if cement ≥ 350 kg/m^3	kg/m^3	450 + (C-350)	450 + (C-350)	

[1)] *for cement concrete of exposed (visible) surfaces only*

The required properties of hardened cement concrete are indicated in Table 4.6.

The values of the micro-pore content are to be considered as the limiting and threshold values.

The values of the cement content and of the content of the grain mixture up to 0.25 mm are the upper threshold values.

Table 4.6: Required properties of hardened cement concrete for drainage works

Properties of hardened cement concrete	Unit measure	Required value for underlaid courses	Required value for other cement concrete	Test method
- compressive strength class:				EN 12390-3
- average	MN/m^2	C 16/20	C 30/37	
- individual	MN/m^2	C 12/15	C 25/30	
- tensile strength with bending	MN/m^2	-	≥ 4	EN 12390-5
- resistance to water penetration - PV II degree	mm	≤ 30	≤ 30	1026
- resistance to freezing/thawing - XF4 degree	mg/mm^2	-	≤ 0.40	EN 12390-8

The values of compressive strength as well as of tensile strength with bending are the lower threshold values.

The resistance to water penetration is the lower threshold value.

The resistance to freezing and thawing is defined as the lower threshold value.

2.2.4.1.5.1.3 Demonstrative Production and Placing / Test Area

By demonstrative production of the cement concrete mixture the contractor shall verify the approved preliminary (laboratory) composition at suitable cement concrete production plant, the transportation to the site, and the placing.

The place of the demonstrative placing shall be approved by the engineer after having verified adequacy of the prepared substrate formation.

A third party institute shall, upon the contractor's order, perform adequate tests during demonstrative production and placing in order to

- establish adequacy of deposit areas and cement concrete production plant, suitability of transportation methods, as well as appropriateness of the placing equipment and placing itself, all in compliance with the requirements provided with these technical conditions,
- take in-situ specimens of the mixture to test conformity of the fresh cement concrete,

- take in-situ specimens of the fresh cement concrete mixture (cubes) for testing the characteristics of the hardened cement concrete,
- establish protection of the cement concrete surface,
- establish the thickness, evenness, height, and inclination of the placed cement concrete layer.

In case the contractor already performed the work with similar cement concrete mixtures during the past year, it is possible to adopt the results of the executed composition as demonstrative production and placing. The engineer shall make the final decision.

2.2.4.1.5.1.4 Regular Production and Placing

The engineer may approve the contractor the regular production only on the basis of results of the demonstrative production and placing. An agreement for a continuous work also includes conditions for the characteristics of cement concrete mixtures, and conditions for the internal production control provided by these technical conditions and the design.

A permit for regular production and placing the cement concrete mixtures shall also include detailed requirements for any eventual additional finishing of the underlaid course surface.

In case any modification in the production and placing a cement concrete mixture occurs, the contractor shall present to the engineer in writing a proposal on such modification. The contractor may bring such modification into effect only after obtaining the approval by the engineer.

2.2.4.1.5.2 Cement Mortar

Unless provided otherwise in the design, suitable cement mortar shall to fill up the joints between the drainage elements shall be used.

2.2.4.1.5.2.1 Composition of Mixture

To the composition of the cement mortar for filling up the joints between the drainage elements, the requirements indicated in 2.2.4.1.5.1.1 shall apply as appropriate.

2.2.4.1.5.2.2 Required Properties

The quality of cement mortar mixtures for filling up the joints shall meet the requirements indicated in Table 4.7.

Table 4.7: Required properties of cement mortar for drainage works

Properties of cement mortar	Unit measure	Required value	Test method
- cement quantity, minimum	kg/m^3	600	-
- compressive strength class	MN/m^2	C 30/37	EN 12390-3
- tensile strength with bending	MN/m^2	≥ 3.5	EN 12390-5
- resistance to water penetration	mm	-	SIST 1026
- resistance to freezing/thawing	-	≤ 0.40	EN 12390-8

All the required values are to be considered as limiting ones.

2.2.4.1.5.2.3 Demonstrative Production and Placing

To the demonstrative and regular production and placing the cement mortar for filling up the joints between drainage elements, the requirements indicated in 2.2.4.1.5.1.3 and 2.2.4.1.5.1.4 shall apply as appropriate.

2.2.4.2 SURFACE DRAINAGE

General

Surface drainage protects the road body from precipitation water, which can jeopardize its durability, when falling onto the road body or the nearby surroundings.

For the surface drainage the following elements are used:

- paved ditches (channels), and
- gutters.

Surface drainage shall be executed in dimensions specified by the design and in compliance with these technical conditions. Any alteration shall be previously approved by the engineer.

2.2.4.2.1 Description

The following is used for surface drainage:

- ditches paved with
  - quarry stone,
  - bound crushed stone (»Colcrete«),
  - cement concrete slabs,
  - cement concrete pavers,
  - cement concrete segments,
  - cement concrete gutter elements
- ditches covered with topsoil, and
- gutters
  - of cement concrete,
  - of bituminous (asphalt) concrete,
  - paved with quarry stone,
  - paved with stone cubes.

Protection of the bottom of curved ditches can be executed with

- bituminous (asphalt) concrete, and
- small stone pavers (cubes).

In order to protect the foot of slopes of drainage ditches, the following shall be placed:

- quarry (broken) stone, and
- meshed baskets (gabions).

Execution of all the a.m. works for assuring surface drainage includes supply of all adequate materials and their placing at such locations as specified by the design.

These works do not comprise the necessary earth works, which are included and explained in detail in section 2.2.2.1 of these technical conditions.

As a rule, the method of paving the ditches, execution of gutters, and protection of both bottom and foot of the slopes of ditches are defined by the design. If not, the engineer shall bring final decision.

2.2.4.2.2 Basic Material

2.2.4.2.2.1 Quarry Stone

Quarry (broken) stone of silicate and carbonate rock shall be applied for paving the drainage ditches and gutters for protection of the foot of slopes of ditches.

2.2.4.2.2.2 Prefabricated Cement Concrete Elements

Various prefabricated cement concrete elements corresponding to the conditions provided particularly by the design can be used for paving the drainage ditches and gutters.

2.2.4.2.2.3 Cement Concrete Mixtures

Cement concrete mixtures are applicable to underlaid courses and to execute gutters.

Basic materials for the preparation of adequate cement concrete mixtures for the works stated are defined in 2.2.4.1.2.2 of these technical conditions.

2.2.4.2.2.4 Cement Mortar

Cement mortar used for filling up the joints between quarry stones, prefabricated cement concrete elements, as well as stone pavers and cubes shall be composed of mixture of sand, cement, and water.

Basic materials for the preparation of adequate cement mortar mixtures for the stated works are defined in 2.2.4.1.2.3 of these technical conditions.

2.2.4.2.2.5 Bituminous (Asphalt) Concrete Mixtures

Mixtures of bituminous (asphalt) concrete can be used for execution of gutters and for protection of the bottom of curved ditches. The applicable materials for production of such bituminous mixtures are defined in 2.2.3.2.2.2 of these technical conditions.

2.2.4.2.2.6 Stone Pavers

To protect the bottom of curved ditches small stone pavers (cubes) made of silicate and carbonate rock, and specified in section 2.2.3.4.2 of these technical conditions, can be used.

3.2.4.0.1.2Mineral Aggregates

Mineral aggregate mixtures for underlaid courses in paved ditches are specified in section 2.2.4.1.2.1 of these technical conditions.

2.2.4.2.2.7 Meshed Baskets

Meshed baskets (gabions) can be made of steel or plastic wires. Quarry stone, rubble, or gravel, exceptionally also rough gravel and roughed chippings can be used to fill up the baskets.

2.2.4.2.3 Quality of Material

2.2.4.2.3.1 Quarry Stone

Quarry (broken) stone for paving the ditches and gutter shall be of stringy, uniform, and against weather, water, and salt impacts resistant rock. The quarry stone for paving the ditches shall be flat. The compressive strength of quarry stone used for paving shall amount to minimum 120 MN/m^2.

The quarry stone for protection of the foot of slopes of ditches and for filling up the wire baskets (gabions) shall be resistant to weather and water actions.

The size of quarry stone pieces shall be adjusted to the purpose of its application, and shall be defined in the design.

2.2.4.2.3.2 Prefabricated Cement Concrete Elements

Prefabricated cement concrete elements used for paving the drainage ditches (slabs, segments), and for gutters shall be made of compact cement concrete without any cracks, and shall comply with the requirements indicated in Table 4.8.

Fig. 4.8: Required properties of prefabricated cement concrete elements

Properties of prefabricated elements	Unit measure	Required value	Test method
- deviation from dimensions, maximum	mm	± 5	-
- compressive strength class:			EN 12390-3
- average	MN/m^2	C 30/37	
- individual	MN/m^2	C 25/30	
- resistance to freezing/thawing – XF4 degree, 50 cycles	mg/mm^2	≤ 0.40	EN 12390-8

The engineer has the right to approve the use of prefabricated elements of cement concrete having different characteristics.

In case the prefabricated elements are produced of two types of cement concrete (main concrete and face concrete), a perfect composite effect between these two layers shall be ensured.

2.2.4.2.3.3 Cement Concrete Mixture

The quality of materials for cement concrete mixtures used for gutters and for underlaid courses shall comply with the requirements indicated in 2.2.4.1.3.2 of these technical conditions as appropriate.

Unless provided otherwise by the design, cement concrete used for surface drainage shall meet the requirements indicated in 2.2.4.1.5.1 of these technical conditions.

2.2.4.2.3.4 Cement Mortar

The quality of materials for the cement mortar used for filling up the joints occurring in paved ditches is specified in detail in 2.2.4.1.3.3 of these technical conditions.

The cement mortar shall meet the requirements indicated in 2.2.4.1.5.2 of these technical conditions.

2.2.4.2.3.5 Bituminous (Asphalt) Concrete Mixtures

For the execution of gutters and for protection of the bottom of segment ditches such quality of the bituminous (asphalt) concrete mixture is required as specified in 2.2.3.2.2.5.2 and 2.2,3.2.2.5.3 for wearing courses for light and very light traffic loading. The void content of the produced bituminous concrete mixture shall be on the lower limiting value.

2.2.4.2.3.6 Stone Pavers

The quality of stone pavers to protect the bottom of segment ditches shall meet the requirements indicated in 2.2.3.4.3.1.

2.2.4.2.3.7 Mineral Aggregates

Mineral aggregate mixtures for underlaid courses and for filling up the joints in paved ditches can be composed of grains of sand and gravel or chippings. The quality of these mixtures shall comply with the provisions indicated in 2.2.4.1.3.1 of these technical conditions. The size of grains in the mixture shall be adjusted to the design thickness of the underlaid course or to the design width of the joint.

2.2.4.2.3.8 Meshed Baskets

Meshes for the baskets (gabions) shall be made of high quality galvanized steel wire or adequate plastic material.

The cross-section of both wire and plastic shall be adjusted to the size of the meshed basket as well as to the material, which the basket will be filled with. In case no requirements for the meshed baskets are specified in the design, the engineer shall define them.

2.2.4.2.4 Method of Execution

All the considered methods of surface drainage consist, as a rule, of the following:

- underlaid course (one or two), and
- coating course (paving).

2.2.4.2.4.1 Winning the Materials

In due time prior to commencement of the surface drainage works, the contractor shall inform the engineer of all the materials he intends to use, submit adequate evidence on the conformity, and obtain an approval by the engineer for the application of these materials.

All material properties specified in 2.2.4.1.3 shall be ensured. The material not meeting the specified requirements shall be eliminated and extra marked by the contractor.

2.2.4.2.4.2 Depositing the Materials

Conditions for depositing the necessary materials for surface drainage are defined in 2.2.4.1.4.2 of these technical conditions.

2.2.4.2.4.3 Substrate Preparation

As a rule, the substrate for the underlaid course is the formation of an excavation or of a fill prepared in compliance with the requirements indicated in 2.2.2.2.5 and 2.2.2.4.5 of these technical conditions. Any deviation form the specified requirements shall be previously approved by the engineer.

2.2.4.2.4.4 Production of Cement Concrete and Cement Mortar Mixtures

The conditions for production of cement concrete and cement mortar mixtures are specified in 2.2.4.1.4.3 of these technical conditions.

2.2.4.2.4.5 Production of Bituminous Concrete Mixture

The conditions for production of bituminous (asphalt) concrete mixture for execution of gutters and for protection of the bottom of curved ditches are described in detail in 2.2.3.2.2.4.4 of these technical conditions.

2.2.4.2.4.6 Bringing the Materials

Onto an adequately prepared substrate formation, which must not be frozen, bringing of mineral aggregate mixture and of cement concrete mixture for the underlaid course of paving the ditches may commence only after this has been approved by the engineer.

Suitably equipped vehicles shall be used to perform the transportation. Both mineral aggregate mixture and cement concrete mixture shall remain uniform during the transportation, and the other properties of the cement concrete mixture must not be altered as well.

The number of vehicles for the transportation of the material for the underlaid course to the site shall be adjusted to conditions of uniform placing in view of the capacity of mechanical facilities for the production, the transportation distance, and the ability of placing.

Also the transportation of all other materials for the coating course or for protection in the surface drainage shall be adapted to the placing conditions.

2.2.4.2.4.7 Placing the Materials

2.2.4.2.4.7.1 Underlaid Courses

The underlaid course can be executed of an unbound mineral aggregate mixture and/or of a cement concrete mixture.

An unbound mineral aggregate mixture placed as an underlaid course in dimensions as provided by the design and in a uniform thickness, shall be so executed as to allow placing of the second underlaid course and/or of the coating course or protection in required inclinations, and adequately evenly. The same requirements also apply to the cement concrete underlaid course to ensure proper water drainage.

An unbound mineral aggregate mixture and/or a cement concrete mixture spread in a uniform layer thickness for underlaid course shall be applied to an excessive height, so that after compaction or consolidation of the coating course the thickness or one more underlaid courses complies with the dimensions as provided by the design.

Placing the cement concrete mixture shall be adjusted to available space and equipment; however it shall be executed in a single layer as a rule. The compaction of the cement concrete mixture shall as uniform as possible. Daily interruptions of placing shall be treated as compressed joint, perpendicularly to the direction of placing as a rule.

The time of placing the cement concrete mixture must not be longer than one hour. The engineer may approve a longer placing time, provided that the contractor submits evidence that the required quality of cement concrete is ensured anyway.

When placing cement concrete as an underlaid course, account shall be taken of the air temperature, and adequate measures shall be taken.

To the placing of mineral aggregate mixtures adequate conditions indicated in these technical conditions shall apply.

Unless appropriately specified in the design, the engineer defined both method and conditions of placing underlaid courses.

The contractor may commence placing the coating course or the protection of the bottom or the foot of slopes of ditches only after the client has already taken over the underlaid course. For the entire period up to the commencement of placing the coating course the contractor shall maintain the formation of the underlaid course in the same condition as it has been at the time of taking over, and shall repair all the damage, which might occur during this period.

2.2.4.2.4.7.2 Coating Course

The method of execution of coating course within the scope of paving the ditches, including all the dimensions, shall be specified by the design.

To ensure the specified shape of the paved ditches, gutters, and protections, the inclinations shall be marked by means of profile boards as a rule.

Placing of materials for coating courses of ditches is predominantly manual. For the execution of cement concrete gutters, besides the fixed formwork and the manual placing, a method of placing by means of a finisher with a sliding formwork is appropriate as well.

Joints between quarry stones, slabs, pavers, segments, and channel elements in paved ditches must not be wider than 20 mm. They shall be so shifted one to another as to prevent joining of more than three elements of the coating course at one location.

As a rule, joints between the elements of the coating courses in paved ditches and gutters shall be filled up with cement mortar, or with a mixture of crushed stone grains. The depth of filling up the joints shall amount to

- minimum 30 mm on an underlaid course of unbound mineral aggregate mixture;
- on an underlaid course of cement concrete mixture it shall reach up to this course.

The thickness of individual crushed stone grains for filling up the joints shall not exceed two thirds of the joint width.

When using quarry (broken) stone to pave ditches, the terminations at edges shall be executed with larger pieces of the quarry stone.

In case the elements for the coating course are placed onto the underlaid course made of cement concrete mixture, they shall be soaked in water prior to being placed. The joints shall be moistened before filling up with cement mortar as well.

To the placing the bituminous concrete into the coating course of gutters, and for protection of the bottom of curved ditches, the conditions specified in 2.2.3.2.2.4.6 of these technical conditions shall apply. The engineer may give additional conditions as well.

2.2.4.2.4.7.3 Protection of Slope Foot

Protection of the slope foot of ditches with quarry stone or meshed baskets (gabions) shall be carried out by placing them onto adequately prepared substrate, according to the requirements provided by the design and these technical conditions.

The size of the quarry stone pieces shall correspond to the conditions for the use of protection. The quarry stone shall be, as a rule, placed "in dry". The engineer shall approve the application of cement mortar or cement concrete mixture for binding together the material and for filling up the quarry stone.

Each single piece of the quarry stone shall be so incorporated in the stone lining or meshed basket as to prevent its carrying away by the water or its displacement.

2.2.4.2.5 Quality of Execution

In due time prior to commencement of the works the contractor shall submit to the engineer evidence on the quality of all the materials he intends to use for the surface drainage. Placing of partly damaged prefabricated cement concrete elements may be approved by the engineer, unless such a use might detriment the quality of the surface drainage.

The contractor must not commence the work until he has obtained an approval by the engineer.

Unless agreed otherwise, the required characteristics of the quality of basic materials specified in 2.2.4.1.3 of these technical conditions shall be considered as limiting values.

The admitted deviations of evenness, height, and inclination of both bottom and slopes of paved ditches and gutters, as well as of protection of the bottom of the ditches, from the design values, are indicated in Table 4.9.

Table 4.9: Required properties of the surface of ditches, gutters, and bottom protection

Surface properties	Unit measure	Admissible deviations	
		bottom	slope *
- Ditches and gutters:			
- evenness	mm	- 15	- 25
- height	mm	± 10	± 50
- inclination	%	± 0.5	± 10
- Bottom protection:			
- evenness	mm	- 15	-
- height	mm	± 10	-
- inclination	%	± 0.5	-

** Admissible deviations of slopes shall not be by leaps and bounds.*

When deviations, which are close to the limiting values, are successive, the engineer shall bring final decision.

2.2.4.2.6 Internal Control

2.2.4.2.6.1 Internal Control

The extent of the internal control during paving the ditches, construction of gutters, protection of the bottom of ditches, and protection of slope foots, which has to be carried out by an authorized laboratory, shall be specified in the approved programme of the average testing frequency. If this is not the case, the engineer shall specify the extent of the internal control. In addition, he shall also appoint locations for taking specimens and measuring places, all in accordance with a statistical random selection.

The minimum testing frequency is indicated in Table 4.10.

Table 4.10: Minimum testing frequency during internal control of surface drainage

Properties	Minimum testing frequency
- compressive strength of quarry stone for paving	800 m^1
- properties of hardened cement concrete (properties according to Table 4.6)	200 m^1
- properties of cement mortar (properties according to Table 4.7)	800 m^1
- properties of bituminous concrete (properties according to Table 3.42)	500 t
- properties of mineral aggregate (properties according to section 2.2.4.1.3.2.1)	2,000 m^1
- surface of ditch (properties according to Table 4.9)	20 m^1

2.2.4.2.6.2 External Control

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 5 to the internal control testing. Places for taking specimens for the external control of quality shall be specified by the engineer in accordance with a statistical random selection.

2.2.4.2.7 Measurement and Take-Over of Works

2.2.4.2.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in adequate units of measurement.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities. In addition, those quantities shall also be recorded in due time.

2.2.4.2.7.2 Take-Over of Works

The engineer shall take-over the executed surface drainage in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. All the established deficiencies with regard to those requirements shall be mended by the contractor prior to continuing the works.

2.2.4.2.8 Final Account of Works

2.2.4.2.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.4.2.7.1 and taken-over in compliance with section 2.2.4.2.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.4.2.8.2 Deductions Due to Insufficient Quality

2.2.4.2.8.2.1 Quality of Materials

Since the adequate quality is unambiguously specified, there shall be no deductions when accounting the executed surface drainage works.

In case the contractor places such material for surface drainage, which does not meet the requirements indicated in 2.2.4.2.3 of these technical conditions, the engineer shall appoint the method of accounting. He also has the right to reject the complete work carried out.

2.2.4.2.8.2.2 Quality of Execution

The required bases to assess the quality are given in Table 4.9.

If the contractor fails to ensure the required quality of the surface drainage, the engineer decides on the method of accounting.

2.2.4.3 DEEP DRAINAGE SYSTEM – DRAINAGES

General

Deep drainage system by means of drainages serves to improve hydrological conditions within the road body. The deep drainage system prevents the water inflow into the road body, as well as ensures lowering of the level and evacuation of the ground water. Thereby, the consolidation, stabilization, and improvement of the bearing capacity of highly compressible and low permeable cohesive soil of very low bearing capacity.

Deep drainage system is made feasible by drainages and structures associated with these drainages.

Deep drainage system by means of drainages shall be executed in dimensions defined by the design and with these technical conditions. Any modification in agreement with the responsible designer shall be also approved by the engineer prior to commencement of the works.

3.2.4.0.2 Description

The following shall be foreseen for the deep drainage system:

- shallow and deep longitudinal and transverse drainages, and
- vertical drainages and piles.

Shallow and deep longitudinal and transverse drainages may be placed onto:

- excavation formation,
- puddle (clay) layer, or
- underlaid course of cement concrete

Vertical drainages and piles can be

- bored in (by removal of the core),
- driven in (impressed).

Execution of all abovementioned drainage types to ensure deep drainage includes supply of all appropriate materials and placing them at locations defined by the design.

However, these works do not comprise the required earth works for both excavation and backfilling, which are taken into consideration and specified in detail in sections 2.2.2.1 and 2.2.2.4 of these technical conditions.

The water arising from the excavations for the deep drainage system shall be pumped out for the whole duration of backfilling, which is to be executed up to the ground water level. Any damage that might occur due to omission of the water pumping out shall be charged to the contractor.

The method of execution of drainages shall be, as a rule, specified by the design. If this is not the case, the engineer shall bring final decision.

2.2.4.3.1 Basic Materials

Basic materials for the deep drainage system with drainages are the following:

- materials for underlaid courses,
- drainage pipes,
- materials for backfilling the drainages,
- drainage tapes.

2.2.4.3.1.1 Materials for Underlaid Courses

Puddle (clay) layer or a cement concrete mixture is particularly used to execute the underlaid course in the deep drainage system.

2.2.4.3.1.2 Drainage Pipes

Pipes for shallow and deep longitudinal and transverse drainages can be made of

- plastic (flexible or hard), or
- cement concrete.

The cross-section of drainage pipes can be either circular or in a shape of a tunnel. The pipes shall be perforated.

2.2.4.3.1.3 Materials for Backfilling the Drainages

Shallow and deep longitudinal and transverse drainages can be backfilled with

- mineral aggregate mixtures, or
- cement concrete mixtures,

unwrapped or wrapped with dividing geosynthetic fabric.

Mixtures of grains of sand, gravel, and crushed stone may also be used to backfill drainage pipes and drainage ribs, as well as to fill up vertical drainages (piles).

2.2.4.3.1.4 Drainage Tapes

For vertical draining particularly drainage tapes made of geosynthetic fabric reinforced with a finisher, with a plastic core or without it, shall be used.

2.2.4.3.2 Quality of Materials

2.2.4.3.2.1 Materials for Underlaid Courses

2.2.4.3.2.1.1 Puddle Layer

Quality of the material for the puddle layer is defined in detail in section 2.2.2.4.3.1, whereas the quality of execution in section 2.2.2.4.5.1 of these technical conditions.

2.2.4.3.2.1.2 Cement Concrete Mixture

The quality of materials for cement concrete mixtures used to execute underlaid courses for deep drainage system shall meet the requirements indicated in 2.2.4.1.3.2 of these technical conditions.

Unless directed otherwise by the design, the cement concrete used to execute underlaid courses for drainage system shall comply with the requirements provided by section 2.2.4.1.5.1 of these technical conditions.

In special cases of execution of the deep drainage system the engineer has the right to supplement the stated requirements for the cement concrete used for underlaid courses.

2.2.4.3.2.2 Drainage Pipes

Plastic drainage pipes for the deep drainage system shall meet the requirements with regard to

- dimensions: pipe diameter and wall thickness,
- mass,
- arrangement and area of openings allowing water inflow, and
- stiffness.

The quality of plastic pipes, bends, and other formed elements for the drainage shall comply with the requirements provided by the DIN 4262-1 Piping systems for underground drainage.

For all drainage pipes and formed elements made of polymer materials the following shall be evident from the design documents:

- nominal diameter,
- required type of perforation: TP (360°), LP (220°), MP (120°), UP (without perforation), and
- pipe category in dependence on the required stiffness: ND or SD.

The design may also require a greater stiffness than the minimum one indicated in the standard (non-standard requirements), for such a case however, the drainage pipes shall be specially fabricated.

For draining the tunnels it is possible to foresee drainage pipes of type R2, C1, and C2. The drainage pipe type shall be specified by the design.

Drainage pipes for tunnels shall meet the following requirements:

- total area of drainage openings: ≥ 200 cm^2/m^1
- width of drainage openings: 5 ± 1 mm
- perforation type (angle of 220°) LP

In pipes of circular cross-section the central longitudinal axis of perforation shall be clearly marked.

Cement concrete drainage pipes shall meet the prescribed requirements for:

- dimensions: pipe length and diameter, as well as wall thickness,

- evenness,
- arrangement and area of opening allowing water inflow,
- resistance to pressure acting on pipe apex, and
- resistance to bending.

2.2.4.3.2.3 Materials for Backfilling

2.2.4.3.2.3.1 Mineral Aggregates

The composition of mineral aggregate mixture for backfilling the transverse, longitudinal, and vertical drainages not wrapped with fabric shall comply with the following boundary conditions:

$$12 \langle \frac{d_{15D}}{d_{15Z}} \langle 40$$

$$12 \langle \frac{d_{50D}}{d_{50Z}} \langle 52$$

where:

$d_{15\,D}$, $d_{50\,D}$ - *grain diameter at 15% or 50% passing sieve (siftings) of mineral aggregate mixture for backfilling the drainage*

$d_{15\,Z}$, $d_{50\,Z}$ - *grain diameter at 15% or 50% passing sieve (siftings) of soil around the drainage, which entering into such drainage is intended to be prevented.*

The diameter of the largest grains in the mineral aggregate for backfilling the drainages may amount to 63 mm, unless specified otherwise by the design and the engineer.

When the mineral aggregate mixture for backfilling the drainages is wrapped with geosynthetic fabric, the composition of the mixture shall be such as to ensure the water permeability quotient to be $k \geq 10^{-4}$ m/s. The specimen shall be prepared in accordance with the modified Proctor method.

The quotient of non-uniform granulometric composition $U = d_{6o}/d_{10}$ shall be greater than 8 for unwrapped mineral aggregate mixture used to backfill the drainage. When the mineral aggregate is wrapped, the quotient U shall be greater than 3, if the aggregate mixture is composed of several fractions; for gap-graded aggregate (basic fraction) no minimum value of the quotient U is specified.

2.2.4.3.2.3.2 Geosynthetic Fabric

Geosynthetic fabric for wrapping mineral aggregate or cement concrete mixtures for deep drainage system – drainages shall meet the requirements indicated in Table 4.11.

Table 4.11: Minimum requirements for dividing geosynthetic fabrics for deep drainage

Geosynthetic fabric properties	Unit measure	Minimum requirements	Test method
Mechanical properties			
- tensile strength transversally - longitudinally	kN/m	> 14	EN ISO 10319
- elongation at failure (rupture)	%	> 30	EN ISO 10319
- resistance to dynamic puncture	mm	< 30	EN 918
- resistance to puncture (CBR)	N	> 2,000	EN ISO 12236
Hydraulic properties:			
- characteristic size of pores	mm	$0.05 \leq O_{90} < 0.5$	EN ISO 12956
- velocity index	m/s	3×10^{-3}	EN ISO 11058
- permeability coefficient at 20 kPa	m/s	$> 10\ k_{soil}$	E-DIN 60 500-4

The lower limiting value shall not be lower than the required values indicated in Table 4.11.

2.2.4.3.2.3.3 Cement Concrete Mixtures

Unless provided otherwise by the design the properties of the cement concrete used to backfill dep drainages may be similar as specified in section 2.2.4.3.3.1.2 for underlaid courses. However, the composition of mineral aggregates for preparation of cement concrete mixtures to backfill drainages shall be such as to allow the water permeability coefficient of the cement concrete placed into the backfill to be $k \geq 10^{-4}$ m/s.

2.2.4.3.2.4 Drainage Tapes

Specified minimum requirements for the properties of drainage tapes shall be harmonized with the conditions of the geotechnical report.

The selected drainage tape shall be defined by the general description of the

- conception,
- material type, and
- dimensions.

As a rule, drainage tape properties indicated in Table 4.12 shall be defined and verified in the geotechnical report.

Table 4.12: Required properties of drainage tapes

Drainage tape properties	Unit measure	Minimum requirements	Test method
Strength properties of core: - tensile strength - elongation at failure (rupture)	 N/cm %	 150 25	 EN 527
Drain capacity of tape – longitudinally	m^3/s	5×10^{-5}	EN ISO 12956
Strength properties of wrapping fabric: - tensile strength - elongation at failure (rupture)	 N/cm %	 120 40	 EN 29073
Filtering-drain properties of wrapping fabric: - effective pore opening - permeability coefficient - permittivity	 μm m/s s^{-1}	 < 100 1×10^{-3} 1.2	 EN ISO 12956 EN ISO 11058 EN ISO 11058

The suitability of the selected drainage tape for the available technology of driving in shall be verified at a test area.

The lower threshold value shall not be lower than the required values indicated in Table 4.12.

Unless provided otherwise by the design, a solid or hollow core of ribbed section of low density polyethylene shall be used for drainage tapes.

The dimensions of polyethylene core shall be specified in the design. The engineer shall approve admissible deviations from the specified dimensions.

2.2.4.3.3 Method of Execution

2.2.4.3.3.1 Winning the Materials

In due time prior to commencement of the deep drainage works, the contractor shall inform the engineer of all the materials he intends to use, submit adequate evidence on the compliance with both design and these technical conditions, and obtain an approval by the engineer for the application of these materials.

All material properties specified in 2.2.4.2.3 shall be ensured, unless provided otherwise by these technical conditions. The material not meeting the specified requirements shall be eliminated and extra marked by the contractor.

2.2.4.3.3.2 Depositing the Materials

In case the contractor, prior to commencement of the works, temporary deposits the materials required, he shall assure and arrange adequate space. Thereby, he shall take account of the instructions issued by the manufacturer of the particular material with regard to its storing, and shall consider instruction given by the engineer, especially with respect to exposure of plastic material to UV light.

Stock of all the materials needed to carry out deep drainage system with drainages shall be of such quantities as to ensure continuous work.

2.2.4.3.3.3 Substrate Preparation

As a rule, the substrate for underlaid course for longitudinal and transverse drainage is the excavation formation, which shall be executed evenly and with adequate inclinations in compliance with the design.

The formation of the course or the working field for placing vertical drainage shall be prepared in accordance with the design and requirements indicated in section 2.2.2.3.5 of these technical conditions.

The engineer shall take-over the substrate formation prior to commencement of placing the underlaid course for the drainages.

2.2.4.3.3.4 Production of Cement Concrete Mixtures

Conditions for production of cement concrete mixtures are specified in 2.2.4.1.4.3 of these technical conditions.

2.2.4.3.3.5 Bringing the Materials

Onto suitably prepared substrate formation, which must not be frozen, cohesive soil for puddle (clay) layer, and cement concrete mixture for underlaid course may be brought only after the engineer has given his approval.

The same conditions also apply to bringing mineral aggregates for execution or backfilling of longitudinal, transverse, and vertical drainages.

For transportation suitable vehicles ensuring keeping suitable properties of the materials for underlaid course, drainages, and backfilling shall be used.

The number of transportation vehicles shall be adjusted to the conditions of uniform placing of drainages for the deep drainage system.

2.2.4.3.3.6 Placing the Materials

2.2.4.3.3.6.1 Underlaid Courses

Underlaid courses of puddle layer or cement concrete mixture shall be placed taking account of the dimensions as provided by the design, evenly and in adequate inclinations to ensure undisturbed evacuation of water.

Due to limited place the puddle layer and cement concrete for underlaid course for drainage shall be placed manually as a rule.

The engineer shall specify the method and conditions of placing underlaid courses for the deep drainage system.

2.2.4.3.3.6.2 Drainage Pipes

The contractor may commence placing the drainage pipes or other materials for draining only after the engineer has taken-over the underlaid course.

Jointing the drainage pipes shall be carried out according to the instructions of both pipe manufacturer and engineer. Tongue-and-groove joints shall remain non-sealed as a rule, whilst the joints where drainage pipes are connected to shafts shall be sealed as specified by the design.

2.2.4.3.3.6.3 Backfilling

The contractor may start backfilling the excavations for drainages, or placing mineral aggregate or cement concrete mixtures only after this has been approved by the engineer.

Backfilling and compacting shall be carried out in layers to achieve approximately 80% compaction of the placed mineral aggregate (defined according to the modified Proctor method), without any hazard of damaging the drainage pipes or of excessive impressing the stone grains into soil around vertical drainages (piles).

The outlet of bored vertical drainages or piles shall be, as a rule, equipped with a protective pipe during backfilling, whereas this applies to the remaining part of the borehole only in case this is indispensable to achieve the specified quality of backfilling the drainage or the pile.

Impressed vertical drainages with backfilling shall be executed by filling up the impressed pipe with mineral aggregates, and by suitable dynamic compaction during pulling out the pipe.

Final backfilling layer applied to drainage shall be executed functionally and in compliance with the subsequent construction according to the design.

2.2.4.3.3.6.4 Vertical Drainages with Tapes

Vertical drainages in tape form shall be impressed into the soil by means of an adequate device equipped with protective guide, so that the change of the soil condition at the drainage tape is as small as possible after pulling out the protective guide, and the drainage tape is clean.

Any imoressed drainage tape may be extended only once. The joint shall be so carried out as to ensure undisturbed water flow and drainage tape mechanical properties required at driving in.

In soft soils the drainage tape shall be adequately anchored at the bottom to ensure the design drainage depth.

All the cohesive soil accumulated at the outlet of the impressed vertical drainage tape during pulling out the protective guide shall be removed to ensure undisturbed water outflow.

The drainage tapes imoressed shall reach at least 30 cm above the formation of the layer to which they are impressed, and above the working field formation respectively. That portion of the drainage tape shall be placed onto the formation and covered with adequate permeable material.

2.2.4.3.4 Quality of Execution

The contractor shall in due time prior to commencement of the works submit to the engineer suitable evidence on the quality of the materials he intends to use for the deep drainage system, all in accordance with the requirements indicated in 2.2.4.2.3.

The engineer may approve placing of partly damaged basic materials provided that this has no adverse impact on the quality of deep drainage.

The contractor must not start the works prior to obtaining an approval by the engineer.

Unless agreed otherwise, the required properties of basic materials specified in section 2.2.4.2.3 of these technical conditions shall be considered as limiting values. The engineer shall specify the threshold values in view of the characteristics of the particular work.

2.2.4.3.5 Quality Control of Execution

2.2.4.3.5.1 Internal Control

The extent of the internal control during the execution of the deep drainage system, which has to be carried out by an authorized laboratory, shall be specified by the engineer on the basis of the submitted documents in compliance with section 2.2.4.3.5, and on the basis of the work progress.

The engineer shall also appoint locations for taking specimens and measuring places, all in accordance with a statistical random selection.

The minimum testing frequency within the scope of the deep drainage internal control is indicated in Table 4.13.

Table 4.13: Minimum testing frequency during the deep drainage system internal control

Properties of	Minimum testing frequency
- puddle layer	400 m^1
- cement concrete mixture	400 m^1
- drainage pipes	400 m^1
- mineral aggregate mixtures	200 m^3
- geosynthetic fabric	4,000 m^2
- drainage tapes	20,000 m^1

2.2.4.3.5.2 External Control

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 5 to the internal control testing. Places for taking specimens for the external control of quality shall be specified by the engineer in accordance with a statistical random selection.

2.2.4.3.6 Measurement and Take-Over of Works

2.2.4.3.6.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in adequate units of measurement.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities. In addition, those quantities shall also be recorded in due time.

2.2.4.3.6.2 Take-Over of Works

The engineer shall take-over the executed deep drainage system in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. All the established deficiencies with regard to those requirements shall be mended by the contractor prior to continuing the works.

2.2.4.3.7 Final Account of Works

2.2.4.3.7.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.4.2.7.1 and taken-over in compliance with section 2.2.4.2.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.4.3.7.2 Deductions Due to Insufficient Quality

2.2.4.3.7.2.1 Quality of Materials

The quality of basic materials for drainages for the deep drainage system is specified in terms of limiting values which shall be achieved as a rule.

In case the engineer also specified the threshold values for the quality of basic materials, he shall appoint the method of accounting the deductions, unless this is the same as provided by the general technical conditions.

In case the contractor places such material for deep drainage, which does not meet the requirements indicated in 2.2.4.2.3 of these technical conditions, the engineer shall appoint the method of accounting. He also has the right to reject the complete work carried out.

3.2.4.0.2.1.1 Quality of Execution

The quality of the deep drainage system with drainages shall be specified in the design and by the properties, the testing of which is indicated in Table 4.13.

If the contractor fails to ensure the required quality of the deep drainage system, the engineer decides on the method of accounting.

2.2.4.4 DEEP DRAINAGE SYSTEM – SEWAGE SYSTEM

General

Sewage system is intended for deep drainage of surface, waste, and faecal water. It shall be executed in dimensions as provided by the design and in accordance with these technical conditions. Any modification in agreement with the responsible designer shall be approved by the engineer prior to commencement of works.

2.2.4.4.1 Description

Sewage system can be constructed

- of pipes,
- by semi-prefabricate method with prefabricated elements for the bottom and/or arch, and with cement concrete, or
- by in-situ method of tiles, brick, and/or cement concrete.

Execution of the sewage system includes the supply of all adequate materials, as well as placing at locations and in the way as provided in detail by the design.

These works do not comprise the required earth works for both excavation and backfilling, which are taken into consideration and specified in detail in sections 3.2.2.1 and 3.2.2.4 of these technical conditions.

The water shall be pumped out from the excavations for the sewage system all the time until the backfilling is completed up to the ground water level. Any damage that might occur due to omission of pumping out the water shall be charged to the contractor.

The construction method and the testing of sewage systems are specified in the design as a rule. If this is not the case, the engineer shall bring final decision.

2.2.4.4.2 Basic Materials

Basic materials used for construction of sewage systems are

- materials for underlaid courses,
- sewerage pipes,
- materials for treatment of joints, and
- materials for backfilling.

2.2.4.4.2.1 Materials for Underlaid Courses

The underlaid course below the sewerage pipes shall be made of

- mineral aggregate mixtures, and/or
- cement concrete mixtures.

Only exceptionally the sewerage pipes may be placed directly onto the excavation formation.

2.2.4.4.2.2 Pipes for Sewage System

For the sewage system the following pipes are recommended:

- plastic pipes (polypropylene, polyester, polyethylene, polyvinylchloride),
- cement concrete pipes,
- pipes of ductile casting, and
- cast iron pipes.

The following types of pipes are rarely applied:

- steel pipes, and
- ceramic pipes.

Pipes for sewage system shall be of circular cross-section as a rule. Cement concrete pipes for special purposes of sewage systems may also be of oval or horseshoe-shaped cross-section or a cross-section with a gutter.

The type of sewerage pipes shall be specified in the design.

2.2.4.4.2.3 Materials for Treating the Joints

Cement mortar for treating the pipe joints shall be composed of a mixture of sand, cement, and water.

Joints between sewerage pipes can also be sealed with bituminous cord and bituminous compound, rubber sealing rings, or sealing mastic.

2.2.4.4.2.4 Materials for Backfilling

Suitable materials for backfilling the sewage system ditches are defined in detail in section 2.2.2.4 of these technical conditions.

2.2.4.4.3 Quality of Materials

2.2.4.4.3.1 Materials for Underlaid Courses

2.2.4.4.3.1.1 Mineral Aggregates

The quality of mineral aggregate mixtures for underlaid course below sewerage pipes is defined in section 2.2.4.1.3.1 of these technical conditions.

2.2.4.4.3.1.2 Cement Concrete Mixtures

The quality of materials for cement concrete mixtures for underlaid courses below the sewerage pipes shall meet the requirements indicated in 2.2.4.1.3.2 of these technical conditions.

Unless provided otherwise by the design, the cement concrete for underlaid courses for sewage systems shall comply with the provisions indicated in 2.2.4.1.5.1 these technical conditions.

In case certain sewage system is to be executed under special conditions, the engineer has the right to supplement the stated requirements for cement concrete mixtures used to carry out underlaid courses.

2.2.4.4.3.2 Pipes for Sewage System

The required quality of sewage system pipes is specified in relevant regulation.

Sewerage pipes shall have tongue-and-groove joints. Application of any other types of pipes shall be approved by the engineer.

Sewerage pipes shall meet the requirements in terms of

- dimensions: diameter, length, and wall thickness,
- water non-permeability,
- resistance to pressure acting on apex.

The quality of plastic pipes, bends, and other pipe fittings for sewage systems shall meet the requirements indicated in Table 4.14.

Table 4.14: Standards to define the quality of plastic pipes and fittings for sewage systems

Type of polymer pipe/fitting	Standard for testing
- with structured (non-solid) wall	EN 13476
- with solid wall: polyethylene	EN 12666
non-softened polyvinylchloride	EN 1401
polypropylene	EN 1852
reinforced polyester	EN 1636

If the pipes are not standardized, the required values shall be specified in the producer's documents and in the design.

2.2.4.4.3.3 Materials for Treating the Joints

2.2.4.4.3.3.1 Cement Mortar

The quality of materials for cement mortar to be applied to the sewerage pipe joints is specified in detail in section 2.2.4.1.3.3 of these technical conditions.

2.2.4.4.3.3.2 Other Materials

The quality of other materials to be applied to the sewerage pipe joints is specified in detail by the prescribed properties in the documents provided by the producer as directed by the engineer.

2.2.4.4.3.4 Materials for Backfilling

The quality of cohesive or stone material for backfilling the sewage system ditches (moisture content, percentage of organic admixtures) shall comply with the conditions for the compaction of the material placed, which is for the sewage system,

- within the road body area specified by the requirements indicated in 2.2.2.4.5.1 (Table 2.14),
- outside this particular area it amounts to 95% with regard to the density of the material used for backfilling, as defined by the standard Proctor method.

The material for backfilling the sewage system ditches to at least 30 cm above the pipe apex must not contain grains larger than 63 mm. Manual placing is mandatory.

2.2.4.4.4 Method of Execution

2.2.4.4.4.1 Winning the Materials

In due time prior to commencement of the sewage system works, the contractor shall inform the engineer of all the materials he intends to use, submit adequate evidence on the quality and conformity with the design and these technical conditions, and shall obtain an approval by the engineer for the application of these materials.

All material properties specified in 2.2.4.3.3 shall be ensured. The material not meeting the specified requirements shall be eliminated and extra marked by the contractor.

2.2.4.4.4.2 Depositing the Materials

The conditions for depositing necessary materials for the sewage system are specified as appropriate in section 2.2.4.1.4.2 of these technical conditions.

2.2.4.4.4.3 Substrate Preparation

As a rule, the substrate for underlaid course for the sewage system is the excavation formation, which shall be executed in accordance with the requirements indicated in 2.2.2.1.4.2 of these technical conditions. Any deviation of these requirements shall be approved by the engineer.

The engineer shall take-over the substrate formation prior to commencement of placing the underlaid course or sewerage pipes, if the latter are placed directly onto the excavation formation.

2.2.4.4.4.4 Production of Cement Concrete and Cement Mortar Mixtures

The conditions of the production of cement concrete mixtures for underlaid courses, and of cement mortar to be applied to the pipe joints are described in detail in section 2.2.4.1.4.3 of these technical conditions.

2.2.4.4.4.5 Bringing the Materials

Onto suitably prepared substrate formation, which must not be frozen, mineral aggregate mixture and cement concrete mixture for underlaid course may be brought only after the engineer has given his approval.

For transportation suitable vehicles shall be used. The mineral aggregate mixture and the cement concrete mixture shall remain uniform during the transportation, and the other properties of the cement concrete mixture must not change.

The number of transportation vehicles shall be adjusted to the conditions of uniform placing of the sewage system.

2.2.4.4.4.6 Placing the Materials

2.2.4.4.4.6.1 Underlaid Courses

Underlaid courses of mineral aggregate or cement concrete mixture, as well as the underlaid plates of cement concrete or wood shall be placed by an extra height, in the dimensions as provided by the design, evenly and in adequate inclinations to ensure suitable placing and fitting of sewerage pipes, as well as undisturbed evacuation of surface, waste, and faecal water.

Due to limited place the materials for underlaid courses shall be placed manually as a rule.

The engineer shall specify the method and conditions of placing underlaid courses for the sewerage pipes.

2.2.4.4.4.6.2 Pipes for Sewage System

The contractor may commence placing the sewerage pipes only after the engineer has taken-over the underlaid course.

Sewage system pipes shall be placed at the same time at least on the section between adjacent shafts.

Sewerage pipe joints shall be watertight. This also applies to the connection of the sewerage pipe to the shaft.

In case that jointing of pipes is not specified in detail in the design, the engineer shall define the method of jointing.

For jointing plastic and cast iron pipes as well as pipes of ductile casting for the sewage system, instructions by the pipe manufacturer shall be taken into consideration as a rule. For jointing cement concrete sewerage pipes it is obligatory that, in addition to the suitable cement mortar applied to the pipe tongue, the pipe joint is also treated with a 3-5 cm thick and 6-10 cm wide cement concrete ring.

2.2.4.4.4.6.3 Backfilling

To the backfilling of sewage system ditches provisions of section 2.2.2.4.4 of these technical conditions shall apply as appropriate.

The backfill of sewage system pipes shall be compacted at least up to 30 cm above the pipe apex using suitable equipment.

Under special conditions the engineer shall decide upon the backfilling method. He shall also specify the quality conditions for such working method.

Pipe Strengthening

The bases for the design analysis of pipelines are specified in the technical regulation ATV A 127 Guidelines for design analysis of sewage channels and installations, in view of the foreseen

- loads,
- quality of soil, and
- method of execution (form of excavation).

When the results of the design analysis (stability verification) show that the declared stiffness of plastic pipes is insufficient to take the design loading, the particular pipe shall be strengthened by means of suitable cement concrete lining, which must be so designed and executed as to be able to take the entire expected loading. In such a case, plastic pipes serve only as shuttering and ensure the system water-tightness.

Both method and quality of the cement concrete lining to be applied to the external surface of the pipeline shall be specified in the design.

For all the pipes and pipe fittings made of plastic materials the type and the series of the pipes (nominal stiffness, series), which depends on the foreseen load on the system, shall be evident from the design.

Unless provided otherwise by the design, the same cement concrete quality may be used for the application of the lining to strengthen the sewage system pipes, as it is specified for the underlaid course in section 2.2.4.3.3.1.2 of these technical conditions.

3.2.4.0.3 Quality of Execution

The contractor shall in due time prior to commencement of the works submit to the engineer suitable evidence on the quality of the materials he intends to use for the sewage system works, all in accordance with the requirements indicated in 2.2.4.3.3.

The engineer may approve placing of partly damaged sewerage pipes provided that this has no adverse impact on the quality of the sewage system executed.

Prior to commencement of placing the sewage system, the contractor shall submit the preliminary (laboratory) composition of the cement concrete mixture he intends to use for the underlaid course, and of the cement mortar. The preliminary composition shall include the data on all the basic properties of both cement concrete mixture and cement mortar as indicated in sections 2.2.4.3.3.1.2 and 2.2.4.3.3.3.1, as well as suitable evidence on the source and adequacy of all the materials used for the preparation of the preliminary composition. The contractor may start to execute the works only after he has obtained an approval by the engineer.

The properties of the executed backfilling of the sewerage pipe shall be at least the same as those of the adjacent fill or of the foundation soil.

Unless agreed otherwise, the required properties of basic materials specified in section 2.2.4.3.3 of these technical conditions shall be considered as limiting values. The engineer shall specify the threshold values in view of the characteristics of the particular work.

2.2.4.4.5 Quality Control of Execution

2.2.4.4.5.1 Internal Control

The extent of the internal control during the execution of the sewage system, which has to be carried out by an authorized laboratory, shall be specified by the engineer on the basis of the submitted documents in compliance with section 2.2.4.3.5, and on the basis of the work progress.

The minimum testing frequency within the scope of the sewage system internal control is indicated in Table 4.15.

In case the design requires a watertight sewage system, adequate check on the pipeline shall be carried out prior to backfilling, however after protecting the pipeline. At the lowest place of the pipeline, the pressure shall amount to 1 m of water column above the water level line specified by the design, whereas at the highest place the pressure must not be more than 0.5 m above the water level line. The pressure shall be maintained for 5 hours. The method and other conditions of such test shall be specified by the engineer. The latter also defined the extent of survey of placed sewerage pipes as well as the corresponding conditions of surveying works.

Table 4.15: Minimum testing frequency during the internal control of the sewage system construction

Properties of	Minimum testing frequency
- mineral aggregate mixtures (acc. to 3.2.4.0.3.1.)	2,000 m^1
- cement concrete mixtures (acc. to 3.2.4.0.5.1.2)	400 m^1
- pipes (acc. to 3.2.4.4.3.2)	200 m^1
- cement mortar (acc. to 3.2.4.0.5.2.2)	800 m^1
- backfilling material (acc. to 3.2.2.4.6.2.1)	Table 2.16

The engineer shall appoint locations for taking specimens and measuring places, all in accordance with a statistical random selection.

2.2.4.4.5.2 External Control

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 5 to the internal control testing. Places for taking specimens for the external control of quality shall be specified by the engineer in accordance with a statistical random selection.

2.2.4.4.6 Measurement and Take-Over of Works

2.2.4.4.6.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in adequate units of measurement.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities. In addition, those quantities shall also be recorded in due time.

2.2.4.4.6.2 Take-Over of Works

The engineer shall take-over the executed sewage system in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. All the established deficiencies with regard to those requirements shall be mended by the contractor prior to continuing the works.

2.2.4.4.7 Final Account of Works

2.2.4.4.7.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.4.3.7.1 and taken-over in compliance with section 2.2.4.3.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.4.4.7.2 Deductions Due to Insufficient Quality

2.2.4.4.7.2.1 Quality of Materials

The quality of basic materials for the sewage system is specified by the limiting values, which shall be reached as a rule.

Where the engineer specifies the threshold values of the quality of basic materials, he shall also define the method for calculation of deductions, unless the method is the same as provided by the general technical conditions.

In case the contractor places such material for sewage system, which does not meet the requirements indicated in 2.2.4.3.3 of these technical conditions, the engineer should appoint the method of accounting. He also has the right to reject the complete work carried out.

2.2.4.4.7.2.2 Quality of Execution

The quality of the sewage system shall be specified in the design and by the properties, the testing of which is indicated in Table 4.15.

If the contractor fails to ensure the required quality of the sewage system, the engineer decides on the method of accounting of the executed works.

2.2.4.5 SHAFTS

General

Shafts are intended for connecting, inspecting, and maintaining the drainage systems.

They shall be executed in dimensions as specified by the design, and in compliance with these technical conditions.

3.2.4.0.4 Description

The following can be used for drainage:

- inlet shafts,
- inspection shafts.

The shafts can be made

- of semi-prefabricated elements,
- in semi-prefabricated execution (of pipes), or
- of cast in situ cement concrete.

All abovementioned types of shafts can be of circular or square section, the latter shall be uniform or double with a transition.

In inlet shafts the water can flow through a grating from above or laterally. The lateral inlet can be executed either as a gully or a cascade. The gully bottom, serving for settling of the foreign material, shall be in a form of shallow depression as a rule. Pipe connections to shafts shall be located next to the bottom of shafts as a rule.

Execution of shafts includes the supply of all necessary materials, and placing at locations specified by the design.

However, these works comprise neither the required earth works for excavations and backfills, which are taken into consideration and specified in detail in sections 2.2.2.1 and 2.2.2.4 of these technical conditions, nor the construction of shafts for special purposes and of special dimensions, which is defined in detail with the works indicated in section 2.2.5 of these technical conditions.

In case the design foresees waterproofing of shafts, it shall be carried out in accordance with the requirements indicated in section 2.2.5 of these technical conditions.

The water from excavations for shafts shall be pumped out all the time, until the backfilling is completed up to the ground water level. Any damage that might occur due to omission of pumping out the water shall be charged to the contractor.

The method of the shaft construction shall be specified by the design as a rule. If this is not the case, the engineer shall bring final decision.

2.2.4.5.1 Basic Materials

Basic materials for shaft construction are materials

- for underlaid courses, and
- for shafts.

2.2.4.5.1.1 Materials for Underlaid Courses

The underlaid course for shafts shall be, as a rule, made of cement concrete mixture, exceptionally also of mineral aggregates.

2.2.4.5.1.2 Materials for Shafts

To shafts particularly prefabricated cement concrete elements, as well as elements made of plastic and other materials are applicable provided that they comply with the design conditions.

Bases of the shaft construction, including shafts made of polyester, are defined in the EN 13598-1.

The following semi-prefabricated products can be used for shafts:

- cement concrete pipes,
- plastic pipes (polyethylene, polypropylene, polyester),
- pipes of ductile casting,
- suitably shaped bottom of plastic or cement concrete,
- sand, petrol, and oil traps, and
- gratings and covers of cast iron, cement concrete covers, or combinations of cast iron and cement concrete.

By the purpose of application one shall distinguish shafts and covers passable by pedestrians and vehicles. The latter are divided to sustain light loading (up to 15 Mp), medium loading (up to 25 Mp), and heavy loading (up to 40 Mp).

For the construction of cast in situ cement concrete shafts of square or rectangular cross-section the following materials are required:

- cement concrete mixtures,
- reinforcing steel,
- formwork.

The basic materials for preparation of suitable cement concrete mixtures for shafts are specified in 2.2.4.1.2.2 of these technical conditions. The formwork and reinforcing steel is discussed in detail in sections 2.2.5.1 and 2.2.5.2 of these technical conditions.

Bases for the design stability analysis of shafts are defined in the technical regulation ATV-A 127 Guidelines for design analysis of drainage channels and installations.

2.2.4.5.2 Quality of Materials

2.2.4.5.2.1 Materials for Underlaid Courses

2.2.4.5.2.1.1 Cement Concrete Mixtures

The quality of materials for cement concrete mixtures for underlaid courses for shafts shall meet the requirements indicated in section 2.2.4.0.3.2 of these technical conditions.

Unless provided otherwise by the design, the underaid course cement concrete for shafts shall comply with the conditions indicated in 2.2.4.0.5.1 of these technical conditions. In special cases the engineer has the right to supplement the stated requirements.

3.2.4.0.4.1.1 Mineral Aggregates

Kakovost zmesi kamnitih zrn za podložne plasti pod jaški je določena v točki 2.2.4.0.3.1 teh tehničnih pogojev.

2.2.4.5.2.2 Materials for Shafts

2.2.4.5.2.2.1 Prefabricated Cement Concrete Elements

Prefabricated cement concrete elements used for shafts shall be of dense cement concrete, without any cracks, and in accordance with requirements indicated in Table 4.8. The engineer has the right to approve the use of precast elements of cement concrete of different properties.

Prefabricated shaft elements shall be made of one piece with an inflow adjusted.

2.2.4.5.2.2.2 Semi-Prefabricated Products

The required quality of the abovementioned semi-prefabricated products for the shaft construction is defined in relevant regulation or agreed conditions or agreed documents issued by the manufacturer.

The quality of pipes as semi-products for the shaft construction shall meet the requirements provided for sewage system pipes in section 2.2.4.3.3.2. In case the design comprises special requirements in view of the quality of semi-prefabricated products for the shaft construction, they shall be considered as preferential.

2.2.4.5.2.2.3 Materials for In-Situ Execution

To the quality of materials for preparation of cement concrete mixtures as well as for cement concrete mixtures for the shaft construction, the requirements indicated in section 2.2.4.4.3.1.1 of these technical conditions shall apply as appropriate.

The quality of wood for shaft formwork shall meet the requirements indicated in 2.2.5.1 of these technical conditions.

The quality of reinforcing steel for shafts shall comply with the provisions of section 2.2.5.2 of these technical conditions.

Under special construction conditions the engineer can also approve such materials for the shaft execution, which are different from those mentioned above.

2.2.4.5.3 Method of Execution

2.2.4.5.3.1 Winning the Materials

In due time prior to commencement of the shaft construction, the contractor shall inform the engineer of all the materials he intends to use, submit adequate evidence on the quality and conformity with the design and these technical conditions, and shall obtain an approval by the engineer for the application of these materials.

All material properties specified in 2.2.4.4.3 shall be ensured. The material not meeting the specified requirements shall be eliminated and extra marked by the contractor.

2.2.4.5.3.2 Depositing the Materials

Conditions for depositing necessary materials for the shaft construction are indicated in section 2.2.4.0.4.2 of these technical conditions as appropriate.

2.2.4.5.3.3 Substrate Preparation

As a rule, the substrate for underlaid course for shafts is the excavation formation, which shall be executed in accordance with the requirements indicated in 2.2.2.2.5 of these technical conditions. Any deviation of these requirements shall be approved by the engineer.

The engineer shall take-over the substrate formation prior to commencement of placing the underlaid course.

2.2.4.5.3.4 Production of Cement Concrete Mixtures

Conditions of the production of cement concrete mixtures for the shaft construction are defined in detail in 2.2.4.0.4.3 of these technical conditions.

2.2.4.5.3.5 Placing

2.2.4.5.3.5.1 Underlaid Course

Onto suitably prepared substrate formation, which must not be frozen, cement concrete mixture or mineral aggregate mixture for underlaid course to be applied under a shaft shall be brought. The underlaid course shall be placed in dimensions as directed by the design to allow proper building-in of a shaft. Due to limited space the material for underlaid courses shall be placed manually. The conditions of placing the underlaid courses shall be specified by the engineer.

2.2.4.5.3.5.2 Shafts

The contractor may commence the shaft construction only after the engineer has taken-over the underlaid course and has approved the working method. All the works shall be so carried out as to ensure water-tightness of the shaft as well as of all the connections to the shaft, a perfect fitting of the grating or cover to the frame, all in dimensions as specified by the design. Any modification shall be previously approved by the engineer.

2.2.4.5.4 Quality of Execution

The contractor shall in due time prior to commencement of the works submit to the engineer suitable evidence on the quality of the materials he intends to use for the shaft construction, all in accordance with the requirements indicated in 2.2.4.4.3 of these technical conditions.

The engineer may approve placing of partly damaged prefabricated or semi-prefabricated products for the shaft construction provided that this has no adverse impact on the quality of the shaft executed.

Prior to commencement of placing a shaft, the contractor shall submit the preliminary (laboratory) composition of the cement concrete mixture he intends to use for the shaft construction. The preliminary composition shall include the data on all the basic properties of cement concrete mixture as indicated in sections 2.2.4.4.3.1.1 and 2.2.4.4.3.2.3, as well as suitable evidence on the source and adequacy of all the materials used for the preparation of the preliminary composition.

The contractor must not commence the shaft construction works prior to obtaining an approval by the engineer.

Unless agreed otherwise, the required properties of basic materials specified in section 2.2.4.4.3 of these technical conditions shall be considered as limiting values. The engineer shall specify the threshold values in view of the characteristics of the particular work.

2.2.4.5.5 Quality Control of Execution

2.2.4.5.5.1 Internal Control

The extent of the internal control during the execution of shafts shall be specified by the engineer on the basis of the submitted documents in compliance with section 2.2.4.4.5, and on the basis of the work progress.

The minimum extent of the internal control to be carried out by an authorized third party testing laboratory is indicated in Table 4.16.

Table 4.16: Minimum testing frequency during the shaft construction internal control

Properties of	Minimum testing frequency
- mineral aggregate mixtures	200 m^1
- cement concrete mixtures	20 m^1
- prefabricated elements	100 pcs
- semi-prefabricated products	100 pcs
- reinforcing steel	5 t

2.2.4.5.5.2 External Control

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 5 to the internal control testing.

Places for taking specimens for the external control of quality shall be specified by the engineer in accordance with a statistical random selection.

2.2.4.5.6 Measurement and Take-Over of Works

2.2.4.5.6.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in adequate units of measurement.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities. In addition, those quantities shall also be recorded in due time.

2.2.4.5.6.2 Take-Over of Works

The engineer shall take-over the executed shafts in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. All the established deficiencies with regard to those requirements shall be mended by the contractor prior to continuing the works.

2.2.4.5.7 Final Account of Works

2.2.4.5.7.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.4.4.7.1 and taken-over in compliance with section 2.2.4.4.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.4.5.7.2 Deductions Due to Insufficient Quality

2.2.4.5.7.2.1 Quality of Materials

The quality of basic materials for shafts is specified by the limiting values, which shall be reached as a rule.

Where the engineer specifies the threshold values of the quality of basic materials, he shall also define the method for calculation of deductions, unless the method is the same as provided by the general technical conditions.

In case the contractor places such material for shafts, which does not meet the requirements indicated in 2.2.4.4.3 of these technical conditions, the engineer should appoint the method of accounting. He also has the right to reject the complete work carried out.

2.2.4.5.7.2.2 Quality of Execution

The quality of the shafts executed shall be specified in the design and by the properties, the testing of which is indicated in Table 4.16.

If the contractor fails to ensure the required quality of the shafts, the engineer decides on the method of accounting of the executed works.

2.2.4.6 CULVERTS

General

Culverts are mainly intended to allow the water passing through the road body or foundation soil below the road body. They rarely serve for a covered water channelling.

Culverts shall be constructed in dimensions specified in the design, and in compliance with these technical conditions.

2.2.4.6.1 Description

For drainage, culverts of the following cross-sections are predominantly used:

- circular,
- parabolic, or
- oval.

Culverts are constructed of pipes of

- cement concrete,
- plastic (polymer) materials, and
- ductile casting.

Parabolic and oval culverts can also be made of suitable profiled metal sheet.

At their ends culverts shall be equipped with adequately shaped inflow and outflow heads.

For draining away major water quantities, slab culverts of rectangular cross-section (of larger dimensions) made of reinforced cement concrete cast in situ, or of precast (prefabricated) elements, shall be used. Exceptionally, wood can also be used for construction of slab culverts.

Execution of culverts includes delivery of all suitable materials, and placing at locations as provided by the design.

These works do not include the necessary earth works, which are taken into consideration and defined in detail in sections 2.2.2.1 and 2.2.2.4 of these technical conditions, nor the construction of culverts for special purposes and of special dimensions, which is specified in detail in section 2.2.5 of these technical conditions.

In case that waterproofing of culverts is foreseen by the design, it shall be carried out in accordance with section 2.2.4 of these technical conditions.

The water arising from the excavations for culverts shall be pumped out all the time as long as the culvert and its backfilling is executed up to the ground water level. Any damage that might occur due to omission of the water pumping out shall be charged to the contractor.

The method of culvert construction is generally determined in the design. If not, the engineer shall bring final decision.

2.2.4.6.2 Basic Materials

Basic materials for the culvert construction are the materials for:

- underlaid courses,
- culverts and culvert heads, and
- cement concrete lining applied to the pipe exterior for strengthening purposes.

2.2.4.6.2.1 Materials for Underlaid Courses

Underlaid courses below culverts are, as a rule, made of two types of materials:

- the lower course made of mineral aggregates for levelling and a uniform fitting of the culvert,
- the upper course made of cement concrete, on which the culvert rests directly.

2.2.4.6.2.2 Materials for Culverts and Culvert Heads

For the execution of culverts of circular cross-section, prefabricated pipes of cement concrete, polymer (plastic) materials, and other materials meeting the requirements of the design are used as a rule.

Culverts of parabolic and rectangular section are, as a rule, constructed in situ of

- cement concrete mixture, and
- reinforcing steel.

In addition to the abovementioned materials, the following is required for the culvert execution:

- formwork,
- cement mortar, and
- quarry (broken) stone for paving.

For the execution of both inflow and outflow heads of culverts of circular and parabolic cross-section, the following materials are required:

- cement concrete mixture,
- reinforcing steel,
- formwork, and
- cement mortar.

Basic materials for preparation of adequate mixtures are specified in these technical conditions as follows:

- in 2.2.4.1.2.1 for mineral aggregate mixtures,
- in 2.2.4.1.2.2 cement concrete mixtures
- in 2.2.4.1.2.3 cement mortars.

Basic reinforcing steel is specified in section 2.2.5.2.2, whereas formwork materials in section 2.2.5.1.2 of these technical conditions.

The applicable quarry stone (broken stone) for paving the culvert bottom is determined in 2.2.4.1.2.1 of these technical conditions.

2.2.4.6.2.3 Materials for Coating Courses

For coating courses applied to the cement concrete pipe exterior (for culvert strengthening purposes), including to the foot on the lower part of the pipe, the following is used:

- cement concrete mixtures, and
- formwork.

2.2.4.6.3 Quality of Materials

2.2.4.6.3.1 Materials for Underlaid Courses

2.2.4.6.3.1.1 Mineral Aggregates

The quality of mineral aggregate mixtures for the lower underlaid course below culverts is defined in section 2.2.4.0.3.1 of these technical conditions, unless provided otherwise by the design or specified otherwise by the engineer.

3.2.4.0.4.1.2 Cement Concrete Mixtures

The quality of basic materials for cement concrete mixtures for the upper underlaid courses below culverts shall meet the requirements indicated in 2.2.4.1.3.2 of these technical conditions.

Unless provided otherwise by the design, the cement concrete for culverts shall comply with the provisions indicated in 2.2.4.1.5.1 these technical conditions.

In special conditions, the engineer has the right to supplement the stated requirements.

2.2.4.6.3.2 Materials for Culverts and Culvert Heads

2.2.4.6.3.2.1 Cement Concrete Pipes

The quality of cement concrete pipes for the culvert construction shall meet the requirements specified for sewage system pipes in section 2.2.4.3.3.2 of these technical conditions.

2.2.4.6.3.2.2 Cement Concrete Mixtures

To the quality of basic materials for cement concrete mixtures, as well as to the quality of cement concrete mixtures for the culvert construction, the requirements indicated in 2.2.4.5.3.1.2 of these technical conditions shall apply as appropriate.

To the quality of the cement concrete for precast (prefabricated) elements for the construction of culverts of rectangular cross-section the same requirements as to the in situ cement concrete shall apply.

2.2.4.6.3.2.3 Pipes of Polymer Materials

The quality of polymer (plastic) circular pipes for culverts is defined by the conditions indicated in 2.2.4.3.3.2 of these technical conditions.

2.2.4.6.3.2.4 Reinforcing Steel

The quality of the reinforcing steel used for the culvert construction shall comply with the conditions indicated in 2.2.5.2.3 of these technical conditions.

2.2.4.6.3.2.5 Formwork

The quality of the wood for the formwork, and of the formwork itself shall meet the requirements indicated in 2.2.5.1.3 of these technical conditions.

In special cases the engineer may approve other materials for the formwork. In such cases he shall also state the quality conditions for the particular material.

2.2.4.6.3.2.6 Cement Mortar

The quality of basic materials for the preparation of cement mortar, as well as of cement mortar for sealing the joints and for cement concrete surface finishing (if foreseen by the design) shall comply with the requirements indicated in sections 2.2.4.0.3.3 and 2.2.4.0.5.2 of these technical conditions unless provided otherwise by the design.

2.2.4.6.3.3 Materials for Coating Courses

2.2.4.6.3.3.1 Cement Concrete Mixtures

To the quality of basic materials for the preparation of cement concrete mixtures, as well as to the quality of cement concrete mixtures for the execution of the coating course applied to the culvert pipe exterior, the requirements indicated in 2.2.4.5.3.1.2 of these technical conditions shall apply as appropriate.

2.2.4.6.3.3.2 Formwork

To the quality of basic materials for the formwork, and to the quality of the formwork for the execution of the coating course, the requirements indicated in 2.2.4.5.3.2.5 of these technical conditions shall apply as appropriate.

2.2.4.6.4 Method of Execution

2.2.4.6.4.1 Winning the Materials

In due time prior to commencement of the culvert construction, the contractor shall inform the engineer of all the materials he intends to use, submit adequate evidence on the quality and conformity with the design and these technical conditions, and shall obtain an approval by the engineer for the application of these materials.

All the material properties specified in 2.2.4.5.3 shall be ensured.

The material not meeting the specified requirements shall be eliminated and extra marked by the contractor.

2.2.4.6.4.2 Depositing the Materials

Conditions for depositing the required materials for the culvert construction are defined in section 2.2.4.1.4.2 of these technical conditions as appropriate.

2.2.4.6.4.3 Substrate Preparation

As a rule, the substrate for underlaid course for culverts is the excavation formation, which shall be executed in accordance with the requirements indicated in 2.2.2.1.4.2 of these technical conditions. Any deviation of these requirements shall be previously approved by the engineer.

The engineer shall take-over the substrate formation prior to commencement of placing the underlaid course.

2.2.4.6.4.4 Production of Cement Concrete and Cement Mortar Mixtures

Conditions of the production of both cement concrete and cement mortar for the culvert construction are defined in detail in 2.2.4.1.4.3 of these technical conditions.

2.2.4.6.4.5 Placing

2.2.4.6.4.5.1 Underlaid Courses

Onto suitably prepared substrate formation, which must not be frozen, a mineral aggregate mixture for the lower underlaid course below the culvert shall be placed after receiving an approval by the engineer. The underlaid course shall be placed in dimensions as directed by the design, and adequately compacted.

Onto the formation of the lower underlaid course a mixture of cement concrete for the upper underlaid course may be placed in dimensions as specified in the design. The placed course shall be even and at suitable inclination to allow adequate culvert construction and to ensure undisturbed water flow through the culvert.

The engineer shall specify the conditions of placing the underlaid courses in view of the working conditions.

2.2.4.6.4.5.2 Culvert and Culvert Heads

The contractor must not commence the construction of the culvert and of culvert heads until the engineer takes-over the placed underlaid course and approves the culvert construction method.

In case that the cement concrete surface finishing with cement mortar is foreseen by the design, the mortar shall be applied to suitably prepared surface, when the cement concrete is at the early stage of setting.

All the works shall be so executed as to ensure water-tightness of the culvert, and undisturbed water flow through the culvert, all in dimensions as provided by the design. Any modificaton shall be previously approved by the engineer.

2.2.4.6.4.5.3 Coating Course

The contractor must not commence to apply the cement concrete mixture to the culvert pipe exterior (coating course for strengthening purposes) until receiving an approval by the engineer. All the joints of cement concrete pipes shall be sealed with cement mortar.

2.2.4.6.5 Quality of Execution

The contractor shall in due time prior to commencement of the works submit to the engineer suitable evidence on the quality of the materials he intends to use for the culvert construction, all in accordance with the requirements indicated in 2.2.4.5.3 of these technical conditions.

The engineer may approve placing of partly damaged prefabricated elements for the culvert construction provided that this has no adverse impact on the quality of the culvert executed.

Prior to commencement of placing, the contractor shall submit to the engineer the preliminary (laboratory) composition of the cement concrete mixture and of the cement mortar he intends to use for the culvert construction.

The preliminary composition shall include the data on all the basic properties of cement concrete mixture and of cement mortar as indicated in sections 2.2.4.5.3.1.2 and 2.2.4.5.3.2.6.

The contractor must not commence the culvert construction prior to obtaining an approval by the engineer.

Unless agreed otherwise, the required properties of basic materials specified in section 2.2.4.5.3 of these technical conditions shall be considered as limiting values. The engineer shall specify the threshold values in view of the characteristics of the particular work.

2.2.4.6.6 Quality Control of Execution

2.2.4.6.6.1 Internal Control

The extent of the internal control during the execution of a culvert shall be specified by the engineer on the basis of the submitted documents in compliance with section 2.2.4.5.5, and on the basis of the work progress.

The minimum extent of the internal control during the culvert construction is indicated in Table 4.17.

Table 4.17: Minimum testing frequency during the culvert construction internal control

Properties of	Minimum testing frequency
- mineral aggregate mixtures	200 m^1
- cement concrete mixtures	20 m^1
- prefabricated elements	100 pcs
- reinforcing steel	5 t
- cement mortar	10 m^3

2.2.4.6.6.2 External Control

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 5 to the internal control testing.

Places for taking specimens for the external control of quality shall be specified by the engineer in accordance with a statistical random selection.

2.2.4.6.7 Measurement and Take-Over of Works

2.2.4.6.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in adequate units of measurement.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities. In addition, those quantities shall also be recorded in due time.

2.2.4.6.7.2 Take-Over of Works

The engineer shall take-over the executed culverts in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. All the established deficiencies with regard to those requirements shall be mended by the contractor prior to continuing the works.

2.2.4.6.8 Final Account of Works

2.2.4.6.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.4.5.7.1 and taken-over in compliance with section 2.2.4.5.7.2 shall be accounted by the contractual unit price.

2.2.4.6.8.2 Deductions Due to Insufficient Quality

2.2.4.6.8.2.1 Quality of Materials

The quality of basic materials for culverts is specified by the limiting values, which shall be reached as a rule.

Where the engineer specifies the threshold values of the quality of basic materials, he shall also define the method for calculation of deductions, unless the method is the same as provided by the general technical conditions.

In case the contractor places such material for culverts, which does not meet the requirements indicated in 2.2.4.5.3 of these technical conditions, the engineer should appoint the method of accounting. He also has the right to reject the complete work carried out.

2.2.4.6.8.2.2 Quality of Execution

The quality of the culverts executed shall be specified in the design and by the properties, the testing of which is indicated in Table 4.17.

If the contractor fails to ensure the required quality of the culverts, the engineer decides on the method of accounting of the executed works.

2.2.4.7 SPRINGS, WELLS, SINKHOLES, FUNNEL-SHAPED HOLES

General

The arrangements of springs, sinkholes and funnel-shaped holes, as well as the construction of wells are intended for controlled evacuation of water from the road body area.

All mentioned drainage types shall be executed in dimensions as specified by the design, and in accordance with these technical conditions.

2.2.4.7.1 Description

The arrangements of springs, sinkholes and funnel-shaped holes, as well as the construction of wells shall be adapted to specific conditions.

For the arrangement of springs and sinkholes in the road alignment, and for the construction of wells, the following is used:

- prefabricated elements,
- perforated pipes, and
- suitable mineral aggregate mixtures,

For the arrangement of funnel-shaped holes, methods adapted to both shape and size of a funnel-shaped hole as well as to its natural function shall be introduced.

The execution of the mentioned works comprises the supply of adequate materials, and their placing at locations and in the way as specified in detail by the design.

These works, however, include neither earth works, which are defined in detail in section 2.2.2, nor execution of special arrangements for funnel-shaped holes, which is defined in detail in section 2.2.5 of these technical conditions.

The water arising from the excavations shall be pumped out all the time. Any damage that might occur due to omission of the water pumping out shall be charged to the contractor.

2.2.4.7.2 Basic Materials

Basic materials for the arrangement of springs, sinkholes and funnel-shaped holes, as well as for the construction of wells, are the following:

- perforated pipes of cement concrete or polymer material
- mineral aggregate mixture.

In addition to the stated materials the following ones are also required for the execution of certain works considered:

- quarry stone (broken stone),
- geosynthetic fabric,
- cement concrete mixture,
- cement mortar,
- reinforcing steel,
- formwork.

2.2.4.7.3 Quality of Materials

2.2.4.7.3.1 Perforated Cement Concrete Pipes and Polymer Pipes

The quality of pipes for arrangement of springs and sinkholes as well as for construction of wells shall comply with the requirements specified for circular sewage system pipes in section 3.2.4.3.3.2 in these technical conditions.

The perforation of pipes shall be such as to ensure undisturbed water flow.

2.2.4.7.3.2 Mineral Aggregates

The quality of mineral aggregates used for the execution of the works discussed shall meet the requirements specified for mineral aggregate mixtures for backfilling the drainages in section 2.2.4.2.3.3.1 of these technical conditions.

2.2.4.7.3.3 Quarry Stone

Quarry (broken) stone for the execution of the works discussed shall be resistant to water immersion, and shall comply with the requirements indicated in section 2.2.4.1.3.1 of these technical conditions.

2.2.4.7.3.4 Geosynthetic Fabric

Geosynthetic fabric of synthetic fibres shall meet the requirements indicated in 2.2.4.2.3.3.2 of these technical conditions. In special conditions the engineer may require special adjustment of the fabric quality to the service conditions, particularly to the granulometric composition of the surrounding soil.

2.2.4.7.3.5 Cement Concrete Mixtures

Unless provided otherwise by the design, the quality of materials for cement concrete mixtures used for the works dealt with shall comply with the requirements in section 2.2.4.0.3.2 of these technical conditions, whilst the quality of the cement concrete mixtures themselves with the requirements indicated in 2.2.4.0.5.1.

2.2.4.7.3.6 Cement Mortar

The quality of materials for cement mortar for the works dealth with shall meet the requirements in section 2.2.4.0.3.3, whereas the quality of the cement mortar itself the requirements in 2.2.4.0.5.2 of these technical conditions.

2.2.4.7.3.7 Reinforcing Steel

The quality of reinforcing steel shall comply with the requirements indicated in 2.2.5.2.3 of these technical conditions.

2.2.4.7.3.8 Formwork

To the quality of wood for the formwork, and to the quality of the formwork for the execution of the works discussed, the requirements indicated in 3.2.5.1.3 of these technical conditions shall apply.

2.2.4.7.4 Method of Execution

2.2.4.7.4.1 Winning the Materials

In due time prior to commencement of the works, the contractor shall inform the engineer of all the materials he intends to use, submit adequate evidence on the quality and conformity with the design and these technical conditions, and shall obtain an approval by the engineer for the application of these materials.

All the material properties specified in 2.2.4.6.3 shall be ensured.

The material not meeting the specified requirements shall be eliminated and extra marked by the contractor.

2.2.4.7.4.2 Depositing the Materials

The conditions for depositing the required materials for the execution of the works dealt with are defined in section 2.2.4.0.4.2 of these technical conditions as appropriate.

2.2.4.7.4.3 Preparation of Ground

The ground for the arrangement of springs, sinkhole and funnel-shaped holes, as well as for the construction of wells shall be prepared as provided by the design and specified by the engineer, so that proper quality of all the subsequent works is ensured.

2.2.4.7.4.4 Production of Cement Concrete and Cement Mortar Mixtures

Pogoji proizvodnje mešanic cementnega betona in cementne malte, potrebnih za izvršitev obravnavanih del, so določeni v točki 2.2.4.0.4.3 teh tehničnih pogojev.

2.2.4.7.4.5 Placing

2.2.4.7.4.5.1 Springs

Excavations in the area of springs in the road alignment shall be carried out to such an extent that placing of perforated pipes of adequate diameter is enabled. If necessary, the pipe shall be wrapped with geosynthetic fabric and backfilled with mineral aggregate.

From an arranged spring the water shall be led via pipes outside the road body.

For the case of a need, the spring shall be so arranged that the traffic loading has no adverse effect on it.

2.2.4.7.4.5.2 Wells

Excavations for wells shall be, as a rule, performed mechanically by boring to such dimensions that placing of cement concrete or polymer perforated pipes of adequate section, wrapped with geosynthetic fabric, is feasible.

On each well a connection for draining away the water from the well shall be ensured.

2.2.4.7.4.5.3 Sinkholes

For sinkholes the excavations shall be carried out, as a rule, by boring to such dimensions that the installation of adequate perforated pipes of cement concrete or polymer is possible.

2.2.4.7.4.5.4 Funnel-Shaped Holes

The preparation of a mixture of coarse mineral grains bound with coarse cement mortar ("colcrete" procedure) requires spreading of such grain mixture on the bottom of a funnel-shaped hole and filling up the voids in the mineral aggregate mixture body with cement mortar under pressure (shot cement concrete).

To ensure functional ability of the mouth and the breathing hole it is possible to make a cover by means of a slab or arch made of reinforced cement concrete.

Detailed conditions for such placing are defined in section 3.2.5.3 of these technical conditions.

2.2.4.7.5 Quality of Execution

The contractor shall in due time prior to commencement of the works submit to the engineer suitable evidence on the quality of the materials he intends to use for the works dealt with, all in accordance with the requirements indicated in 2.2.4.6.3 of these technical conditions.

The engineer may approve placing of partly damaged perforated pipes provided that this has no adverse impact on the quality of the executed arrangement of a spring, a well, or a sinkhole.

Prior to commencement of placing, the contractor shall submit to the engineer the preliminary (laboratory) composition of the cement concrete mixture and of the cement mortar he intends to use.

The preliminary composition shall include the data on all the basic properties of cement concrete mixture and of cement mortar as indicated in sections 2.2.4.6.3.5 and 2.2.4.6.3.6.

The contractor must not commence the placing prior to obtaining an approval by the engineer.

Unless agreed otherwise, the required properties of basic materials specified in section 2.2.4.6.3 of these technical conditions shall be considered as limiting values. The engineer shall specify the threshold values in view of the characteristics of the particular work.

2.2.4.7.6 Quality Control of Execution

2.2.4.7.6.1 Internal Control

The extent of the internal control to be performed by an authorized laboratory during the execution of the works discussed shall be specified by the engineer on the basis of the submitted documents in compliance with section 2.2.4.6.5, and on the basis of the work progress.

The minimum extent of the internal control during the works is indicated in Table 4.18.

Table 4.18: Minimum testing frequency during the internal control of arrangement of springs, wells, sinkholes, and funnel-shaped holes

Properties of	Minimum testing frequency
- mineral aggregate mixtures	100 m^3
- geosynthetic fabric	1,000 m^2
- pipes - cement concrete mixtures - cement mortar - reinforcing steel	100 pcs 20 m^3 20 m^3 5 t

The quality of the works dealt with can also be specified in accordance with other approved method, however in agreement with the engineer. In such cases the engineer shall define the quality assessment criteria, all in agreement with the contractor.

2.2.4.7.6.2 External Control

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 5 to the internal control testing.

Places for taking specimens for the external control of the performance conformity shall be specified by the engineer in accordance with a statistical random selection.

2.2.4.7.7 Measurement and Take-Over of Works

2.2.4.7.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in adequate units of measurement.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities. In addition, those quantities shall also be recorded in due time.

2.2.4.7.7.2 Take-Over of Works

The engineer shall take-over the executed works in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. All the established deficiencies with regard to those requirements shall be mended by the contractor prior to continuing the works.

2.2.4.7.8 Final Account of Works

2.2.4.7.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.4.6.7.1 and taken-over in compliance with section 2.2.4.6.7.2 shall be accounted by the contractual unit price.

2.2.4.7.8.2 Deductions Due to Insufficient Quality

2.2.4.7.8.2.1 Quality of Materials

The quality of basic materials for the works discussed is specified by the limiting values, which shall be reached as a rule.

Where the engineer specifies the threshold values of the quality of basic materials, he shall also define the method for calculation of deductions, unless the method is the same as provided by the general technical conditions.

In case the contractor places such material for the arrangement of springs, sinkholes and funnel-shaped holes, as well as for the construction of wells, which does not meet the requirements indicated in 2.2.4.6.3 of these technical conditions, the engineer should appoint the method of accounting. He also has the right to reject the complete work carried out.

2.2.4.7.8.2.2 Quality of Execution

The quality of the works executed shall be specified in the design.

If the contractor fails to ensure the required quality, the engineer decides on the method of accounting of the executed works.

2.2.4.8 DRAINAGE SYSTEM – BILL OF WORKS

2.2.4.8.1 Surface Drainage

Item	Unit Measure	Description of Work
41 111	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 112	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 113	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 114	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 25 cm thickness
41 116	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 117	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 118	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 119	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 25 cm thickness
41 121	m^2	Paving the ditch with quarry (broken) stone of 10 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 10 cm thickness
41 122	m^2	Paving the ditch with quarry (broken) stone of 10 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 15 cm thickness
41 123	m^2	Paving the ditch with quarry (broken) stone of 10 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 20 cm thickness
41 124	m^2	Paving the ditch with quarry (broken) stone of 10 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 25 cm thickness
41 126	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of cement concrete of 10 cm thickness
41 127	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of cement concrete of 15 cm thickness
41 128	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of cement concrete of 20 cm thickness
41 129	m^2	Paving the ditch with quarry (broken) stone of 20 cm thickness, joints filled up with cement mortar, on underlaid course of cement concrete of … cm thickness
41 131	m^2	Strengthening the ditch acc. to the »Colcrete« method with crushed stone

Item	Unit Measure	Description of Work
		bound with cement concrete, in a layer of 10 cm thickness
41 132	m^2	Strengthening the ditch acc. to the »Colcrete« method with crushed stone bound with cement concrete, in a layer of 15 cm thickness
41 133	m^2	Strengthening the ditch acc. to the »Colcrete« method with crushed stone bound with cement concrete, in a layer of 20 cm thickness
41 134	m^2	Strengthening the ditch acc. to the »Colcrete« method with crushed stone bound with cement concrete, in a layer of 25 cm thickness
41 135	m^2	Strengthening the ditch acc. to the »Colcrete« method with crushed stone bound with cement concrete, in a layer of 30 cm thickness
41 136	m^2	Strengthening the ditch acc. to the »Colcrete« method with crushed stone bound with cement concrete, in a layer of 40 cm thickness
41 137	m^2	Strengthening the ditch acc. to the »Colcrete« method with crushed stone bound with cement concrete, in a layer of 50 cm thickness
41 141	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 142	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 143	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 144	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 50 cm thickness
41 146	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 147	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 148	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 149	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 25 cm thickness
41 151	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of cement concrete of 10 cm thickness
41 152	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of cement concrete of 15 cm thickness
41 153	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of cement concrete of 20 cm thickness
41 154	m^2	Paving the ditch with cement concrete slabs of size up to 0.25 m^2, of thickness 10 cm, joints filled up with cement mortar, on underlaid course of cement concrete of 25 cm thickness

Item	Unit Measure	Description of Work
41 161	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 162	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 163	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 164	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with crushed stone, on underlaid course of crushed stone grain mixture of 25 cm thickness
41 166	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 167	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 168	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 169	m^2	Paving the ditch with cement concrete pavers of 10 cm thickness, joints filled up with cement mortar, on underlaid course of crushed stone grain mixture of 25 cm thickness
41 171	m^1	Strengthening the ditch with cement concrete segments of 80 cm width and 120 cm diameter, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 172	m^1	Strengthening the ditch with cement concrete segments of 80 cm width and 120 cm diameter, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 173	m^1	Strengthening the ditch with cement concrete segments of 80 cm width and 120 cm diameter, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 174	m^1	Strengthening the ditch with cement concrete segments of 80 cm width and 120 cm diameter, on underlaid course of crushed stone grain mixture of 25 cm thickness
41 176	m^1	Strengthening the ditch with cement concrete segments of 100 cm width and 150 cm diameter, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 177	m^1	Strengthening the ditch with cement concrete segments of 100 cm width and 150 cm diameter, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 178	m^1	Strengthening the ditch with cement concrete segments of 100 cm width and 150 cm diameter, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 179	m^1	Strengthening the ditch with cement concrete segments of 100 cm width and 150 cm diameter, on underlaid course of crushed stone grain mixture of 25 cm thickness
41 181	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 30 cm bottom internal width, on underlaid course of crushed stone grain mixture of 10 cm thickness

Item	Unit Measure	Description of Work
41 182	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 30 cm bottom internal width, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 183	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 30 cm bottom internal width, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 184	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 40 cm bottom internal width, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 185	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 40 cm bottom internal width, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 186	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 40 cm bottom internal width, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 187	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 50 cm bottom internal width, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 188	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 50 cm bottom internal width, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 189	m^1	Strengthening the ditch with cement concrete jointed channel elements of 100 cm length and 50 cm bottom internal width, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 191	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 110 cm length and 40 cm bottom internal width, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 192	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 110 cm length and 40 cm bottom internal width, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 193	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 110 cm length and 40 cm bottom internal width, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 194	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 115 cm length and 50 cm bottom internal width, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 195	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 115 cm length and 50 cm bottom internal width, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 196	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 115 cm length and 50 cm bottom internal width, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 197	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 120 cm length and 60 cm bottom internal width, on underlaid course of crushed stone grain mixture of 10 cm thickness
41 198	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 120 cm length and 60 cm bottom internal width, on underlaid course of crushed stone grain mixture of 15 cm thickness
41 199	m^1	Strengthening the ditch with cement concrete overlapped channel elements of 120 cm length and 60 cm bottom internal width, on underlaid course of crushed stone grain mixture of 20 cm thickness
41 211	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, next to

Item	Unit Measure	Description of Work
		already executed kerb, gutter width 50 cm
41 212	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, next to already executed kerb, gutter width 75 cm
41 213	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, next to already executed kerb, gutter width 100 cm
41 214	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, with a cement concrete kerb, gutter width 50 cm
41 215	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, with a cement concrete kerb, gutter width 75 cm
41 216	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, with a cement concrete kerb, gutter width … cm
41 217	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, onto existing substrate, with a cement concrete kerb, gutter width 50 cm
41 218	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, onto existing substrate, with a cement concrete kerb, gutter width 75 cm
41 219	m^1	Execution of C 25/30 cement concrete gutter of 10 cm thickness, on underlaid course of crushed stone grain mixture of 15 cm thickness, onto existing substrate, with a cement concrete kerb, gutter width 100 cm
41 221	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto existing substrate next to already executed cement concrete kerb, gutter width 50 cm
41 222	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto existing substrate next to already executed cement concrete kerb, gutter width 75 cm
41 223	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto existing substrate next to already executed cement concrete kerb, gutter width 100 cm
41 224	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto existing substrate, including as a base for bituminous concrete kerb, gutter width 50 cm
41 225	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto existing substrate, including as a base for bituminous concrete kerb, gutter width 75 cm
41 226	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto existing substrate, including as a base for bituminous concrete kerb, gutter width 100 cm
41 227	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto underlaid course of crushed stone grain mixture of 20 cm thickness, including as a base for bituminous concrete kerb, gutter width 50 cm
41 228	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto underlaid course of crushed stone grain mixture of 20 cm thickness, including as a base for bituminous concrete kerb, gutter width 75 cm
41 229	m^1	Execution of bituminous concrete gutter of 5 cm thickness onto underlaid course of crushed stone grain mixture of 20 cm thickness, including as a base for bituminous concrete kerb, gutter width 100 cm

Item	Unit Measure	Description of Work
41 231	m^1	Execution of gutter of quarry stone pavement of 15 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 5 cm thickness, onto existing substrate, gutter width 50 cm
41 232	m^1	Execution of gutter of quarry stone pavement of 15 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 5 cm thickness, onto existing substrate, gutter width 75 cm
41 233	m^1	Execution of gutter of quarry stone pavement of 15 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 5 cm thickness, onto existing substrate, gutter width 100 cm
41 241	m^1	Execution of gutter of quarry stone pavement of 10 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 10 cm thickness, onto existing substrate, gutter width 50 cm
41 242	m^1	Execution of gutter of quarry stone pavement of 10 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 10 cm thickness, onto existing substrate, gutter width 75 cm
41 243	m^1	Execution of gutter of quarry stone pavement of 10 cm thickness, joints filled up with cement mortar, on underlaid course of cement mortar of 10 cm thickness, onto existing substrate, gutter width 100 cm
41 251	m^1	Execution of gutter of stone cube pavement, joints filled up with cement mortar, on underlaid course of cement concrete of 20 cm total thickness, gutter width 50 cm
41 252	m^1	Execution of gutter of stone cube pavement, joints filled up with cement mortar, on underlaid course of cement concrete of 20 cm total thickness, gutter width 75 cm
41 253	m^1	Execution of gutter of stone cube pavement, joints filled up with cement mortar, on underlaid course of cement concrete of 20 cm total thickness, gutter width 100 cm
41 261	pcs	Execution of ditch outlet into slope ditch/channel
41 262	pcs	Execution of channel outlet into slope ditch/channel
41 263	pcs	Execution of gutter outlet into slope ditch/channel
41 311	m^1	Protection of curved ditch bottom with bituminous concrete course, 4 cm thick and 50 cm wide
41 312	m^1	Protection of curved ditch bottom with bituminous concrete course, 4 cm thick and 60 cm wide
41 313	m^1	Protection of curved ditch bottom with bituminous concrete course, 4 cm thick and 70 cm wide
41 314	m^1	Protection of curved ditch bottom with bituminous concrete course, 4 cm thick and 80 cm wide
41 315	m^1	Protection of curved ditch bottom with bituminous concrete course, 4 cm thick and 100 cm wide
41 321	m^1	Protection of curved ditch bottom with bituminous concrete course, 5 cm thick and 50 cm wide
41 322	m^1	Protection of curved ditch bottom with bituminous concrete course, 5 cm thick and 60 cm wide
41 323	m^1	Protection of curved ditch bottom with bituminous concrete course, 5 cm thick and 70 cm wide
41 324	m^1	Protection of curved ditch bottom with bituminous concrete course, 5 cm thick and 80 cm wide

Item	Unit Measure	Description of Work
41 325	m^1	Protection of curved ditch bottom with bituminous concrete course, 5 cm thick and 100 cm wide
41 331	m^1	Protection of curved ditch bottom with bituminous concrete course, 6 cm thick and 50 cm wide
41 332	m^1	Protection of curved ditch bottom with bituminous concrete course, 6 cm thick and 60 cm wide
41 333	m^1	Protection of curved ditch bottom with bituminous concrete course, 6 cm thick and 70 cm wide
41 334	m^1	Protection of curved ditch bottom with bituminous concrete course, 6 cm thick and 80 cm wide
41 335	m^1	Protection of curved ditch bottom with bituminous concrete course, 6 cm thick and 100 cm wide
41 331	m^1	Protection of curved ditch bottom with small stone pavers (cubes) on underlaid course of cement concrete, 10 cm thick and 50 cm wide
41 332	m^1	Protection of curved ditch bottom with small stone pavers (cubes) on underlaid course of cement concrete, 10 cm thick and 60 cm wide
41 333	m^1	Protection of curved ditch bottom with small stone pavers (cubes) on underlaid course of cement concrete, 10 cm thick and 70 cm wide
41 334	m^1	Protection of curved ditch bottom with small stone pavers (cubes) on underlaid course of cement concrete, 10 cm thick and 80 cm wide
41 335	m^1	Protection of curved ditch bottom with small stone pavers (cubes) on underlaid course of cement concrete, 10 cm thick and 100 cm wide
41 411	m^3	Protection of ditch slope foot with quarry (broken) stone larger than 0.1 m^3/pc
41 421	m^3	Protection of ditch slope foot with steel wire basket filled up with rough stone grains (larger than 30 mm)
41 431	m^3	Protection of ditch slope foot with plastic basket filled up with rough stone grains (larger than 30 mm)
41 441	m^3	Protection of ditch slope foot with …..…………………….
41 511	m^1	Collecting the water over the tunnel lining surface, using flexible PVC pipes of 1 1/2” of diameter, including fixing and execution of both inlet and outlet
41 521	m^1	Collecting the water over the tunnel lining surface, using flexible PVC semi-pipes of 100 mm of diameter, including fixing and execution of both inlet and outlet
41 522	m^1	Collecting the water over the tunnel lining surface, using flexible PVC semi-pipes of 200 mm of diameter, including fixing and execution of both inlet and outlet
41 531	m^1	Collecting the rear water using PVC drainage pipes with filters, 40 cm of diameter, including execution of a borehole, fixing, and execution of both inlet and outlet

2.2.4.8.2 Deep Drainage System – Drainages

Item	Unit Measure	Description of Work
42 111	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with flexible plastic pipes of 5 cm diameter
42 112	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with flexible plastic pipes of 8 cm diameter
42 113	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with flexible plastic pipes of 10 cm diameter
42 114	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with flexible plastic pipes of 15 cm diameter
42 115	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with flexible plastic pipes of 20 cm diameter
42 121	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with flexible plastic pipes of 5 cm diameter
42 122	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with flexible plastic pipes of 8 cm diameter
42 123	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with flexible plastic pipes of 10 cm diameter
42 124	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with flexible plastic pipes of 15 cm diameter
42 125	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with flexible plastic pipes of 20 cm diameter
42 131	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete unerlay course, with flexible plastic pipes of 5 cm diameter
42 132	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete unerlay course, with flexible plastic pipes of 8 cm diameter
42 133	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete unerlay course, with flexible plastic pipes of 10 cm diameter
42 134	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete unerlay course, with flexible plastic pipes of 15 cm diameter
42 135	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete unerlay course, with flexible plastic pipes of 20 cm diameter
42 141	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with hard plastic pipes of 5 cm diameter
42 142	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with hard plastic pipes of 10 cm diameter
42 143	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with hard plastic pipes of 15 cm diameter
42 144	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with hard plastic pipes of 20 cm diameter
42 145	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with hard plastic pipes of 25 cm diameter
42 146	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with hard plastic pipes of 30 cm diameter
42 147	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with hard plastic pipes of 40 cm diameter
42 151	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with hard plastic pipes of 5 cm diameter
42 152	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on

Item	Unit Measure	Description of Work
		puddle layer, with hard plastic pipes of 10 cm diameter
42 153	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with hard plastic pipes of 15 cm diameter
42 154	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with hard plastic pipes of 20 cm diameter
42 155	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with hard plastic pipes of 25 cm diameter
42 156	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with hard plastic pipes of 30 cm diameter
42 157	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with hard plastic pipes of 40 cm diameter
42 161	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with hard plastic pipes of 5 cm diameter
42 162	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with hard plastic pipes of 10 cm diameter
42 163	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with hard plastic pipes of 15 cm diameter
42 164	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with hard plastic pipes of 20 cm diameter
42 165	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with hard plastic pipes of 25 cm diameter
42 166	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with hard plastic pipes of 30 cm diameter
42 167	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with hard plastic pipes of 40 cm diameter
42 171	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with perforated cement concrete pipes of 10 cm diameter
42 172	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with perforated cement concrete pipes of 15 cm diameter
42 173	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with perforated cement concrete pipes of 20 cm diameter
42 174	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with perforated cement concrete pipes of 25 cm diameter
42 175	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with perforated cement concrete pipes of 30 cm diameter
42 176	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with perforated cement concrete pipes of 40 cm diameter
42 177	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on excavation formation, with perforated cement concrete pipes of 50 cm diameter
42 181	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with perforated cement concrete pipes of 10 cm diameter
42 182	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with perforated cement concrete pipes of 15 cm diameter
42 183	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on

Item	Unit Measure	Description of Work
		puddle layer, with perforated cement concrete pipes of 20 cm diameter
42 184	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with perforated cement concrete pipes of 25 cm diameter
42 185	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with perforated cement concrete pipes of 30 cm diameter
42 186	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with perforated cement concrete pipes of 40 cm diameter
42 187	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on puddle layer, with perforated cement concrete pipes of 50 cm diameter
42 191	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with perforated cement concrete pipes of 10 cm diameter
42 192	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with perforated cement concrete pipes of 15 cm diameter
42 193	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with perforated cement concrete pipes of 20 cm diameter
42 194	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with perforated cement concrete pipes of 25 cm diameter
42 195	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with perforated cement concrete pipes of 30 cm diameter
42 196	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with perforated cement concrete pipes of 40 cm diameter
42 197	m^1	Execution of longitudinal and transverse drainage of depth up to 1.0 m, on cement concrete underlaid course, with perforated cement concrete pipes of … cm diameter
42 211	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, of mineral aggregate mixture, on excavation formation
42 212	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, of mineral aggregate mixture, on puddle layer
42 213	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, of mineral aggregate mixture, on cement concrete underlaid course
42 221	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, of mineral aggregate mixture wrapped with fabric, on excavation formation
42 222	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, of mineral aggregate mixture wrapped with fabric, on puddle layer
42 223	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, of mineral aggregate mixture wrapped with fabric, on cement concrete underlaid course
42 231	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, gap-graded cement concrete mixture, on excavation formation
42 232	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, gap-graded cement concrete mixture, on puddle layer
42 233	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, gap-graded cement concrete mixture, on cement concrete underlaid course
42 241	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, gap-graded

Item	Unit Measure	Description of Work
		cement concrete mixture wrapped with fabric, on excavation formation
42 242	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, gap-graded cement concrete mixture wrapped with fabric, on puddle layer
42 243	m^1	Execution of longitudinal and transverse drainage of 1.0 m depth, gap-graded cement concrete mixture wrapped with fabric, on cement concrete underlaid course
42 251	m^1	Backfill of pipe drainage with mineral aggregate wrapped with fabric, 0.1 do 0.2 m^3/m^1
42 252	m^1	Backfill of pipe drainage with mineral aggregate wrapped with fabric, 0.21 to 0.4 m^3/m^1
42 253	m^1	Backfill of pipe drainage with mineral aggregate wrapped with fabric, 0.41 to 0.8 m^3/m^1
42 254	m^1	Backfill of pipe drainage with mineral aggregate wrapped with fabric, 0.81 to 1.5 m^3/m^1
42 255	m^1	Backfill of pipe drainage with mineral aggregate wrapped with fabric, 1.51 to 2.5 m^3/m^1
42 256	m^1	Backfill of pipe drainage with mineral aggregate wrapped with fabric, 2.51 to 3.5 m^3/m^1
42 257	m^1	Backfill of pipe drainage with mineral aggregate wrapped with fabric, above 3.5 m^3/m^1
42 261	m^1	Extra payment for execution of longitudinal and transverse drainage of 1 – 2 m depth
42 262	m^1	Extra payment for execution of longitudinal and transverse drainage of 2.1 – 4 m depth
42 263	m^1	Extra payment for execution of longitudinal and transverse drainage of more than 4 m depth
42 265	m^1	Extra payment for the work inside normal formwork
42 266	m^1	Extra payment for the work inside dense formwork
42 271	m^3	Backfill of drainage rib with mineral aggregate
42 311	pcs	Placing flexible plastic filtering pipe of 5 cm diameter and up to 50 cm length
42 312	pcs	Placing flexible plastic filtering pipe of 5 cm diameter and of 51 - 100 cm length
42 313	pcs	Placing flexible plastic filtering pipe of 5 cm diameter and of more than 100 cm length
42 321	pcs	Placing flexible plastic filtering pipe of 8 cm diameter and up to 50 cm length
42 322	pcs	Placing flexible plastic filtering pipe of 8 cm diameter and of 51 - 100 cm length
42 323	pcs	Placing flexible plastic filtering pipe of 8 cm diameter and of more than 100 cm length
42 331	pcs	Placing flexible plastic filtering pipe of 10 cm diameter and up to 50 cm length
42 332	pcs	Placing flexible plastic filtering pipe of 10 cm diameter and of 51 - 100 cm length
42 333	pcs	Placing flexible plastic filtering pipe of 10 cm diameter and of more than 100 cm length
42 341	pcs	Placing hard plastic filtering pipe of 5 cm diameter and up to 50 cm length

Item	Unit Measure	Description of Work
42 342	pcs	Placing hard plastic filtering pipe of 5 cm diameter and of 51 - 100 cm length
42 343	pcs	Placing hard plastic filtering pipe of 5 cm diameter and of more than 100 cm length
42 351	pcs	Placing hard plastic filtering pipe of 8 cm diameter and up to 50 cm length
42 352	pcs	Placing hard plastic filtering pipe of 8 cm diameter and of 51 - 100 cm length
42 353	pcs	Placing hard plastic filtering pipe of 8 cm diameter and of more than 100 cm length
42 361	pcs	Placing hard plastic filtering pipe of 10 cm diameter and up to 50 cm length
42 362	pcs	Placing hard plastic filtering pipe of 10 cm diameter and of 51 - 100 cm length
42 363	pcs	Placing hard plastic filtering pipe of 10 cm diameter and of more than 100 cm length
42 371	pcs	Placing …………………… filtering pipe of ….. cm diameter and of ……… length
42 411	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 5 cm
42 412	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 8 cm
42 413	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 10 cm
42 414	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 15 cm
42 415	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 20 cm
42 416	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 25 cm
42 417	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 30 cm
42 418	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 40 cm
42 419	pcs	Execution of drainage outlet, acc. to design detail, irrespective of the depth or hindrance by the formwork, diameter 50 cm
42 511	m^1	Execution of vertical drainage, bored and filled up with sand grain mixture for drainages, diameter 6 cm
42 512	m^1	Execution of vertical drainage, bored and filled up with sand grain mixture for drainages, diameter 8 cm
42 513	m^1	Execution of vertical drainage, bored and filled up with sand grain mixture for drainages, diameter 10 cm
42 514	m^1	Execution of vertical drainage, bored and filled up with sand grain mixture for drainages, diameter 12 cm
42 515	m^1	Execution of vertical drainage, bored and filled up with sand grain mixture for drainages, diameter 15 cm
42 516	m^1	Execution of vertical drainage, bored and filled up with sand grain mixture for drainages, diameter 20 cm
42 517	m^1	Execution of vertical drainage, bored and filled up with sand grain mixture for drainages, diameter … cm
42 521	m^1	Execution of vertical drainage, bored and filled up with gravel or crushed

Item	Unit Measure	Description of Work
		stone mixture for drainages, diameter 6 cm
42 522	m^1	Execution of vertical drainage, bored and filled up with gravel or crushed stone mixture for drainages, diameter 8 cm
42 523	m^1	Execution of vertical drainage, bored and filled up with gravel or crushed stone mixture for drainages, diameter 10 cm
42 524	m^1	Execution of vertical drainage, bored and filled up with gravel or crushed stone mixture for drainages, diameter 12 cm
42 525	m^1	Execution of vertical drainage, bored and filled up with gravel or crushed stone mixture for drainages, diameter 15 cm
42 526	m^1	Execution of vertical drainage, bored and filled up with gravel or crushed stone mixture for drainages, diameter 20 cm
42 527	m^1	Execution of vertical drainage, bored and filled up with gravel or crushed stone mixture for drainages, diameter … cm
42 531	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 10 cm
42 532	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 15 cm
42 533	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 20 cm
42 534	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 30 cm
42 535	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 40 cm
42 536	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 50 cm
42 537	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 60 cm
42 538	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 80 cm
42 539	m^1	Execution of vertical drainage, impressed and filled up with gravel or crushed stone mixture for drainages, diameter 100 cm
42 541	m^1	Execution of vertical drainage, impressed and with drainage fabric tape, depth up to 10 m
42 542	m^1	Execution of vertical drainage, impressed and with drainage fabric tape, depth 10-15 m
42 543	m^1	Execution of vertical drainage, impressed and with drainage fabric tape, depth more than 15 m
42 551	m^1	Execution of vertical drainage, impressed, with a tape of grooved core, wrapped with drainage fabric, depth up to 10 m
42 552	m^1	Execution of vertical drainage, impressed, with a tape of grooved core, wrapped with drainage fabric, depth 10-15 m
42 553	m^1	Execution of vertical drainage, impressed, with a tape of grooved core, wrapped with drainage fabric, depth more than 15 m
42 561	m^1	Execution of vertical drainage, impressed, with a tape of grooved hollow core, wrapped with drainage fabric, depth up to 10 m
42 562	m^1	Execution of vertical drainage, impressed, with a tape of grooved hollow core, wrapped with drainage fabric, depth 10-15 m
42 563	m^1	Execution of vertical drainage, impressed, with a tape of grooved hollow core, wrapped with drainage fabric, depth more than 15 m

Item	Unit Measure	Description of Work
42 571	m^1	Execution of vertical drainage, impressed, with …………, depth ………… m
42 581	m^1	Both-sided lateral drainage in cut-and-cover, with possibility of cleaning under high pressure of 120 bar, diameter 200 mm, placed into drainage cement concrete of 16/32 granulometric composition, including final cleaning and TV-control prior to handing-over to the Client
42 582	m^1	Both-sided lateral drainage in cut-and-cover, with possibility of cleaning under high pressure of 120 bar, diameter 250 mm, placed into drainage cement concrete of 16/32 granulometric composition, including final cleaning and TV-control prior to handing-over to the Client
42 585	m^1	Both-sided lateral drainage in tunnel, with possibility of cleaning under high pressure of 120 bar, diameter 200 mm, placed into drainage cement concrete of 16/32 granulometric composition, including final cleaning and TV-control prior to handing-over to the Client
42 586	m^1	Both-sided lateral drainage in tunnel, with possibility of cleaning under high pressure of 120 bar, diameter 250 mm, placed into drainage cement concrete of 16/32 granulometric composition, including final cleaning and TV-control prior to handing-over to the Client

2.2.4.8.3 Deep Drainage System – Sewage System

Item	Unit Measure	Description of Work
43 111	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 15 cm
43 112	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 20 cm
43 113	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 25 cm
43 114	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 30 cm
43 115	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 40 cm
43 116	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 50 cm
43 117	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 60 cm
43 118	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 80 cm
43 119	m^1	Execution of sewage system of polypropylene pipes, placed on the excavation formation, diameter 100 cm
43 121	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 15 cm
43 122	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 20 cm
43 123	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 25 cm
43 124	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 30 cm
43 125	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid, diameter 40 cm
43 126	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 50 cm
43 127	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 60 cm
43 128	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 80 cm
43 129	m^1	Execution of sewage system of polypropylene pipes, including mineral aggregate underlaid course, diameter 100 cm
43 131	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 15 cm
43 132	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 20 cm
43 133	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 25 cm
43 134	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 30 cm
43 135	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid, diameter 40 cm
43 136	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 50 cm

Item	Unit Measure	Description of Work
43 137	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 60 cm
43 138	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 80 cm
43 139	m^1	Execution of sewage system of polypropylene pipes, including cement concrete underlaid course, diameter 100 cm
43 141	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 15 cm
43 142	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 20 cm
43 143	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 25 cm
43 144	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 30 cm
43 145	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 40 cm
43 146	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 50 cm
43 147	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 60 cm
43 148	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 80 cm
43 149	m^1	Execution of sewage system of polyester pipes, placed on the excavation formation, diameter 100 cm
43 151	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 15 cm
43 152	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 20 cm
43 153	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 25 cm
43 154	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 30 cm
43 155	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid, diameter 40 cm
43 156	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 50 cm
43 157	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 60 cm
43 158	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 80 cm
43 159	m^1	Execution of sewage system of polyester pipes, including mineral aggregate underlaid course, diameter 100 cm
43 161	m^1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 15 cm
43 162	m^1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 20 cm
43 163	m^1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 25 cm
43 164	m^1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 30 cm

Item	Unit Measure	Description of Work
43 165	m1	Execution of sewage system of polyester pipes, including cement concrete underlaid, diameter 40 cm
43 166	m1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 50 cm
43 167	m1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 60 cm
43 168	m1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 80 cm
43 169	m1	Execution of sewage system of polyester pipes, including cement concrete underlaid course, diameter 100 cm
43 171	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 15 cm
43 172	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 20 cm
43 173	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 25 cm
43 174	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 30 cm
43 175	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 40 cm
43 176	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 50 cm
43 177	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 60 cm
43 178	m1	Execution of sewage system of polyethylene pipes, placed on the excavation formation, diameter 80 cm
43 181	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid course, diameter 15 cm
43 182	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid course, diameter 20 cm
43 183	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid course, diameter 25 cm
43 184	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid course, diameter 30 cm
43 185	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid, diameter 40 cm
43 186	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid course, diameter 50 cm
43 187	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid course, diameter 60 cm
43 188	m1	Execution of sewage system of polyethylene pipes, including mineral aggregate underlaid course, diameter 80 cm
43 191	m1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid course, diameter 15 cm
43 192	m1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid course, diameter 20 cm
43 193	m1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid course, diameter 25 cm
43 194	m1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid course, diameter 30 cm

Item	Unit Measure	Description of Work
43 195	m^1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid, diameter 40 cm
43 196	m^1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid course, diameter 50 cm
43 197	m^1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid course, diameter 60 cm
43 198	m^1	Execution of sewage system of polyethylene pipes, including cement concrete underlaid course, diameter 80 cm
43 211	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 15 cm
43 212	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 20 cm
43 213	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 25 cm
43 214	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 30 cm
43 215	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 40 cm
43 216	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 50 cm
43 217	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 60 cm
43 218	m^1	Execution of sewage system of polyvinylchloride pipes, placed on the excavation formation, diameter 80 cm
43 221	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid course, diameter 15 cm
43 222	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid course, diameter 20 cm
43 223	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid course, diameter 25 cm
43 224	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid course, diameter 30 cm
43 225	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid, diameter 40 cm
43 226	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid course, diameter 50 cm
43 227	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid course, diameter 60 cm
43 228	m^1	Execution of sewage system of polyvinylchloride pipes, including mineral aggregate underlaid course, diameter 80 cm
43 231	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid course, diameter 15 cm
43 232	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid course, diameter 20 cm
43 233	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid course, diameter 25 cm
43 234	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid course, diameter 30 cm
43 235	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid, diameter 40 cm

Item	Unit Measure	Description of Work
43 236	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid course, diameter 50 cm
43 237	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid course, diameter 60 cm
43 238	m^1	Execution of sewage system of polyvinylchloride pipes, including cement concrete underlaid course, diameter 80 cm
43 241	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 15 cm
43 242	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 20 cm
43 243	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 25 cm
43 244	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 30 cm
43 245	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 40 cm
43 246	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 50 cm
43 247	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 60 cm
43 248	m^1	Execution of sewage system of plastic pipes made of ...., placed on the excavation formation, diameter 80 cm
43 251	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid course, diameter 15 cm
43 252	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid course, diameter 20 cm
43 253	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid course, diameter 25 cm
43 254	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid course, diameter 30 cm
43 255	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid, diameter 40 cm
43 256	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid course, diameter 50 cm
43 257	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid course, diameter 60 cm
43 258	m^1	Execution of sewage system of plastic pipes made of ...., including mineral aggregate underlaid course, diameter 80 cm
43 261	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 15 cm
43 262	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 20 cm
43 263	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 25 cm
43 264	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 30 cm
43 265	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid, diameter 40 cm
43 266	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 50 cm

Item	Unit Measure	Description of Work
43 267	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 60 cm
43 268	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 80 cm
43 269	m^1	Execution of sewage system of plastic pipes made of ...., including cement concrete underlaid course, diameter 100 cm
43 271	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 15 cm
43 272	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 20 cm
43 273	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 25 cm
43 274	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 30 cm
43 275	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 40 cm
43 276	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 50 cm
43 277	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 60 cm
43 278	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter 80 cm
43 279	m^1	Application of external strengthening lining to sewage system pipes with C 8/10 cement concrete, according to design detail, diameter ... cm
43 281	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 15 cm
43 282	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 20 cm
43 283	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 25 cm
43 284	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 30 cm
43 285	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 40 cm
43 286	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 50 cm
43 287	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 60 cm
43 288	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter 80 cm
43 289	m^1	Application of external strengthening lining to sewage system pipes with C 12/15 cement concrete, according to design detail, diameter ... cm
43 291	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 15 cm
43 292	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 20 cm
43 293	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 25 cm
43 294	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 30 cm

Item	Unit Measure	Description of Work
43 295	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 40 cm
43 296	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 50 cm
43 297	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 60 cm
43 298	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter 80 cm
43 299	m^1	Application of external strengthening lining to sewage system pipes with C 16/20 cement concrete, according to design detail, diameter ... cm
43 311	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 15 cm
43 312	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 20 cm
43 313	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 25 cm
43 314	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 30 cm
43 315	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 40 cm
43 316	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 50 cm
43 317	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 60 cm
43 318	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 80 cm
43 319	m^1	Execution of sewage system of cement concrete pipes, placed on the excavation formation, diameter 100 cm
43 321	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 15 cm
43 322	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 20 cm
43 323	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 25 cm
43 324	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 30 cm
43 325	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid, diameter 40 cm
43 326	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 50 cm
43 327	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 60 cm
43 328	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 80 cm
43 329	m^1	Execution of sewage system of cement concrete pipes, including mineral aggregate underlaid course, diameter 100 cm
43 331	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 15 cm
43 332	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 20 cm

Item	Unit Measure	Description of Work
43 333	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 25 cm
43 334	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 30 cm
43 335	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid, diameter 40 cm
43 336	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 50 cm
43 337	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 60 cm
43 338	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 80 cm
43 339	m^1	Execution of sewage system of cement concrete pipes, including cement concrete underlaid course, diameter 100 cm
43 341	m^1	Execution of sewage system of reinforced concrete pipes, including mineral aggregate underlaid course, diameter 120 cm
43 342	m^1	Execution of sewage system of reinforced concrete pipes, including mineral aggregate underlaid course, diameter 140 cm
43 343	m^1	Execution of sewage system of reinforced concrete pipes, including mineral aggregate underlaid course, diameter 160 cm
43 344	m^1	Execution of sewage system of reinforced concrete pipes, including mineral aggregate underlaid course, diameter 180 cm
43 345	m^1	Execution of sewage system of reinforced concrete pipes, including mineral aggregate underlaid course, diameter 200 cm
43 346	m^1	Execution of sewage system of reinforced concrete pipes, including mineral aggregate underlaid course, diameter above 200 cm
43 351	m^1	Execution of sewage system of reinforced concrete pipes, including cement concrete underlaid course, diameter 120 cm
43 352	m^1	Execution of sewage system of reinforced concrete pipes, including cement concrete underlaid course, diameter 140 cm
43 353	m^1	Execution of sewage system of reinforced concrete pipes, including cement concrete underlaid course, diameter 160 cm
43 354	m^1	Execution of sewage system of reinforced concrete pipes, including cement concrete underlaid course, diameter 180 cm
43 355	m^1	Execution of sewage system of reinforced concrete pipes, including cement concrete underlaid course, diameter 200 cm
43 356	m^1	Execution of sewage system of reinforced concrete pipes, including cement concrete underlaid course, diameter above 200 cm
43 411	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 60 and 80 mm
43 412	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 100 and 125 mm
43 413	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 150 and 200 mm
43 414	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 250 and 300 mm
43 415	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 350 and 400 mm
43 416	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 500 and 600 mm

Item	Unit Measure	Description of Work
43 417	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 700 and 800 mm
43 418	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter 900 and 1,000 mm
43 419	m^1	Execution of sewage system of ductile casting, placed on the excavation formation, diameter above 1,000 mm
43 421	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 60 and 80 mm
43 422	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 100 and 125 mm
43 423	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 150 and 200 mm
43 424	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 250 and 300 mm
43 425	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 350 and 400 mm
43 426	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 500 and 600 mm
43 427	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 700 and 800 mm
43 428	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter 900 and 1,000 mm
43 429	m^1	Execution of sewage system of ductile casting, including mineral aggregate underlaid course, diameter above 1,000 mm
43 431	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 60 and 80 mm
43 432	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 100 and 125 mm
43 433	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 150 and 200 mm
43 434	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 250 and 300 mm
43 435	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 350 and 400 mm
43 436	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 500 and 600 mm
43 437	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 700 and 800 mm
43 438	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter 900 and 1,000 mm
43 439	m^1	Execution of sewage system of ductile casting, including cement concrete underlaid course, diameter above 1,000 mm
43 511	m^1	Execution of sewage system of cast iron pipes, placed on the excavation formation, diameter 50 mm
43 512	m^1	Execution of sewage system of cast iron pipes, placed on the excavation formation, diameter 75 mm
43 513	m^1	Execution of sewage system of cast iron pipes, placed on the excavation formation, diameter 100 mm
43 514	m^1	Execution of sewage system of cast iron pipes, placed on the excavation formation, diameter 125 mm

Item	Unit Measure	Description of Work
43 515	m^1	Execution of sewage system of cast iron pipes, placed on the excavation formation, diameter 150 mm
43 516	m^1	Execution of sewage system of cast iron pipes, placed on the excavation formation, diameter 200 mm
43 517	m^1	Execution of sewage system of cast iron pipes, placed on the excavation formation, diameter above 200 mm
43 521	m^1	Execution of sewage system of cast iron pipes, including mineral aggregate underlaid course, diameter 50 mm
43 522	m^1	Execution of sewage system of cast iron pipes, including mineral aggregate underlaid course, diameter 75 mm
43 523	m^1	Execution of sewage system of cast iron pipes, including mineral aggregate underlaid course, diameter 100 mm
43 524	m^1	Execution of sewage system of cast iron pipes, including mineral aggregate underlaid course, diameter 125 mm
43 525	m^1	Execution of sewage system of cast iron pipes, including mineral aggregate underlaid course, diameter 150 mm
43 526	m^1	Execution of sewage system of cast iron pipes, including mineral aggregate underlaid course, diameter 200 mm
43 527	m^1	Execution of sewage system of cast iron pipes, including mineral aggregate underlaid course, diameter above 200 mm
43 531	m^1	Execution of sewage system of cast iron pipes, including cement concrete underlaid course, diameter 50 mm
43 532	m^1	Execution of sewage system of cast iron pipes, including cement concrete underlaid course, diameter 75 mm
43 533	m^1	Execution of sewage system of cast iron pipes, including cement concrete underlaid course, diameter 100 mm
43 534	m^1	Execution of sewage system of cast iron pipes, including cement concrete underlaid course, diameter 125 mm
43 535	m^1	Execution of sewage system of cast iron pipes, including cement concrete underlaid course, diameter 150 mm
43 536	m^1	Execution of sewage system of cast iron pipes, including cement concrete underlaid course, diameter 200 mm
43 537	m^1	Execution of sewage system of cast iron pipes, including cement concrete underlaid course, diameter above 200 mm
43 611	m^1	Extra payment for execution of sewage system in a depth of 1.1 to 2 m, with pipes of diameter up to 30 cm
43 612	m^1	Extra payment for execution of sewage system in a depth of 1.1 to 2 m, with pipes of diameter 31 - 60 cm
43 613	m^1	Extra payment for execution of sewage system in a depth of 1.1 to 2 m, with pipes of diameter 61 - 100 cm
43 614	m^1	Extra payment for execution of sewage system in a depth of 1.1 to 2 m, with pipes of diameter 101 - 140 cm
43 615	m^1	Extra payment for execution of sewage system in a depth of 1.1 to 2 m, with pipes of diameter 141 - 200 cm
43 616	m^1	Extra payment for execution of sewage system in a depth of 1.1 to 2 m, with pipes of diameter above 200 cm
43 621	m^1	Extra payment for execution of sewage system in a depth of 2.1 to 4 m, with pipes of diameter up to 30 cm

Item	Unit Measure	Description of Work
43 622	m^1	Extra payment for execution of sewage system in a depth of 2.1 to 4 m, with pipes of diameter 31 - 60 cm
43 623	m^1	Extra payment for execution of sewage system in a depth of 2.1 to 4 m, with pipes of diameter 61 - 100 cm
43 624	m^1	Extra payment for execution of sewage system in a depth of 2.1 to 4 m, with pipes of diameter 101 - 140 cm
43 625	m^1	Extra payment for execution of sewage system in a depth of 2.1 to 4 m, with pipes of diameter 141 - 200 cm
43 626	m^1	Extra payment for execution of sewage system in a depth of 2.1 to 4 m, with pipes of diameter above 200 cm
43 631	m^1	Extra payment for execution of sewage system in a depth of more than 4 m, with pipes of diameter up to 30 cm
43 632	m^1	Extra payment for execution of sewage system in a depth of more than 4 m, with pipes of diameter 31 - 60 cm
43 633	m^1	Extra payment for execution of sewage system in a depth of more than 4 m, with pipes of diameter 61 - 100 cm
43 634	m^1	Extra payment for execution of sewage system in a depth of more than 4 m, with pipes of diameter 101 - 140 cm
43 635	m^1	Extra payment for execution of sewage system in a depth of more than 4 m, with pipes of diameter 141 - 200 cm
43 636	m^1	Extra payment for execution of sewage system in a depth of more than 4 m, with pipes of diameter above 200 cm
43 641	m^1	Extra payment for the work inside normal formwork, sewage system pipes of diameter up to 30 cm
43 642	m^1	Extra payment for the work inside normal formwork, sewage system pipes of diameter 31 - 60 cm
43 643	m^1	Extra payment for the work inside normal formwork, sewage system pipes of diameter 61 – 100 cm
43 644	m^1	Extra payment for the work inside normal formwork, sewage system pipes of diameter 101 – 140 cm
43 645	m^1	Extra payment for the work inside normal formwork, sewage system pipes of diameter 141 – 200 cm
43 646	m^1	Extra payment for the work inside normal formwork, sewage system pipes of diameter more than 200 cm
43 651	m^1	Extra payment for the work inside dense formwork, sewage system pipes of diameter up to 30 cm
43 652	m^1	Extra payment for the work inside dense formwork, sewage system pipes of diameter 31 - 60 cm
43 653	m^1	Extra payment for the work inside dense formwork, sewage system pipes of diameter 61 – 100 cm
43 654	m^1	Extra payment for the work inside dense formwork, sewage system pipes of diameter 101 – 140 cm
43 655	m^1	Extra payment for the work inside dense formwork, sewage system pipes of diameter 141 – 200 cm
43 656	m^1	Extra payment for the work inside dense formwork, sewage system pipes of diameter more than 200 cm
43 711	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 100 mm, including all the necessary corrosion resistant or stainless fixing material

Item	Unit Measure	Description of Work
43 712	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 125 mm, including all the necessary corrosion resistant or stainless fixing material
43 713	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 150 mm, including all the necessary corrosion resistant or stainless fixing material
43 714	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 200 mm, including all the necessary corrosion resistant or stainless fixing material
43 715	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 250 mm, including all the necessary corrosion resistant or stainless fixing material
43 716	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 300 mm, including all the necessary corrosion resistant or stainless fixing material
43 717	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 350 mm, including all the necessary corrosion resistant or stainless fixing material
43 718	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter 400 mm, including all the necessary corrosion resistant or stainless fixing material
43 719	m^1	Execution of bridge dewatering system, of cast iron pipes of diameter more than 400 mm, including all the necessary corrosion resistant or stainless fixing material
43 721	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 100 mm, including all the necessary corrosion resistant or stainless fixing material
43 722	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 125 mm, including all the necessary corrosion resistant or stainless fixing material
43 723	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 150 mm, including all the necessary corrosion resistant or stainless fixing material
43 724	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 200 mm, including all the necessary corrosion resistant or stainless fixing material
43 725	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 250 mm, including all the necessary corrosion resistant or stainless fixing material
43 726	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 300 mm, including all the necessary corrosion resistant or stainless fixing material
43 727	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 350 mm, including all the necessary corrosion resistant or stainless fixing material
43 728	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter 400 mm, including all the necessary corrosion resistant or stainless fixing material
43 729	m^1	Execution of bridge dewatering system, of ductile casting pipes of diameter more than 400 mm, including all the necessary corrosion resistant or stainless fixing material
43 731	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 150 mm, including all the necessary corrosion resistant or stainless fixing material
43 732	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 200 mm, including all the necessary corrosion resistant or stainless fixing material
43 733	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 250 mm, including all the necessary corrosion resistant or stainless fixing material
43 734	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 300 mm, including all the necessary corrosion resistant or stainless fixing material

Item	Unit Measure	Description of Work
43 735	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 400 mm, including all the necessary corrosion resistant or stainless fixing material
43 736	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 500 mm, including all the necessary corrosion resistant or stainless fixing material
43 737	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 600 mm, including all the necessary corrosion resistant or stainless fixing material
43 738	m^1	Execution of bridge dewatering system, of polyester pipes of diameter 800 mm, including all the necessary corrosion resistant or stainless fixing material
43 739	m^1	Execution of bridge dewatering system, of polyester pipes of diameter more than 800 mm, including all the necessary corrosion resistant or stainless fixing material
43 811	pcs	Supply and installation of bridge gully or cleansing unit with bottom inlet; gully components made of grey casting and bituminized
43 812	pcs	Supply and installation of bridge gully or cleansing unit with lateral inlet; Dobava in vgraditev mostnega izlivnika ali čistilnega kosa s stranskim vtokom; gully components made of grey casting and bituminized
43 821	pcs	Supply and installation of cleansing unit, diameter up to 250 mm, on collecting drainage pipe inside the superstructure box section
43 822	pcs	Supply and installation of cleansing unit, diameter more than 250 mm, on collecting drainage pipe inside the superstructure box section
43 831	pcs	Supply and installation of corrosion resistant small pipe for draining the seepage water
43 832	pcs	Supply and installation of corrosion resistant pipe of 200 mm diameter, at the lowest point of each bridge span inside the superstructure box section
43 841	pcs	Supply and installation of flexible elastic pipe of diameter more than 200 mm, for movements up to ± 120 mm
43 842	pcs	Supply and installation of flexible elastic pipe of diameter more than 200 mm, for movements greater than ± 120 mm

2.2.4.8.4 Shafts

Item	Unit Measure	Description of Work
44 111	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 30 cm, depth up to 1.0 m
44 112	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 30 cm, depth 1.0 – 1.5 m
44 113	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 30 cm, depth 1.5 – 2.0 m
44 114	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 30 cm, depth 2.0 – 2.5 m
44 115	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 30 cm, depth above 2.5 m
44 121	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 40 cm, depth up to 1.0 m
44 122	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 40 cm, depth 1.0 – 1.5 m
44 123	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 40 cm, depth 1.5 – 2.0 m
44 124	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 40 cm, depth 2.0 – 2.5 m
44 125	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 40 cm, depth above 2.5 m
44 131	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 50 cm, depth up to 1.0 m
44 132	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 50 cm, depth 1.0 – 1.5 m
44 133	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 50 cm, depth 1.5 – 2.0 m
44 134	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 50 cm, depth 2.0 – 2.5 m
44 135	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 50 cm, depth above 2.5 m
44 141	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 60 cm, depth up to 1.0 m
44 142	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 60 cm, depth 1.0 – 1.5 m
44 143	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 60 cm, depth 1.5 – 2.0 m
44 144	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 60 cm, depth 2.0 – 2.5 m
44 145	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 60 cm, depth above 2.5 m
44 151	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 70 cm, depth up to 1.0 m
44 152	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 70 cm, depth 1.0 – 1.5 m
44 153	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 70 cm, depth 1.5 – 2.0 m

Item	Unit Measure	Description of Work
44 154	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 70 cm, depth 2.0 – 2.5 m
44 155	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 70 cm, depth above 2.5 m
44 161	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 80 cm, depth up to 1.0 m
44 162	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 80 cm, depth 1.0 – 1.5 m
44 163	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 80 cm, depth 1.5 – 2.0 m
44 164	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 80 cm, depth 2.0 – 2.5 m
44 165	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 80 cm, depth above 2.5 m
44 171	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 100 cm, depth up to 1.0 m
44 172	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 100 cm, depth 1.0 – 1.5 m
44 173	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 100 cm, depth 1.5 – 2.0 m
44 174	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 100 cm, depth 2.0 – 2.5 m
44 175	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 100 cm, depth above 2.5 m
44 181	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 120 cm, depth up to 1.0 m
44 182	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 120 cm, depth 1.0 – 1.5 m
44 183	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 120 cm, depth 1.5 – 2.0 m
44 184	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 120 cm, depth 2.0 – 2.5 m
44 185	pcs	Execution of cement concrete shaft, of circular cross-section of diameter 120 cm, depth above 2.5 m
44 191	pcs	Execution of cement concrete shaft, of circular cross-section of diameter above 120 cm, depth up to 1.0 m
44 192	pcs	Execution of cement concrete shaft, of circular cross-section of diameter above 120 cm, depth 1.0 – 1.5 m
44 193	pcs	Execution of cement concrete shaft, of circular cross-section of diameter above 120 cm, depth 1.5 – 2.0 m
44 194	pcs	Execution of cement concrete shaft, of circular cross-section of diameter above 120 cm, depth 2.0 – 2.5 m
44 195	pcs	Execution of cement concrete shaft, of circular cross-section of diameter above 120 cm, depth above 2.5 m
44 211	pcs	Execution of cement concrete shaft, of cross-section 50/50 cm, depth up to 1.0 m
44 212	pcs	Execution of cement concrete shaft, of cross-section 50/50 cm, depth 1.0 –

Item	Unit Measure	Description of Work
		1.5 m
44 213	pcs	Execution of cement concrete shaft, of cross-section 50/50 cm, depth 1.5 – 2.0 m
44 214	pcs	Execution of cement concrete shaft, of cross-section 50/50 cm, depth 2.0 – 2.5 m
44 215	pcs	Execution of cement concrete shaft, of cross-section 50/50 cm, depth above 2.5 m
44 221	pcs	Execution of cement concrete shaft, of cross-section 60/60 cm, depth up to 1.0 m
44 222	pcs	Execution of cement concrete shaft, of cross-section 60/60 cm, depth 1.0 – 1.5 m
44 223	pcs	Execution of cement concrete shaft, of cross-section 60/60 cm, depth 1.5 – 2.0 m
44 224	pcs	Execution of cement concrete shaft, of cross-section 60/60 cm, depth 2.0 – 2.5 m
44 225	pcs	Execution of cement concrete shaft, of cross-section 60/60 cm, depth above 2.5 m
44 231	pcs	Execution of cement concrete shaft, of cross-section 80/80 cm, depth up to 1.0 m
44 232	pcs	Execution of cement concrete shaft, of cross-section 80/80 cm, depth 1.0 – 1.5 m
44 233	pcs	Execution of cement concrete shaft, of cross-section 80/80 cm, depth 1.5 – 2.0 m
44 234	pcs	Execution of cement concrete shaft, of cross-section 80/80 cm, depth 2.0 – 2.5 m
44 235	pcs	Execution of cement concrete shaft, of cross-section 80/80 cm, depth above 2.5 m
44 241	pcs	Execution of cement concrete shaft, of cross-section 100/100 cm, depth up to 1.0 m
44 242	pcs	Execution of cement concrete shaft, of cross-section 100/100 cm, depth 1.0 – 1.5 m
44 243	pcs	Execution of cement concrete shaft, of cross-section 100/100 cm, depth 1.5 – 2.0 m
44 244	pcs	Execution of cement concrete shaft, of cross-section 100/100 cm, depth 2.0 – 2.5 m
44 245	pcs	Execution of cement concrete shaft, of cross-section 100/100 cm, depth above 2.5 m
44 251	pcs	Execution of cement concrete shaft, of cross-section 60/100 cm, depth up to 1.0 m
44 252	pcs	Execution of cement concrete shaft, of cross-section 60/100 cm, depth 1.0 – 1.5 m
44 253	pcs	Execution of cement concrete shaft, of cross-section 60/100 cm, depth 1.5 – 2.0 m
44 254	pcs	Execution of cement concrete shaft, of cross-section 60/100 cm, depth 2.0 – 2.5 m
44 255	pcs	Execution of cement concrete shaft, of cross-section 60/100 cm, depth above 2.5 m

Item	Unit Measure	Description of Work
44 261	pcs	Execution of cement concrete shaft, of cross-section 60/120 cm, depth up to 1.0 m
44 262	pcs	Execution of cement concrete shaft, of cross-section 60/120 cm, depth 1.0 – 1.5 m
44 263	pcs	Execution of cement concrete shaft, of cross-section 60/120 cm, depth 1.5 – 2.0 m
44 264	pcs	Execution of cement concrete shaft, of cross-section 60/120 cm, depth 2.0 – 2.5 m
44 265	pcs	Execution of cement concrete shaft, of cross-section 60/120 cm, depth above 2.5 m
44 271	pcs	Execution of cement concrete shaft, of cross-section 80/100 cm, depth up to 1.0 m
44 272	pcs	Execution of cement concrete shaft, of cross-section 80/100 cm, depth 1.0 – 1.5 m
44 273	pcs	Execution of cement concrete shaft, of cross-section 80/100 cm, depth 1.5 – 2.0 m
44 274	pcs	Execution of cement concrete shaft, of cross-section 80/100 cm, depth 2.0 – 2.5 m
44 275	pcs	Execution of cement concrete shaft, of cross-section 80/100 cm, depth above 2.5 m
44 281	pcs	Execution of cement concrete shaft, of cross-section 80/120 cm, depth up to 1.0 m
44 282	pcs	Execution of cement concrete shaft, of cross-section 80/120 cm, depth 1.0 – 1.5 m
44 283	pcs	Execution of cement concrete shaft, of cross-section 80/120 cm, depth 1.5 – 2.0 m
44 284	pcs	Execution of cement concrete shaft, of cross-section 80/120 cm, depth 2.0 – 2.5 m
44 285	pcs	Execution of cement concrete shaft, of cross-section 80/120 cm, depth above 2.5 m
44 291	pcs	Execution of cement concrete shaft, of cross-section ../.. cm, depth up to 1.0 m
44 292	pcs	Execution of cement concrete shaft, of cross-section ../.. cm, depth 1.0 – 1.5 m
44 293	pcs	Execution of cement concrete shaft, of cross-section ../.. cm, depth 1.5 – 2.0 m
44 294	pcs	Execution of cement concrete shaft, of cross-section ../.. cm, depth 2.0 – 2.5 m
44 295	pcs	Execution of cement concrete shaft, of cross-section ../.. cm, depth above 2.5 m
44 311	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 30 cm, depth up to 1.0 m
44 312	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 30 cm, depth 1.0 – 1.5 m
44 313	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 30 cm, depth 1.5 – 2.0 m
44 314	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 30 cm, depth 2.0 – 2.5 m

Item	Unit Measure	Description of Work
44 315	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 30 cm, depth above 2.5 m
44 321	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 40 cm, depth up to 1.0 m
44 322	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 40 cm, depth 1.0 – 1.5 m
44 323	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 40 cm, depth 1.5 – 2.0 m
44 324	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 40 cm, depth 2.0 – 2.5 m
44 325	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 40 cm, depth above 2.5 m
44 331	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 50 cm, depth up to 1.0 m
44 332	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 50 cm, depth 1.0 – 1.5 m
44 333	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 50 cm, depth 1.5 – 2.0 m
44 334	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 50 cm, depth 2.0 – 2.5 m
44 335	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 50 cm, depth above 2.5 m
44 341	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 60 cm, depth up to 1.0 m
44 342	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 60 cm, depth 1.0 – 1.5 m
44 343	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 60 cm, depth 1.5 – 2.0 m
44 344	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 60 cm, depth 2.0 – 2.5 m
44 345	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 60 cm, depth above 2.5 m
44 351	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 70 cm, depth up to 1.0 m
44 352	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 70 cm, depth 1.0 – 1.5 m
44 353	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 70 cm, depth 1.5 – 2.0 m
44 354	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 70 cm, depth 2.0 – 2.5 m
44 355	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 70 cm, depth above 2.5 m
44 361	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 80 cm, depth up to 1.0 m
44 362	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 80 cm, depth 1.0 – 1.5 m
44 363	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 80 cm,

Item	Unit Measure	Description of Work
		depth 1.5 – 2.0 m
44 364	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 80 cm, depth 2.0 – 2.5 m
44 365	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 80 cm, depth above 2.5 m
44 371	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 90 cm, depth up to 1.0 m
44 372	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 90 cm, depth 1.0 – 1.5 m
44 373	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 90 cm, depth 1.5 – 2.0 m
44 374	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 90 cm, depth 2.0 – 2.5 m
44 375	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 90 cm, depth above 2.5 m
44 381	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 100 cm, depth up to 1.0 m
44 382	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 100 cm, depth 1.0 – 1.5 m
44 383	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 100 cm, depth 1.5 – 2.0 m
44 384	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 100 cm, depth 2.0 – 2.5 m
44 385	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 100 cm, depth above 2.5 m
44 391	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 120 cm, depth up to 1.0 m
44 392	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 120 cm, depth 1.0 – 1.5 m
44 393	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 120 cm, depth 1.5 – 2.0 m
44 394	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 120 cm, depth 2.0 – 2.5 m
44 395	pcs	Execution of polyethylene shaft, of circular cross-section of diameter 120 cm, depth above 2.5 m
44 411	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 30 cm, depth up to 1.0 m
44 412	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 30 cm, depth 1.0 – 1.5 m
44 413	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 30 cm, depth 1.5 – 2.0 m
44 414	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 30 cm, depth 2.0 – 2.5 m
44 415	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 30 cm, depth above 2.5 m
44 421	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 40 cm, depth up to 1.0 m

Item	Unit Measure	Description of Work
44 422	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 40 cm, depth 1.0 – 1.5 m
44 423	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 40 cm, depth 1.5 – 2.0 m
44 424	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 40 cm, depth 2.0 – 2.5 m
44 425	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 40 cm, depth above 2.5 m
44 431	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 50 cm, depth up to 1.0 m
44 432	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 50 cm, depth 1.0 – 1.5 m
44 433	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 50 cm, depth 1.5 – 2.0 m
44 434	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 50 cm, depth 2.0 – 2.5 m
44 435	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 50 cm, depth above 2.5 m
44 441	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 60 cm, depth up to 1.0 m
44 442	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 60 cm, depth 1.0 – 1.5 m
44 443	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 60 cm, depth 1.5 – 2.0 m
44 444	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 60 cm, depth 2.0 – 2.5 m
44 445	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 60 cm, depth above 2.5 m
44 451	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 70 cm, depth up to 1.0 m
44 452	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 70 cm, depth 1.0 – 1.5 m
44 453	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 70 cm, depth 1.5 – 2.0 m
44 454	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 70 cm, depth 2.0 – 2.5 m
44 455	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 70 cm, depth above 2.5 m
44 461	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 80 cm, depth up to 1.0 m
44 462	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 80 cm, depth 1.0 – 1.5 m
44 463	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 80 cm, depth 1.5 – 2.0 m
44 464	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 80 cm, depth 2.0 – 2.5 m
44 465	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 80 cm, depth above 2.5 m

Item	Unit Measure	Description of Work
44 471	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 90 cm, depth up to 1.0 m
44 472	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 90 cm, depth 1.0 – 1.5 m
44 473	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 90 cm, depth 1.5 – 2.0 m
44 474	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 90 cm, depth 2.0 – 2.5 m
44 475	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 90 cm, depth above 2.5 m
44 481	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 100 cm, depth up to 1.0 m
44 482	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 100 cm, depth 1.0 – 1.5 m
44 483	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 100 cm, depth 1.5 – 2.0 m
44 484	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 100 cm, depth 2.0 – 2.5 m
44 485	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 100 cm, depth above 2.5 m
44 491	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 120 cm, depth up to 1.0 m
44 492	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 120 cm, depth 1.0 – 1.5 m
44 493	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 120 cm, depth 1.5 – 2.0 m
44 494	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 120 cm, depth 2.0 – 2.5 m
44 495	pcs	Execution of polypropylene shaft, of circular cross-section of diameter 120 cm, depth above 2.5 m
44 511	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 40 cm, depth up to 1.0 m
44 512	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 40 cm, depth 1.0 – 1.5 m
44 513	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 40 cm, depth 1.5 – 2.0 m
44 514	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 40 cm, depth 2.0 - 2.5 m
44 515	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 40 cm, depth above 2.5 m
44 521	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 60 cm, depth up to 1.0 m
44 522	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 60 cm, depth 1.0 – 1.5 m
44 523	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 60 cm, depth 1.5 – 2.0 m
44 524	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section

Item	Unit Measure	Description of Work
		60 cm, depth 2.0 - 2.5 m
44 525	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 60 cm, depth above 2.5 m
44 531	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 80 cm, depth up to 1.0 m
44 532	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 80 cm, depth 1.0 – 1.5 m
44 533	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 80 cm, depth 1.5 – 2.0 m
44 534	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 80 cm, depth 2.0 - 2.5 m
44 535	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 80 cm, depth above 2.5 m
44 541	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 100 cm, depth up to 1.0 m
44 542	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 100 cm, depth 1.0 – 1.5 m
44 543	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 100 cm, depth 1.5 – 2.0 m
44 544	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 100 cm, depth 2.0 - 2.5 m
44 545	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 100 cm, depth above 2.5 m
44 551	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 110 cm, depth up to 1.0 m
44 552	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 110 cm, depth 1.0 – 1.5 m
44 553	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 110 cm, depth 1.5 – 2.0 m
44 554	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 110 cm, depth 2.0 - 2.5 m
44 555	pcs	Execution of polyester shaft passable for vehicles, of circular cross-section 110 cm, depth above 2.5 m
44 611	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 40 cm, depth up to 1.0 m
44 612	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 40 cm, depth 1.0 – 1.5 m
44 613	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 40 cm, depth 1.5 – 2.0 m
44 614	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 40 cm, depth 2.0 - 2.5 m
44 615	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 40 cm, depth above 2.5 m
44 621	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 60 cm, depth up to 1.0 m
44 622	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 60 cm, depth 1.0 – 1.5 m

Item	Unit Measure	Description of Work
44 623	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 60 cm, depth 1.5 – 2.0 m
44 624	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 60 cm, depth 2.0 - 2.5 m
44 625	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 60 cm, depth above 2.5 m
44 631	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 80 cm, depth up to 1.0 m
44 632	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 80 cm, depth 1.0 – 1.5 m
44 633	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 80 cm, depth 1.5 – 2.0 m
44 634	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 80 cm, depth 2.0 - 2.5 m
44 635	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 80 cm, depth above 2.5 m
44 641	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 100 cm, depth up to 1.0 m
44 642	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 100 cm, depth 1.0 – 1.5 m
44 643	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 100 cm, depth 1.5 – 2.0 m
44 644	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 100 cm, depth 2.0 - 2.5 m
44 645	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 100 cm, depth above 2.5 m
44 651	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 110 cm, depth up to 1.0 m
44 652	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 110 cm, depth 1.0 – 1.5 m
44 653	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 110 cm, depth 1.5 – 2.0 m
44 654	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 110 cm, depth 2.0 - 2.5 m
44 655	pcs	Execution of polyester shaft not passable for vehicles, of circular cross-section 110 cm, depth above 2.5 m
44 711	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 30 cm, depth up to 1.0 m
44 712	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 30 cm, depth 1.0 – 1.5 m
44 713	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 30 cm, depth 1.5 – 2.0 m
44 714	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 30 cm, depth 2.0 – 2.5 m
44 715	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 30 cm, depth above 2.5 m
44 721	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 40 cm,

Item	Unit Measure	Description of Work
		depth up to 1.0 m
44 722	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 40 cm, depth 1.0 – 1.5 m
44 723	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 40 cm, depth 1.5 – 2.0 m
44 724	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 40 cm, depth 2.0 – 2.5 m
44 725	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 40 cm, depth above 2.5 m
44 731	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 50 cm, depth up to 1.0 m
44 732	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 50 cm, depth 1.0 – 1.5 m
44 733	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 50 cm, depth 1.5 – 2.0 m
44 734	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 50 cm, depth 2.0 – 2.5 m
44 735	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 50 cm, depth above 2.5 m
44 741	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 60 cm, depth up to 1.0 m
44 742	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 60 cm, depth 1.0 – 1.5 m
44 743	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 60 cm, depth 1.5 – 2.0 m
44 744	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 60 cm, depth 2.0 – 2.5 m
44 745	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 60 cm, depth above 2.5 m
44 751	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 70 cm, depth up to 1.0 m
44 752	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 70 cm, depth 1.0 – 1.5 m
44 753	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 70 cm, depth 1.5 – 2.0 m
44 754	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 70 cm, depth 2.0 – 2.5 m
44 755	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 70 cm, depth above 2.5 m
44 761	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 80 cm, depth up to 1.0 m
44 762	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 80 cm, depth 1.0 – 1.5 m
44 763	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 80 cm, depth 1.5 – 2.0 m
44 764	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 80 cm, depth 2.0 – 2.5 m
44 765	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 80 cm, depth above 2.5 m

Item	Unit Measure	Description of Work
44 771	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 90 cm, depth up to 1.0 m
44 772	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 90 cm, depth 1.0 – 1.5 m
44 773	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 90 cm, depth 1.5 – 2.0 m
44 774	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 90 cm, depth 2.0 – 2.5 m
44 775	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 90 cm, depth above 2.5 m
44 781	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 100 cm, depth up to 1.0 m
44 782	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 100 cm, depth 1.0 – 1.5 m
44 783	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 100 cm, depth 1.5 – 2.0 m
44 784	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 100 cm, depth 2.0 – 2.5 m
44 785	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 100 cm, depth above 2.5 m
44 791	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 120 cm, depth up to 1.0 m
44 792	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 120 cm, depth 1.0 – 1.5 m
44 793	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 120 cm, depth 1.5 – 2.0 m
44 794	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 120 cm, depth 2.0 – 2.5 m
44 795	pcs	Execution of ductile casting shaft, of circular cross-section of diameter 120 cm, depth above 2.5 m
44 811	pcs	Supply and installation of cast iron grating, of 15 kN bearing capacity, of circular cross-section of diameter 450 mm
44 812	pcs	Supply and installation of cast iron grating, of 15 kN bearing capacity, of circular cross-section of diameter 500 mm
44 813	pcs	Supply and installation of cast iron grating, of 15 kN bearing capacity, of circular cross-section of diameter 600 mm
44 814	pcs	Supply and installation of cast iron grating, of 15 kN bearing capacity, of circular cross-section of diameter 700 mm
44 815	pcs	Supply and installation of cast iron grating, of 15 kN bearing capacity, of circular cross-section of diameter 800 mm
44 816	pcs	Supply and installation of cast iron grating, of 15 kN bearing capacity, of circular cross-section of diameter above 800 mm
44 821	pcs	Supply and installation of cast iron grating, of 50 kN bearing capacity, of circular cross-section of diameter 450 mm
44 822	pcs	Supply and installation of cast iron grating, of 50 kN bearing capacity, of circular cross-section of diameter 500 mm
44 823	pcs	Supply and installation of cast iron grating, of 50 kN bearing capacity, of

Item	Unit Measure	Description of Work
		circular cross-section of diameter 600 mm
44 824	pcs	Supply and installation of cast iron grating, of 50 kN bearing capacity, of circular cross-section of diameter 700 mm
44 825	pcs	Supply and installation of cast iron grating, of 50 kN bearing capacity, of circular cross-section of diameter 800 mm
44 826	pcs	Supply and installation of cast iron grating, of 50 kN bearing capacity, of circular cross-section of diameter above 800 mm
44 831	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of circular cross-section of diameter 500 mm
44 832	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of circular cross-section of diameter 600 mm
44 833	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of circular cross-section of diameter 700 mm
44 834	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of circular cross-section of diameter 800 mm
44 835	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of circular cross-section of diameter above 800 mm
44 836	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of cross-section 300/300 mm
44 837	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of cross-section 400/300 mm
44 838	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of cross-section 500/300 mm
44 839	pcs	Supply and installation of cast iron grating, of 150 kN bearing capacity, of cross-section .../... mm
44 841	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of circular cross-section of diameter 500 mm
44 842	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of circular cross-section of diameter 600 mm
44 843	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of circular cross-section of diameter 700 mm
44 844	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of circular cross-section of diameter above 700 mm
44 846	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of cross-section 300/300 mm
44 847	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of cross-section 400/300 mm
44 848	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of cross-section 500/300 mm
44 849	pcs	Supply and installation of cast iron grating, of 250 kN bearing capacity, of cross-section .../... mm
44 851	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 450 mm, depth 0.5 m
44 852	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 450 mm, depth 1.0 m
44 853	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 450 mm, depth 1.5 m

Item	Unit Measure	Description of Work
44 854	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 450 mm, depth above 1.5 m
44 856	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 500 mm, depth 0.5 m
44 857	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 500 mm, depth 1.0 m
44 858	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 500 mm, depth 1.5 m
44 859	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 500 mm, depth above 1.5 m
44 861	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 600 mm, depth 0.5 m
44 862	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 600 mm, depth 1.0 m
44 863	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 600 mm, depth 1.5 m
44 864	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 600 mm, depth above 1.5 m
44 866	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 700 mm, depth 0.5 m
44 867	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 700 mm, depth 1.0 m
44 868	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 700 mm, depth 1.5 m
44 869	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 700 mm, depth above 1.5 m
44 871	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 800 mm, depth 0.5 m
44 872	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 800 mm, depth 1.0 m
44 873	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 800 mm, depth 1.5 m
44 874	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter 800 mm, depth above 1.5 m
44 876	pcs	Supply and installation of sand trap of galvanized steel plate, of diameter ... mm, depth .... m
44 881	pcs	Execution of petrol and oil trap of cement concrete, acc. to design detail, Q = 3 l/s
44 882	pcs	Execution of petrol and oil trap of cement concrete, acc. to design detail, Q = 6 l/s
44 883	pcs	Execution of petrol and oil trap of cement concrete, acc. to design detail, Q = 10 l/s
44 884	pcs	Execution of petrol and oil trap of cement concrete, acc. to design detail, Q = 15 l/s
44 885	pcs	Execution of petrol and oil trap of cement concrete, acc. to design detail, Q > 15 l/s

Item	Unit Measure	Description of Work
44 891	pcs	Execution of standard petrol and oil trap of cement concrete, acc. to design detail, of circular cross-section of ..... cm
44 896	pcs	Execution of standard petrol and oil trap of cement concrete, acc. to design detail, of circular cross-section of ..... cm
44 911	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 30 cm
44 912	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 40 cm
44 913	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 50 cm
44 914	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 60 cm
44 915	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 70 cm
44 916	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 80 cm
44 917	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 100 cm
44 918	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter 120 cm
44 919	pcs	Supply and installation of cement concrete cover, of circular cross-section of diameter above 120 cm
44 921	pcs	Supply and installation of cement concrete cover, of cross-section 50/50 cm
44 922	pcs	Supply and installation of cement concrete cover, of cross-section 60/60 cm
44 923	pcs	Supply and installation of cement concrete cover, of cross-section 80/80 cm
44 924	pcs	Supply and installation of cement concrete cover, of cross-section 100/100 cm
44 925	pcs	Supply and installation of cement concrete cover, of cross-section 60/100 cm
44 926	pcs	Supply and installation of cement concrete cover, of cross-section 60/120 cm
44 927	pcs	Supply and installation of cement concrete cover, of cross-section 80/100 cm
44 928	pcs	Supply and installation of cement concrete cover, of cross-section 80/120 cm
44 929	pcs	Supply and installation of cement concrete cover, of cross-section .../.... cm
44 931	pcs	Supply and installation of cast iron cover, of 15 kN bearing capacity, of circular cross-section of diameter 450 mm
44 932	pcs	Supply and installation of cast iron cover, of 15 kN bearing capacity, of circular cross-section of diameter 500 mm
44 933	pcs	Supply and installation of cast iron cover, of 15 kN bearing capacity, of circular cross-section of diameter 600 mm
44 934	pcs	Supply and installation of cast iron cover, of 15 kN bearing capacity, of circular cross-section of diameter 700 mm
44 935	pcs	Supply and installation of cast iron cover, of 15 kN bearing capacity, of circular cross-section of diameter 800 mm
44 936	pcs	Supply and installation of cast iron cover, of 15 kN bearing capacity, of circular cross-section of diameter above 800 mm
44 941	pcs	Supply and installation of cast iron cover, of 50 kN bearing capacity, of circular cross-section of diameter 450 mm

Item	Unit Measure	Description of Work
44 942	pcs	Supply and installation of cast iron cover, of 50 kN bearing capacity, of circular cross-section of diameter 500 mm
44 943	pcs	Supply and installation of cast iron cover, of 50 kN bearing capacity, of circular cross-section of diameter 600 mm
44 944	pcs	Supply and installation of cast iron cover, of 50 kN bearing capacity, of circular cross-section of diameter 700 mm
44 945	pcs	Supply and installation of cast iron cover, of 50 kN bearing capacity, of circular cross-section of diameter 800 mm
44 946	pcs	Supply and installation of cast iron cover, of 50 kN bearing capacity, of circular cross-section of diameter above 800 mm
44 951	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of circular cross-section of diameter 500 mm
44 952	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of circular cross-section of diameter 600 mm
44 953	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of circular cross-section of diameter 700 mm
44 954	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of circular cross-section of diameter above 700 mm
44 956	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of cross-section 400/400 mm
44 957	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of cross-section 500/500 mm
44 958	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of cross-section 600/600 mm
44 959	pcs	Supply and installation of cast iron cover, of 150 kN bearing capacity, of cross-section .../... mm
44 961	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of circular cross-section of diameter 500 mm
44 962	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of circular cross-section of diameter 600 mm
44 963	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of circular cross-section of diameter 700 mm
44 964	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of circular cross-section of diameter above 700 mm
44 966	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of cross-section 400/400 mm
44 967	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of cross-section 500/500 mm
44 968	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of cross-section 600/600 mm
44 969	pcs	Supply and installation of cast iron cover, of 250 kN bearing capacity, of cross-section .../... mm
44 971	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of circular cross-section of diameter 500 mm
44 972	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of circular cross-section of diameter 600 mm
44 973	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of circular cross-section of diameter 700 mm

Item	Unit Measure	Description of Work
44 974	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of circular cross-section of diameter ..... mm
44 976	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of cross-section 400/400 mm
44 977	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of cross-section 500/500 mm
44 978	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of cross-section 600/600 mm
44 979	pcs	Supply and installation of cast iron cover, of 400 kN bearing capacity, of cross-section .../... mm
44 981	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 15 kN bearing capacity, of circular cross section of diameter 500 mm
44 982	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 15 kN bearing capacity, of circular cross section of diameter 600 mm
44 983	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 15 kN bearing capacity, of circular cross section of diameter 700 mm
44 984	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 15 kN bearing capacity, of circular cross section of diameter above 700 mm
44 986	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 50 kN bearing capacity, of circular cross section of diameter 500 mm
44 987	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 50 kN bearing capacity, of circular cross section of diameter 600 mm
44 988	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 50 kN bearing capacity, of circular cross section of diameter 700 mm
44 989	pcs	Supply and installation of cover of cast iron and cement concrete combination, of 50 kN bearing capacity, of circular cross section of diameter above 700 mm
44 991	pcs	Raising of existing cement concrete shaft by up to 50 cm, acc. to design detail, of circular cross section of diameter up to 50 cm
44 992	pcs	Raising of existing cement concrete shaft by up to 50 cm, acc. to design detail, of circular cross section of diameter 60 - 80 cm
44 993	pcs	Raising of existing cement concrete shaft by up to 50 cm, acc. to design detail, of circular cross section of diameter above 80 cm
44 995	pcs	Raising of existing cement concrete shaft by up to 50 cm, acc. to design detail, of cross section up to 60/60 cm
44 996	pcs	Raising of existing cement concrete shaft by up to 50 cm, acc. to design detail, of cross section above 60/60 cm
44 998	m^1	Pipe tightness test
44 999	pcs	Shaft tightness test

2.2.4.8.5 Culverts

Item	Unit Measure	Description of Work
45 111	m^1	Execution of culvert of circular cross-section of cement concrete pipes, diameter 40 cm
45 112	m^1	Execution of culvert of circular cross-section of cement concrete pipes, diameter 50 cm
45 113	m^1	Execution of culvert of circular cross-section of cement concrete pipes, diameter 60 cm
45 114	m^1	Execution of culvert of circular cross-section of cement concrete pipes, diameter 80 cm
45 115	m^1	Execution of culvert of circular cross-section of cement concrete pipes, diameter 100 cm
45 121	m^1	Execution of culvert of circular cross-section of reinforced cement concrete pipes, diameter 120 cm
45 122	m^1	Execution of culvert of circular cross-section of reinforced cement concrete pipes, diameter 140 cm
45 123	m^1	Execution of culvert of circular cross-section of reinforced cement concrete pipes, diameter 150 cm
45 124	m^1	Execution of culvert of circular cross-section of reinforced cement concrete pipes, diameter 180 cm
45 125	m^1	Execution of culvert of circular cross-section of reinforced cement concrete pipes, diameter 200 cm
45 126	m^1	Execution of culvert of circular cross-section of reinforced cement concrete pipes, diameter above 200 cm
45 131	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 40 cm in diameter, with C 12/15 cement concrete
45 132	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 50 cm in diameter, with C 12/15 cement concrete
45 133	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 60 cm in diameter, with C 12/15 cement concrete
45 134	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 80 cm in diameter, with C 12/15 cement concrete
45 135	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 100 cm in diameter, with C 12/15 cement concrete
45 136	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 120 cm in diameter, with C 12/15 cement concrete
45 137	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 150 cm in diameter, with C 12/15 cement concrete
45 138	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring 200 cm in diameter, with C 12/15 cement concrete
45 139	m^1	Coating course applied to exterior of culvert of circular cross-section of pipes measuring above 200 cm in diameter, with C 12/15 cement concrete
45 141	m^1	Execution of culvert of circular cross-section of polypropylene pipes, diameter 40 cm
45 142	m^1	Execution of culvert of circular cross-section of polypropylene pipes, diameter 50 cm
45 143	m^1	Execution of culvert of circular cross-section of polypropylene pipes, diameter 60 cm
45 144	m^1	Execution of culvert of circular cross-section of polypropylene pipes,

Item	Unit Measure	Description of Work
		diameter 80 cm
45 145	m^1	Execution of culvert of circular cross-section of polypropylene pipes, diameter 100 cm
45 146	m^1	Execution of culvert of circular cross-section of polypropylene pipes, diameter 120 cm
45 147	m^1	Execution of culvert of circular cross-section of polypropylene pipes, diameter 140 cm
45 148	m^1	Execution of culvert of circular cross-section of polypropylene pipes, diameter above 140 cm
45 151	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter 40 cm
45 152	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter 50 cm
45 153	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter 60 cm
45 154	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter 80 cm
45 155	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter 100 cm
45 156	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter 120 cm
45 157	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter 140 cm
45 158	m^1	Execution of culvert of circular cross-section of polyethylene pipes, diameter above 140 cm
45 161	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter 40 cm
45 162	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter 50 cm
45 163	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter 60 cm
45 164	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter 80 cm
45 165	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter 100 cm
45 166	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter 120 cm
45 167	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter 140 cm
45 168	m^1	Execution of culvert of circular cross-section of ductile casting pipes, diameter above 140 cm
45 171	m^1	Execution of culvert of parabolic cross-section of cement concrete measuring 80 cm in height
45 172	m^1	Execution of culvert of parabolic cross-section of cement concrete measuring 100 cm in height
45 173	m^1	Execution of culvert of parabolic cross-section of cement concrete measuring 120 cm in height
45 174	m^1	Execution of culvert of parabolic cross-section of cement concrete measuring 150 cm in height
45 175	m^1	Execution of culvert of parabolic cross-section of cement concrete

Item	Unit Measure	Description of Work
		measuring 200 cm in height
45 176	m^1	Execution of culvert of parabolic cross-section of cement concrete measuring 250 cm in height
45 177	m^1	Execution of culvert of parabolic cross-section of cement concrete measuring above 250 cm in height
45 181	m^1	Execution of culvert of oval cross-section of corrugated galvanized steel sheet of cross-sectional area up to 5 m^2
45 182	m^1	Execution of culvert of oval cross-section of corrugated galvanized steel sheet of cross-sectional area 5.1 - 10 m^2
45 183	m^1	Execution of culvert of oval cross-section of corrugated galvanized steel sheet of cross-sectional area 10.1 - 20 m^2
45 184	m^1	Execution of culvert of oval cross-section of corrugated galvanized steel sheet of cross-sectional area 20.1 - 30 m^2
45 185	m^1	Execution of culvert of oval cross-section of corrugated galvanized steel sheet of cross-sectional area 30.1 - 40 m^2
45 186	m^1	Execution of culvert of oval cross-section of corrugated galvanized steel sheet of cross-sectional area 40.1 - 50 m^2
45 187	m^1	Execution of culvert of oval cross-section of corrugated galvanized steel sheet of cross-sectional area above 50 m^2
45 191	m^1	Execution of frame slab culvert of reinforced cement concrete of clear cross-section above foundations up to 4 m^2
45 192	m^1	Execution of frame slab culvert of reinforced cement concrete of clear cross-section above foundations 4.1 - 8 m^2
45 193	m^1	Execution of frame slab culvert of reinforced cement concrete of clear cross-section above foundations 8.1 - 12 m^2
45 194	m^1	Execution of frame slab culvert of reinforced cement concrete of clear cross-section above foundations 12.1 - 16 m^2
45 195	m^1	Execution of frame slab culvert of reinforced cement concrete of clear cross-section above foundations 16.1 - 20 m^2
45 196	m^1	Execution of frame slab culvert of reinforced cement concrete of clear cross-section above foundations above 20 m^2
45 211	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 40 cm
45 212	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 50 cm
45 213	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 60 cm
45 214	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 80 cm
45 215	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 100 cm
45 216	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 120 – 150 cm
45 217	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 150 - 200 cm
45 218	pcs	Execution of inclined inflow or outflow head of culvert of circular cross-section of cement concrete, diameter above 200 cm
45 231	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 40 cm

Item	Unit Measure	Description of Work
45 232	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 50 cm
45 233	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 60 cm
45 234	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 80 cm
45 235	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 100 cm
45 236	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 120 – 150 cm
45 237	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter 150 - 200 cm
45 238	pcs	Execution of flat or wing inflow or outflow head of culvert of circular cross-section of cement concrete, diameter above 200 cm
45 241	pcs	Execution of inflow or outflow head of culvert of parabolic cross-section of cement concrete measuring 80 cm in height
45 242	pcs	Execution of inflow or outflow head of culvert of parabolic cross-section of cement concrete measuring 100 cm in height
45 243	pcs	Execution of inflow or outflow head of culvert of parabolic cross-section of cement concrete measuring 120 cm in height
45 244	pcs	Execution of inflow or outflow head of culvert of parabolic cross-section of cement concrete measuring 150 cm in height
45 245	pcs	Execution of inflow or outflow head of culvert of parabolic cross-section of cement concrete measuring 200 cm in height
45 246	pcs	Execution of inflow or outflow head of culvert of parabolic cross-section of cement concrete measuring above 200 cm in height

2.2.4.8.6 Springs, Wells, Sinkholes, Funnel-Shaped Holes

Item	Unit Measure	Description of Work
46 111	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of cement concrete, circular section, diameter 30 cm
46 112	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of cement concrete, circular section, diameter 40 cm
46 113	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of cement concrete, circular section, diameter 50 cm
46 114	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of cement concrete, circular section, diameter 60 cm
46 115	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of cement concrete, circular section, diameter 80 cm
46 116	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of cement concrete, circular section, diameter 100 cm
46 117	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of cement concrete, circular section, diameter above 100 cm
46 121	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of polymer, circular section, diameter 30 cm
46 122	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of polymer, circular section, diameter 40 cm
46 123	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of polymer, circular section, diameter 50 cm
46 124	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of polymer, circular section, diameter 60 cm
46 125	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of polymer, circular section, diameter 80 cm
46 126	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of polymer, circular section, diameter 100 cm
46 127	pcs	Arrangement of spring in road alignment, depth up to 1 m, by means of perforated pipe made of polymer, circular section, diameter above 100 cm
46 131	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of cement concrete, circular section, diameter 30 cm
46 132	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of cement concrete, circular section, diameter 40 cm
46 133	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of cement concrete, circular section, diameter 50 cm
46 134	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of cement concrete, circular section, diameter 60 cm
46 135	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of cement concrete, circular section, diameter 80 cm
46 136	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of cement concrete, circular section, diameter 100 cm
46 137	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of cement concrete, circular section, diameter above 100 cm
46 141	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of polymer, circular section, diameter 30 cm

Item	Unit Measure	Description of Work
46 142	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of polymer, circular section, diameter 40 cm
46 143	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of polymer, circular section, diameter 50 cm
46 144	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of polymer, circular section, diameter 60 cm
46 145	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of polymer, circular section, diameter 80 cm
46 136	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of polymer, circular section, diameter 100 cm
46 147	pcs	Arrangement of spring in road alignment, depth 1.1 – 2.0 m, by means of perforated pipe made of polymer, circular section, diameter above 100 cm
46 211	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 30 cm
46 212	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 40 cm
46 213	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 50 cm
46 214	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 60 cm
46 215	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 80 cm
46 216	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 100 cm
46 217	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 120 cm
46 218	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter 150 cm
46 219	m^1	Execution of well with perforated pipe of cement concrete, circular section, diameter above 150 cm
46 221	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 30 cm
46 222	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 40 cm
46 223	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 50 cm
46 224	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 60 cm
46 225	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 80 cm
46 226	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 100 cm
46 227	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 120 cm
46 228	m^1	Execution of well with perforated pipe of polymer, circular section, diameter 150 cm
46 229	m^1	Execution of well with perforated pipe of polymer, circular section, diameter above 150 cm
46 311	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 60 cm, depth up to 1.0 m

Item	Unit Measure	Description of Work
46 312	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 60 cm, depth 1.1 – 2.0 m
46 313	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 60 cm, depth 2.1 – 3.0 m
46 314	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 60 cm, depth 3.1 – 4.0 m
46 315	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 60 cm, depth 4.1 – 5.0 m
46 316	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 60 cm, depth above 5.0 m
46 321	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 60 cm, depth up to 1.0 m
46 322	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 60 cm, depth 1.1 – 2.0 m
46 323	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 60 cm, depth 2.1 – 3.0 m
46 324	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 60 cm, depth 3.1 – 4.0 m
46 325	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 60 cm, depth 4.1 – 5.0 m
46 326	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 60 cm, depth above 5.0 m
46 331	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 80 cm, depth up to 1.0 m
46 332	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 80 cm, depth 1.1 – 2.0 m
46 333	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 80 cm, depth 2.1 – 3.0 m
46 334	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 80 cm, depth 3.1 – 4.0 m
46 335	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 80 cm, depth 4.1 – 5.0 m
46 336	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 80 cm, depth above 5.0 m
46 341	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 80 cm, depth up to 1.0 m
46 342	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 80 cm, depth 1.1 – 2.0 m
46 343	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 80 cm, depth 2.1 – 3.0 m
46 344	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 80 cm, depth 3.1 – 4.0 m
46 345	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 80 cm, depth 4.1 – 5.0 m
46 346	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 80 cm, depth above 5.0 m
46 351	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 100 cm, depth up to 1.0 m
46 352	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular

Item	Unit Measure	Description of Work
		section, diameter 100 cm, depth 1.1 – 2.0 m
46 353	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 100 cm, depth 2.1 – 3.0 m
46 354	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 100 cm, depth 3.1 – 4.0 m
46 355	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 100 cm, depth 4.1 – 5.0 m
46 356	pcs	Arrangement of sinkhole with perforated pipe of cement concrete, circular section, diameter 100 cm, depth above 5.0 m
46 361	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 100 cm, depth up to 1.0 m
46 362	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 100 cm, depth 1.1 – 2.0 m
46 363	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 100 cm, depth 2.1 – 3.0 m
46 364	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 100 cm, depth 3.1 – 4.0 m
46 365	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 100 cm, depth 4.1 – 5.0 m
46 366	pcs	Arrangement of sinkhole with perforated pipe of polymer, circular section, diameter 100 cm, depth above 5.0 m
46 371	pcs	Arrangement of sinkhole with perforated pipes of …………………….., circular section, diameter …… cm, depth ……….. m
46 411	m^3	Arrangement of funnel-shaped hole with stones bound together with cement concrete
46 421	m^3	Arrangement of funnel-shaped hole by covering the swallowing hole with cement concrete slab
46 422	m^3	Arrangement of funnel-shaped hole by covering the swallowing hole with cement concrete arch

GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

VOLUME II: CONSTRUCTION

SECTION 2: SPECIAL TECHNICAL CONDITIONS

Part 5: CRAFTSMEN WORKS

Sarajevo/Banja Luka
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2.2.5 CRAFTSMEN WORKS

2.2.5.1 CARPENTRY

General

Both appearance and quality of structural surfaces and the quality of structures made of cement concrete mainly depend on the carpentry carried out. Therefore, the basic materials for such works shall be selected very carefully, and the accuracy of execution of the entire structure as well as of individual structural members, all in compliance with the design dimensions, shall be ensured.

2.2.5.1.1 Description

Carpentry includes the following:

- supply and installation of suitable materials for scaffolds and formwork,
- erecting and fixing,
- removal, as well as
- cleaning and storing.

Scaffolds and formwork shall enable casting cement concrete in dimensions as specified by the design. The contractor shall provide design documents for both scaffolding and formwork proving their bearing capacity nad stability, unless such documents have already been attached to the structural design. The contractor shall also ensure all the required documents such as drawings, design analyses, and certificates for working and protective platforms, protective roofing, and other auxiliary apparatus as well as for the equipment for the erection.

In formwork for exposed (visible) cement concrete surfaces, and for prestressed structures, certain special requirements shall be met, if they are indicated in the design or specified by the engineer.

2.2.5.1.2 Basic Materials

Basic materials for the carpentry are:

- planks
- formwork boards (wooden, steel),
- beams,
- posts,
- steel props,
- joining materials (nails, wire, clamps, couplers, anchors).

The contractor is free to use other materials for the carpentry provided that he has previously proven suitability of such materials, and that he has obtained an approval by the engineer.

2.2.5.1.3 Quality of Materials

The quality of all the materials for the carpentry works shall comply with the requirements (type, dimensions, shape) provided by the design and contractor's drawings.

Wood for the carpentry shall correspond to the specifications of current regulation for the following:

- round technical wood,
- hewed coniferous wood, and
- sawed coniferous wood.

Planks and formwork boards for visible (exposed) cement concrete surfaces shall be, as a rule, completely smooth (planed), and without any sharp edges. For formworks used for non-exposed (hidden) cement concrete surfaces it is possible to introduce sawed or hewed wood without any additional finishing. Such wood is also suitable to the production of scaffolds.

For scaffolds and formwork it is allowed to use wood with insignificant damage or imperfections. However, the latter must not contribute to reduction of both strength and durability below the minimum requirement as provided by the design.

2.2.5.1.4 Method of Execution

2.2.5.1.4.1 Erection of Scaffolds and Formwork

Scaffolds and formwork shall be placed in compliance with detailed drawings including all the foreseen linkages, in order to be capable to take the design load arising from the cast cement concrete and steel reinforcement, and to ensure their removal without any adverse consequences for the structures as well as for the scaffolds and formwork themselves.

As a rule, for all exposed (visible) cement concrete surfaces of the entire structure, the same type of formwork shall be introduced, and the dimensions of individual elements shall be as similar as possible.

Such elements shall be installed into the formwork structure as well as into fastening of both scaffolding and formwork, which allow the required adaptation of the formwork during casting, and an adequate striking the formwork (spindles, hydraulic jacks, lifting dvices). The use of wedges or pins is not admitted.

The joints between formwork elements shall be specified in advance in the carpentry plans. They shall be distributed as uniform as possible, and shall run continuously.

2.2.5.1.4.2 Fastening the Scaffolding and Formwork

Both scaffolding and formwork shall be anchored and supported in such a way that their movement and deformation due to loading, arising from the cement concrete and dynamic actions during casting, do not exceed the values foreseen by the design.

All the formwork fastening elements shall so adjusted as to allow each element, which remains in the exposed concrete and may oxidize, to be covered by at least 3.5 cm thick cement concrete or cement mortar layer, or to be protected in some different appropriate way.

All transverse anchors shall be equipped with stressing heads enabling their subsequent tensioning and removal without any damage to cement concrete. Openings, which the anchors or stressing heads are pulled through, shall be so closed (with an exception of certain cases) as to be watertight.

In exposed (visible) cement concrete surfaces the arrangement of the openings for anchoring the formwork, and the mode of their installation shall be such as to correspond both technologically and visually to the visible cement concrete. This shall be already specified in the formwork plans.

The use of anchors with coiled up wire is not admitted.

2.2.5.1.4.3 Removal of Scaffolding and Striking the Formwork

Both scaffolding and formwork shall not be removed until the cement concrete sets to such an extent that structural safety is ensured.

To the commencement of striking the formwork from the cement concrete, which sets in normal temperature conditions (above +5 °C), the following common measures apply:

- vertical lateral formwork after 2 – 3 days,
- scaffolds and propping formwork after the cement concrete has reached the strength corresponding to 2.5 times the stresses, which actually occur after striking.

For prestressed structures, detailed conditions relating to the removal of scaffolding and striking the formwork shall be provided by the design.

To reduce the hazard of cracks and to reduce deformations due to cement concrete creep, the time periods up to the removal of bearing scaffolding shall be as long as possible. After striking the formwork, if possible, provisional supports shall be reinstalled. During striking the formwork no damage to the setting cement concrete must take rise.

2.2.5.1.5 Quality of Execution

Inner surfaces of formwork shall be smooth and properly geometrically shaped as provided by the design. Where boards are foreseen for the formwork for exposed surfaces, the joints between the boards shall be formed as tongue-and-groove ones as a rule. By accurate execution and sealing of the joints, water-tightness of formwork shall be ensured. Flowing away of water or cement concrete shall be prevented. For sealing the joints only such materials are admitted, which do not affect adversely binding of cement in fresh cement concrete, and which do not colour the cement concrete surface.

Formwork, which soak liquids, shall be suitably prepared prior to casting cement concrete (water saturation, protective coating). It shall be ensured that the formwork or the material for protective coating does not chemically react nor it affects adversely the appearance and quality of the cement concrete whatsoever. The cement concrete colour shall remain uniform.

Boards and plates for formwork shall always be thoroughly cleaned prior to installation. Snow and ice shall be removed as well.

2.2.5.1.6 Quality Control of Execution

The quality of preparation, i.e. erection and fastening both scaffolding and formwork in the sense of the design requirements shall be checked by the engineer prior to commencement of laying the reinforcing steel and casting cement concrete respectively. The contractor shall make good any deficiencies discovered on scaffolding and/or formwork prior to continuation of the works.

2.2.5.1.7 Measurement and Take-Over of Works

Erected scaffolds and formwork are, as a rule, neither measured nor taken-over as a work carried out independently. When specially agreed, the formwork shall be measured in accordance with section 2.1.7.1 of the general technical conditions, and calculated to the actually executed extent within the scope of design bill of quantities (in m^2). In such a case, the erected formwork shall be taken over in compliance with section 2.1.7.2 of the general technical conditions.

The contractor shall not be entitled to payment for the works, which do not comply with the design quality requirements as well as with the provisions of these technical conditions, and which have not been made good by the contractor as directed by the engineer. The same also applies to the cement concrete and reinforcing steel placed into the subject formwork.

2.2.5.1.8 Final Account of Works

As a rule, the erected scaffolds and formwork are not accounted separately. They are included in the unit price per cubic metre of cement concrete.

In case the contractor fails to use adequate material for scaffolds and formwork, and/or to ensure suitable quality of the formwork, the engineer shall decide upon the method of accounting.

2.2.5.2 WORK WITH REINFORCING STEEL

General

Reinforcing steel will only implement its function, if it is prepared in accordance with the prescribed conditions and laid to match exactly the reinforcement drawing. This applies to the equal extent to the simplest as well as to the most complex works with reinforcing steel.

2.2.5.2.1 Description

Works related to classic reinforcing of cement concrete structures with steel comprise the following:

- straightening,
- cutting, and
- bending the steel wires, bars, and meshes, as well as
- laying and
- binding reinforcing steel on suitably prepared formwork.

Where steel is used for prestressing cement concrete structures, not all the abovementioned working stages are necessarily required.

The following three types of works with reinforcing steel shall be distinguished:

- simple: single reinforcing over one span for girders and slabs, reinforcement for foundations, walls and ordinary columns
- medium complex: single reinforcing over several spans for girders and slabs, double reinforcing over one span, reinforcement for continuous foundations and girders as well as arched walls and girders, ordinary frames, and complex columns
- complex: double reinforcing over several spans for girders and slabs, reinforcing of inclined frames and shells.

The conditions relating to grouting the reinforcing steel of prestressed structures are specified in detail in section 2.2.5.7 of these technical conditions.

2.2.5.2.2 Basic Materials

Basic steel materials used to reinforce structures associated with the road construction are the following.

- smooth, ribbed, and deformed steel
- steel meshes
- welded steel bars
- wires, bars, and strands for prestressing
- protective sheathing for prestressed tendons made of strands
- tunnel arches
- tunnel anchors (SN, IBO).

2.2.5.2.2.1 Reinforcing Steel for Cement Concrete Structures

The following can be used to reinforce cement concrete structures:

- smooth, ribbed, and deformed steel wires ($\varnothing \leq 12$ mm) and bars ($\varnothing > 12$ mm) of circular cross-section, and
- steel meshes (made by welding together wires and expanded metal).

Smooth wires of soft steel of 220/340 and 240/360 grade are available in the following nominal diameters: 5, 6, 8, 10, and 12 mm.

Smooth bars of soft steel of 240/360 grade are available in the following nominal diameters: 14, 16, 18, 20, 22, 25, 28, 32, and 36 mm.

Ribbed wires and bars RA2 of high-performance naturally hard steel of 400/500 grade have transverse ribs of variable cross-section. They are available in the following diameters: 6, 8, 10, 12, 14, 16, 19, 22, 25, 28, 32, 36, and 40 mm.

Drawn steel reinforcing wires and meshes of longitudinal bearing capacity as well as of bearing capacity in both directions are available in the following diameters: 4.0, 4.2, 4.6, 5.0, 5.5, 6.0, 6.5, 7.0, 8.0, 8.5, 9.0, 10.0, and 12.0 mm.

2.2.5.2.2.2 Prestressing Steel for Cement Concrete Structures

For prestressed cement concrete structures, prestressing steel may only be used, which can be:

- smooth and profiled steel wires of circular cross-section,
- smooth and ribbed steel bars of circular cross-section, and
- steel strands (made of smooth wires).

Steel wires, bars, and strands for prestressing shall be produced of alloyed or unalloyed warm rolled carbon steel.

The following nominal diameters of wores and bars used for prestressing the cement concrete structures are avialable:

- smooth wire: 2.5, 3, 5, 7, 8, 10, and 12 mm
- profiled wire: 4, 5, and 7 mm
- smooth and ribbed bars: 14, 16, 20, 25, 28, 32, 36, and 40 mm
- steel strands of:
  - two or three smooth wires: diameter of each individual wire is 2 to 4 mm
  - seven smooth wires: nominal diameter of strand is 6.4, 7.9, 9.3, 1.0, 12.5, and 15.2 mm.

Adequate devices for anchoring the prestressing steel are required as well.

2.2.5.2.2.3 Construction of Structures in Unbound Materials

The following materials can be used for reinforcement of structures built in unstabilized materials (tunnels, supporting walls, retaining walls):

- steel anchors,
- steel spears,
- steel arches, and
- steel formwork – tunnel boards.

The contractor may also use other materials (e.g. carbon laminates, glass fibre anchors) for reinforcing the structures, on condition that he has proven suitability of such materials to certain application conditions, their safety, and durability, and that the engineer has approved the use of these materials.

2.2.5.2.3 Quality of Materials

The quality of steel for reinforcing classical cement concrete structures, for prestressing the cement concrete structures, and for reinforcing the structures built in unstabilized materials shall comply with all the prescribed requirements as a rule.

The producer of steel or other material is responsible for the certification of conformity, while the contractor's internal control and the client's external control are responsible for taking-over.

2.2.5.2.3.1 Steel for Reinforcing Cement Concrete

For reinforcing the cement concrete in structures on roads such steel may be used, which meets the requirements of standards indicated in Table 5.1.

Table 5.1: Types of reinforcing steel and technical regulation

Steel type	Technical regulation
- smooth, ribbed, and deformed	prEN 10080, DIN 488, JUS C.K6.020, JUS C.K6.120
- steel meshes	prEN 10080, DIN 488, JUS U.M1.091, JUS C.B6.013
- welded steel bars	prEN 17660, prEN 10080, DIN 488, JUS C.K6.020, JUS C.K6.121

2.2.5.2.3.2 Steel for Prestressing Cement Concrete

For prestressing the cement concrete structures and for anchoring both supporting and retaining structures and tunnels, as well as for the construction of other structures on roads such steel may be used, which complies with the standards indicated in Table 5.2.

Table 5.2: Types of steel for prestressing and technical regulation

Steel type	Technical regulation
- wires, bars, and strands for prestressing, and	Rulebook on technical norms for steel wires, bars, and strands for prestressing the structures (Official Gazette of SFR Yugoslavia, No. 41, 1985), prEN 10138
- protective sheathing for prestressed tendons made of strands	EN 523

2.2.5.2.3.3 Supporting of Tunnel Arches

For supporting of tunnel arches and construction of other underground structures on roads such steel may be used, which complies with the provisions of standards indicated in Table 5.3.

Table 5.3: Types of steel for supporting of tunnel arches and technical regulation

Steel type	Technical regulation
- tunnel arches	DIN 21544, DIN 21545, EN 10025, NTC*
- tunnel anchors (SN, IBO)	technical consent

** NTC – national technical consent*

2.2.5.2.3.4 Taking-Over Construction Products of Steel

For taking-over the construction products of steel both contractor's internal control and client's external control are responsible.

The minimum extent and types of testing for the individual product type are specified in Table 5.4.

Table 5.4: Minimum testing frequency of internal and external control at taking-over construction products of steel

Steel type	Mechanical properties	Chemical Analysis	Internal control frequency	External control frequency
smooth steel	Re, Rm, A10 (Agt), bending, elastic bending		1 test / 20 tons	1 test / 80 tons
ribbed steel	Re, Rm, A10 (Agt), bending, elastic bending	C, Mn, Si, P, S, N, C_{equ}	1 test / 20 tons	1 test / 80 tons
deformed steel	Re, Rm, A10 (Agt), bending, elastic bending, height of ribs	C, Mn, Si, P, S, N, C_{equ}	1 test / 20 tons	1 test / 80 tons
steel meshes	Rp0,2, Rm, Agt, bending, shear forces	C, Mn, Si, P, S, N	1 test / 20 tons	1 test / 80 tons
welded steel bars, smooth and ribbed	Rm, bending	C, Mn, Si, P, S, N	2 × tensile test/ 150 welds 2 × bending test / 150 welds	2 × tensile / 600 welds 2 × bending test / 600 welds
wires, bars, and prestressing strands	Rp0,2, Rm, E, Agt		1 test / coil	- if all final products for the structure are of one batch (up to 40 tons): 3 tests - if all final products for the structure are of several batches: min. 2 tests/2 batches
	relaxation of steel*			
protective sheathing for prestressed tendons made of steel strands	control of dimensions	C, Mn, Si, P, S, N	1 sample / structure	
tunnel arches	Rp0,2, Rm, A5, impact strength	C, Mn, Si, P, S, N	1 test / 30 tons	1 test / 120 tons
tunnel anchors	- anchor as a whole Fm, bar ReH, Rm, A10 - bar, coupler, tie-plate, nut: hardness by Brinell, metallographic test (if necessary – e.g. in case these elements are made of cast iron)	C, Mn, Si, P, S, N (extra for bar, coupler, tie-plate, and nut)	1 test / 200 pieces	1 test / 800 pieces

* carried out at the certification stage

2.2.5.2.4 Method of Execution

2.2.5.2.4.1 Shaping

Shaping of steel for reinforcing and prestressing cement concrete structures is specified in detail in corresponding drawings as a rule.

The smallest diameters for bending and hooks are indicated in Table 5.5 for different types of steel wires, bars, and rolled steel meshes for stirrups:

Table 5.5: The smallest diameters for bending and hooks for different types of steel wires, bars, and welded meshes for stirrups

Type of bending	GA 240/360	Type of steel RA 400/500 Required value	MAG 500/560
- bending of wires and bars (except hooks)	15∅	15∅	are not bent
- bending of hooks	6∅ for ∅ ≤ 20 mm 8∅ for ∅ > 20 mm	10∅	without hooks
- bending and hooks on stirrups	4∅, ∅ ≤ 16 mm	5∅, ∅ < 12 mm	5∅, ∅ ≤ 10 mm

Standard hooks are semicircular (180°) at the ends of smooth steel wires and bars, while they are sloped (135°) at the ends of stirrups. At the ends of ribbed wires and bars as well as stirrups the standard hooks are rectangular (90°).

2.2.5.2.4.2 Arrangement

The arrangement of reinforcing and prestressing steel for cement concrete is specified in detail in the design.

The horizontal and vertical steel wire and bar spacing shall

- not be smaller than 3 cm,
- be at least equal to the diameter of (thicker) bars,
- not be smaller than 0.8 times nominal size of the largest grain in the cement concrete mixture,
- enable the access of suitable machine for cement concrete compaction.

If necessary, maximum four wires and/or bars can be combined in a bundle without any interspacing. The diameter of the bundle shall not exceed 44 mm. Where conditions for effective bonding and anchoring of steel wires and bars are ensured, bundles of larger diameters may also be used. The engineer shall approve such an arrangement.

2.2.5.2.4.3 Jointing

Jointing of steel wires, bars, and meshes for reinforcing can be carried out by

- overlapping,
- overlapping with hooks,
- electric welding, and
- crossbars welded-on.

The length of an overlapped joint is determined particularly in dependence on the wire and bar diameter, as well as on the bonding conditions. It shall, however, not be less than 20 cm.

The quality of jointing of wires and bars by welding shall be demonstrated by a preliminary test.

The foreseen method of jointing shall ensure the specified safety.

Jointing of prestressing strands for cement concrete structures and of steel anchors for reinforcing in tunnel construction, which are planned to be grouted, is not admitted as a rule.

Jointing of steel arches, spears, and formwork boards shall be specified in detail by the design. If not, this shall be specified by the engineer.

2.2.5.2.4.4 Anchoring

Steel wires and bars can be anchored by means of

- a straight extension,
- a hook,
- a sling, and
- crossbars welded-on.

Reinforcing meshes are anchored without hooks, unless they are used for stirrups.

The prescribed conditions for anchoring of all the steel elements used for reinforcement shall be taken into consideration at the design stage. The conditions for anchoring shall be specified in the design.

When the contractor intends to carry out anchoring in a different way as specified in the design, he shall demonstrate by means of a preliminary test that the safety factor of anchoring amounts to at least 1.8. The engineer shall approve such alternative method of anchoring in advance.

2.2.5.2.4.5 Prestressing

Prestressing of structures and individual elements shall be executed in accordance with the design provisions.

Prestressing is allowed only after it is established that the cement concrete has reached the minimum strength as prescribed for prestressing.

The sequence of tensioning the steel wires, bars, and strands, as well as the magnitude of prestressing forces shall all the time comply with the provisions indicated in the design. In the prestresing protocol, the minimum measured force, and elongation of the steel wire, bar, or strand, as well as stresses established by direct measuring shall be recorded, if this is specified by the design.

2.2.5.2.4.6 Protection

Steel wires, bars, and meshes for reinforcing are predominantly exposed to extremely aggressive environment. Therefore, in accordance with the relevant regulation the minimum concrete cover to these steel elements is specified, which shall not be less than 3.5 cm, or the protective coating to be applied to these steel elements.

The protective concrete cover to steel bars shall also not be thinner than the diameter of bundle of bars. When the required thickness of the concrete cover is greater than 5 cm, such a layer shall be reinforced with a thin steel mesh, which must be at a distance of at least 2 cm from the external surface of the cement concrete.

The required distance of steel wires, bars, and reinforcing meshes from the formwork shall be ensured by means of suitable tie-plates, which shall be resistant and provide a firm position.

The required thickness of the protective layer of the grouting mixture for prestressing steel strands for cement concrete structures, and for steel anchors for reinforcing shall be specified by the design.

The design shall also provide the type of sheathing for protection of steel wires, bars, and prestressed tendons from the contact with cement concrete during the works.

2.2.5.2.5 Quality of Execution

In due time prior to commencement of the works, the contractor shall submit to the engineer a detail method statement, as well as all the required evidence on the source and quality of all steel elements foreseen for reinforcing in compliance with the design and these technical conditions.

All the steel elements for reinforcing shall be placed in compliance with the design and these technical conditions.

2.2.5.2.6 Quality Control of Execution

Prior to commencement of casting cement concrete and of applying the grouting mortar, the engineer shall check the quality of shaping and the way of arrangement, jointing, anchoring, and protection of reinforcing steel elements as specified by both design and these technical conditions. The surface of reinforcing steel elements built-in shall be clean. Only partial corrosion is admitted.

Steel bars shall be fixed in such a way that their moving or bending is prevented.

The contractor shall make good all the deficiencies before continuing the works.

The extent of both internal and external testing of reinforcing steel elements shall be adapted to specific conditions of use and to conditions in relevant regulation as appropriate.

As a rule, all the required properties shall be tested within the scope of the internal control of:

- steel wires, bars, and strands per every 20 tons of steel of the same dimensions and source, with 5 specimens,
- reinforcing steel meshes per 1% of the number of the delivered meshes, with an adequate number of specimens for each individual test,
- steel arches, spears, and formwork boards per every 20 tons of steel, with three specimens.

The engineer shall approve the programme of the internal control testing proposed by the contractor for each individual structure.

The engineer shall specify the extent of the external control testing, which is in a ratio of 1 to 4 with regard to the internal control testing as a rule.

2.2.5.2.7 Measurement and Take-Over of Works

2.2.5.2.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions, and calculated in adequate unit measures.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities.

2.2.5.2.7.2 Take-Over of Works

The engineer shall take-over the reinforcing steel built-in in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. All the established deficiencies with regard to those requirements shall be mended by the contractor prior to continuing the works.

2.2.5.2.8 Final Account of Works

2.2.5.2.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.2.7.1 and taken-over in compliance with section 2.2.5.2.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

In special cases the reinforcing steel can be included in the contractual unit price for cubic metre of cement concrete. The engineer shall approve such method of accounting.

2.2.5.2.8.2 Deductions Due to Insufficient Quality

2.2.5.2.8.2.1 Quality of Materials

Since the adequate quality is unambiguously specified, there shall be no deductions when accounting the executed steel reinforcement.

In case the contractor places such reinforcing steel, which does not meet the requirements, indicated in 2.2.5.2.3 of these technical conditions, the engineer shall appoint the method of accounting. He also has the right to reject the complete work carried out.

2.2.5.2.8.2.2 Quality of Execution

If the contractor fails to ensure the required quality of the works with reinforcing steel, the engineer decides on the method of accounting.

2.2.5.3 WORK WITH CEMENT CONCRETE

General

The special technical conditions for the work with cement concrete deal with all the cement concrete types required for the construction of bridges and other structures on roads, as well as for the fabrication of semi-products. These works also include all other work with cement concrete for special purposes.

Cement concrete shall be cast in a manner, dimensions, and quality as specified in the design and in compliance with these technical conditions.

2.2.5.3.1 Description

The work with cement concrete includes the supply of basic materials for the production of cement concrete mixes (aggregate, cement, water, chemical and mineral additives), as well as the production, transport, and placing of fresh cement concrete mixture at locations and in the manner as specified in the design. These works also comprise the protection of the cement concrete surface after casting.

These works shall be performed in weather without precipitations and at air temperature between 5°C and 30°C provided that there is no wind during casting. If the works have to be carried out in conditions beyond the mentioned limits, special measures such as heating and cooling shall be introduced to ensure such concrete temperature as specified in these technical conditions. After casting, the concrete shall be adequately after-treated.

Normal concrete used for structures on roads shall comply with the provisions of the standard EN 206-1.

For special cement concrete types such as

- for roads and other traffic surfaces (refer to 2.2.3.3 of these technical conditions),
- concrete made of other materials (e.g. fibres) and basic materials not included in the standard EN 206-1 (e.g. polymers),
- with the largest grain of mineral aggregate of 4 mm or less (mortar),
- for special technologies (e.g. shot cement concrete),
- for depositing liquid and gas waste,
- for containers to store materials, which pollute the environment,
- for massive structures (e.g. dams),
- for dry mixes, and similar,

additional or special requirements shall be provided by the design.

In view of the place of preparation, the following concrete types shall be distinguished:

- cement concrete prepared in situ,
- ready-mix cement concrete prepared at production plant, and
- cement concrete prepared at a plant for fabrication of cement concrete products.

With regard to the rate of setting, cement concrete can be fresh, hardening (young), and hardened.

Cement concrete surface can be finished as visible/exposed by washing or by some other method, or as wearing or protective cement concrete.

A corresponding cement concrete type for the particular conditions of use shall be, as a rule, specified in the design, whereas it shall be ensured by introducing adequate basic materials and procedures, as well as by an initial test of the cement concrete proposed.

Cement concrete for bridges shall comply with the EN 206-1 and the 1026 as a rule.

According to the provisions of the standards EN 206-1 and 1026, the concrete is classified in different classes with regard to its different characteristics or properties.

In view of its consistency, the fresh concrete is classified in different rates of

- settling down (S1 to S5),
- Vebe (V0 to V4),
- compaction (C0 to C3), or
- spread (F1 to F6),

where the consistency rates are not directly interdependent, and in different classes with regard to the largest grain of mineral aggregate, where the nominal size of the coarsest fraction in the cement concrete is taken into account, by which the aggregate size is specified in compliance with the EN 12620.

Hardened cement concrete is classified in

- strength classes (C 8/10 to C 100/115 for normal and heavy-weight cement concrete, and LC 8/9 to LC 80/88 for light-weight cement concrete),
- density classes (for light-weight cement concrete only),
- rates of resistance to water penetration (PV-I to PV-III),
- rates of resistance to wearing by grinding (XB 1 to XB 3),
- rates of inner resistance to freezing and thawing (XF1, XF3), and
- rates of resistance of the cement concrete surface to freezing and thawing (XF2, XF4).

The requirements to be met by both fresh and hardened cement concrete are defined in the cement concrete specification. When preparing such a specification, the author (e.g. client, designer, producer) shall consider the following:

- the use of fresh and hardened cement concrete,
- conditions of after-treatment (curing),
- structural dimensions,
- environmental impact (exposure rate),
- requirements regarding the appearance of the surface,
- requirements related to the protective concrete cover,
- restrictions with regard to the use of basic materials, etc.

Due to different exposure of individual structural members of bridges and other structures on roads, additional requirements with regard to the classes and exposure rates indicated in Table 5.6 shall be taken into consideration when designing and constructing such members.

Table 5.6: Classes and exposure rates of cement concrete

Structural member	Cement concrete specification
foundations	XC2, PV-I
»white tubs«	PV-II
edge beams	C25/30, XF4, PV-II (recommended w/c<0.5)

For the mentioned purpose of use of cement concrete, the portion of chlorides in the cement concrete expressed by the percentage of chloride ions per cement mass shall not exceed the values indicated in Table 5.7.

The percentage of chlorides in the cement concrete shall be determined by calculation in accordance with the EN 206-1.

2.2.5.3.2 Basic Materials

Basic materials for the cement concrete preparation must not contain harmful admixtures, which might impair the cement concrete durability or cause corrosion of steel reinforcement. It is essential that the basic materials be suitable to the foreseen use in the cement concrete.

If certain basic materials pass for generally adequate, it does not automatically mean that it is suitable in all circumstances and to each cement concrete composition.

For cement concrete complying with the EN 206-1, only those basic materials may be used, which pass for adequate for such an application.

Table 5.7: Maximum admitted percentages of chlorides in cement concrete

Cement concrete composition	Exposure rate	Chloride content class	Maximum percentage of Cl^- per cement mass*
Contains reinforcing steel or other metals, except lifting devices resistant to corrosion	-	Cl 1.00	1 %
Contains reinforcing steel or other metals incorporated	XD1, XD2, XS1, XS2	Cl 0.20	0.20 %
	XD3, XS3	Cl 0.40	0.40 %
Contains prestressing steel	XD1, XD2, XS1, XS2	Cl 0.10	0.10 %
	XD3, XS3	Cl 0.20	0.20 %

*Note: * If mineral additives of type II are used and taken into account in the cement amount, the percentage of chlorides shall be expressed as the percentage of chloride ion mass in the total mass of cement and mineral additives.*

2.2.5.3.2.1 Mineral Aggregate

Mineral aggregate for cement concrete mixtures can be composed of mixes of natural rounded-off grains of gravel or sand, or of mixes of natural crushed grains of chippings and sand. Recycled aggregate may be used as well.

Aggregate for cement concrete mixtures shall meet the requirements provided by the standard EN 206-1, by the cement concrete specification, and by the design. Natural and recycled normal-weight aggregates (of grain volume mass > 2,000 kg/m3) shall comply with the provisions of the EN 12620, while the light-weight ones shall comply with the EN 13055-1.

When selecting aggregate, granulometric composition, and other categories (e.g. flatness, resistance to freezing/thawing, resistance to abrasion, fine particle content), the following shall be considered:

- method of work execution,
- final use of cement concrete,
- requirements in view of protective concrete cover,
- structural dimensions,
- environmental conditions, which the structure will be exposed to, and
- all the requirements for the aggregate exposed on the cement concrete surface, or for the aggregate suitable to machine finishing of the cement concrete surface.

The applicability of recycled materials shall be previously demonstrated.

2.2.5.3.2.2 Cement

Cement is a hydraulic binder, i.e. fine-ground inorganic material, which, mixed with water, forms a paste, and the latter, on the base of both reaction and hydration process, sets and hardens, and retains its hardness and stability after hardening.

Cement is composed of different materials, which also affect the cement properties thus the characteristics of both fresh and hardened cement concrete as well.

For cement concrete complying with the EN 206-1, the cement, which is in accordance with the EN 197-1, is considered as generally applicable. In special cases, for cement concrete not complying with the EN 206-1 some other cements such as sulphate resistant cement (according to 1023), calcium aluminate cement (according to 1024), or cement of low hydration heat (according to 14216) can be used.

2.2.5.3.2.3 Water

The quality of water used for preparation of cement concrete can affect the setting time, strength development, durability, and protection of reinforcing steel to corrosion.

When assessing suitability of water for preparation of cement concrete, the purpose of the produced cement concrete shall be taken into consideration as well.

For the preparation of cement concrete it is admitted to use the water complying with the provisions of the standard EN 206-1. Under conditions specified in the EN 1008 the following types of water are appropriate for preparation of cement concrete:

- drinking water,
- water won by processes of the cement concrete industry,
- ground water,
- natural surface water and industrial waste water, and, exceptionally,
- sea water or less saline water.

Communal water shall in no way be used for the cement concrete production.

Suitability of all types of water except drinking water shall be proven by testing.

2.2.5.3.2.4 Chemical Additives

Chemical additives are materials added in small quantities, with regard to the cement mass, to cement concrete during mixing. Their intention is to ensure, improve, or modify certain properties of cement concrete. The following chemical additives are distinguished:

- plasticizers,
- super-plasticizers,
- additives for water retardation,
- air-entraining agents
- accelerators of setting,
- accelerators of hardening,
- decelerators (retarding agents) of setting,
- thickeners,
- decelerators (retarding agents) of setting/plasticizers, and
- decelerators (retarding agents) of setting/super-plasticizers.

The use of chemical and other additives shall be in accordance with the provisions of the EN 206-1.

The total amount of chemical additives shall not exceed 50 g per kg of cement, unless specified otherwise by the producer.

The use of chemical additives, the amount of which is less than 2 g per kg of cement, is only admitted on condition that the additive is uniformly admixed into the water used for the cement concrete production.

When the amount of liquid additives exceeds 3 litres per m^3 of concrete, the contained water shall be taken into account upon calculating the w/c ratio.

The influence of chemical additives, their mutual compatibility as well as compatibility with the cement used shall be previously tested within the scope of initial testing.

Maker's instructions shall be obligatorily taken into consideration when applying chemical additives.

2.2.5.3.2.5 Mineral Additives

A mineral additive is a fine sieved material used in cement concrete to improve certain properties of either fresh or hardened cement concrete. Two types of inorganic (mineral) additives are distinguished:

- inert mineral additives (type I), and
- pozzolanic or latent hydraulic mineral additives (type II).

Amounts of mineral additives of type I and type II shall be checked by initial testing.

When a mineral additive is considered as appropriate, its amount may be taken into account upon calculation of the cement portion and the w/c ratio. For such a calculation it is advised to adopt the k-value conception described in the EN 206-1, section 5.2.5.2.1. Suitability of other methods shall be previously established.

2.2.5.3.2.6 Protective Agents

For temporary protection of surfaces of fresh and hardening cement concrete from drying up and/or damage due to rainfall, liquid chemical protective agents can be applied by spraying to ensure uniform film in the cement concrete surface.

For a durable protection of setting and hardened cement concrete from climatic actions as well as from chemical impacts (carbonatization, corrosion of reinforcing steel), liquid chemical protective agents can be used

- as additives upon preparation of cement concrete (water emulsions of silicones and acrylates),
- as a coating applied to cement concrete surface (epoxy, acrylic, and vinyl resins), and
- for surface and depth penetration or impregnation of cement concrete (e.g. water rejecting materials such as silicones, siloxanes, silanes, linseed oil, or resins diluted with solvents such as epoxy and acrylic resins).

A suitable method of protection of hardened cement concrete from water and chemical impacts is to apply linseed oil, which might be, if necessary, diluted by solvent (50% solution), or heated to increase its penetrating capacity.

The use of chemical protective agent shall be approved by the engineer.

Producer's instructions shall be obligatorily considered when applying a protective agent.

2.2.5.3.2.7 Polymers

For polymer, polymerized (modified with polymers), and with polymers impregnated cement concrete and mortar, polymers in the form of

- either an additive to improve cement concrete (polyvinyl acetates, polyvinyl propionates, butadiene-styrene and acrylic water emulsions), or
- adhesives for cement concrete (epoxy resins with additives and amine curing agent, or with diluents and polyamide curing agents)

can be used.

2.2.5.3.3 Quality of Materials

2.2.5.3.3.1 Aggregate

In general, for preparation of cement concrete complying with the provisions of EN 206-1, normal-weight aggregate is appropriate, which meets the requirements of the EN 12620, or light-weight aggregate, which meets the requirements of the prEN 13055-1.

The selection of the aggregate type is subordinate to the purpose of the cement concrete use, and depends on the following:

- method of work execution,
- final use of cement concrete,
- requirements with regard to the protective concrete cover,
- structural dimensions,
- environmental conditions, which the structure will be exposed to, and
- exposure of the surface and eventual machine finishing of the cement concrete surface.

The aggregate for the cement concrete production shall particularly be of suitable granulometric composition, and the mineral grains shall be chemically inert, washed/dedusted, and fractioned. A good adhesion to the hydrated cement paste shall be ensured. The adequacy of individual aggregate types shall be verified within the scope of the cement concrete initial testing.

Ensuring quality and certifying conformity are carried out in accordance with the 2+ system, which means that the producer performs the quality control in compliance with the provisions of the standard, and obtains a production control certificate issued by the authorized certification body. On the basis of the certificate the contractor issues a statement on product conformity.

2.2.5.3.3.1.1 Geometric, Physical, and Chemical Properties

The aggregate to be used for the cement concrete production shall have the properties indicated in Table 5.8.

Table 5.8: Required properties of aggregates for cement concrete production

Properties of mineral grains	Required category	Test method
- water absorption capacity of stone grains	$WA_{24}2$	EN 1097-6
- resistance of stone grains to crushing according to the Los Angeles method	LA_{15} to LA_{30}	EN 1097-2
- resistance of stone grains to frost action	F_1 or MS_{18}	EN 1367-1 EN 1367-2
- content of poorly shaped stone grains	SI_{15}	EN 933-4

2.2.5.3.3.1.2 Granulometric Composition

The selection of the mineral aggregate granulometric composition to produce cement concrete shall be adjusted to the intention of use of the particular cement concrete mixture, and shall ensure sufficient workability and compaction of the cement concrete.

When selecting mineral aggregate, it shall be considered that the largest grain in the mixture

- must not be larger than one fourth the smallest dimension of the section of cement concrete member (in slabs not larger than one third the slab thickness), and
- must not be larger than 1.25 times the smallest clear horizontal distance between adjacent steel reinforcing bars.

The adequacy of the granulometric composition of mineral aggregate shall be verified within the scope of the initial testing of the cement concrete mix.

The recommended granulometric composition ranges of mineral grains for cement concrete mixes are indicated in Table 5.9 as well as in Figures 5.1 to 5.3.

Table 5.9: Recommended limiting values of granulometric composition of aggregates for cement concrete

Aggregate mixture	Limiting curve	Sieve opening size [mm]							
		0.25	0.5	1.0	2.0	4.0	8.0	16.0	31.5
		Sifting passing sieve [% by mass]							
0/8 mm	upper	11	27	42	57	74	100		
	lower	5	13	21	36	61	100		
0/16 mm	upper	8	20	32	42	56	76	100	
	lower	3	7	12	21	36	60	100	
0/32 mm	upper	8	18	28	37	47	62	80	100
	lower	2	5	8	14	23	38	62	100

x = length of sieve square opening side; y/levo = sifting passing sieve; y/desno = sifting remaining on sieve

Fig. 5 1: Limiting grading curves for aggregate 0/8 mm

Fig. 5 2: Limiting grading curves for aggregate 0/16 mm

Fig. 5 3: Limiting grading curves for aggregate 0/32 mm

2.2.5.3.3.2 Cement

For the construction of cement concrete structures on roads, cement complying with the EN 197-1 shall be used as a rule.

In view of the content of main components, which are:

- Portland cement clinker,
- granulated furnace slag,
- micro-silica,
- natural, and natural calcinated pozzolans,
- silicon and calcium fly ash,
- burnt slate,
- limestone, and
- less important components (0 – 5 %),

the code EN 197-1 distinguishes 27 different cement types classified in the following five main groups:

- CEM I, Portland cement,
- CEM II, mixed Portland cement,
- CEM III, slag cement,
- CEM IV, pozzolanic cement,
- CEM V, mixed cement.

In addition, cements are classified in six strength classes as well (Table 5.10).

Table 5.10: Cement strength classes according to EN 197-1

Strength class*	Compressive strength [MPa]				Beginning of setting	Volume constancy (expansion)
	early strength		standard strength			
	2 days	7 days	28 days		[min]	[mm]
32.5 N	-	≥ 16.0	≥ 32.5	≤ 52.5	≥ 75	≤ 10
32.5 R	≥ 10.0	-				
42.5 N	≥ 10.0	-	≥ 42.5	≤ 62.5	≥ 60	
42.5 R	≥ 20.0	-				
52.5 N	≥ 20.0	-	≥ 52.5	-	≥ 45	
52.5 R	≥ 30.0	-				

*Note: * N – usual early strength, R – high early strength*

The following shall be taken into account when selecting the cement type:

- method of work execution
- final use of cement concrete
- conditions of curing (after-treatment)
- structural dimensions
- conditions of environment, which the structure will be exposed to
- potential reactivity of the aggregate with alkalis in basic materials.

To achieve uniform quality of cement concrete, uniform quality of the cement shall be ensured.

Portland cements of different grades and made by different producers must not be mixed unless suitable quality has been previously demonstrated.

For more than one layer of cement concrete in the same section, cement of the same properties and produced of the same primary materials (uniform quality) shall be used as a rule.

Assuring quality and certifying conformity of the cement are carried out in compliance with the 1+ system, which means that an authorized certification body performs the product quality control in compliance with the provisions of the standard, and that the same body issues an EC-certificate on the product conformity. On the basis of that certificate the contractor issues a statement on the product conformity.

2.2.5.3.3.3 Water

The required properties of the water for the preparation of cement concrete mixtures and for the protection of cement concrete, as well as the type and frequency of testing are specified in the standard EN 1008.

Drinking water may also be used without any additional demonstration of its suitability to the cement concrete production.

Sea water may only be used for the production of cement concrete for non-reinforced structures, whilst the communal water is not suitable to the production of any cement concrete.

2.2.5.3.3.4 Chemical Additives

In general, chemical additives complying with the EN 934-2 are suitable to the preparation of cement concrete complying with the EN 206-1.

Chemical and other additives used shall ensure the required improved properties of the cement concrete mixture in its particular condition (fresh, setting, hardened cement concrete). This shall be previously verified by initial testing.

Assuring quality and certifying conformity of chemical additives shall be carried out according to the 2+ system.

2.2.5.3.3.5 Mineral Additives

For cement concrete complying with the EN 206-1 the following mineral additives are recommended:

- mineral additives of type I
- mineral fillers complying with the EN 12620
- pigments (EN 12878)
- mineral additives of type II
- fly ash (EN 450)
- micro-silica (prEN 13263)

The quantities of mineral additives of types I and II shall be verified by initial testing of cement concrete.

Assuring quality and certifying conformity of mineral additives of type I shall be carried out according to the 2+ system.

Assuring quality and certifying conformity of mineral additives of type II shall be carried out according to the 1+ system.

2.2.5.3.3.6 Protective Agents

The properties of liquid chemical agents for the protection of the cement concrete surface are specified in the technical conditions and application instructions issued by the producers of such agents.

The film of a chemical agent for temporary protection shall adequately protect the cement concrete surface for 7 – 14 days, depending on the cement hydration process.

A protective agent must not affect adversely the cement binding process nor the surface or the surface layer of the cast cement concrete, which shall be demonstrated by initial testing.

2.2.5.3.4 Method of Execution

2.2.5.3.4.1 Winning the Materials

In due time prior to commencement of the works, the contractor shall submit to the engineer a list and quantities of the materials he intends to use. For all the cement concrete mixtures cast, and for all the materials he intends to use for the production of cement concrete mixtures (cement, water, chemical and other additives, protective agents, and adhesives), the contractor shall submit to the engineer adequate evidence on suitability (conformity statements, certificates) for approval prior to commencement of the works.

2.2.5.3.4.2 Depositing the Materials

When the contractor, prior to the production of cement concrete mixes, provisionally deposits mineral aggregate fractions, the area or space for this purpose shall be previously marked, suitably prepared, and protected from rainfall as a rule.

Cement shall be stored in adequate silos.

In case that for the cement concrete production other water than that from the water supply is used, it shall be stored in tanks or in a way as proposed by the contractor and approved by the engineer.

Chemical and other additives to cement concrete shall be stored in accordance with the producer’s instructions.

Protective agents for curing (after-treatment) and maintenance of fresh or young cement concrete, as well as polymers shall be stored as directed by the producer.

Stocks of all the materials on deposit areas shall be such as to ensure a continuous production of adequate mixture of fresh cement concrete.

2.2.5.3.4.3 Preparation of Fromwork and Substrate

Formwork for casting cement concrete shall be executed in such a way that the dimensions of constructed structures and other cement concrete properties comply with the design requirements.

As a base for the cement concrete, unbound or bound mineral aggregate mixture can be used as well, if this is foreseen by the design.

If the substrate absorbs water, it shall be

- covered with adequate impermeable material (PVC foil),
- sprayed with bituminous emulsion, or
- soaked with water.

The method of substrate preparation shall be foreseen by the design. The engineer shall approve the performance suitability prior to commencement of the works with cement concrete.

The contractor may start casting cement concrete after the engineer has taken-over the formwork or the substrate, as well as the designed reinforcing steel.

The contractor is obliged, all the time up to the commencement of casting fresh cement concrete, to maintain the formwork or the substrate formation, and the placed reinforcing steel in the same conditions as it has been upon taking-over. All damages shall be made good in due time.

2.2.5.3.4.4 Production of Cement Concrete Mixtures

The production of cement concrete mixtures shall be mechanical and carried out at suitable plant where batch-based production is provided.

Assessing, supervising, and certifying the production control shall be carried out to such an extent and frequency as specified in the EN 206-1.

The cement concrete mixture composition shall be adjusted to the transportation and casting methods.

Mixing time and other impacts on the quality shall be so adjusted as to ensure a uniform mixture of cement concrete.

For the work at lower temperatures a possibility of heating the mixtures of grains and/or water up to an adequate temperature shall be ensured.

The produced cement concrete mixture may be, upon previous approval by the engineer, put at stock in adequate silos within the plant for shorter period, or it shall be immediately transported to the application place. Segregation, drying, or access of water, and excessive heating or cooling of the fresh cement concrete mixture shall be prevented.

2.2.5.3.4.5 Production of Prefabricated Elements

The plant for the production of cement concrete prefabricated elements shall be equipped with suitable machines and devices for casting fresh cement concrete, and shall also have an appropriate place for maturing the prefabricated elements. Such a place shall be adequately protected from weather impacts such as rainfall or frost as a rule.

Suitably marked precast elements (dare of production, marking according to the design, marking by the position of building-in) may be transported from the plant only after they have reached adequate strength. Any damage shall not affect their bearing capacity, durability, appearance, and serviceability.

2.2.5.3.4.6 Bringing Fresh Cement Concrete Mixtures

Adequate fresh cement concrete mixtures may be cast into formwork or onto substrate formation suitably prepared, which shall not be frozen, after the engineer has given his approval.

Suitable vehicles such as mixers or agitators shall be used for the transportation. During the transportation, the cement concrete mixture shall remain uniform, and the properties of the fresh cement concrete must not change as well.

The number of vehicles for transporting the fresh cement concrete mixture to the site shall be adapted to the conditions of uniform casting, capacity of the production facilities, transportation distance, and casting capacity.

2.2.5.3.4.7 Casting Fresh Cement Concrete Mixtures

2.2.5.3.4.7.1 General

Cement concrete shall be cast as soon as possible after mixing in order to avoid a decrease of its workability due to changed consistency, or prior to commencement of cement binding (approximately 1.5 hours). In case it is indispensably necessary, the consistency may be modified taking into consideration the provisions of the standard EN 206-1 and the instructions issued by the producer of additives.

Usually, the free fall height of fresh cement concrete during placing does not exceed 1.5 m as a rule, unless necessary measures to prevent segregation have been taken.

The height of the spread layers shall be adjusted to the mode and effectiveness of thickening agents, and to the capacity of the cement concrete production plant. Each layer shall be placed onto the previous one in such a time that merging of both layers is still feasible by vibrating (recompacting), which, in such cases, shall be performed over the entire layer thickness.

Fresh cement concrete shall be correctly compacted by means of mechanical vibrations (immersion vibrators, planvibrators, and formwork vibrators), with special care taken near steel reinforcing bars and formwork. The engineer shall approve the method and conditions of use of cement concrete compacting means.

The temperature of the fresh cement concrete during casting shall amount to at least 7°C (exceptionally at least 3°C), and to maximum 25°C (exceptionally to maximum 30°C). The temperature of formwork or the substrate for cement concrete shall be between 3°C and 40°C. When the air temperature is less than 5°C or above 30°C, hardening of cement concrete shall be ensured by suitable measures to be approved by the engineer.

2.2.5.3.4.7.2 Construction Joints

If a layer of cast cement concrete is no more suitable to be treated by repeated vibrating, a construction joint shall be introduced. The method of execution of such construction joints shall be, as a rule, specified in the design. In addition, locations of construction joints and the manner of their execution at places where the fresh cement concrete is being applied to an already hardened one shall be specified in the design and considered in the programme of cement concrete casting. The number of construction joints shall be as limited as possible.

In prestressed structural members, the construction joint of the cement concrete shall not be parallel with steel wires or bars.

In the area of construction joints, cement concrete surface shall be preliminarily finished by adequate procedure such as blowing and/or washing under high pressure, sandblasting, or etching to achieve a solid cement texture.

The method of finishing a construction joint, including the use of an additive to retard the cement concrete setting, and tie coats or mortars based on polymer additives and adhesives, or execution of ribs, teeth, and building-in steel bars to increase the construction joint bearing capacity, shall be approved by both designer and engineer.

2.2.5.3.4.7.3 Exposed Cement Concrete Surfaces

As a rule, the extent and the method of finishing cement concrete exposed (visible) surfaces shall be specified in the design.

The contractor shall in due time prior to commencement of casting cement concrete submit to the engineer a sample of appearance of the cement concrete exposed surface (texture and visual effects, geometry).

Both colour and texture (appearance) of the cement concrete shall be uniform on exposed surfaces. Any repair, which is allowed to be performed to minimum extent only, shall be approved and taken-over by the engineer.

Exposed surfaces of cement concrete can be suitably settled by subsequent finishing of shuttered surfaces as well.

2.2.5.3.4.8 Protection and Curing of Cement Concrete

2.2.5.3.4.8.1 General

To achieve expected potential properties of cement concrete, particularly of that applied as protective cover to the reinforcing steel, it shall be, if necessary, protected and adequately after-treated (cured). The protecting and after-treating procedures shall commence as soon as possible after completion of compaction and surface finishing respectively.

The cast cement concrete shall be protected

- from drying up, heating, cooling, damage due to rainfall, vibrations, and mechanical damage during binding and hardening, and
- from weathering and chemicals in the hardened condition.

The following shall be prevented by adequate protection of cement concrete:

- too fast drying of cement concrete surface due to
  - low air humidity,
  - high air temperature,
  - high cement concrete temperature,
  - high wind speed, and
  - direct exposure to sun

- leaching out due to rain and running water
- too fast cooling some days after casting
- great differences between inner and outer temperature
- unfavourable effects of low temperatures on setting, and freezing
- adverse impacts of vibrations and shocks, which might cause cracks in the young cement concrete thus jeopardizing the bond effect of the reinforcing steel.

By curing (after-treating) the cement concrete, sufficient amount of water or moisture shall be assured in capillary pores for an as complete as possible cement hydration thus for achieving the expected properties of the hardened concrete.

Excessive drying up of cast cement concrete can be prevented by suitable wet after-treatment and/or chemical protective agents. An adequate protection of the fresh cement concrete shall be ensured immediately after compaction, and maintained for at least 7 days, however not less then the time required for the cement concrete to achieve 60% of the foreseen strength. When chemical agents are introduced to protect cement concrete from drying up, technical conditions issued by the producer shall be considered. The conditions of the duration of protection of the fresh or hardening cement concrete, which shall comply with these technical conditions, shall be proposed by the contractor and approved by the engineer.

Excessive heating, quick cooling, and damage to particularly larger areas of cast fresh and hardening cement concrete due to precipitations can be prevented by covering the surfaces with felt, plastic fabric, foil, or any other appropriate material. Such a protection shall be provided until the cement concrete attains at least 50% of the specified compressive strength.

As the porosity of the surface of hardened cement concrete reduces its durability, suitable surface protection shall be provided. This can be carried out by introducing methods, which prevent access of water into the cement concrete. The foreseen protection according to the design or as proposed by the contractor shall be approved by the engineer.

2.2.5.3.4.8.2 After-Treatment Methods

The after-treatment (curing) method shall be specified prior to commencing the site works. Possible after-treatment methods that can be used either independently or in mutual combinations are:

- formwork not removed
- covering with plastic foil
- placing wet cover
- sprinkling or spraying water
- immersion in water
- spray application of chemical after-treatment (curing) agent, which forms an impermeable protective film.

In view of the effectiveness of individual methods it can be stated that the structure of pores becomes denser in case of wet after-treatment, i.e. when the cement concrete is soaked during setting, than in methods where only evaporation of water from the concrete is prevented. In cold weather, wet after-treatment is not allowed. Sprinkling of warm surfaces with clod water can provoke thermal stresses and cracks, therefore the water temperature shall be adequately high.

2.2.5.3.4.8.3 After-Treatment Duration

The after-treatment (curing) duration depends on climatic conditions and on the attained cement concrete strength upon completion of the after-treatment, expressed as a ratio of the mean strength upon completion of after treatment to the mean strength after 28 days (Table 5.1).

Table 5.11: Environmental conditions and after-treatment duration in dependence on the cement concrete compressive strength upon completion of after-treatment

Climatic conditions		Mean rel. humidity [%]	Required portion of strength
H	humid	> 80	0.1
M	moderate	65 to 80	0.4
D	dry	45 to 65	0.5
VD	very dry	< 45	0.6

A criterion of the after-treatment duration can also be

- the minimum time with regard to the climatic conditions and dynamics of cement concrete setting (Table 5.12),
- the maturity of cement concrete, i.e. attained hydration rate expressed by the sum of products of measured temperatures and belonging times of duration of each temperature.

Table 5.12: After-Treatment Duration in Days

Environmental conditions during after-treatment	Relative air humidity [%]	Cement concrete temperature [°C]								
		5	10	15	5	10	15	5	10	15
		Minimum after-treatment duration [days]								
- no direct exposure to sun	> 80	2	2	1	3	3	2	3	3	2
- moderate exposure to sun, moderate wind speed	> 50	4	3	2	6	4	3	8	5	4
- intensive exposure to sun, high wind speed	< 50	4	3	2	8	6	4	10	8	5
		fast			moderate			slow		
		Increase of cement concrete strength								

2.2.5.3.4.9 Concreting in Cold Weather

2.2.5.3.4.9.1 General

In the present section conditions of cold weather are dealt with, in which, due to low temperatures, the cement hydration is slowed-down. In addition, supplemental measures are specified, which shall be taken during casting to protect young concrete from freezing, and to ensure conditions allowing normal development of the foreseen properties of the hardened cement concrete.

Such period can be considered as cold weather where the air temperatures are below 0°C at any time in the course of the day, and where the mean air temperatures drop below +5°C for more than three successive days. The mean temperature is the average value of the highest and the lowest measured temperature from midnight to midnight. The cold weather period ceases when the air temperature is above 10°C at least half a day for at least three consecutive days.

A transitional period is the time where not all the conditions for a cold weather are fulfilled, but temperatures below 0°C are possible at night.

The time of protection is the required period, on which the prescribed cement concrete temperature must be maintained.

The term concreting comprises the following activates: mixing, transport, casting, protection, and after-treatment (curing) of cement concrete.

2.2.5.3.4.9.2 Preparatory Activities Prior to Concreting

In due time prior to concreting, the contractor shall submit to the engineer a detailed method statement comprising all the procedures he intends to perform during concreting in cold weather.

Before concreting all the materials and/or equipment for the cement concrete protection as well as the instruments for regular temperature measurement shall be ready at site.

At the place of casting all snow and ice shall be removed from the surfaces to be in contact with cement concrete, which also applies to the reinforcing steel. Casting onto an already executed cement concrete member, which is frozen or damaged due to frost, is not admitted.

The foundation soil shall be thawed up to a depth as specified by the soil mechanics specialist. The temperature of the foundation soil, onto which cement concrete will be cast, shall not be lower than 3°C.

The temperature of the cement concrete, in which tendons will be grouted, shall not be lower than 5°C.

Casting works shall be carried out at the time of the highest daily temperatures.

2.2.5.3.4.9.3 Cement Concrete Temperature

2.2.5.3.4.9.3.1 Temperature upon Casting

The lowest admitted cement concrete temperature upon casting and during the period of protection is indicated in Table 5.13 in dependence on the smallest sectional dimension. This temperature should not be exceeded by more than 10°C. The temperature of the grouting compound shall never be lower than 5°C.

In massive cement concrete the temperature in the middle of the section should never exceed 60°C, and the difference to the temperature on the surface shall not be greater than 20°C.

The temperature of the fresh cement concrete shall be measured for each amount delivered to the site, when the cement concrete is actually cast. The temperature of the setting (hardening) cement concrete shall be measured at least once a day on the surface or at the contact with the formwork.

2.2.5.3.4.9.3.2 Temperature upon Completion of Protection

The temperature drop of the hardening (setting) cement concrete upon completion of protection shall, in 24 hours, not be greater than the values indicated in Table 5.13.

Table 5.13: Admitted cement concrete temperatures in dependence on the sectional dimensions

Minimum sectional dimension	Minimum cement concrete temperature upon casting	Maximum admitted temperature drop in 24 hours after removal of protection
less than 30 cm	11°C	20°C
30 to 90 cm	9°C	17°C
90 to 180 cm	7°C	12°C
more than 180 cm	5°C	10°C

2.2.5.3.4.9.4 Cement Concrete Strength

Before the cement concrete is exposed to the first frost at temperatures below 0°C, its compressive strength shall amount to at least 5 MPa.

Table 5.14: Minimum compressive strength of cement concrete in dependence on the mean daily temperature

Probable mean daily temperature after completed protection	Percentage of specified characteristic compressive strength
above 0°C	50
0°C to -5°C	65
-5°C to -10°C	85
below -10°C	95

Upon striking the vertical formwork the cement concrete strength shall be sufficiently high to avoid damage to the surface.

The cement concrete strength upon removal of supports and eventual need of provisional supports shall be specified by the designer. However, the cement concrete strength shall never be smaller than the values indicated in Table 5.14, in dependence on the expected temperature after removal of protection.

The strength shall be specified on at least three specimens, which have been preserved in the same conditions of protection as the cast cement concrete.

2.2.5.3.4.9.5 Concreting

2.2.5.3.4.9.5.1 Preparation of Cement Concrete

Mineral aggregate fractions at deposit area at the concrete production plant must not contain frozen clods.

The initial temperature of cement concrete after mixing at the plant shall be higher than the temperature upon casting by the foreseen cooling during transportation. However, that difference shall not exceed

- 2°C, when the outer temperature is higher than 1°C,
- 5°C, when the outer temperature is -1 to -10°C, and
- 8°C, when the outer temperature is -10 to -15°C.

The fresh cement concrete temperature shall generally never be higher than 30°C, except in case of steamed cement concrete.

The required initial temperature shall be attained by heating individual primary materials for the cement concrete production, where the following temperature values shall not be exceeded:

- water: 100°C
- mineral aggregate: 65°C
- cement: 50°C.

Prior to adding cement the temperature of the mix in the mixer shall amount to no more than 40°C.

No frozen aggregate clods, ice or snow must enter the mixer. Sand shall not be heated with steam.

To accelerate hydration it is recommended to introduce quick-setting cements, an increased cement quantity, and/or lower w/c values. In cement concrete for prestressed structures, accelerating agents containing chlorides are not admitted.

2.2.5.3.4.9.5.2 Transport and Casting

Both transport and casting of cement concrete shall be carried out without any unnecessary standstills, which shall be ensured by thorough organization of work.

2.2.5.3.4.9.5.3 After-Treatment and Thermal Protection

The required amount of water in the setting (hardening) cement concrete shall be ensured by adequate after-treatment (curing) method, while the required heat for normal hydration shall be ensured by thermal protection.

Measures to prevent drying up of cement concrete shall be taken or continued, when in a closed room or in the open air, after removal of the protection,

- the cement concrete is warmer by 15°C, and the air temperature amounts to 10°C or more,
- the air temperature exceeds 10°C, and the relative humidity is lower than 40%.

Drying up of cement concrete shall also be obligatorily prevented in cases where a covered structural member or a closed room is dryly heated by means of oil or gas heaters, at stronger wind and at simultaneous high temperature of cement concrete.

For the protection from drying up and for after-treatment (curing), steam, cover saturated with water, impermeable foil, sprayed chemical agent, or water can be used. After-treatment with water is less appropriate, particularly when there is a hazard of freezing of the cement concrete after removal of the thermal protection. After-treatment with steam or water shall be finished at least 24 hours prior to completion of protection, and the cement concrete shall be allowed to dry before being exposed to frost.

The following methods are adequate for the thermal protection of cast cement concrete:

- covering free areas with isolative materials, e.g. with plates of foamy polystyrene, polyurethane foam, mineral wool, cellulose fibres, straw, or textiles
- covering of the entire structural member or casting in a closed room,
- thermally isolated formwork
- water steam.

In the transitional period, young cement concrete shall be protected for at least 24 hours after casting.

In cold weather, cement concrete shall be protected and after-treated (cured)

- for at least 3 days, if the structural member needs not to have certain strength, where minimum temperatures and allowed temperature drops indicated in Table 5.13 have to be considered, or
- until the strength required for the structural safety is attained.

2.2.5.3.5 Quality of Execution

In due time prior to commencement of the works, the contractor shall submit to the engineer a design of cement concrete containing all the required information as specified by these technical conditions.

2.2.5.3.5.1 Preliminary Composition

Before commencing the work with new cement concrete, the contractor shall, in compliance with the provisions of the 206-1, define the composition, which meets the prescribed requirements for both fresh and hardened cement concrete. The contractor can also demonstrate the suitability of the design of a cement concrete mixture on the basis of previous tests or long-term experience.

The quantity of the air (micro-pores) in cement concrete exposed to frost and salt action (XF4) shall be determined in accordance with the provisions of the EN 12350-7, and shall comply with the limiting values indicated in Table 5.15.

Table 5.15: Quantity of air in cement concrete exposed to frost and salt actions (XF4)

Largest aggregate mixture fraction [mm]	Air quantity [% by volume]
16/32	3 to 5
8/16	5 to 7
4/8	7 to 10

The quantity of air (micro-pores) in cement concrete can substitute the corresponding volume of grains smaller than 0.25 mm.

In addition to the statement of conformity of the cement concrete mixture, the contractor shall also submit to the engineer adequate evidence on the source and suitable quality of all the materials used to prepare the preliminary composition.

By the preliminary composition the contractor shall demonstrate that the cement concrete quality specified in these technical conditions can be attained with the foreseen mineral aggregate mixture, cement, water, as well as chemical and other additives.

The contractor must not commence casting the cement concrete before obtaining the engineer's approval to the proposed cement concrete composition.

2.2.5.3.5.2 Required Properties

The properties of the cast cement concrete shall comply with the design provisions. Testing shall be carried out in accordance with the Rulebook of technical norms for concrete and reinforced concrete (Official Gazette of SFR Yugoslavia No. 11/87).

The following criteria shall be adopted to assess the concrete grade:

- if the number of results of testing the strength is $n \leq 15$ from three, six, and more specimens taken consecutively:

$$m_3 \geq MB + k_1$$
$$x_1 \geq MB - k_2$$

where:

- *$k_1 = k_2 = 3\ MN/m^2$ – at routine production*
- *$k_1 = 4\ MN/m^2$ and $k_2 = 2\ MN/m^2$ – during the introduction of production*
- *m_3 – arithmetic mean*
- *x_1 – the smallest value of three consecutive test results in MN/m^2*

- if the number of results of testing the strength is $10 \leq n \leq 30$, and the standard deviation σ is known and determined from a larger number of previous tests ($n_0 \geq 30$):

$$m_n\ \ MB + 1{,}2\ \sigma$$
$$x_1 \geq MB - 4.$$

- if the number of results of testing the strength is $15 \leq n \leq 30$, and the standard deviation s_n is assessed on the basis of n results:

$$m_n \geq MB + 1{,}3\ s_n$$
$$x_1 \geq MB - 4$$

Chemical additives to the cement concrete may modify the properties within the limits as specified in the design or relevant technical regulation.

Unless provided otherwise by the design, the water/cement ratio of cement concrete mixture reinforced with wires and bars shall not exceed 0.70.

The consistency of fresh cement concrete is not specified. It shall however be such as to be able to achieve the required properties of both fresh and hardened cement concrete by means of available transportation and casting means.

The reduction of compressive strength of shot cement concrete prepared with an agent to accelerate binding of cement, shall, after 28 days, not exceed 40% compared to the compressive strength of shot cement concrete without the accelerating agent.

2.2.5.3.5.3 Demonstrative Production and Placing

The contractor shall check and demonstrate the cement concrete mix composition at suitable production plant, the transportation to the site, as well as casting, when the engineer approves this.

As a rule, the engineer shall approve the location of demonstrative placing at the contractual structure, after he has verified suitability of the erected formwork or the substrate formation, and the reinforcing steel laid.

During the demonstrative production and placing, the following shall be carried out by the internal control testing:

- to establish the suitability of deposit areas and the plant for production of fresh cement concrete mixtures, of the transportation method, of the equipment for placing and of placing itself, all in compliance with these technical conditions,
- to take a specimen of the mixture at the location of casting to test the properties of both fresh and hardened cement concrete,
- to establish the adeqacy of finishing the exposed (visible) cement concrete surface,
- to check the execution of joints,
- to establish the quality of the cement concrete surface protection,
- to find out the evenness and height of the cement concrete,
- to establish the binding rate of the cement concrete.

In case the contractor already performed the work with similar cement concrete mixtures during the past year, it is possible to adopt the results of the executed composition as demonstrative production and placing. The engineer shall make the final decision.

2.2.5.3.5.4 Regular Production and Placing

The engineer may approve the contractor the regular production only on the basis of results of the demonstrative production and placing. An agreement for a continuous work also includes conditions for the characteristics of cement concrete mixtures, and conditions for the internal production control provided by these technical conditions.

A permit for regular production and placing the cement concrete mixtures shall also include detailed requirements for any eventual additional preparation of the formwork surface or underlaid course, all in accordance with section 2.2.5.3.4.3 of these technical conditions.

In case any modification in the production and placing a cement concrete mixture occurs, the contractor shall present to the engineer in writing a proposal on such modification. The contractor may bring such modification into effect only after obtaining the approval by the engineer.

2.2.5.3.6 Quality Control of Execution

2.2.5.3.6.1 Internal Quality Control

The contractor shall submit to the engineer for approval the extent of the internal control testing during placing cement concrete, all in accordance with the provisions of these technical conditions. The minimum extent of the internal quality control to be performed by the contractor or an institution engaged by the contractor, is indicated in Table 5.16.

Table 5.16: Minimum extent of testing within the scope of the internal control during placing cement concrete

Cement concrete property	Testing frequency	Note	Test method
- fresh cement concrete			
- density		at each test of fresh cement concrete	EN 12350-6
- temperature of fresh cement concrete		in case of doubt of conformity: each mixture	-
- consistency	per 20 m^3		EN 1235-2 to 5
- micro-pore content: internal resistance of cement concrete to freezing and thawing	per 20 m^3		EN 12350-7
- micro-pore content: surface resistance of cement concrete to freezing and thawing	per 5 m^3	each delivered quantity	EN 12350-7
- hardened cement concrete			
- compressive strength	per 100 m^3	1x a day, at least 3 specimens per each batch of concrete, or, according to special provision, for each segment, section or structural member	EN 12390-3
- resistance to water penetration	per 500 m^3	at least 3 tests for cement concrete cast by the same contractor in different structures on certain road section, and supplied from the same production plant	EN 12390-8
- inner resistance to freezing and thawing	per 2,000 m^3		1026, Annex 2
- surface resistance to freezing and thawing	per 1,000 m^3	at least 3 tests for cement concrete cast by the same contractor in different structures on certain road section, and supplied from the same production plant	1026, Annex 3
- linear deformations (90 days)	once	cement concrete for prestressed superstructures and walls of length above 100 m	-
- creep	per		-
- static modulus of elasticity	structure		-

In case that the engineer establishes greater deviations of results from the preliminary technological tests, he may additionally increase the minimum extent of the internal control testing. However, when the results are uniform, the engineer has the right to reduce the extent of such testing.

The quality of the works dealt with can also be specified in accordance with other approved method, however in agreement with the engineer. In such cases the engineer shall define the quality assessment criteria, all in agreement with the contractor.

2.2.5.3.6.2 External Quality Control

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 4 to the internal control testing.

Places for taking cement concrete specimens, as well as the measuring locations for both internal and external control testing shall be specified by the statistical random selection method.

2.2.5.3.6.3 Subsequent Demonstration of Inner Resistance of Cement Concrete to Freezing and Thawing

The procedure is intended to demonstrate the inner resistance of cement concrete to freezing and thawing, where, for any reason, specimens to determine the inner resistance have not been taken, or, where the results of testing performed on the specimens taken have been negative.

The subsequent demonstration of the inner resistance of cement concrete to freezing and thawing on specimens taken from the structure shall be carried out in accordance with the 1026, Annex 2. A test specimen consists of 3 cylinders measuring 100 mm in diameter and 300 mm in length.

On the specimens, per every 25 freezing/thawing cycles (up to the specified number), the dynamic modulus of elasticity shall be measured, and the value obtained shall be compared with the basic measurement value carried out on specimens saturated with moisture.

The admitted drop of the modulus of elasticity shall not exceed 25%.

If the decrease of the modulus of elasticity is less than or equal to 25% (average of three specimens), the particular cement concrete can be assessed as internally resistant to freezing and thawing actions.

2.2.5.3.7 Measurement and Take-Over of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in cubic metres.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities.

2.2.5.3.7.1 Take-Over of Works

The engineer shall take-over the cast cement concrete in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. The contractor prior to continuing the works shall mend all the established deficiencies with regard to those requirements, otherwise deductions due to insufficient quality of the executed works will be charged to his account.

2.2.5.3.8 Final Account of Works

2.2.5.3.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.3.7.1 and taken-over in compliance with section 2.2.5.3.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.5.3.8.2 Deductions Due to Insufficient Quality of Cement Concrete

2.2.5.3.8.2.1 Quality of Materials

Since the adequate quality of materials is unambiguously specified, there shall be no deductions when accounting the executed works with cement concrete.

In case the contractor places such material, which does not meet the requirements indicated in 2.2.5.3.3 of these technical conditions, the engineer shall appoint the method of accounting.

2.2.5.3.8.2.2 Quality of Execution

The cast cement concrete shall be accounted:

- in dimensions as specified in section 2.1.7.1 of the general technical conditions,
- by the contractual unit price, and
- in compliance with the provisions of the agreed general technical conditions.

In case of insufficient quality of the cast cement concrete the client has the right to put into effect adequate financial deductions.

The following bases shall be considered to assess insufficient quality of the executed works and to calculate deductions:

2.2.5.3.8.2.2.1 Unattained Compressive Strength

Financial deductions shall be calculated according to the following equation:

$$FO = \frac{O}{100} \cdot K \cdot C \cdot PD \ \text{(SIT)}$$

where:

O - deviation from the limiting value; it shall be calculated from the equation below:

$$O = \frac{f_{ck} - f_{ckd}}{f_{ck}} \cdot 100 \ (\%)$$

f_{ck} - *design (characteristic) compressive strength (MN/m²)*

f_{ckd} - *attained (measured) characteristic compressive strength (MN/m²)*

K - *quotient of impact on serviceability*

C - *contractual unit price (SIT/m²)*

PD - *extent of the work carried out insufficiently (m²).*

The determination of the financial deduction for each individual insufficient result of cement concrete compressive strength testing shall be based on the required (limiting) values and the specified threshold values f_{cksm}.

Example:

f_{ck} = 37 MN/m^2

f_{cksm} = 33,3MN/m^2

K = 3

C = 7.000 SIT/m^2

PD_1 = 600 m^2: f_{ckd} = 35,2 MN/m^2

PD_2 = 2.600 m^2: f_{ckd} = 35,5 MN/m^2

$$FO1 = \frac{37{,}0 - 35{,}2}{37{,}0} \cdot 3 \cdot 7.000 \cdot 600 = 612.972 \ \text{SIT}$$

$$FO2 = \frac{37{,}0 - 35{,}5}{37{,}0} \cdot 3 \cdot 7.000 \cdot 2.600 = 2.213.514 \ \text{SIT}$$

. $\sum FO = 2.826.486 \ \text{SIT}$

2.2.5.3.8.2.2.2 Unattained Flexural Tensile Strength

Financial deductions shall be calculated according to the following equation:

$$FO = \frac{O}{100} \cdot K \cdot C \cdot PD \ \text{(SIT)}$$

where:

O - deviation from the limiting value; it shall be calculated from the equation below:

$$O = \frac{f_{fk} - f_{fkd}}{f_{fk}} \cdot 100 \ (\%)$$

f_{fk} - *design (characteristic) flexural tensile strength (MN/m2)*

f_{fkd} - *attained (measured) characteristic flexural tensile strength (MN/m2)*

The determination of the financial deduction for each individual insufficient result of cement concrete flexural tensile strength strength testing shall be based on the required (limiting) values and the specified threshold values f_{fksm}.

Example:

f_{fk} = 5 MN/m^2

f_{fksm} = 4 MN/m^2

K = 5

C = 7.000 SIT/m^2

PD_1 = 150 m^2: f_{fkd} = 4,4 MN/m^2

PD_2 = 150 m^2: f_{fkd} = 4,1 MN/m^2

$$FO1 = \frac{5{,}0 - 4{,}4}{5{,}0} \cdot 5 \cdot 7.000 \cdot 150 = 630.000 \ \text{SIT}$$

$$FO1 = \frac{5{,}0 - 4{,}1}{5{,}0} \cdot 5 \cdot 7.000 \cdot 150 = 945.000 \ \text{SIT}$$

. $\sum FO = 1.575.0006$ ΣFO = 1.575.000 SIT

2.2.5.3.8.2.2.3 Unattained Inner Resistance to Freezing/Thawing

Financial deductions shall be calculated according to the following equation:

$$FO = \frac{O}{100} \cdot K \cdot C \cdot PD \ \text{(SIT)}$$

where:

O - deviation from the limiting value; it shall be calculated from the equation below:

$$O = \frac{0{,}75 - ZO_d}{0{,}75} \cdot 100 \ (\%)$$

where the threshold value amounts to: ZO_{sm} = 0,65

ZO_d - actually attained quotient of E_{din} of concrete specimens having been exposed to the required number of cycles to E_{din} of concrete specimens not having been exposed to freezing/thawing cycles

K - quotient of impact on serviceability = 1

C - contractual unit price (SIT/m^2)

PD - extent of the work carried out insufficiently (m^2)

Example:

ZO_d = 0,70

K = 1

C = 7.000 SIT/m2

PD = 150 m2

$$FO = \frac{0{,}75 - 0{,}70}{0{,}75} \cdot 1 \cdot 7.000 \cdot 150 = 70.000 \ \text{SIT}$$

2.2.5.3.8.2.2.4 Unattained Surface Resistance to Freezing/Thawing

Financial deductions shall be calculated according to the following equation:

$$FO = \frac{O}{100} \cdot K \cdot C \cdot PD \ \text{(SIT)}$$

where:

O - deviation from the limiting value; it shall be calculated from the equation below:

$$O = \frac{m_d - m_m}{m_m} \cdot 100 \ (\%)$$

m_{sm} - threshold value = 0.40 mg/mm^2

m_m - admitted value of loss of mass during required testing cycles = 0.20 mg/mm^2

m_d - attained (established) value of loss of concrete mass during required cycles (mg/mm^2)

K - quotient of impact on serviceability = 0.3

C - contractual unit price (SIT/m²)

PD - extent of work carried out insufficiently (m²)

In each case where $m_d > m_m$ is exceeded, protection of cement concrete surface is obligatory.

Example:

m_d = 0,30 mg/mm^2

m_m = 0,20 mg/mm^2

K = 0,3

C = 7.000 SIT/m^2

PD = 2000 m^2

$$FO = \frac{0{,}30 - 0{,}20}{0{,}2} \cdot 0{,}3 \cdot 7.000 \cdot 2000 = 2.100.000 \ \text{SIT}$$

2.2.5.3.8.2.2.5 Unattained Resistance to Water Penetration

Financial deductions shall be calculated according to the following equation:

$$FO = \frac{O}{100} \cdot K \cdot C \cdot PD \ \ (\text{SIT})$$

where:

O - deviation from the limiting value; it shall be calculated from the equation below:

$$O = \frac{e_{\max.d} - e_{\max.m}}{e_{\max.m}} \cdot 100 \ \ (\%)$$

$e_{max.sm}$ - *threshold value of maximum water penetration depth =* $e_{max.m}$ *+ 2 cm*

$e_{max.m}$ - *admitted value of maximum water penetration depth (cm)*

$e_{max.d}$ - *attained (measured) value of maximum water penetration depth (cm)*

K - quotient of impact on serviceability = 0.3

C - contractual unit price (SIT/m²)

PD - extent of work carried out insufficiently (m²)

In each case where $e_{max.d} > e_{max.m}$ is exceeded, protection of cement concrete surface is obligatory.

Example:

$e_{max.d}$ = 4,0 cm

$e_{max.m}$ = 3,0 cm

K = 0,3

C = 7.000 SIT/m^2

PD = 1500 m^2

$$FO = \frac{4{,}0 - 3{,}0}{3{,}0} \cdot 0{,}3 \cdot 7.000 \cdot 1500 = 1.050.000 \ \ \text{SIT}$$

2.2.5.3.8.2.2.6 Unattained Thickness of Surface Course

Financial deductions shall be calculated according to the following equation:

$$FO = f \cdot C \cdot PD \ \ (\text{SIT})$$

where:

f - quotient of deduction in dependence on O

$$O = \frac{h_n - h_{dop} - h_d}{h_n} \cdot 100 \ (\%)$$

h_n - design thickness of surface course (cm)
h_{dop} - admitted deviation of thickness = 0.5 cm
h_d - attained (measured) thickness of surface course (cm)

The value of the quotient f shall be assessed on the basis of the Table 5.17.

Table 5.17: Quotients of deduction in dependence on the deviation of the surface course thickness from the design thickness

O (%)	0.5	1	2	3	4	5	6	7	8	9	10
f	0.03	0.05	0.10	0.15	0.19	0.23	0.27	0.31	0.35	0.39	0.42

Financial deduction shall be determined for each individual insufficient result of the surface course thickness. This shall be carried out taking account of the specified limiting values.

Example:

h_n = 24 cm
h_d = 22,5 cm
C = 7.000 SIT/m^2
PD = 110 m^2

$$O = \frac{24{,}0 - 0{,}5 - 22{,}5}{24} \cdot 100 = 4{,}2\%$$

f = 0,20 (from Table 5.17)

$$FO = 0{,}20 \cdot 7.000 \cdot 110 = 154.000 \ \text{SIT}$$

2.2.5.3.8.2.2.7 Excessive Unevenness

Where individual unevenness on the cement concrete surface course exceed the limiting value, adequate financial deduction shall be calculated from the equation indicated below:

$$FO = \sum O_i^2 \cdot š \cdot K \cdot C$$

where:

$\sum O_i^2$ *- sum of squares of deviations of evenness*

š - width of traffic lane at the place of measurement, including the marginal strip (m)

Example:

O1 = 2 mm	$O1^2$ = 4
O2 = 1 mm	$O2^2$ = 1
O3 = 2 mm	$O3^2$ = 4
	ΣO_i^2 = 9

K = 0,3
C = 7.000 SIT/m2
š = 4,25 m

$$FO = 9 \cdot 0{,}3 \cdot 7.000 \cdot 4{,}25 = 80.325 \ \text{SIT}$$

2.2.5.3.8.2.2.8 Unattained Requirements for Exposed Cement Concrete

2.2.5.3.8.2.2.8.1 Requirements for Exposed Cement Concrete

Requirements in view of both evenness and surface porosity shall be considered when assessing the quality of the exposed (visible) cement concrete.

The following deviations are allowed when measuring unevenness:

- below a straight edge of 4 m length the allowed deviation amounts to OD_m = 20 mm
- below a straight edge of 2.5 m length the allowed deviation amounts to OD_m = 16 mm

When assessing the surface porosity, only pores of diameter ≥ 1 mm and ≤ 15 mm are taken into consideration. The admitted percentage of the area of such pores (on the measured surface of ≥ 50 x 50 cm) amounts to 0.3 %.

2.2.5.3.8.2.2.8.2 Calculation of Deductions

Financial deductions shall be calculated according to the following equation:

$$FO = \left(\frac{O_R}{100} \cdot K_R \cdot PD_R + \frac{O_{PP}}{100} \cdot K_{PP} \cdot PD_{PP} \right) \cdot C \ \text{(SIT)}$$

where:

O_R - deviation from limiting value to be calculated from the equation below:

$$O_R = \frac{OD_d - OD_m}{OD_m} \cdot 100 \ (\%)$$

OD_{sm} - threshold value = OD_m + 4 mm

OD_m - admitted value of deviation of evenness with regard to the length of straight edge (mm)

OD_d - attained (measured) value of deviation (mm)

K_R - quotient of impact on serviceability = 0.1

C = contractual unit price (SIT/m^2)

PD_R = extent of work carried out insufficiently – evenness (m^2)

O_{PP} - deviation from limiting value to be calculated form the equation below:

$$O_{PP} = \frac{PP_d - 0{,}3}{0{,}3} \cdot 100 \ (\%)$$

PP_{sm} - threshold value of percentage of area of pores (on measured surface of ≥ 50 x 50 cm) = 0.4 %

PP_d - attained (established) value of percentage of area of pores (on measured surface of ≥ 50 x 50 cm) (%)

K_{PP} - quotient of impact o the surface on serviceability = 0.3

C = contractual unit price (SIT/m^2)

PD_{PP} = extent of work carried out insufficiently – area of pores (m^2)

Example:

OD_d = 22 mm
OD_m = 20 mm
K_R = 0,1
PD_R = 750 m^2
PP_d = 0,35 %
PP_m = 0,30 %
K_{PP} = 0,3
PD_{PP} = 1200 m^2
C = 7.000 SIT/m^2

$$FO = \left(\frac{22-20}{20} \cdot 0{,}1 \cdot 750 + \frac{0{,}35-0{,}30}{0{,}30} \cdot 0{,}3 \cdot 1200 \right) \cdot 7.000 = 472.500 \ \text{SIT}$$

2.2.5.4 MASONRY AND STONECUTTING WORKS

Special technical conditions for masonry and stonecutting works only deal with special works for arranging the surface of structures on roads or of their individual parts.

Masonry and stonecutting works shall be executed in the manner as well as in dimensions and quality as provided by the design and in compliance with these technical conditions.

2.2.5.4.1 Description

Masonry and stonecutting works include the supply and placing of all the required materials for arrangement and protection of the surface of structures or their individual components as provided by the design.

The basic methods of arranging surfaces of structures are:

- lining and building with stone, cement concrete prefabricated elements, or suitable brick,
- coating with cement mortar,
- chopping – stamping
- grinding.

The method of arranging and protecting the surface shall be specified in detail in the design. If this is not the case, the contractor shall propose suitable methods to be approved by the engineer.

The contractor shall, on the demand of the engineer, demonstrate on a test surface that he is capable to execute the required or offered arrangement of the surface.

2.2.5.4.2 Basic Materials

Basic materials for masonry and stonecutting works for arranging surfaces of structures or their individual parts are:

- natural stone (quarry or broken stone) and finished stone
- prefabricated elements, unfinished or finished
- solid face brick
- mortar for building or plastering.

2.2.5.4.2.1 Stone

Quarry (broken) stone and finished stone of silicate and carbonate rock us applicable to arrange surfaces of structures.

2.2.5.4.2.2 Prefabricated Elements

Unfinished and finished elements of light-weight and normal-weight cement concrete, as well as autoclaved cement-silicate products shall fulfil the conditions specified by the design of arrangement of surfaces of structures or of their components.

2.2.5.4.2.3 Solid Face Brick

Face brick used to line exposed (visible) surfaces of structures shall meet the requirements as foreseen in the design.

2.2.5.4.2.4 Mortar for Building and Plastering

The mortar for building with stone, prefabricated elements, and face brick, as well as for filling the joints between the materials indicated above, shall be composed of suitable mixture of sand, cement, water, and additives. As a rule, a mixture of coarse sand of 0/4 mm composed of natural and/or crushed grains shall be used.

Chemical and other additives to improve certain properties of mortar can be used provided that they are foreseen in the design and that the engineer approves their application. Producer's instructions shall be obligatorily considered.

The value of the w/c ratio in the mixture of mortar shall be less than 0.7, while the air amount (micro-pores) shall amount to more than 10% by volume.

For the protection of the mortar used for plastering, different liquid chemical agents can be used to ensure uniform and watertight film. Such agents shall be, however, approved by the engineer.

2.2.5.4.3 Quality of Materials

2.2.5.4.3.1 Stone

Stone for lining or building shall be of though and uniform rock, which shall also be resistant to actions of weather, water, and salt. Natural stone for building shall meet the requirements provided by the EN 771-6, whereas the stone for lining shall comply with the EN 13383-1.

The compressive strength of the rock shall amount to at least 120 kN/m^2, unless provided otherwise by the design.

The size of stone pieces and the method of finishing respectively, shall be adapted to the design requirements and to the purpose of use.

In addition, the stone for lining shall comply with the conditions indicated in Table 5.18, unless provided otherwise in the design.

Table 5.18: Requirements to be met by the stone for lining

Material property	Required value	Test method
- shape category	LT_A	EN 13383-2
- resistance to rupture	min CS_{80}	EN 1962
- resistance to wear		EN 1097-1
- gravel-carrying water streams	$M_{DE}10$	
- water streams	$M_{DE}20$	
- no hazard of wear	$M_{DE}30$	
- resistance to frost		
- water absorption criterion	$WA_{0.5}$	EN 13383-2
- frost criterion	FT_A	

Assuring quality and certifying conformity are carried out in accordance with the 2+ system, which means that the producer performs the quality control in compliance with the provisions of the standard, and obtains a production control certificate issued by the authorized certification body. On the basis of the certificate the contractor issues a statement on product conformity.

2.2.5.4.3.2 Cement Concrete Bricks

Cement concrete bricks used for lining or building shall meet the requirements of the EN 771-3. Unless provided otherwise by the design, they shall comply with the requirements indicated in Table 5.19.

Table 5.19: Requirements to be met by cement concrete bricks

Material property	Required value	Test method
dimensions and evenness of surfaces	D3	EN 772-16 and EN 772-20
compressive strength	category I	EN 772-1
water absorption capacity	suitable to further use	EN 772-11

In case the prefabricated elements are produced of two types of cement concrete (main concrete and face mix), a perfect composite effect between these two layers shall be ensured.

The quality assurance and the conformity certification shall be carried out in compliance with the 2+ system.

2.2.5.4.3.3 Bricks of Lime and Sand

Bricks of lime and sand used for lining or building shall comply with the provisions of the EN 771-2. Unless provided otherwise by the design, they shall meet the requirements indicated in Table 5.20.

Table 5.20: Requirements to be met by bricks of lime and sand

Material property	Required value	Test method
- compressive strength - durability	category I durable	EN 772-1 EN 772-18

The quality assurance and the conformity certification shall be carried out in compliance with the 2+ system.

2.2.5.4.3.4 Clay Bricks

Clay bricks used for lining or building shall meet the requirements of the EN 771-1. Unless provided otherwise by the design, they shall comply with the requirements indicated in Table 5.21.

Table 5.21: Requirements to be met by clay bricks

Material property	Required value	Test method
- compressive strength - water soluble salts - durability	category I S2 F2	EN 772-1 EN 772-5 EN 772-18

Clay bricks shall be declared as bricks suitable to civil engineering structures.

The quality assurance and the conformity certification shall be carried out in compliance with the 2+ system.

2.2.5.4.3.5 Mortar for Building

Mortar used for lining or building shall comply with the provisions of the EN 998-2. The requirements with regard to the mortar properties shall be specified by the design.

In addition, the mortar to be used for lining or building of structures on roads shall be declared as "suitable to severe climatic conditions", all in accordance with the standard.

The quality assurance and the conformity certification shall be carried out in compliance with the 2+ system.

2.2.5.4.3.6 Mortar for Plastering

Mortar used for plastering shall comply with the provisions of the EN 998-1. The requirements with regard to the mortar properties shall be specified by the design.

Notwithstanding the design provisions the mortar for plastering shall have properties indicated in Table 5.22.

In addition, the mortar to be used for plastering the structures on/at roads shall be declared as "suitable to severe climatic conditions", all in accordance with the standard.

The quality assurance and the conformity certification shall be carried out in compliance with the 2+ system.

Table 5.22: Requirements to be met by mortar for plastering

Mortar property	Required value	Test method
compressive strength adhesion after freezing capillary water absorption capacity	min. SC II (declaration by producer) min. W 1	EN 1015-11 EN 1015-21 EN 1015-18

2.2.5.4.4 Method of Execution

2.2.5.4.4.1 Winning the Materials

In due time prior to commencement of the works, the contractor shall submit to the engineer a method statement, which includes all the material types to be used for masonry and stonecurring works. The contractor shall also submit to the engineer adequate evidence on quality of the materials, and shall obtain the engineer's approval prior to commencement of the works.

All the material properties specified in section 2.2.5.4.3 shall be ensured. Any material not complying with the requirements indicated must not be used.

2.2.5.4.4.2 Depositing the Materials

When the contractor, prior to the execution of masonry and stonecutting work, provisionally deposits the material required for hese works, suitable space for this purpose shall be ensured and arranged. He shall take account of the instructions issued by the producers of the materials, as well as the engineer's instructions.

Stocks of all the materials shall be such as to ensure continuous work.

2.2.5.4.4.3 Production and Quality of Mortars for Building and Plastering

As a rule, the production of cement mortar mixtures shall be mechanical and carried out at suitable plant where batch-based production is provided.

Mixing time and other impacts on the quality shall be so adjusted as to ensure a uniform mixture of cement mortar.

For the work at lower temperatures (up to +2°C) a possibility of heating the mixtures of grains and/or water up to an adequate temperature shall be ensured, so that the temperature of the fresh cement mortar mixture amounts to 5 – 30°C.

The mortar production plant shall be protected from atmospheric actions.

A possibility of permanent visual control of dosing the quantities of individual materials for the mortar production shall be assured at the plant.

The produced cement concrete mixture may be put at stock in adequate silos within the plant for shorter period, or it shall be immediately transported to the application place.

The contractor shall, by demonstrative production of cement mortar mixture, verify the preliminary (laboratory) composition at suitable plant. Within the scope of the demonstrative production certain internal control tests shall be carried to establish the adequacy of deposit areas and the production plant, all in compliance with the requirements provided by these technical conditions.

The engineer may approve the contractor the regular production only on the basis of results of the demonstrative production and placing. An agreement for a continuous work also includes conditions for the characteristics of cement mortar mixtures, and conditions for the internal production control provided by these technical conditions.

A permit for regular production of cement mortar mixtures shall also include detailed requirements for any eventual additional works.

In case any modification in the production of a cement mortar mixture occurs, the contractor shall present to the engineer in writing a proposal on such modification. The contractor may bring such modification into effect only after obtaining the approval by the engineer.

2.2.5.4.4.4 Execution of Works

2.2.5.4.4.4.1 Building and Lining

Both building and lining the walls with

- unfinished or finished quarry (broken) stone or hewed stone,
- suitably shaped prefabricated elements, or
- adequate brick

shall be, as a rule, executed with the use of mortar for interconnecting individual elements and for linking those elements with the substrate.

In hot weather, the surface of walls, in which cement mortar has been used, shall be maintained wet for at least 7 days.

Where provided by the design, building or lining the walls can also be carried out without mortar (dry method).

2.2.5.4.4.4.2 Plastering

The surface of structures of their individual components shall be suitably prepared to receive plaster of mortar, i.e. it shall be even, uniform, cleaned, and moistened.

Daily breaks in plaster application shall be adequately finished to prevent damage to such locations.

Plastering works shall be stopped as soon as the air temperature drops below 2°C.

Plastered surface, which can be finished by roughening and sealing, smoothing, or brushing, shall be so protected as to prevent the cement mortar temperature to drop below 5°C until the mortar attains at least 50% of the required compressive strength.

Plaster surface shall be protected from weather actions immediately after setting and adequate surface finishing. The protection can be carried out by spraying liquid chemical or any other protective agent. Technical conditions issued by the producer of the particular chemical agent shall be considered. The engineer shall approve the contractor's proposal of the method of protecting such surface.

2.2.5.4.4.4.3 Chopping - Stamping

Surfaces of individual structural members can be finished by means of special tools, e.g. stamping hammers, in order to become rough. During these works, one shall take care that the surface layer of cement concrete or stone is damaged to the smallest possible extent. The remaining sharp superficial grains shall be firmly bound to the substrate.

A chopped surface shall be protected from weather action. The engineer shall approve the contractor's proposal of the method of protecting such surface.

2.2.5.4.4.4.4 Grinding

Grinding the cement concrete surface is usually a measure to prepare the particular surface for other works within the scope of the arrangement of surfaces of structures on roads. The executed work shall be in accordance with the design provisions.

The ground exposed (visible) surface shall be protected from weather actions.

2.2.5.4.5 Quality of Execution

During the works the contractor or the authorized performer of the internal control shall

- take specimens of the material for lining and building or plastering, and execute testing of properties in compliance with section 3.2.5.4.3 of these technical conditions,
- determine the surface protection, and
- establish the quality of the excited surface of the structure or its component (evenness, height).

The required properties specified in 2.2.5.4.3 of these technical conditions are limiting values unless provided otherwise.

The contractor shall not commence masonry and stonecutting works until he receives an approval by the engineer to the proposed and demonstrated method of execution of the works.

2.2.5.4.5.1 Building and Lining

All the materials for building and lining shall be clean and adequately moistened prior to placing.

The mortar layer between elements shall be at least 1 cm thick. All the joints between elements shall be perfectly filled up with mortar. On the exposed (visible) side of walls, the joints shall be finished as provided by the design or by the engineer.

Unless specified otherwise in the design, the exposed (visible) surface of walls shall be level. As a rule, the joints on the exposed (visible) side of a wall shall be appropriately arranged.

2.2.5.4.5.2 Plastering

The thickness of the mortar for plastering shall be uniform, in compliance with the design thickness, and uniformly thickened.

2.2.5.4.6 Quality Control of Execution

The extent of checking the quality of both arrangement and protection of the surface of structures or their individual members shall be specified by the engineer, all in accordance with the design and these technical conditions. It shall however be adapted to specific conditions of work.

The tests of individual properties of the mortar for building and plastering (in compliance with the requirements indicated in 2.2.5.4.4.3) shall be carried to such an extent, which assures a possibility of interventions in due time.

The engineer may change the already specified extent of testing the masonry and stonecutting works, if he establishes unequal quality of the executed works.

The extent of the external control testing to be executed by third party institution authorized by the Client is usually in the ratio of 1 to 4 to the internal control testing.

2.2.5.4.7 Measurement and Take-Over of Works

2.2.5.4.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in appropriate unit measures.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities.

2.2.5.4.7.2 Take-Over of Works

The engineer shall take-over the performed stonecutting and masonry works in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. The contractor prior to continuing the works shall mend all the established deficiencies with regard to those requirements.

2.2.5.4.8 Final Account of Works

2.2.5.4.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.4.7.1 and taken-over in compliance with section 2.2.5.4.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.5.4.8.2 Deductions Due to Insufficient Quality

2.2.5.4.8.2.1 Quality of Materials

Since the adequate quality of materials for masonry and stonecutting works is unambiguously specified, there shall be no deductions when accounting the executed works.

In case the contractor places such material, which does not meet the requirements indicated in 2.2.5.4.3 of these technical conditions, the engineer shall appoint the method of accounting.

2.2.5.4.8.2.2 Quality of Execution

If the contractor does not ensure the required quality of the executed masonry and stonecutting works, the engineer decides on the method of accounting. He has also the right to reject the entire executed work.

2.2.5.5 RESTORATION WORKS ON STRUCTURES

General

Technical conditions for restoration works on cement concrete and reinforced cement concrete bridges and other structures on roads deal with renewal, partial repair, or strengthening of such structures with the aim to extend their service life or to improve their serviceability.

The technical conditions are intended for all types of structures such as bridges, buildings, water economy structures, tunnels, etc., of non-reinforced, reinforced, and prestressed cement concrete.

Skilled and adequately equipped contractors can only carry out restoration works on structures.

2.2.5.5.1 Description

The works on the restoration of structures comprise the procedures of establishing the actual condition, on the basis of which an adequate method of structural renewal, repair, and surface protection is selected. When assessing the actual condition of the particular structure it is required to determine the type and expanse of damages (damage due to freezing and salts, moisture or water, carbonatization or chlorides, mechanical damages, cracks, etc.) and to establish the condition of cement concrete, its residual strength, carbonatization depth, chloride penetration depth, as well as the condition of the reinforcing steel.

After the actual condition of the structure is assessed, adequate design for the repair shall be worked out, and measures shall be foreseen, which ensure the required bearing capacity, serviceability, and durability of the structure.

Restoration work carried out on structures comprises the removal of damaged cement concrete, surface preparation, corrosion protection of reinforcing steel, replacement of removed parts, and surface protection.

These works shall be executed in weather without precipitations, and when both air and substrate temperature is within the limits of 5°C - 30°C.

2.2.5.5.2 Basic Materials

Basic materials for trhe execution of restoration of cement concrete structures can be used either individually or as a system. The applied materials shall ensure

- corrosion protection of reinforcing steel,
- adequate adhesion coat,
- required re-profiling, and
- surface protection (application of hydrophobic coating, impregnation, coloured paint coat, or protective high-build coating).

With the selected basic materials the contractor shall assure such properties of the restored structural member as specified by the design.

2.2.5.5.3 Quality of Materials

The quality of all the applied materials shall comply with the requirements specified by the structural restoration design as well as by appropriate method statements provided by the contractor.

As a rule, the quality of materials for the repair works shall meet the requirements provided by the standards of the series EN 1504 (1-10).

Adequacy of the selected materials shall be demonstrated on a test area.

2.2.5.5.4 Method of Execution

2.2.5.5.4.1 Assessment of Actual Condition of Cement Concrete

When assessing the actual condition of structural cement concrete the following shall be established:

- carbonatization depth,
- chloride penetration depth,
- residual compressive strength of cement concrete, and
- reasons of crack formation.

To assess actual properties of cement concrete structures the following methods can be introduced:

- non-destructive methods, and
- destructive methods by boring or cutting out specimens of required dimensions.

Professional laboratories can only perform tests on specimens taken.

2.2.5.5.4.2 Removal of Damaged Cement Concrete

Damaged cement concrete shall be removed up to the sound substrate, which must fulfil the requirements specified by the structural restoration design. Damaged cement concrete can be removed

- manually,
- by means of pneumatic or electric tools, or
- by means of high-pressure water jet.

2.2.5.5.4.3 Substrate Preparation

The substrate shall be so prepared as to achieve an optimum adhesion between the existing cement concrete (substrate) and newly applied repairing materials. The cement concrete substrate shall be firm, without any loose or weak parts, and free of residuals of old coating. By the selected method of substrate preparation the following shall be ensured:

- cleaning the cement concrete surface,
- removal of cement skin,
- removal of old coating,
- removal of surface of damaged cement concrete,
- removal of cement concrete up to the existing steel reinforcement,
- cleaning the corrosion damage to steel, and
- moistening the substrate.

The substrate can be prepared by

- removal by cutting out,
- milling,
- sand blasting with hard abrasive (quartz sand, steel shot),
- high-pressure water jet,
- cleaning with water or water steam.

In his method statement the contractor shall specify the method of removal of damaged cement concrete as well as the method of the substrate preparation. The engineer shall approve these proposals.

2.2.5.5.4.4 Adhesion Coat

To ensure suitable adhesion between the old cement concrete and the newly applied material, the adhesion coat shall be applied. The material used to execute the adhesion coat shall be compatible with the material specified to perform the repairing works. The adhesion coat can be

- cement coating modified with polymers (a mix of cement, polymer, and water, and – if specified – of mineral filler as well),
- polymer coating (synthetic resisns with or without fillers).

2.2.5.5.4.5 Corrosion Protection of Reinforcing Steel

To ensure suitable corrosion protection of reinforcing steel the following shall be carried out:

- cleaning of steel up to Sa 2 grade (by sand blasting or high-pressure water jet), and
- application of one or two coats of protective material (according to maker's instructions).

The contractor shall foresee the type of protective coating and the method of application in his method statement.

2.2.5.5.4.6 Re-Profiling

Prior to the execution of re-profiling, adequate roughness and strength of the substrate shall be ensured. The pull-off strength of the re-profiling material shall not be less than 1.5 N/mm^2. The adhesion coat shall be applied in compliance with the instructions issued by the producer of the re-profiling mortar.

The materials for the execution of re-profiling shall be selected in accordance with the design requirements. The following materials are applicable to re-profiling works:

- repairing cement mortar,
- cement mortar modified with polymers, or
- repairing mortar made of synthetic resins.

The size of the largest grain shall be selected with regard to the required thickness of coating to be applied.

The re-profiling mortar can be applied

- manually,
- mechanically (spiral pump), or
- by dry or wet spraying (thickness of one coat between 1 and 5 cm).

2.2.5.5.4.7 Crack Repair

Cracks on cement concrete structures can take rise for different reasons. Cracks occurring in fresh or young cement concrete, can be a consequence of

- settlements,
- shrinkage, and/or
- temperature differences.

Cracks arising later in hardened cement concrete can be a consequence of

- external actions (load),
- shrinkage or temperature variation, and/or
- effects of corrosion, freezing, etc.

Cracks can be active or at rest; they can be either dry or water permeable.

The method of crack repair depends on the condition of the particular crack as well as on the cause of its formation.

Crack repair shall, as a rule, be carried out by grouting. In view of both size and depth of a crack, one can use

- surface grouting packers, and
- depth grouting packers.

With regard to both width and condition of a crack (at rest, active, dry, or wet) the type of grouting compound shall be specified, which can be either

- cement grouting compound, or
- synthetic resin grouting compound (epoxy, polyurethane).

Both method and material for the crack repair shall be defined in the design.

2.2.5.5.4.8 Surface Protection

The method of cement concrete surface protection shall be specified by the design. The following can be used for the cement concrete surface protection:

- making the surface hydrophobic, i.e. to protect it so as to prevent water penetration as well as penetration of adverse substances diluted in water,
- impregnation, i.e. depth protection, which improves the properties of cement concrete next to the surface,
- thin-layer colour paint coats in thickness up to 0.3 mm, and
- high-build protective coating in thickness more than 0.3 mm, which are able to bridge the cracks.

The material for the execution of the cement concrete surface protection shall be specified by the design.

2.2.5.5.5 Quality of Execution

The quality of materials used and works performed shall be checked and evaluated in accordance with the EN 1504-8 and EN 1504-9. Checking the quality of materials and executed works shall be carried out by the contractor's internal control and by the third party (external control) institution authorized by the client.

The contractor shall carry out demonstrative application, by which he can prove that the design requirements are implemented.

The contractor must not commence the works until he has acquired an approval by the engineer. The approval shall be based on the results obtained upon demonstrative application.

2.2.5.5.6 Quality Control of Execution

The extent of the quality control in the sense of design requirements and these technical conditions shall be specified by the engineer. The extent shall be adapted to specific conditions of the work execution on the particular structure, and shall, as a rule, not deviate from the following requirements:

- control of substrate:
  - pull-off strength of substrate — every 500 m^2 or at least 1x per structural member
  - humidity of substrate — each structural member
  - temperature of air and substrate — 3x a day
  - dew point — 3x a day or when the conditions change
  - roughness depth — every 500 m^2 or at least 1x per structural member
- control during and after execution:
  - temperature of air and substrate — 3x a day
  - dew point — 3x a day or when the conditions change
  - wet film thickness — every 500 m^2 or at least 1x per structural member
  - pull-off strength of protective coat — every 500 m^2 or at least 1x per structural member
  - thickness of applied repair mortar — every 500 m^2 or at least 1x per structural member
  - pull-off strength of repair mortar — every 500 m^2 or at least 1x per structural member
  - pull-off strength of protective coats — every 500 m^2 or at least 1x per structural member

The abovementioned measurements of temperature, humidity, and dew point shall be carried out by the contractor's internal control in the specified frequency. For other measurements the frequency of external testing is indicated. The number of the internal control measurements shall be four times the number of the external control measurements.

The dew point shall be at least by 3º higher than the substrate temperature.

The pull-off strength of re-profiling mortar shall not be less than 1.5 $N/mm^{2,}$ whereas each individual measurement value shall not be less than 1.0 N/mm^2. The pull-off strength of the protective coats (both coloured and heavy-build) must not amount to less than 1.0 $N/mm^{2,}$ while the minimum individual measurement result shall not be less than 0.8 $N/mm^{2.}$

2.2.5.5.7 Measurement and Take-Over of Works

2.2.5.5.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in appropriate unit measures.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities.

2.2.5.5.7.2 Take-Over of Works

The engineer shall take-over the performed restoration of structures in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. The contractor prior to continuing the works shall mend all the established deficiencies with regard to those requirements.

2.2.5.5.8 Final Account of Works

2.2.5.5.8.1 3.2.5.5.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.5.7.1 and taken-over in compliance with section 2.2.5.5.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.5.5.8.2 Deductions Due to Insufficient Quality

2.2.5.5.8.2.1 Quality of Materials

Since the adequate quality of materials for the restoration works on structures is unambiguously specified, there shall be no deductions when accounting the executed works.

In case the contractor places such material, which does not meet the requirements indicated in 2.2.5.5.3 of these technical conditions, the engineer shall appoint the method of accounting.

2.2.5.5.8.2.2 Quality of Execution

If the contractor does not ensure the required quality of the executed restoration of cement concrete structures, the engineer decides on the method of accounting.

2.2.5.6 ANCHORING

Basically, anchoring is intended for structural strengthening, i.e. to ensure or increase the capacity of structures of their individual members to take certain loading.

Anchors are special and very specific elements within the structure. As they are located in the foundation soil they are inaccessible and cannot be directly controlled. So they are situated in a heterogeneous, never exactly known, and generally water containing medium where aggressive compounds and stray currents may circulate.

Anchors shall be designed and executed to implement their function throughout the service life. Therefore anchors are always of existential importance for a particular structure. Permanent anchors shall be long-term safe structural elements.

2.2.5.6.1 Description

2.2.5.6.1.1 General

Anchors can be classified in different ways. The most frequent classifications are as follows:

- by components: on one bar, of several wires or strands,
- by the ground where they are anchored: rock anchors or soil anchor
- by the character of load transfer: 1D-, 2D-, or 3D
- by the character of functioning: passive or active (prestressed) anchors,
- by the application mode: permanent, temporary, test, and structural anchors.

The service life of permanent anchors shall be the same as that of the anchored structure.

The service life of temporary anchors shall amount up to 2 years.

Test anchors are specially designed and installed in a common way to obtain sufficient information for the selection of suitable anchors and to specify the fixed anchor length.

EUROCODE 7 distinguishes permanent and temporary ground anchors when calculating the design (admissible) resistance of anchors by introducing two different Y_m factors amounting to 1.25 for temporary and 1.5 for permanent anchors.

As a rule, an anchor consists of the anchor head, free anchor length, and fixed anchor length. All the details concerning anchors shall be specified by the design.

The complete anchoring is composed of two main operations:

- drilling the boreholes, and
- assembling and inserting the anchors,

And, in addition, for certain types of anchors, of

- grouting, and
- stressing.

The grouting conditions are described in detail in 2.2.5.7 of these technical conditions.

According to the provisions of these technical conditions (2.2.5.6.5.3) the contractor shall previously demonstrate with suitable test loading of anchors, that the anchoring characteristics specified by the design are ensured.

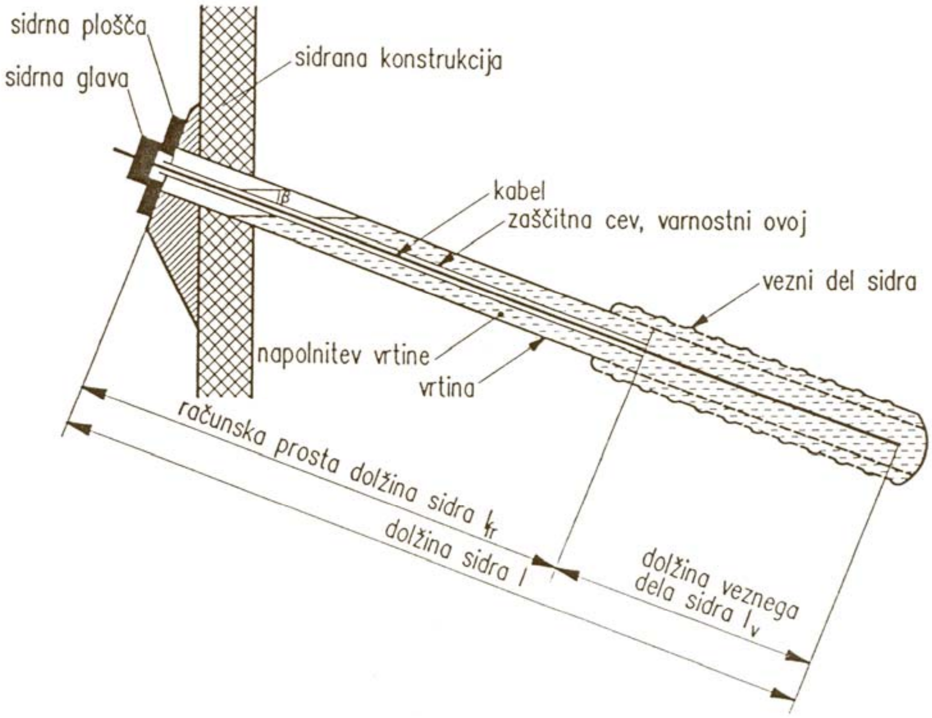
2.2.5.6.1.2 Permanent (Prestressed) Anchors

The most important anchors are those of 1D (lineal) transfer of load, and of clearly expressed free anchor length. Such an anchor represents a geo-static element being a constituent part of the structure-anchor-ground system, where the stress and deformation states are always very complex, especially at the contact between the anchor cylinder and the surrounding ground called anchoring base.

To achieve the expected effects of prestressing it is essential that an anchor be composed of the following components:

- fixed (anchored) length,
- free length, and
- anchor head.

A ground anchor consists of components as shown in Fig. 5.1.



translation:
sidrna plošča = bearing plate
sidrna glava = anchor head
sidrana konstrukcija = anchored structure
kabel = tendon
zaščitna cev, varnostni ovoj = protective sheath, encapsulation
vezni del sidra = fixed anchor part
napolnitev vrtine = grouted borehole
vrtina = borehole
računska prosta dolžina sidra = design free anchor length L_{free} (oznaka po EN 1537!)
dolžina veznega dela sidra = fixed anchor length L_{fixed} (oznaka po EN 1537!)
dolžina sidra = anchor length L

Fig. 5.1: Prestressed ground anchor with typical elements and symbols

The fixed anchor length serves for transferring the load into the ground.

The role of the free anchor length seems to be formal and less notable than the fixed anchor length, yet its importance is multiple. The essence of prestressed ground anchors is a correctly selected free anchor length, therefore attention should be paid to it.

The free anchor length depends on the following:

- soil-mechanical properties of the ground,
- results of stability analyses,
- weight of the earth mass activated at the anchor for a reliable load transfer,
- rock strength, and
- dimension of the block at the contact, which has to be stabilized in its position.

Permanent anchors shall be long-term safe structural elements fulfilling the following conditions:

- the service life of an anchor shall be at least the same as that pf the anchored structure,
- an eventual early failure of an anchor shall be perceived in due time not only to evacuate endangered persons but also to replace the anchors.

As anchors are liable to

- surface corrosion,
- spot corrosion (“pitting”),
- stress corrosion,

- hydrogen brittle failure, etc.,

an anchor can be considered as a long-term reliable only on condition that it is composed of high-performance steel suitably protected from corrosion.

The following corrosion protection principles shall apply:

- prevention of access of aggressive media,
- prevention of electric contact with the structure, and
- ensuring possibility of inspection.

All up-to-date systems of permanent anchors are based on a double corrosion protection generally consisting of the outer protection (PE sheath over the entire length) and the inner protection of individual strands with grouting compound (or with suitable grease in the free anchor length). The most important requirement is a waterproof plastic (hard PE) protective sheath preventing water to enter the anchor. At the same time the waterproof protective sheath ensures protection from stray currents.

2.2.5.6.2 Basic Materials

Basic materials for anchoring are special steels, glass fibres, and other bearing materials.

For strengthening in the construction of supporting and retaining structures, foundations, and tunnels in non-cohesive soils, soil anchors can be used. In particular steel grouting anchors are in question, which can be

- steel expansion anchors,
- steel frictional anchors, or
- steel alluvial anchors,

each type also equipped with an anchor head.

For anchoring in predominantly uniform rocks special rock anchors can be used, which, by means of cement mortar or synthetic resin mortar, can transfer the anchor force into the rock.

The types of steel anchors and anchor heads are specified with regard to the required strength at failure. The following anchors are particularly used:

- temporary and permanent ground anchors of resistance of 250 kN, 350 kN, 500 kN, and above 500 kN;
- expansion ground anchors of resistance of 150 kN and 250 kN;
- alluvial anchors of resistance 60 kN;
- frictional anchors:
  - without prestressing, of resistance 150 kN, 250 kN, and 350 kN
  - with prestressing, of resistance 250 kN, 350 kN, 500 kN, and above 500 kN.

Anchor heads, used particularly in anchoring in non-cohesive materials, shall ensure bearing capacity of 400 kN to 1,000 kN.

The contractor is free to propose other types of anchors and anchor heads as well, provided that they comply with the design provisions, that he has previously demonstrated suitability of such materials to the foreseen purpose of use, and that the engineer approves them.

2.2.5.6.3 Quality of Materials

Specific properties of steel for anchoring in non-cohesive soils and rocks shall generally be provided by the design. In case the design specifies only conditions to which the steel or the anchors will be exposed, the contractor shall submit to the engineer a list of all materials he intends to introduce, as well as adequate evidence on their conformity.

2.2.5.6.3.1 Permanent (Prestressed) Ground Anchors

The quality of permanent (prestressed) ground anchors depends on the quality of

- the material of which the components of permanent anchors are made, and
- the compound for grouting prestressed ground anchors.

On the basis of the selected methods the contractor shall acquire a certificate of the material conformity. Prior to commencement of the works, the contractor shall submit to the engineer a detailed method statement, which shall also include the following:

- a conformity certificate for the permanent ground anchor,

- conformity certificates or declarations by producers and certificates for materials, industrial products, and semi-products, and
- a programme of the average testing frequency within the scope of the internal (production) control.

Certificates of conformity of domestic and imported materials and products shall be issued by an authorized institution on the basis of appropriate documents and essential characteristics obtained by individual tests.

All certificates of conformity and attestations shall be based on assessments in accordance with the following criteria of suitability and testing methods:

- for grouting compounds: EN 445, EN 446, and EN 447
- for protective grease: EN 1537
- for polyethylene: DIN 8074, DIN 8075, and EN 1537

2.2.5.6.3.1.1 Steel Components of Permanent Ground Anchors

For strands, bearing plates, anchor heads, and wedges being constituent parts of permanent ground anchors, the contractor shall submit adequate certificates.

From coils, of which the contractor produces permanent ground anchors, specimens from individual batches shall be taken for the preliminary control of strands as provided in section 2.2.5.2.6 of these technical conditions. Testing of bearing plates, anchor heads, and wedges shall be carried out to the extent, which is, within the programme of the average testing frequency, foreseen for the approved prestressing system of the permanent ground anchors.

In case the producer of ground anchors purchases strands from another producer, and the strands are already formed in the corresponding fixed and free anchor length, then he shall, for each batch and coil, manufacture three anchors with a free length longer by 1 m. The performer of the testing control takes specimens from three free lengths of strands. When the producer, however, does not supply anchors with a longer free part, which would be intended to perform the control, specimens of strands shall be destructively taken from the finished anchors.

The producer of permanent ground anchors is obliged to enable the inspection of degreasing of the anchor fixed length and of greasing of the anchor free length.

2.2.5.6.3.1.2 Polyethylene Sheaths and Trumpets

Polyethylene sheaths and trumpets to be used for the production of permanent ground anchors shall be resistant to ultraviolet rays during storing, transportation, and installation. During the entire service life of permanent ground anchors however, polyethylene sheaths and trumpets shall be homogeneous, watertight, and resistant to ageing.

Specimens of polyethylene sheathing and trumpets for testing shall be taken upon delivery. For each profile of a sheath from one batch, four specimens each measuring 1 m in length shall be taken to perform the tests. In case polyethylene sheaths and trumpets from different batches are delivered simultaneously, the number of test specimens shall be specified by the engineer or by an authorized institution in agreement with the engineer.

Circumferential (outer) smooth polyethylene sheaths shall, with regard to the dimensions (diameter and wall thickness) as well as to the material properties, comply with the requirements for PEHD sheaths of type S 10, all in accordance with the DIN 8074 and DIN 8075. The minimum wall thickness of corrugated polyethylene sheaths shall amount to 2 mm.

Tests indicated in Table 5.23 shall be performed on specimens from the same batch in both smooth and corrugated polyethylene sheaths.

The minimum wall thickness of smooth PE sheaths (for strands in the anchor free length) shall amount to 1 mm.

The documents of the internal (production) control of materials built-in shall be so organized as to allow perfect traceability. For each supplied permanent ground anchor the information on batch numbers of both smooth and corrugated polyethylene sheathing and trumpets shall be evident.

Table 5.23: Requirements for polyethylene sheaths and trumpets

Material property	Required value	Test method
- density	≥ 0.95 kg/m^3	ISO 1183, method A
- yielding point	≥ 18 MPa	ISO 527, specimen type 1 B
- hardness Shore D	≥ 50	ISO 868
- resistance to hydrostatic pressure	without any damage to or major deformation of sheath	EN 921

2.2.5.6.3.1.3 Protective Grease

Upon the first delivery of protective grease the contractor shall perform the tests indicated in Table 5.24.

Upon each delivery of grease the supplier shall submit a factory certificate. In case the contractor permanently uses the same grease of the same supplier, all the characteristics are verified upon the first delivery only, whereas upon the subsequent ones the IR spectrum is checked only. If the latter does not comply with the spectrum established during the first testing, all the tests indicated in Table 5.24 shall be carried out. As the test results refer to the delivered amount, the contractor shall keep a record of the consumption of the protective grease for individual groups of permanent ground anchors on structures.

In case of negative results the contractor must not place the delivered amount of protective grease within the scope of the contractual execution of permanent anchoring. He shall explain in writing the further procedures of how to handle with the grease of unsuitable quality.

Table 5.24: Requirements for protective grease

Material property	Required value	Test method
- water absorption	≤ 2 %	DIN 53483
- softening point	≥ 60 °C	DIN ISO 2176
- saponification	≤ 5 mg KOH/gm	DIN 53401
- penetration	≤ 2 mm	ISO 2137
- loss due to evaporation	≤ 0.5 % by mass	DIN 58397
- IR spectrum	-	DIN 51820
- chloride content	≤ 5 ppm	ASTM D512
- nitrate content	≤ 5 ppm	ASTM D992
- resistance to oxidation	100 hours: loss ≤ 70 kPa 400 hours: loss ≤ 140 kPa 1,000 hours: loss ≤ 210 kPa visual assessment	DIN 51808
- corrosion resistance at 100 % relative humidity		ASTM D-1743 (ASTM B-117*)

** testing of corrosion resistance in salt chamber according to ASTM B-117 shall only be carried out in case that the protection of ground anchors in maritime atmosphere is foreseen*

2.2.5.6.3.1.4 Grouting for Grouting Prestressed Ground Anchors

The certification of conformity and the control of quality of anchor grouting compounds shall be carried out in accordance with section 2.2.5.7.3 of these technical conditions.

2.2.5.6.3.2 Testing the Components of Completed Ground Anchors

Where doubtable quality and/or condition of ground anchor materials (steel strands, polyethylene sheaths and trumpets, joints between free and fixed anchor length, arrangement of inner spacers, etc.) occurs during installation or testing of anchors, certain number of anchors shall be randomly selected as required by an authorized institution or by the engineer. From these anchors specimens shall be destructively taken to test the material quality.

2.2.5.6.3.3 Certification of Conformity of Permanent Ground Anchors

A certificate of conformity of a permanent ground anchor shall be issued by an authorized institution on the basis of

- ascertainment upon reviewing the documents related to the production of a permanent ground anchor,
- ascertainment upon reviewing the documents related to the quality of materials and semi-products built-in into a permanent ground anchor,
- presence at production plant during assembling a permanent ground anchor, and
- installation of anchors on test area to be provided by the anchor producer.

Technical documents to be provided by the producer of permanent ground anchors shall include the following:

- a technical description of components of a permanent ground anchor, as well as of their technical characteristics,
- detailed drawings of anchors including all alternatives of execution,
- a method statement for production, transportation, storing, and installation of permanent ground anchors,
- an approval for use of the prestressing system,
- certificates of calibration of hydraulic stressing jack, of dynamometer, and electrical resistance RI and RII measuring instruments to be used during testing the anchors
- certificates of declarations of conformity for all materials and semi-products built-in into the permanent ground anchors, as well as of conformity of the grouting compound composition.

The quality conditions indicated above shall also apply as appropriate to all other materials, which might be proposed or used for the anchoring works.

2.2.5.6.4 Method of Execution

2.2.5.6.4.1.1 General

Execution of permanent ground anchors shall be in full compliance with technical documents and procedures, on the basis of which the conformity certificate has been issued. When the producer of ground anchors intends, for the reasons of technological development, intends to modify certain details or individual procedures, or a necessity of installing new/modified elements arises, then he shall obtain appropriate approvals by the designer, the authorized third party institution, and the engineer.

Formation of steel wires, bars, and strands for ground anchors, as well as anchor arrangement and eventually required coupling and protection of anchors shall be, as a rule, specified in the design.

Drilling boreholes for ground anchors shall be carried out according to the method, which complies with the material (in dry, by blowing away, by washing out), all in design direction and dimensions. Here, the results established upon testing the anchors with the test loading up to failure, i.e. drawing out of the fixed anchor length. The load at failure shall be correspondingly greater than the tensile force. When, during the test, the foreseen bearing capacity (resistance) has not been achieved, the anchor characteristics shall be modified.

The conditions of anchoring shall be defined in detail in the design. Where the contractor intends to adopt a different way of anchoring compared to that specified by the design, then he shall acquire approvals by both designer and engineer.

Both size and thickness of anchor plates, as well as properties of nuts, bolts, and washers shall be adapted to the grade of the steel used, and to the anchor resistance (bearing capacity).

Anchors, anchor heads with bearings, all the accessories, and steel coupling elements shall be adequately protected from corrosion.

Anchors shall be stressed to the foreseen load as soon as possible. If necessary, the contractor shall also carry out an additional stressing of anchors. Therefore, the anchor heads shall be so built-in as to allow subsequent checking the anchor force and executing additional stressing if required.

Where special protection of anchors from environmental impacts is foreseen by the design, the appropriate method of protection shall be described in detail.

The aforementioned conditions for steel anchoring materials apply as appropriate to other materials such as anchors of glass fibres and synthetic resins as well.

2.2.5.6.4.1.2 Permanent (Prestressed) Ground Anchors

2.2.5.6.4.1.2.1 Execution

The execution of a complete ground anchor consists of four principal operations:

- drilling of a borehole,
- assembling and inserting of an anchor,
- grouting,
- stressing, and
- measurements and monitoring during installation.

2.2.5.6.4.1.2.1.1 Drilling Boreholes

The borehole drilling method shall comply with the type of the ground and the required borehole diameter. During the drilling works it is obligatory to keep an adequate record. After completion of drilling the boreholes shall be protected from eventual entry of foreign materials. In soils containing clay as well as in soils and rocks subjected to rapid weathering the anchors shall be immediately inserted into boreholes and grouted. Water-tightness of boreholes in rock shall be verified. Eventual consolidation grouting or other suitable measures shall be foreseen.

In sandy-gravel materials where the boreholes are not stable drilling shall be carried through using protective pipes enabling the installation of anchors. These pipes are pulled out from the borehole simultaneously with grouting.

The position, inclination and length of the boreholes shall be checked during drilling works.

2.2.5.6.4.1.2.2 Assembling and Installation of Anchors

Ground anchors shall be assembled in factory conditions. Transportation, storing and installation of anchors shall be organized in such a way that the function and efficiency of the corrosion protection are not jeopardized.

Anchors can be inserted manually as well as by means of different cranes or special devices.

During production, transportation, storing, and installation it is obligatory to prevent local corrosion of still not grouted anchors. Temporary protection such as wrapping in oiled paper, transport in well ventilated wooden boxes) is quite understandable. From the examples of damages it is evident that formation of condensed water shall be prevented. Prestressing steel shall not be exposed to temperature variations (sun).

Prestressing steel is particularly endangered by surplus (residual) water from the cement concrete, which is located in the protective sheath and contains chlorides and sulphates. Therefore such water shall be removed by blowing away after casting. In general one shall consider that prestressing steel in protective sheathing shall be non-grouted as shortly as possible, so that the threat due to condensed water is reduced to the smallest extent possible.

2.2.5.6.4.1.2.3 Grouting

Grouting is an operation particularly ensuring the anchor load transfer from the fixed anchor length to the ground as well as the protection of anchors from corrosion.

Grouting pressures and quantities shall be adjusted or selected in compliance with the geometrical, geological and hydro-geological conditions as well as with the type and composition of an anchor. Grouting shall start at the lower end of the anchor whereas an air outlet and an outflow of eventual water from the borehole shall be ensured at the opposite end.

The grouting mixture consists particularly of pure Portland cement, additives to reduce the water content, and water. The grouting mixture shall comply with the provisions of section 2.2.5.6.3 of these technical conditions.

To obtain a correct viscosity of the colloidal mixture highly turbulent mixers are used. The grouting mixture is preserved in special tanks where continuous stirring and pumping is granted. To achieve high pressures, piston pumps shall be employed.

The grouting mixture quality required to create the fixed anchor length shall be adjusted to the capability of the ground to grouting.

When instead of a cement suspension some other material is used for grouting, its suitability with regard to application, corrosion protection and durability as well as to mechanical properties shall be demonstrated.

In general, grouting is carried through in two stages. First the fixed anchor length is grouted; then, after completion of stressing, the free anchor length is grouted.

Grouting is one of the most important procedures of the anchor execution. Therefore a record of all the procedures adopted and the composition of grouting compound shall be kept.

2.2.5.6.4.1.2.4 Stressing

By stressing the high-performance steel an anchor attains its intended function.

An anchor may be stressed when the grouting compound of the primary grouting has reached the prescribed strength. The period after which this can be performed is determined on the basis of tests or in accordance with the manufacturer of the grouting mixture.

Prior to commencement of the stressing, the site manager shall appoint a responsible person to manage the entire stressing procedure. Stressing shall be consistently carried out in compliance with the written procedure of stressing to be elaborated by the designing engineer.

Stressing shall be executed in the spirit of the anchor investigation and of the stressing test. The first serves for the anchor dimensioning whereas the second for the assessment of the anchor resistance and for the acceptance of anchors.

2.2.5.6.5 Quality of Execution

All the materials related to anchoring shall be installed in compliance with the design and these technical conditions.

Anchors shall be placed in the centre of the borehole as accurately as possible.

Grouting of anchors shall be carried out in accordance with the provisions of section 2.2.5.7 of these technical conditions.

2.2.5.6.5.1 Technological and Economical Report

Prior to commencement of the works on the structure, the contractor shall submit to the engineer for approval a technological and economical report as well as all the required evidence of the origin and quality of all the materials necessary to execute the foreseen anchoring as directed by the design and these technical conditions. The report shall include the following mandatory constituent parts:

- a general information on the structure
- a valid certificate of conformity for permanent ground anchors
- a programme of frequency of internal and external control testing
- a work programme
- a programme of monitoring the anchors after installation.

2.2.5.6.5.1.1 General Information on Structure

The structure as a whole shall be described, all the peculiarities shall be indicated, and the characteristic graphical details shall be attached.

2.2.5.6.5.1.2 Conformity Certificate

Valid conformity certificates for materials shall be attached. Such certificates are issued by an authorized third party institution.

2.2.5.6.5.1.3 Programme of Average Frequency of Internal and External Control Testing

A base for the control of production, transportation, storing, and installation of permanent ground anchors is a programme of average frequency of internal and external control testing, as well as the approved technical documents for the permanent ground anchors including the issued conformity certificate.

As permanent ground anchors are structural elements, which can no more be inspected after installation, the contractor shall inform the engineer and the authorized third party institution of the progress of production and installation of permanent ground anchors, including of the stressing, and shall also ensure the specified quality.

2.2.5.6.5.1.4 Work Programme

A harmonized execution of all the working stages shall be defined in the work programme, particularly the following activities:

- preparation of boreholes for anchoring, as well as
- supply,
- installation, and
- stressing of permanent ground anchors.

The contractor shall, in due time, notify the engineer of any modification of the work programme. The works must not commence until the engineer approves the modified work programme.

2.2.5.6.5.1.5 Programme of Monitoring After Anchor Installation

It shall be specified, how and when the anchor forces have to be monitored after the installation of anchors.

2.2.5.6.5.2 Anchor Installation

The following works belong the the control of execution of installation of permanent ground anchors:

- drilling boreholes
- installation and grouting
- stressing
- measurements on and monitoring of anchors during installation.

2.2.5.6.5.2.1 Drilling Boreholes

During the drilling works the contractor shall ensure a permanent professional geotechnical control and keep adequate documents for individual boreholes. All the essential geotechnical information on composition and length of the boreholes, drilling method, drilling media, amount of eventual water, caverns, modifications of drilling speed, etc. shall be evident from these documents.

Where water occurs during the drilling, hydro-geological conditions and eventual aggressiveness of the water shall be established. After completion of drilling, pressure tests shall be carried out on boreholes in permeable rock where anchor fixed lengths will be installed. All boreholes, from which more than 5 litres of water per minute is lost in a period longer than 5 minutes and at pressure of 3-4 bars, shall first be grouted and then re-drilled. Such boreholes shall be retested as well.

Suitably skilled geologist or expert in soil mechanics shall prepare a record of drilling.

During the drilling works carried out for test anchors as well as for anchors to be subjected to complete stressing tests, a client's representative shall be present. The presence of a representative of the third party external control institution during the drilling works to establish the conformity of site conditions with the design is generally defined by the programme of frequency of both internal and external testing. In exceptional cases the engineer shall bring final decision.

The contractor shall ensure the control over drilling, while the engineer shall regularly inspect actual lengths and inclination of borehole axes with regard to the anchoring block. After the anchor installation the deviation of the anchor head axis from the longitudinal axis must not be greater than 2.5°, unless provided otherwise by the design.

All eventual deviations from the design values, as well as movements of the rock behind the anchored structure shall be immediately reported to both designer and engineer, who have to take adequate steps.

2.2.5.6.5.2.2 Installation and Grouting of Anchors

All anchors delivered to the construction site shall be equipped with a control sheet where the following information is indicated:

- number of workshop order and/or anchor designation enabling traceability of the anchor production process,
- total anchor length,
- fixed anchor length and free anchor length
- date of production,
- name of the structure into which the anchor will be installed.

As soon as possbile, however not later than 12 hours after drilling, the borehole shall be cleaned and the anchor inserted. Sufficient number of labour shall participate in this work, i.e. one worker per 3-4 m of anchor.

After the grouting mix is prepared, its flowing capacity and temperature shall be checked. In case that the results are within the specified values, the contractor may commence grouting of the anchor interior and the space between the anchor and the surrounding ground. The grouting procedure shall be so carried out as to assure uniform and continuous filling the anchor interior and the void between the anchor and the ground. During primary grouting, the effective pressure of the inner part at the end of the grouted pipe at the anchor nib shall not exceed 3 bar. In case that rear water enters the borehole during the primary grouting of the external part of the anchor, the goruting procedure shall continue for such a period that the grouting mixture presses out all the water in front of it, and that the flowing capacity of the grouting compound at the outlet is approximately the same as at the inlet.

In case the anchor block is constructed after anchor installation, the perpendicularity between the strands and the steel bearing plate under the anchor head shall be controlled and ensured.

2.2.5.6.5.2.3 Stressing the Anchors

All the anchors installed shall be subjected to stressing tests as specified in these technical conditions.

Stressing shall be consistently carried out in accordance with the stressing programme prescribed by the responsible designer.

After the stressing test, a permanent ground anchor can be stressed to the lock-off load P_o and locked-off only after all the conditions indicated below are fulfilled:

- creep shall not be greater than the maximum admissible one $k \le k_{adm}$
- permanent deformation shall not exceed the admissible one $\Delta l_{bl}\ (P_p) \le \Delta l_{bl.adm}$
- specified effective anchor free length at proof load $0.9\ l_{fr} \le l_f(P_p) \le l_{fr} + 0.3\ l_v$
- corrosion protection quality shall meet the prescribed requirements (electrical resistance: $R_I \ge 0.1\ M\Omega$ or $R_{II} \ge 100\ \Omega$).

In cases where one or more conditions indicated above for the particular permanent ground anchor is not fulfilled, such an anchor must not be definitively stressed and locked-off, but the responsible designer shall be immediately advised to decide upon the further procedure.

Immediately after completion of stressing and locking-off the anchor head shall be protected. Where it is not feasible to execute the definitive protection of the anchorage as per the approved detail, the contractor shall cover the strands and steel components of the anchorage with protective grease and perform a provisional protection in such a way as to prevent the rear water and/or the precipitation water to penetrate into the interior of the anchorage area. A vapour permeable foil can also be used, however for the protection of short duration only.

2.2.5.6.5.2.4 Measurements and Monitoring

During the anchoring works measurements of displacements and monitoring of the structure shall be carried out according to the programme and the work progress.

In case of special circumstances during the construction period the engineer has the right to modify or supplement the foreseen extent and frequency of measurements and monitoring.

The contractor is obliged to submit interim reports on measurements and monitoring of the anchored structure or its members to both responsible designer and the engineer.

An authorized third party institution shall perform control measurements on the anchored structure in compliance with the programme of frequency of both internal and external control testing. The engineer has the right to order an increased extent of the measurements.

2.2.5.6.5.3 Stressing Tests

During testing the anchors as well as during the execution of the complete stressing tests, deformations or displacements of the anchored structure in the stressing area shall be monitored. If the measured values obtained by the complete stressing tests exceed 15 mm, deformations or displacements shall be measured during the execution of simple stressing tests as well.

As soon as the specified minimum strength of the primary grouting compound is achieved, anchors can be subjected to the stressing test and locked-off. The time period after expiry of which this can be performed shall be specified on the basis of the tests or of the instructions issued by the producer of the grouting mix.

2.2.5.6.5.3.1 Anchor Tests

The SIA V 1991 prescribes the execution of the anchor tests, which shall be carried out in advance or at least at the beginning of the anchoring works.

Test anchors differ from other anchors in the fact that they are equipped with an additional strand. For permanent ground anchors the number of the test anchors shall amount to at least 2% of the total number of the anchors foreseen, however not less than 3. The responsible designer shall specify the number, position, and dimensions of the test anchors.

Anchor tests need exceptionally not be repated, if results of testing similar anchors in similar geological – soil mechanical conditions exist, on the basis of which the parameters for the execution of the stressing tests are unambiguously known. As the results of the anchor tests are of extreme importance, testing may only be omitted if agreed by both responsible designer and engineer.

The contractor shall organize a protection from weather conditions (excessive temperature impacrs on measurements, precipitations) at locations of test anchors prior to commencement of the test.

All the anchor tests shall be obligatorily attended by the representatives of both responsible designer and client. The performer of the anchor test shall submit, not later than within two days after the executed test, to both designer and engineer a copy of the protocol on the anchor test. On the basis of the results obtained by anchor tests carried out up to anchor failure, the responsible designer verifies the existing anchor design.

On the basis of the results of the anchor tests the responsible deisgner shall specify the following:

- proof loads P_p for stressing tests, lock-off loads P_o, as well as minimum required and maximum admissible anchor forces, which may act on the anchored structure in the service life,
- stressing programme and criteria for the execution of stressing tests,
- in agreement with the contractor, the required fixed anchor lengts, the amount of the grouting mix, and eventual measures related to additional grouting, and
- further procedures in case of deviations from the criteria prescribed for the tests.

2.2.5.6.5.3.2 Stressing Tests

Stressing tests are intended for the assessment of bearing capacity (resistance) and for taking-over the structural anchors. This shall be based on the results of the preliminary anchor testing. In case three-stage complete stressing tests do not comply with the results of the anchor tests as expected, additional anchor tests shall be directed. The programme of the stressing tests as well as of the anchor tests shall be adjusted to the geological – soil mechanical site conditions.

Any prestressed permanent ground anchors shall be checked by suitable stressing test. For each group of anchors, complete tests shall be first carried out on at least 10% of the total number of anchors (however not less than 3). Then, simple stressing tests may be performed on the remaining structural anchors. Where a retaining structure is executed by sectional excavations, that rule shall apply as appropriate at the level of each individual wall section (segment).

If the results of the complete stressing tests show that one cannot expect reliable results from single-stage stressing tests with the foreseen creep criteria and minimum observation times, it is mandatory to extend the minimum observation times or even to direct many-stage stressing tests for all anchors.

The evaluated results of the complete and the simple stressing tests shall be submitted to both responsible designer and engineer.

2.2.5.6.5.4 Corrosion Protection of Anchors

2.2.5.6.5.4.1 General

Any permanent ground anchor shall be completely protected from corrosion as follows:

- prestressed tendons over their entire length shall be protected by full and permanent isolation from the surrounding rock/soil, and against penetration of aggressive medium – water,
- by electric insulation placed between the anchor head and the structure, thus preventing electric contact between the anchor and the anchored structure,

- anchor heads of permanent anchors shall be protected from external actions by means of corrosion protected caps designed to prevent penetration of water into the tendon area.

Corrosion protection of prestressing steel and steel components of anchors shall be durable and in functional over the entire service life of the structure. Steel elements, which are inaccessible after production of anchors, shall be protected from corrosion for the entire anchor service life.

Corrosion shall be prevented on non-stressed and non-grouted tendons of permanent ground anchors. Therefore the transportation and storing shall be such as to prevent occurrence of condensed moisture thus the temperature oscillations shall not be excessive. During the transportation with lorries the load shall be covered with a wax cloth, and mechanical damage to the anchors shall be prevented. In case that anchors are transported simultaneously with sharp-edged metal elements, the latter shall be kept in wooden boxes.

The contractor shall supply completed permanent ground anchors to the construction site in accordance with the work progress. Where the contractor is not able to ensure storing the anchors in a storehouse, the period of storing shall be generally limited to:

- maximum 7 days in case of storing the anchors under a jutting roof, which offers a minimum mechanical protection as well as protection from sun and weather actions;
- maximum 3 days, if the anchors are covered with a vapour permeable foil on a raised wooden podium placed at an inclination, and if the anchors are orientated with their opened – upper part downwards in the slope direction.

2.2.5.6.5.4.2 Testing the Corrosion Protection

According to the recommendation SIA V 1991 the electric insulation between the anchor head and the structure as well as between the tendon and the ground shall be checked for each installed anchor by measuring electric resistance RI (with 500 V voltage and measurement range of >10 kΩ). During the measurement the anchor shall be attached to the positive, while the earthing element to the negative pole of the electric circuit.

The contractor or his subcontractor specialized for the execution of such measurements and having suitable equipment at his disposal, shall, within the scope of the internal control, perform measurements of insulation resistance RI on all the structural anchors

- after inserting the anchor into the borehole,
- before and after execution of the stressing test,
- after completed stressing (locking-off), and
- not before 7 days after anchor locking-off.

Within three days after the execution the performer of the internal control shall submit to both responsible designer and engineer the results of electrical resistance measurements. The corrosion protection can be considered as perfect, if a definitively grouted and stressed permanent ground anchor shows the electrical resistance of RI ≥ 0.1 MΩ. To a definitive evaluation of the corrosion protection performance, the last two of the aforementioned measurements are relevant. Therefore, the engineer shall be present during the execution of these measurements, and he shall finally take-over the particular anchor as well.

According to his own judgement the responsible designer may tolerate certain portion of anchors of RI < 0.1 MΩ. The admissible percentage of such anchors shall be indicated in the design and shall in no way exceed 10% of the number of all the anchors installed. The anchors of insufficient electric insulation resistance RI shall be uniformly distributed over the anchored structure, and it shall be demonstrated by measuring the earthing resistance RII that the anchor head is not in electric contact with the structural (anchor block) reinforcement. According to SIA V 191 such anchors shall have the earthing resistance RII ≥ 100 Ω. If the results of measurements show that an electric contact between the anchor head and the structural reinforcement is established, repair measures in the sense of interrupting the contact shall be taken prior to placing the protective caps.

External control (testing) measurements of electric resistance on 20% of all the installed anchors (or at least on three anchors) shall be carried out by a third party institution authorized by the client. Where a larger number of anchors are foreseen on certain structure, one third of those anchors shall be so selected for the control measurements as to execute the measurements on a group of anchors at the beginning, in the middle, and at the end of the anchor installation and stressing. In case that a minor number of anchors is foreseen for a structure, the number of anchors to be controlled shall be selected with regard to the number of anchors, which can be stressed in one working day. Within three days after the executed measurements the contractor shall submit the results of the testing measurements to both engineer and responsible designer.

The following activities shall be performed to enable control measurements according to the described method:

- the contractor shall inform both responsible designer and engineer of the commencement of construction, and shall submit the plan of ground anchors including a list indicating which anchors are foreseen for testing, which for stressing tests, and which are foreseen as control anchors. On the basis of this information the engineer works out a skeleton programme of external control measurements of the electrical resistance;
- the contractor shall inform both responsible designer and engineer at least three day in advance of the commencement of each working stage for anchors, which are foreseen for the execution of measurements of the electrical resistance (anchor installation, grouting, stressing).

2.2.5.6.5.5 Monitoring of Anchors After Installation

For each anchored structure the responsible designer shall prepare the following documents being constituent parts of the design:

- monitoring programme, and
- maintenance plan.

2.2.5.6.5.5.1 Monitoring Programme

The programme of monitoring the permanent ground anchors shall include the following:

- number and locations of measuring and control anchors to be determined for permanent monitoring (at least 5% of the total number of anchors or at least three anchors per anchored structure)
- execution of zero-measurements prior to commencement of the works on the structure
- type, number, and position of anchors equipped with dynamometers, instruments to measure displacements and deformations of rock/soil and structure, as well as devices for measuring water levels and pore pressures; the specified accuracies of measurements shall also be indicated.
- extent and sequence of measurements during construction and in the service life.

For all the measurements, limiting values shall be specified in the monitoring programme; in addition, measures to be taken in case that the limiting values are exceeded shall be indicated as well, which particularly applies to the following:

- maximum admissible and minimum required anchor forces in the service life of the structure,
- admissible displacements and deformations of the structure or its members, and
- admissible water levels and pore pressures respectively (as necessary).

During the execution of anchoring, monitoring and measurements of structural displacements shall be carried out according to the programme of measurements with regard to the work progress and circumstances. In case of specific circumstances or special conditions, which might occur during the construction, the monitoring extent and frequency can also be increased. The contractor shall submit periodical monitoring reports to the engineer and the authorized third party institution. Measurements of displacement of the anchored structure in compliance with the approved programme of average frequency of internal and external testing shall be carried out by the authorized third party institution as well.

2.2.5.6.5.5.2 Maintenance Plan

In the plan of maintenance of anchored structures the following shall be particularly defined:

- renewal of corrosion protection of anchorage elements, and
- maintenance of measuring instruments (according to producer's instructions).

2.2.5.6.5.6 Final Report

After completion of anchor works executed on the structure or its members the authorized third party institution shall prepare a final report on the completed anchoring of the structure. The following bases shall apply:

- declaration by the contractor, and

- technical documents consisting particularly of
  - completed cards of geotechnical anchors,
  - reports on testing the water-tightness of boreholes,
  - completed control sheets,
  - protocols of testing the anchors and of stressing tests,
  - reports of testing steel and PE components of anchors, protective grease, and grouting mix, and
  - data provided by the own control of the anchor works.

In case of comprehensive anchoring or significant anchored structures the performer of the external quality control shall, in agreement with the engineer, prepare interim reports on the executed anchoring by individual structural members. In the final report he shall summarize the most important results and conclusions of the interim reports.

2.2.5.6.6 Quality Control of Execution

Prior to commencement of the anchor installation, the engineer shall check the design, arrangement, jointing, and protection of anchors.

The surface of anchoring components shall be clean. Only partial rustiness of steel is allowed.

The contractor shall make good all deficiencies prior to continuing the works.

The extent of internal control testing of materials required for anchoring shall be adjusted to the specific conditions of anchoring as appropriate. As a rule, internal testing of the specified materials properties shall be carried out per every 100 pieces by introducing two specimens. The ratio of the testing force to the design load shall amount to

- 1.5 for permanent anchors,
- 1.25 for temporary anchors.

The extent of testing within the scope of the external control is generally at a ratio of 1:4 to the internal quality control.

2.2.5.6.7 Measurement and Take-Over of Works

2.2.5.6.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in appropriate unit measures.

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities.

2.2.5.6.7.2 Take-Over of Works

The engineer shall take-over the performed works in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. The contractor prior to continuing the works shall mend all the established deficiencies with regard to those requirements.

2.2.5.6.8 Final Account of Works

2.2.5.6.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.6.7.1 and taken-over in compliance with section 2.2.5.6.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.5.6.8.2 Deductions Due to Insufficient Quality

2.2.5.6.8.2.1 Quality of Materials

Since the adequate quality of materials for anchoring works is unambiguously specified, there shall be no deductions when accounting the executed works.

In case the contractor places such material, which does not meet the requirements indicated in 2.2.5.6.3 of these technical conditions, the engineer shall appoint the method of accounting. He has also the right to reject the entire work carried out.

2.2.5.6.8.2.2 Quality of Execution

If the contractor does not ensure the required quality of the executed anchoring works, the engineer decides on the method of accounting. He has also the right to reject the entire executed work.

2.2.5.6.9 Maintenance of Ground Anchors

In accordance with the Rulebook of detailed content of design documents, with the client's requirements, and with the behaviour of a good master, structural maintenance shall be specified in detail in the design.

In anchored structures special attention shall be paid to ground anchors. By suitable report the owner of the structure shall be informed of activities, which will come under his jurisdiction.

Both inspection plan and maintenance plan shall be worked out. In the inspection plan, type, position, and number of existing measuring instruments to control anchor forces, displacements and deformations of foundation soil and structure shall be indicated; devices to check the water level, etc. shall be included as well. The contractor shall submit a programme of measurements, which will take account the effect of possible threats to the structure.

In the maintenance plan all the activities shall be described, which are usual in these works, and, additionally, the maintenance of measuring instruments as directed by the producer, the renewal of corrosion protection of anchor heads including bearing plates, as well as the renewal of sealing rings and protective coatings on anchor caps.

2.2.5.7 GROUTING

Grouting is mostly used in different geotechnical works and structures on roads. It is aimed for improving certain materials thus increasing their load bearing capacity, and for some special measures, e.g. waterproofing, protection of steel wires and strands from corrosion, etc. All these methods and materials for grouting shall be applied in a manner as specified by the design and in accordance with these technical conditions. The contractor may propose another manner of grouting, which he shall demonstrate. The engineer shall previously approve the selection and any change relating to grouting.

2.2.5.7.1 Description

Grouting includes the supply and preparation of all the appropriate materials and the production, transport, and placing of the fresh mixture for grouting at locations specified by the design. If grouting details are not provided by the design, then they shall be proposed by the contractor and approved by the engineer.

Similar as for grouting, all work associated with pre-grouting (e.g. unstabilized or cracked rock or soil at borehole locations), or post-grouting (e.g. of steel strands, even before the mixture begins to set, because of the danger of the effect of sedimentary segregation) is defined as well.

Cement suspensions and cement mortars are mostly used as grouting compounds.

Requirements and methods of the quality control of input materials, of fresh and hardened grouting compound, and of the control upon grouting works are specified in the adopted European Norms. The requirements and methods refer to habitual grouting mixes composed of Portland cement, water, and an additive. The norms do not include any procedures related to special grouting compounds.

For grouting compounds for prestressed tendons and ground anchors the provisions of the following European Norms shall be considered:

- EN 445: Grouting Compound for Prestressed Tendons – Methods of Testing
- EN 446: Grouting Compound for Prestressed Tendons – Grouting Methods
- EN 447: Grouting Compound for Prestressed Tendons – Requirements for Habitual Grouting Compound

In addition to the requirements provided by the adopted European Norms, adequate instructions shall also be considered referring to those requirements only, which are not sufficiently precisely defined in the standards.

2.2.5.7.2 Basic Materials

Depending on the purpose of grouting, the following basic materials are used for the preparation of grouting compounds:

- cement
- water
- chemical additives.

The type of the required basic materials for the preparation of grouting mixtures shall be, as a rule, specified in the design. The contractor is however free to introduce other materials for the preparation of grouting compounds provided that he can demonstrate their suitability and that the engineer approves the use of such materials.

In view of the required properties of the grouting mixture and of the given service conditions, the engineer shall approve the composition of the grouting compound, although it has already been specified by the design. The engineer may also require a modification of the foreseen composition of the grouting mix, if the latter is better adapted to the service conditions in such a way.

2.2.5.7.3 Quality of Materials

The required properties of all basic materials for the preparation of grouting mixes shall be, as a rule, defined by the design. In case that only quality of the grouting compound is specified in the design, then the contractor shall carry out a preliminary investigation and submit the results of testing the properties of materials used.

2.2.5.7.3.1 Cement

For the preparation of grouting compound only cement of type CEM I according to the EN 197 – 1 may be used. Cement suitability shall be proven by the conformity declaration issued by the producer, and by the cement production control certificate.

Exceptionally cement with a 20 % additive of fly ash may be used, if permitted by the current national codes.

2.2.5.7.3.2 Water

For the preparation of grouting compound only water complying to the EN 1008 may be used. Drinking water from the water supply suits the mentioned standard and needs not be demonstrated as adequate.

2.2.5.7.3.3 Additive

For the preparation of grouting compound only additives complying with the provisions of the EN 934 – 4 may be used. The evidence of the product suitability is a conformity declaration issued by the producer, and the production control certificate.

2.2.5.7.3.4 Properties of Grouting Compound

Where the flowing capacity of a grouting compound foreseen for ground anchors is in question, then the requirements immediately after mixing shall only be taken into consideration.

2.2.5.7.4 Method of Execution

The standard EN 446 specifies the procedures of grouting with habitual grouting compounds. The standard contains the requirements relating to preliminary testing to verify the suitability, and the methods of the quality control.

In case that the contractor produces a grouting mix for the first time, or he has changed machines and procedures, the engineer shall approve the contractor’s capability. The engineer has also the right to request trial grouting, which shall be carried out on a sample form of the structure or on a test area.

2.2.5.7.4.1 Winning the Materials

The performer of grouting works shall carry out a laboratory control of the input materials, as well as a test of grouting compound, all in compliance with the procedures indicated in the standard EN 445.

An authorized third party institution shall approve the results of laboratory testing. This shall be done on the basis of the submitted laboratory testing reports. The institution shall also prepare a report on the evaluation of the preliminary testing.

In due time prior to commencement of using the grouting compound, the contractor shall report to the engineer the origin of all the basic materials he intends to use for the preparation of such compound. At the same time, the contractor shall also submit to the engineer all necessary evidence of the quality of these materials.

2.2.5.7.4.2 Depositing the Materials

As a rule, the material quantities required for grouting (particularly of the Portland cement) shall be stored and tested in such a way that the properties of the materials and of the grouting mixture are known in advance.

2.2.5.7.4.3 Preparation of Boreholes

The method of preparing boreholes shall be specified in the design. Diameter, length, and direction of boreholes, as well as the borehole spacing shall be defined as a rule.

The contractor may commence grouting work, after the engineer has taken-over the boreholes and approves the work.

2.2.5.7.4.4 Production of Grouting Compounds

The production of grouting compounds shal be mechanical and without interruptions.

Dosing devices shall ensure suitable quantities of all the components in the mixture by mass, as provided by the preliminary composition.

Adequate water amount shall be added to the dry mix for preparation of grouting suspension or mortar, depending on both grouting conditions and equipment.

2.2.5.7.4.5 Application of Grouting Compounds

If necessary, prior to grouting, the borehole or pipe is washed (soaked) with water and blown out with air.

For grouting, adapted pumps are necessary, operating at suitable pressure and equipped with a safety valve, enabling uniform entering the grouting compound into the borehole or pipe without any interruption.

Pressing-in the grouting compound may be interrupted only after an appropriate mixture flows from the borehole.

Grouting of prestressed tendons and anchors shall be carried through at temperatures indicated in Table 5.25 (standard EN 446, section 7.5). For the grouting of permanent ground anchors, requirements relating to the air and grouting compound temperature shall only be considered. Eventual special conditions for the application of grouting compounds at high and low temperatures shall be specified in the design.

Table 5.25: Temperature conditions relating to the execution of grouting

Temperature [°C]	Air	Structure	Grouting compound
- minimum	5	5	10
- maximum	30	25	25

2.2.5.7.5 Quality of Execution

In due time prior to grouting works the contractor shall submit to the engineer the results of the preliminary investigation of the grouting compound, including all the required data as specified in these technical conditions.

If requested by the engineer, the contractor shall demonstrate by preliminary trial grouting that he is capable to ensure the grouting characteristics provided by the design.

The required properties of the grouting compound shall be specified in the design. Informative properties of cement mortar for grouting pipes with strands in prestressed cement concrete structures are as follows:

- flowing capacity of fresh cement mortar
- change of volume
- separation of water
- compressive strength
- resistance to freezing and thawing actions.

2.2.5.7.5.1 Flowing Capacity of Fresh Cement Mortar

The flow rate of the cement mortar shall meet the requirements indicated in Table 5.26.

Testing of flow rate of grouting compound shall be carried out according to the metal funnel method specified in the EN 445.

Table 5.26: Requirements for the flow rate of grouting compound

Test method	Flow rate of grouting compound		
	after mixing	30 minutes after mixing and after completion of grouting respectively	at the exit from the grouting hose
»with funnel«	17 s ≤ T ≤ 23 s	≤ 23 s	≥ 10s

2.2.5.7.5.2 Change of Volume

Volume decrease due to sedimentary segregation of fresh mortar and due to hydration shrinking of the hardening mortar shall generally not be greater than 1 % by volume, while the increase shall not be greater than 5 % by volume. A moderate swelling of the cement mortar is wished for (2 to 4 % by volume).

The test of the change of volume shall be carried out according to the can method. The method is defined in the EN 445. To the measurement a method with a plate placed onto the upper edge of the can shall be applied.

2.2.5.7.5.3 Separation of Water

The quantity of separated water measured 3 hours after mixing shall not be greater than 2 % by volume.

The test of the water separation shall be executed in accordance with the method described in the EN 445.

2.2.5.7.5.4 Compressive Strength

The compressive strength of the cement mortar determined on three cylinders shall amount to:

- at least 27 MN/m^2 after 7 days
- at least 30 MN/m^2 after 28 days

unless specified otherwise in the design.

Compressive strength shall be tested on cylinders. The testing method is indicated in the EN 445. Each specimen shall be so prepared for testing as to take account the requirements provided by the standard EN 12390-1. The strength test shall be carried out in compliance with the method defined in the standards ISO 4012 and EN 12390 - 3.

2.2.5.7.5.5 Resistance to Freezing and Thawing Actions

The resistance of cement mortar is ensured, when, after a single freezing to -20°C, its volume does not increase.

2.2.5.7.6 Quality Control of Execution

2.2.5.7.6.1 Internal Control

The internal control carried out by the grouting contractor shall ensure the compliance of the grouting compound with the requirements provided by the standard EN 447.

Prior to and during grouting works on the structure the following properties shall be tested:

- test of the system 24 hours before grouting
- flow rate: each mixture measured at the mixer outlet and at the grouted pipe outlet
- separation of water: once a day from the mixer, once a day at the grouted pipe outlet
- volume change: once a day on a specimen used to test the compressive strength
- compressive strength: once a day, the grouting mixture specimens shall be taken at the grouted pipe outlet, or at least three times per structure.

The test of flow rate of grouting compounds for ground anchors shall be executed on each mixture taken from the mixer.

In addition to the control of input materials (i.e. cement and additive), the internal control also includes a review of the documents upon delivery of the material, as well as checking the cement supplies according to current regulation.

The record of the performed grouting and of the internal control shall include, in addition to the test results, the information on the input materials, composition, site conditions, temperature of the compound, the type of machines, and the data related to the grouted element. Daily records are required.

The foreseen number of days of grouting is information to be entered by the contractor into the column "internal control" of the programme of frequency of both internal and external control testing.

2.2.5.7.6.2 External Control

An authorized third party institution shall perform the external control in compliance with the programme of frequency of both internal and external control, i.e.:

- for permanent ground anchors at least once per structure, however not less than once per 50 permanent ground anchors,
- for prestressed tendons on bridges nor less than once per structure, however not less than once a month in case of works of long duration.

External control comprises the following:

- control of used materials and compositions, which shall fully correspond to the composition determined by preliminary testing,
- testing the flow rate, volume change, separation of water, and compressive strength on specimens taken by the representative of the third party institution to carry out the tests on his own apparatus,
- control of conditions during grouting works.

After completion of the works and handing-over the documents relating to the internal control, the authorized third party institution shall prepare a final report on the quality control carried out on the grouting mixture. The engineer shall check and approve the personnel and equipment, as well as control the installation of grouting devices. In special cases he has the right to request additional tests.

2.2.5.7.7 Measurement and Take-Over of Works

2.2.5.7.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in tons of the grouting compound used.

2.2.5.7.7.2 Take-Over of Works

The engineer shall take-over the performed grouting works in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. The contractor prior to continuing the works shall mend all the established deficiencies with regard to those requirements.

2.2.5.7.8 Final Account of Works

2.2.5.7.8.1 General

The executed works shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.7.7.1 and taken-over in compliance with section 2.2.5.7.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the works. The contractor has no right to claim any extra payment.

2.2.5.7.8.2 Deductions Due to Insufficient Quality

2.2.5.7.8.2.1 Quality of Materials

Since the adequate quality of materials for grouting compounds is unambiguously specified, there shall be no deductions when accounting the executed works.

In case the contractor places such material, which does not meet the requirements indicated in 2.2.5.7.3 of these technical conditions, the engineer shall appoint the method of accounting. He has also the right to reject the entire work carried out.

2.2.5.7.8.2.2 Quality of Execution

If the contractor does not ensure the required quality of the executed grouting works as provided by the section 2.2.5.7.5, the engineer decides on the method of accounting.

Since the adequate quality of execution is unambiguously specified, there shall be no deductions when accounting the executed works.

2.2.5.8 METALWORK

Special technical conditions for metalwork deal with metals required to arrange individual details on road bridges and other structures.

Metalwork shall be carried out in dimensions and manner as specified in detail in the design and in compliance with these technical conditions.

2.2.5.8.1 Description

Metalwork includes supply of all necessary materials, manufacture of adequate structural components and their preparation for installation as specified by the design.

The following belongs to the metalwork associated to construction of road bridges and other structures:

- guard rails,
- expansion joints,
- bearings, and
- edges.

The way of execution of individual structural member shall be specified in detail in the design; the same also applies to the method of preparation for the installation. Suitable bases for this purpose are defined in special technical conditions for details on bridges and other road structures.

Guard rails on road bridges can be made of

- pipes of circular or rectangular cross-section, and
- vertical or horizontal fillings, exceptionally closed as well.

Steel expansion joints can be executed

- without clearance,
- of T sections anchored in the front face of open or sealed clearance,
- of special structure consisting of combs or sliding sheet metal, and
- of chained steel plates on rollers.

Bridge bearings can be particularly of the following types:

- allowing no movement (tangential, ball-jointed, pot, roller, hinge bearing),
- allowing movement in one direction (ball-jointed, one-roller or two-roller bearing),
- allowing movement in more directions (tangential, ball-jointed, pot, elastomer bearing),
- tensile-compressive, and
- to take horizontal forces.

Edges or end profiles (with anchors and reinforcements) can be made of adequate L, T, or half I sections, or of flat steel.

2.2.5.8.2 Basic Materials

Basic material for metalwork is particularly adequate steel. The steel type shall be adjusted to the purpose of use. The same also applies to the types of other basic metal materials to be used for certain metalwork (e.g. aluminium for railings), and of synthetic material to be used together with the basic metal materials.

2.2.5.8.3 Quality of Materials

The quality of all the materials for the metalwork, used for the production of individual road bridge components, shall comply with the provisions of current regulation, and shall meet the requirements indicated in the design, and shall be in accordance with the purpose of use.

For the metalwork it is obligatory to introduce structural steel of adequate toughness (impact strength) and of good weldability. Steels complying with the EN 10025 are particularly suitable.

All bolts required for individual metalwork to arrange bridge details shall be made of stainless steel.

To relieve residual stresses due to welding, all the elements having been subjected to excessive welding shall be annealed.

When only conditions to which the materials (steel, aluminium, synthetic materials) in different structural members will be exposed are indicated in the design, the contractor shall submit to the engineer a list of all the materials he intends to use, as well as adequate documents proving that the materials suit the foreseen purpose. Such evidence shall be issued by an authorized third party institution.

2.2.5.8.4 Method of Execution

The production of individual elements to arrange the details on road bridges and other structures shall be perfectly harmonized with the design provisions. The same also applies to the required additional preparation of those elements for the installation in the structure.

All the necessary additional construction work during installation, which surpasses the metalwork, shall be carried out by the bridge contractor, provided that it is in accordance with his work programme approved by the engineer.

When the contractor intends to execute the metalwork in a different way than it is foreseen by the design, he shall demonstrate that such a manner of execution is suitable, and shall obtain an approval by the engineer. The contractor must not perform the metalwork differently than stated in the design until he receives approval from the engineer.

If the design foresees special protection of the used metal from environmental impacts (corrosion), then the method of the protection shall be described in detail.

2.2.5.8.5 Quality of Execution

The contractor shall, upon delivers of individual elements for the structures, submit to the engineer the required certificates proving the quality of all materials used in the metalwork executed.

The quality of the executed metalwork shall comply with the prescribed and agreed conditions; the same also applies to the quality of the installation of individual metalwork elements in bridges and other structures on roads.

An adequate corrosion protection of metal elements for bridges and other structures shall be carried out in accordance with the provisions of section 3.2.5.9 of these technical conditions. Any damage to the corrosion protection shall be made good prior to installing individual steel elements. The engineer shall inspect such a repair in due time, i.e. when adequate measures can still be taken.

2.2.5.8.6 Quality Control of Execution

As a rule, the quality of the metalwork executed shall be checked by testing the dimensions and serviceability.

Dimensional verification upon delivery is required for each element functionally in connection with other elements of a bridge or another structure on a road. Where corrosion protection is foreseen, its quality shall be checked at the same time.

The metalwork contractor shall mend all the deficiencies established on the supplied elements prior to commencement of their installation.

The extent of both internal and external testing of the metalwork shall be adjusted to specific working conditions as appropriate. The contractor shall submit his proposal of such testing for each type of works and for each bridge or other structure on a road separately, and the engineer shall bring his final decision.

2.2.5.8.7 Measurement and Take-Over of Works

2.2.5.8.7.1 Measurement of Works

The executed works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in appropriate unit measures.

All the quantities of the metalwork shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities or on the basis of the engineer’s extra order.

2.2.5.8.7.2 Take-Over of Works

The engineer shall take-over the installed metalwork on structures in accordance with the quality requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. The contractor prior to continuing the works shall mend all the established deficiencies with regard to those requirements.

2.2.5.8.8 Final Account of Works

2.2.5.8.8.1 General

The executed metalworks shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.8.7.1 and taken-over in compliance with section 2.2.5.8.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the metalwork. The contractor has no right to claim any extra payment.

2.2.5.8.8.2 Deductions Due to Insufficient Quality

Since the adequate quality of materials for metalwork to arrange the details on structures is unambiguously specified, there shall be no deductions when accounting the executed works.

In case the contractor places such material, which does not meet the requirements indicated in 2.2.5.8.3, or does not ensure the quality as specified in 2.2.5.8.5 of these technical conditions, the engineer shall appoint the method of accounting.

2.2.5.9 PROTECTION OF MATERIAL AND STRUCTURES

2.2.5.9.1 CORROSION PROTECTION OF METAL

All metal parts installed in or on bridges and other structures on roads shall be adequately protected from corrosion (rusting), when they are located in the open air, in water, soil, or when they are in contact with other corrosive construction materials, e.g. partly built-in into or onto cement concrete, in contact with wood, other metal, etc.

Corrosion cells occur on the metal surface due to an aggressive electrolyte. Steel in cement concrete corrodes

- in dependence on the pH value of the cement concrete:

$pH \leq 5$	corrosion:	accelerated
$5 < pH \leq 10$		slowed down
$10 < pH \leq 12$		minimum
$pH > 12$		none

- in dependence on the cement concrete permeability:

  where the water permeability quotient is less than 0.7, there is no danger of corrosion

  where the amount of SO_4^{2-} and CO_3^{2-} ions is substantial, the corrosion is increased.

Any chemical or electrolytic activity between metals and other construction materials shall be avoided.

The corrosion protection of metal parts is a constituent part of the execution of bridges and other structures on roads, as well as of the road furniture. Therefore the design shall take account of all the influences on the selection of the corrosion protectionm particularly of the metal type, method of shaping, loading type (mechanical, climatic, biological), the foreseen duration of corrosion protection, as well as the possibility of the access to the metal surfaces before and after installation of the metal parts. As a rule, the corrosion protection systems and the selected materials specified in the design shall be tested and aproved in practice.

Surfaces of metal elements installed into bridges and road furniture are burdenend particularly due to the following actions:

- mechanical: chippings and sand upon winter scattering of carriageways, and suction behind vehicles
- chemical: exhaust gas and salt (scattered and in the air moisture)
- biological: microorganisms and fungi.

When assessing the impacts on the loading of metal surfaces of parts built-in in bridges and road furniture, particularly the following shall be considered:

- location of installation: bearing or non-bearing members, on or at the carriageway, outside the roadway, and
- local aggressive impacts:
  - changes in the micro-climate: temperature, humidity,
  - salts: frequency, duration
  - stray currents,
  - biological impacts.

On the basis of the abovementioned impacts, the following classes of corrosion protection of metal parts installed in bridges and road furniture shall be considered:

- 1st class: load bearing members of bridges (superstructures, bearings, piers, piles)

  load bearing parts of the road furniture above the carriageway (portals) and at the carriageway (safety barriers)

- 2nd class: load bearing parts of the road furniture at the carriageway (guard rails on bridges, lighting masts, traffic lights)

- 3rd class: remaining furniture at the carriageway (traffic sign posts, emergency call phones, electric cabinets)

  furniture at the road (game fences).

In view of the local aggressive impacts the following corrosion protection classes shall be considered:

Class A:	normal atmospheric conditions
Class B:	industrial atmospheric conditions
Class C:	coastal atmospheric conditions
Class D:	extremely aggressive atmospheric conditions
	parts immersed in water
	parts burried in ground
	parts in contact with other corrosive constructon materials

In case that the details of corrosion protection of metal parts for bridges and road furniture are not provided by the design, the contractor shall propose them by taking account of the aforementioned impacts, and the engineer shall approve, modify, or reject such a proposal.

The contractor may also propose a method of corrosion protection, which differs from that specified in the design, however he shall not apply it before obtaining an approval by the engineer.

2.2.5.9.2 Description

The methods of corrosion protection of metal parts, which are dealt with in these technical conditions, can be applied particularly to steel and aluminium parts being constituent parts of bridges and road furniture.

Depending on the conditions of use of the metal parts, adequate

- preparation and
- protection

of metal surfaces of elements built-in in bridges and road furniture shall be ensured.

The surface preparation of new metal elements for the corrosion protection consists of the following:

- degresaing,
- cleaning,
- de-dusting, and
- preliminary protection.

In addition to the abovementioned works, the surface preparation also comprises the removal of mill scale, rust, and damaged existing protective coating.

The surface corrosion protection can be carried out by means of the following:

- paint coatings,
- hot-dip galvanizing,
- metal-spraying,
- cathodic protection, or
- inert insulation from environmental impacts.

Structural members of metal (particularly of steel), which are buried in ground, shall be protected with bituminous materials as a rule.

Essential load bearing structural members made of metals and buried in ground (e.g. piles) shall receive double corrosion protection as a rule, i.e. the cathodic protection and paint coating (bituminous and/or synthetic organic materials).

2.2.5.9.3 Basic Materials

The type of material required for both preparation and protection of metals depends on the selected corrosion protection system.

The contractor may use any materials for the corrosion protection, for which he can demonstrate by submitting adequate certificates that it corresponds to the foreseen purpose, and that the engineer approves the application of such materials.

2.2.5.9.3.1 Surface Preparation

The following materials can be used to perform the surface preparation of metal elements:

- for degreasing: organic solvents or agents for diminishing the surface tension

- for cleaning:
  - abrasive for blast-cleaning: sharp-edged (steel grit, aluminium oxide), rounded (steel shot), quartz sand, granulated furnace slag
  - chemical agents: solutions of organic and inorganic acids or hydroxides
  - for preliminary protection: shop primers, etch primers.

2.2.5.9.3.2 Surface Protection

For the corrosion protection of metal surfaces such materials shall be used, which meet the requirements of the selected procedure and are mutually compatible.

2.2.5.9.3.2.1 Materials for Protective Coatings

In view of the properties and the use, the following materials shall be distinguished:

- for temporary protection,
- to improve adhesion,
- for workshop protection,
- for priming coats,
- for top coats, and
- for inert coats, and insulation foils.

For coatings for temporary and workshop protection, shop primers made of binders and pigments indicated in Table 5.27 can be used.

Table 5.27: Coatings for temporary and workshop protection

Type of binder	Type of pigment			
	iron oxide	zinc chromate, tetraoxy-chromate	zinc dust	basic lead silico-chromate
- alkyd resins, epoxy-ester resins	+	+	+	+
- chlorinated rubber, vinyl-chloride co-polymers	-	+	+	+
- polyvinylbutyral	+	+	-	-
- epoxies	+	+	+	+
- epoxy-polyurethane	+	+	+	+
- alkali silicate, ethylsilicate	-	-	+	-

Temporary protection of machined and varnished surfaces can be carried out by means of suitable preservation materials.

Wash primers shall be used to improve the adhesion of coats to the metal surface.

For the workshop protection also materials predominantly intended for primer coats can be used.

Both durability and resistance to corrosion are determined for the materials for priming, eventual intermediate, and topcoats

- by the type of binder, which can be particularly
  - physically oxidative fast or slow drying, or
  - multi-component reaction, and
- by the type of pigment.

For the abovementioned coats particularly materials containing the following binders shall be used:

- alkyd resins,
- epoxy-ester resins,
- chlorinated rubber,

- vinyl-chloride (co-polymers),
- bitumen,
- epoxies,
- polyurethanes, and
- alkali-silicates and ethyl-silicates (especially with zinc).

2.2.5.9.3.2.2 Hot-Dip Galvanizing

Adequate zinc shall be used for hot-dip galvanizing.

2.2.5.9.3.2.3 Metal-Spraying

For metal-spraying suitable zinc, aluminium, or lead shall be used.

2.2.5.9.3.2.4 Cathodic Protection

The following is necessary for the cathodic protection:

- galvanic (sacrificial) anodes, or
- anodes (inert) with external source of electric supply.

The material for anodes shall be specified by the cathodic protection design with regard to the manner and foreseen duration of the protection and the metal parts respectively.

2.2.5.9.3.2.5 Double Protection

For double protection, suitable materials with bituminous and/or synthetic organic compounds are required. They are defined in detail in the technical conditions for the bridge waterproofing (section 2.2.4).

2.2.5.9.4 Quality of Materials

The properties of basic materials for the corrosion protection of steel elements are specified in both instructions and technical conditions provided by makers of protective materials. Moreover, the materials for the corrosion protection of metals shall meet additional quality requirements according to these technical conditions.

The contractor shall in due time prior to commencement of the use of certain material for the corrosion protection obtain an approval by the engineer.

All the required properties of basic materials for the corrosion protection of metal parts in compliance with these technical conditions are defined by the limiting values to be ensured. Therefore, the contractor shall in due course prior to commencement of the works provide evidence on the quality of all the materials required for the corrosion protection, which shall be stored in sufficient amounts, and separated one from the other.

Evidence on the quality of the material for the protection of metal against corrosion shall not be older than the terms prescribed by the maker of the material, where the required period up to the complete installation shall be taken into account as well. Material, not meeting these and the additional requirements according to these technical conditions shall be immediately rejected and removed by the contractor.

The contractor may apply certain material for the corrosion protection of metal elements only after obtaining adequate approval by the engineer.

2.2.5.9.4.1 Surface Preparation

Both quality and type of materials for surface preparation of metal elements to be protected from corrosion shall generally be specified in the design: e.g. quality and type of degreasing solvent, of abrasive and/or material for rust and mill scale removal, of preliminary protection primers, etc.

For cleaning the metal surfaces with a jet of abrasive materials the following shall be used:

- for protective coatings:
    - sharp-edged steel grit or aluminium oxide, grain size 0.4 – 1.2 mm
    - steel shot of grain size 0.5 – 1.5 mm
- for metal coatings:
    - sharp-edged steel grit or aluminium oxide, grain size 0.5 – 1.2 mm
- for both protective coatings and metal coatings:
    - pure quartz sand, grain size 0.5 - 2.5 mm
    - pure granulated furnace slag, grain size 0.5 - 2 mm.

Where the conditions for the quality of the material for surface preparation are not defined, the contractor shall propose and the engineer shall approve adequate material. The contractor shall inform the engineer of the expected time of beginning the works in due time.

2.2.5.9.4.2 Surface Protection

As a rule, the required quality of materials for the corrosion protection of metal parts shall be specified by the design. When selecting certain material for the corrosion protection of metal surfaces, maker's instructions shall be taken into account.

2.2.5.9.4.2.1 Materials for Coatings

Both quality and type of materials for coatings applied to metal surfaces shall be checked by testing the basic properties, which are:

- appearance upon delivery: formation of skin or crust, sediments
- viscosity: outflow time or thixotropy
- volume weight (specific mass)
- volume solids
- suitability to application (with brush or roller, by spraying, etc.)
- film thickness:
  - wet
  - dry
- drying time
- pot life
- grinding fineness (for multi-component materials)
- covering capacity
- flash point
- adhesion
- hardness
- elasticity
- gloss
- colour shade.

Where metal elements are exposed to special circumstances, suitable supplemental testing of the required properties of corrosion protection materials, as well as locations to appraise the protective coatings shall be defined in the design.

2.2.5.9.4.2.2 Hot-Dip Galvanizing

Zinc of ZN 97.5 to ZN 99.5 shall be used for the preparation of melted zinc to protect metal parts from corrosion by means of hot-dip galvanizing.

The steel intended to be hot-dip galvanized shall contain as little carbon, silicon, and phosphorus as possible, thus ensuring a perfect corrosion protection. All the elements of the same structure shall be made of steel of the same grade.

2.2.5.9.4.2.3 Metal-Spraying

The purity of metals for the corrosion protection of steel parts by spraying melted metal shall amount to:

- for zinc Zn 99.99,
- for aluminium Al 99.5,
- for lead:
  - less than 0.5 % by mass of iron,
  - less than 1 % by mass of antimony.

The preparation of metal, which is intended to be applied by spraying, shall correspond to the selected spraying equipment.

2.2.5.9.4.2.4 Cathodic Protection

Electrodes of electronegative metals or their alloys (magnesium, aluminium, and zinc) shall be used as galvanic anodes for the cathodic protection of foundations or metal parts in earth or water.

It is possible to use various materials from alloys (ferrosilicium, magnetite, platinum-titan, etc.), which shall be in an adequate activator (a mixture of gypsum, bentonite, Glauber's salt, and sodium sulphate, or in fine grained coke), may be used as anodes with an external source of electric supply.

2.2.5.9.4.2.5 Double Protection

As a rule, bearing steel piles and pipelines buried in ground shall be for economical reasons protected from corrosion with the following materials:

- materials for cathodic protection as specified in section 2.2.5.9.3.2.4, and
- materials based on bituminous binder,
- materials based on synthetic organic compounds complying with requirements specified in section 1.2.4 Bridge and Road Structure Design.

Properties of adhesive tape of polyethylene foil and of the material for the priming coat shall be mutually compatible. In addition, the self-adhesive tape of polyethylene for double corrosion protection shall correspond to the requirements indicated in Table 5.28 as well.

When the producer of the self-adhesive tape from polyethylene foil prescribes special properties, and the engineer approves these properties, the contractor shall demonstrate them by appropriate evidence.

Table 5.28: Properties of self-adhesive tapes made of polyethylene foil

Material property		Unit measure	Required value
- thickness:	foil	mm	0.3 to 0.5
	adhesive film	mm	0.1
- adhesion:	to the steel surface, minimum	N/cm	7
	tape to tape, minimum	N/cm	6
- resistance to direct current		-	resistant
- breakthrough voltage, minimum		kV	20
- specific resistance		kΩ	10 to 14
- water absorption, maximum		% by volume	0.02
- temperature range of application		°C	-30 to 80

2.2.5.9.5 Method of Execution

2.2.5.9.5.1 Surface Preparation

The selection of the material for protective coating as well as the durability of the corrosion protection applied depend on the preparation of the metal surfaces of elements required for the construction of bridges and road furniture.

The surface preparation shall be generally carried out in the following sequence:

- degreasing
- cleaning
- dedusting
- preliminary protection.

2.2.5.9.5.1.1 Degreasing

Degreasing shall be executed

- manually: with cloths or brushes soaked in corresponding material, or
- mechanically: in adequate devices.

All the surfaces shall be dried after degreasing.

2.2.5.9.5.1.2 Cleaning

Prior to being protected from corrosion, metal surfaces shall be mechanically or manually cleaned by means of

- a jet of abrasive,
- flame, or
- chemical agents.

Besides the abovementioned methods of surface cleaning, water may also be used for cleaning, i.e.

- high pressure water,
- hot water, or
- steam.

Metal surfaces shall generally be blast cleaned to grey colour shade and an average roughness of 30 micrometers.

The method of cleaning metal surfaces depends particularly on the condition of these surfaces. The contractor's proposal of how to clean the surfaces shall be approved by the engineer.

2.2.5.9.5.1.3 Dedusting

Dust shall be removed from metal surfaces by means of dry compressed air as a rule (blowing away and sucking in).

2.2.5.9.5.1.4 Preliminary Protection

A preliminary protection of metal surfaces shall, as a rule, be carried out with an adequate material, when the priming coat or any other material for the surface protection cannot be applied within eight hours and in and/or in favourable weather conditions after all other stages of the surface preparation have been completed.

The material for the preliminary protection of metal surfaces may only be applied after the mill scale has been removed from the surface by means of suitable method, i.e. abrasive cleaning as a rule.

2.2.5.9.5.2 Surface Protection

To a dry and clean metal surface a protective paint coat shall be applied not later than eight hours, while the metal coating not later than four hours after the surface preparation.

Metal surfaces may be adequately protected from corrosion after a third party institution, authorized by the contractor, has checked and approved in writing that they are appropriately prepared to receive the specified protective coating.

2.2.5.9.5.2.1 Paint Coats

Metal surfaces may be protected with paint coating on condition that

- the metal surface is dry,
- the relative air humidity is less than 80 %,
- dust has been removed from the previous coat,
- the air temperature is higher than 5° C and lower than 40°C, and formation of condensed water on the surface is prevented, i.e. the surface temperature shall be higher than the dew point by at least 3°C.

Paint coats may be applied either manually or by spraying, in both cases as soon as possible after the surface preparation. In case the maximum time interval from the surface preparation till the surface protection is exceeded, the surface shall be repeatedly prepared as specified.

Materials for both priming and top coats shall be applied in appropriate layers.

Unless provided otherwise by the design, the workshop paint coats shall be applied at the premises of the producer of metal elements to be installed on bridges and road furniture, while all the subsequent paint coats shall be applied after site installation.

Previous coating shall be adequately dry prior to application of the subsequent one. The minimum drying time for certain basic materials for paint coatings is indicated in Table 5.29.

Table 5.29: Minimum drying time for basic materials for paint coatings

Basic material for coating	Minimum drying time
- alkyd resin	15 hours
- epoxy resin	18 hours
- zinc silicate	3 days

All the damaged paint coatings on metal surfaces shall be adequately touched up prior to continuing the corrosion protection works.

Informative minimum dry film thicknesses of priming and top coats are specified in Table 5.30.

Table 5.30: Informative minimum dry film thicknesses of priming and top coats

Type of coating	Dry film thickness (μm) priming coat	top coat 1st coat	top coat 2nd coat
- with zinc chromate	40	-	-
- with zinc dust	40	-	-
- with calcium plumbate	40	-	-
- with titanium dioxide	-	25	30
- with iron oxide	-	30	40
- with bitumen*	-	100	100
- hot bitumen	500	-	-
- alkyd resins, epoxy-ester resins	30	40	40
- chlorinated rubber, vinyl co-polymers	40	75	40
- epoxies	40	40	40
- epoxy polyurethane	40	30	40
- alkali-silicate, ethyl-silicate: shop primer	15	-	-
primer or full system	75	-	-

** Bitumen and aluminium dust is required for top coats in thickness of 20 micrometers.*

The minimum paint coat thicknesses shall be specified by the design. If this is not the case, the contractor shall propose and the engineer shall approve them, all in accordance with the instructions of the paint maker.

As a rule, paint coats shall be applied by means of

- airless spraying under low or high pressure,
- spraying two-component materials, or
- electrostatic spraying.

Manual application (with brush) is only allowed for priming coats and touching-up damaged coats. Application by dipping is admitted only for the protection of minor elements of suitable shape.

2.2.5.9.5.2.2 Hot-Dip Galvanizing

The surface preparation of steel elements foreseen for bridges and road furniture, which shall be protected from corrosion, comprises the following works:

- degreasing,
- acid pickling,
- rinsing with water, and
- application of solvents.

Next to hot-dip galvanizing, the steel part shall be submerged into adequate flux.

Hot-dip galvanizing shall be carried out by dipping the steel part into melted zinc.

The required thicknesses of zinc coating for local aggressive actions of A, B, and C class are specified in Table 5.31 with regard to the location of installation.

Table 5.31: Required thicknesses of zinc coating

Location of installation – element	Zinc coating thickness average [μm]	minimum [μm]
1st class	86	76
2nd class	71	64
3rd class	57	50
bolts, nuts, washers	54	43
meshes for railings	43	36

The applied zinc layer shall be uniform and clear, without any sagging or embossment. Eventual surplus zinc shall be removed from the steel surface with a jet of steam and hot air.

The zinc coating shall not peel-off from the steel parts, neither it shall crack, be porous, or damaged.

2.2.5.9.5.2.3 Metal-Spraying

Steel surfaces shall be next to the metal spraying suitably prepared by means of blast cleaning. In case that the appearance of the steel surface has slightly changed, blast cleaning shall be repeated to the specified standard.

Metal coating shall be applied by means of adequate apparatus enabling melting of the metal and its spraying-on with the help of compressed air.

The required type and thickness of sprayed metal coatings shall be specified by the design as a rule.

The minimum measured thicknesses of sprayed metal coatings are indicated in Table 5.32.

A sprayed metal coating can be additionally sealed (e.g. with adequate water solution of inorganic compounds), or protected with paint coats.

A sprayed metal coating shall be clean, uniform, even, smooth, and well adhered to the metal parts intended for bridges and road furniture to be protected from corrosion.

Table 5.32: Minimum thicknesses of sprayed metal coatings

Type of metal		Minimum thickness [μm]
- zinc:	Zn M 40	40
	Zn M 80	80
	Zn M 120	120
	Zn M 200	200
- aluminium:	Al M 120	120
	Al M 200	200
	Al M 300	300
- lead:	Pb M 300	300
	Pb M 500	500
	Pb M 1,000	1,000

2.2.5.9.5.2.4 Cathodic Protection

Metal parts of bridges and road furniture shall be cathodic protected in case they are substantially threatened by corrosion. This applies where

- the specific resistance of soil is less than 100Ω,
- the pH value of the environment is less than 6,
- the influence of stray currents (by interferential criteria) are greater than admitted,
- there is a galvanic connection (corrosion cell) between different metals, and
- the soil (electrolyte) is anaerobic.

Where not sufficient data is known, the following shall be tested:

- soil aggressiveness,
- required protective current, and
- presence of stray currents.

A preliminary solution of the method of cathodic protection shall be considered when designing a bridge or furniture. The required preliminary measures with regard to the cathodic protection shall include the following:

- description and extent of the cathodic protection,
- method of passive protection of metal parts,
- way of interconnection or separation of metal parts one from the other,
- placing of protective elements (anodes, rectifiers) and distributors, and

- measures to be taken on other apparatus (displacement, insulation).

The engineer shall regularly inspect the abovementioned measures, as any subsequent execution might be very difficult.

After the cathodic connections are already carried out and the measuring contacts prepared, control measurements shall be performed. On the basis of the results of these measurements, a cathodic protection design shall be worked out, which shall include the following:

- calculations and selection of individual cathodic protection elements (type of rectifier, composition and dimension of anodes, types and cross-section of cables, location of protective elements),
- instructions including all the drawings required for the execution of cathodic protection,
- instructions for turning-on the protection, locations of measurements, measurements themselves, and criteria to assess the results,
- instructions for both control and maintenance of the cathodic protection system,
- a bill of all the material necessary to carry out the cathodic protection.

In addition to the abovementioned documents, the design of the cathodic protection of bridges and road furniture shall also include detailed technical conditions for the execution of these works.

The engineer shall approve all the details of the cathodic protection of metal elements for bridges and road furniture, notwithstanding such details have already been specified by the cathodic protection designer.

2.2.5.9.5.2.5 Double Protection

Double surface protection of metal parts, which are greatly subjected to corrosion (D class of aggressive actions), shall be carried out taking into consideration the following conditions:

- surface preparation in compliance with section 2.2.5.9.4.1,
- priming coat in compliance with section 2.2.5.9.4.2,
- priming the surfaces with materials based on bituminous binder or synthetic organic resins in accordance with section 1.2.4 Bridge and Road Structure Design,
- additional cathodic protection as specified in section 2.2.5.9.4.2.4.

When using self-adhesive tape made of polyethylene foil, the temperature conditions prescribed by the producer for storing and wrapping shall be considered. In case of spiral wrapping, the overlapping of the tape shall amount to at least 25 mm. Uniform wrapping shall be ensured by adequate stretching the tape. The direction of wrapping the tape onto piles to be driven in the ground shall be such as to ensure that the overlapping is carried out in the opposite direction to that of ramming the piles.

The protection of welds at locations of extending the piles, and the protection of damaged places shall be performed in the same way as specified in these technical conditions. Overlapping over already executed protection shall amount to at least 150 mm.

Piles driven in the ground shall be primed up to at least 200 mm above the ground level.

2.2.5.9.6 Quality of Execution

All the corrosion protection works shall be entirely inspected by the contractor’s internal control Prior to commencement of the use of all the apparatus for the surface preparation, which the quality of the corrosion protection of metal surfaces may depend on, their suitability to ensuring the quality, specified in these technical conditions, shall be verified.

During the execution of corrosion protection of metal surfaces all other conditions, stipulated by the maker of the basic material, shall also be taken into account.

Not later than 15 days prior to commencement of the application of paint material, the contractor shall submit to the engineer all the necessary evidence on the suitability of basic materials in compliance with section 3.2.5.9.3 of these technical conditions. The contractor must not commence to apply the corrosion protection material, until he obtains an approval by the engineer for each individual material.

For all the preliminary corrosion protection works that had been executed prior to delivery of metal elements for bridges and road furniture to the site, the contractor shall submit adequate evidence on the quality issued by an authorized third party institution.

If required by the engineer, the contractor shall carry out a partial or complete demonstrative corrosion protection of certain metal parts. By testing, which is to be performed by a third party institution engaged by the contractor, properties specified in these technical conditions, or only certain properties specified by the engineer, shall be established.

The approval for routine execution of corrosion protection of metal elements usually includes all the quality conditions specified in these technical conditions. It also includes all the detailed requirements of how to keep a logbook on the execution of the corrosion protection at all the working stages.

The contractor may perform individual corrosion protection stages only after the engineer has taken-over the preceding working stage.

2.2.5.9.7 Quality Control of Execution

2.2.5.9.7.1 Internal Control

Minimum internal control testing of the quality of stored materials to be used for corrosion protection of metal parts, which shall be performed or ordered by the contractor notwithstanding he has already submitted to the engineer suitable evidence of the material conformity, comprises the testing of at least two specimens taken from each individual batch of every type of material used.

In case the engineer establishes significant deviations of the internal control testing results from the specified values, he has the right to increase the extent of testing. On the contrary, if the results of the internal control are uniform and similar to the results indicated in the certificates, the engineer may reduce the extent of foreseen testing.

In case of major works, the engineer has the right to order the execution of partial material testing only.

2.2.5.9.7.2 External Control

The extent of the external control testing, which is carried out by a third party institution engaged by the contractor, is usually in a 1:4 ratio to the internal control testing. The engineer specifies locations for taking specimens by the statistical random selection method.

External control tests of all the used materials for the corrosion protection of metal parts shall be executed for every type of protection. For minor works, the engineer may also specify the execution of partial testing of certain material types only.

2.2.5.9.7.3 Quality Control of Executed Works

The quality of the executed corrosion protection works shall be demonstrated by the contractor after completion of individual working stages, as well as of the work as a whole. The contractor shall propose the method and extent of quality control of individual stages and of the complete protection, and the engineer shall approve such a proposal. As a rule, the engineer shall attend both sampling and testing.

Izvajalec lahko nadaljuje z deli po posameznih fazah šele, ko mu to dovoli nadzornik.

All the characteristics of the individual type of corrosion protection, specified in these technical conditions, shall be verified. In case of the cathodic protection of metal parts for bridges and road furniture, the following measurements shall be carried out after turning-on:

- protective potentials,
- protective current,
- potential differences between structures,
- insulating inserted pieces, and
- interference.

On the basis of the results of these measurements eventual supplements and/or corrections of the cathodic protection shall be carried out.

As the protection of elements buried in ground cannot be maintained or touched-up, the quality of the executed corrosion protection shall be perfect thus ensuring a durable protection as specified by the design for the entire structure.

2.2.5.9.8 Measurement andTake-Over of Works

2.2.5.9.8.1 Measurement of Works

The executed corrosion protection works shall be measured in compliance with section 2.1.7.1 of the general technical conditions and calculated in square metres, except the cathodic protection, which shall be calculated in pieces (structures).

All the quantities shall be measured to the actually completed extent and type of work having been executed within the framework of the design Bill of Quantities or on the basis of the engineer's order.

2.2.5.9.8.2 Take-Over of Works

The engineer shall take-over the applied corrosion protection in accordance with the quality and performance requirements provided by these technical conditions and by section 2.1.7.2 of the general technical conditions. The contractor prior to continuing the works shall mend all the established deficiencies with regard to those requirements.

2.2.5.9.9 Final Account of Works

The executed corrosion protection shall be accounted in accordance with 2.1.7.3 of the general technical conditions.

The quantities defined under section 2.2.5.9.7.1 and taken-over in compliance with section 2.2.5.9.7.2 shall be accounted by the contractual unit price.

The contractual unit price shall include all services required for a complete execution of the corrosion protection works. The contractor has no right to claim any extra payment.

Since the adequate quality of both materials for and performance of the corrosion protection is unambiguously specified, there shall be no deductions when accounting the executed works.

In case the contractor applies such material, which does not meet the requirements indicated in 2.2.5.9.3, or does not ensure the quality as specified in 2.2.5.9.5 of these technical conditions, the engineer shall appoint the method of accounting. He can also reject the whole work.

2.2.5.9.10 WATERPROOFING OF STRUCTURES

Special technical conditions for the waterproofing of structures are dealt with in section 1.2.4 Design of Bridges and Structures on Roads

2.2.5.10 CRAFTSMEN WORKS - BILL OF WORKS

2.2.5.10.1.1 Carpentry

Item	Unit Measure	Description of Works
51 111	m^2	Execution of mobile scaffolding, height up to 4 m
51 112	m^2	Execution of mobile scaffolding, height above 4 m
51 121	m^2	Execution of fixed scaffolding, height up to 4 m
51 122	m^2	Execution of fixed scaffolding, height 4.1 – 8.0 m
51 123	m^2	Execution of fixed scaffolding, height 8.1 – 12.0 m
51 124	m^2	Execution of fixed scaffolding, height 12.1 – 18.0 m
51 125	m^2	Execution of fixed scaffolding, height above 18.0 m
51 131	m^2	Execution of protective (capturing) scaffolding
51 141	m^2	Execution of transportable scaffolding
51 151	m^2	Execution of scaffolding railing
51 211	m^2	Execution of supported formwork for even foundations
51 212	m^2	Execution of supported formwork for curved foundation
51 213	m^2	Execution of supported formwork for reinforced cement concrete column on slope inclined by up to 45^o
51 214	m^2	Execution of supported formwork for reinforced cement concrete column on slope inclined by more than 45^o
51 221	m^2	Execution of two-sided bound formwork for even foundation
51 222	m^2	Execution of two-sided formwork for curved foundation
51 223	m^2	Execution of bound formwork for reinforced cement concrete column on slope inclined by up to 45^o
51 224	m^2	Execution of bound formwork for reinforced cement concrete column on slope inclined by more than 45^o
51 311	m^2	Execution of supported formwork for upright wall, height up to 2 m
51 312	m^2	Execution of supported formwork for upright wall, height 2.1 – 4.0 m
51 313	m^2	Execution of supported formwork for upright wall, height 4.1 – 6.0 m
51 314	m^2	Execution of supported formwork for upright wall, height 6.1 – 8.0 m
51 315	m^2	Execution of supported formwork for upright wall, height above 8.0 m
51 321	m^2	Execution of supported formwork for curved wall, height up to 2 m
51 322	m^2	Execution of supported formwork for curved wall, height 2.1 – 4.0 m
51 323	m^2	Execution of supported formwork for curved wall, height 4.1 – 6.0 m
51 324	m^2	Execution of supported formwork for curved wall, height 6.1 – 8.0 m
51 325	m^2	Execution of supported formwork for curved wall, height above 8.0 m
51 331	m^2	Execution of two-sided bound formwork for upright wall, height up to 2 m
51 332	m^2	Execution of two-sided bound formwork for upright wall, height 2.1 – 4.0 m
51 333	m^2	Execution of two-sided bound formwork for upright wall, height 4.1 – 6.0 m
51 334	m^2	Execution of two-sided bound formwork for upright wall, height 6.1 – 8.0 m

Item	Unit Measure	Description of Works
51 335	m^2	Execution of two-sided bound formwork for upright wall, height above 8.0 m
51 341	m^2	Execution of two-sided bound formwork for curved wall, height up to 2 m
51 342	m^2	Execution of two-sided bound formwork for curved wall, height 2.1 – 4.0 m
51 343	m^2	Execution of two-sided bound formwork for curved wall, height 4.1 – 6.0 m
51 344	m^2	Execution of two-sided bound formwork for curved wall, height 6.1 – 8.0 m
51 345	m^2	Execution of two-sided bound formwork for curved wall, height above 8.0 m
51 351	m^2	Extra payment for execution of formwork for inclined wall
51 411	m^2	Execution of supported formwork for rectangular pier, height up to 2 m
51 412	m^2	Execution of supported formwork for rectangular pier, height 4.1 – 8.0 m
51 413	m^2	Execution of supported formwork for rectangular pier, height 8.1 – 12.0 m
51 414	m^2	Execution of supported formwork for rectangular pier, height 12.1 – 20.0 m
51 415	m^2	Execution of supported formwork for rectangular pier, height 20.1 – 35.0 m
51 416	m^2	Execution of supported formwork for rectangular pier, height above 35.0 m
51 421	m^2	Execution of bound formwork for rectangular pier, height up to 2 m
51 422	m^2	Execution of bound formwork for rectangular pier, height 4.1 – 8.0 m
51 423	m^2	Execution of bound formwork for rectangular pier, height 8.1 – 12.0 m
51 424	m^2	Execution of bound formwork for rectangular pier, height 12.1 – 20.0 m
51 425	m^2	Execution of bound formwork for rectangular pier, height 20.1 – 35.0 m
51 426	m^2	Execution of bound formwork for rectangular pier, height above 35.0 m
51 431	m^2	Execution of formwork for circular pier, height up to 2 m
51 432	m^2	Execution of formwork for circular pier, height up to 4 m
51 433	m^2	Execution of formwork for circular pier, height up to 6 m
51 434	m^2	Execution of formwork for circular pier, height up to 8 m
51 441	m^2	Execution of formwork for circular or oval pier, height up to 12 m
51 442	m^2	Execution of formwork for circular or oval pier, height up to 20 m
51 443	m^2	Execution of formwork for circular or oval pier, height up to 35 m
51 444	m^2	Execution of formwork for circular or oval pier, height above 35 m
51 451	m^2	Execution of formwork for polygonal or H pier, height up to 6 m
51 452	m^2	Execution of formwork for polygonal or H pier, height up to 8 m
51 453	m^2	Execution of formwork for polygonal or H pier, height up to 12 m
51 454	m^2	Execution of formwork for polygonal or H pier, height up to 20 m
51 455	m^2	Execution of formwork for polygonal or H pier, height above 20 m
51 461	m^2	Execution of formwork for pier of box section, height up to 4 m
51 462	m^2	Execution of formwork for pier of box section, height 4.1 to 6 m
51 463	m^2	Execution of formwork for pier of box section, height 6.1 to 8 m
51 464	m^2	Execution of formwork for pier of box section, height 8.1 to 12 m
51 465	m^2	Execution of formwork for pier of box section, height 12.1 to 20 m
51 466	m^2	Execution of formwork for pier of box section, height 20.1 to 35 m

Item	Unit Measure	Description of Works
51 467	m^2	Execution of formwork for pier of box section, height above 35 m
51 471	m^2	Execution of formwork for pier head of even surfaces
51 472	m^2	Execution of formwork for pier head of curved surfaces
51 481	m^2	Execution of formwork for pier of …………….. section, height …… m
51 491	m^2	Extra payment for execution of formwork for inclined pier
51 511	m^2	Execution of supported formwork for straight girder with support of up to 2 m height
51 512	m^2	Execution of supported formwork for straight girder with support of height 2.1 to 4 m
51 513	m^2	Execution of supported formwork for straight girder with support of height 4.1 to 6 m
51 514	m^2	Execution of supported formwork for straight girder with support of height above 6 m
51 521	m^2	Execution of supported formwork for curved girder with support of up to 2 m height
51 522	m^2	Execution of supported formwork for curved girder with support of height 2.1 to 4 m
51 523	m^2	Execution of supported formwork for curved girder with support of height 4.1 to 6 m
51 524	m^2	Execution of supported formwork for curved girder with support of height above 6 m
51 531	m^2	Execution of two-sided bound formwork for straight girder
51 532	m^2	Execution of two-sided bound formwork for curved girder
51 541	m^2	Execution of supported formwork for arched girder with support of up to 2 m height
51 542	m^2	Execution of supported formwork for arched girder with support of height 2.1 to 4 m
51 543	m^2	Execution of supported formwork for arched girder with support of height 4.1 to 6 m
51 544	m^2	Execution of supported formwork for arched girder with support of height above 6 m
51 551	m^2	Execution of supported formwork for curved arched girder with support of up to 2 m height
51 552	m^2	Execution of supported formwork for curved arched girder with support of height 2.1 to 4 m
51 553	m^2	Execution of supported formwork for curved arched girder with support of height 4.1 to 6 m
51 554	m^2	Execution of supported formwork for curved arched girder with support of height above 6 m
51 561	m^2	Execution of two-sided bound formwork for arched girder
51 562	m^2	Execution of two-sided bound formwork for curved arched girder

Item	Unit Measure	Description of Works
51 571	m^2	Execution of supported formwork for trapezoidal girder with support of up to 2 m height
51 572	m^2	Execution of supported formwork for trapezoidal girder with support of height 2.1 to 4 m
51 573	m^2	Execution of supported formwork for trapezoidal girder with support of height 4.1 to 6 m
51 574	m^2	Execution of supported formwork for trapezoidal girder with support of height above 6 m
51 581	m^2	Execution of supported formwork for curved trapezoidal girder with support of up to 2 m height
51 582	m^2	Execution of supported formwork for curved trapezoidal girder with support of height 2.1 to 4 m
51 583	m^2	Execution of supported formwork for curved trapezoidal girder with support of height 4.1 to 6 m
51 584	m^2	Execution of supported formwork for curved trapezoidal girder with support of height above 6 m
51 591	m^2	Execution of two-sided bound formwork for trapezoidal girder
51 592	m^2	Execution of two-sided bound formwork for curved trapezoidal girder
51 595	m^2	Execution of formwork for …….. girder with ……. support, of … m height
51 611	m^2	Execution of supported formwork for even slab with support of 2 m height
51 612	m^2	Execution of supported formwork for even slab with support of 2.1 to 4 m height
51 613	m^2	Execution of supported formwork for even slab with support of 4.1 to 6 m height
51 614	m^2	Execution of supported formwork for even slab with support of height 6.1 to 8 m
51 615	m^2	Execution of supported formwork for even slab with support of height above 8 m
51 621	m^2	Execution of formwork for even slab (only formwork without supports)
51 631	m^2	Execution of supported formwork for lateral sides of even slabs
51 641	m^2	Execution of supported formwork for arched slab with support of 2 m height
51 642	m^2	Execution of supported formwork for arched slab with support of 2.1 to 4 m height
51 643	m^2	Execution of supported formwork for arched slab with support of 4.1 – 6 m height
51 644	m^2	Execution of supported formwork for arched slab with support of 6.1 – 8 m height
51 645	m^2	Execution of supported formwork for arched slab with support of height above 8 m
51 651	m^2	Execution of formwork for arched slab (only formwork without supports)
51 661	m^2	Execution of formwork for lateral sides of arched slab

Item	Unit Measure	Description of Works
51 671	m^2	Execution of supported formwork for circular slab with support of 2 m height
51 672	m^2	Execution of supported formwork for circular slab with support of 2.1 to 4 m height
51 673	m^2	Execution of supported formwork for circular slab with support of … m height
51 681	m^2	Execution of formwork for …………. slab
51 711	m^2	Execution of supported formwork for edge beam on bridge, retaining wall, and supporting wall
51 712	m^2	Execution of suspended formwork for edge beam on bridge, retaining wall, and supporting wall
51 721	m^2	Execution of box formwork for different openings of up to 0.10 m^2
51 722	m^2	Execution of box formwork for different openings of 0.11 – 0.20 m^2
51 723	m^2	Execution of box formwork for different openings of more than 0.20 m^2
51 731	m^2	Execution of formwork for anchor heads of up to 0.10 m^2
51 732	m^2	Execution of formwork for anchor heads of more than 0.10 m^2
51 741	m^2	Execution of box formwork for bearing blocks, cross-beams, and seismic protection blocks, area up to 0.50 m^2
51 742	m^2	Execution of box formwork for bearing blocks, cross-beams, and seismic protection blocks, area 0.51 m^2 to 1.00 m^2
51 743	m^2	Execution of box formwork for bearing blocks, cross-beams, and seismic protection blocks, area above 1.00 m^2
51 751	m^2	Extra payment for finishing visible (exposed) cement concrete surface with grooves at executing the formwork
51 761	m^2	Execution of two-sided formwork for cylinders
51 762	m^2	Execution of one-soded formwork of cylinders
51 771	m^2	Execution of formwork for …………………
51 772	m^2	Execution of formwork for …………………
51 773	m^2	Execution of formwork for …………………
51 811	m^2	Supply, preparation, and installation of equipment for free cantilever construction, segment length up to 5 m
51 812	m^2	Supply, preparation, and installation of equipment for free cantilever construction, segment length above 5 m
51 813	m^2	Supply, preparation, and installation of equipment for incremental launching, segment length up to 25 m
51 814	m^2	Supply, preparation, and installation of equipment for incremental launching, segment length above 25 m
51 815	m^2	Supply, preparation, and installation of equipment for …………….. construction, segment length ……. m

Item	Unit Measure	Description of Works
51 821	m^2	Execution of supported formwork for cantilever on bridge, retaining wall, and supporting wall, span up to 1.0 m, supported to either superstructure or substructure
51 822	m^2	Execution of supported formwork for cantilever on bridge, retaining wall, and supporting wall, span 1.1 – 2.0 m, supported to either superstructure or substructure
51 823	m^2	Execution of supported formwork for cantilever on bridge, retaining wall, and supporting wall, span 2.1 – 3.0 m, supported to either superstructure or substructure
51 824	m^2	Execution of supported formwork for cantilever on bridge, retaining wall, and supporting wall, span ………. m, supported to either superstructure or substructure
51 831	m^2	Execution of suspended formwork for cantilever on bridge, retaining wall, and supporting wall, span up to 1.0 m, supported to either superstructure or substructure
51 832	m^2	Execution of suspended formwork for cantilever on bridge, retaining wall, and supporting wall, span 1.1 – 2.0 m, supported to either superstructure or substructure
51 833	m^2	Execution of suspended formwork for cantilever on bridge, retaining wall, and supporting wall, span 2.1 – 3.0 m, supported to either superstructure or substructure
51 834	m^2	Execution of suspended formwork for cantilever on bridge, retaining wall, and supporting wall, span ………. m, supported to either superstructure or substructure
51 841	m^2	Execution of formwork for application of additional concrete layer – damage repair on girder of cross-section ……………

2.2.5.10.1.2 Work With Reinforcing Steel

Item	Unit Measure	Description of Work
52 111	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 220/340 of diameter up to 12 mm, for simple reinforcement
52 112	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 220/340 of diameter up to 12 mm, for medium complex reinforcement
52 113	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 220/340 of diameter up to 12 mm, for complex reinforcement
52 121	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 240/360 of diameter up to 12 mm, for simple reinforcement
52 122	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 240/360 of diameter up to 12 mm, for medium complex reinforcement
52 123	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 240/360 of diameter up to 12 mm, for complex reinforcement
52 131	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 240/360 of diameter up to 14 mm, for simple reinforcement
52 132	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 240/360 of diameter up to 14 mm, for medium complex reinforcement
52 133	kg	Supply and placing smooth wire of soft steel Č 0200 - GA 240/360 of diameter up to 14 mm, for complex reinforcement
52 211	kg	Supply and placing ribbed wires of high-performance hard steel Č 0550 - RA 400/500-1 of diameter up to 14 mm, for simple reinforcement
52 212	kg	Supply and placing ribbed wires of high-performance hard steel Č 0550 - RA 400/500-1 of diameter up to 14 mm, for medium complex reinforcement
52 213	kg	Supply and placing ribbed wires of high-performance hard steel Č 0550 - RA 400/500-1 of diameter up to 14 mm, for complex reinforcement
52 221	kg	Supply and placing ribbed wires of high-performance naturally hard steel Č 0551 - RA 400/500-2 of diameter up to 12 mm, for simple reinforcement
52 222	kg	Supply and placing ribbed wires of high-performance naturally hard steel Č 0551 - RA 400/500-2 of diameter up to 12 mm, for medium complex reinforcement
52 223	kg	Supply and placing ribbed wires of high-performance naturally hard steel Č 0551 - RA 400/500-2 of diameter up to 12 mm, for complex reinforcement
52 231	kg	Supply and placing ribbed wires of high-performance naturally hard steel Č 0551 - RA 400/500-2 of diameter 14 mm and more, for simple reinforcement
52 232	kg	Supply and placing ribbed wires of high-performance naturally hard steel Č 0551 - RA 400/500-2 of diameter 14 mm and more, for medium complex reinforcement
52 233	kg	Supply and placing ribbed wires of high-performance naturally hard steel Č 0551 - RA 400/500-2 of diameter 14 mm and more, for complex reinforcement
52 241	kg	Supply and placing ribbed bars of high-performance naturally hard steel - RA 500/600 (S 500/600) with accessory for screwing the bars without overlapping, diameter 14 mm and more

Item	Unit Measure	Description of Work
52 251	kg	Supply and placing reinforcing boards with hidden bars for continuation of ribbed bars, of high-performance naturally hard steel Č 0550 - RA 400/500-1, of diameter up to 12 mm
52 252	kg	Supply and placing reinforcing boards with hidden bars for continuation of ribbed bars, of high-performance naturally hard steel Č 0550 - RA 400/500-2, of diameter up to 12 mm
52 311	kg	Supply and placing mesh reinforcement of drawn steel wire ČBM-50-MAG 500/560, diameter > 4 mm and < 12 mm, mass up to 2 kg/m^2
52 312	kg	Supply and placing mesh reinforcement of drawn steel wire ČBM-50-MAG 500/560, diameter > 4 mm and < 12 mm, mass 2.1 – 3.0 kg/m^2
52 313	kg	Supply and placing mesh reinforcement of drawn steel wire ČBM-50-MAG 500/560, diameter > 4 mm and < 12 mm, mass 3.1 – 4.0 kg/m^2
52 314	kg	Supply and placing mesh reinforcement of drawn steel wire ČBM-50-MAG 500/560, diameter > 4 mm and < 12 mm, mass 4.1 – 6.0 kg/m^2
52 315	kg	Supply and placing mesh reinforcement of drawn steel wire ČBM-50-MAG 500/560, diameter > 4 mm and < 12 mm, mass above 6.0 kg/m^2
52 321	kg	Supply and placing mesh reinforcement of expanded steel plate, mass up to 2 kg/m^2
52 322	kg	Supply and placing mesh reinforcement of expanded steel plate, mass 2.1 – 3.0 kg/m^2
52 323	kg	Supply and placing mesh reinforcement of expanded steel plate, mass 3.1 – 4.0 kg/m^2
52 324	kg	Supply and placing mesh reinforcement of expanded steel plate, mass 4.1 – 6.0 kg/m^2
52 325	kg	Supply and placing mesh reinforcement of expanded steel plate, mass above 6.0 kg/m^2
52 331	m^2	Supply and placing meshed fabric of carbon fibres for strengthening the section as per design and maker's instructions, including preparation and checking the surfaces, pasting, and fastening by wet procedure
52 332	m^2	Supply and placing meshed fabric of carbon fibres for strengthening the section as per design and maker's instructions, including preparation and checking the surfaces, pasting, and fastening by dry procedure
52 341	m^1	Supply and placing steel laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, steel grade Č 0562, laminate cross-sectional area up to 100 mm^2
52 342	m^1	Supply and placing steel laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, steel grade Č 0562, laminate cross-sectional area 101 - 200 mm^2
52 343	m^1	Supply and placing steel laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, steel grade Č 0562, laminate cross-sectional area 201 - 300 mm^2
52 344	m^1	Supply and placing steel laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, steel grade Č 0562, laminate cross-sectional area …… mm^2
52 351	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity $>$ 155.000 N/mm^2, cross-section up to 70 mm^2
52 352	m^1	Supply and placing carbon laminate for strengthening the section,

Item	Unit Measure	Description of Work
		including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 155.000 N/mm^2, cross-section 71 - 100 mm^2
52 353	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 155.000 N/mm^2, cross-section 101 – 130 mm^2
52 354	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 155.000 N/mm^2, cross-section 131 – 160 mm^2
52 355	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 155.000 N/mm^2, cross-section above 160 mm^2
52 361	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 210.000 N/mm^2, cross-section up to 70 mm^2
52 362	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 210.000 N/mm^2, cross-section 71 - 100 mm^2
52 363	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 210.000 N/mm^2, cross-section 101 – 130 mm^2
52 364	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 210.000 N/mm^2, cross-section 131 – 160 mm^2
52 365	m^1	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 210.000 N/mm^2, cross-section above 160 mm^2
52 371	m^2	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 300.000 N/mm^2, cross-section up to 70 mm^2
52 372	m^2	Supply and placing carbon laminate for strengthening the section, including preparation and checking the surfaces, pasting, and fastening, modulus of elasticity > 300.000 N/mm^2, cross-section 71 - 100 mm^2
52 411	kg	Supply and placing smooth steel wire of circular cross-section, of high tensile strength, for prestressed structures
52 421	kg	Supply and placing profiled steel wire of circular cross-section, of high tensile strength, for prestressed structures
52 431	kg	Supply and placing smooth steel bars of circular cross-section, of high tensile strength, for prestressed structures
52 441	kg	Supply and placing ribbed steel bars of circular cross-section, of high tensile strength, for prestressed structures
52 451	kg	Supply and placing strands of smooth steel wires of circular cross-section, of high tensile strength, for prestressed structures; strand made of two coiled wires
52 452	kg	Supply and placing strands of smooth steel wires of circular cross-section, of high tensile strength, for prestressed structures; strand made of three coiled wires

Item	Unit Measure	Description of Work
52 453	kg	Supply and placing strands of smooth steel wires of circular cross-section, of high tensile strength, for prestressed structures; strand made of seven coiled wires
52 454	kg	Supply and placing strands of smooth steel wires of circular cross-section, of high tensile strength, for prestressed structures; strand made of …. coiled wires
52 461	kg	Supply of external prestressing polygonal tendon (outside the section) for strengthening the bridge superstructure, including equipment and installation, capacity 200 kN
52 462	kg	Supply of external prestressing polygonal tendon (outside the section) for strengthening the bridge superstructure, including equipment and installation, capacity 400 kN
52 463	kg	Supply of external prestressing polygonal tendon (outside the section) for strengthening the bridge superstructure, including equipment and installation, capacity 600 kN
52 464	kg	Supply of external prestressing polygonal tendon (outside the section) for strengthening the bridge superstructure, including equipment and installation, capacity 800 kN
52 465	kg	Supply of external prestressing polygonal tendon (outside the section) for strengthening the bridge superstructure, including equipment and installation, capacity …. kN
52 471	pcs	Supply and placing of anchor head of type ……….
52 474	pcs	Supply and placing of extending head of type ………
52 477	pcs	Supply and placing of stressing head of type ……….
52 481	kg	Supply, installation, and tensioning of bonded tendon, including all the works for completion of prestressing
52 486	kg	Supply, installation, and tensioning of tendon inserted into PE sheathing, protected with grease, including all the works for completion of prestressing
52 511	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 26.5 mm, length up to 1.0 m
52 512	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 26.5 mm, length 1.1 – 2.0 m
52 513	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 26.5 mm, length 2.1 – 3.0 m
52 514	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 26.5 mm, length above 3.0 m
52 521	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 32 mm, length up to 1.0 m
52 522	m^1	Supply and installation of Dywidag bar, including all the equipment,

Item	Unit Measure	Description of Work
		tensioning, without grouting, steel grade ST 85/105, diameter 32 mm, length 1.1 – 2.0 m
52 523	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 32 mm, length 2.1 – 3.0 m
52 524	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 32 mm, length above 3.0 m
52 531	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 36 mm, length up to 1.0 m
52 532	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 36 mm, length 1.1 – 2.0 m
52 533	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 36 mm, length 2.1 – 3.0 m
52 534	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 85/105, diameter 36 mm, length above 3.0 m
52 541	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 26.5 mm, length up to 1.0 m
52 542	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 26.5 mm, length 1.1 – 2.0 m
52 543	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 26.5 mm, length 2.1 – 3.0 m
52 544	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 26.5 mm, length above 3.0 m
52 551	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 32 mm, length up to 1.0 m
52 552	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 32 mm, length 1.1 – 2.0 m
52 553	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 32 mm, length 2.1 – 3.0 m
52 554	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 32 mm, length above 3.0 m
52 561	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 36 mm, length up to 1.0 m
52 562	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 36 mm, length 1.1 – 2.0 m
52 563	m^1	Supply and installation of Dywidag bar, including all the equipment,

Item	Unit Measure	Description of Work
		tensioning, without grouting, steel grade ST 110/125, diameter 36 mm, length 2.1 – 3.0 m
52 564	m^1	Supply and installation of Dywidag bar, including all the equipment, tensioning, without grouting, steel grade ST 110/125, diameter 36 mm, length above 3.0 m
52 611	t	Supply and placing steel arches TH 21
52 612	t	Supply and placing steel arches TH 25
52 613	t	Supply and placing steel arches TH 27
52 614	t	Supply and placing steel arches TH 29
52 621	t	Supply and placing steel arches HEB 100
52 622	t	Supply and placing steel arches HEB 120
52 623	t	Supply and placing steel arches HEB 140
52 624	t	Supply and placing steel arches HEB 160
52 631	kg	Supply and placing steel arches of T-section
52 632	kg	Supply and placing steel arches ofH-section
52 633	kg	Supply and placing steel arches of I-section
52 641	t	Supply and placing latticed arches of minimum moment of resistance W_x = 38 cm^3
52 642	t	Supply and placing latticed arches of minimum moment of resistance W_x = 51 cm^3
52 643	t	Supply and placing latticed arches of minimum moment of resistance W_x = 66 cm^3
52 651	t	Supply and placing steel formwork boards of 6 mm thickness, length 1.6 m
52 652	t	Supply and placing steel formwork boards of 6 mm thickness, length 2.0 m
52 661	pcs	Supply and placing steel linking locks for arches
52 711	pcs	Supply and placing micro-piles, made of IBI or IBO anchors, of bearing capacity 500 kN, including grouting with cement suspension, length 4 m
52 712	pcs	Supply and placing micro-piles, made of IBI or IBO anchors, of bearing capacity 500 kN, including grouting with cement suspension, length 6 m
52 721	pcs	Supply and placing micro-piles, made of steel perforated pipes of ϕ 4", wall thickness min. 6 mm, including grouting with cement suspension at low pressure, length 6 m
52 722	pcs	Supply and placing micro-piles, made of steel perforated pipes of ϕ 4", wall thickness min. 6 mm, including grouting with cement suspension at low pressure, length 8 m
52 731	pcs	Strengthening the tunnel ceiling with steel tubular shield, made of pipes ϕ 4", wall thickness min. 6 mm, including supply, placing, and grouting, length 12 m
52 732	pcs	Strengthening the tunnel ceiling with steel tubular shield, made of pipes ϕ 4", wall thickness min. 6 mm, including supply, placing, and grouting, length 15 m
52 733	pcs	Strengthening the tunnel ceiling with steel tubular shield, made of pipes ϕ

Item	Unit Measure	Description of Work
		4", wall thickness min. 6 mm, including supply, placing, and grouting, length 18 m
52 741	pcs	Strengthening the tunnel ceiling with steel tubular shield, made of pipes ϕ 6", wall thickness min. 6 mm, including supply, placing, and grouting, length 12 m
52 742	pcs	Strengthening the tunnel ceiling with steel tubular shield, made of pipes ϕ 6", wall thickness min. 6 mm, including supply, placing, and grouting, length 15 m
52 743	pcs	Strengthening the tunnel ceiling with steel tubular shield, made of pipes ϕ 6", wall thickness min. 6 mm, including supply, placing, and grouting, length 18 m
52 751	m^1	Execution of earthing in tunnel by means of Fe-Zn strip of 40/4 mm and transverse connections of main earthing strips with Fe-Zn strip of 25/4 mm, installed into tunnel foundations including all fastening and connections to steel elements of the tunnel primary lining, as well as branches to kinetes
52 752	m^1	Execution of earthing in tunnel by means of Fe-Zn strip of 40/4 mm and transverse connections of main earthing strips with Fe-Zn strip of 25/4 mm, installed into tunnel filling cement concrete including branches to kinetes

2.2.5.10.1.3 Works with Cement Concrete

Item	Unit Measure	Description of Work
53 111	m^3	Supply and casting mixture of cement concrete C8/10 (MB 10) in section up to 0.15 m^3/m^2-m^1
53 112	m^3	Supply and casting mixture of cement concrete C8/10 (MB 10) in section 0.16 – 0.30 m^3/m^2-m^1
53 113	m^3	Supply and casting mixture of cement concrete C8/10 (MB 10) in section 0.31 – 0.50 m^3/m^2-m^1
53 114	m^3	Supply and casting mixture of cement concrete C8/10 (MB 10) in section over 0.50 m^3/m^2-m^1
53 121	m^3	Supply and casting mixture of cement concrete C12/15 (MB 15) in section up to 0.15 m^3/m^2-m^1
53 122	m^3	Supply and casting mixture of cement concrete C12/15 (MB 15) in section 0.16 – 0.30 m^3/m^2-m^1
53 123	m^3	Supply and casting mixture of cement concrete C12/15 (MB 15) in section 0.31 – 0.50 m^3/m^2-m^1
53 124	m^3	Supply and casting mixture of cement concrete C12/15 (MB 15) in section over 0.50 m^3/m^2-m^1
53 131	m^3	Supply and casting mixture of cement concrete C16/20 (MB 20) in section up to 0.15 m^3/m^2-m^1
53 132	m^3	Supply and casting mixture of cement concrete C16/20 (MB 20) in section 0.16 – 0.30 m^3/m^2-m^1
53 133	m^3	Supply and casting mixture of cement concrete C16/20 (MB 20) in section 0.31 – 0.50 m^3/m^2-m^1
53 134	m^3	Supply and casting mixture of cement concrete C16/20 (MB 20) in section over 0.50 m^3/m^2-m^1
53 141	m^3	Supply and casting mixture of cement concrete C20/25 (MB 25) in section up to 0.15 m^3/m^2-m^1
53 142	m^3	Supply and casting mixture of cement concrete C20/25 (MB 25) in section 0.16 – 0.30 m^3/m^2-m^1
53 143	m^3	Supply and casting mixture of cement concrete C20/25 (MB 25) in section 0.31 – 0.50 m^3/m^2-m^1
53 144	m^3	Supply and casting mixture of cement concrete C20/25 (MB 25) in section over 0.50 m^3/m^2-m^1
53 151	m^3	Supply and casting mixture of cement concrete C../.. in section up to 0.15 m^3/m^2-m^1
53 152	m^3	Supply and casting mixture of cement concrete C../.. in section 0.16 – 0.30 m^3/m^2-m^1
53 153	m^3	Supply and casting mixture of cement concrete C../.. in section 0.31 – 0.50 m^3/m^2-m^1
53 154	m^3	Supply and casting mixture of cement concrete C../.. in section over 0.50 m^3/m^2-m^1
53 161	m^3	Supply and placing underlay cement concrete C12/15 in section up to 0.15 m^3/m^2
53 162	m^3	Supply and placing underlay cement concrete C12/15 in section over 0.15 m^3/m^2

Item	Unit Measure	Description of Work
53 164	m^3	Supply and placing underlay cement concrete C16/20 in section up to 0.15 m^3/m^2
53 165	m^3	Supply and placing underlay cement concrete C16/20 in section over 0.15 m^3/m^2
53 167	m^3	Supply and placing underlay cement concrete C../.. in section up to 0.15 m^3/m^2
53 168	m^3	Supply and placing underlay cement concrete C ../.. in section over 0.15 m^3/m^2
53 171	m^3	Supply and casting filling cement concrete C12/15 in section up to 0.50 m^3/m^2
53 172	m^3	Supply and casting filling cement concrete C12/15 in section over 0.50 m^3/m^2
53 173	m^3	Supply and casting filling cement concrete C16/20 in section up to 0.50 m^3/m^2
53 174	m^3	Supply and casting filling cement concrete C16/20 in section over 0.50 m^3/m^2
53 175	m^3	Supply and casting filling cement concrete C25/30 in section up to 0.50 m^3/m^2
53 176	m^3	Supply and casting filling cement concrete C25/30 in section over 0.50 m^3/m^2
53 177	m^3	Dobava in vgraditev polnilnega cementnega betona C../… v prerez do 0,50 m^3/m^2
53 178	m^3	Dobava in vgraditev polnilnega cementnega betona C../... v prerez nad 0,50 m^3/m^2
53 181	m^3	Supply and casting filling cement concrete C../.. in section up to 0.50 m^3/m^2
53 182	m^3	Supply and casting filling cement concrete C../.. in section over 0.50 m^3/m^2
53 184	m^3	Supply and casting protective / levelling / sloping cement concrete C16/20 in section up to 0.15 m^3/m^2
53 185	m^3	Supply and casting protective / levelling / sloping cement concrete C16/20 in section over 0.15 m^3/m^2
53 187	m^3	Supply and casting protective / levelling / sloping cement concrete C../.. in section up to 0.15 m^3/m^2
53 188	m^3	Supply and casting protective / levelling / sloping cement concrete C../.. in section over 0.15 m^3/m^2
53 191	m^3	Extra payment for placing cement concrete mixture underwater
53 211	m3	Supply and casting mixture of reinforced cement concrete C12/15 in section up to 0.15 m^3/m^2-m^1
53 212	m3	Supply and casting mixture of reinforced cement concrete C12/15 in section 0.16 – 0.30 m^3/m^2-m^1
53 213	m3	Supply and casting mixture of reinforced cement concrete C12/15 in section 0.31 – 0.50 m^3/m^2-m^1

Item	Unit Measure	Description of Work
53 214	m3	Supply and casting mixture of reinforced cement concrete C12/15 in section over 0.50 m^3/m^2-m^1
53 221	m^3	Supply and casting mixture of reinforced cement concrete C16/20 in section up to 0.15 m^3/m^2-m^1
53 222	m^3	Supply and casting mixture of reinforced cement concrete C16/20 in section 0.16 – 0.30 m^3/m^2-m^1
53 223	m^3	Supply and casting mixture of reinforced cement concrete C16/20 in section 0.31 – 0.50 m^3/m^2-m^1
53 224	m^3	Supply and casting mixture of reinforced cement concrete C16/20in section over 0.50 m^3/m^2-m^1
53 231	m^3	Supply and casting mixture of reinforced cement concrete C20/25 in section up to 0.15 m^3/m^2-m^1
53 232	m^3	Supply and casting mixture of reinforced cement concrete C20/25 in section 0.16 – 0.30 m^3/m^2-m^1
53 233	m^3	Supply and casting mixture of reinforced cement concrete C20/25 in section 0.31 – 0.50 m^3/m^2-m^1
53 234	m^3	Supply and casting mixture of reinforced cement concrete C20/25 in section over 0.50 m^3/m^2-m^1
53 241	m^3	Supply and casting mixture of reinforced cement concrete C25/30 in section up to 0.15 m^3/m^2-m^1
53 242	m^3	Supply and casting mixture of reinforced cement concrete C25/30 in section 0.16 – 0.30 m^3/m^2-m^1
53 243	m^3	Supply and casting mixture of reinforced cement concrete C25/30 in section 0.31 – 0.50 m^3/m^2-m^1
53 244	m^3	Supply and casting mixture of reinforced cement concrete C25/30 in section over 0.50 m^3/m^2-m^1
53 251	m^3	Supply and casting mixture of reinforced cement concrete C30/37 in section up to 0.15 m^3/m^2-m^1
53 252	m^3	Supply and casting mixture of reinforced cement concrete C30/37 in section 0.16 – 0.30 m^3/m^2-m^1
53 253	m^3	Supply and casting mixture of reinforced cement concrete C30/37 in section 0.31 – 0.50 m^3/m^2-m^1
53 254	m^3	Supply and casting mixture of reinforced cement concrete C30/37 in section over 0.50 m^3/m^2-m^1
53 261	m^3	Supply and casting mixture of reinforced cement concrete C35/45 in section up to 0.15 m^3/m^2-m^1
53 262	m^3	Supply and casting mixture of reinforced cement concrete C35/45 in section 0.16 – 0.30 m^3/m^2-m^1
53 263	m^3	Supply and casting mixture of reinforced cement concrete C35/45 in section 0.31 – 0.50 m^3/m^2-m^1
53 264	m^3	Supply and casting mixture of reinforced cement concrete C35/45 in section over 0.50 m^3/m^2-m^1
53 271	m^3	Supply and casting mixture of reinforced cement concrete C40/50 in section up to 0.15 m^3/m^2-m^1
53 272	m^3	Supply and casting mixture of reinforced cement concrete C40/50 in section 0.16 – 0.30 m^3/m^2-m^1

Item	Unit Measure	Description of Work
53 273	m^3	Supply and casting mixture of reinforced cement concrete C40/50 in section 0.31 – 0.50 m^3/m^2-m^1
53 274	m^3	Supply and casting mixture of reinforced cement concrete C40/50 in section over 0.50 m^3/m^2-m^1
53 281	m^3	Supply and casting mixture of reinforced cement concrete C../.. in section up to 0.15 m^3/m^2-m^1
53 282	m^3	Supply and casting mixture of reinforced cement concrete C../.. in section 0.16 – 0.30 m^3/m^2-m^1
53 283	m^3	Supply and casting mixture of reinforced cement concrete C../.. in section 0.31 – 0.50 m^3/m^2-m^1
53 284	m^3	Supply and casting mixture of reinforced cement concrete C../.. in section over 0.50 m^3/m^2-m^1
53 311	m^3	Supply and casting reinforced cement concrete C25/30 in spot foundations or foundation blocks
53 312	m^3	Supply and casting reinforced cement concrete C25/30 in strip foundations, foundation beams, or inclined or vertical columns
53 313	m^3	Supply and casting reinforced cement concrete C25/30 in foundation slabs
53 314	m^3	Supply and casting reinforced cement concrete C25/30 in transition slabs
53 315	m^3	Supply and casting reinforced cement concrete C25/30 in foundations ……
53 317	m^3	Supply and casting reinforced cement concrete C25/30 in abutment walls, wing walls, and wings
53 318	m^3	Supply and casting reinforced cement concrete C25/30 in supporting or retaining walls
53 319	m^3	Supply and casting reinforced cement concrete C25/30 in walls ……
53 321	m^3	Supply and casting reinforced cement concrete C25/30 in piers of rectangular or circular cross-section
53 322	m^3	Supply and casting reinforced cement concrete C25/30 in piers of polygonal/H cross-section
53 323	m^3	Supply and casting reinforced cement concrete C25/30 in piers of box cross-section
53 324	m^3	Supply and casting reinforced cement concrete C25/30 in piers of …… cross-section
53 331	m^3	Supply and casting reinforced cement concrete C25/30 in superstructure of solid slab type
53 332	m^3	Supply and casting reinforced cement concrete C25/30 in superstructure of coffered slab type or hollow slab type
53 333	m^3	Supply and casting reinforced cement concrete C25/30 in superstructure of beam type with rectangular or trapezoidal bemas with or without cross-beams
53 334	m^3	Supply and casting reinforced cement concrete C25/30 in superstructure of box type with one or more spans
53 335	m^3	Supply and casting reinforced cement concrete C25/30 in superstructure ……….…
53 337	m^3	Supply and casting reinforced cement concrete C25/30 in bearing blocks, seismic protection blocks, and other similar elements of volume up to 2 m^3

Item	Unit Measure	Description of Work
53 338	m^3	Supply and casting reinforced cement concrete C25/30 in footways and edge beams on bridges and supporting/retaining structures
53 341	m^3	Supply and casting reinforced cement concrete C30/37 in spot foundations or foundation blocks
53 342	m^3	Supply and casting reinforced cement concrete C30/37 in strip foundations, foundation beams, or inclined or vertical columns
53 343	m^3	Supply and casting reinforced cement concrete C30/37 in foundation slabs
53 344	m^3	Supply and casting reinforced cement concrete C30/37 in transition slabs
53 345	m^3	Supply and casting reinforced cement concrete C30/37 in foundations ……
53 347	m^3	Supply and casting reinforced cement concrete C30/37 in abutment walls, wing walls, and wings
53 348	m^3	Supply and casting reinforced cement concrete C30/37 in supporting or retaining walls
53 349	m^3	Supply and casting reinforced cement concrete C30/37 in walls ……
53 351	m^3	Supply and casting reinforced cement concrete C30/37 in piers of rectangular or circular cross-section
53 352	m^3	Supply and casting reinforced cement concrete C30/37 in piers of polygonal/H cross-section
53 353	m^3	Supply and casting reinforced cement concrete C30/37 in piers of box cross-section
53 354	m^3	Supply and casting reinforced cement concrete C30/37 in piers of …… cross-section
53 361	m^3	Supply and casting reinforced cement concrete C30/37 in superstructure of solid slab type
53 362	m^3	Supply and casting reinforced cement concrete C30/37 in superstructure of coffered slab type or hollow slab type
53 363	m^3	Supply and casting reinforced cement concrete C30/37 in superstructure of beam type with rectangular or trapezoidal bemas with or without cross-beams
53 364	m^3	Supply and casting reinforced cement concrete C30/37 in superstructure of box type with one or more spans on falsework or by free cantilevering
53 365	m^3	Supply and casting reinforced cement concrete C30/37 in superstructure of box type with one or more spans by incremental launching
53 366	m^3	Supply and casting reinforced cement concrete C30/37 in superstructure …………
53 371	m^3	Supply and casting reinforced cement concrete C30/37 in bearing blocks, seismic protection blocks, and other similar elements of volume up to 2 m^3
53 372	m^3	Supply and casting reinforced cement concrete C30/37 in footways and edge beams on bridges and supporting/retaining structures
53 374	m^3	Supply and casting reinforced cement concrete C35/45 in spot foundations or foundation blocks
53 375	m^3	Supply and casting reinforced cement concrete C35/45 in strip foundations, foundation beams, or inclined or vertical columns
53 376	m^3	Supply and casting reinforced cement concrete C35/45 in foundation slabs

Item	Unit Measure	Description of Work
53 377	m^3	Supply and casting reinforced cement concrete C35/45 in transition slabs
53 378	m^3	Supply and casting reinforced cement concrete C35/45 in foundations ……
53 381	m^3	Supply and casting reinforced cement concrete C35/45 in abutment walls, wing walls, and wings
53 382	m^3	Supply and casting reinforced cement concrete C35/45 in supporting or retaining walls
53 383	m^3	Supply and casting reinforced cement concrete C35/45 in walls ……
53 385	m^3	Supply and casting reinforced cement concrete C35/45 in piers of rectangular or circular cross-section
53 386	m^3	Supply and casting reinforced cement concrete C35/45 in piers of polygonal/H cross-section
53 387	m^3	Supply and casting reinforced cement concrete C35/45 in piers of box cross-section
53 388	m^3	Supply and casting reinforced cement concrete C35/45 in piers of …… cross-section
53 391	m^3	Supply and casting reinforced cement concrete C35/45 in superstructure of solid slab type
53 392	m^3	Supply and casting reinforced cement concrete C35/45 in superstructure of coffered slab type or hollow slab type
53 393	m^3	Supply and casting reinforced cement concrete C35/45 in superstructure of beam type with rectangular or trapezoidal bemas with or without cross-beams
53 394	m^3	Supply and casting reinforced cement concrete C35/45 in superstructure of box type with one or more spans on falsework or by free cantilevering
53 395	m^3	Supply and casting reinforced cement concrete C35/45 in superstructure of box type with one or more spans by incremental launching
53 396	m^3	Supply and casting reinforced cement concrete C35/45 in superstructure …………
53 411	m^3	Supply and casting reinforced cement concrete C35/45 in bearing blocks, seismic protection blocks, and other similar elements of volume up to 2 m^3
53 412	m^3	Supply and casting reinforced cement concrete C35/45 in footways and edge beams on bridges and supporting/retaining structures
53 414	m^3	Supply and casting reinforced cement concrete C../.. in spot foundations or foundation blocks
53 415	m^3	Supply and casting reinforced cement concrete C../.. in strip foundations, foundation beams, or inclined or vertical columns
53 416	m^3	Supply and casting reinforced cement concrete C../.. in foundation slabs
53 417	m^3	Supply and casting reinforced cement concrete C../.. in transition slabs
53 418	m^3	Supply and casting reinforced cement concrete C../.. in foundations ……
53 421	m^3	Supply and casting reinforced cement concrete C../.. in abutment walls, wing walls, and wings
53 422	m^3	Supply and casting reinforced cement concrete C../.. in supporting or retaining walls
53 423	m^3	Supply and casting reinforced cement concrete C../.. in walls ……

Item	Unit Measure	Description of Work
53 425	m^3	Supply and casting reinforced cement concrete C../.. in piers of rectangular or circular cross-section
53 426	m^3	Supply and casting reinforced cement concrete C../.. in piers of polygonal/H cross-section
53 427	m^3	Supply and casting reinforced cement concrete C../.. in piers of box cross-section
53 428	m^3	Supply and casting reinforced cement concrete C../.. in piers of …… cross-section
53 431	m^3	Supply and casting reinforced cement concrete C../.. in superstructure of solid slab type
53 432	m^3	Supply and casting reinforced cement concrete C../.. in superstructure of coffered slab type or hollow slab type
53 433	m^3	Supply and casting reinforced cement concrete C../.. in superstructure of beam type with rectangular or trapezoidal bemas with or without cross-beams
53 434	m^3	Supply and casting reinforced cement concrete C../.. in superstructure of box type with one or more spans on falsework or by free cantilevering
53 435	m^3	Supply and casting reinforced cement concrete C../.. in superstructure of box type with one or more spans by incremental launching
53 436	m^3	Supply and casting reinforced cement concrete C../.. in superstructure …………
53 438	m^3	Supply and casting reinforced cement concrete C../.. in bearing blocks, seismic protection blocks, and other similar elements of volume up to 2 m^3
53 439	m^3	Supply and casting reinforced cement concrete C../.. in footways and edge beams on bridges and supporting/retaining structures
53 441	kg	Application of chloride additive to accelerate setting of fresh cement concrete
53 442	kg	Application of chloride-less additive to accelerate setting of fresh cement concrete
53 443	kg	Application of additive to retard setting of fresh cement concrete
53 444	kg	Application of additive to plasticize fresh cement concrete
53 445	kg	Application of additive to super-plasticize fresh cement concrete
53 446	kg	Application of additive to retain the water in cement concrete
53 447	kg	Application of additive to aerate cement concrete
53 448	kg	Application of additive for heat development in fresh cement concrete
53 449	kg	Application of additive for lowering the water freezing point in cement concrete
53 451	kg	Application of additive to prevent shrinkage of cement concrete and mortar
53 452	kg	Application of additive for swelling of mortars and grouting compounds
53 453	kg	Application of additive to increase resistance of cement concrete and mortar to chemical corrosion

Item	Unit Measure	Description of Work
53 454	kg	Application of additive – micro-silica to produce high-performance mortar and concrete
53 455	kg	Application of additive for/to ………………………………
53 511	m^3	Supply and casting mixture of porous (drainage) cement concrete
53 521	m^3	Supply and casting mixture of foamy cement concrete C12/15 (MB 15)
53 522	m^3	Supply and casting mixture of foamy cement concrete C16/20 (MB 20)
53 523	m^3	Supply and casting mixture of foamy cement concrete C20/25 (MB 25)
53 524	m^3	Supply and casting mixture of foamy cement concrete C25/30 (MB 30)
53 525	m^3	Supply and casting mixture of foamy cement concrete C30/37 (MB 35)
53 526	m^3	Supply and casting mixture of foamy cement concrete C35/45 (MB 40)
53 527	m^3	Supply and casting mixture of foamy cement concrete C35/45 (MB 45)
53 531	m^3	Supply and casting mixture of light-weight cement concrete C8/10
53 532	m^3	Supply and casting mixture of light-weight cement concrete C12/15
53 533	m^3	Supply and casting mixture of light-weight cement concrete C16/20
53 534	m^3	Supply and casting mixture of light-weight cement concrete C20/25
53 535	m^3	Supply and casting mixture of light-weight cement concrete C25/30
53 536	m^3	Supply and casting mixture of light-weight cement concrete C ../…
53 541	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section up to 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 542	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section up to 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 543	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section up to 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 544	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section up to 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 546	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section over 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 547	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section over 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 548	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section over 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 549	m^3	Supply and placing prefabricated element of reinforced cement concrete C25/30, section over 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 551	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section up to 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 552	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section up to 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 553	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section up to 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 554	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section up to 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m

Item	Unit Measure	Description of Work
53 556	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section over 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 557	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section over 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 558	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section over 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 559	m^3	Supply and placing prefabricated element of reinforced cement concrete C30/37, section over 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 561	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section up to 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 562	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section up to 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 563	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section up to 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 564	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section up to 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 566	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section over 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 567	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section over 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 568	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section over 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 569	m^3	Supply and placing prefabricated element of reinforced cement concrete C35/45, section over 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 571	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section up to 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 572	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section up to 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 573	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section up to 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 574	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section up to 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 576	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section over 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 577	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section over 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 578	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section over 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 579	m^3	Supply and placing prefabricated element of reinforced cement concrete C40/50, section over 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 581	m^3	Supply and placing prefabricated element of reinforced cement concrete C../.., section up to 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 582	m^3	Supply and placing prefabricated element of reinforced cement concrete C../.., section up to 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 583	m^3	Supply and placing prefabricated element of reinforced cement concrete C../.., section up to 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 584	m^3	Supply and placing prefabricated element of reinforced cement concrete

Item	Unit Measure	Description of Work
		C../.., section up to 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 586	m^3	Supply and placing prefabricated element of reinforced cement concrete C../.., section over 0.50 m^3/m^2-m^1, maximum dimension up to 2.5 m
53 587	m^3	Supply and placing prefabricated element of reinforced cement concrete C../.., section over 0.50 m^3/m^2-m^1, maximum dimension 2.6 – 5.0 m
53 588	m^3	Supply and placing prefabricated element of reinforced cement concrete C../.., section over 0.50 m^3/m^2-m^1, maximum dimension 5.1 – 10.0 m
53 589	m^3	Supply and placing prefabricated element of reinforced cement concrete C../.., section over 0.50 m^3/m^2-m^1, maximum dimension over 10.0 m
53 591	m^3	Supply and casting mixture of reinforced polymer cement concrete C30/37 for carriageway slabs on bridges, thickness of additional casting up to 10 cm, polymer additive as per design
53 592	m^3	Supply and casting mixture of reinforced polymer cement concrete C30/37 for carriageway slabs on bridges, thickness of additional casting 11 - 15 cm, polymer additive as per design
53 593	m^3	Supply and casting mixture of reinforced polymer cement concrete C30/37 for carriageway slabs on bridges, thickness of additional casting ……… cm, polymer additive as per design
53 595	m^3	Supply and casting mixture of reinforced polymer cement concrete C../.. for carriageway slabs on bridges, thickness of additional casting up to 10 cm, polymer additive as per design
53 596	m^3	Supply and casting mixture of reinforced polymer cement concrete C../.. for carriageway slabs on bridges, thickness of additional casting 11 - 15 cm, polymer additive as per design
53 597	m^3	Supply and casting mixture of reinforced polymer cement concrete C../.. for carriageway slabs on bridges, thickness of additional casting ……… cm, polymer additive as per design
53 611	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 5 cm thickness
53 612	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 10 cm thickness
53 613	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 15 cm thickness
53 614	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 20 cm thickness
53 615	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 25 cm thickness
53 616	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 30 cm thickness
53 617	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 35 cm thickness
53 618	m^2	Supply and application of mixture of shot cement concrete C20/25 in top heading, bench, and niche, of 40 cm thickness
53 621	m^2	Supply and application of mixture of micro-reinforced shot cement concrete C20/25 in top heading, bench, and niche, of 5 cm thickness
53 622	m^2	Supply and application of mixture of micro-reinforced shot cement concrete C20/25 in top heading, bench, and niche, of 10 cm thickness
53 623	m^2	Supply and application of mixture of micro-reinforced shot cement

Item	Unit Measure	Description of Work
		concrete C20/25 in top heading, bench, and niche, of 15 cm thickness
53 624	m^2	Supply and application of mixture of micro-reinforced shot cement concrete C20/25 in top heading, bench, and niche, of 20 cm thickness
53 631	m^2	Supply and application of mixture of shot cement concrete C20/25 for invert, of 20 cm thickness
53 632	m^2	Supply and application of mixture of shot cement concrete C20/25 for invert, of 25 cm thickness
53 633	m^2	Supply and application of mixture of shot cement concrete C20/25 for invert, of 30 cm thickness
53 634	m^2	Supply and application of mixture of shot cement concrete C20/25 for invert, of 35 cm thickness
53 641	m^2	Supply and application of mixture of shot cement concrete C20/25 to execute temporary invert in top heading, of 20 cm thickness
53 642	m^2	Supply and application of mixture of shot cement concrete C20/25 to execute temporary invert in top heading, of 25 cm thickness
53 646	m^1	Supply and application of shot cement concrete C20/25 to execute a widened foot in top heading (elephant foot), of 50 cm minimum thickness
53 651	m^2	Supply and application of mixture of shot cement concrete C20/25 to protect the front in top heading, of 3 cm thickness
53 652	m^2	Supply and application of mixture of shot cement concrete C20/25 to protect the front in top heading, of 5 cm thickness
53 653	m^2	Supply and application of mixture of shot cement concrete C20/25 to protect the front in top heading, of 10 cm thickness
53 661	m^3	Supply and application of mixture of shot cement concrete C16/20, section up to 0.10 m^3/m^2
53 662	m^3	Supply and application of mixture of shot cement concrete C16/20, section 0.11 – 0.20 m^3/m^2
53 663	m^3	Supply and application of mixture of shot cement concrete C16/20, section over 0.20 m^3/m^2
53 665	m^3	Supply and application of mixture of shot cement concrete C25/30, section up to 0.10 m^3/m^2
53 666	m^3	Supply and application of mixture of shot cement concrete C25/30, section 0.11 – 0.20 m^3/m^2
53 667	m^3	Supply and application of mixture of shot cement concrete C25/30, section over 0.20 m^3/m^2
53 671	m^3	Supply and application of mixture of shot cement concrete C../.., section up to 0.10 m^3/m^2
53 672	m^3	Supply and application of mixture of shot cement concrete C../.., section 0.11 – 0.20 m^3/m^2
53 673	m^3	Supply and application of mixture of shot cement concrete C../.. section over 0.20 m^3/m^2
53 681	m^3	Supply and application of mixture of shot cement concrete C20/25 to fill up voids due to crumbling, volume over 2 m^3

Item	Unit Measure	Description of Work
53 691	m^2	Extra payment for application of mixture of shot cement concrete, of 10 cm thickness, more than 50 m behind the tunnel front
53 692	m^2	Extra payment for application of mixture of shot cement concrete, of 15 cm thickness, more than 50 m behind the tunnel front
53 693	m^2	Extra payment for application of mixture of shot cement concrete, of 20 cm thickness, more than 50 m behind the tunnel front
53 697	m^3	Extra payment for shot cement concrete resistant to sulphates
53 711	m^3	Supply and placing mixture of poured cement concrete C8/10
53 712	m^3	Supply and placing mixture of poured cement concrete C12/15
53 713	m^3	Supply and placing mixture of poured cement concrete C18/20
53 714	m^3	Supply and placing mixture of poured cement concrete C20/25
53 715	m^3	Supply and placing mixture of poured cement concrete C25/30
53 716	m^3	Supply and placing mixture of poured cement concrete C30/37
53 717	m^3	Supply and placing mixture of poured cement concrete C37/45
53 718	m^3	Supply and placing mixture of poured cement concrete C…/…
53 721	m^3	Supply and placing mixture of slag cement concrete C8/10
53 722	m^3	Supply and placing mixture of slag cement concrete C12/15
53 723	m^3	Supply and placing mixture of slag cement concrete C16/20
53 724	m^3	Supply and placing mixture of slag cement concrete C20/25
53 725	m^3	Supply and placing mixture of slag cement concrete C25/30
53 726	m^3	Supply and placing mixture of slag cement concrete C30/37
53 727	m^3	Supply and placing mixture of slag cement concrete C37/45
53 728	m^3	Supply and placing mixture of slag cement concrete C…/…
53 811	m^3	Supply and casting mixture of cement concrete resistant to water penetration, class PV-I
53 812	m^3	Supply and casting mixture of cement concrete resistant to water penetration, class PV-II
53 813	m^3	Supply and casting mixture of cement concrete resistant to water penetration, class PV-III
53 821	m^3	Supply and placing mixture of cement concrete C16/20 resistant to wear
53 822	m^3	Supply and placing mixture of cement concrete C20/25 resistant to wear
53 823	m^3	Supply and placing mixture of cement concrete C25/30 resistant to wear
53 824	m^3	Supply and placing mixture of cement concrete C30/37 resistant to wear
53 825	m^3	Supply and placing mixture of cement concrete C37/45 resistant to wear
53 826	m^3	Supply and placing mixture of cement concrete C…/… resistant to wear
53 831	m^3	Supply and placing mixture of cement concrete C25/30 resistant to chemical action
53 832	m^3	Supply and placing mixture of cement concrete C30/37 resistant to chemical action
53 833	m^3	Supply and placing mixture of cement concrete C37/45 resistant to chemical action
53 834	m^3	Supply and placing mixture of cement concrete C…/… resistant to chemical action

Item	Unit Measure	Description of Work
53 911	m^3	Application of silicone coating to cement concrete surface exposed to salt water action, as per design
53 912	m^3	Application of …… coating to cement concrete surface exposed to salt water action, as per design
53 921	m^3	Application of vapour-diffusive coating to cement concrete surface inside gallery or cut-and-cover, as per design
53 922	m^3	Application of ………….. coating to cement concrete surface inside gallery or cut-and-cover, as per design

2.2.5.10.1.4 Masonry and Stonecutting Works

Item	Unit Measure	Description of Work
54 111	m^2	Lining with quarry (broken) stone of silicate rock, bound with cement mortar, in thickness up to 10 cm
54 112	m^2	Lining with quarry (broken) stone of silicate rock, bound with cement mortar, in thickness 11 - 15 cm
54 113	m^2	Lining with quarry (broken) stone of silicate rock, bound with cement mortar, in thickness 16 - 20 cm
54 114	m^2	Lining with quarry (broken) stone of silicate rock, bound with cement mortar, in thickness over 20 cm
54 121	m^2	Lining with quarry (broken) stone of carbonate rock, bound with cement mortar, in thickness up to 10 cm
54 122	m^2	Lining with quarry (broken) stone of carbonate rock, bound with cement mortar, in thickness 11 - 15 cm
54 123	m^2	Lining with quarry (broken) stone of carbonate rock, bound with cement mortar, in thickness 16 - 20 cm
54 124	m^2	Lining with quarry (broken) stone of carbonate rock, bound with cement mortar, in thickness over 20 cm
54 131	m^2	Lining with finished stone of silicate rock, bound with cement mortar, in thickness up to 10 cm
54 132	m^2	Lining with finished stone of silicate rock, bound with cement mortar, in thickness 11 - 15 cm
54 133	m^2	Lining with finished stone of silicate rock, bound with cement mortar, in thickness 16 - 20 cm
54 134	m^2	Lining with finished stone of silicate rock, bound with cement mortar, in thickness over 20 cm
54 141	m^2	Lining with finished stone of carbonate rock, bound with cement mortar, in thickness up to 10 cm
54 142	m^2	Lining with finished stone of carbonate rock, bound with cement mortar, in thickness 11 - 15 cm
54 143	m^2	Lining with finished stone of carbonate rock, bound with cement mortar, in thickness 16 - 20 cm
54 144	m^2	Lining with finished stone of carbonate rock, bound with cement mortar, in thickness over 20 cm
54 151	m^1	Execution of deepened joint
54 211	m^3	Building with quarry stone of silicate rock in cement mortar, on one face, section up to 0.15 m^3/m^2
54 212	m^3	Building with quarry stone of silicate rock in cement mortar, on one face, section 0.16 - 0.25 m^3/m^2
54 213	m^3	Building with quarry stone of silicate rock in cement mortar, on one face, section 0.26 - 0.35 m^3/m^2
54 214	m^3	Building with quarry stone of silicate rock in cement mortar, on one face, section 0.36 - 0.50 m^3/m^2
54 215	m^3	Building with quarry stone of silicate rock in cement mortar, on one face, section over 0.50 m^3/m^2

Item	Unit Measure	Description of Work
54 221	m^3	Building with quarry stone of silicate rock in cement mortar, on two faces, section up to 0.15 m^3/m^2
54 222	m^3	Building with quarry stone of silicate rock in cement mortar, on two faces, section 0.16 - 0.25 m^3/m^2
54 223	m^3	Building with quarry stone of silicate rock in cement mortar, on two faces, section 0.26 - 0.35 m^3/m^2
54 224	m^3	Building with quarry stone of silicate rock in cement mortar, on two faces, section 0.36 - 0.50 m^3/m^2
54 225	m^3	Building with quarry stone of silicate rock in cement mortar, on two faces, section over 0.50 m^3/m^2
54 231	m^3	Building with quarry stone of carbonate rock in cement mortar, on one face, section up to 0.15 m^3/m^2
54 232	m^3	Building with quarry stone of carbonate rock in cement mortar, on one face, section 0.16 - 0.25 m^3/m^2
54 233	m^3	Building with quarry stone of carbonate rock in cement mortar, on one face, section 0.26 - 0.35 m^3/m^2
54 234	m^3	Building with quarry stone of carbonate rock in cement mortar, on one face, section 0.36 - 0.50 m^3/m^2
54 235	m^3	Building with quarry stone of carbonate rock in cement mortar, on one face, section over 0.50 m^3/m^2
54 241	m^3	Building with quarry stone of carbonate rock in cement mortar, on two faces, section up to 0.15 m^3/m^2
54 242	m^3	Building with quarry stone of carbonate rock in cement mortar, on two faces, section 0.16 - 0.25 m^3/m^2
54 243	m^3	Building with quarry stone of carbonate rock in cement mortar, on two faces, section 0.26 - 0.35 m^3/m^2
54 244	m^3	Building with quarry stone of carbonate rock in cement mortar, on two faces, section 0.36 - 0.50 m^3/m^2
54 245	m^3	Building with quarry stone of carbonate rock in cement mortar, on two faces, section over 0.50 m^3/m^2
54 251	m^3	Building with finished stone of silicate rock in cement mortar, on one face, section up to 0.15 m^3/m^2
54 252	m^3	Building with finished stone of silicate rock in cement mortar, on one face, section 0.16 - 0.25 m^3/m^2
54 253	m^3	Building with finished stone of silicate rock in cement mortar, on one face, section 0.26 - 0.35 m^3/m^2
54 254	m^3	Building with finished stone of silicate rock in cement mortar, on one face, section 0.36 - 0.50 m^3/m^2
54 255	m^3	Building with finished stone of silicate rock in cement mortar, on one face, section over 0.50 m^3/m^2
54 261	m^3	Building with finished stone of silicate rock in cement mortar, on two faces, section up to 0.15 m^3/m^2
54 262	m^3	Building with finished stone of silicate rock in cement mortar, on two faces, section 0.16 - 0.25 m^3/m^2
54 263	m^3	Building with finished stone of silicate rock in cement mortar, on two faces, section 0.26 - 0.35 m^3/m^2
54 264	m^3	Building with finished stone of silicate rock in cement mortar, on two faces, section 0.36 - 0.50 m^3/m^2

Item	Unit Measure	Description of Work
54 265	m^3	Building with finished stone of silicate rock in cement mortar, on two faces, section over 0.50 m^3/m^2
54 271	m^3	Building with finished stone of carbonate rock in cement mortar, on one face, section up to 0.15 m^3/m^2
54 272	m^3	Building with finished stone of carbonate rock in cement mortar, on one face, section 0.16 - 0.25 m^3/m^2
54 273	m^3	Building with finished stone of carbonate rock in cement mortar, on one face, section 0.26 - 0.35 m^3/m^2
54 274	m^3	Building with finished stone of carbonate rock in cement mortar, on one face, section 0.36 - 0.50 m^3/m^2
54 275	m^3	Building with finished stone of carbonate rock in cement mortar, on one face, section over 0.50 m^3/m^2
54 281	m^3	Building with finished stone of carbonate rock in cement mortar, on two faces, section up to 0.15 m^3/m^2
54 282	m^3	Building with finished stone of carbonate rock in cement mortar, on two faces, section 0.16 - 0.25 m^3/m^2
54 283	m^3	Building with finished stone of carbonate rock in cement mortar, on two faces, section 0.26 - 0.35 m^3/m^2
54 284	m^3	Building with finished stone of carbonate rock in cement mortar, on two faces, section 0.36 - 0.50 m^3/m^2
54 285	m^3	Building with finished stone of carbonate rock in cement mortar, on two faces, section over 0.50 m^3/m^2
54 311	m^2	Lining with cement concrete prefabricated elements, bound with cement mortar, in thickness up to 10 cm
54 312	m^2	Lining with cement concrete prefabricated elements, bound with cement mortar, in thickness 11 – 15 cm
54 313	m^2	Lining with cement concrete prefabricated elements, bound with cement mortar, in thickness 16 – 20 cm
54 314	m^2	Lining with cement concrete prefabricated elements, bound with cement mortar, in thickness over 20 cm
54 321	m^2	Lining with face brick, bound with cement mortar, in thickness 12 cm
54 411	m^3	Building with prefabricated cement concrete elements in cement mortar, on one face, in thickness up to 0.15 m^3/m^2
54 412	m^3	Building with prefabricated cement concrete elements in cement mortar, on one face, in thickness 0.16 – 0.25 m^3/m^2
54 413	m^3	Building with prefabricated cement concrete elements in cement mortar, on one face, in thickness 0.26 – 0.35 m^3/m^2
54 414	m^3	Building with prefabricated cement concrete elements in cement mortar, on one face, in thickness 0.36 – 0.50 m^3/m^2
54 415	m^3	Building with prefabricated cement concrete elements in cement mortar, on one face, in thickness over 0.50 m^3/m^2
54 421	m^3	Building with prefabricated cement concrete elements in cement mortar, on two faces, in thickness up to 0.15 m^3/m^2
54 422	m^3	Building with prefabricated cement concrete elements in cement mortar, on two faces, in thickness 0.16 – 0.25 m^3/m^2
54 423	m^3	Building with prefabricated cement concrete elements in cement mortar,

Item	Unit Measure	Description of Work
		on two faces, in thickness 0.26 – 0.35 m^3/m^2
54 424	m^3	Building with prefabricated cement concrete elements in cement mortar, on two faces, in thickness 0.36 – 0.50 m^3/m^2
54 425	m^3	Building with prefabricated cement concrete elements in cement mortar, on two faces, in thickness over 0.50 m^3/m^2
54 431	m^2	Building with face brick in cement mortar, in thickness 12 cm
54 432	m^2	Building with face brick in cement mortar, in thickness 25 cm
54 441	m^2	Building with clay brick in cement mortar, on one face, in thickness 12 cm
54 442	m^2	Building with clay brick in cement mortar, on one face, in thickness 18 cm
54 443	m^2	Building with clay brick in cement mortar, on one face, in thickness 25 cm
54 444	m^2	Building with clay brick in cement mortar, on one face, in thickness 31 cm
54 445	m^2	Building with clay brick in cement mortar, on one face, in thickness 38 cm
54 451	m^2	Building with clay brick in cement mortar, on two faces, in thickness 12 cm
54 452	m^2	Building with clay brick in cement mortar, on two faces, in thickness 25 cm
54 453	m^2	Building with clay brick in cement mortar, on two faces, in thickness 38 cm
54 511	m^2	Execution of plaster with cement mortar in thickness 1 cm
54 512	m^2	Execution of plaster with cement mortar in thickness 2 cm
54 513	m^2	Execution of plaster with cement mortar in thickness 3 cm
54 514	m^2	Execution of plaster with cement mortar in thickness 4 cm
54 521	m^2	Roughening and sealing the plaster surface with cement mortar
54 531	m^2	Smoothing the plaster surface with cement mortar
54 541	m^2	Brushing the plaster surface with cement mortar
54 551	m^2	Chopping – stamping the cement concrete surface
54 552	m^2	Chopping – stamping the silicate stone surface
54 553	m^2	Chopping – stamping the carbonate stone surface
54 561	m^2	Grinding the cement concrete surface
54 562	m^2	Grinding the silicate stone surface
54 563	m^2	Grinding the carbonate rock surface

2.2.5.10.1.5 Restoration Works on Structures

Item	Unit Measure	Description of Work
55 111	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces up to 1.0 m^2
55 112	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 113	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 114	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces above 10.0 m^2
55 121	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces up to 1.0 m^2
55 122	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 123	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 124	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces above 10.0 m^2
55 131	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces up to 1.0 m^2
55 132	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 133	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 134	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces above 10.0 m^2
55 141	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces up to 1.0 m^2
55 142	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 143	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 144	m^2	Manual or machine roughening of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces above 10.0 m^2

Item	Unit Measure	Description of Work
55 151	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces up to 1.0 m^2
55 152	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 153	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 154	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface horizontal or inclined by up to 20° to horizontal, individual surfaces above 10.0 m^2
55 161	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces up to 1.0 m^2
55 162	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 163	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 164	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 21-70° to horizontal, individual surfaces above 10.0 m^2
55 171	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces up to 1.0 m^2
55 172	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 173	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 174	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface inclined by 71-90° to horizontal, individual surfaces above 10.0 m^2
55 181	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces up to 1.0 m^2
55 182	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces 1.1 – 5.0 m^2
55 183	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces 5.1 – 10.0 m^2
55 184	m^2	Manual or partly machine grinding of cement concrete surface by chopping or stamping, surface overhead horizontal or inclined by up to 20° to horizontal, individual surfaces above 10.0 m^2
55 191	m^2	Roughening of cement concrete by milling machine, surface horizontal or inclined by up to 20°to horizontal, individual surfaces up to 10.0 m^2

Item	Unit Measure	Description of Work
55 192	m^2	Roughening of cement concrete by milling machine, surface horizontal or inclined by up to 20°to horizontal, individual surfaces 10.1 20.0 m^2
55 193	m^2	Roughening of cement concrete by milling machine, surface horizontal or inclined by up to 20°to horizontal, individual surfaces above 20.0 m^2
55 211	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2
55 212	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 5.0 m^2
55 213	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 5.1 – 10.0 m^2
55 214	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2
55 221	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2
55 222	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 5.0 m^2
55 223	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 21-70˚ to horizontal, individual surfaces 5.1 – 10.0 m^2
55 224	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2
55 231	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2
55 232	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 5.0 m^2
55 233	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 71-90˚ to horizontal, individual surfaces 5.1 – 10.0 m^2
55 234	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2
55 241	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2
55 242	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 5.0 m^2
55 243	m^2	Sand blasting of cement concrete or steel surfaces including collecting the abrasive and transportation to deposit area, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 5.1 – 10.0 m^2
55 244	m^2	Sand blasting of cement concrete or steel surfaces including collecting the

Item	Unit Measure	Description of Work
		abrasive and transportation to deposit area, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2
55 251	m^2	Roughening of cement concrete with high-pressure water jet, surface inclined by 20-70˚ to horizontal, individual surfaces up to 1.0 m^2
55 252	m^2	Roughening of cement concrete with high-pressure water jet, surface inclined by 20-70˚ to horizontal, individual surfaces 1.1 – 5.0 m^2
55 253	m^2	Roughening of cement concrete with high-pressure water jet, surface inclined by 20-70˚ to horizontal, individual surfaces 5.1 – 10.0 m^2
55 254	m^2	Roughening of cement concrete with high-pressure water jet, surface inclined by 20-70˚ to horizontal, individual surfaces above 10.0 m^2
55 261	m^2	Roughening of cement concrete with high-pressure water jet, surface horizontal or inclined by 20-70˚ to horizontal, individual surfaces up to 1.0 m^2
55 262	m^2	Roughening of cement concrete with high-pressure water jet, surface horizontal or inclined by 20-70˚ to horizontal, individual surfaces 1.1 – 5.0 m^2
55 263	m^2	Roughening of cement concrete with high-pressure water jet, surface horizontal or inclined by 20-70˚ to horizontal, individual surfaces 5.1 – 10.0 m^2
55 264	m^2	Roughening of cement concrete with high-pressure water jet, surface horizontal or inclined by 20-70˚ to horizontal, individual surfaces above 10.0 m^2
55 311	m^2	Cleaning of cement concrete surface, without uncovering the reinforcement, with compressed air, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2
55 312	m^2	Cleaning of cement concrete surface, without uncovering the reinforcement, with compressed air, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2
55 313	m^2	Cleaning of cement concrete surface, without uncovering the reinforcement, with compressed air, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2
55 316	m^2	Cleaning of cement concrete surface, with uncovering the reinforcement, with compressed air, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2
55 317	m^2	Cleaning of cement concrete surface, with uncovering the reinforcement, with compressed air, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2
55 318	m^2	Cleaning of cement concrete surface, with uncovering the reinforcement, with compressed air, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2
55 321	m^2	Cleaning of cement concrete surface, without uncovering the reinforcement, with water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2
55 322	m^2	Cleaning of cement concrete surface, without uncovering the reinforcement, with water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2
55 323	m^2	Cleaning of cement concrete surface, without uncovering the reinforcement, with water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2

Item	Unit Measure	Description of Work
55 326	m^2	Cleaning of cement concrete surface, with uncovering the reinforcement, with water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2
55 327	m^2	Cleaning of cement concrete surface, with uncovering the reinforcement, with water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2
55 328	m^2	Cleaning of cement concrete surface, with uncovering the reinforcement, with water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2
55 411	m^2	Working out a cadastre and identification of width, length, depth, cause of formation, and activity of cracks
55 421	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width up to 1 mm
55 422	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width 1.1 – 3.0 mm
55 423	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width 3.1 – 5.0 mm
55 424	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width above 5 mm
55 426	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined 21-70° to the horizontal, crack width up to 1 mm
55 427	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 21-70° to the horizontal, crack width 1.1 – 3.0 mm
55 428	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 21-70° to the horizontal, crack width 3.1 – 5.0 mm
55 429	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 21-70° to the horizontal, crack width above 5 mm
55 431	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined 71-90° to the horizontal, crack width up to 1 mm
55 432	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 71-90° to the horizontal, crack width 1.1 –

Item	Unit Measure	Description of Work
		3.0 mm
55 433	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker's instructions, surface inclined by 71-90° to the horizontal, crack width 3.1 – 5.0 mm
55 434	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker's instructions, surface inclined by 71-90° to the horizontal, crack width above 5 mm
55 436	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker's instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width up to 1 mm
55 437	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker's instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width 1.1 – 3.0 mm
55 438	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker's instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width 3.1 – 5.0 mm
55 439	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 10 mm, with epoxy or polyurethane resin, according to design and maker's instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width above 5 mm
55 441	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker's instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width up to 1 mm
55 442	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker's instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width 1.1 – 3.0 mm
55 443	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker's instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width 3.1 – 5.0 mm
55 444	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker's instructions, surface horizontal or inclined by up to 20° to the horizontal, crack width above 5 mm
55 446	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker's instructions, surface inclined by 21-70° to the horizontal, crack width up to 1 mm
55 447	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker's instructions, surface inclined by 21-70° to the horizontal, crack width 1.1 – 3.0 mm
55 448	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker's instructions, surface inclined by 21-70° to the horizontal, crack width 3.1 – 5.0 mm

Item	Unit Measure	Description of Work
55 449	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 21-70° to the horizontal, crack width above 5 mm
55 451	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 71-90° to the horizontal, crack width up to 1 mm
55 452	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 71-90° to the horizontal, crack width 1.1 – 3.0 mm
55 453	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 71-90° to the horizontal, crack width 3.1 – 5.0 mm
55 454	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface inclined by 71-90° to the horizontal, crack width above 5 mm
55 456	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width up to 1 mm
55 457	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width 1.1 – 3.0 mm
55 458	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width 3.1 – 5.0 mm
55 459	m^1	Repair – grouting of surface cracks in cement concrete, depth up to 40 mm (up to reinforcement), with epoxy or polyurethane resin, according to design and maker’s instructions, surface overhead horizontal or inclined by up to 20° to the horizontal, crack width above 5 mm
55 461	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface horizontal or inclined by up to 20˚ to horizontal, crack width up to 1 mm
55 462	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface horizontal or inclined by up to 20˚ to horizontal, crack width 1.1 – 3.0 mm
55 463	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface horizontal or inclined by up to 20˚ to horizontal, crack width 3.1 – 5.0 mm
55 464	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or

Item	Unit Measure	Description of Work
		polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface horizontal or inclined by up to 20˚ to horizontal, crack width above 5.0 mm
55 466	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 21-70˚ to horizontal, crack width up to 1 mm
55 467	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 21-70˚ to horizontal, crack width 1.1 – 3.0 mm
55 468	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 21-70˚ to horizontal, crack width 3.1 – 5.0 mm
55 469	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 21-70˚ to horizontal, crack width above 5.0 mm
55 471	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 71-90˚ to horizontal, crack width up to 1 mm
55 472	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 71-90˚ to horizontal, crack width 1.1 – 3.0 mm
55 473	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 71-90˚ to horizontal, crack width 3.1 – 5.0 mm
55 474	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface inclined by 71-90˚ to horizontal, crack width above 5.0 mm
55 476	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, crack width up to 1 mm
55 477	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker’s instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, crack width 1.1 – 3.0 mm

Item	Unit Measure	Description of Work
55 478	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, crack width 3.1 – 5.0 mm
55 479	m^1	Repair – grouting of deep cracks, and of cracks running through the entire section, with low-viscosity epoxy resin, cement suspension, or polyurethane resin, by means of surface or depth packers, according to design and maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, crack width above 5.0 mm
55 481	m^1	Modification of inclination of existing steel reinforcement after removal of concrete of the carriageway slab cantilever part
55 491	m^2	Active corrosion protection of reinforcement and tendons by applying migrating inhibitors onto prepared cement concrete surface according to maker's instructions
55 501	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.5 m^2
55 502	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 503	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 504	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 506	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface inclined by 21-70˚ to horizontal, individual surfaces up to 0.5 m^2
55 507	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface inclined by 21-70˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 508	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 509	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface inclined by 21-70˚ to horizontal, individual surfaces above 3.0 m^2
55 511	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface inclined by 71-90˚ to horizontal, individual surfaces up to 0.5 m^2
55 512	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface inclined by 71-90˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 513	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 514	m^2	Cleaning of corroded reinforcement and tendons by means of

Item	Unit Measure	Description of Work
		sandblasting, surface inclined by 71-90˚ to horizontal, individual surfaces above 3.0 m^2
55 516	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.5 m^2
55 517	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 518	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 519	m^2	Cleaning of corroded reinforcement and tendons by means of sandblasting, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 521	m^2	Cleaning of corroded reinforcement and tendons by means of high-presure water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.5 m^2
55 522	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 523	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 524	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 526	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 21-70˚ to horizontal, individual surfaces up to 0.5 m^2
55 527	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 21-70˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 528	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 529	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 21-70˚ to horizontal, individual surfaces above 3.0 m^2
55 531	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 71-90˚ to horizontal, individual surfaces up to 0.5 m^2
55 532	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 71-90˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 533	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 534	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface inclined by 71-90˚ to horizontal, individual surfaces above 3.0 m^2

Item	Unit Measure	Description of Work
55 536	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.5 m^2
55 537	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 538	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 539	m^2	Cleaning of corroded reinforcement and tendons by means of high-pressure water jet, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 541	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.3 m^2
55 542	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.31 – 0.50 m^2
55 543	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 544	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 1.0 m^2
55 546	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 21-70˚ to horizontal, individual surfaces up to 0.3 m^2
55 547	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 21-70˚ to horizontal, individual surfaces 0.31 – 0.5 m^2
55 548	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 21-70˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 549	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 21-70˚ to horizontal, individual surfaces above 1.0 m^2
55 551	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 71-90˚ to horizontal, individual surfaces up to 0.3 m^2
55 552	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 71-90˚ to horizontal, individual surfaces 0.31 – 0.5 m^2
55 553	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 71-90˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 554	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface inclined by 71-90˚ to horizontal, individual surfaces above 1.0 m^2
55 556	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel

Item	Unit Measure	Description of Work
		brushes or grinding, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.3 m^2
55 557	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.31 – 0.50 m^2
55 558	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 559	m^2	Manual cleaning of corroded reinforcement and tendons by means of steel brushes or grinding, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 1.0 m^2
55 561	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.5 m^2
55 562	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 563	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 564	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 566	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 0.5 m^2
55 567	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 568	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 569	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 3.0 m^2
55 571	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 0.5 m^2
55 572	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 573	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 574	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 3.0 m^2
55 576	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.5 m^2

Item	Unit Measure	Description of Work
55 577	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 578	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 579	m^2	Corrosion protection of reinforcement and tendons by applying coating on cement base in accordance with maker's instructions, surface overhead orizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 581	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 0.5 m^2
55 582	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 583	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 584	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 586	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 0.5 m^2
55 587	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 588	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 589	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 3.0 m^2
55 591	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 0.5 m^2
55 592	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 593	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 594	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 3.0 m^2
55 596	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to

Item	Unit Measure	Description of Work
		0.5 m^2
55 597	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 0.51 – 1.0 m^2
55 598	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 3.0 m^2
55 599	m^2	Corrosion protection of reinforepoxy and tendons by applying coating on epoxy base in accordance with maker's instructions, surface overhead orizontal or inclined by up to 20˚ to horizontal, individual surfaces above 3.0 m^2
55 611	m^2	Preparation and casting reinforced cement concrete mixture C 30/37 to damaged bridge girder, section of supplemental casting up to 0.15 m^2
55 612	m^2	Preparation and casting reinforced cement concrete mixture C 30/37 to damaged bridge girder, section of supplemental casting 0.16 – 0.25 m^2
55 615	m^2	Preparation and casting reinforced cement concrete mixture C ../.. to damaged bridge girder, section of supplemental casting up to 0.15 m^2
55 616	m^2	Preparation and casting reinforced cement concrete mixture C ../.. to damaged bridge girder, section of supplemental casting 0.16 – 0.25 m^2
55 621	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 622	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 - 40 mm
55 623	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 40 mm
55 624	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 625	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 626	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 - 10.0 m^2, thickness above 40 mm
55 627	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 628	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 629	m^2	Preparation and placing levelling cement mortar, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 40 mm

Item	Unit Measure	Description of Work
55 631	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 632	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 - 40 mm
55 633	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 40 mm
55 634	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 635	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 636	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 40 mm
55 637	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 638	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 639	m^2	Preparation and placing levelling cement mortar, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 40 mm
55 641	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 642	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 - 40 mm
55 643	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 40 mm
55 644	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 645	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 646	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 40 mm
55 647	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 648	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 649	m^2	Preparation and placing levelling cement mortar, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 40 mm
55 651	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 652	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to

Item	Unit Measure	Description of Work
		1.0 m^2, thickness 21 - 40 mm
55 653	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 40 mm
55 654	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 655	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 656	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 - 10.0 m^2, thickness above 40 mm
55 657	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 658	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 659	m^2	Preparation and placing levelling cement mortar, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 40 mm
55 661	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 662	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 - 40 mm
55 663	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 41 - 60 mm
55 664	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 666	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 667	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 668	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 41 - 60 mm
55 669	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 671	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm

Item	Unit Measure	Description of Work
55 672	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 673	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 41 - 60 mm
55 674	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 676	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 677	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 - 40 mm
55 678	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 41 - 60 mm
55 679	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 681	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 682	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 683	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 41 - 60 mm
55 684	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 686	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 687	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 688	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness 41 - 60 mm
55 689	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 21-70˚ to horizontal, individual surfaces a above 10.0 m^2, thickness above 60 mm
55 691	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 692	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 - 40 mm

Item	Unit Measure	Description of Work
55 693	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 41 - 60 mm
55 694	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 696	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 697	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 698	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 41 - 60 mm
55 699	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 711	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 712	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 713	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness 41 - 60 mm
55 714	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface inclined by 71-90˚ to horizontal, individual surfaces a above 10.0 m^2, thickness above 60 mm
55 716	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 717	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 - 40 mm
55 718	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 41 - 60 mm
55 719	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 721	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 722	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 - 40 mm
55 723	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 41 - 60 mm

Item	Unit Measure	Description of Work
55 724	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 726	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 727	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 - 40 mm
55 728	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 41 - 60 mm
55 729	m^2	Preparation and placing cement mortar without additives for repair of inner protected surfaces, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 731	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 732	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 – 40 mm
55 733	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm
55 734	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 736	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 737	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm
55 738	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 739	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 741	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 742	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 743	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to

Item	Unit Measure	Description of Work
		20˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 744	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 746	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 747	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 – 40 mm
55 748	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm
55 749	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 751	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 752	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm
55 753	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 754	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 756	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 757	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 758	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 759	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 761	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 762	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 – 40 mm
55 763	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm

Item	Unit Measure	Description of Work
55 764	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 766	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 767	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm
55 768	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 769	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 771	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 772	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 773	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 774	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 776	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 777	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 – 40 mm
55 778	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm
55 779	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 781	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 782	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm

Item	Unit Measure	Description of Work
55 783	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 784	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 786	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 787	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 788	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 789	m^2	Preparation and placing cement mortar with synthetic fibres added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 791	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 792	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 – 40 mm
55 793	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm
55 794	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 796	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 797	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm
55 798	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 799	m^2	Preparation and placing cement mortar with synthetic fibres and micro-

Item	Unit Measure	Description of Work
		silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 811	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 812	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 813	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 814	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 816	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 817	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 – 40 mm
55 818	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm
55 819	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 821	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 822	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm
55 823	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 824	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 826	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 827	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 828	m^2	Preparation and placing cement mortar with synthetic fibres and micro-

Item	Unit Measure	Description of Work
		silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 829	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 21-70˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 831	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 832	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness 21 – 40 mm
55 833	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm
55 834	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 836	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 837	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm
55 838	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 839	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 841	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 842	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 843	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 844	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface inclined by 71-90˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 846	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 20 mm
55 847	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to

Item	Unit Measure	Description of Work
		1.0 m^2, thickness 21 – 40 mm
55 848	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness up to 41 – 60 mm
55 849	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces up to 1.0 m^2, thickness above 60 mm
55 851	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 20 mm
55 852	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness 21 – 40 mm
55 853	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness up to 41 – 60 mm
55 854	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces 1.1 – 10.0 m^2, thickness above 60 mm
55 856	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness up to 20 mm
55 857	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness 21 – 40 mm
55 858	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above10.0 m^2, thickness up to 41 – 60 mm
55 859	m^2	Preparation and placing cement mortar with synthetic fibres and micro-silica added, according to maker's instructions, surface overhead horizontal or inclined by up to 20˚ to horizontal, individual surfaces above 10.0 m^2, thickness above 60 mm
55 911	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, surface vertical or inclined by up to 45° to vertical, wall thickness up to 40 cm
55 912	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, surface vertical or inclined by up to 45° to vertical, wall thickness 41 - 60 cm
55 913	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, surface vertical or inclined by up to 45° to vertical, wall thickness above 60 cm
55 921	m^2	Strengthening – repair of walls, made of stone or brick, by grouting

Item	Unit Measure	Description of Work
		sulphate resistant hydraulic binder of low modulus of elasticity, surface overhead horizontal or inclined by up to 45° to horizontal, wall thickness up to 40 cm
55 922	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, surface overhead horizontal or inclined by up to 45° to horizontal, wall thickness 41 - 60 cm
55 923	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, surface overhad horizontal or inclined by up to 45° to horizontal, wall thickness above 60 cm
55 926	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, overhead arched surface, arch thickness up to 40 cm
55 927	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, overhead arched surface, arch thickness 41 - 60 cm
55 928	m^2	Strengthening – repair of walls, made of stone or brick, by grouting sulphate resistant hydraulic binder of low modulus of elasticity, overhead arched surface, arch thickness above 60 cm
55 931	m^2	Repair of superficially segregated locations up to 4 cm of depth (up to reinforcement), with coarse micro-reinforced repair mortar, including surface preparation and application of fine micro-reinforced mortar in 2 mm thickness, according to maker's instructions, individual surfaces up to 0.50 m^2
55 932	m^2	Repair of superficially segregated locations up to 4 cm of depth (up to reinforcement), with coarse micro-reinforced repair mortar, including surface preparation and application of fine micro-reinforced mortar in 2 mm thickness, according to maker's instructions, individual surfaces 0.51 – 1.0 m^2
55 933	m^2	Repair of superficially segregated locations up to 4 cm of depth (up to reinforcement), with coarse micro-reinforced repair mortar, including surface preparation and application of fine micro-reinforced mortar in 2 mm thickness, according to maker's instructions, individual surfaces above 1.0 m^2
55 941	m^2	Repair of deeply segregated locations running through entire section of structural member, including cutting out of cement concrete, boring holes, grouting, and finishing of the surface with fine micro-reinforced mortar in 2 mm thickness, according to design and maker's instructions, individual surfaces up to 0.50 m^2
55 942	m^2	Repair of deeply segregated locations running through entire section of structural member, including cutting out of cement concrete, boring holes, grouting, and finishing of the surface with fine micro-reinforced mortar in 2 mm thickness, according to design and maker's instructions, individual surfaces 0.51 – 1.0 m^2
55 943	m^2	Repair of deeply segregated locations running through entire section of structural member, including cutting out of cement concrete, boring holes, grouting, and finishing of the surface with fine micro-reinforced mortar in 2 mm thickness, according to design and maker's instructions, individual surfaces above 1.0 m^2
55 951	pcs	Protection of anchor heads of existing tendons in bridge superstructure and cross-beams according to design and instructions by the producer of

Item	Unit Measure	Description of Work
		foreseen protective agent
55 961	m^1	Repair of corrosion centres in tendon areas according to design and to instructions by the foreseen repairing agent, length up to 2.0 m
55 962	m^1	Repair of corrosion centres in tendon areas according to design and to instructions by the foreseen repairing agent, length 2.1 – 4.0 m
55 963	m^1	Repair of corrosion centres in tendon areas according to design and to instructions by the foreseen repairing agent, length abvoe 4.0 m

2.2.5.10.1.6 Anchoring

Item	Unit Measure	Description of Work
56 111	m^1	Execution of borehole in cohesive soil, diameter 45 mm
56 112	m^1	Execution of borehole in cohesive soil, diameter 60 mm
56 113	m^1	Execution of borehole in cohesive soil, diameter 75 mm
56 114	m^1	Execution of borehole in cohesive soil, diameter 90 mm
56 115	m^1	Execution of borehole in cohesive soil, diameter 100 mm
56 116	m^1	Execution of borehole in cohesive soil, diameter 110 mm
56 117	m^1	Execution of borehole in cohesive soil, diameter … mm
56 121	m^1	Execution of borehole in granular rock, diameter 45 mm
56 122	m^1	Execution of borehole in granular rock, diameter 60 mm
56 123	m^1	Execution of borehole in granular rock, diameter 75 mm
56 124	m^1	Execution of borehole in granular rock, diameter 90 mm
56 125	m^1	Execution of borehole in granular rock, diameter 100 mm
56 126	m^1	Execution of borehole in granular rock, diameter 110 mm
56 127	m^1	Execution of borehole in granular rock, diameter … mm
56 131	m^1	Execution of borehole in soft rock, diameter 45 mm
56 132	m^1	Execution of borehole in soft rock, diameter 60 mm
56 133	m^1	Execution of borehole in soft rock, diameter 75 mm
56 134	m^1	Execution of borehole in soft rock, diameter 90 mm
56 135	m^1	Execution of borehole in soft rock, diameter 100 mm
56 136	m^1	Execution of borehole in soft rock, diameter 110 mm
56 137	m^1	Execution of borehole in soft rock, diameter … mm
56 141	m^1	Execution of borehole in hard rock, diameter 45 mm
56 142	m^1	Execution of borehole in hard rock, diameter 60 mm
56 143	m^1	Execution of borehole in hard rock, diameter 75 mm
56 144	m^1	Execution of borehole in hard rock, diameter 90 mm
56 145	m^1	Execution of borehole in hard rock, diameter 100 mm
56 146	m^1	Execution of borehole in hard rock, diameter 110 mm
56 147	m^1	Execution of borehole in hard rock, diameter … mm
56 151	m^1	Execution of rotational borehole on core in all directions, diameter min. 80 mm, length up to 10 m
56 152	m^1	Execution of rotational borehole on core in all directions, diameter min. 80 mm, length 10-20 m
56 153	m^1	Execution of rotational borehole on core in all directions, diameter min. 80 mm, length 20-30 m
56 154	m^1	Execution of rotational borehole on core in all directions, diameter min. 80 mm, length 30-40 m
56 155	m^1	Execution of rotational borehole on core in all directions, diameter min. 80 mm, length …… m
56 161	m^1	Execution of borehole without protective pipe, diameter 40-50 mm, length up to 5 m
56 162	m^1	Execution of borehole without protective pipe, diameter 40-50 mm, length 5-10 m

Item	Unit Measure	Description of Work
56 163	m^1	Execution of borehole without protective pipe, diameter 40-50 mm, length 10-20 m
56 164	m^1	Execution of borehole without protective pipe, diameter 40-50 mm, length 20-30 m
56 165	m^1	Execution of borehole without protective pipe, diameter 40-50 mm, length …….. m
56 171	m^1	Execution of borehole with protective pipe, without core, diameter up to 80 mm, length up to 10 m
56 172	m^1	Execution of borehole with protective pipe, without core, diameter up to 80 mm, length 10-20 m
56 173	m^1	Execution of borehole with protective pipe, without core, diameter up to 80 mm, length 20-30 m
56 174	m^1	Execution of borehole with protective pipe, without core, diameter up to 80 mm, length ….. m
56 181	m^1	Execution of borehole on core in cement concrete, diameter 100 mm
56 182	m^1	Execution of borehole on core in shot cement concrete, diameter 100 mm
56 211	m^1	Extra payment for protective pipe in borehole on core, length up to 10 m
56 212	m^1	Extra payment for protective pipe in borehole on core, length 10-20 m
56 213	m^1	Extra payment for protective pipe in borehole on core, length 20-30 m
56 214	m^1	Extra payment for protective pipe in borehole on core, length 30-40 m
56 215	m^1	Extra payment for protective pipe in borehole on core, length …… m
56 221	m^1	Extra payment for cementing and re-drilling of borehole on core, length up to 10 m
56 222	m^1	Extra payment for cementing and re-drilling of borehole on core, length 10-20 m
56 223	m^1	Extra payment for cementing and re-drilling of borehole on core, length 20-30 m
56 224	m^1	Extra payment for cementing and re-drilling of borehole on core, length 30-40 m
56 225	m^1	Extra payment for cementing and re-drilling of borehole on core, length …… m
56 231	m^1	Extra payment for cementing and re-drilling of borehole, without protective pipe, on core, length up to 5 m
56 232	m^1	Extra payment for cementing and re-drilling of borehole, without protective pipe, on core, length 5-10 m
56 233	m^1	Extra payment for cementing and re-drilling of borehole, without protective pipe, on core, length 10-20 m
56 234	m^1	Extra payment for cementing and re-drilling of borehole, without protective pipe, on core, length 20-30 m
56 235	m^1	Extra payment for cementing and re-drilling of borehole, without protective pipe, on core, length 30-40 m
56 236	m^1	Extra payment for cementing and re-drilling of borehole, without protective pipe, on core, length ….. m
56 241	m^1	Extra payment for execution of borehole with protective pipe at inclination, without core, diameter up to 80 mm, length up to 10 m

Item	Unit Measure	Description of Work
56 242	m^1	Extra payment for execution of borehole with protective pipe at inclination, without core, diameter up to 80 mm, length 10-20 m
56 243	m^1	Extra payment for execution of borehole with protective pipe at inclination, without core, diameter up to 80 mm, length 20-30 m
56 244	m^1	Extra payment for execution of borehole with protective pipe at inclination, without core, diameter up to 80 mm, length 30-40 m
56 245	m^1	Extra payment for execution of borehole with protective pipe at inclination, without core, diameter up to 80 mm, length ….. m
56 311	pcs	Installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length up to 10 m
56 312	pcs	Installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length 10-20 m
56 313	pcs	Installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length 20-30 m
56 314	pcs	Installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length 30-40 m
56 315	pcs	Installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length …… m
56 321	pcs	Installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length up to 10 m
56 322	pcs	Installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length 10-20 m
56 323	pcs	Installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length 20-30 m
56 324	pcs	Installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length 30-40 m
56 325	pcs	Installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length …… m
56 331	pcs	Installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length up to 10 m
56 332	pcs	Installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length 10-20 m
56 333	pcs	Installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length 20-30 m
56 334	pcs	Installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length 30-40 m
56 335	pcs	Installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length …… m
56 341	pcs	Installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length up to 10 m
56 342	pcs	Installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length 10-20 m
56 343	pcs	Installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length 20-30 m
56 344	pcs	Installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length 30-40 m
56 345	pcs	Installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length …… m

Item	Unit Measure	Description of Work
56 351	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length up to 10 m
56 352	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length 10-20 m
56 353	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length 20-30 m
56 354	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length 30-40 m
56 355	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 250 kN capacity, length …… m
56 361	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length up to 10 m
56 362	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length 10-20 m
56 363	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length 20-30 m
56 364	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length 30-40 m
56 365	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 350 kN capacity, length …… m
56 371	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length up to 10 m
56 372	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length 10-20 m
56 373	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length 20-30 m
56 374	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length 30-40 m
56 375	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of 500 kN capacity, length …… m
56 381	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length up to 10 m
56 382	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length 10-20 m
56 383	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length 20-30 m
56 384	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length 30-40 m
56 385	pcs	Drilling borehole, installation, prestressing, and grouting of temporary ground anchor of over 500 kN capacity, length …… m
56 411	pcs	Installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length up to 10 m
56 412	pcs	Installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length 10-20 m
56 413	pcs	Installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length 20-30 m
56 414	pcs	Installation, prestressing, and grouting of permanent ground anchor of 250

Item	Unit Measure	Description of Work
		kN capacity, length 30-40 m
56 415	pcs	Installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length …… m
56 421	pcs	Installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length up to 10 m
56 422	pcs	Installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length 10-20 m
56 423	pcs	Installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length 20-30 m
56 424	pcs	Installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length 30-40 m
56 425	pcs	Installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length …… m
56 431	pcs	Installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length up to 10 m
56 432	pcs	Installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length 10-20 m
56 433	pcs	Installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length 20-30 m
56 434	pcs	Installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length 30-40 m
56 435	pcs	Installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length …… m
56 441	pcs	Installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length up to 10 m
56 442	pcs	Installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length 10-20 m
56 443	pcs	Installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length 20-30 m
56 444	pcs	Installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length 30-40 m
56 445	pcs	Installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length …… m
56 451	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length up to 10 m
56 452	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length 10-20 m
56 453	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length 20-30 m
56 454	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length 30-40 m
56 455	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 250 kN capacity, length …… m
56 461	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length up to 10 m
56 462	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length 10-20 m

Item	Unit Measure	Description of Work
56 463	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length 20-30 m
56 464	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length 30-40 m
56 465	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 350 kN capacity, length …… m
56 471	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length up to 10 m
56 472	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length 10-20 m
56 473	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length 20-30 m
56 474	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length 30-40 m
56 475	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of 500 kN capacity, length …… m
56 481	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length up to 10 m
56 482	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length 10-20 m
56 483	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length 20-30 m
56 484	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length 30-40 m
56 485	pcs	Drilling borehole, installation, prestressing, and grouting of permanent ground anchor of over 500 kN capacity, length …… m
56 511	pcs	Supply and installation of steel expansion anchor of 150 kN, with anchor head, length 2 m
56 512	pcs	Supply and installation of steel expansion anchor of 150 kN, with anchor head, length 3 m
56 513	pcs	Supply and installation of steel expansion anchor of 150 kN, with anchor head, length 4 m
56 514	pcs	Supply and installation of steel expansion anchor of 150 kN, with anchor head, length .. m
56 521	pcs	Supply and installation of steel expansion anchor of 250 kN, with anchor head, length 2 m
56 522	pcs	Supply and installation of steel expansion anchor of 250 kN, with anchor head, length 3 m
56 523	pcs	Supply and installation of steel expansion anchor of 250 kN, with anchor head, length 4 m
56 524	pcs	Supply and installation of steel expansion anchor of 250 kN, with anchor head, length .. m
56 531	pcs	Supply and installation of steel frictional anchor of 150 kN capacity, without prestressing, length 3 m
56 532	pcs	Supply and installation of steel frictional anchor of 150 kN capacity, without prestressing, length 6 m
56 533	pcs	Supply and installation of steel frictional anchor of 150 kN capacity, without

Item	Unit Measure	Description of Work
		prestressing, length 9 m
56 534	pcs	Supply and installation of steel frictional anchor of 150 kN capacity, without prestressing, length 12 m
56 535	pcs	Supply and installation of steel frictional anchor of 150 kN capacity, without prestressing, length .. m
56 541	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, without prestressing, length 3 m
56 542	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, without prestressing, length 6 m
56 543	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, without prestressing, length 9 m
56 544	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, without prestressing, length 12 m
56 545	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, without prestressing, length .. m
56 551	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, without prestressing, length 3 m
56 552	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, without prestressing, length 6 m
56 553	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, without prestressing, length 9 m
56 554	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, without prestressing, length 12 m
56 555	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, without prestressing, length .. m
56 561	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, with prestressing, length 3 m
56 562	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, with prestressing, length 6 m
56 563	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, with prestressing, length 9 m
56 564	pcs	Supply and installation of steel frictional anchor of 250 kN capacity, with prestressing, length .. m
56 571	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, with prestressing, length 3 m
56 572	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, with prestressing, length 6 m
56 573	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, with prestressing, length 9 m
56 574	pcs	Supply and installation of steel frictional anchor of 350 kN capacity, with prestressing, length .. m
56 581	pcs	Supply and installation of steel frictional anchor of 500 kN capacity, with prestressing, length 3 m
56 582	pcs	Supply and installation of steel frictional anchor of 500 kN capacity, with prestressing, length 6 m
56 583	pcs	Supply and installation of steel frictional anchor of 500 kN capacity, with prestressing, length 9 m
56 584	pcs	Supply and installation of steel frictional anchor of 500 kN capacity, with

Item	Unit Measure	Description of Work
		prestressing, length .. m
56 591	pcs	Supply and installation of alluvial anchor of 60 kN capacity, length up to 10 m
56 592	pcs	Supply and installation of alluvial anchor of 60 kN capacity, length 10-20 m
56 593	pcs	Supply and installation of alluvial anchor of 60 kN capacity, length …. m
56 611	pcs	Supply and placing of SN anchor of 250 kN capacity, length 3 m
56 612	pcs	Supply and placing of SN anchor of 250 kN capacity, length 4 m
56 613	pcs	Supply and placing of SN anchor of 250 kN capacity, length 6 m
56 614	pcs	Supply and placing of SN anchor of 250 kN capacity, length 9 m
56 615	pcs	Supply and placing of SN anchor of 250 kN capacity, length 12 m
56 616	pcs	Supply and placing of SN anchor of 250 kN capacity, length … m
56 621	pcs	Supply and placing of SN anchor of 350 kN capacity, length 6 m
56 622	pcs	Supply and placing of SN anchor of 350 kN capacity, length 9 m
56 623	pcs	Supply and placing of SN anchor of 350 kN capacity, length 12 m
56 624	pcs	Supply and placing of SN anchor of 350 kN capacity, length … m
56 626	pcs	Supply and placing of SN anchor of 500 kN capacity, length 9 m
56 627	pcs	Supply and placing of SN anchor of 500 kN capacity, length 12 m
56 628	pcs	Supply and placing of SN anchor of 500 kN capacity, length … m
56 631	m^1	Extra payment for SN anchor, installed by more than 50 m behind the tunnel front
56 632	m^1	Extra payment for IBO anchor, installed by more than 50 m behind the tunnel front
56 633	m^1	Extra payment for PG anchor, installed by more than 50 m behind the tunnel front
56 634	m^1	Extra payment for Super Swellex anchor, installed by more than 50 m behind the tunnel front
56 641	pcs	Supply and installation of grouting IBO anchors of 250 kN capacity, length 3 m
56 642	pcs	Supply and installation of grouting IBO anchors of 250 kN capacity, length 4 m
56 643	pcs	Supply and installation of grouting IBO anchors of 250 kN capacity, length 6 m
56 644	pcs	Supply and installation of grouting IBO anchors of 250 kN capacity, length 9 m
56 645	pcs	Supply and installation of grouting IBO anchors of 250 kN capacity, length 12 m
56 646	pcs	Supply and installation of grouting IBO anchors of 250 kN capacity, length … m
56 651	pcs	Supply and installation of grouting IBO anchors of 350 kN capacity, length 6 m
56 652	pcs	Supply and installation of grouting IBO anchors of 350 kN capacity, length 9 m

Item	Unit Measure	Description of Work
56 653	pcs	Supply and installation of grouting IBO anchors of 350 kN capacity, length 12 m
56 654	pcs	Supply and installation of grouting IBO anchors of 350 kN capacity, length … m
56 661	pcs	Supply and installation of grouting IBO anchors of 500 kN capacity, length 9 m
56 662	pcs	Supply and installation of grouting IBO anchors of 500 kN capacity, length 12 m
56 663	pcs	Supply and installation of grouting IBO anchors of 500 kN capacity, length 15 m
56 664	pcs	Supply and installation of grouting IBO anchors of 500 kN capacity, length … m
56 671	pcs	Supply and installation of grouting PG anchors of 250 kN capacity, length 6 m
56 672	pcs	Supply and installation of grouting PG anchors of 250 kN capacity, length 9 m
56 673	pcs	Supply and installation of grouting PG anchors of 250 kN capacity, length … m
56 675	pcs	Supply and installation of grouting PG anchors of 350 kN capacity, length 6 m
56 676	pcs	Supply and installation of grouting PG anchors of 350 kN capacity, length 9 m
56 677	pcs	Supply and installation of grouting PG anchors of 350 kN capacity, length 12 m
56 678	pcs	Supply and installation of grouting PG anchors of 350 kN capacity, length … m
56 681	pcs	Supply and installation of Standard Swellex anchors of 100 kN capacity, length 3 m
56 682	pcs	Supply and installation of Standard Swellex anchors of 100 kN capacity, length 4 m
56 683	pcs	Supply and installation of Standard Swellex anchors of 100 kN capacity, length .. m
56 685	pcs	Supply and installation of Super Swellex anchors of 200 kN capacity, length 3 m
56 686	pcs	Supply and installation of Super Swellex anchors of 200 kN capacity, length 6 m
56 687	pcs	Supply and installation of Super Swellex anchors of 200 kN capacity, length 9 m
56 688	pcs	Supply and installation of Super Swellex anchors of 200 kN capacity, length .. m
56 711	pcs	Supply and installation of steel spears of grouting pipes of ϕ 1 ½", length 2 m
56 712	pcs	Supply and installation of steel spears of grouting pipes of ϕ 1 ½", length 3 m
56 713	pcs	Supply and installation of steel spears of grouting pipes of ϕ 1 ½", length 4 m

Item	Unit Measure	Description of Work
56 714	pcs	Supply and installation of steel spears of grouting pipes of ϕ 1 ½", length .. m
56 721	pcs	Supply and installation of steel spears of grouting pipes of ϕ 2", length 4 m
56 722	pcs	Supply and installation of steel spears of grouting pipes of ϕ 2", length 6 m
56 723	pcs	Supply and installation of steel spears of grouting pipes of ϕ 2", length 9 m
56 724	pcs	Supply and installation of steel spears of grouting pipes of ϕ 2", length .. m
56 731	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 28 mm, placed in cement mortar, length 2 m
56 732	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 28 mm, placed in cement mortar, length 3 m
56 733	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 28 mm, placed in cement mortar, length 4 m
56 734	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 28 mm, placed in cement mortar, length .. m
56 741	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 32 mm, placed in cement mortar, length 2 m
56 742	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 32 mm, placed in cement mortar, length 3 m
56 743	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 32 mm, placed in cement mortar, length 4 m
56 744	pcs	Supply and installation of steel spears of ribbed reinforcing bars of diameter 32 mm, placed in cement mortar, length .. m
56 751	pcs	Supply and installation of driven-in spears of steel pipes of ϕ 1 ½", length 3 m
56 752	pcs	Supply and installation of driven-in spears of steel pipes of ϕ 1 ½", length 4 m
56 753	pcs	Supply and installation of driven-in spears of steel pipes of ϕ 1 ½", length .. m
56 761	pcs	Supply and installation of driven-in spears of steel pipes of ϕ 2", length 3 m
56 762	pcs	Supply and installation of driven-in spears of steel pipes of ϕ 2", length 4 m
56 763	pcs	Supply and installation of driven-in spears of steel pipes of ϕ 2", length .. m
56 771	pcs	Supply and installation of steel spears made of IBO anchors of 250 kN capacity, length 3 m
56 772	pcs	Supply and installation of steel spears made of IBO anchors of 250 kN capacity, length 4 m
56 773	pcs	Supply and installation of steel spears made of IBO anchors of 250 kN capacity, length 4 m
56 774	pcs	Supply and installation of steel spears made of IBO anchors of 250 kN capacity, length … m
56 811	pcs	Supply and installation of steel pins RA of diameter 25 mm, length 2 m
56 812	pcs	Supply and installation of steel pins RA of diameter 25 mm, length 2.5 m
56 813	pcs	Supply and installation of steel pins RA of diameter 25 mm, length 3 m
56 814	pcs	Supply and installation of steel pins RA of diameter 25 mm, length 3.5 m

Item	Unit Measure	Description of Work
56 815	pcs	Supply and installation of steel pins RA of diameter 25 mm, length 4 m
56 816	pcs	Supply and installation of steel pins RA of diameter 25 mm, length … m
56 821	pcs	Supply and installation of steel pins RA of diameter 36 mm, length 2 m
56 822	pcs	Supply and installation of steel pins RA of diameter 36 mm, length 2.5 m
56 823	pcs	Supply and installation of steel pins RA of diameter 36 mm, length 3 m
56 824	pcs	Supply and installation of steel pins RA of diameter 36 mm, length 3.5 m
56 825	pcs	Supply and installation of steel pins RA of diameter 36 mm, length 4 m
56 826	pcs	Supply and installation of steel pins RA of diameter 36 mm, length … m
56 831	pcs	Supply and installation of steel grouting pipe pin of 200 kN capacity, length 2 m
56 832	pcs	Supply and installation of steel grouting pipe pin of 200 kN capacity, length 4 m
56 833	pcs	Supply and installation of steel grouting pipe pin of 200 kN capacity, length 6 m
56 834	pcs	Supply and installation of steel grouting pipe pin of 200 kN capacity, length.. m
56 841	pcs	Supply and installation of steel anchor head of 400 kN bearing capacity
56 842	pcs	Supply and installation of steel anchor head of 600 kN bearing capacity
56 843	pcs	Supply and installation of steel anchor head of 800 kN bearing capacity
56 844	pcs	Supply and installation of steel anchor head of 1,000 kN bearing capacity
56 845	pcs	Supply and installation of steel anchor head of over 1,000 kN bearing capacity
56 911	m^1	Anchoring of reinforcement or dowels in expansion mortar, including drilling holes of diameter up to 12 mm
56 912	m^1	Anchoring of reinforcement or dowels in expansion mortar, including drilling holes of diameter 14-22 mm
56 913	m^1	Anchoring of reinforcement or dowels in expansion mortar, including drilling holes of diameter 24-36 mm
56 914	m^1	Anchoring of reinforcement or dowels in expansion mortar, including drilling holes of diameter above 36 mm
56 921	m^1	Anchoring of reinforcement or dowels with stuck anchors, including drilling holes of diameter up to 12 mm
56 922	m^1	Anchoring of reinforcement or dowels with stuck anchors, including drilling holes of diameter 14-22 mm
56 923	m^1	Anchoring of reinforcement or dowels with stuck anchors, including drilling holes of diameter 24-36 mm
56 924	m^1	Anchoring of reinforcement or dowels with stuck anchors, including drilling holes of diameter above 36 mm
56 931	pcs	Supply and installation of measuring anchor with anchor head, of 250 kN capacity, length 6 m
56 932	pcs	Supply and installation of measuring anchor with anchor head, of 250 kN capacity, length 9 m
56 933	pcs	Supply and installation of measuring anchor with anchor head, of 250 kN capacity, length .. m

Item	Unit Measure	Description of Work
56 941	pcs	Supply and installation of measuring anchor, length 6 m
56 942	pcs	Supply and installation of measuring anchor, length 9 m
56 943	pcs	Supply and installation of measuring anchor, length .. m
56 951	pcs	Execution of pressure test in borehole with single packer
56 952	pcs	Execution of pressure test in borehole with double packer
56 961	pcs	Test of anchor resistance by loading up to failure
56 966	pcs	Additional stressing of anchor
56 971	pcs	Preparation and arrangement of a niche with equipment for measuring anchor.

2.2.5.10.1.7 Grouting

Item	Unit Measure	Description of Work
57 111	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement CEM I 32,5 N
57 112	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement CEM I 42,5 N
57 113	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement CEM I 52,5 N
57 121	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement CEM I........ as per design
57 131	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement CEM II / A-S 42,5 R
57 141	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement with pozzolan additive CEM II/A-P 32,5 N
57 142	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement with pozzolan additive CEM II/A-P 42,5 N
57 143	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement with pozzolan additive CEM II/A-P 52,5 N
57 151	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement with pozzolan additive CEM II/B-P 32,5 N
57 152	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement with pozzolan additive CEM II/B-P 42,5 N
57 153	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement with pozzolan additive CEM II/B-P 52,5 N
57 161	t	Grouting or pre-grouting a borehole with cement suspension of Portland cement with pozzolan additive CEM II/..-P ..... as per design
57 171	pcs	Supply and installation of perforated grouting pipes of diameter 1 1/2" to 2", wall thickness 4 mm, length 4 m
57 172	pcs	Supply and installation of perforated grouting pipes of diameter 1 1/2" to 2", wall thickness 4 mm, length 6 m
57 173	pcs	Supply and installation of perforated grouting pipes of diameter 1 1/2" to 2", wall thickness 4 mm, length 9 m
57 211	t	Grouting a borehole with cement mortar of Portland cement CEM I 32,5 N and mixing ratio cement to sand of 1 : 0.5 by mass
57 212	t	Grouting a borehole with cement mortar of Portland cement CEM I 32,5 N and mixing ratio cement to sand of 1 : 1 by mass
57 213	t	Grouting a borehole with cement mortar of Portland cement CEM I 32,5 N and mixing ratio cement to sand of 1 : 2 by mass
57 221	t	Grouting a borehole with cement mortar of Portland cement CEM I 42,5 N and mixing ratio cement to sand of 1 : 0.5 by mass
57 222	t	Grouting a borehole with cement mortar of Portland cement CEM I 42,5 N and mixing ratio cement to sand of 1 : 1 by mass
57 223	t	Grouting a borehole with cement mortar of Portland cement CEM I 42,5 N

Item	Unit Measure	Description of Work
		and mixing ratio cement to sand of 1 : 2 by mass
57 231	t	Grouting a borehole with cement mortar of Portland cement CEM I 52,5 N and mixing ratio cement to sand of 1 : 0.5 by mass
57 232	t	Grouting a borehole with cement mortar of Portland cement CEM I 52,5 N and mixing ratio cement to sand of 1 : 1 by mass
57 233	t	Grouting a borehole with cement mortar of Portland cement CEM I 52,5 N and mixing ratio cement to sand of 1 : 2 by mass
57 241	t	Grouting a borehole with cement mortar of Portland cement CEM I .... and mixing ratio cement to sand of .... by mass as per design
57 311	t	Grouting of anchor with cement suspension of Portland cement CEM I 32,5 N
57 312	t	Grouting of anchor with cement suspension of Portland cement CEM I 42,5 N
57 313	t	Grouting of anchor with cement suspension of Portland cement CEM I 52,5 N
57 321	t	Grouting of anchor with cement suspension of Portland cement CEM I ..... as per design
57 331	t	Grouting of anchor with cement suspension of Portland cement resistant to sulphates CEM II / A-S 42,5 R
57 341	t	Grouting of anchor with cement mortar of Portland cement CEM I 32,5 N and mixing ratio cement to sand of 1 : 0.5 by mass
57 342	t	Grouting of anchor with cement mortar of Portland cement CEM I 32,5 N and mixing ratio cement to sand of 1 : 1 by mass
57 343	t	Grouting of anchor with cement mortar of Portland cement CEM I 32,5 N and mixing ratio cement to sand of 1 : 2 by mass
57 351	t	Grouting of anchor with cement mortar of Portland cement CEM I 42,5 N and mixing ratio cement to sand of 1 : 0.5 by mass
57 352	t	Grouting of anchor with cement mortar of Portland cement CEM I 42,5 N and mixing ratio cement to sand of 1 : 1 by mass
57 353	t	Grouting of anchor with cement mortar of Portland cement CEM I 42,5 N and mixing ratio cement to sand of 1 : 2 by mass
57 361	t	Grouting of anchor with cement mortar of Portland cement CEM I 52,5 N and mixing ratio cement to sand of 1 : 0.5 by mass
57 362	t	Grouting of anchor with cement mortar of Portland cement CEM I 52,5 N and mixing ratio cement to sand of 1 : 1 by mass
57 363	t	Grouting of anchor with cement mortar of Portland cement CEM I 52,5 N and mixing ratio cement to sand of 1 : 2 by mass
57 371	t	Grouting of anchor with cement mortar of Portland cement .... and mixing ratio cement to sand of ...... by mass
57 411	m^1	Grouting Dywidag bars of diameter 26 mm with cement based grouting compound including installation of grouting and ventilating pipes
57 412	m^1	Grouting Dywidag bars of diameter 32 mm with cement based grouting

Item	Unit Measure	Description of Work
		compound including installation of grouting and ventilating pipes
57 413	m^1	Grouting Dywidag bars of diameter 36 mm with cement based grouting compound including installation of grouting and ventilating pipes
57 421	m^1	Grouting Dywidag bars of diameter 26 mm with flexible grouting compound including installation of grouting and ventilating pipes
57 422	m^1	Grouting Dywidag bars of diameter 32 mm with flexible grouting compound including installation of grouting and ventilating pipes
57 423	m^1	Grouting Dywidag bars of diameter 36 mm with flexible grouting compound including installation of grouting and ventilating pipes
57 511	t	Grouting prestressed tendons of bridge superstructure with cement mixture including preparation of cement mixture
57 512	t	Additional grouting prestressed tendons of bridge superstructure with cement mixture including preparation of cement mixture
57 521	t	Grouting vertical tendons of bridge substructure with cement mixture including preparation of cement mixture
57 522	t	Additional grouting vertical tendons of bridge substructure with cement mixture including preparation of cement mixture
57 611	t	Execution of strengthening under pressure with cement wash based on cement CEM I 32,5 R
57 621	t	Supply of bentonite additive
57 621	kg	Chemical additive to accelerate setting
57 622	kg	Chemical additive to retard setting
57 623	kg	Chemical additive for plasticizing
57 624	kg	Chemical additive for swelling
57 625	kg	Chemical additive to prevent sedimentation
57 631	kg	Adding silicate gel to the grouting compound

2.2.5.10.1.8 Metalwork

Item	Unit Measure	Description of Work
58 111	m^1	Fabrication and preparation for installation of supporting structure of a guard rail on a bridge, of steel pipes of circular section (as per design)
58 112	m^1	Fabrication and preparation for installation of supporting structure of a guard rail on a bridge, of steel pipes of rectangular section (as per design)
58 121	m^1	Fabrication and preparation for installation of supporting structure of a guard rail on a bridge, of aluminium pipes of circular section (as per design)
58 122	m^1	Fabrication and preparation for installation of supporting structure of a guard rail on a bridge, of aluminium pipes of rectangular section (as per design)
58 131	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical steel bars, mass up to 10 kg/m^2 (as per design)
58 132	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical steel bars, mass 10.5 – 12 kg/m^2 (as per design)
58 133	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical steel bars, mass 12.5 – 14 kg/m^2 (as per design)
58 134	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical steel bars, mass 14.5 – 16 kg/m^2 (as per design)
58 135	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical steel bars, mass above 16 kg/m^2 (as per design)
58 141	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical aluminium bars, mass up to 8 kg/m^2 (as per design)
58 142	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical aluminium bars, mass 8.5 – 10 kg/m^2 (as per design)
58 143	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical aluminium bars, mass 10.5 – 12 kg/m^2 (as per design)
58 144	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical aluminium bars, mass 12.5 – 14 kg/m^2 (as per design)
58 145	m^1	Fabrication and installation of filling for guard rail of horizontal or vertical aluminium bars, mass above 14 kg/m^2 (as per design)
58 151	m^1	Fabrication and installation of closed filling for guard rail of steel sheet (as per design)
58 152	m^1	Fabrication and installation of closed filling for guard rail of aluminium sheet (as per design)
58 161	pcs	Supply, preparation, and installation of galvanized bolts for anchoring a post of a noise barrier or a wind barrier
58 162	pcs	Supply, preparation, and installation of stainless steel bolts for anchoring a post for public lighting
58 163	pcs	Supply, preparation, and installation of corrosion resistant bolts, for anchoring ...., as per design detail
58 171	m^1	Fabrication, preparation, and installation of steel parapet on a bridge, fixed to pedestrian guard rail posts, height 1.75 m, with panels of 2.0 m width
58 172	m^1	Fabrication, preparation, and installation of steel parapet on a bridge, fixed to pedestrian guard rail posts, height 2.0 m, with panels of 2.0 m width

Item	Unit Measure	Description of Work
58 181	m^1	Fabrication, preparation, and installation of steel parapet on a bridge, fixed to pedestrian guard rail horizontal elements, height 1.75, with panels of 0.75 m width
58 182	m^1	Fabrication, preparation, and installation of steel parapet on a bridge, fixed to pedestrian guard rail horizontal elements, height 2.0, with panels of 0.75 m width
58 186	m^1	Fabrication, preparation, and installation of steel parapet on a bridge, fixed to pedestrian guard rail horizontal elements, height ..., with panels of ... m width (as per design)
58 191	m^2	Fabrication and installation of protective railing above electrified railway track, height 2.0 m, with panels of 2.0 m width
58 211	m^1	Fabrication, preparation, and installation of pedestrian railing of steel tubular sections with vertical fillings, height 110 cm
58 212	m^1	Fabrication, preparation, and installation of pedestrian railing of steel tubular sections with horizontal fillings, height 110 cm
58 213	m^1	Fabrication, preparation, and installation of pedestrian railing of aluminium tubular sections with vertical fillings, height 110 cm
58 214	m^1	Fabrication, preparation, and installation of pedestrian railing of aluminium tubular sections with horizontal fillings, height 110 cm
58 221	m^1	Fabrication, preparation, and installation of pedestrian railing of steel rectangular sections with vertical fillings, height 110 cm
58 222	m^1	Fabrication, preparation, and installation of pedestrian railing of steel rectangular sections with vertical and horizontal fillings, height 110 cm
58 223	m^1	Fabrication, preparation, and installation of pedestrian railing of aluminium rectangular sections with vertical fillings, height 110 cm
58 224	m^1	Fabrication, preparation, and installation of pedestrian railing of aluminium rectangular sections with vertical and horizontal fillings, height 110 cm
58 225	m^1	Fabrication, preparation, and installation of pedestrian railing of steel rectangular sections with vertical and horizontal fillings, and with upper flange reinforced with steel strand, height 110 cm
58 226	m^1	Fabrication, preparation, and installation of pedestrian railing of aluminium rectangular sections with vertical and horizontal fillings, and with upper flange reinforced with steel strand, height 110 cm
58 231	m^1	Fabrication, preparation, and installation of handrail of steel sections, onto outer concrete safety barrier (height 50 cm)
58 232	m^1	Fabrication, preparation, and installation of pedestrian railing as per design detail, of steel tubular or rectangular sections, with vertical and/or horizontal fillings, height ... cm
58 233	m^1	Fabrication, preparation, and installation of pedestrian railing as per design detail, of stainless steel tubular or rectangular sections, with vertical and/or horizontal fillings, height ... cm
58 234	m^1	Fabrication, preparation, and installation of pedestrian railing as per design detail, of aluminium tubular or rectangular sections, with vertical and/or horizontal fillings, height ... cm
58 241	m^1	Fabrication, preparation, and installation of railing of ...., as per special architectural drawing

Item	Unit Measure	Description of Work
58 251	m^1	Fabrication and preparation for installation of expansion joint, without clearance, as per design
58 261	m^1	Fabrication and preparation for installation of expansion joint with two T sections, open, as per design
58 262	m^1	Fabrication and preparation for installation of expansion joint with two T sections, sealed with neoprene strip, as per design
58 263	m^1	Fabrication and preparation for installation of expansion joint with two T sections, sealed with rubber strip, as per design
58 264	m^1	Fabrication and preparation for installation of expansion joint with two combs, as per design
58 265	m^1	Fabrication and preparation for installation of expansion joint with sliding steel plate, as per design
58 266	m^1	Fabrication and preparation for installation of expansion joint with chained steel plates on rollers, as per design
58 271	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 80 mm (± 40 mm)
58 272	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 160 mm (± 80 mm)
58 273	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 240 mm (± 120 mm)
58 274	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 320 mm (± 160 mm)
58 275	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 400 mm (± 200 mm)
58 276	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 480 mm (± 240 mm)
58 277	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 560 mm (± 280 mm)
58 278	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity up to 640 mm (± 320 mm)
58 279	m^1	Supply, preparation for installation, and installation of waterproof expansion joint (as per design), movement capacity 640 mm and above ($\geq$ 320 mm)
58 281	m^1	Supply, preparation, and installation of new neoprene sealing strip into expansion joint ...
58 282	m^1	Supply, preparation, and installation of new polypropylene sealing strip into expansion joint ...
58 283	m^1	Supply, preparation, and installation of new rubber sealing strip into expansion joint ...
58 284	m^1	Supply, preparation, and installation of new deformable sealing rubber elements into expansion joint ...

Item	Unit Measure	Description of Work
58 311	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new reinforced elastomer bearing of capacity up to 2,000 kN
58 312	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new reinforced elastomer bearing of capacity 2,001 – 4,500 kN
58 313	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new reinforced elastomer bearing of capacity above 4,500 kN
58 321	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, allowing movements in all directions, of capacity up to 4,000 kN
58 322	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, allowing movements in all directions, of capacity 4,001 – 8,000 kN
58 323	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, allowing movements in all directions, of capacity above 8,000 kN
58 324	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, allowing movement in one direction, of capacity up to 4,000 kN
58 325	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, allowing movement in one direction, of capacity 4,001 – 8,000 kN
58 326	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, allowing movement in one direction, of capacity above 8,000 kN
58 327	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, not allowing any movement, of capacity up to 4,000 kN
58 328	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, not allowing any movement, of capacity 4,001 – 8,000 kN
58 329	pcs	Replacement of damaged bridge superstructure bearing, including supply, preparation of cement concrete surface on both pier cap and superstructure, and installation of new pot elastomer sliding bearing, not allowing any movement, of capacity above 8,000 kN
58 331	pcs	Supply and placing hydraulic jacks of capacity up to 500 kN (as per design), including lifting the bridge superstructure upon replacement of bearings

Item	Unit Measure	Description of Work
58 332	pcs	Supply and placing hydraulic jacks of capacity 501 – 1,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 333	pcs	Supply and placing hydraulic jacks of capacity 1,000 – 2,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 334	pcs	Supply and placing hydraulic jacks of capacity 2,000 – 3,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 335	pcs	Supply and placing hydraulic jacks of capacity above 3,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 341	pcs	Supply and placing hydraulic blocks of capacity up to 500 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 342	pcs	Supply and placing hydraulic blocks of capacity 501 – 1,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 343	pcs	Supply and placing hydraulic blocks of capacity 1,000 – 2,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 344	pcs	Supply and placing hydraulic blocks of capacity 2,000 – 3,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 345	pcs	Supply and placing hydraulic blocks of capacity above 3,000 kN (as per design), including lifting the bridge superstructure upon replacement of bearings
58 351	pcs	Supply, preparation, and installation of fixed tangential rocker bearing (as per design)
58 352	pcs	Supply, preparation, and installation of fixed ball-jointedl rocker bearing (as per design)
58 353	pcs	Supply, preparation, and installation of fixed pot bearing (as per design)
58 354	pcs	Supply, preparation, and installation of fixed roller bearing (as per design)
58 355	pcs	Supply, preparation, and installation of fixed hinge bearing of cement concrete (as per design)
58 356	pcs	Supply, preparation, and installation of fixed elastomer block bearing (as per design)
58 361	pcs	Supply, preparation, and installation of ball-jointed rocker bearing, allowing movement in one direction (as per design)
58 362	pcs	Supply, preparation, and installation of single-roller bearing, allowing movement in one direction (as per design)
58 363	pcs	Supply, preparation, and installation of double-roller bearing, allowing movement in one direction (as per design)
58 364	pcs	Supply, preparation, and installation of pot bearing, allowing movement in one direction (as per design)
58 365	pcs	Supply, preparation, and installation of elastomer block bearing, allowing movement in one direction (as per design)
58 371	pcs	Supply, preparation, and installation of tangential rocker PTFE slide bearing, allowing movement in all directions (as per design)

Item	Unit Measure	Description of Work
58 372	pcs	Supply, preparation, and installation of ball-jointed rocker PTFE slide bearing, allowing movement in all directions (as per design)
58 373	pcs	Supply, preparation, and installation of pot PTFE slide bearing, allowing movement in all directions (as per design)
58 374	pcs	Supply, preparation, and installation of elastomer block slide bearing, allowing movement in all directions (as per design)
58 375	pcs	Supply, preparation, and installation of elastomer PTFE slide bearing, allowing movement in all directions (as per design)
58 376	pcs	Supply, preparation, and installation of spherical bearing, allowing movement in all direction (as per design)
58 381	pcs	Supply, preparation, and installation of tensile-compressive bearing, type 1 (as per design)
58 382	pcs	Supply, preparation, and installation of tensile-compressive prestressed bearing, type 2 (as per design)
58 385	pcs	Supply, preparation, and installation of bearing to take horizontal dynamical forces, without energy absorption, capacity ...., for movement capacity ± …… mm (as per design)
58 386	pcs	Supply, preparation, and installation of bearing to take horizontal dynamical forces, with energy absorption, capacity ...., for movement capacity ± …… mm (as per design)
58 387	pcs	Supply, preparation, and installation of measuring device to control structural displacements due to dynamical (seismic) forces (as per design)
58 391	pcs	Supply, peparation, and installation of shear thorn (as per design)
58 393	pcs	Supply, preparation, and installation of guided bearing (as per design)
58 395	pcs	Supply, preparation, and installation of combined pot bearing (incremental launching), allowing movements in two directions (as per design)
58 396	pcs	Supply, preparation, and installation of combined pot bearing (incremental launching), allowing movement in one direction (as per design)
58 397	pcs	Supply, preparation, and installation of combined pot bearing (incremental launching), not allowing any movement (as per design)
58 411	m^1	Fabrication and preparation for installation of edge (end profile) of L section 40/40/4 mm including anchors and reinforcements (as per design)
58 412	m^1	Fabrication and preparation for installation of edge (end profile) of L section 50/50/5 mm including anchors and reinforcements (as per design)
58 413	m^1	Fabrication and preparation for installation of edge (end profile) of L section 60/60/6 mm including anchors and reinforcements (as per design)
58 414	m^1	Fabrication and preparation for installation of edge (end profile) of L section 70/70/7 mm including anchors and reinforcements (as per design)
58 415	m^1	Fabrication and preparation for installation of edge (end profile) of L section 80/80/8 mm including anchors and reinforcements (as per design)
58 416	m^1	Fabrication and preparation for installation of edge (end profile) of L section ../../. mm including anchors and reinforcements (as per design)
58 421	m^1	Fabrication and preparation for installation of edge (end profile) of T-80

Item	Unit Measure	Description of Work
		section including anchors and reinforcements (as per design)
58 422	m^1	Fabrication and preparation for installation of edge (end profile) of T-100 section including anchors and reinforcements (as per design)
58 423	m^1	Fabrication and preparation for installation of edge (end profile) of T-120 section including anchors and reinforcements (as per design)
58 424	m^1	Fabrication and preparation for installation of edge (end profile) of T-140 section including anchors and reinforcements (as per design)
58 425	m^1	Fabrication and preparation for installation of edge (end profile) of T-160 section including anchors and reinforcements (as per design)
58 426	m^1	Fabrication and preparation for installation of edge (end profile) of T-...section including anchors and reinforcements (as per design)
58 431	m^1	Fabrication and preparation for installation of edge (end profile) of half I-160 section including anchors and reinforcements (as per design)
58 432	m^1	Fabrication and preparation for installation of edge (end profile) of half I-200 section including anchors and reinforcements (as per design)
58 433	m^1	Fabrication and preparation for installation of edge (end profile) of half I-240 section including anchors and reinforcements (as per design)
58 434	m^1	Fabrication and preparation for installation of edge (end profile) of half I-280 section including anchors and reinforcements (as per design)
58 435	m^1	Fabrication and preparation for installation of edge (end profile) of half I-320 section including anchors and reinforcements (as per design)
58 436	m^1	Fabrication and preparation for installation of edge (end profile) of half I- ... section including anchors and reinforcements (as per design)
58 441	m^1	Fabrication and preparation for installation of edge (end profile) of flat steel 50/5 mm including anchors and reinforcements (as per design)
58 442	m^1	Fabrication and preparation for installation of edge (end profile) of flat steel 60/5 mm including anchors and reinforcements (as per design)
58 443	m^1	Fabrication and preparation for installation of edge (end profile) of flat steel 70/5 mm including anchors and reinforcements (as per design)
58 444	m^1	Fabrication and preparation for installation of edge (end profile) of flat steel 80/6 mm including anchors and reinforcements (as per design)
58 445	m^1	Fabrication and preparation for installation of edge (end profile) of flat steel 90/6 mm including anchors and reinforcements (as per design)
58 446	m^1	Fabrication and preparation for installation of edge (end profile) of flat steel 100/6 mm including anchors and reinforcements (as per design)
58 447	m^1	Fabrication and preparation for installation of edge (end profile) of flat steel .../.. mm including anchors and reinforcements (as per design)
58 511	t	Rail for inspection trolley
58 521	pcs	Protective profile against contact, made of angle steel 60/60/6 mm
58 522	pcs	Protective profile against contact, made of flat steel 60/5 mm
58 523	pcs	Protective profile against contact, made of …….
58 531	pcs	Plug for subsequent installation of protective profile against contact
58 541	pcs	Tie-bar for fixing the earthing, and for fixing the protective profile against contact
58 611	pcs	Inspection footway, 600 mm wide, with railing of 1,100 mm height

Item	Unit Measure	Description of Work
58 621	m^1	Climbing ladder, without safety basket
58 622	m^1	Climbing ladder, with safety basket
58 623	pcs	Tie-bar for fixing the climbing ladder
58 624	pcs	Climbing iron
58 631	pcs	Single-leaf steel door with ventilation shutter
58 632	pcs	Single-leaf steel door without ventilation shutter
58 633	pcs	Single-leaf galvanized steel door with steel frame, bolt, and lock, dimensions 600/1400 mm
58 635	pcs	Single-leaf galvanized steel door with steel frame, bolt, and lock, dimensions 900/1400 mm
58 636	pcs	Single-leaf galvanized steel door with steel frame, bolt, and lock, dimensions 900/2,000 mm
58 637	pcs	Single-leaf galvanized steel door with steel frame, bolt, and lock, dimensions .../.... mm
58 641	pcs	Ventilation screen … x …. mm
58 642	pcs	Removable mesh with steel frame, galvanized, dimensions 800/800 mm
58 643	pcs	Mesh for covering ventilation openings, circular shape, diameter 200 mm
58 644	pcs	Mesh for covering ventilation openings, circular shape, diameter ... mm
58 645	pcs	Mesh for covering ventilation openings, rectangular shape, dimensions 200/300 mm
58 646	pcs	Mesh for covering ventilation openings, rectangular shape, dimensions .../... mm
58 651	pcs	Supply, preparation, and installation of benchmarks including incorporation into the current level net
58 652	pcs	Supply, preparation, and placing inclinometers and survey measuring points
58 653	pcs	Extension of inclinometers and placing survey measuring point
58 661	pcs	Supply, preparation, and installation of protective stainless steel sheet at the transition of expansion joints through footways and concrete safety barrier elements (as per design), width ... cm, length ... cm
58 671	pcs	Supply, preparation, and installation of galvanized steel deviators for conducting external prestressed tendons
58 681	kg	Supply, preparation, and installation of steel blocks for anchoring external tendons to strengthen damaged girders, as per design, including workshop drawing and corrosion protection, in steel Č 0563
58 682	kg	Supply, preparation, and installation of steel elements for anchoring vertical external tendons to strengthen webs of girders, as per design, including workshop drawing and corrosion protection, in steel Č 0563
58 683	kg	Supply, preparation, and installation of steel elements (saddles) for supporting external tendons, as per design, including workshop drawing and corrosion protection, in steel Č 0563
58 691	pcs	Supply, preparation, and installation of steel plate indicating the

Item	Unit Measure	Description of Work
		contractor’s name and year of completion of construction
58 711	kg	Fabrication, supply, and installation of welded supporting steel structure, of structural steel S 235 (Č 0360) J2 G3
58 712	kg	Fabrication, supply, and installation of welded supporting steel structure, of structural steel S 335 (Č 0560) J2 G3
58 713	kg	Fabrication, supply, and installation of welded supporting steel structure, of structural steel S 460 (......) J2 G3
58 714	kg	Fabrication, supply, and installation of welded supporting steel structure, of structural steel ....
58 721	kg	Fabrication, supply, and installation of bolted (riveted) supporting steel structure, of structural steel S 235 (Č 0360) J2 G3
58 722	kg	Fabrication, supply, and installation of bolted (riveted) supporting steel structure, of structural steel S 335 (Č 0560) J2 G3
58 723	kg	Fabrication, supply, and installation of bolted (riveted) supporting steel structure, of structural steel S 460 (......) J2 G3
58 724	kg	Fabrication, supply, and installation of bolted (riveted) supporting steel structure, of structural steel ....

2.2.5.10.1.9 Protection of Material and Structures

2.2.5.10.1.9.1 Corrosion Protection of Metal

Item	Unit Measure	Description of Work
59 111	m^2	Manual degreasing of metal surface with organic solvent
59 112	m^2	Manual degreasing of metal surface with tenzide
59 113	m^2	Manual degreasing of metal surface with …….
59 121	m^2	Machine degreasing of metal surface with organic solvent
59 122	m^2	Machine degreasing of metal surface with tenzide
59 123	m^2	Machine degreasing of metal surface with …….
59 131	m^2	Cleaning metal surface with sharp-edged abrasive (steel grit)
59 132	m^2	Cleaning metal surface with rounded abrasive (steel shot)
59 133	m^2	Cleaning metal surface with quartz sand
59 134	m^2	Cleaning metal surface with granulated furnace slag
59 141	m^2	Cleaning metal surface with flame
59 151	m^2	Cleaning metal surface with acid solution
59 152	m^2	Cleaning metal surface with base solution
59 161	m^2	Mechanical cleaning of metal surface
59 171	m^2	Manual cleaning of metal surface
59 181	m^2	Dedusting cleaned surface with dry compressed air
59 182	m^2	Dedusting cleaned surface with …………..
59 211	m^2	Preliminary protection of surface with wash primer
59 212	m^2	Preliminary protection of surface with rinsing agent
59 213	m^2	Preliminary protection of surface with etch primer
59 214	m^2	Preliminary protection of surface with ……..
59 221	m^2	Application of shop primer with alkyd resin
59 222	m^2	Application of shop primer with epoxy-ester resin
59 231	m^2	Application of shop primer with chlorinated rubber
59 241	m^2	Application of shop primer with vinyl chloride co-polymers
59 242	m^2	Application of shop primer with polyvinyl butyral
59 251	m^2	Application of shop primer with epoxies
59 252	m^2	Application of shop primer with polyurethane
59 261	m^2	Application of shop primer with alkali-silicate
59 262	m^2	Application of shop primer with ethyl-silicate

Item	Unit Measure	Description of Work
59 271	m^2	Application of shop primer with ………
59 311	m^2	Application of priming coat with zinc chromate
59 312	m^2	Application of priming coat with zinc dust
59 313	m^2	Application of priming coat with calcium plumbate
59 314	m^2	Application of priming coat with hot bitumen
59 321	m^2	Application of priming coat with alkali-silicate
59 322	m^2	Application of priming coat with ethyl silicate
59 326	m^2	Application of priming coat with …..…
59 331	m^2	Application of priming or top coat with alkyd resin
59 332	m^2	Application of priming or top coat with epoxy-ester resin
59 334	m^2	Application of priming or top coat with chlorinated rubber
59 335	m^2	Application of priming or top coat vinyl chloride co-polymers
59 337	m^2	Application of priming or top coat with epoxies
59 338	m^2	Application of priming or top coat with epoxy-polyurethane
59 339	m^2	Application of priming or top coat with …….
59 341	m^2	Application of top coat with titanium oxide
59 342	m^2	Application of top coat with iron oxide
59 343	m^2	Application of top coat with bitumen
59 344	m^2	Application of top coat with bitumen and aluminium dust
59 351	m^2	Hot-dip galvanizing of average thickness 37 micrometers
59 352	m^2	Hot-dip galvanizing of average thickness 43 micrometers
59 353	m^2	Hot-dip galvanizing of average thickness 54 micrometers
59 354	m^2	Hot-dip galvanizing of average thickness 57 micrometers
59 355	m^2	Hot-dip galvanizing of average thickness 71 micrometers
59 356	m^2	Hot-dip galvanizing of average thickness 86 micrometers
59 357	m^2	Hot-dip galvanizing of average thickness 90 micrometers and above
59 361	m^2	Metal-spraying of zinc of thickness 40 to 79 micrometers
59 362	m^2	Metal-spraying of zinc of thickness 80 to 119 micrometers
59 363	m^2	Metal-spraying of zinc of thickness 120 to 199 micrometers
59 364	m^2	Metal-spraying of zinc of thickness 200 micrometers minimum
59 365	m^2	Metal-spraying of zinc of thickness …… micrometers
59 371	m^2	Metal-spraying of aluminium of thickness 120 to 199 micrometers
59 372	m^2	Metal-spraying of aluminium of thickness 200 to 299 micrometers
59 373	m^2	Metal-spraying of aluminium of thickness 300 micrometers minimum
59 374	m^2	Metal-spraying of aluminium of thickness …… micrometers
59 381	m^2	Metal-spraying of lead of thickness 300 to 499 micrometers
59 382	m^2	Metal-spraying of lead of thickness 500 to 999 micrometers

Item	Unit Measure	Description of Work
59 383	m^2	Metal-spraying of lead of thickness 1,000 micrometers minimum
59 384	m^2	Metal-spraying of lead of thickness …… micrometers
59 391	pcs	Cathodic protection of structure ….. with anodes with an external electric supply
59 392	pcs	Cathodic protection of structure ….. with anodes with an external electric supply
59 393	pcs	Cathodic protection of structure ……. with galvanic anodes
59 394	pcs	Cathodic protection of structure ……. with galvanic anodes
59 396	m^2	Basic protection with self-adhesive tape of polyethylene foil of thickness 0.3 mm
59 397	m^2	Basic protection with self-adhesive tape of polyethylene foil of thickness 0.4 mm
59 398	m^2	Basic protection with self-adhesive tape of polyethylene foil of thickness 0.5 mm
59 399	m^2	Basic protection with self-adhesive tape of polyethylene foil of thickness ….. mm

2.2.5.10.1.9.2 5.9/2 Waterproofing

Item	Unit Measure	Description of Work
59 411	m^2	Preparation of substrate – cement concrete surface with water jet
59 412	m^2	Preparation of substrate – cement concrete surface by milling
59 413	m^2	Preparation of substrate – cement concrete surface with mechanical hammer
59 414	m^2	Preparation of substrate – cement concrete surface by blast cleaning
59 415	m^2	Preparation of substrate – cement concrete surface with vacuum cleaner
59 416	m^2	Preparation of substrate – cement concrete surface with/by …..
59 421	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in one coat, consumption up to 0.3 kg/m^2
59 422	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in one coat, consumption 0.31 – 0.4 kg/m^2
59 423	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in one coat, consumption 0.41 – 0.5 kg/m^2
59 424	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in one coat, consumption above 0.5 kg/m^2
59 431	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in two or more coats, consumption up to 0.6 kg/m^2
59 432	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in two or more coats, consumption 0.61 – 0.8 kg/m^2
59 433	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in two or more coats, consumption 0.81 – 1.0 kg/m^2
59 434	m^2	Execution of adhesive layer – priming coat or sealing coat with reaction resin in two or more coats, consumption above 1.0 kg/m^2
59 441	m^2	Scattering adhesive layer – priming coat with dried quartz sand of granulometric composition 0.5/1 mm, quantity up to 1.0 kg/m^2
59 442	m^2	Scattering adhesive layer – priming coat with dried quartz sand of

Item	Unit Measure	Description of Work
		granulometric composition 0.5/1 mm, quantity 1.1 -1.5 kg/m^2
59 443	m^2	Scattering adhesive layer – priming coat with dried quartz sand of granulometric composition 0.5/1 mm, quantity 1.6 – 2.0 kg/m^2
59 444	m^2	Scattering adhesive layer – priming coat with dried quartz sand of granulometric composition 0.5/1 mm, quantity 2.1 – 2.5 kg/m^2
59 445	m^2	Scattering adhesive layer – priming coat with dried quartz sand of granulometric composition 0.5/1 mm, quantity above 2.5 kg/m^2
59 451	m^2	Execution of adhesive layer – priming coat with cold bituminous binder, quantity up to 0.2 kg/m^2
59 452	m^2	Execution of adhesive layer – priming coat with cold bituminous binder, quantity 0.21 – 0.30 kg/m^2
59 453	m^2	Execution of adhesive layer – priming coat with cold bituminous binder, quantity 0.31 – 0.4 kg/m^2
59 454	m^2	Execution of adhesive layer – priming coat with cold bituminous binder, quantity above 0.4 kg/m^2
59 461	m^2	Execution of adhesive layer – priming coat with hot bituminous binder, quantity up to 0.2 kg/m^2
59 462	m^2	Execution of adhesive layer – priming coat with hot bituminous binder, quantity 0.21 – 0.30 kg/m^2
59 463	m^2	Execution of adhesive layer – priming coat with hot bituminous binder, quantity 0.31 – 0.4 kg/m^2
59 464	m^2	Execution of adhesive layer – priming coat with hot bituminous binder, quantity above 0.4 kg/m^2
59 471	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:3 for trowel, quantity up to 1.5 kg/m^2
59 472	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:3 for trowel, quantity 1.6 – 2.0 kg/m^2
59 473	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:3 for trowel, quantity 2.0 – 2.5 kg/m^2
59 474	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:3 for trowel, quantity above 2.5 kg/m^2
59 481	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:4 for trowel, quantity up to 2.0 kg/m^2
59 482	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:4 for trowel, quantity 2.1 – 2.5 kg/m^2
59 483	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:4 for trowel, quantity 2.6 – 3.0 kg/m^2
59 484	m^2	Execution of adhesive layer – levelling with epoxy mortar 1:4 for trowel, quantity above 3.0 kg/m^2
59 491	m^2	Execution of adhesive layer – levelling with bituminous adhesive compound for trowel, quantity up to 1.5 kg/m^2
59 492	m^2	Execution of adhesive layer – levelling with bituminous adhesive compound for trowel, quantity 1.6 – 2.0 kg/m^2
59 493	m^2	Execution of adhesive layer – levelling with bituminous adhesive compound for trowel, quantity 2.1 – 2.5 kg/m^2
59 494	m^2	Execution of adhesive layer – levelling with bituminous adhesive compound for trowel, quantity above 2.5 kg/m^2

Item	Unit Measure	Description of Work
59 496	m^2	Execution of additional adhesive layer with approximately 250 g/m^2 of epoxy resin binder
59 497	m^2	Execution of additional adhesive layer with approximately 250 g/m^2 of bituminous binder
59 498	m^2	Execution of additional adhesive layer with approximately …. g/m^2 of binder
59 511	m^2	Execution of intermediate waterproof layer with single welded bituminous tape (t=4.5 mm), butt jointing
59 512	m^2	Execution of intermediate waterproof layer with single welded bituminous tape (t=4.5 mm), overlapping jointing
59 521	m^2	Execution of intermediate waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound up to 1.5 kg/m^2
59 522	m^2	Execution of intermediate waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound 1.6 – 2.0 kg/m^2
59 523	m^2	Execution of intermediate waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound 2.1 - 2.5 kg/m^2
59 524	m^2	Execution of intermediate waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound above 2.5 kg/m^2
59 531	m^2	Execution of top waterproof layer with single welded bituminous strip of 4.5 mm thickness, butt jointing
59 532	m^2	Execution of top waterproof layer with single welded bituminous strip of 4.5 mm thickness, overlapping jointing
59 541	m^2	Execution of top waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound up to 1.5 kg/m^2
59 542	m^2	Execution of top waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound 1.6 – 2.0 kg/m^2
59 543	m^2	Execution of top waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound 2.1 - 2.5 kg/m^2
59 544	m^2	Execution of top waterproof layer with single stuck bituminous tape of 3 mm thickness, butt jointing, consumption of bituminous adhesive compound above 2.5 kg/m^2
59 551	m^2	Execution of top waterproof layer with two bituminous tapes, the lower one of 3 mm and stuck, the upper one of 3.6 mm thickness and welded, butt jointing, consumption of bituminous adhesive compound up to 1.5 kg/m^2
59 552	m^2	Execution of top waterproof layer with two bituminous tapes, the lower one of 3 mm and stuck, the upper one of 3.6 mm thickness and welded, butt jointing, consumption of bituminous adhesive compound 1.6 – 2.0 kg/m^2
59 553	m^2	Execution of top waterproof layer with two bituminous tapes, the lower one of 3 mm and stuck, the upper one of 3.6 mm thickness and welded, butt jointing, consumption of bituminous adhesive compound 2.1 – 2.5 kg/m^2
59 554	m^2	Execution of top waterproof layer with two bituminous tapes, the lower one of 3 mm and stuck, the upper one of 3.6 mm thickness and welded, butt

Item	Unit Measure	Description of Work
		jointing, consumption of bituminous adhesive compound above 2.5 kg/m^2
59 561	m^1	Wrapping butt joints of bituminous tapes in a width of 20 cm, with self-adhesive tape
59 562	m^1	Wrapping butt joints of bituminous tapes in a width of 20 cm, with bituminous tape
59 571	m^2	Execution of waterproof layer of bituminous mastic in one coat of 10 mm thickness
59 572	m^2	Execution of waterprooflayer of bituminous mastic in two coats of 20 mm total thickness
59 581	m^2	Execution of waterproof layer of polymer modified bitumen by means of spraying, consumption up to 2.0 kg/m^2
59 582	m^2	Execution of waterproof layer of polymer modified bitumen by means of spraying, consumption 2.1 – 2.5 kg/m^2
59 583	m^2	Execution of waterproof layer of polymer modified bitumen by means of spraying, consumption 2.6 – 3.0 kg/m^2
59 584	m^2	Execution of waterproof layer of polymer modified bitumen by means of spraying, consumption above 3.0 kg/m^2
59 611	m^2	Execution of waterproof layer of liquid polymers by means of spraying, including adhesive layer, in thickness up to 2.5 mm
59 612	m^2	Execution of waterproof layer of liquid polymers by means of spraying, including adhesive layer, in thickness 2.6 – 3.0 mm
59 613	m^2	Execution of waterproof layer of liquid polymers by means of spraying, including adhesive layer, in thickness 3.1 – 3.5 mm
59 614	m^2	Execution of waterproof layer of liquid polymers by means of spraying, including adhesive layer, in thickness 3.6 – 4.0 mm
59 615	m^2	Execution of waterproof layer of liquid polymers by means of spraying, including adhesive layer, in thickness 4.1 – 4.5 mm
59 616	m^2	Execution of waterproof layer of liquid polymers by means of spraying, including adhesive layer, in thickness above 4.5 mm
59 621	m^2	Execution of waterproof layer of stuck polymer foil in thickness up to 1.5 mm
59 622	m^2	Execution of waterproof layer of stuck polymer foil in thickness 1.6 – 2.0 mm
59 623	m^2	Execution of waterproof layer of stuck polymer foil in thickness 2.1 – 2.5 mm
59 624	m^2	Execution of waterproof layer of stuck polymer foil in thickness above 2.5 mm
59 631	m	Execution of unbound waterproof layer of smooth polymer foil
59 632	m	Execution of unbound waterproof layer of rough polymer foil
59 641	m	Supply, preparation, and laying bituminous cork to form supports for transition slabs
59 646	m^1	Execution of carriageway termination by the method of extended waterproofing at the contact transition slab – superstructure, as per design

Item	Unit Measure	Description of Work
59 651	m^2	Execution of carriageway waterproofing with bituminous tapes, of 4.5 or 5 mm thickness, adhesive layer of reaction resin, in one coat, scattering with quartz sand
59 652	m^2	Execution of carriageway waterproofing with bituminous tapes, of 4.5 or 5 mm thickness, adhesive layer of 1:4 epoxy mortar, scattering with quartz sand
59 653	m^2	Execution of carriageway waterproofing with bituminous tapes, of 4.5 or 5 mm thickness, adhesive layer of cold bituminous binder
59 654	m^2	Execution of carriageway waterproofing with bituminous tapes, of 4.5 or 5 mm thickness, adhesive layer of bituminous adhesive compound
59 661	m^2	Execution of carriageway waterproofing with bituminous mastic, adhesive layer of reaction resin, scattering with quartz sand
59 671	m^2	Execution of carriageway waterproofing with liquid polymers for spraying, adhesive layer of reaction resin, scattering with quartz sand
59 672	m^2	Execution of carriageway waterproofing with liquid polymers for spraying, adhesive layer of 1:4 epoxy mortar, scattering with quartz sand
59 673	m^2	Execution of carriageway waterproofing with liquid polymers for spraying, adhesive layer of cold bituminous binder
59 674	m^2	Execution of carriageway waterproofing with liquid polymers for spraying, adhesive layer of bituminous adhesive compound
59 681	m^2	Execution of tunnel waterproofing with PVC foil of 2 mm thickness, including one layer of geo-textiles (500 gr/m^2)
59 682	m^2	Finishing tunnel surface with fine shot cement concrete of 3 – 5 cm thickness
59 684	m^2	Execution of waterproofing of cross tunnel with PVC foil of 2 mm thickness, including one layer of geo-textiles (500 gr/m^2)
59 685	m^2	Finishing cross tunnel surface with fine shot cement concrete of 3 – 5 cm thickness
59 687	m^2	Execution of waterproofing of cut-and-cover with PVC foil of 2 mm thickness, including two layers of geo-textiles (500 gr/m^2)
59 688	m^2	Protection of waterproofing of cut-and-cover with shot cement concrete of 10 cm thickness, reinforced with steel mesh (3 kg/m^2)
59 691	m^2	Izdelava hidroizolacije zasutih cementnobetonskih površin z bitumenskimi trakovi, debelimi 4 mm
59 693	m^2	Execution of waterproofing of backfilled cement concrete surfaces by means of spraying polymer modified bitumen
59 695	m^2	Execution of waterproofing of backfilled cement concrete surfaces with rough polymer foil
59 697	m^1	Waterproofing at the contact of two cement concrete blocks, with rubber tape built-in to cement concrete
59 698	m^1	Waterproofing at the contact of two cement concrete blocks, with folded rubber tape built-in to cement concrete

Item	Unit Measure	Description of Work
59 711	m^2	Execution of protective layer of felt of 300 g/m^2
59 712	m^2	Execution of protective layer of felt of 400 g/m^2
59 713	m^2	Execution of protective layer of felt of 500 g/m^2
59 721	m^2	Execution of protective layer of hard foamy plates in thickness up to 2.0 cm
59 722	m^2	Execution of protective layer of hard foamy plates in thickness 2.1 – 3.0 cm
59 723	m^2	Execution of protective layer of hard foamy plates in thickness 3.1 – 4.0 cm
59 724	m^2	Execution of protective layer of hard foamy plates in thickness 4.1 – 5.0 cm
59 725	m^2	Execution of protective layer of hard foamy plates in thickness above 5.0 cm
59 731	m^2	Execution of protective layer of wooden slabs in thickness up to 1.5 cm
59 732	m^2	Execution of protective layer of wooden slabs in thickness 1.6 – 2.0 cm
59 733	m^2	Execution of protective layer of wooden slabs in thickness 2.1 – 2.5 cm
59 734	m^2	Execution of protective layer of wooden slabs in thickness above 2.5 cm
59 741	m^2	Execution of protective layer of 1:4 cement mortar in thickness 4 cm
59 742	m^2	Execution of protective layer of 1:4 cement mortar in thickness 5 cm
59 743	m^2	Execution of protective layer of 1:4 cement mortar in thickness 6 cm
59 744	m^2	Execution of protective layer of 1:4 cement mortar in thickness above 6 cm
59 751	m^2	Execution of protective layer of rough foil
59 761	m^2	Execution of separating layer of hard foamy plates in thickness 1 cm
59 762	m^2	Execution of separating layer of hard foamy plates in thickness 2 cm
59 771	m^2	Execution of separating layer of rubber plates in thickness 1 cm
59 772	m^2	Execution of separating layer of rubber plates in thickness 2 cm
59 781	m^2	Execution of separating layer of bituminous plates in thickness 1 cm
59 782	m^2	Execution of separating layer of bituminous plates in thickness 2 cm
59 791	m^2	Execution of separating layer of ………. plates/slabs in thickness 1 cm
59 792	m^2	Execution of separating layer of ………. plates/slabs in thickness 2 cm
59 811	m^1	Sealing boundary surfaces – joints, of up to 20 mm width and up to 4 cm depth, with preliminary coating applied to adjacent surfaces and by filling up with bituminous joint filling compound
59 821	m^1	Sealing boundary surfaces – joints, of up to 15 mm width and up to 4 cm depth, with preliminary coating applied to adjacent surfaces and filling up with synthetic organic compound
59 831	m^1	Sealing boundary surfaces – joints, of up to 10 mm width and up to 4 cm depth, with preliminary coating applied to adjacent cement concrete surfaces, and with stuck bituminous sealing tape for joints

Item	Unit Measure	Description of Work
59 841	m^1	Sealing of boundary surface at the kerb in approximately 25 cm width, with a compound for trowel, and by means of spraying modified bituminous binder (up to 1.5 kg/m^2), and scattering with chippings of 2/4 mm of carbonate rock (up to 2,5 kg/m^2)
59 851	m^1	Sealing expansion joint with a joint filler (foamy rubber)
59 852	m^1	Sealing expansion joint with durable elastic filling material
59 853	m^1	Sealing expansion joint with durable elastic joint sealing compound
59 854	m^1	Sealing expansion joint with adequate tape
59 861	m^1	Placing sliding foil into the joint with tooth
59 862	m^1	Placing ribbed expanded metal plate into the joint
59 863	m^1	Placing corrugated fibre-cement slab into the joint
59 864	m^1	Placing corrugated plastic plate into the joint
59 865	m^1	Placing flat steel plate of 300/1 mm into the joint
59 911	m^1	Execution of expansion joint in waterproofing tapes – structural elements, thickness up to 50 cm, with sealing tape on outer side
59 912	m^1	Execution of expansion joint in waterproofing tapes – structural elements, thickness over 50 cm (with a tooth), with sealing tape on outer side
59 921	m^1	Execution of expansion joint in waterproofing tapes – structural elements, thickness over 50 cm, with sealing tape within the section
59 922	m^1	Execution of expansion joint in waterproofing tapes – structural elements, thickness over 80 cm (with a tooth), with sealing tape within the section
59 931	m^1	Execution of expansion joint without waterproofing tapes – structural elements, thickness up to 50 cm, with sealing tape on outer side
59 932	m^1	Execution of expansion joint without waterproofing tapes – structural elements, thickness over 50 cm (with a tooth), with sealing tape on outer side
59 941	m^1	Execution of expansion joint without waterproofing tapes – structural elements, thickness over 50 cm, with sealing tape within the section
59 942	m^1	Execution of expansion joint without waterproofing tapes – structural elements, thickness over 80 cm (with a tooth), with sealing tape within the section
59 946	m^1	Execution of expansion joints ……… as per design
59 951	m^1	Execution of contact joint without gap for structural elements, thickness up to 50 cm, with sealing tape on the outer side
59 961	m^1	Execution of contact joint without gap for structural elements, thickness over 50 cm, with sealing tape within the section
59 962	m^1	Execution of contact joint without gap for structural elements, thickness over 60 cm (with a tooth), with sealing tape within the section
59 963	m^1	Execution of contact joint without gap for structural elements, thickness over 80 cm (with a tooth), with sealing tape within the section
59 971	m^1	Execution of contact joint with a gap on carriageway slab or in a wall,

Item	Unit Measure	Description of Work
		without contact to the soil, thickness up to 50 cm
59 972	m^1	Execution of contact joint with a gap on carriageway slab or in a wall, without contact to the soil, thickness over 80 cm
59 973	m^1	Execution of contact joint with a gap on carriageway slab or in a wall, with contact to the soil, thickness over 50 cm
59 976	m^1	Execution of contact joint ……………. as per design
59 981	m^1	Execution of dummy (fictive) joint with sealing strip on the backfilled side, without waterproofing tapes
59 982	m^1	Execution of dummy (fictive) joint with a joint waterproofing tape
59 983	m^1	Execution of dummy (fictive) joint with corrugated plate in the middle
59 986	m^1	Execution of dummy (fictive) joint …….. as per design
59 991	m^1	Execution of construction joint in a wall with waterproofing tapes
59 992	m^1	Execution of construction joint in a wall with steel sheet 300/1 mm, without waterproofing tapes
59 993	m^1	Execution of construction joint in a wall with swelling tape of profile, without waterproofing tapes
59 996	m^1	Execution of construction joint in a wall ………… as per design
59 997	m^1	Execution of construction joint in a wall ……………. as per design

* Special technical conditions for waterproofing of structures are presented in section 1.2.4

GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

VOLUME II: CONSTRUCTION

SECTION 2: SPECIAL TECHNICAL CONDITIONS

Part 6: TRAFFIC EQUIPMENT AND SIGNALISATION

Sarajevo/Banja Luka
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CONTENTS :

2.2.6 TRAFFIC EQUIPMENT AND SIGNALISATION

2.2.6.0 GENERAL

2.2.6.0.1 Description

Road furniture shall be specified in detail by the design taking account of the requirements provided by the regulation. At the design stage one shall consider that the traffic furniture may be, in principle, placed at such locations and to such an extent as to ensure adequate conditions for a safe use of traffic surfaces to all the participants.

The road furniture shall:

- guide the traffic participants,
- warn them against permanent or periodical hazard,
- announce them traffic restriction, prohibitions, and obligations,
- provide them with necessary and useful information, and
- ensure other conditions for safe, comfortable, and undisturbed traffic.

The road furniture is basically classified in the following:

- roadside and overhead road furniture,
- road markings,
- traffic guiding equipment,
- traffic safety equipment,
- snow removal and ice control equipment, and
- other road furniture.

2.2.6.0.2 Basic Materials

In dependence on the designed use of, and the conditions under which the road furniture will be used, the following materials should mainly be used:

- products made of steel and aluminium,
- plastic materials,
- cement concrete,
- wood, and
- paint material.

All the materials designed to be used for road furniture shall meet the requirements specified for a particular piece of work in applicable design and technical conditions.

The contractor may only use such material as has been specified in applicable documents or has been approved by the engineer subsequent to an agreed modification.

2.2.6.0.3 Quality of Materials

All the materials to be used for road furniture shall conform to design specifications, applicable regulations, and these technical conditions, so that adequate quality of the executed works related to road furniture is ensured.

The quality of each type of material that the contractor intends to use for the road furniture shall be demonstrated by adequate documented evidence, in accordance with the requirements set in the general technical conditions and other relevant regulations.

3.2.6.0.1 Method of Execution

The method of executing the works in connection with road furniture shall be determined in detail by the design, which shall take into consideration all the conditions provided in relevant regulations as well as any other technical conditions that may be agreed.

The design for road furniture shall be approved by the client, or by the engineer, however within the limits of his authority.

If during the execution of work in connection with road furniture the design should be found to be incomplete, the contractor shall take account of the explanations and instructions given by the engineer. Such explanations and instructions shall constitute an integral part of the design and shall not be considered as design modifications.

If any job within the scope of road furniture is not dealt with in these technical conditions, the technical conditions applying to the execution of such a job shall make an integral part of the design. If this is not the case, the engineer shall provide appropriate specifications.

The execution of work in connection with road furniture shall be harmonized with the construction programme, and adapted to such conditions as may be encountered on the road in each particular case.

2.2.6.0.4 Quality of Execution

The quality of road furniture specified by the design, applicable regulations, and relevant technical conditions shall be ensured.

If resistance to corrosion and other adverse environmental impacts is naturally lacking in the material foreseen for road furniture, such material shall be protected as appropriate by applying one of the methods specified in section 2.2.5.8 of these technical conditions. As a rule, any part of furniture made of steel shall be protected by hot-dip galvanizing.

Partially deficient or damaged road furniture may only be placed if approved by the engineer, and if this does not reduce the quality of the work concerned.

All the equipment and machinery used in executing the work in connection with road furniture shall be provided with appropriate test certificates. The capacity of such equipment shall meet the requirements of the design, applicable regulations, and technical conditions.

If so required by the engineer, before the commencement of work, the contractor shall prove his ability and the specified quality by demonstrative placing a particular piece of work in connection with road furniture at a location specified by the engineer.

The contractor may only commence to execute the work in connection with road furniture after having obtained the approval from the engineer. If during the execution of work the engineer notices any deviation of the completed work from the agreed method of execution, he has the right to interrupt the work and take appropriate measures.

2.2.6.0.5 Quality Control of Execution

The quality of the work carried out in connection with road furniture specified in these technical conditions shall be controlled by adequate testing to such an extent as required or agreed upon, and introducing such methods as agreed upon or specified in applicable regulations and technical conditions.

Upon completion of the work, the contractor shall submit to the supervising engineer appropriate documented evidence that the required quality of the work has been achieved.

3.2.6.0.2 Measurement and Take-Over of Works

The executed works shall be measured in accordance with section 2.1.7.1 of the general technical conditions and calculated in appropriate units of measure.

The quantities shall be assessed to the extent and type of work actually carried out within the limits of measurements specified in the design.

For the purpose of taking-over the executed work, the requirements of these technical conditions and of section 2.1.7.2 of the general technical conditions shall be observed. Any defective work that might be found shall be made good within a time period specified by the engineer.

For any work not conforming to the quality requirements, and which the contractor has failed to repair in compliance with the engineer’s instructions, the contractor shall not have the right to claim any payment whatsoever.

Warranty conditions for road furniture shall be specified in the contract documents.

For each new or supplemented item of road furniture the contractor shall prepare adequate documents, submitting it to the engineer for the purpose of entering the information into the road data bank.

3.2.6.0.3 Final Account of Works

Bases for the final account of the work carried out are indicated in section 2.1.7.3 of the general technical conditions.

All the quantities of the work performed specified in section 2.2.6.0.7 shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for perfect completion of the work. The contractor shall have no right to claim any extra payment.

2.2.6.1 ROADSIDE AND OVERHEAD ROAD FURNITURE

General

Roadside and overhead road furniture, also called vertical signs and signals, shall be placed in such a way that traffic participants can perceive it easily by day and night, reacting duly to the indications provided.

2.2.6.1.1 Description

Roadside and overhead road furniture comprises the following:

- foundations,
- supporting structures, and
- traffic signs.

The erection of roadside and overhead road furniture includes all such earthworks as may be required, complete supply of adequate materials, and their placing at such locations as specified by the design.

Usually, the roadside and vertical road furniture is placed as permanent. However, traffic signs shall be replaceable.

For quick adaptation of roadside and overhead road furniture to traffic conditions, adequate traffic signs for alternate priority control and varying traffic conditions respectively may be used (based on mechanical means or light control).

Unless directed otherwise by the engineer, the temporary roadside and overhead road furniture shall comply with all the conditions specified for permanent furniture.

2.2.6.1.2 Basic Materials

2.2.6.1.2.1 Foundations

Foundations for roadside and overhead road furniture shall be of cement concrete. They may be entirely prefabricated, i.e. precast elements with adequate cement concrete pipes of round cross-section serving as external casing.

2.2.6.1.2.2 Supporting Structures

Supporting structures for roadside and overhead road furniture include the following:

- posts,
- poles,
- supporting frames,
- semi-portals and portals, and
- stands (for temporary traffic signs).

As a rule, supporting structures shall be made of durable materials such as steel, aluminium, non-reinforced and reinforced concrete, or plastic materials.

2.2.6.1.2.3 Traffic Signs

According to their intended use, traffic signs are classified as follows:

- danger warning signs (equilateral triangle),
- regulatory signs – prohibitions, restrictions, and obligations (circle, octagon),
- informational signs (circle, square, rectangle ending in an arrow),
- light signals (traffic control lights, etc.), and
- supplementary signs – panels (rectangle).

Mounting accessories for traffic signs shall be considered as an integral part of traffic signs.

The shape and size of traffic signs are specified in detail by the relevant regulation.

The size of danger warning and regulatory signs, which depends on the type of the road, is indicated in Table 6.1.

Table 6.1: Size of traffic signs

Type of sign	Unit measure	Type of road: motorway, expressway, out of settlement[1)]	out of settlement[2)], in settlement	other [3)]	Inserted signs [4)]
- danger warning sign side length	mm	1,200	900	600	450
- regulatory sign diameter	mm	900	600	400	300

[1)] *with one-way carriageway with at least two traffic lanes for the same direction, and on roads of carriageway width of ≥ 7,0 m*

[2)] *if one-way carriageway is less than 7.0 m wide*

[3)] *in areas of slow traffic, non-classified, cycle track*

[4)] *on signs for conducting the traffic by directions*

The size (width) of supplementary signs (panels) shall be harmonized with the size of basic signs they supplement.

Where it is required for safety and technical traffic requirements, the signs of variable purpose may be in the form of

- turning leaves,
- turning prisms,
- movable strips,
- light fields added to usual traffic signs,
- optic fibres, or
- high-illuminative diodes.

3.2.6.0.3.1.1 Backing Sheet

The backing sheet of traffic signs and the housing of internally illuminated traffic signs shall be made of

- glass fibre reinforced polyester, or
- sheet metal (steel or aluminium).

The face of internally illuminated traffic signs shall be made of transparent or translucent plastic material (acrylic glass, etc.).

For the backing sheet of temporary traffic signs other materials may also be used on condition they are adequately durable and approved by the engineer.

The backing sheet of traffic signs shall be of reflecting type. Any other adequate backing sheet shall be approved by the engineer.

2.2.6.1.2.3.1 Signs and Worded Messages

Signs and wording messages on traffic signs can be

- unreflecting: painted or provided by means of unreflecting foil,
- reflecting: made of reflecting materials (type 1 or type 2),
- illuminated: externally or internally illuminated (by their own source of light).

The surface of the housing of internally illuminated traffic signs shall be characterized by light transmitting capacity.

The shape, size, and type of lighting fixtures and luminous elements shall be suited to the traffic sign. In principle, the following shall be used:

- for traffic light signals: halogen and ordinary bulbs,
- for illuminated traffic signs:
    - externally: sodium or high-pressure mercury lamps,

- internally: fluorescent and neon lamps.

3.2.6.0.3.1.2 Moutning Accessories

In principle, mounting accessories for traffic signs (clamps, bolts, nuts, and washers) shall be made of steel suitable protected from corrosion.

2.2.6.1.3 Quality of Materials

2.2.6.1.3.1 Foundations

Quality specifications for cement concrete for foundations of roadside and overhead road furniture are detailed in section 3.2.5.3 of these technical conditions as appropriate.

Unless otherwise specified by the design or directed by the engineer, cement concrete C 12/15 or C 16/20 shall be used for foundations of roadside and overhead road furniture. For foundations of semi-portals and portals, cement concrete shall be appropriately reinforced.

Since circular cement concrete pipes mainly serve as formwork for precast foundations for posts, the quality of such pipes shall comply with the quality of cement concrete specified for foundations.

3.2.6.0.3.2Supporting Structures

2.2.6.1.3.1.1 Posts

Traffic sign posts shall in principle be made of steel pipes ϕ 51 mm (for local road furniture only) and ϕ 64 mm, of wall thickness of not less than 2 mm, and externally and internally protected by hot-dip galvanizing or any other appropriate method (plastic-coated, painted, metallization).

In exceptional cases, and in agreement with the engineer, other adequate materials (aluminium, oak and pine wood) may also be used for the erection of temporary traffic signs.

2.2.6.1.3.1.2 Poles

The quality of material for vertical poles and cantilever supports, which are primarily used for traffic control lights, shall conform to the design specifications.

2.2.6.1.3.1.3 Supporting Frame

The supporting frame for permanent informational signs (lane use, direction confirmation panels, etc.) shall in principle be made of steel pipes of adequate cross-section.

2.2.6.1.3.1.4 Semi-portals and Portals

Semi-portals and portals shall generally be made of steel.

Steel grade shall conform to the conditions stated in the design and section 3.2.5.3 of these technical conditions, this also applies to any other materials that may be used in constructing a semi-portal or portal.

2.2.6.1.3.1.5 Stands

The stands for temporary roadside and overhead road equipment shall be made of such materials as to suit perfectly for their designed use within a limited time period (steel, aluminium, wood).

2.2.6.1.3.2 Traffic Signs

During the design service life of traffic signs, their shape and colour may not change or fade, to ensure reliable and unambiguous directions and information for traffic participants.

Various materials that may be combined in a traffic sign should remain compatible in all temperature and weather conditions, ensuring the required durability of the traffic sign.

The material used for traffic signs shall be resistant to

- weathering and water (hydrophobic),
- changes of chemical properties,
- excessive weathering and ageing, and
- fire and related hazards.

2.2.6.1.3.3 Backing Sheet

The backing sheet for traffic signs shall be capable of withstanding

- wind loads of 10 MN/m^2, and
- temperature changes between – 35 °C and 70 °C,

with such stresses allowed as are within the elasticity limits of the particular material. Elastic deformations should not decrease the traffic sign durability.

The thickness of the backing sheet of a traffic sign shall be assessed in dependence on

- specified size of a traffic sign,
- type of material, and
- method of its shaping and reinforcement.

Metal plates for backing sheet shall not be less than 2 mm thick.

2.2.6.1.3.3.1 Signs and Worded Messages

The limiting values of colorimetric and photometric properties of materials for backing sheet, signs, worded messages, and the back of traffic signs are specified in applicable regulations.

To determine the colour visibility during the day, relative luminosity shall be considered as the most important factor, while for the visibility by night, the retro-reflection shall be taken into account.

Glossy paints shall not be used for traffic signs, to avoid night glare produced by the light of car headlights.

Adequate paints may only be used for traffic signs and protective coating of sign posts on non-classified roads.

The back of traffic signs (including all mounting accessories) shall be coated with a flat grey paint.

In case of reflecting foils, two types shall be taken into consideration:

- first type with normal retro-reflection (e.g.. Engineer Grade), and
- second type with intense retro-reflection (e.g. High Intensity).

Detailed conditions concerning the quality of paints, foils, and other materials for backing sheets, signs, and worded messages on traffic signs shall be specified in the design.

The materials for signs and worded messages on traffic signs (paints and foils) shall be resistant to such agents as may be used for cleaning the traffic signs.

Paints used with traffic signs and worded messages shall adhere perfectly to the backing sheet.

Retro-reflecting materials which photometric properties during the period of their use would be reduced by more than a half with regard to the minimum values required for new material must not be used for signs and worded messages on traffic signs. For first type of reflecting foils, service life of 7 years is specified, and for second type of reflecting foils 10 years.

2.2.6.1.3.3.2 Mounting Accessories

Accessories for fixing traffic signs to supporting structures shall be made of such materials as to ensure that their designed function is performed as appropriate during the service life, enabling economical replacement of traffic signs to be carried out.

Clamps and washers shall be made of adequate steel strip, whereas bolts and washers of high-grade steel protected from corrosion.

2.2.6.1.4 Method of Execution

Roadside and overhead road furniture shall be erected at locations specified in the design and applicable regulations.

3.2.6.0.3.3Foundations

Excavation of foundations for roadside and overhead road furniture shall be carried out in accordance with conditions set in section 2.2.2.1, whereas backfilling of foundation excavation in compliance with conditions set in section 2.2.2.4 of these technical conditions.

The method of execution of cement concrete foundations for roadside and overhead road furniture is defined in sections 2.2.5.1, 2.2.5.2, and 2.2.5.3 of these technical conditions as appropriate.

A detailed method of executing foundations, as proposed by the contractor, shall be approved by the engineer who may specify additional conditions to be observed in executing foundation work.

3.2.6.0.3.4Supporting Structures

The method of constructing supporting structures for roadside and overhead road furniture shall be specified in detail in the design.

For any justified modification proposed by the contractor approval shall be obtained from the engineer preliminarily.

2.2.6.1.4.1 Traffic Signs

Traffic signs may either be single- or double-faced. Exceptionally, an adequate backing sheet (panel) may include several traffic signs. Not more than two traffic signs and a supplementary panel may be mounted on a single post at a time.

The surface of a traffic sign shall be even, smooth, and closed. Its admitted reflection shall not decrease the facility of identifying the signs and worded messages.

To reduce the reflection by a traffic sign and the contrast between the sign and its background, traffic signs shall be positioned at an angle of 85° to 87° with respect to the road axis.

2.2.6.1.4.1.1 Backing Sheet

To ensure the required buckling and impact strength (stiffness) of backing sheet, reinforcement shall be provided as appropriate:

- by forming suitable ribs at the edges,
- by folding back the edges, or
- by adequate metal frames onto which backing sheet can be fixed.

No traces of such strengthening must be visible on the face of a traffic sign. If such traces are expected to emerge subsequently, the backing sheet should be previously prepared as appropriate.

Backing sheets of greater size (panels) may be composed of several horizontal strips, which should be suitably mounted to a frame so as to form a single panel. The two materials used shall be compatible particularly as regards their shrinkage and expansion.

The surface of the backing sheet shall be even, uniform, and without any convexity. The face of the backing sheet of a traffic sign shall not reveal its composition.

The back of the backing sheet shall be smooth, closed, and suitably protected.

The housing of an internally illuminated traffic sign shall be protected against

- water to withstand rain intensity of 3 mm/min, and
- dust, so that silica dust particles with the velocity of 10 m/s (of size not exceeding 200 μm) are prevented from penetrating the interior.

Illuminated traffic signs and traffic control lights shall comply with special electro-technical requirements (connection, earthing, and insulation, photometric and colorimetric properties).

The light source shall provide the required uniform illumination of the effective surface of an internally or externally illuminated traffic sign.

3.2.6.0.3.4.1 Signs and Worded Messages

The shape, colour, dimensions, and graphic design of signs and worded messages on backing sheets of traffic signs are specified in relevant regulations.

All the materials for signs and worded messages shall be so applied to the backing sheet as to ensure sharp contours and edges (as a rule, by using screen process printing).

Paint for signs and worded messages shall be applied uniformly.

2.2.6.1.4.1.2 Traffic Control Light Signals

The lights of traffic control light signals may be permanent and/or intermittent or flashing.

The number of heads and the colour of the lights shall be selected in accordance with the design use of a traffic control light signal. Green, yellow, and red colour are mainly used for traffic control light signals, and, rarely, white as well. Single signal heads or signal head assemblies may be used.

One or more supplementary heads may be added to a primary traffic control light (consisting of three head assembly, for example).

The control (manual, automatic, programmed) of traffic lights shall be adjusted to the planned intention of use.

2.2.6.1.4.1.3 Mounting Accessories

Clamps used for mounting the traffic signs shall be adequately shaped and

- riveted or welded to the backing sheet, or
- fixed by means of bolts.

The fixing of a clamp shall not be visible from the front side of a traffic sign.

The method of mounting a traffic sign shal ensure a position, which will be satisfactory in all conditions of use.

2.2.6.1.5 Quality of Execution

Concerning the quality of execution of roadside and overhead road equipment, the conditions set in section 2.2.6.0.5 of these technical conditions shall apply.

Roadside and overhead road furniture as a whole, and individual materials, shall retain their dimensions within the admitted limits even after having been subjected to the specified mechanical actions. Dimensional variation of up to ± 2 % will be allowed, unless agreed otherwise and unless specified otherwise by the engineer.

The mounting accessories of a traffic sign shall withstand

- vertical force of 7.5 MN, and
- horizontal force of 3 MN.

2.2.6.1.6 Quality Control of Execution

Concerning the quality control of execution of roadside and overhead road furniture, the conditions indicated in section 2.2.6.0.6 of these technical conditions shall apply.

For individual works within the scope of roadside and overhead road furniture that are executed in accordance with conditions provided by these technical conditions, the specifications of applicable quality control provisions shall apply.

The method and scope of testing during erection of roadside and overhead road furniture shall be specified by the engineer on the basis of the design submitted, and on the basis of work progress.

3.2.6.0.4 Measurement and Take-Over of Works

The conditions for measuring and taking-over the erected roadside and overhead road furniture are specified in section 2.2.6.0.7 of these technical conditions.

3.2.6.0.5 Final Account of Works

The final account for the erected roadside and overhead road furniture shall be carried through in compliance with conditions indicated in section 2.2.6.0.8 of these technical conditions.

2.2.6.2 ROAD MARKINGS

General

Road (carriageway) markings (horizontal traffic signs) shall be made in such a way that reliable guidance and safe driving in ensured to traffic participants at all times.

2.2.6.2.1 Description

Road markings can be

- longitudinal,
- transverse and hatched,
- other, and
- reflecting.

They can be executed as

- preliminary markings,
- permanent markings, or
- temporary markings, and

as

- unreflecting or
- reflecting (with spread, or admixed and spread reflecting glass beads.

As a rule, the road markings on carriageway not illuminated by means of public lighting shall contain adequate reflecting glass beads spread over their surface.

The location of a road marking on the carriageway will determine whether the road marking is subjected to traffic loads

- infrequently,
- frequently, or
- permanently.

Road marking shall include adequate safety measures, all the required measurements and preliminary markings, cleaning and preparation of carriageway surface (including recessing), complete supply of adequate materials, and their application at locations specified by the design.

2.2.6.2.1.1 Longitudinal Markings

Longitudinal markings shall be parallel with the road axis. They can be

- dividing (separating), if running along the carriageway axis, between traffic lanes, or between a traffic lane and other traffic areas,
- marginal when provided at the edges of a carriageway, and
- guiding lines at crossroads.

Longitudinal road markings (lines) can be carried out as

- single:
  - continuous (uninterrupted), or
  - interrupted: ordinary, warning, short, wide), and
- double:
  - continuous,
  - interrupted, and
  - combined.

2.2.6.2.1.2 Transverse and Hatched Markings

Transverse and hatched road markings are used to mark carriageway areas with traffic restrictions. Such areas are marked either by continuous or interrupted lines. Such road markings include:

- stop lines,
- hatched markings for lane closing (narrowing) or opening (widening),
- boundary lines,
- pedestrian crossings, and
- cycle track crossings.

2.2.6.2.1.3 Other Markings

Other road markings are of special shapes. They include:
- arrow markings and guide lines,
- markings on road areas with traffic restrictions,
- wording messages and signs for traffic control, and
- markings on traffic areas for special purposes (BUS, TAXI, etc.).

2.2.6.2.1.4 Reflecting Markings

Reflecting road markings with reflectors on the carriageway should primarily improve traffic guidance at night and in conditions of poor visibility.

In principle, reflecting road markings shall only supplement other types of road markings.

2.2.6.2.2 Basic Materials

Only those materials may be used for road markings which properties with respect to traffic engineering and quality requirements ensure good visibility of the markings in day and night driving conditions, adequate skidding friction, and appropriate durability within the design service life.

Basic materials used for road markings include:
- paints,
- foils, and
- plastic compounds.

Road marking materials shall be
- applied to carriageway surface, or
- placed into the recess provided in the wearing course.

In case of application of road marking to the carriageway surface, the applied layer of the markings can be of
- thin-layer type (dry film thickness up to 400 μm), and
- medium- and thick-layer type (dry film thickness between 800 and 3,000 μm).

With regard to their composition and the method of their application and curing, thin-layer road markings can be executed by using
- one-component paints,
- multi-component paints,
- paints with preliminarily added quantity of reflecting glass beads (premix paints), and
- hot applied paints (spraying at 60 to 100 °C).

With standard paints, adequate reflectivity of road markings can be achieved by spreading reflecting glass beads.

Thick-layer road markings can be made by using
- foils (to be stuck-on), or
- plastic compounds (to be spread or sprayed, either hot or cold).

For placing into the recess in the wearing course, plastic compounds shall be used.

Road marking materials consist of binders, pigments, fillers, solvents, driers, softeners, and admixtures for reflection and increase of friction. With multi-component materials, curing agent will also be required.

Auxiliary materials for road markings are those used for priming coating, subsequent spreading reflecting glass beads, increase of skidding friction, thinners, and any such materials as may be specified by the manufacturer of road marking material.

Reflecting traffic markers (cat's eyes or others) shall in principle be made of adequate plastic material. The body can be made of metal or ceramics. They can be incorporated as temporary or permanent road markers. The light reflected by them should by white, red, or yellow.

2.2.6.2.3 Quality of Materials

The properties and the quality of road marking materials shall conform to the design traffic loading.

Road marking materials shall not have adverse effect on the materials incorporated in the pavement wearing course, causing any damage to such materials (e.g. cracks).

In due time prior to using any of the materials for thin-layer road markings, the contractor shall submit to the engineer:

- material conformity certificate indicating the following:
  - types and content of all the components (binders, pigments, fillers, etc.),
  - density,
  - paint viscosity before thinning,
  - content of non-volatile substances,
  - inflammation point,
  - infrared spectrum of the binder,
  - gas chromatogram of volatile compounds,
  - X-ray fluorescent analysis (solid material content);
- thinner conformity certificate indicating the following:
  - type,
  - inflammation point,
  - toxicity;
- conformity certificate for reflecting glass beads indicating the following:
  - chemical composition of glass,
  - refraction coefficient,
  - bulk density of spread glass,
  - bulk density of glass,
  - moisture content,
  - granulometric composition,
  - portion of acceptable glass beads.

The required evidence to demonstrate the quality of materials for thick-layer road markings shall be specified by the engineer in compliance with the requirements applying to thin-layer road markings as appropriate, as well as in agreement with the manufacturer.

Before using any of road marking materials, the contractor shall submit to the engineer the information concerning the conditions for the application of such materials, such information to indicate

- shelf life,
- drying time and curing time, and
- wet film thickness and dry firm thickness of road marking material.

The contractor shall also submit to the engineer a report on testing road marking materials with identical properties as those of the materials designed to be used, such reports to serve as an evidence that during the required service life the specified properties of road markings are provided. In addition to the quality of materials, such reports shall include

- evidence of properties of applied layer of road marking material indicating the following:
  - adhesion strength,
  - elasticity,
  - resistance to chemicals,
  - resistance to ultraviolet rays,
  - resistance to wear, and
- a report on the properties of road markings with regard to traffic engineering, that is, on
  - durability in view of the traffic loading as well as of the type and location of road marking,
  - skid resistance,
  - visibility by day - colour variation, and
  - visibility by night.

The contractor is free to use a prepared road marking material, if the data indicated in the quality certificate and test report are identical. If not, the contractor shall exclude such road marking material, providing it with special identification, or remove it from the site upon the engineer's request.

For some particular thin-layer road markings, the contractor may also use other materials, if prior to such use it has been established by a third party institution that the quality of the materials concerned conforms to the requirements, and if the use of such materials has been approved by the engineer.

2.2.6.2.4 Method of Execution

2.2.6.2.4.1 General

Road markings shall be made in accordance with the instructions of the manufacturer of the materials used in such work.

In principle, longitudinal road markings shall be made by means of suitable machines. Manual application is only allowed is special cases and shall be approved by the engineer.

With thin-layer road markings, as a rule, account shall be taken of the following:

- working viscosity of the paint at the time of application,
- degree of thinning,
- required wet film thickness and dry film thickness,
- average quantity of paint used per 1 m^2 of road marking,
- curing time to the moment the road is ready for use,
- specified weather conditions during the execution of work,
- method and conditions for the preparation of carriageway surface before starting with road marking,
- proposed procedure and equipment for the execution of work,
- safety-at-work requirements,
- material storing conditions,
- fire protection requirements.

The type, shape, size, and location of road markings, as well as the method of road marking, are specified in applicable regulations.

Road markings (with the exception of reflective traffic markers) shall not protrude above carriageway surface by more than 3 mm, to avoid excessive hindering of water drainage. This sets a limit to the thickness of thick-layer road markings (foil and plastic compounds).

Road marking shall be performed

- at air temperatures between 10 and 30°C,
- at carriageway surface temperatures between 5 and 45°C,
- in dry weather,
- at air relative humidity of not more than 85%.

In case of higher temperatures, the properties of road marking materials shall be made to suit to the conditions encountered during the execution of work. However, an approval by the engineer shall be obtained previously.

Before applying a road marking material, carriageway surface shall be dry, clean, as well as free of dust, salt residues, and oil stains.

Before application of a road marking material, carriageway surfaces of considerable roughness shall be brushed, cleaned with compressed air, and washed. Carriageway surfaces of excessive smoothness, on the other hand, shall first be roughened as appropriate.

In case of newly constructed traffic areas (particularly asphalt ones), temporary road marking shall be carried out; permanent road markings should only be provided when bituminous or cement binders, or mortar are removed from the surface of grains on the carriageway.

With every change of road markings, previous markings shall be removed in such a way that subsequent ambiguity is prevented.

Instead of road markings applied to a damaged carriageway area (such as cracks in the longitudinal joint at the carriageway centre, if not sealed as appropriate), a parallel shift shall be made, and the road marking provided immediately next to the damaged area.

The method of road marking shall not jeopardize the safety of traffic participants, and/or labour carrying out road marking operations.

Reflecting glass beads shall be sprayed over the surface by using appropriate spraying machines. The surface of the applied layer of premix paint shall also be covered with reflecting glass beads.

Plastic compounds designed to be placed in the recess provided on the surface of the wearing course may be placed

- between 3 and 8 mm,
- above 8 to 15 mm, and
- more than 15 mm

deep, depending on the properties of plastic compound and the required characteristics of road markings.

Road marking foils shall be adequately stuck to the carriageway surface, or in the recess in the wearing course.

Reflective traffic markers may be placed onto the wearing course surface (temporary in principle), or in appropriate recesses (permanent). They shall be adequately glued to the underlying course. They shall not protrude above the level of the carriageway by more than 15 mm.

In principle, road markings are white, except for temporary marking.

During road marking, a record shall be kept on the following:

- type and quantities of materials used (per unit of measure),
- wet film thickness and dry film thickness of road markings,
- weather conditions (temperature, relative humidity).

2.2.6.2.5 Quality of Execution

Road markings shall be uniform, of appropriate shape, and shall ensure the required

- durability,
- skid resistance,
- visibility by day,
- visibility by night,
- drying time, and
- dry film thickness of material.

The quality of the material used for road markings shall comply with the following requirements:

- the admitted material density tolerance with regard to the specified value shall amount to maximum ± 5 %,
- the material for thin-layer road markings shall not contain insoluble admixtures, clots, or coagulated surface film,
- the colour (white, yellow) shall be as agreed, and in compliance with the applicable colour charts,
- the content of non-volatile compounds in the road marking material shall amount to at least 60 % by mass,
- the shelf life shall not be less than one year.

The quality of reflecting glass beads shall meet the requirements indicated in Table 6.2.

Table 6.2: Required quality of reflecting glass beads

Properties	Unit of measure	Required value
- refraction coefficient,	-	1.50 to 1.53
- bulk density of glass	g/cm^3	2.4 to 2.6
- granulometric composition:		
- up to 100 μm	% by mass	up to 5
- up to 200 μm	% by mass	3 to 25
- up to 315 μm	% by mass	25 to 65
- up to 500 μm	% by mass	80 to 100
- up to 800 μm	% by mass	100
- portion of acceptable beads, not less than	% by mass	80

The limiting values of the required traffic engineering properties of road markings are indicated in Table 6.3.

In normal conditions, the drying time of the applied road marking material shall not be more than 20 minutes.

The minimum dry film thickness of the thin-layer road marking is specified in Table 6.4.

In justified cases, the engineer may allow that the dry film thickness of the thin-layer road marking be less than the required in Table 6.2, however, not by more than 50 μm.

If the dry film thickness of road marking material is less than the required limit thickness on more than 10% of the area, the contractor shall re-apply such road marking without being entitled to any extra payment.

The minimum quantity of reflecting glass beads spread over road markings shall amount to 0.20 kg/m^2 for newly constructed roads, while in case of existing roads this quantity shall be specified by the engineer.

Table 6.3: Required properties of road markings

Properties	Unit of measure	Required value
- durability to 50% wear for		
- longitudinal markings	month	12
- transverse markings	month	10
- skid resistance on carriageway markings for		
- flowing traffic	SRT	45
- stationary traffic	SRT	35
- visibility by day:		
degree of colour change	-	4 to 8
- visibility by night:		
retro-reflection	-	to be specified

Table 6.4: Required dry film thickness of material for thin-layer road markings

Type of marking	Unit of measure	Traffic loading up to 4,000 vehicles/day	Traffic loading above 4,000 vehicles/day
- longitudinal	μm	200	250
- transverse, hatched	μm	250	300

2.2.6.2.6 Quality Control of Execution

The minimum extent of control testing of road markings shall be specified by the engineer on the basis of the road marking design and work progress. During the execution of work, the engineer may change the scope of the testing.

Unless directed otherwise by the engineer, both wet and dry film thickness of road marking shall be checked on every 1,000 m^1 of the marked carriageway in case of a newly constructed road, and on every 2,000 m^1 in case of marking existing roads.

In principle, documented evidence in accordance with the requirements set in section 2.2.6.2.5 of these technical conditions shall be provided for every road marking.

2.2.6.2.7 Measurement and Take-Over of Works

Basic conditions relating to the measurement and take-over of road markings are specified in section 2.2.6.0.7 of these technical conditions.

The engineer has the right to supplement these conditions.

2.2.6.2.8 Final Account of Works

The final account of executed road markings shall be carried out in compliance with provisions indicated in section 2.2.6.0.8 of these technical conditions.

2.2.6.3 TRAFFIC GUIDING FURNITURE

General

Traffic guiding furniture is particularly intended for permanent or temporary marking of the driving direction and ob obstacles within the specified clearance above the carriageway, especially at night and in conditions of poor visibility.

3.2.6.0.6 Description

Traffic guiding furniture includes the following:

- delineation markers, marker posts, and raised reflective traffic markers,
- bollards and cones,
- chevron alignment and stop boards,
- barriers, and
- other furniture.

Road guiding furniture can be

- unreflecting: painted,
- reflecting: provided with adequate foil or plastic material,
- illuminated: externally or internally (own light source).

Appropriate portion of the surface of internally illuminated traffic guiding furniture shall be translucent.

The erection of road traffic guiding furniture includes all such earthworks as may be required, complete supply of adequate materials, and their incorporation at locations specified by the design.

2.2.6.3.1 Basic Materials

2.2.6.3.1.1 Foundations

Unless otherwise agreed, foundations for traffic guiding furniture shall be constructed of adequate cement concrete. They can be precast (with circular cross-section pipes of cement concrete serving as external casing.

2.2.6.3.1.2 Delineation Markers, Marker Posts, and Raised Reflective Traffic Markers

Delineation markers, which can be either hollow or solid, shall in principle be made of plastic material. Any other material shall be approved by the engineer.

Delineation markers shall be adequately anchored.

The post of plastic material, which should be white, shall be fitted with markings for guidance by day and by night. As a rule, day markings shall be of black plastic material (square or rhomboidal in shape) or painted black. For night marking, a flat area of delineation marker shall be fitted with squares, either of reflecting foil or some other reflecting plastic material of adequate shape: if viewed in the direction of driving, the squares on the right hand side of the carriageway shall be red, and those on the left hand side white.

Marker posts can be made of cement concrete, natural stone, or wood.

Marker posts may only exceptionally be used as traffic guiding furniture. In justified cases, however, their use shall be approved by the engineer.

Raised reflective markers shall consist of a body of permanent flexibility with adequate reflecting plastic material.

2.2.6.3.1.3 Bollards and Traffic Cones

Bollards can be in the form of plates or cylinders (internally illuminated), with alternating black and yellow stripes. The backing sheet for bollards shall be made of

- plastic material (glass-reinforced polyester or acrylic material), or
- steel plate,

whereas the markings of

- reflecting foil or
- transparent or ordinary paint.

Portable (temporary) traffic cones shall be made of plastic material or rubber of appropriate colour, the same also applying to the weights. At night, only such traffic cones may be used for traffic guidance as will reflect the light with a portion of their surface.

3.2.6.0.6.1 Chevron Alignment and Stop Boards

Posts for chevron alignment and stop boards shall be made of adequate metal pipes (steel, aluminium).

The backing of permanent chevron alignment and stop boards shall be made of

- sheet metal (steel or aluminium) or
- glass-reinforced polyester.

Other materials may also be used as backing for chevron alignment and stop boards, if their durability is adequate and if their use has been approved by the engineer.

The markings on chevron alignment and stop boards can be provided by

- applying ordinary paint (if fitted with reflectors) or
- reflecting foil.

3.2.6.0.6.2 Zapornice

Zapornice, ki preprečujejo prehod vozilom na cesti, morajo biti narejene iz materialov po projektni dokumentaciji. Za zapornice se lahko uporabijo kovine, izjemoma tudi ustrezne ojačene umetne snovi ali les.

3.2.6.0.6.3 Other Furniture

Other traffic guiding furniture includes primarily

- reflectors: on railings, obstacles, etc.,
- intermittent guiding lights: independent, supplementary (to traffic guiding furniture),
- mirrors.

Adequate types of durable materials shall be used for traffic guiding furniture other than mentioned above.

The base for reflectors shall be made of aluminium or hot dip galvanized steel sheet, while the reflecting elements can be reflecting foils or adequately shaped plastic materials or glass of rectangular or round shape, their colour being red or white.

2.2.6.3.2 Quality of Materials

2.2.6.3.2.1 Foundations

The specifications concerning the quality of cement concrete for foundations of traffic guiding furniture are indicated in detail in sections 2.2.5.3 and 2.2.6.1.3.1 of these technical conditions.

2.2.6.3.2.2 Delineator Markers, Marker Posts, and Raised Reflective Traffic Markers

Quality specifications concerning delineation markers and marker posts, including their reflectors, and raised reflective traffic markers shall be agreed between the client and the contractor or the manufacturer respectively. The quality of plastic materials for delineation markers (in principle of high-grade PVC) and materials for marker posts and raised reflective traffic markers shall conform to the conditions specified with regard to the durability and shape retention of such materials. Delineation markers and raised reflective traffic markers shall be flexible and shall not break at temperature of -20°C.

2.2.6.3.2.3 Bollards and Traffic Cones

Different materials (plastic materials and metals) for bollards and traffic cones shall be durable and compatible in all temperature and weather conditions.

2.2.6.3.2.4 Chevron Alignment and Stop Boards

Quality conditions concerning the posts are defined in section 2.2.6.1.3.2.1 of these technical conditions as appropriate.

The backing of chevron alignment and stop boards, the markings on the backing, and mounting accessories shall conform to the requirements applying to traffic signs, as indicated in section 2.2.6.1.3.3 of these technical conditions.

2.2.6.3.2.5 Barriers

The quality of materials for barriers shall comply with the specified requirements based on the loads indicated in the design.

3.2.6.0.6.4 Other Furniture

The quality of materials for other furniture shall be compatible and shall ensure the required durability of such furniture as a whole.

2.2.6.3.3 Method of Execution

Traffic guiding furniture shall be provided at such locations as are specified in the design and in regulations applying to particular conditions.

2.2.6.3.3.1 Foundations

Foundation excavation shall be carried out in accordance with conditions set in section 2.2.2.1, and backfilling of foundation excavation in accordance with conditions indicated in section 2.2.2.4 of these technical conditions.

The method of execution of cement concrete foundations is defined in sections 2.2.5.1, 2.2.5.2, and 2.2.5.3 of these technical conditions as appropriate.

A detailed method of foundation work, as proposed by the contractor, shall be approved by the supervising engineer.

2.2.6.3.3.2 Delineation Markers, marker Posts, and Raised Reflective Traffic Markers

A delineation marker shall be erected in such a way that

- the top of the marker is 75 cm above the ground level,
- the marker is shifted by 50 – 90 cm from the carriageway edge.

The spacing between delineation markers and marker posts respectively will depend on visibility conditions and on road elements. For each such delineation marker or marker post another of the same kind shall be positioned on the opposite side of the carriageway.

Raised reflective traffic markers shall be placed in compliance with the design for temporary traffic guidance.

2.2.6.3.3.3 Bollards and Traffic Cones

Bollards may be erected independently or in combination with traffic signs.

In principle, bollards shall be erected at the apex of the traffic island, and portable traffic cones at locations where such guidance is required for traffic safety.

2.2.6.3.3.4 Chevron Alignment and Stop Bollards

The length of the posts for chevron alignment and stop boards shall be suited to the designed use and type of furniture.

The method of placing the posts shall be specified in the design. Any change shall be approved by the engineer.

The method of execution applying to chevron alignment and stop boards is defined in section 2.2.6.1.4.3 of these technical conditions as appropriate.

The markings on chevron alignment and stop boards shall be either hatched or made of chevron stripes of alternating white and red, or black, as specified in applicable regulations.

2.2.6.3.3.5 Barriers

Barriers shall be erected in compliance with the agreed design. Any change shall be approved by the engineer.

2.2.6.3.3.6 Other Furniture

Raised reflectors shall primarily be fitted on roadside guard rails (with on the left hand side and red on the right hand side), on structures, and at all such locations where delineation markers cannot be placed.

The locations where reflectors, intermittent lights, mirrors, etc. are to be fitted shall be specified in the design.

2.2.6.3.4 Quality of Execution

The quality of execution of traffic guiding furniture shall comply with the basic conditions set in section 2.2.6.0.5 of these technical conditions.

The furniture as a whole, and its individual parts, shall retain the dimensions within the allowed limits (± 2 % from specified).

2.2.6.3.5 Quality Control of Execution

Quality control for the completed traffic guiding furniture shall be carried out in compliance with basic conditions indicated in section 2.2.6.0.6 of these technical conditions.

The method and scope of testing during the placing of traffic furniture shall be specified by the engineer on the basis of the documents submitted, and on the basis of the work progress.

2.2.6.3.6 Measurement and Take-Over of Works

Basic conditions for the measurement and take-over of completed traffic guiding furniture are specified in section 2.2.6.0.7 of these technical conditions.

2.2.6.3.7 Final Account of Works

The final account for the completed traffic guiding furniture shall be performed in accordance with provisions of section 2.2.6.0.8 of these technical conditions.

2.2.6.4 TRAFFIC SAFETY FURNITURE

General

Traffic safety furniture shall be erected to provide optimum protection of traffic participants against hazards that may be encountered while driving.

2.2.6.4.1 Description

Basically, traffic safety furniture includes

- guard rails,
- safety fences,
- safety barriers,
- glare fences
- warning devices.

The execution of traffic safety furniture includes all such earthworks as may be required, complete supply of adequate materials and devices, and their placing at locations specified by the design.

2.2.6.4.1.1 Guard Rail

A guard rail consists of

- rails and end pieces,
- posts and spacers, and
- fixing accessories (bolts, nuts, washers, tie-plates).

Depending on circumstances, guard rails can be provided with

- one-sided rail, or
- two-sided rail.

The rail may be fixed either

- directly to the post, or
- indirectly, by means of spacers.

The rail can be single, or, in exceptional cases, double (one above the other on the same post).

2.2.6.4.1.2 Safety Fence

A safety fence consists of

- foundations,
- posts and fixing anchors, and
- mesh and fixing wire.

It shall be suited for those wild animals which access to the carriageway should be prevented.

2.2.6.4.1.3 Safety Barrier

A safety barrier consists of

- precast elements, and
- accessories for fixing to the bridge.

It shall be adjusted to safeguard the traffic.

2.2.6.4.1.4 Glare Fence

A glare fence can either be

- a hedge in the central reserve, or
- be made of adequate elements mounted on guard rail in the central reserve.

2.2.6.4.1.5 Warning Devices

In certain circumstances, devices should be provided for warning traffic participants against

- the danger of poor visibility (fog),
- gas hazard,
- fire.

Detailed designs shall be prepared for making such devices.

2.2.6.4.2 Basic Materials

2.2.6.4.2.1 Foundations

Foundations for traffic safety furniture shall be made of cement concrete. They can be precast (cement concrete pipes of round cross-section serving as external casing).

2.2.6.4.2.2 Guard Rail

Rails and end pieces can be made of

- metal: steel of aluminium sheet,
- cement concrete, or
- adequate plastic materials, reinforced as appropriate.

For rails and end pieces, adequately profiled sheet metal is mainly used.

As a rule, posts and spacers shall be made of particular steel sections (I, U, C).

Fixing accessories shall be made of such material as will be compatible with the two materials they should connect.

2.2.6.4.2.3 Safety Fence

The posts for the safety fence shall be made of

- steel or aluminium pipe of appropriate cross-section, or
- reinforced cement concrete (precast).

Anchors for fixing the posts shall be made of steel or aluminium wire.

The mesh for safety fence shall be suited for such animals as may be expected (deer, roe-deer, wild boar) and shall be made of steel or aluminium wire, with such aperture size as appropriate. The wire for fixing the mesh to the posts shall be made of adequate steel or aluminium.

2.2.6.4.2.4 Safety Barrier

A safety barrier shall generally be made of

- steel or aluminium frame, and
- filling material such as metal or plastic mesh, all in compliance with the design details.

2.2.6.4.2.5 Glare Fence

Plants for antiglare hedge shall be specified in detail in the design and shall be suited for the given conditions.

Elements for glare fence shall be made of metal or plastic materials.

Accessories for fixing glare fence elements to the guard rail shall be compatible with the two materials they should connect.

2.2.6.4.2.6 Warning Devices

Warning devices shall be such as to ensure the evaluation of certain events on the basis of data obtained by adequate measurements.

Warning devices shall be made of such materials as will be appropriate to the conditions in which the devices will be used.

2.2.6.4.3 Quality of Materials

2.2.6.4.3.1 Foundations

The specifications concerning the quality of cement concrete for foundations of traffic safety furniture are defined in detail in section 2.2.5.3 of these technical conditions as appropriate.

Unless specified otherwise in the design or by the engineer, cement concrete C 12/15 or C 16/20 shall be used for foundations.

2.2.6.4.3.2 Guard Rail

All the materials for guard rails shall ensure the designed or agreed mechanical properties. Adequate corrosion protection shall be provided for all the materials.

Accessories for fixing guard rails shall perform their designed function faultlessly during the entire service life, enabling economical replacement.

2.2.6.4.3.3 Safety Fence and Safety Barrier

All the materials for safety fences and safety barriers shall ensure such mechanical properties as are specified in the design, or as will be agreed upon. materials subject to corrosive attack shall be protected as appropriate.

2.2.6.4.3.4 Glare Fence

In vertical position, the quality of the materials used for the glare fence elements shall ensure 70° plastic bending of the fixed lower part of an element.

Fixing accessories shall perform their designed function faultlessly during the entire service life, enabling economical replacement.

2.2.6.4.3.5 Warning Devices

The measuring devices warning against poor visibility on the basis of light ray transmission and light scatter measurements respectively shall provide measurements within the accuracy of ± 5%, which also applies to the devices for measuring the CO concentration in the air (by introducing the method of infrared absorption or catalytic oxidation).

The measuring devices warning against fire shall respond to the value of temperature and to the rate of temperature rise. The values shall be specified in the design.

2.2.6.4.4 Method of Execution

Concerning the method of execution of traffic safety furniture, the basic conditions indicated in section 2.2.6.0.4 of these technical conditions shall apply.

2.2.6.4.4.1 Guard Rail

A guard rail shall be erected in such a way that

- the upper edge of the rail is 0.75 m above the edge of the carriageway,
- the face of the rail is shifted from the edge of the carriageway by not less than 0.5 m,
- the spacing between the posts is
    - maximum 4 m on an open section,
    - maximum 2 m on a bridge.

The length of posts shall be specified in the design. The engineer has the right to specify different post length in justified cases.

End pieces of rails shall be shaped as appropriate: recessed or rounded.

The joints between rails shall overlap in the driving direction, with stepping in the direction opposite to driving.

In the areas of expansion joints on bridges the guard rail shall also be constructed in such a way that it sustains the changes caused by external impacts without any detrimental consequences.

2.2.6.4.4.2 Safety Fence

Post foundations shall reach at least 0.85 m deep.

Posts shall be placed at spacing of 4 to 6 m and secured against movement by adequate anchors.

The mesh shall be fixed to the carrying wire, strained between the posts, and to the ground.

The height of the mesh for safety fence shall amount to at least 1.4 m, and the total height of the fence to 1.8 m minimum. The wires above the mesh shall be fixed at spacing of 0.2 m.

The strength of the mesh wire at rupture shall be specified in the design.

2.2.6.4.4.3 Safety Barrier

The method of execution of a safety barrier shall be specified in detail in the design.

2.2.6.4.4.4 Glare Fence

The method of execution of a glare fence shall be specified in detail in the design.

The hedge in the central reserve shall be selected taking account of biological conditions.

2.2.6.4.4.5 Warning Devices

The method of placing the warning devices shall be specified in detail in the design.

2.2.6.4.5 Quality of Execution

With regard to the quality of execution of traffic safety furniture, basic conditions indicated in section 2.2.6.0.5 of these technical conditions shall apply.

2.2.6.4.6 Quality Control of Execution

For traffic safety furniture, quality control shall be performed on the basis of basic conditions indicated in section 2.2.6.0.6 of these technical conditions.

For traffic safety furniture, the method and scope of quality control testing shall be specified by the engineer on the basis of the documents submitted, and on the basis of the work progress.

2.2.6.4.7 Measurement and Take-Over of Works

Basic conditions for the measurement and take-over of completed traffic safety furniture are specified in section 2.2.6.0.7 of these technical conditions.

Such conditions may be supplemented by the engineer as appropriate.

2.2.6.4.8 Final Account of Works

The final account of the completed traffic safety furniture shall be performed in accordance with provisions of section 2.2.6.0.8 of these technical conditions.

2.2.6.5 ROAD FURNITURE FOR SNOW REMOVAL AND ICE CONTROL

General

Road furniture for snow removal and ice control shall be provided particularly as

- an aid to road maintenance in winter, and
- as a warning indicating road conditions to traffic participants.

3.2.6.0.7 Description

Road furniture for snow removal and ice control mainly cpmprises the following:

- marker posts for snow removal,
- barriers for protection from:
    - snow drift,
    - snow slide, and
- warning devices indicating road conditions.

The erection of road furniture for snow removal and ice control includes all such earthworks as may be required, complete supply of adequate materials and devices, and their incorporation at locations specified by the design, or their storage at a specified location.

3.2.6.0.8 Basic Materials

2.2.6.5.1.1 Foundations

Where foreseen by the design, foundations for road furniture for snow removal and ice control shall be made of cement concrete.

2.2.6.5.1.2 Marker Posts for Snow Removal

Marker posts for snow removal can be made of wood or adequate plastic material.

2.2.6.5.1.3 Snow Drift Barriers

Basic materials used for snow drift barriers include wood, metal, and plastic materials. Wooden barriers shall be made of vertical wooden laths or bars interconnected as appropriate. Such elements of 2 to 2.5 m in length shall be fixed to wooden posts driven into the ground. Meshes of plastic material shall be fixed either to metal or wooden posts. Such barriers shall be anchored or fixed as appropriate. Hedges, plantation of tress, or adequate constructional measure such as embankment or structure can also be introduced as snow drift barriers.

2.2.6.5.1.4 Snow Slide Barriers

In principle, snow slide barriers are constructed as permanent structures. They can be vertical or inclined (approximately perpendicular to the slope), massive (free-standing or backfilled walls, cones of soil and/or rock), discontinuous (grids of vertical and cross beams, reinforced mesh), and as a rule, additionally protected by appropriate anchors.

Basic materials used for snow slide barriers include

- supporting part: girders of structural steel or aluminium, discarded railway rails, beams or walls of cement concrete of stone,
- for grid: round timber and railway sleepers, wire ropes and/or wattle-work, plastic meshes.

The height of snow drift barriers depends on the volume of wind-transported snow:

- for small volumes of snow, the barrier shall be 1.2 to 1.4 m high,
- for great volumes of snow, the barrier shall be 1.5 to 1.8 m high,
- exceptionally, it may by more than 1.8 m high.

2.2.6.5.1.5 Warning Devices

Devices for warning against certain conditions on the road are mainly those to assess

- weather conditions (temperature, air humidity, and air pressure),
- glazed frost hazard,
- snow volume on the carriageway, and
- salt quantity remaining on the carriageway.

The functioning of such devices is based on the measurement or detection of certain physical properties on the carriageway surface.

2.2.6.5.2 Quality of Materials

With regard to the quality of the materials used for road furniture for snow removal and ice control, the contractor shall consider the requirements specified in general conditions set in section 2.2.6.0.3 of these technical conditions.

2.2.6.5.2.1 Foundations

Quality requirements applying to cement concrete for foundations of road furniture for snow removal and ice control are defined in detail in section 2.2.5.3 of these technical conditions as appropriate.

Unless specified otherwise in the design or by the engineer, non-reinforced cement concrete C 12/15 or C 16/20.

2.2.6.5.2.2 Marker Posts for Snow Removal

Marker posts for snow removal shall be made of materials of appropriate durability and flexibility, with round cross-section of diameter of not less than 5 cm, and the length of 1 to 3 m (depending on snow conditions), painted with alternating red and yellow stripes 33 cm wide.

The engineer shall establish the conformity of a marker post for snow removal.

2.2.6.5.2.3 Snow Drift Barriers

The condition set for the quality of wooden elements, posts, anchors, and meshes of plastic material used for snow drift barriers is to be durable as appropriate for the given conditions of their use.

Quality criteria shall be specified by the engineer on the basis of data provided by the manufacturer.

2.2.6.5.2.4 Snow Slide Barriers

The quality of the materials used for snow slide barriers shall be specified in detail in the design. If not, the specifications defined in relevant parts of these technical conditions (sections 2.2.5.1, 2.2.5.2, and 2.2.5.3) shall logically apply.

2.2.6.5.2.5 Warning Devices

Prior to actually using any warning device, he quality of all such warning devices shall be tested as appropriate under conditions in which they will be used, unless the contractor has submitted an adequate documented evidence to the engineer.

3.2.6.0.9 Method of Execution

The method of execution of road furniture for snow removal and ice control shall comply with general conditions set in section 2.2.6.0.4 of these technical conditions.

2.2.6.5.2.6 Marker Posts for Snow Removal

As a rule, marker posts for snow removal shall be positioned as least 50 cm from the edge of the carriageway (next to delineation markers), except in the case when an obstacle into which snow remover could bump is located nearer to the carriageway edge.

2.2.6.5.2.7 Snow Drift Barriers

Snow drift barriers shall be built perpendicular to the predominant wind direction, either as continuous barriers or as stepped sections covering smaller areas. The distance between the barrier and the road shall amount to approx. 12 to 15 times the barrier height, and the spacing between parallel (stepped) barriers 10 times the barrier height. The barrier length can be up to 100 m, with overlapping of approx. 10 m in case of stepped barrier sections. At the lower edge of the barrier, a 0.3 m high clearance for the wind to pass through shall be provided, with openings constituting approx. 50% of the barrier area (surface filling factor of 0.5).

2.2.6.5.2.8 Snow Slide Fences

Snow slide barriers shall be built perpendicular to the direction of snow pressure (parallel with contour line). They can be constructed as continuous, in chain, or in steps. The spacing between individual elements of the barrier shall not be more than 2 m; if more, it shall be protected as appropriate (cluster of tress, stone cone, etc.).

Snow slide barriers shall be built throughout the area of snow slide hazard. Details concerning the method of execution shall be specified in the design, and the following shall be taken into consideration:

- slope inclination, snow height, and predominant wind direction,
- density, settlement (creep) coefficient, and snow slide coefficient,
- roughness of slope ground surface, and
- exposure to sun.

When selecting the method of execution of snow slide barriers, the hazard of simultaneous creeping of stony materials shall be taken into consideration.

3.2.6.0.9.1 Warning Devices

The method of incorporating the warning devices shall conform to the conditions set by the manufacturer, and to ground conditions, and shall be specified in the design.

3.2.6.0.10 Quality of Execution

Basic quality requirements for road furniture for snow removal and ice control are specified in section 2.2.6.0.5 of these technical conditions. Any additional conditions shall be specified in the design.

3.2.6.0.11 Quality Control of Execution

Unless quality control requirements for individual works are specified in applicable parts of these technical conditions, the quality of completed road furniture for snow removal and ice control shall be specified in detail in the design.

3.2.6.0.12 Measurement and Take-Over of Works

Basic conditions for the measurement and take over of completed road furniture for snow removal and ice control are specified in section 2.2.6.0.7 of these technical conditions. The engineer is entitled to supplement these conditions in justified cases.

3.2.6.0.13 Fianl Account of Works

The final account of completed road furniture for snow removal and ice control shall be made in accordance with provisions of section 2.2.6.0.8 of these technical conditions.

2.2.6.6 OTHER ROAD FURNITURE

2.2.6.6.1 Description

Other road furniture dealt with these special technical conditions includes

- noise barriers,
- wind barriers,
- emergency call equipment, and
- traffic counting devices.

The execution of the abovementioned furniture shall include all such earthworks as may be required, complete supply of adequate materials and devices, and their incorporation at locations specified by the design.

The execution of noise barriers is discussed in detail in Guidelines for design, construction, and maintenance of road traffic noise barriers.

In principle, all the road furniture mentioned above shall be constructed or incorporated as permanent furniture.

2.2.6.6.2 Basic Materials

2.2.6.6.2.1 Noise Barriers

Noise suppression provided by the barrier shall not be less than 25 dB(A), this mainly depending on the type of material used, and on the method of its preparation. Noise barriers can be

- vegetation zone consisting of shrubs and trees,
- embankments of soil and/or rock material,
- steep embankment with revetment of cement concrete elements or other appropriate materials,
- walls of brick, wooden elements, transparent plastic materials, cement concerete. glass-cement, light materials, or metal elements with adequate fillers.

The efficiency of the barrier for the suppression of reflected noise, which is shown in Table 6.5, will also depend on the type of material used and on the method of its preparation.

Table 6.5: Classification of noise barriers

Type of noise barrier	Noise reduction at reflection dB(A)
- reflecting	up to 4
- absorbing	above 4 to 8
- highly absorbing	above 8 to 11
- super-absorbing	above 11

Foundations for noise barriers shall be made of cement concrete. They may also be precast.

As supporting elements for noise barriers, poles of adequate section made of metal (steel, aluminium) or cement concrete shall be used. Unless specified otherwise in the design, the flange of metal I-beam shall not be less than 120 mm wide.

Bricks and elements of cement concrete and light materials shall be as porous as possible (light-weight), so that the highest possible ratio of the developed to the projected face surface is ensured.

Metal elements of the barrier shall in principle be made of adequately perforated steel or aluminium sheet, whist as filler material self-supporting glass of mineral wool panels shall be used, their thickness to be as follows

- 40 mm to ensure noise absorption, and
- 60 to 80 mm to ensure high noise absorption.

2.2.6.6.2.2 Wind Barriers

Wind barriers, which are generally placed as permanent ones, are made of wood, plastic, and metal.

The type of material shall be specified in the design.

2.2.6.6.2.3 Emergency Call Equipment

Emergency call equipment comprises

- telephone exchange (at maintenance depot),
- telephone posts (at the road), and
- power supply and telecommunication system.

The types of materials that are required for the construction of an emergency call system shall be specified in detail in the design.

2.2.6.6.2.4 Traffic Counting Devices

In principle, automatic traffic counting equipment shall be of electric type, and only exceptionally of pneumatic type.

The materials required for this equipment and for its incorporation in road foundation shall be specified in detail in applicable design.

2.2.6.6.3 Quality of Materials

All the materials used for the above mentioned road furniture shall be resistant to weather and traffic impacts, and as durable as possible.

The material used shall be characterized by appropriate strength, ensuring dimensional accuracy and stability. They shall be resistant to moisture, temperature, impacts of industrial atmosphere, salt, oil, and light effects, and they shall also be flameproof.

2.2.6.6.3.1 Noise Barriers

The quality of the materials incorporated in embankments of soil or rock shall conform to the conditions set in section 2.2.2.4 of these technical conditions.

The quality of the materials and elements for revetment of steep embankments of soil or rock material (in principle of cement concrete) shall conform to work requirements specified in these technical conditions. Cement concrete compressive strength class shall be at least C 30/37, and the concrete shall be resistant to frost and salt.

Foundations for noise barrier walls shall be constructed either of plain (non-reinforced) or reinforced cement concrete. Both type and quality of cement concrete shall be specified in the design.

The quality of the materials for barrier posts and supporting elements shall conform to design requirements.

The quality of the wood for noise barrier elements shall comply with the designed use and requirements provided by the design. Wood shall be resistant to, or protected against wood pests. Wood thickness shall not be less than 8 mm.

Plastic materials for noise barrier elements shall be resistant to microorganisms, rodents, fungus attack, and protected from UV radiation. When burning, they shall not produce noxious gases in such concentrations as would be harmful to the environment. The minimum thickness of polyacrylic plates shall amount to 15 mm, whereas of polycarbonate ones to 12 mm.

The quality of the materials for bricks, posts, cement concrete elements, and metal elements shall meet the requirements provided by the design, such requirements to be detailed separately in each particular case.

2.2.6.6.3.2 Wind Barriers

The quality of the materials for wind protection shall be specified in detail in the design. If not, requirements indicated in sections 2.2.5.1, 2.2.5.2, and 2.2.5.3 of these technical conditions shall apply as appropriate.

2.2.6.6.3.3 Emergency Call Equipment

The quality of the materials for emergency call equipment shall be specified in the design. If not, it shall be specified by the engineer.

2.2.6.6.3.4 Traffic Counting Devices

The quality of the materials for traffic counting devices shall be specified in the design. If not, it shall be specified by the engineer.

2.2.6.6.4 Method of Execution

2.2.6.6.4.1 Noise Barriers

Noise barriers shall be designed to withstand loads specified in the EN 1794-1.

The method of execution of the zone with vegetation cover of shrubs and/or trees shall meet the biological and technical requirements. The types of plants and trees to be used, and the method of planting them shall be specified in the design.

The shape of embankments of soil and/or rock, on which suitable barrier will be provided, shall be specified in the design. The method of execution of an embankment is specified in section 3.2.2.4 of these technical conditions. The embankments shall be planted with grass.

Elements of cement concrete or any other adequate material for the revetment of steep embankments of soil and/or rock material shall be joined in such a way that the specified stability of the embankments is ensured. Soil and/or rock material shall be placed in the embankment in compliance with conditions set in section 3.2.2.4 of these technical conditions. In principle, the shape of revetment elements shall allow placing the soil required for planting with grass the steep embankment. The detailed method of execution of steep embankments with revetment shall be specified in the design.

The method of constructing the foundations for noise barriers is outlined in applicable sections of these technical conditions. Adequate holes or plates shall be provided in foundations, to enable erection or fixing of prefabricated supports, which shall afterwards be protected as appropriate.

Brick walls shall be built by using suitable mortar, as defined in section 2.2.5.4 of these technical conditions, with expansion joints provided at a spacing of 8 m.

The posts that will serve as supports for precast elements of a barrier shall be made in accordance with the requirements of the design, this applying to all of the elements as well.

If the contractor proposes any changes or amendments to the design for posts or for noise barrier elements, he shall provide an appropriate design. However, such changes may only be carried out after having been approved by the engineer.

2.2.6.6.4.2 Wind Barriers

The method of execution of wind barriers shall be adapted to site conditions, and specified in detail in the design.

2.2.6.6.4.3 Emergency Call Equipment

Emergency call equipment shall be executed in accordance with the design. Any changes shall be approved by the engineer.

2.2.6.6.4.4 Traffic Counting Devices

The method of installation of traffic counting devices shall be specified in detail and carried out in accordance with the design.

2.2.6.6.5 Quality of Execution

General requirements for the quality of execution of the above road mentioned furniture, equipment, and devices are specified in section 2.2.6.0.5 of these technical conditions.

2.2.6.6.6 Quality Control of Execution

For the above mentioned road furniture, equipment, and devices, quality control shall be performed on the basis of general conditions specified in section 2.2.6.0.6 of these technical conditions.

2.2.6.6.7 Measurement and Take-Over of Works

The method of measurement and take-over of works is defined in section 2.2.6.0.7 of these technical conditions.

2.2.6.6.8 Final Account of Works

Road furniture shall be accounted in compliance with provisions indicated in section 2.2.6.0.8 of these technical conditions.

2.2.6.7 ROAD FURNITURE – BILL OF WORKS

2.2.6.7.1 Roadside and Overhead Road Furniture

Item	Unit Measure	Description of Work
61 111	pcs	Construction of foundation of cement concrete C 12/15, 50 cm long, ∅ 20 cm
61 112	pcs	Construction of foundation of cement concrete C 12/15, 50 cm long, ∅ 30 cm
61 113	pcs	Construction of foundation of cement concrete C 12/15, 50 cm long, ∅ 40 cm
61 114	pcs	Construction of foundation of cement concrete C 12/15, 50 cm long, ∅ 50 cm
61 115	pcs	Construction of foundation of cement concrete C 12/15, 50 cm long, ∅ .... cm
61 121	pcs	Construction of foundation of cement concrete C 12/15, 80 cm long, ∅ 20 cm
61 122	pcs	Construction of foundation of cement concrete C 12/15, 80 cm long, ∅ 30 cm
61 123	pcs	Construction of foundation of cement concrete C 12/15, 80 cm long, ∅ 40 cm
61 124	pcs	Construction of foundation of cement concrete C 12/15, 80 cm long, ∅ 50 cm
61 125	pcs	Construction of foundation of cement concrete C 12/15, 80 cm long, ∅ .... cm
61 131	pcs	Construction of foundation of cement concrete C 12/15, 100 cm long, ∅ 20 cm
61 132	pcs	Construction of foundation of cement concrete C 12/15, 100 cm long, ∅ 30 cm
61 133	pcs	Construction of foundation of cement concrete C 12/15, 100 cm long, ∅ 40 cm
61 134	pcs	Construction of foundation of cement concrete C 12/15, 100 cm long, ∅ 50 cm
61 135	pcs	Construction of foundation of cement concrete C 12/15, 100 cm long, ∅ 60 cm
61 136	pcs	Construction of foundation of cement concrete C 12/15, 100 cm long, ∅ .... cm
61 141	m^3	Construction of foundation of cement concrete C 12/15, up to 0.10 m^3 / foundation
61 142	m^3	Construction of foundation of cement concrete C 12/15, 0.11 – 0.20 m^3 / foundation
61 143	m^3	Construction of foundation of cement concrete C 12/15, 0.21 – 0.40 m^3 / foundation
61 144	m^3	Construction of foundation of cement concrete C 12/15, 0.41 – 0.80 m^3 / foundation
61 145	m^3	Construction of foundation of cement concrete C 12/15, above 0.80 m^3 / foundation
61 151	m^3	Construction of foundation of cement concrete C 16/20, up to 0.10 m^3 / foundation
61 152	m^3	Construction of foundation of cement concrete C 16/20, 0.11 – 0.20 m^3 / foundation
61 153	m^3	Construction of foundation of cement concrete C 16/20, 0.21 – 0.40 m^3 / foundation
61 154	m^3	Construction of foundation of cement concrete C 16/20, 0.41 – 0.80 m^3 / foundation
61 155	m^3	Construction of foundation of cement concrete C 16/20, above 0.80 m^3 / foundation

Item	Unit Measure	Description of Work
61 161	pcs	Construction of reinforced concrete foundation for vertical post, as per drawing ……….
61 162	pcs	Construction of reinforced concrete foundation for vertical post, as per drawing ……….
61 165	pcs	Construction of reinforced concrete foundation for cantilever post, as per drawing ……….
61 166	pcs	Construction of reinforced concrete foundation for cantilever post, as per drawing ……….
61 171	pcs	Construction of reinforced concrete foundation for semi-portal, as per drawing ……….
61 172	pcs	Construction of reinforced concrete foundation for semi-portal, as per drawing ……….
61 175	pcs	Construction of reinforced concrete foundation for portal, as per drawing ………..
61 176	pcs	Construction of reinforced concrete foundation for portal, as per drawing ………..
61 211	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 1,000 mm
61 212	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 1,200 mm
61 213	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 1,500 mm
61 214	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 2,000 mm
61 215	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 2,500 mm
61 216	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 3,000 mm
61 217	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 3,500 mm
61 218	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 4,000 mm
61 219	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 64 mm, length 4,500 mm
61 221	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 1,000 mm
61 222	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 1,200 mm
61 223	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 1,500 mm
61 224	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 2,000 mm
61 225	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 2,500 mm
61 226	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 3,000 mm

Item	Unit Measure	Description of Work
61 227	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 3,500 mm
61 228	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 4,000 mm
61 229	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 89 mm, length 4,500 mm
61 231	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 1,000 mm
61 232	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 1,200 mm
61 233	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 1,500 mm
61 234	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 2,000 mm
61 235	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 2,500 mm
61 236	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 3,000 mm
61 237	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 3,500 mm
61 238	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 4,000 mm
61 239	pcs	Supply and erection of traffic sign post of hot-dip galvanized steel pipe ∅ 102 mm, length 4,500 mm
61 241	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 1,000 mm
61 242	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 1,200 mm
61 243	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 1,500 mm
61 244	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 2,000 mm
61 245	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 2,500 mm
61 246	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 3,000 mm
61 247	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 3,500 mm
61 248	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 4,000 mm
61 249	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 64 mm, length 4,500 mm
61 251	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 1,000 mm
61 252	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 1,200 mm
61 253	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 1,500 mm

Item	Unit Measure	Description of Work
61 254	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 2,000 mm
61 255	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 2,500 mm
61 256	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 3,000 mm
61 257	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 3,500 mm
61 258	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 4,000 mm
61 259	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 89 mm, length 4,500 mm
61 261	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 1,000 mm
61 262	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 1,200 mm
61 263	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 1,500 mm
61 264	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 2,000 mm
61 265	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 2,500 mm
61 266	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 3,000 mm
61 267	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 3,500 mm
61 268	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 4,000 mm
61 269	pcs	Supply and erection of traffic sign post of plastic-coated steel pipe ∅ 102 mm, length 4,500 mm
61 271	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 1,000 mm
61 272	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 1,200 mm
61 273	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 2,000 mm
61 274	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 2,500 mm
61 275	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 3,000 mm
61 276	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 3,500 mm
61 277	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 4,000 mm
61 278	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length 4,500 mm
61 279	pcs	Supply and erection of traffic sign post of ………………….. ∅ .... / side.… mm, length .... mm

Item	Unit Measure	Description of Work
61 311	kg	Supply and erection of vertical traffic light support of protected steel pipe, as per drawing ...., length 3,000 mm
61 312	kg	Supply and erection of vertical traffic light support of protected steel pipe, as per drawing ...., length 3,500 mm
61 313	kg	Supply and erection of vertical traffic light support of protected steel pipe, as per drawing ...., length .... mm
61 321	kg	Supply and erection of cantilever post for illuminated traffic sign and lamp, of protected steel pipe, as per drawing ...., height .... mm, clear height (below the sign) h = 5,200 mm, cantilever length L = 4,000 to 6,000 mm
61 322	kg	Supply and erection of cantilever post for illuminated traffic sign and lamp, of protected steel pipe, as per drawing ...., height .... mm, clear height (below the sign) h = 5,200 mm, cantilever length L = 6,000 to 8,000 mm
61 323	kg	Supply and erection of cantilever post for illuminated traffic sign and lamp, of protected steel pipe, as per drawing ...., height .... mm, clear height (below the sign) h = 5,200 mm, cantilever length L = above 8,000 mm
61 325	kg	Supply and erection of cantilever post for traffic light, of protected steel pipe, as per drawing ...., height .... mm, clear height (below the sign) h = 5,200 mm, cantilever length L = 4,000 to 6,000 mm
61 326	kg	Supply and erection of cantilever post for traffic light, of protected steel pipe, as per drawing ...., height .... mm, clear height (below the sign) h = 5,200 mm, cantilever length L = 6,000 to 8,000 mm
61 327	kg	Supply and erection of cantilever post for traffic sign, of protected steel pipe, as per drawing ...., height .... mm, clear height (below the sign) h = 5,200 mm, cantilever length L = above 8,000 mm
61 331	kg	Supply and erection of supporting frame for traffic sign of hot-dip galvanized steel pipe, as per drawing …………….
61 332	kg	Supply and erection of supporting frame for traffic sign of hot-dip galvanized steel pipe, as per drawing …………….
61 335	kg	Supply and erection of supporting frame for traffic sign of plastic-coated teel pipe, as per drawing …………….
61 336	kg	Supply and erection of supporting frame for traffic sign of plastic-coated steel pipe, as per drawing …………….
61 341	kg	Supply and erection of semi-portal of hot-dip galvanized steel, for mild conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = up to 6,000 mm
61 342	kg	Supply and erection of semi-portal of hot-dip galvanized steel, for mild conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = above 6,000 mm
61 345	kg	Supply and erection of semi-portal of hot-dip galvanized steel, for severe conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = up to 6,000 mm
61 346	kg	Supply and erection of semi-portal of hot-dip galvanized steel, for severe conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = above 6,000 mm

Item	Unit Measure	Description of Work
61 351	kg	Supply and erection of T portal of hot-dip galvanized steel, for mild conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = up to 6,000 mm
61 352	kg	Supply and erection of T portal of hot-dip galvanized steel, for mild conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = above 6,000 mm
61 355	kg	Supply and erection of T portal of hot-dip galvanized steel, for severe conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = up to 6,000 mm
61 356	kg	Supply and erection of T portal of hot-dip galvanized steel, for severe conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = above 6,000 mm
61 361	kg	Supply and erection of portal of hot-dip galvanized steel, for mild conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = up to 12,000 mm
61 362	kg	Supply and erection of portal of hot-dip galvanized steel, for mild conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = 12,000 – 20,000 mm
61 363	kg	Supply and erection of portal of hot-dip galvanized steel, for mild conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = above 20,000 mm
61 365	kg	Supply and erection of portal of hot-dip galvanized steel, for severe conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = up to 12,000 mm
61 366	kg	Supply and erection of portal of hot-dip galvanized steel, for severe conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = 12,000 – 20,000 mm
61 367	kg	Supply and erection of portal of hot-dip galvanized steel, for severe conditions, as per drawing ...., clear height h = 5,200 mm, cantilever length L = above 20,000 mm
61 371	kg	Extra payment for cantilever, as per drawing ...., length L = up to 400 mm
61 372	kg	Extra payment for cantilever, as per drawing ...., length L = above 400 mm
61 381	pcs	Supply and erection of tripod base for traffic sign stand, as per drawing ....
61 382	pcs	Supply and erection of tripod base for traffic sign stand, as per drawing ....
61 385	pcs	Supply and erection of four-legged base for traffic sign stand, as per drawing ....
61 386	pcs	Supply and erection of four-legged for traffic sign stand, as per drawing ....
61 391	pcs	Supply and provisional erection of metal base for traffic sign – without weights
61 392	pcs	Supply and provisional erection of metal base for traffic sign – with weights
61 393	pcs	Supply and provisional erection of cement concrete base for traffic sign

Item	Unit Measure	Description of Work
61 394	pcs	Supply and provisional erection of plastic base for traffic sign
61 395	pcs	Supply and provisional erection of .... base for traffic sign
61 411	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel backing sheet, 1st class reflecting foil sign, length of side a = 600 mm
61 412	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel backing sheet, 1st class reflecting foil sign, length of side a = 900 mm
61 413	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel backing sheet, 1st class reflecting foil sign, length of side a = 1,200 mm
61 421	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel backing sheet, 2nd class reflecting foil sign, length of side a = 600 mm
61 422	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel backing sheet, 2nd class reflecting foil sign, length of side a = 900 mm
61 423	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel backing sheet, 2nd class reflecting foil sign, length of side a = 1,200 mm
61 431	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel housing, internally illuminated, length of side a = 600 mm
61 432	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel housing, internally illuminated, length of side a = 900 mm
61 433	pcs	Supply and mounting triangular traffic sign, hot-dip galvanized steel housing, internally illuminated, length of side a = 1,200 mm
61 441	pcs	Supply and mounting triangular traffic sign, aluminium backing sheet, 1st class reflecting foil sign, length of side a = 600 mm
61 442	pcs	Supply and mounting triangular traffic sign, aluminium backing sheet, 1st class reflecting foil sign, length of side a = 900 mm
61 443	pcs	Supply and mounting triangular traffic sign, aluminium sheet, 1st class reflecting foil sign, length of side a = 1,200 mm
61 451	pcs	Supply and mounting triangular traffic sign, aluminium backing sheet, 2nd class reflecting foil sign, length of side a = 600 mm
61 452	pcs	Supply and mounting triangular traffic sign, aluminium backing sheet, 2nd class reflecting foil sign, length of side a = 900 mm
61 453	pcs	Supply and mounting triangular traffic sign, aluminium sheet, 2nd class reflecting foil sign, length of side a = 1,200 mm
61 461	pcs	Supply and mounting triangular traffic sign, aluminium sheet housing, internally illuminated, length of side a = 600 mm
61 462	pcs	Supply and mounting triangular traffic sign, aluminium sheet housing, internally illuminated, length of side a = 900 mm
61 463	pcs	Supply and mounting triangular traffic sign, aluminium sheet housing, internally illuminated, length of side a = 1,200 mm
61 471	pcs	Supply and mounting triangular traffic sign, glass-reinforced polyester housing, internally illuminated, length of side a = 600 mm
61 472	pcs	Supply and mounting triangular traffic sign, glass-reinforced polyester housing, internally illuminated, length of side a = 900 mm
61 473	pcs	Supply and mounting triangular traffic sign, glass-reinforced polyester housing, internally illuminated, length of side a = 1,200 mm

Item	Unit Measure	Description of Work
61 511	pcs	Supply and mounting single St. Andrew's cross, backing sheet of ...., size 1,000 x 120 mm, with ordinary paint coat
61 512	pcs	Supply and mounting single St. Andrew's cross, backing sheet of ...., size 1,000 x 120 mm, with unreflecting foil
61 513	pcs	Supply and mounting single St. Andrew's cross, backing sheet of ...., size 1,000 x 120 mm, with 1st class reflecting foil
61 514	pcs	Supply and mounting single St. Andrew's cross, backing sheet of ...., size 1,000 x 120 mm, with 2nd class reflecting foil
61 521	pcs	Supply and mounting double St. Andrew's cross, backing sheet of …………........., size 1,000 x 120 mm, with 1st class reflecting foil
61 522	pcs	Supply and mounting double St. Andrew's cross, backing sheet of …………........., size 1,000 x 120 mm, with 2nd class reflecting foil
61 531	pcs	Supply and mounting of signs indicating approaching road-railway level crossing, backing sheet of ...., size 300 x 1,000 mm (3x), with 1st class reflecting foil
61 532	pcs	Supply and mounting of signs indicating approaching road-railway level crossing, backing sheet of ...., size 300 x 1,000 mm (3x), with 2nd class reflecting foil
61 541	pcs	Supply and mounting of traffic sign, housing of ...., single-face internal illumination, size 600 x 600 mm
61 542	pcs	Supply and mounting of traffic sign, housing of ...., single-face internal illumination, size 600 x 900 mm
61 543	pcs	Supply and mounting of traffic sign, housing of ...., single-face internal illumination, size 900 x 900 mm
61 544	pcs	Supply and mounting of traffic sign, housing of ...., single-face internal illumination, size 1,300 x 250 mm
61 545	pcs	Supply and mounting of traffic sign, housing of ...., single-face internal illumination, size 1,600 x 350 mm
61 546	pcs	Supply and mounting of traffic sign, housing of ...., single-face internal illumination, size .... x .... mm
61 551	pcs	Supply and mounting of traffic sign, housing of ...., double-face internal illumination, size 600 x 600 mm
61 552	pcs	Supply and mounting of traffic sign, housing of ...., double-face internal illumination, size 600 x 900 mm
61 553	pcs	Supply and mounting of traffic sign, housing of ...., double-face internal illumination, size 900 x 900 mm
61 554	pcs	Supply and mounting of traffic sign, housing of ...., double-face internal illumination, size 1,300 x 250 mm
61 555	pcs	Supply and mounting of traffic sign, housing of ...., double-face internal illumination, size 1,600 x 350 mm
61 556	pcs	Supply and mounting of traffic sign, housing of ...., double-face internal illumination, size .... x .... mm
61 561	pcs	Supply and mounting of lighting fixture with luminous element 125 W for external traffic sign illumination, as per drawing …………..
61 611	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel backing sheet, with 1st class reflecting foil, ∅ 400 mm

Item	Unit Measure	Description of Work
61 612	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel backing sheet, with 1st class reflecting foil, ∅ 600 mm
61 613	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel backing sheet, with 1st class reflecting foil, ∅ 900 mm
61 621	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel backing sheet, with 2nd class reflecting foil, ∅ 400 mm
61 622	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel backing sheet, with 2nd class reflecting foil, ∅ 600 mm
61 623	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel backing sheet, with 2nd class reflecting foil, ∅ 900 mm
61 631	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel sheet housing, internally illuminated, ∅ 400 mm
61 632	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel sheet housing, internally illuminated, ∅ 600 mm
61 633	pcs	Supply and mounting of circular traffic sign, hot-dip galvanized steel sheet housing, internally illuminated, ∅ 900 mm
61 641	pcs	Supply and mounting of circular traffic sign, aluminium backing sheet, with 1st class reflecting foil, ∅ 400 mm
61 642	pcs	Supply and mounting of circular traffic sign, aluminium backing sheet, with 1st class reflecting foil, ∅ 600 mm
61 643	pcs	Supply and mounting of circular traffic sign, aluminium backing sheet, with 1st class reflecting foil, ∅ 900 mm
61 651	pcs	Supply and mounting of circular traffic sign, aluminium backing sheet, with 2nd class reflecting foil, ∅ 400 mm
61 652	pcs	Supply and mounting of circular traffic sign, aluminium backing sheet, with 2nd class reflecting foil, ∅ 600 mm
61 653	pcs	Supply and mounting of circular traffic sign, aluminium backing sheet, with 2nd class reflecting foil, ∅ 900 mm
61 661	pcs	Supply and mounting of circular traffic sign, aluminium sheet housing, internally illuminated, ∅ 400 mm
61 662	pcs	Supply and mounting of circular traffic sign, aluminium sheet housing, internally illuminated, ∅ 600 mm
61 663	pcs	Supply and mounting of circular traffic sign, aluminium sheet housing, internally illuminated, ∅ 900 mm
61 671	pcs	Supply and mounting of circular traffic sign, glass-reinforced polyester housing, internally illuminated, ∅ 400 mm
61 672	pcs	Supply and mounting of circular traffic sign, glass-reinforced polyester housing, internally illuminated, ∅ 600 mm
61 673	pcs	Supply and mounting of circular traffic sign, glass-reinforced polyester housing, internally illuminated, ∅ 900 mm
61 681	pcs	Displacement of traffic sign with side / ∅ 400 mm
61 682	pcs	Displacement of traffic sign with side / ∅ 600 mm
61 683	pcs	Displacement of traffic sign with side / ∅ 900 mm

Item	Unit Measure	Description of Work
61 691	pcs	Displacement of post including traffic sign with side / ∅ 400 mm
61 692	pcs	Displacement of post including traffic sign with side / ∅ 600 mm
61 693	pcs	Displacement of post including traffic sign with side / ∅ 900 mm
61 711	pcs	Supply and mounting of traffic sign, hot-dip galvanized steel backing sheet, sign with .... paint – foil, ... class, size up to 0.10 m^2
61 712	pcs	Supply and mounting of traffic sign, hot-dip galvanized steel backing sheet, sign with .... paint – foil, ... class, size 0.11 – 0.20 m^2
61 713	pcs	Supply and mounting of traffic sign, hot-dip galvanized steel backing sheet, sign with .... paint – foil, ... class, size 0.21 – 0.40 m^2
61 714	pcs	Supply and mounting of traffic sign, hot-dip galvanized steel backing sheet, sign with .... paint – foil, ... class, size 0.41 – 0.70 m^2
61 715	pcs	Supply and mounting of traffic sign, hot-dip galvanized steel backing sheet, sign with .... paint – foil, ... class, size 0.71 – 1.00 m^2
61 716	pcs	Supply and mounting of traffic sign, hot-dip galvanized steel backing sheet, sign with .... paint – foil, ... class, size above 1.00 m^2
61 721	pcs	Supply and mounting of traffic sign, aluminium backing sheet, sign with .... paint – foil, ... class, size up to 0.10 m^2
61 722	pcs	Supply and mounting of traffic sign, aluminium backing sheet, sign with .... paint – foil, ... class, size 0.11 – 0.20 m^2
61 723	pcs	Supply and mounting of traffic sign, aluminium backing sheet, sign with .... paint – foil, ... class, size 0.21 – 0.40 m^2
61 724	pcs	Supply and mounting of traffic sign, aluminium backing sheet, sign with .... paint – foil, ... class, size 0.41 – 0.70 m^2
61 725	pcs	Supply and mounting of traffic sign, aluminium backing sheet, sign with .... paint – foil, ... class, size 0.71 – 1.00 m^2
61 726	pcs	Supply and mounting of traffic sign, aluminium backing sheet, sign with .... paint – foil, ... class, size above 1.00 m^2
61 811	pcs	Supply and erection of foil cone traffic sign, aluminium backing sheet, foundation of cement concrete C 12/15
61 911	pcs	Supply and erection of traffic light as per drawing with one signal head
61 912	pcs	Supply and erection of traffic light as per drawing with two signal heads
61 913	pcs	Supply and erection of traffic light as per drawing with three signal heads
61 916	pcs	Supply and installation of extra signal head for traffic light
61 921	pcs	External illumination of traffic sign with sodium lamp
61 922	pcs	External illumination of traffic sign with high-pressure mercury lamp
61 923	pcs	External illumination of traffic sign with .... lamp

2.2.6.7.2 Road Markings

Item	Unit Measure	Description of Work
62 111	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 10 cm
62 112	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 12 cm
62 113	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 15 cm
62 114	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 20 cm
62 115	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 25 cm
62 116	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 30 cm
62 117	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 50 cm
62 118	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width … cm
62 121	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 10 cm
62 122	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 12 cm
62 123	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 15 cm
62 124	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 20 cm
62 125	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 25 cm
62 126	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 30 cm
62 127	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 50 cm
62 128	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width … cm
62 131	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-

Item	Unit Measure	Description of Work
		component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 10 cm
62 132	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 12 cm
62 133	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 15 cm
62 134	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 20 cm
62 135	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 25 cm
62 136	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 30 cm
62 137	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 50 cm
62 138	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width … cm
62 141	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 10 cm
62 142	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 12 cm
62 143	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 15 cm
62 144	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 20 cm
62 145	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 25 cm
62 146	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 30 cm
62 147	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 50 cm
62 148	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width … cm
62 151	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness … μm, line width 10 cm
62 152	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry

Item	Unit Measure	Description of Work
		film thickness … μm, line width 12 cm
62 153	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness … μm, line width 15 cm
62 154	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness … μm, line width 20 cm
62 155	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness … μm, line width 25 cm
62 156	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness … μm, line width 30 cm
62 157	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness … μm, line width 50 cm
62 158	m^1	Machine execution of thin-layer longitudinal carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness … μm, line width … cm
62 161	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 10 - 15 cm
62 162	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 20 – 30 cm
62 163	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 50 cm
62 165	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking up to 0.5 m^2
62 166	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking 0.6 – 1.0 m^2
62 167	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking 1.1 – 1.5 m^2
62 168	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking above 1.5 m^2
62 171	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 10 - 15 cm
62 172	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 20 – 30 cm
62 173	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, line width 50 cm

Item	Unit Measure	Description of Work
62 175	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, area of marking up to 0.5 m^2
62 176	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, area of marking 0.6 – 1.0 m^2
62 177	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, area of marking 1.1 – 1.5 m^2
62 178	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 300 μm, area of marking above 1.5 m^2
62 181	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 10 - 15 cm
62 182	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 20 – 30 cm
62 183	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, line width 50 cm
62 185	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, area of marking up to 0.5 m^2
62 186	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, area of marking 0.6 – 1.0 m^2
62 187	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, area of marking 1.1 – 1.5 m^2
62 188	m^2	Machine execution of thin-layer transverse and other carriageway marking with one-component white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 400 μm, area of marking above 1.5 m^2
62 211	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width 10 cm
62 212	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width 12 cm
62 213	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width 15 cm
62 214	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width 20 cm
62 215	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width 25 cm
62 216	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width 30 cm
62 217	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width 50 cm
62 218	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 250 μm, line width … cm

Item	Unit Measure	Description of Work
62 221	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width 10 cm
62 222	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width 12 cm
62 223	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width 15 cm
62 224	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width 20 cm
62 225	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width 25 cm
62 226	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width 30 cm
62 227	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width 50 cm
62 228	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 300 μm, line width … cm
62 231	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width 10 cm
62 232	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width 12 cm
62 233	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width 15 cm
62 234	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width 20 cm
62 235	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width 25 cm
62 236	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width 30 cm
62 237	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width 50 cm
62 238	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness 400 μm, line width … cm
62 241	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width 10 cm
62 242	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width 12 cm
62 243	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width 15 cm
62 244	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width 20 cm
62 245	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width 25 cm
62 246	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width 30 cm
62 247	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width 50 cm
62 248	m^1	Machine execution of thin-layer longitudinal carriageway marking with premix white paint, dry film thickness … μm, line width … cm

Item	Unit Measure	Description of Work
62 251	m^2	Machine execution of thin-layer transverse and other carriageway marking with premix white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 10 - 15 cm
62 252	m^2	Machine execution of thin-layer transverse and other carriageway marking with premix white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 20 – 30 cm
62 253	m^2	Machine execution of thin-layer transverse and other carriageway marking with premix white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, line width 50 cm
62 255	m^2	Machine execution of thin-layer transverse and other carriageway marking with premix white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking up to 0.5 m^2
62 256	m^2	Machine execution of thin-layer transverse and other carriageway marking with premix white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking 0.6 – 1.0 m^2
62 257	m^2	Machine execution of thin-layer transverse and other carriageway marking with premix white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking 1.1 – 1.5 m^2
62 258	m^2	Machine execution of thin-layer transverse and other carriageway marking with premix white paint, including spreading 250 g/m^2 of glass beads, dry film thickness 250 μm, area of marking above 1.5 m^2
62 261	m^1	Machine execution of temporary thin-layer longitudinal carriageway marking with one-component yellow paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 10 cm
62 262	m^1	Machine execution of temporary thin-layer longitudinal carriageway marking with one-component yellow paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 12 cm
62 263	m^1	Machine execution of temporary thin-layer longitudinal carriageway marking with one-component yellow paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 15 cm
62 264	m^1	Machine execution of temporary thin-layer longitudinal carriageway marking with one-component yellow paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width 20 cm
62 265	m^1	Machine execution of temporary thin-layer longitudinal carriageway marking with one-component yellow paint, including spreading 250 g/m^2 of glass beads, dry film thickness 200 μm, line width … cm
62 271	m^1	Extra payment for manual execution of thin-layer marking, line width 10 cm
62 272	m^1	Extra payment for manual execution of thin-layer marking, line width 12 cm
62 273	m^1	Extra payment for manual execution of thin-layer marking, line width 15 cm
62 274	m^1	Extra payment for manual execution of thin-layer marking, line width 20 cm
62 275	m^1	Extra payment for manual execution of thin-layer marking, line width 25 cm
62 276	m^1	Extra payment for manual execution of thin-layer marking, line width 30 cm
62 277	m^1	Extra payment for manual execution of thin-layer marking, line width 50 cm
62 278	m^1	Extra payment for manual execution of thin-layer marking, line width … cm
62 281	m^2	Extra payment for manual execution of other markings, area up to 0.5 m^2
62 282	m^2	Extra payment for manual execution of other markings, area 0.6 – 1.0 m^2
62 283	m^2	Extra payment for manual execution of other markings, area 1.1 – 1.5 m^2
62 284	m^2	Extra payment for manual execution of other markings, area above 1.5 m^2

Item	Unit Measure	Description of Work
62 291	m^1	Removal of invalid paint layers and other carriageway markings by milling, line width 10 – 15 cm
62 292	m^1	Removal of invalid paint layers and other carriageway markings by milling, line width 20 – 30 cm
62 293	m^1	Removal of invalid paint layers and other carriageway markings by milling, line width 50 cm
62 295	m^1	Removal of invalid paint layers and other carriageway markings by milling, area up to 0.5 m^2
62 296	m^1	Removal of invalid paint layers and other carriageway markings by milling, area 0.6 – 1.0 m^2
62 297	m^1	Removal of invalid paint layers and other carriageway markings by milling, area 1.1 – 1.5 m^2
62 298	m^1	Removal of invalid paint layers and other carriageway markings by milling, area above 0.5 m^2
62 311	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 10 cm
62 312	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 12 cm
62 313	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 15 cm
62 314	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 20 cm
62 315	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 25 cm
62 316	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 30 cm
62 317	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 50 cm
62 318	m^1	Machine execution of medium-layer longitudinal carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width … cm
62 321	m^2	Machine execution of medium-layer transverse and other carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 10 to 15 cm
62 322	m^2	Machine execution of medium-layer transverse and other carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 20 to 30 cm
62 323	m^2	Machine execution of medium-layer transverse and other carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, line width 50 cm
62 325	m^2	Machine execution of medium-layer transverse and other carriageway

Item	Unit Measure	Description of Work
		marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, area of marking up to 0.5 m^2
62 326	m^2	Machine execution of medium-layer transverse and other carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, area of marking 0.6 – 1.0 m^2
62 327	m^2	Machine execution of medium-layer transverse and other carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, area of marking 1.1 – 1.5 m^2
62 328	m^2	Machine execution of medium-layer transverse and other carriageway marking by spraying multi-component plastic, including spreading 200 g/m^2 of glass beads, dry film thickness ….. μm, area of marking above 1.5 m^2
62 411	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 10 cm
62 412	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 12 cm
62 413	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 15 cm
62 414	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 20 cm
62 415	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 25 cm
62 416	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 30 cm
62 417	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 50 cm
62 418	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width … cm
62 421	m^2	Machine execution of thick-layer transverse and other carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 10 - 15 cm
62 422	m^2	Machine execution of thick-layer transverse and other carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film

Item	Unit Measure	Description of Work
		thickness 3 mm, line width 20 - 30 cm
62 423	m^2	Machine execution of thick-layer transverse and other carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 50 cm
62 425	m^2	Machine execution of thick-layer transverse and other carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, area of marking up to 0.5 m^2
62 426	m^2	Machine execution of thick-layer transverse and other carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, area of marking 0.6 – 1.0 m^2,
62 427	m^2	Machine execution of thick-layer transverse and other carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, area of marking 1.1 – 1.5 m^2
62 428	m^2	Machine execution of thick-layer transverse and other carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, area of marking above 1.5 m^2
62 431	m^1	Machine execution of thick-layer longitudinal carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 10 cm
62 432	m^1	Machine execution of thick-layer longitudinal carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 12 cm
62 433	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 15 cm
62 434	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 20 cm
62 435	m^1	Machine execution of thick-layer longitudinal carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 25 cm
62 436	m^1	Machine execution of thick-layer longitudinal carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 30 cm
62 437	m^1	Machine execution of thick-layer longitudinal carriageway marking with multi-component cold plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 50 cm
62 438	m^1	Machine execution of thick-layer longitudinal carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width … cm
62 441	m^2	Machine execution of thick-layer transverse and other carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 10 - 15 cm

Item	Unit Measure	Description of Work
62 442	m^2	Machine execution of thick-layer transverse and other carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 20 - 30 cm
62 443	m^2	Machine execution of thick-layer transverse and other carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, line width 50 cm
62 445	m^2	Machine execution of thick-layer transverse and other carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, area of marking up to 0.5 m^2
62 446	m^2	Machine execution of thick-layer transverse and other carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, area of marking 0.6 – 1.0 m^2,
62 447	m^2	Machine execution of thick-layer transverse and other carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, area of marking 1.1 – 1.5 m^2
62 448	m^2	Machine execution of thick-layer transverse and other carriageway marking with hot plastic with admixed glass beads, including additional spreading of 200 g/m^2 of glass beads, dry film thickness 3 mm, area of marking above 1.5 m^2
62 451	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width 10 cm
62 452	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width 12 cm
62 453	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width 15 cm
62 454	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width 20 cm
62 455	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width 25 cm
62 456	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width 30 cm
62 457	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width 50 cm
62 458	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent longitudinal carriageway marking, including application of priming coat, line width … cm
62 461	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of priming coat, line width 10 cm
62 462	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of

Item	Unit Measure	Description of Work
		priming coat, line width 12 cm
62 463	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of priming coat, line width 15 cm
62 464	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of priming coat, line width 20 cm
62 465	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of priming coat, line width 25 cm
62 466	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of priming coat, line width 30 cm
62 467	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of priming coat, line width 50 cm
62 468	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer permanent transverse carriageway marking, including application of priming coat, line width … cm
62 471	m^2	Supply and placing prefabricated plastic ……………… permanent carriageway marking, including application of priming coat, area of marking up to 0.5 m^2
62 472	m^2	Supply and placing prefabricated plastic ……………… permanent carriageway marking, including application of priming coat, area of marking 0.6 – 1.0 m^2
62 473	m^2	Supply and placing prefabricated plastic ……………… permanent carriageway marking, including application of priming coat, area of marking 1.1 – 1.5 m^2
62 474	m^2	Supply and placing prefabricated plastic ……………… permanent carriageway marking, including application of priming coat, area of marking above 1.5 m^2
62 481	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary longitudinal carriageway marking, including application of priming coat, line width 10 cm
62 482	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary longitudinal carriageway marking, including application of priming coat, line width 12 cm
62 483	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary longitudinal carriageway marking, including application of priming coat, line width 15 cm
62 484	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary longitudinal carriageway marking, including application of priming coat, line width 20 cm
62 485	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary longitudinal carriageway marking, including application of priming coat, line width 25 cm
62 486	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary longitudinal carriageway marking, including application of priming coat, line width 30 cm
62 487	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary longitudinal carriageway marking, including application of priming coat, line width 50 cm
62 488	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary

Item	Unit Measure	Description of Work
		longitudinal carriageway marking, including application of priming coat, line width … cm
62 491	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width 10 cm
62 492	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width 12 cm
62 493	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width 15 cm
62 494	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width 20 cm
62 495	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width 25 cm
62 496	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width 30 cm
62 497	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width 50 cm
62 498	m^1	Supply and placing prefabricated plastic stripe/foil for thick-layer temporary transverse carriageway marking, including application of priming coat, line width … cm
62 511	pcs	Supply and placing plastic reflecting body with anchor thorn, reflecting part of prism or plastic foil of 2nd or 3rd class
62 512	pcs	Supply and placing plastic reflecting body without anchor thorn, reflecting part of prism or plastic foil of 2nd or 3rd class

For all carriageway markings, the actual marked length or area shall be considered.

2.2.6.7.3 Traffic Guiding Furniture

Item	Unit Measure	Description of Work
63 111	pcs	Supply and erection of plastic delineation marker of hollow section, length 1,200 mm, with reflector of foil
63 112	pcs	Supply and erection of plastic delineation marker of hollow section, length 1,200 mm, with reflector of plastic
63 113	pcs	Supply and erection of plastic delineation marker of hollow section, length 1,200 mm, with reflector of …
63 121	pcs	Supply and erection of plastic delineation marker of solid section, length 1,200 mm, with reflector of foil
63 122	pcs	Supply and erection of plastic delineation marker of solid section, length 1,200 mm, with reflector of plastic
63 123	pcs	Supply and erection of plastic delineation marker of solid section, length 1,200 mm, with reflector of …
63 131	pcs	Supply and erection of delineation marker of ………………………length …. m, with reflector of foil
63 132	pcs	Supply and erection of delineation marker of ………………………length …. m, with reflector of plastic
63 133	pcs	Supply and erection of delineation marker of ………………………length …. m, with reflector of …
63 141	pcs	Supply and erection of cement concrete delineation marker, with reflector of foil
63 142	pcs	Supply and erection of cement concrete delineation marker, with reflector of plastic
63 143	pcs	Supply and erection of cement concrete delineation marker, with reflector of ………..
63 151	pcs	Supply and erection of natural stone delineation marker, with reflector of foil
63 152	pcs	Supply and erection of natural stone delineation marker, with reflector of plastic
63 153	pcs	Supply and erection of natural stone delineation marker, with reflector of ………..
63 161	pcs	Supply and erection of wooden delineation marker as per drawing ……………, with reflector of foil
63 162	pcs	Supply and erection of wooden delineation marker as per drawing ……………, with reflector of plastic
63 163	pcs	Supply and erection of wooden delineation marker as per drawing ……………, with reflector of ….
63 211	pcs	Supply and erection of flat bollard, backing sheet of glass-reinforced polyester, with marking of 1st class reflecting foil
63 212	pcs	Supply and erection of flat bollard, backing sheet of glass-reinforced polyester, with marking of 2nd class reflecting foil
63 213	pcs	Supply and erection of flat bollard, backing sheet of glass-reinforced polyester, with marking of ………………..
63 221	pcs	Supply and erection of flat bollard, backing sheet of hot-dip galvanized

Item	Unit Measure	Description of Work
		steel, with marking of 1st class reflecting foil
63 222	pcs	Supply and erection of flat bollard, backing sheet of hot-dip galvanized steel, with marking of 2nd class reflecting foil
63 223	pcs	Supply and erection of flat bollard, backing sheet of hot-dip galvanized steel, with marking of ……………….
63 231	pcs	Supply and erection of flat bollard, backing sheet of aluminium, with marking of 1st class reflecting foil
63 232	pcs	Supply and erection of flat bollard, backing sheet of aluminium, with marking of 2nd class reflecting foil
63 233	pcs	Supply and erection of flat bollard, backing sheet of aluminium, with marking of ……………….
63 241	pcs	Supply and erection of cylindrical bollard, internally illuminated, backing sheet of glass-reinforced polyester
63 242	pcs	Supply and erection of cylindrical bollard, internally illuminated, backing sheet of acryl
63 243	pcs	Supply and erection of cylindrical bollard, internally illuminated, backing sheet of ………..
63 251	pcs	Extra payment for additional illuminated traffic sign (side length or diameter 600 mm) mounted to bollard
63 261	pcs	Extra payment for additional illuminated double traffic sign mounted to bollard
63 271	pcs	Supply of portable traffic cone with weight, of plastic, height 33 cm
63 272	pcs	Supply of portable traffic cone with weight, of plastic, height 45 cm
63 273	pcs	Supply of portable traffic cone with weight, of plastic, height 60 cm
63 274	pcs	Supply of portable traffic cone with weight, of plastic, height 70 cm
63 281	pcs	Supply of portable traffic cone with weight, of rubber, height 33 cm
63 282	pcs	Supply of portable traffic cone with weight, of rubber, height 45 cm
63 283	pcs	Supply of portable traffic cone with weight, of rubber, height 60 cm
63 284	pcs	Supply of portable traffic cone with weight, of rubber, height 70 cm
63 311	pcs	Supply and erection of chevron alignment and stop board of glass-reinforced polyester, with markings of 1st class reflecting foil, size 330 x 1,200 mm
63 312	pcs	Supply and erection of chevron alignment and stop board of glass-reinforced polyester, with markings of 1st class reflecting foil, size 500 x 500 mm
63 313	pcs	Supply and erection of chevron alignment and stop board of glass-reinforced polyester, with markings of 1st class reflecting foil, size 750 x 750 mm
63 314	pcs	Supply and erection of chevron alignment and stop board of glass-reinforced polyester, with markings of 1st class reflecting foil, size 1,500 x 250 mm
63 315	pcs	Supply and erection of chevron alignment and stop board of glass-reinforced polyester, with markings of 1st class reflecting foil, size 1,500 x 500 mm
63 316	pcs	Supply and erection of chevron alignment and stop board of glass-

Item	Unit Measure	Description of Work
		reinforced polyester, with markings of 1st class reflecting foil, size 2,250 x 750 mm
63 317	pcs	Supply and erection of chevron alignment and stop board of glass-reinforced polyester, with markings of 1st class reflecting foil, size 3,000 x 250 mm
63 318	pcs	Supply and erection of chevron alignment and stop board of glass-reinforced polyester, with markings of 1st class reflecting foil, size …… x ……. mm
63 321	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size 330 x 1,200 mm
63 322	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size 500 x 500 mm
63 323	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size 750 x 750 mm
63 324	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size 1,500 x 250 mm
63 325	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size 1,500 x 500 mm
63 326	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size 2,250 x 750 mm
63 327	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size 3,000 x 250 mm
63 328	pcs	Supply and erection of chevron alignment and stop board of hot-dip galvanized steel, with markings of 1st class reflecting foil, size …… x ……. mm
63 331	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size 330 x 1,200 mm
63 332	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size 500 x 500 mm
63 333	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size 750 x 750 mm
63 334	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size 1,500 x 250 mm
63 335	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size 1,500 x 500 mm
63 336	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size 2,250 x 750 mm
63 337	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size 3,000 x 250 mm
63 338	pcs	Supply and erection of chevron alignment and stop board of aluminium, with markings of 1st class reflecting foil, size …… x ……. mm
63 341	pcs	Supply and erection of chevron alignment and stop board of wood, with paint coat markings, size 330 x 1,200 mm
63 342	pcs	Supply and erection of chevron alignment and stop board of wood, with

Item	Unit Measure	Description of Work
		paint coat markings, size 500 x 500 mm
63 343	pcs	Supply and erection of chevron alignment and stop board of wood, with paint coat markings of, size 750 x 750 mm
63 344	pcs	Supply and erection of chevron alignment and stop board of wood, with paint coat markings, size 1,500 x 250 mm
63 345	pcs	Supply and erection of chevron alignment and stop board of wood, with paint coat markings, size 1,500 x 500 mm
63 346	pcs	Supply and erection of chevron alignment and stop board of wood, with paint coat markings, size 2,250 x 750 mm
63 347	pcs	Supply and erection of chevron alignment and stop board of wood, with paint coat markings, size 3,000 x 250 mm
63 348	pcs	Supply and erection of chevron alignment and stop board of wood, with paint coat markings, size …… x ……. mm
63 351	pcs	Supply and erection of stop board of ...………., markings with ………., size 330 x 1,200 mm
63 352	pcs	Supply and erection of stop board of ...………., markings with ………., size 500 x 500 mm
63 353	pcs	Supply and erection of stop board of ...………., markings with ………., size 750 x 750 mm
63 354	pcs	Supply and erection of stop board of ...………., markings with ………., size 1,500 x 250 mm
63 355	pcs	Supply and erection of stop board of ...………., markings with ………., size 1,500 x 500 mm
63 356	pcs	Supply and erection of stop board of ...………., markings with ………., size 2,250 x 750 mm
63 357	pcs	Supply and erection of stop board of ...………., markings with ………., size 3,000 x 250 mm
63 358	pcs	…… x ……. mm
63 411	pcs	Supply and erection of barriers, as per drawing ……………
63 412	pcs	Supply and erection of barriers, as per drawing ……………..
63 511	pcs	Supply and installation of reflective traffic marker with base of hot-dip galvanized steel sheet and with 1st class reflecting foil
63 512	pcs	Supply and installation of reflective traffic marker with base of hot-dip galvanized steel sheet and with 2nd class reflecting foil
63 513	pcs	Supply and installation of reflective traffic marker with base of hot-dip galvanized steel sheet and with reflecting plastic material
63 514	pcs	Supply and installation of reflective traffic marker with base of hot-dip galvanized steel sheet and ……………………..
63 521	pcs	Supply and installation of reflective traffic marker with base of aluminium sheet and with 1st class reflecting foil
63 522	pcs	Supply and installation of reflective traffic marker with base of aluminium sheet and with 2nd class reflecting foil
63 523	pcs	Supply and installation of reflective traffic marker with base of aluminium sheet and with reflecting plastic material
63 524	pcs	Supply and installation of reflective traffic marker with base of aluminium sheet and ……………………..
63 531	pcs	Supply and installation of autonomous, single-head, alternately blinking

Item	Unit Measure	Description of Work
		yellow light of diameter 200 mm
63 532	pcs	Supply and installation of autonomous, single-head, alternately blinking yellow light of diameter 300 mm
63 533	pcs	Supply and installation of autonomous, single-head, alternately blinking yellow light of diameter ….. mm
63 541	pcs	Supply and installation of autonomous, double-head, alternately blinking yellow light of diameter 200 mm
63 542	pcs	Supply and installation of autonomous, double-head, alternately blinking yellow light of diameter 300 mm
63 543	pcs	Supply and installation of autonomous, double-head, alternately blinking yellow light of diameter ….. mm
63 551	pcs	Supply and installation of direction indicating blinking lamps of diameter 180 mm, in series of 4 lamps
63 551	pcs	Supply and installation of direction indicating blinking lamps of diameter 180 mm, in series of 8 lamps
63 561	pcs	Supply and installation of direction indicating flashing lamps of diameter 180 mm, in series of 4 lamps
63 561	pcs	Supply and installation of direction indicating flashing lamps of diameter 180 mm, in series of 8 lamps
63 571	pcs	Supply and installation of road mirror (without post)
63 611	pcs	Supply and placing of raised-type temporary reflective traffic marker of ...…………..
63 612	pcs	Supply and placing of raised-type temporary reflective traffic marker of ...…………..

2.2.6.7.4 Traffic Safety Furniture

Item	Unit Measure	Description of Work
64 111	pcs	Supply and erection of steel post for guard rail, C-section, length 1,500 mm
64 112	pcs	Supply and erection of steel post for guard rail, C-section, length 1,750 mm
64 113	pcs	Supply and erection of steel post for guard rail, C-section, length 2,000 mm
64 114	pcs	Supply and erection of steel post for guard rail, C-section, length 2,250 mm
64 115	pcs	Supply and erection of steel post for guard rail, C-section, length ….. mm
64 121	pcs	Supply and erection of steel post for guard rail, C-section, length 482 mm, with tie-plate
64 122	pcs	Supply and erection of steel post for guard rail, C-section, length 632 mm, with tie-plate
64 131	pcs	Supply and placing steel spacer for guard rail, length 150 mm
64 132	pcs	Supply and placing steel spacer for guard rail, length 420 mm
64 211	m^1	Supply and erection of one-sided single steel guard rail with C-section posts driven into shoulder at spacing of 4 m
64 213	m^1	Supply and erection of one-sided single steel guard rail with C-section posts (including tie-plate) and anchor plate on a bridge at spacing of 4 m
64 214	m^1	Supply and erection of one-sided single steel guard rail with C-section posts (including tie-plate) and anchor bolts on a bridge at spacing of 4 m
64 216	m^1	Supply and erection of one-sided single steel guard rail with C-section posts driven into ground (in the central reserve) at spacing of 4 m
64 221	m^1	Extra payment for posts driven into shoulder at spacing of 2 m
64 223	m^1	Extra payment for posts and anchor plates installed on a bridge at spacing of 2 m
64 224	m^1	Extra payment for posts and anchor plates installed on a bridge at spacing of 1.33 m
64 225	m^1	Extra payment for posts and anchor bolts installed on a bridge at spacing of 2 m
64 226	m^1	Extra payment for posts and anchor bolts installed on a bridge at spacing of 1.33
64 228	m^1	Extra payment for posts driven in ground (in the central reserve) at spacing of 2 m
64 231	m^1	Supply and erection of one-sided double steel guard rail with C-section posts driven into shoulder at spacing of 4 m
64 233	m^1	Supply and erection of one-sided double steel guard rail with C-section posts (including tie-plate) and anchor plate on a bridge at spacing of 4 m
64 234	m^1	Supply and erection of one-sided double steel guard rail with C-section

Item	Unit Measure	Description of Work
		posts (including tie-plate) and anchor bolts on a bridge at spacing of 4 m
64 241	m1	Supply and erection of two-sided single steel guard rail with C-section posts driven into shoulder at spacing of 4 m
64 243	m1	Supply and erection of two-sided single steel guard rail with C-section posts (including tie-plate) and anchor plate on a bridge at spacing of 2 m
64 244	m1	Supply and erection of two-sided single steel guard rail with C-section posts (including tie-plate) and anchor bolts on a bridge at spacing of 2 m
64 246	m1	Supply and erection of two-sided single steel guard rail with C-section posts driven into ground (in the central reserve) at spacing of 4 m
64 251	m1	Supply and erection of two-sided double steel guard rail with C-section posts (including tie-plate) and anchor plate on a bridge at spacing of 2 m
64 252	m1	Supply and erection of two-sided double steel guard rail with C-section posts (including tie-plate) and anchor bolts on a bridge at spacing of 2 m
64 254	m1	Supply and erection of two-sided double steel guard rail with C-section posts driven into ground (in the central reserve) at spacing of 4 m
64 261	pcs	Supply and erection of steel rail, length 4.20 m
64 262	pcs	Supply and erection of steel rail, length 2.20 m
64 263	pcs	Supply and erection of steel rail, length 1.53 m
64 264	pcs	Supply and erection of steel rail, length ….. m
64 271	pcs	Extra payment for concave bending, radius 15 to 20 m
64 272	pcs	Extra payment for concave bending, radius 21 to 40 m
64 273	pcs	Extra payment for concave bending, radius above 40 m
64 275	pcs	Extra payment for convex bending, radius 15 to 20 m
64 276	pcs	Extra payment for convex bending, radius 21 to 40 m
64 277	pcs	Extra payment for convex bending, radius above 40 m
64 281	pcs	Supply and mounting buried end piece, length 4 m
64 282	pcs	Supply and mounting buried end piece, length 8 m
64 283	pcs	Supply and mounting buried end piece, length 12 m
64 284	pcs	Supply and mounting buried end piece, length .... m
64 286	pcs	Supply and mounting circular end piece, length 12 m
64 287	pcs	Supply and mounting circular end piece, length ….. m
64 311	m1	Execution of safety barrier (New Jersey) of cement concrete, height 80 cm, without foundation
64 312	m1	Execution of safety barrier (New Jersey) of cement concrete, height 110 cm, without foundation
64 313	m1	Execution of safety barrier (New Jersey) of cement concrete, height ... cm, without foundation
64 321	m1	Supply and mounting safety barrier of precast cement concrete elements,

Item	Unit Measure	Description of Work
		height 80 cm, without foundation
64 322	m^1	Supply and mounting safety barrier of precast cement concrete elements, height 110 cm, without foundation
64 323	m^1	Supply and mounting safety barrier of precast cement concrete elements, height .... cm, without foundation
64 331	m^1	Supply and mounting of safety barrier of precast cement concrete elements, height 80 cm, without connection to steel guard rail
64 332	m^1	Supply and mounting of safety barrier of precast cement concrete elements, height 110 cm, without connection to steel guard rail
64 333	m^1	Supply and mounting of safety barrier of precast cement concrete elements, height .... cm, without connection to steel guard rail
64 336	pcs	Extra payment for connection to steel guard rail
64 341	m^1	Supply and mounting of precast external cement concrete safety barrier on the bridge, height 80 cm
64 342	m^1	Supply and mounting of precast external cement concrete safety barrier on the bridge, height 110 cm
64 343	m^1	Supply and mounting of precast external cement concrete safety barrier on the bridge, height ...... cm
64 351	m^1	Supply and mounting semi-precast external cement concrete safety barrier on a bridge, height 80 cm
64 352	m^1	Supply and mounting semi-precast external cement concrete safety barrier on a bridge, height 110 cm
64 353	m^1	Supply and mounting semi-precast external cement concrete safety barrier on a bridge, height ... cm
64 361	m^1	Execution of monolithic external cement concrete safety barrier on a bridge, height 80 cm
64 362	m^1	Execution of monolithic external cement concrete safety barrier on a bridge, height 110 cm
64 363	m^1	Execution of monolithic external cement concrete safety barrier on a bridge, height ... cm
64 371	m^1	Supply and mounting precast internal cement concrete safety barrier on a bridge, height 80 cm
64 372	m^1	Supply and mounting precast internal cement concrete safety barrier on a bridge, height ... cm
64 374	m^1	Supply and mounting semi-precast internal cement concrete safety barrier on a bridge, height 80 cm
64 375	m^1	Supply and mounting semi-precast internal cement concrete safety barrier on a bridge as per drawing, height .... cm
64 377	m^1	Execution of monolithic internal cement concrete safety barrier on a bridge, height 80 cm
64 378	m^1	Execution of monolithic internal cement concrete safety barrier on a bridge as per drawing, height .... cm
64 411	pcs	Supply and mounting foundation and tensioning post for safety fence,

Item	Unit Measure	Description of Work
		including anchors and reinforcing struts as per drawing, post of steel pipe
64 412	pcs	Supply and mounting foundation and tensioning post for safety fence, including anchors and reinforcing struts as per drawing, post of aluminium pipe
64 413	pcs	Supply and mounting foundation and tensioning post for safety fence, including anchors and reinforcing struts as per drawing, post of plastic coated steel pipe
64 414	pcs	Supply and mounting foundation and tensioning post for safety fence, including anchors and reinforcing struts as per drawing, post of reinforced cement concrete
64 415	pcs	Supply and mounting foundation and tensioning post for safety fence, including anchors and reinforcing struts as per drawing, post of ....
64 421	pcs	Supply and erection of foundation and intermediate post for safety fence as per drawing, post of steel pipe
64 422	pcs	Supply and erection of foundation and intermediate post for safety fence as per drawing, post of aluminium pipe
64 423	pcs	Supply and erection of foundation and intermediate post for safety fence as per drawing, post of plastic coated steel pipe
64 424	pcs	Supply and erection of foundation and intermediate post for safety fence as per drawing, post of reinforced cement concrete
64 425	pcs	Supply and erection of foundation and intermediate post for safety fence as per drawing, post of ....
64 431	m^2	Supply and mounting of mesh for safety fence as per drawing made of hot-dip galvanized steel wire
64 432	m^2	Supply and mounting of mesh for safety fence as per drawing made of aluminium wire
64 433	m^2	Supply and mounting of mesh for safety fence as per drawing made of plastic coated steel wire
64 434	m^2	Supply and mounting of mesh for safety fence as per drawing made of ....
64 441	m^2	Supply and mounting of extra height of safety fence as per drawing made of hot-dip galvanized steel wire
64 442	m^2	Supply and mounting of extra height of protective fence as per drawing made of aluminium wire
64 443	m^2	Supply and mounting of extra height of safety fence as per drawing made of plastic coated steel wire
64 444	m^2	Supply and mounting of extra height of safety fence as per drawing made of ....
64 451	m^2	Supply and mounting of mesh of hot-dip galvanized steel wire for protection of amphibians, including all accessories for fixing as independent safety fence
64 452	m^2	Supply and mounting of mesh of hot-dip galvanized steel wire for protection of amphibians, including all accessories for fixing to the existing safety fence
64 454	m^2	Supply and mounting of mesh of hot-dip galvanized and plastic coated steel wire for protection of amphibians, including all accessories for fixing as independent safety fence

Item	Unit Measure	Description of Work
64 455	m^2	Supply and mounting of mesh of hot-dip galvanized and plastic coated steel wire for protection of amphibians, including all accessories for fixing to the existing safety fence
64 457	m^2	Supply and mounting of mesh for fixing to the existing safety fence, including all accessories for fixing, made of hot-dip galvanized steel wire
64 458	m^2	Supply and mounting of mesh for fixing to the existing safety fence, including all accessories for fixing, made of hot-dip galvanized and plastic coated steel wire
64 461	m^2	Supply and mounting of mesh of aluminium wire for protection of amphibians, including all accessories for fixing as independent safety fence
64 462	m^2	Supply and mounting of mesh of aluminium wire for protection of amphibians, including all accessories for fixing to the existing safety fence
64 466	pcs	Supply and installation of steel insertion of L = 1,000 m for tensioning post
64 467	pcs	Supply and installation of steel insertion of L = 1,000 m for intermediate post
64 471	m^1	Supply and installation of extra wire above the mesh at spacing of 200 mm, including all fixing accessories; extra wire made of aluminium
64 472	m^1	Supply and installation of extra wire above the mesh at spacing of 200 mm, including all fixing accessories; extra wire made of hot-dip galvanized steel
64 473	m^1	Supply and installation of extra wire above the mesh at spacing of 200 mm, including all fixing accessories; extra wire made of hot-dip galvanized and plastic coated steel
64 476	m^1	Supply and installation of reinforced wire for tensioning – extra payment
64 481	pcs	Supply and mounting single-leaf door of h = 1.8 m, w = 1 m of aluminium profiles
64 482	pcs	Supply and mounting single-leaf door of h = 1.8 m, w = 1 m of hot-dip galvanized steel profiles
64 483	pcs	Supply and mounting single-leaf door of h = 1.8 m, w = 1 m of painted steel profiles
64 486	pcs	Supply and mounting single-leaf door of h = 1.8 m, w = 3.5 m of aluminium profiles
64 487	pcs	Supply and mounting single-leaf door of h = 1.8 m, w = 3.5 m of hot-dip galvanized steel profiles
64 488	pcs	Supply and mounting single-leaf door of h = 1.8 m, w = 3.5 m of painted steel profiles
64 491	pcs	Supply of galvanized steel wire for electrical safety fence for deer, placing above the existing safety fence, including insulators and installation accessories
64 492	pcs	Supply of pasture device (15 to 20 J), including all the equipment for functioning on the safety fence, and for earthing

Item	Unit Measure	Description of Work
64 511	m^2	Supply and mounting of frame with mesh for safety fence as per drawing made of hot-dip galvanized steel wire
64 512	m^2	Supply and mounting of frame with mesh for safety fence as per drawing made of aluminium wire
64 513	m^2	Supply and mounting of frame with mesh for safety fence as per drawing made of plastic coated steel wire
64 514	m^2	Supply and mounting of frame with mesh for safety fence as per drawing made of ....
64 611	pcs	Supply and mounting of pedestrian parapet as per drawing
64 621	pcs	Supply and mounting of pedestrian parapet as per drawing
64 631	pcs	Supply and mounting of end piece of pedestrian parapet as per drawing
64 711	m^1	Supply and fixing metal antiglare elements to safety fence
64 712	m^1	Supply and fixing plastic antiglare elements to safety fence
64 713	m^1	Supply and fixing .... antiglare elements to safety fence
64 721	m^1	Planting hedge in the central reserve for antiglare purposes
64 811	m^2	Supply and mounting of grating to secure the opening between edge beams in the central reserve as per drawing
64 812	m^2	Supply and mounting of reinforced rubber to secure the opening between edge beams in the central reserve as per drawing
64 813	m^2	Supply and mounting of .... to secure the opening between edge beams in the central reserve as per drawing
64 911	pcs	Supply and installation of warning device for poor visibility as per drawing ………….
64 921	pcs	Supply and installation of warning device for CO concentration in the air, as per drawing …………..
64 931	pcs	Supply and installation of fire hazard warning device, as per drawing .....……..
64 941	pcs	Supply and installation of wind hazard warning device, as per drawing ………….

Note:

All the traffic safety furniture shall be adequately protected from corrosion

2.2.6.7.5 Road Furniture for Snow Removal and Ice Control

Item	Unit Measure	Description of Work
65 111	pcs	Supply of wooden marker post for snow removal, length 2 m
65 112	pcs	Supply of wooden marker post for snow removal, length 2.5 m
65 113	pcs	Supply of wooden marker post for snow removal, length 3 m
65 114	pcs	Supply of wooden marker post for snow removal, length ... m
65 121	pcs	Supply of plastic marker post for snow removal, length 2 m
65 122	pcs	Supply of plastic marker post for snow removal, length 2.5 m
65 123	pcs	Supply of plastic marker post for snow removal, length 3 m
65 124	pcs	Supply of plastic marker post for snow removal, length ... m
65 211	m^2	Supply of wooden element for snow drift barrier, with wooden post, support, and/or anchor, of wooden bars
65 212	m^2	Supply of wooden element for snow drift barrier, with wooden post, support, and/or anchor, of off-cuts
65 213	m^2	Supply of wooden element for snow drift barrier, with wooden post, support, and/or anchor, of ....
65 221	m^2	Supply of mesh of plastic material for snow drift barrier, with anchor and metal post
65 222	m^2	Supply of mesh of plastic material for snow drift barrier, with anchor and wooden post
65 223	m^2	Supply of mesh of plastic material for snow drift barrier, with anchor and .... post
65 231	m^1	Planting of hedge for snow drift barrier as per drawing ………..
65 241	pcs	Supply of material for, and erection of snow drift barrier as per drawing ………..
65 242	pcs	Supply of material for, and erection of snow drift barrier as per drawing ………..
65 311	pcs	Supply of material for, and erection of snow slide barrier as per drawing ………..
65 312	pcs	Supply of material for, and erection of snow slide barrier as per drawing ………..
65 411	pcs	Supply and erection of thermometer shelter (incorporating thermometer, hygrometer, and barometer) as per drawing ………
65 412	pcs	Supply and erection of thermometer shelter (incorporating thermometer, hygrometer, and barometer) as per drawing ………
65 421	pcs	Supply and installation of glazed frost detecting and warning devices (sounds) as per drawing …………
65 422	pcs	Supply and installation of glazed frost detecting and warning devices (sounds) as per drawing …………
65 431	pcs	Supply and installation of snow quantity measuring device as per drawing ……………..
65 432	pcs	Supply and installation of snow quantity measuring device as per drawing

Item	Unit Measure	Description of Work
		……………..
65 441	pcs	Supply and installation of device for measuring the quantity of salt remaining on the carriageway, as per drawing …………….
65 442	pcs	Supply and installation of device for measuring the quantity of salt remaining on the carriageway, as per drawing …………….

2.2.6.7.6 6.6 Other Road Furniture

Item	Unit Measure	Description of Work
66 111	m^2	Execution of vegetation zone of shrubs, 1 plant/m^2
66 112	m^2	Execution of vegetation zone of shrubs, 2 plants/m^2
66 121	m^2	Execution of vegetation zone of trees, 1 plant/m^2
66 122	m^2	Execution of vegetation zone of trees, 2 plants/m^2
66 131	m^2	Execution of vegetation zone of shrubs and trees, 1 plant/m^2
66 132	m^2	Execution of vegetation zone of shrubs and trees, 2 plants/m^2
66 211	m^3	Execution of noise barrier embankment of cohesive soil
66 212	m^3	Execution of noise barrier embankment of granular rock
66 213	m^3	Execution of noise barrier embankment of mixed material
66 214	m^3	Execution of noise barrier embankment of ....
66 221	m^2	Strengthening of noise barrier embankment (as per drawing) with geo-textiles
66 222	m^2	Strengthening of noise barrier embankment (as per drawing) with geo-mesh
66 223	m^2	Strengthening of noise barrier embankment (as per drawing) with curved mesh reinforcement and geo-textiles
66 231	m^2	Lining applied to noise barrier (as per drawing) with vegetation polyester geo-textiles
66 232	m^2	Lining applied to noise barrier (as per drawing) with vegetation coconut geo-textiles
66 233	m^2	Lining applied to noise barrier (as per drawing) with cement concrete elements
66 234	m^2	Lining applied to noise barrier (as per drawing) with glass-cement elements
66 235	m^2	Lining applied to noise barrier (as per drawing) with expanded clay
66 236	m^2	Lining applied to noise barrier (as per drawing) with used rubber tyres
66 241	m^3	Supply and placing topsoil for making green the slope of noise protective embankment
66 242	m^2	Supply and application (by spraying) a mixture of grass seed, fertilizer, turf, and paste for making green the slope of noise protective embankment

Item	Unit Measure	Description of Work
66 311	m^3	Construction of spot foundation of reinforced cement concrete C 25/30
66 312	m^3	Supply and placing of precast spot foundation of reinforced cement concrete C 25/30
66 321	m^1	Supply and execution of spot foundation of driven steel pile, HEA 140 profile
66 322	m^1	Supply and execution of spot foundation of driven steel pile, HEA 160 profile
66 323	m^1	Supply and execution of spot foundation of driven steel pile, ...
66 331	m^1	Supply and execution of spot foundation of driven micro-pile made of reinforced cement concrete C 25/30, diameter 30 cm
66 332	m^1	Supply and execution of spot foundation of driven micro-pile made of reinforced cement concrete C 25/30, diameter .... cm
66 335	m^1	Supply and execution of spot foundation of bored micro-pile made of reinforced cement concrete C 25/30, diameter 30 cm
66 336	m^1	Supply and execution of spot foundation of bored micro-pile made of reinforced cement concrete C 25/30, diameter .... cm
66 341	pcs	Supply and building-in of metal tie-plate for fixing the post
66 351	m^3	Execution of strip foundation of reinforced cement concrete C 25/30
66 361	m^3	Supply and building-in of precast beam of reinforced cement concrete C 25/30 for strip foundation
66 411	m^1	Supply and building-in of supporting post of steel for noise protection elements, including necessary accessories for sealing and fixing the elements; hot-rolled profile of the post
66 412	m^1	Supply and building-in of supporting post of steel for noise protection elements, including necessary accessories for sealing and fixing the elements; cold-rolled profile of the post
66 413	m^1	Supply and building-in of supporting post of steel for noise protection elements, including necessary accessories for sealing and fixing the elements; cold-recast profile of the post
66 414	m^1	Supply and building-in of supporting post of steel for noise protection elements, including necessary accessories for sealing and fixing the elements; welded profile of the post
66 421	pcs	Extra payment for welding the anchor plate to the steel post, and the necessary accessories for fixing to the tie-plate
66 431	pcs	Supply and erection of precast post of reinforced cement concrete C 30/37 (as per drawing), height up to 2 m
66 432	pcs	Supply and erection of precast post of reinforced cement concrete C 30/37 (as per drawing), height 2.5 - 3 m
66 433	pcs	Supply and erection of precast post of reinforced cement concrete C 30/37 (as per drawing), height 3.5 - 4 m
66 434	pcs	Supply and erection of precast post of reinforced cement concrete C 30/37 (as per drawing), height above 4 m

Item	Unit Measure	Description of Work
66 441	pcs	Supply and erection of wooden post (as per drawing), height .... m
66 511	m^2	Supply and mounting of sound reflecting element of protected wood
66 512	m^2	Supply and mounting of sound absorbing element of protected wood
66 513	m^2	Supply and mounting of sound highly absorbing element of protected wood
66 521	m^2	Supply and mounting of sound absorbing element of perforated and profiled steel sheet
66 522	m^2	Supply and mounting of sound highly absorbing element of perforated and profiled steel sheet
66 531	m^2	Supply and mounting of sound absorbing element of perforated and profiled aluminium sheet
66 532	m^2	Supply and mounting of sound highly absorbing element of perforated and profiled aluminium sheet
66 541	m^2	Supply and mounting of sound reflecting element of polyacryl, thickness 15 mm
66 542	m^2	Supply and mounting of sound reflecting element of polyacryl, thickness 20 mm
66 543	m^2	Supply and mounting of sound reflecting element of polyacryl, thickness 25 mm
66 551	m^2	Supply and mounting of sound reflecting element of polycarbonate, thickness 12 mm
66 552	m^2	Supply and mounting of sound reflecting element of polycarbonate, thickness 20 mm
66 553	m^2	Supply and mounting of sound reflecting element of polycarbonate, thickness 25 mm
66 561	m^2	Supply and mounting of sound reflecting element of plastic, thickness 15 mm
66 562	m^2	Supply and mounting of sound reflecting element of plastic, thickness 20 mm
66 563	m^2	Supply and mounting of sound reflecting element of plastic, thickness 25 mm
66 571	m^2	Supply and mounting of sound reflecting element of plastic............., thickness ... mm
66 572	m^2	Supply and mounting of sound reflecting element of plastic............., thickness ... mm
66 581	m^2	Extra payment for reinforcing of polyacryl or polycarbonate element with polyamide fibres
66 591	pcs	Supply and pasting of a label containing an image of bird of prey
66 611	m^2	Supply and mounting of noise reflecting element of reinforced cement concrete C 35/45

Item	Unit Measure	Description of Work
66 621	m^2	Supply and mounting of noise absorbing element of wood-concrete
66 622	m^2	Supply and mounting of noise highly absorbing element of wood-concrete
66 631	m^2	Supply and mounting of noise absorbing element of gas-concrete
66 632	m^2	Supply and mounting of noise highly absorbing element of gas-concrete
66 641	m^2	Supply and mounting of noise absorbing element of foam-concrete
66 642	m^2	Supply and mounting of noise highly absorbing element of foam-concrete
66 651	m^2	Supply and mounting of noise absorbing element of expanded clay
66 652	m^2	Supply and mounting of noise highly absorbing element of expanded clay
66 661	m^2	Supply and mounting of noise absorbing element of glass-cement
66 662	m^2	Supply and mounting of noise highly absorbing element of glass-cement
66 671	m^2	Supply and mounting of noise absorbing element of light-weight cement concrete
66 681	m^2	Supply and mounting of noise absorbing element of very light-weight cement concrete
66 682	m^2	Supply and mounting of noise highly absorbing element of very light-weight cement concrete
66 711	m^2	Supply and mounting of noise absorbing door of perforated steel sheet
66 712	m^2	Supply and mounting of noise highly absorbing door of perforated steel sheet
66 721	m^2	Supply and mounting of noise absorbing door of perforated aluminium sheet
66 722	m^2	Supply and mounting of noise highly absorbing door of perforated aluminium sheet
66 731	m^2	Supply and mounting noise reflecting door of ....
66 732	m^2	Supply and mounting noise absorbing door of ……………..
66 733	m^2	Supply and mounting noise highly absorbing door of …………..
66 811	m^1	Supply and mounting of end element/roof as a shelter of noise protecting elements, including fixing accessories, of wood
66 812	m^1	Supply and mounting of end element/roof as a shelter of noise protecting elements, including fixing accessories, of steel sheet
66 813	m^1	Supply and mounting of end element/roof as a shelter of noise protecting elements, including fixing accessories, of painted steel sheet
66 814	m^1	Supply and mounting of end element/roof as a shelter of noise protecting elements, including fixing accessories, of aluminium sheet
66 815	m^1	Supply and mounting of end element/roof as a shelter of noise protecting elements, including fixing accessories, of cement concrete
66 821	pcs	Dobava in postavitev predfabriciranega korita iz ojačenega cementnega betona, velikosti ……/……/…. cm

Item	Unit Measure	Description of Work
66 822	pcs	Dobava in postavitev predfabriciranega korita iz ……………………………….., velikosti ……/……/…. cm
66 831	pcs	Execution of measurement of noise barrier efficiency
66 911	pcs	Supply of material for and execution of wind barrier, as per drawing ....
66 921	pcs	Supply and installation of emergency call telephone exchange, as per drawing ……………..
66 922	pcs	Supply and erection of emergency call telephone post, as per drawing ....
66 923	pcs	Supply and erection of emergency call telephone post, including guard-rail, as per drawing ....
66 924	pcs	Supply and installation of power supply and telecommunication device for emergency call, as per drawing ……………
66 931	pcs	Supply and installation of traffic counting device with induction loop, as per drawing …………..
66 932	pcs	Supply and installation of traffic counting device with .... loop, as per drawing …………..
66 935	pcs	Supply and installation of axle load counter per categories, as per drawing ....

GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

VOLUME II: CONSTRUCTION

SECTION 2: SPECIAL TECHNICAL CONDITIONS

Part 7: THIRD PARTY SERVICES

Sarajevo/Banja Luka
2005

CONTENTS:

2.2.7 THIRD PARTY SERVICES

2.2.7.1 GENERAL

2.2.7.1.1 Description

Other services are such works as may be required for the road construction and maintenance, and which may be performed by professional companies qualified and authorized to execute such works.

All the said works shall be carried out in compliance with relevant designs, which have to ensure full completion of the works, including all the works by other contractors (subcontractors) if any.

If the design for a particular other service is provided by the contractor, he shall obtain investor's or engineer's approval for the execution of such work in due time prior to commencement of the work.

If relevant regulations or special technical conditions are specified to perform a particular job within the scope of other works, such a job shall be executed in accordance with the requirements set herein, unless such requirements are in conflict with the requirements specified by the engineer.

2.2.7.1.2 Applicable Materials

All the materials intended to be used for the execution of other services shall comply with applicable requirements specified in both design and relevant technical conditions for such works.

The contractor may only use such materials as will be approved by the engineer. This should also apply to any variations in the type of material that has been foreseen to be used for the other works dealt with herein.

2.2.7.1.3 Quality of Materials

The quality of all the materials to be used for other services shall comply with design specifications, applicable regulations, and these special technical conditions.

The contractor shall demonstrate the quality of each material he intends to use in executing such works, all in accordance with the design, technical conditions, and other applicable regulations.

2.2.7.1.4 Method of Execution

The method of execution of other services is specified by the design, relevant regulations, and technical conditions.

Where during the execution of work the design is found to be incomplete, the contractor shall in such take into consideration the explanations and instructions given by the engineer. Such explanations and instructions shall constitute an integral part of the design and must not be considered as design modifications.

Within the mandate delegated to him, the contractor to whom any other work has been awarded may prepare suitable designs for such works. For any modifications, however, that are proposed by the contractor in connection with the method of executing the work, and which are approved by the engineer, the contractor shall provide appropriate designs.

Where any job within the scope of other works should not be dealt with in these special technical conditions, the technical conditions applying to the execution of such a job shall make an integral part of the design. Each design shall be approved by the investor or, within the limits of his mandate, the engineer.

The execution of other works shall be coordinated with the site work programme.

In principle, adequate hydraulic and pneumatic machinery shall be used to execute breakthrough and boring operations required for placing any utility line into the existing road body.

2.2.7.1.5 Quality of Execution

For the work carried out within the scope of other works, the quality specified by the design, applicable regulations, and relevant technical conditions shall be ensured.

In due time before the commencement of works, the contractor shall submit to the engineer adequate evidence on the quality of all the materials that will be used in the execution of the particular work. Partially defective items may only be incorporated if this is approved by the engineer, and if this does not reduce the quality of the work concerned.

All the equipment and machinery used in the execution of work shall be provided with appropriate test certificates, their capacity conforming to the requirements of the design, applicable regulations, and technical conditions.

If so required by the engineer, prior to the commencement of a particular work, the contractor shall demonstrate his ability to provide the specified quality of that work by executing a demonstrative placing at a location specified by the engineer.

The contractor may only commence the execution of work after having obtained the approval by the engineer.

2.2.7.1.6 Quality Control of Execution

The quality of the executed works specified in these technical conditions shall be controlled by internal and external testing carried out in such a scope and manner as required. The quality of any other works within the scope of other works, however, shall be controlled to the extent and manner specified by applicable regulations and technical conditions.

The details concerning testing the quality of executed work shall be determined by the engineer, unless such details are specified in the design.

Upon completion of the work, the contractor shall submit to the engineer appropriate evidence proving that the required quality of the executed work has been achieved, such evidence to include the evaluation of the test results and of the performed work.

2.2.7.1.7 Measurement and Take-Over of Works

The executed works shall be measured in accordance with the general technical conditions and calculated in appropriate units of measure.

All the quantities shall be measured by actually executed scope and type of works within the limits of measurements specified in the design.

For the purpose of taking over the executed work, the requirements of these special technical conditions shall be considered. Any deficiencies that might be established shall be made good by the contractor within a time period specified by the engineer.

All the costs of mending deficiencies shall be charged to the contractor, including the costs of all types of testing to demonstrate the inappropriate quality of the executed work, as well as of such retesting as will be required upon having executed the necessary repairs, to determine the quality of the work.

For any work not conforming to the quality requirements, and which the contractor fails to repair in accordance with the engineer’s instructions, the contractor shall have no right to claim any payment whatsoever.

For all the types of public utility lines and their installation within the scope of the other works, appropriate documents such as geodesic survey and as-built design shall be prepared by the contractor, and adequate entries shall be made into both land register and register of public utilities. The contractor shall also obtain a statement by the future operator proving that all the conditions set in his approval for the execution of the work concerned have been fulfilled.

2.2.7.1.8 Final Account of Works

The bases for the final account of the works are specified in the general technical conditions.

All the quantities of the executed works shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a perfect completion of the works. The contractor shall have no right to claim any extra payment.

2.2.7.2 POWER LINES

General

Electric power supply can be realized by means of:

- power cables, and
- overhead power lines.

To build a power line, adequate design documents shall be worked out and suitable approvals by electric supply company and other authorities should be obtained.

The power line route shall be harmonized with the existing arrangement of various utility lines running through the particular public area, and shall comply with the specified conditions.

Power and other cables must not be placed under the carriageway. Inevitable crossings shall be so executed as to enable replacement of a cable without demolishing the road pavement.

3.2.7.1.1 Description

When building power lines related to construction of roads and structures on/along the roads, special requirements shall be considered concerning placing of power cables, when:

- running freely through an area
- running in parallel,
- crossing the road,
- crossing other utility lines,
- crossing railway tracks,
- running on/through bridges and other structures, and
- placed underwater; and

concerning building of overhead power lines.

2.2.7.2.1 Types of Materials

The following items are used to build power lines:

- conduits,
- cable shafts,
- cable shaft covers, and
- cables.

2.2.7.2.1.1 Conduits

The following types of conduits may be used:

- PC 110 - polyvinyl chloride pipe, external diameter 110 mm
- PC 160 - polyvinyl chloride pipe, external diameter 160 mm
- PC 110-EZ – polyvinyl chloride pipe, external diameter 110 mm (internal wall smooth, external wall profiled)
- PC 160-EZ – polyvinyl chloride pipe, external diameter 160 mm (internal wall smooth, external wall profiled)
- PE 110 – polyethylene pipe, external diameter 110 mm
- PE 160 – polyethylene pipe, external diameter 125 mm.

PC or PE conduits for cables are circular cross-section, made of hard polyvinyl chloride or polyethylene, of adequate mechanical and other properties. PC conduits shall be of red colour.

For conduits to be directly placed into the ground, the tensile modulus of elasticity (E), measured on both product and raw material, shall be less than 800 N/mm^2, while for conduits placed into another conduit it shall amount to more than 800 N/mm^2.

All the conduits shall be adequately marked to indicate the dimensions of conduits or combinations, the name of the producer, year of production, and length (designation per running metre).

2.2.7.2.1.2 Cable Shafts

The following cable shafts can be used:

- of thermo-plastic materials,
- of circular cement concrete conduits, or
- of square cement concrete conduits, either cast in situ or prefabricated.

The size of cable shafts depends on the type and number of conduits and cables respectively.

2.2.7.2.1.3 Cable Shaft Covers

Three types of cast-iron covers can be used: for 50 kN, 125 kN, and 400 kN of point loading.

Covers of 50 kN bearing capacity can only be used for shafts on green surfaces inaccessible to vehicles.

Covers of 125 kN bearing capacity can be used for shafts on surfaces where minor loading is expected (footways).

Covers of 400 kN bearing capacity shall be used for shafts on areas where major loading is expected (roadways).

2.2.7.2.1.4 Cables

Medium-voltage and low-voltage cables with PVC and PE insulation and with copper or aluminium wires may be used.

2.2.7.2.2 Quality of Materials

Adequate quality of the material to be placed is specified by the design, regulations, and appropriate technical conditions.

The contractor shall in due course prior to commencement of the works submit to the engineer adequate evidence on the quality of all materials he intends to introduce.

The contractor may commence to place the material only after having obtained the engineer's approval.

The quality of materials shall be verified on the basis of the technical data for the particular product, and of the accompanying documents such as form of delivery, certificates, declarations, etc.

Prior to laying the cables, the latter shall be tested on drums: both breakdown strength and insulating resistance shall be measured.

2.2.7.2.3 Method of Execution

2.2.7.2.3.1 Placing Power Cables

2.2.7.2.3.1.1 Running Freely Through an Area

The cable placing depth depends on the nominal cable voltage and are given in Table 7.1.

Table 7.1: Minimum depth of placing a power cable

Nominal voltage [kV]	Minimum cable depth [m]
1	0.7
10	0.8
20	1.0
35	1.0
110	1.2

The trench width shall amount to as follows:

- 0.4 m for voltages 1 kV and 10 kV,
- 0.5 m for voltages 20 kV and 35 kV.

The minimum distance between a power cable trench and building foundations shall amount to 0.5 m, while it shall not be less than 2 m between a trench and trees.

A layer of non-compacted mineral aggregate layer of 0/4 mm in a thickness of 10 cm shall be spread and levelled at the bottom of the trench.

When a power cable is laid by means of mechanization, measurements shall be carried out as appropriate (with dynamometer) to ensure that the admissible tensile force in the cable is not exceeded.

Upon uncoiling and laying a power cable the lowest recommended temperature (+5 ^{0}C) or the maker's instructions shall be taken into consideration.

Upon uncoiling and laying a power cable the minimum allowable bending radius as specified in Table 7.2 or in accordance with the maker's instructions shall be considered.

Table 7.2: Minimum admissible bending radius of power cables

Cable type	Nominal voltage [kV]	Impregnated cable		Thermoplastic cable	
		Lead sheath	Aluminium sheath	PVC sheath	EP XP sheath
		Minimum admissible bending radius			
- single-core	1 to 35	25 D	30 D	20 D	15 D
- multicore	1 to 10	15 D	25 D	12 D	10 D
	20 to 35	15 D	25 D	15 D	12 D

D – external cable diameter in mm.

A power cable shall be covered with a layer of mineral aggregate 0/4 mm in a thickness of at least 10 cm.

Above the cable or soil layer, additional mechanical protection shall be provided (e.g. plastic shield SAL).

Approximately 40 cm above the cable, a warning tape of red colour made of soft PVC shall be placed. It shall be equipped with the following inscription. "WARNING – POWER CABLE".

Above the power cable, an earthing strip of Fe/Zn, 25 x 4 mm, shall be placed.

2.2.7.2.3.1.2 Running in Parallel

The lowest allowed depth for parallel power cables is the same as indicated in Table 7.1. Signalling cables, however, should be placed 0.6 to 0.8 m deep in the ground.

The required width of the bottom of the trench for parallel cables is specified in Table 7.3.

Table 7.3: Minimum depth of trenches for parallel power cables

Number of cables	Nominal cable voltage	
	1 kV and 10 kV	20 kV and 35 kV
	Trench bottom width (m)	
2	0.4	0.6
3	0.6	0.9
4	0.8	1.3
5	1.0	1.6

The minimum admissible spacing of parallel power and other cables are given in Table 7.4.

Table 7.4: Minimum spacing of parallel power cables

Cable type	Minimum spacing (m)
- two signal cables	/
- two telephone cables	/
- a signal and a telephone cable	0.05
- power cables:	
- two cables of less than 1 kV voltage	0.07
- a 10 kV cable and a cable of lower voltage	0.15
- a 20 kV or 35 kV cable and some other power cable	0.2
- a cable of less than 1 kV and a telephone cable	0.3
- a 10 kV cable and a telephone cable	0.5
- a cable of more than 10 kV and a telephone cable	1.0*

** provided with extra thermal protection*

2.2.7.2.3.1.3 Crossing the Road

At the point of crossing the road and at any other location where greater mechanical loading or mechanical damage may be expected, power cables shall be placed into appropriate cable ducts, which shall be assembled of thermoplastic pipe elements.

Cable ducts shall be placed so as to be as perpendicular to the road axis as possible, and shall project by not less than 1 m beyond each side of the carriageway.

Both width and depth of the trench for cable ducts depends on the number of cables and conduits that may be placed in it, either on a single level or several ones.

The upper edge of the topmost conduit shall not be less than 0.8 m below the carriageway level.

In case of cable ducts of greater length, shafts (manholes) shall be constructed as appropriate. The shaft spacing depends on both type and diameter of the cable. Shafts shall also be executed wherever the duct direction changes, as well as at every crossing of the road. The shaft dimensions depend on the number, diameter and nominal voltage of cables, as well as on the allowable cable bending diameter and site conditions. The minimum inlet opening of the shaft should amount to 0.60 x 0.60 m. In larger shafts, a double cast-iron cover equipped with removable crossbar shall be foreseen. At the shaft bottom, a drainage opening shall be designed, while the walls shall be equipped with step irons.

2.2.7.2.3.1.4 Crossing Other Utility Lines

Such minimum spacing as required to exclude the possibility of interference and damage from occurring whenever the power cables cross other utility lines or come near to them, shall be provided. table 7.5 lists the minimum spacing to be provided between power cables and any other utility lines and devices.

Table 7.5: Minimum clear distance between power cable and some other cable or device

Type of line or device	Minimum clear distance of the power line Parallel running [m]	At crossing [m]
- telecommunication cable	0.5 to 2.0	0.5
- water supply	0.5 to 2.0	0.5
- gas main	1.0	0.6
- oil pipeline	1.0	0.5
- hot water supply:		
- from signalling and 1 kV cables	1.0	0.3
- from 10 kV - 35 kV cables	0.7	0.6
- from 60 kV cable	1.5	1.0
- sewage system	0.5	0.5

2.2.7.2.3.1.5 Crossing Railway Tracks

Where crossing railway tracks, a power cable shall be placed into thermoplastic or metal conduits, adequately resistant to mechanical impacts. Such conduits shall be laid in such a manner that the cable can be replaced without excavation.

When a power cable crosses an electrified railway track, the protective conduits shall be made of non-conductive material, which shall be additionally protected (thermoplastic conduits). The power cable should intersect the railway at an angle of 90° and at least 1 m below the top of the rails.

The point of intersection railway – cable shall be visibly marked (marker of cement concrete or stone).

2.2.7.2.3.1.6 Running On/Through Bridges and Other Structures

When running on or through a bridge or other structure on road, power cables shall, as a rule, be placed in special conduits or channels (made of fire resistant material), which are laid in the footway or on special girders. In the latter case, however, the power cable shall be mechanically protected as appropriate.

A power cable that is placed in conduits or channels on a bridge, must not be wrapped with inflammable material such as jute or similar.

No couplers for joining power cables are admitted within the bridges as well as in the vicinity of structures that might cause vibrations of the ground.

In case vibrations are expected on a bridge, a special vibration resistant power cable shall be foreseen.

Power cables on reinforced cement concrete or steel bridges, which also carry electrified railway tracks, shall be so placed as to prevent their contact with steel parts or reinforcing steel of the bridge structure.

2.2.7.2.3.1.7 Placed Underwater

A power cable that will be placed underwater should run at a safe distance from structures, anchorages, and similar locations where it could be damaged.

A power cable laid underwater shall cross the narrowest section of the watercourse. The method of intersecting the watercourse by the power cable shall, as a rule, be specified by the competent water authority. The location where cables cross a navigable watercourse shall be marked as appropriate.

2.2.7.2.3.2 Building of Overhead Power Cables

Reinforced concrete poles and metal towers for high-voltage lines, as well as metal strips providing lightning protection for wooden poles, shall be earthed as appropriate.

Towers for low-voltage power lines and wooden poles for high-voltage power lines without metal earthing strip need not be earthed nor do they required any other protective measures.

At the points of crossing of overhead power lines, and at places where they come close to structures of various kinds, safety height and distance shall be provided as appropriate. Table 7.6 gives values of such distances to be ensured. In cases where the Table 7.6 does not specify any particular safety height, the specified value of safety distance shall also be used as the safety height.

Table 7.6: Minimum safety height and distance from nearby locations/structures

Location – structure	Safety height (m)	Safety distance (m)
- Inaccessible location	4	3
- Location inaccessible to vehicles	5	4
- Location accessible to vehicles:		
- HV power lines of less than 110 kV	6	5
- LV power lines	5	4
- Buildings		
- Inaccessible locations (roof, chimney, etc.)		
- HV power lines of less than 110 kV (above the ridge)	-	3
- Permanently accessible places (terraces, balconies, scaffolding, etc.):		
- HV power lines of less than 110kV	5	4
- LV lines	2.5	1.25
- With inflammable roofing		
- HV power lines of less than 110 kV	12	5
- Settlements		
- HV power lines of less than 110 kV	7	-
- LV power lines	5	-
- Sports grounds		
- HV power lines of less than 110 kV (exceptionally)	-	12
- Woods and trees		
- HV power lines of less than 110 kV	-	12
- LV power lines	-	1
- Regional, local, and less important roads:		

- HV power lines of less than 110 kV	7	10 (5)
- LV power lines	6	-
- Main roads:		
- HV power lines of less than 110 kV	7	20 (10)
- LV power lines	6	2
- Motorways:		
- HV power lines of less than 110 kV	7	40 (10)
- LV power lines	6	-
- Motorways - running in parallel at a section more than 5 km in length:		
- HV power lines of more than 35 kV	-	10
- HV power lines of less than 35 kV	-	50
- Rivers suitable to rafts (above highest water level)	7	-
- Navigable rivers and canals	15	10
- Navigable rivers and canals - parallel running at a section of more than 5 km in length		
- HV power lines (from river banks)	-	50
- Bridges and similar structures	-	5

For power lines of 220 kV nominal voltage, safety heights and distances shall be increased by 0.75 m, while for those of 400 kV nominal voltage by 2 m with regard to the values specified for 110 kV lines.

When a HV power line of less than 110 kV passes above another HV power lines of less than 110 kV, the safety height shall amount to 2.5 m, while the safety distance to 1.0 m.

When a HV power lines of less than 110 kV passes above a LV power line, the safety height shall amount to 2.5 m, while the safety distance to 2.0 m.

At locations where an overhead power line passes above a telecommunication line, the safety height between the lowest wire of the power line and the highest wire of the telecommunication line shall amount to as follows:

- HV power lines of 400 kV 5.5 m
- HV power lines of 220 kV 4.0 m
- HV power lines of 35 kV to 110 kV 3.0 m
- HV power lines of 1 kV to 35 kV 2.5 m
- HV power lines of 250 V to 1 kV 2.0 m
- LV power lines of less than 250 V 1.0 m

At the places where telecommunication and power lines run close to each other, the horizontal distance between the nearest wires shall be equal to the height of the higher poles increased by 3 m.

When gas pipelines, oil pipelines, steam heating pipes, and similar installations are laid on the ground, the safety height and distance shall in case of LV power lines be 2.5 m, and in case of HV power lines of less than 110 kV 8.0 m. In case of parallel running, the safety distance shall not be less than the height of the poles increased by 3 m.

Overhead HV power lines must not cross airports nor come closer than 1,000 m to the runway, or cut across its direction at a distance of less than 3,000 m.

The safety height between the wires and the top of the rails of an electrified railway shall not be less than 12 m, and the horizontal distance between a pole and the rail not less than 15 m.

Selection and calculation of poles, as well as construction of foundations placing the poles shall comply with relevant regulations.

2.2.7.2.4 Quality of Execution

The contractor shall ensure adequate quality of the executed works as specified by the design, relevant regulations, and appropriate technical conditions.

In due time prior to commencement of the works, the contractor shall submit to the engineer all the evidence on quality of the materials he intends to use.

All equipment and machinery employed to execute the works shall be certified, and their capacity shall fulfil the requirements as specified by the design, relevant regulations, and technical conditions.

The contractor must not commence to perform the works until he has obtained the engineer's approval.

2.2.7.2.5 Quality Control of Execution

After completion of execution of cable ducts and other construction works, it shall be checked whether the conduits are passable.

After completion of cable shafts the execution of inlets (smoothed concrete), drainage, and protective mesh against rodents shall be checked.

During laying the power cables, resistance, breakdown strength, and insulation resistance shall be measured. The measurements shall be carried out in accordance with applicable technical regulations and codes. Measurements can only be performed by professional and authorized companies. A written report including all the results shall be worked out for any measurement. The report shall indicate whether the measurement results are acceptable or not. For all the reports a record shall be kept.

2.2.7.2.6 Measurement and Take-Over of Works

The executed works shall be measured in accordance with the general technical conditions and calculated in appropriate units of measure.

All the quantities shall be measured by actually executed scope and type of works within the limits of measurements specified in the design.

2.2.7.2.7 Final Account of Works

The bases for the final account of the works are specified in the general technical conditions.

All the quantities of the executed works shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a perfect completion of the works. The contractor shall have no right to claim any extra payment.

2.2.7.3 TELECOMMUNICATION LINES

General

Telecommunication (TC) lines comprise:

- overhead TC lines,
- buried TC cables, and
- telephone cable ducts.

For the construction of TC lines, appropriate design and technical documents shall be prepared in accordance with the instructions and regulations concerning design and construction of such systems, and adequate approvals shall be obtained.

The route of a TC line shall be adjusted to the existing condition of different utility lines within the public traffic area, and shall comply with the specified requirements.

TC lines must not be placed under the carriageway. However, when such a crossing is unavoidable, it shall be carried out in such a way that the cables can be replaced without demolishing the pavement. A TC cable shall be laid into a previously constructed cable duct.

2.2.7.3.1 Description

2.2.7.3.1.1 Overhead Telecommunication Line

The construction of an overhead telecommunication line comprises the following:

- staking out,
- supply and erection of supporting items such as poles, equipment, insulators, protective devices, including any earthwork as may be required,
- supply, laying, and fixing of wires and other accessories, and
- entry into the cadastral register of public utility lines.

An optimum solution should allow for the following:

- an easy access to the overhead TC line at any time,
- the length of an the overhead TC line as short as possible,
- a simple connection of branches.

The above-mentioned conditions will be fulfilled, if an overhead TC line is built along a road or railway.

2.2.7.3.1.2 Buried TC line

The placing of a buried TC cable includes the following:

- staking out,
- supply and laying both cable and cable protective elements, including any such earthworks as may be required, and
- entry into the cadastral register of public utility lines.

2.2.7.3.1.3 Telephone Cable Ducts

Telephone cable ducts comprise the following:

- conduits for cable ducts,
- telephone cables, and
- cable shafts (manholes).

For telephone cable ducts particularly conduits made of thermoplastic material, smooth or ribbed (deformed) are suitable.

The construction of telephone cable ducts shall include the following:

- staking out,
- all the necessary earth works (excavation and backfilling of trenches, arrangement of the ground),
- preparation of substrate,
- supply and placing conduits and construction of shafts (manholes),

- supply, placing, and connecting cables, and
- entry into cadastral register of public utility lines.

Telephone cable ducts should

- be preferably placed in footways or surfaces not accessible to vehicles,
- have the smallest possible number of shafts (manholes), and
- be placed at certain distance from other underground lines.

2.2.7.3.2 Types of Materials

The following items are used for TC lines:

- conduits,
- cable shafts (manholes),
- cable shaft covers, and
- cables.

2.2.7.3.2.1 Conduits

The following types of conduits can be used:

- PC 110 - polyvinyl chloride pipe of external diameter 110 mm
- PC 125 - polyvinyl chloride pipe of external diameter 125 mm
- PC 110-EZ – polyethylene pipe of external diameter 110 mm, inner wall smooth, outer wall profiled
- PC 125-EZ – polyethylene pipe of external diameter 125 mm, inner wall smooth, outer wall profiled
- PE 110 –polyethylene pipe of external diameter 110 mm
- PE 125 – polyethylene pipe, external diameter 125 mm.

PC or PE conduits for cable ducts are of circular cross-section, made of hard PC or PE material of adequate mechanical and other properties. PC conduits shall be yellow, while PE ones black.

The following conduits of small diameter can also be used:

- PE 40 – polyethylene pipe, external diameter 40 mm,
- PE 50 – polyethylene pipe, external diameter 50 mm,
- 2x PE 50 – double polyethylene pipe – coupled, diameter 2x50mm.

PE conduits of small diameter are inserted into the conduit of existing or new TC cable duct, or are placed directly into the ground. Into these conduits, TC cables are inserted.

For conduits, which are placed directly into the ground, the tensile modulus of elasticity (E) measured on both product and raw material, shall amount to less than 800 N/mm^2, while for conduits, which are inserted into cable duct conduits, it shall amount to more than 800 N/mm^2.

All the conduits shall be adequately marked to indicate the dimensions of conduits or combinations, the name of the producer, year of production, and length (designation per running metre).

To coupled conduits of 2x50 mm the same requirements and dimensions apply as to a single conduit of 50 mm.

2.2.7.3.2.2 Cable Shafts (Manholes)

Cable shafts (manholes) can be made of

- thermoplastic material,
- cement concrete pipes of circular cross-section, or
- cement concrete of square cross-section, either cast in situ or prefabricated.

The size of cable shafts depends on both type and number of pipes or cables.

2.2.7.3.2.3 Cable Shaft Covers

Three types of cast-iron covers can be used: for 50 kN, 125 kN, and 400 kN of point loading.

Covers of 50 kN bearing capacity can only be used for shafts on green surfaces inaccessible to vehicles.

Covers of 125 kN bearing capacity can be used for shafts on surfaces where minor loading is expected (footways).

Covers of 400 kN bearing capacity shall be used for shafts on areas where major loading is expected (roadways).

2.2.7.3.2.4 Cables

For local connections, TK 59... cables can be used, while TD 59... and optical cables are suitable to interurban connection.

2.2.7.3.3 Quality of Materials

Adequate quality of the material to be placed is specified by the design, regulations, and appropriate technical conditions.

The contractor shall in due course prior to commencement of the works submit to the engineer adequate evidence on the quality of all materials he intends to introduce.

The contractor may commence to place the material only after having obtained the engineer's approval.

The quality of materials shall be verified on the basis of the technical data for the particular product, and of the accompanying documents such as form of delivery, certificates, declarations, etc.

Prior to laying the cables, the latter shall be tested on drums: measurements of weakening by means of OTDR device shall be executed, as well as insulating resistance and breakdown resistance shall be measured.

2.2.7.3.3.1 Method of Execution

2.2.7.3.3.2 Overhead Telecommunication Line

Overhead TC lines may be executed either by means of wires or by self-supporting cables.

The shaping of pole pits for overhead TC lines depends on the type of material in the ground and the height of the poles. In materials of class 3, 4, and 5, as per classification indicated in 2.2.2.1.3.1 of these technical conditions, the following shapes of pole pits shall be provided:

- cylindrical shape for poles of 6 – 7 m height,
- rectangular shape for poles of 8 – 12 m height, and the pit shall be provided with a step,
- rectangular shape for poles higher than 12 m, and the pit shall be provided with two steps.

The required depth for burying the poles is indicated in Table 7.7.

Table 7.7: Required depth of burying the poles for overhead TC lines

Material category	Pole height [m]						
	6	7	8	9	10	11	12
3	1.4	1.5	1.7	1.9	2.1	2.2	2.3
4	1.2	1.3	1.5	1.7	1.8	1.9	2.0
5	0.9	1.0	1.2	1.3	1.4	1.4	1.5

Once placed in the pits, the poles shall be made to stand firm by backfilling the pits with excavated material which layers shall be compacted either manually or by using compacting machines. The conical extra height shall reach 20 cm above the level of the ground.

Equipment, insulators, protective elements, and wires shall be placed in accordance with the directives specified in the design.

At terminal supports and at places where an overhead TC line descend into the ground (buried TC line), overvoltage arresters and suitable earthing shall be provided.

Along motorways and roads reserved exclusively to power-driven vehicles, overhead TC lines must not be built at a distance of less than 20 m from the edge of the carriageway. When such lines are built along other types of roads, such a distance shall not be less than the height of the poles.

In most unfavourable conditions, the safety height from the ground to the lowest wire of an overhead TC line must not be less than 5 m.

TC lines on bridges, overpasses, viaducts, and in tunnels shall be executed by laying the cables in specially designed ducts. If no such ducts are available, the cables shall be laid along the external side of the bridge, overpass, or viaduct, or in the tunnel sidewalk, and protected as appropriate.

If an overhead TC line runs next to another similar line, the spacing between the two shall not be less than 15 m.

If an overhead TC line runs next to a power transmission line, the horizontal distance between the nearest wires of such lines shall be at least equal to the height of the poles, increased by 3 m. If such a distance cannot be provided, the minimum distance of 1 m in case of 250 V against the ground, and 4 m for voltages in excess of 250 V against the ground, will be allowed.

When TC lines cross roads, railway tracks, rivers, other TC lines, and, exceptionally, low-voltage power lines (of 250 V against the ground), special measures that will increase the safety of such a crossing shall be taken. It is not allowed, however, for overhead TC lines to cross high-voltage power lines.

The safety height between the lowest wire of an overhead TC line crossing the road, and the surface of the road, ensuring free traffic flow, shall, in most unfavourable conditions, amount to:

- at least 7.0 m for motorways, main roads, and regional roads,
- at least 4.5 m for other roads.

Where an overhead TC line crosses another such line, the minimum safety distance between the lowest wire of the upper line and the highest wire of the lower line shall be 0.6 m.

When an overhead TC line crosses navigable rivers, canals, storage reservoirs, and other such water areas, the safety height between the lowest wire of such a line and the surface of the water shall be provided to ensure safe navigation of the vessels even at the time of the highest water level.

In addition to providing such safety heights as will be appropriate, attention should be paid to the angle of crossing and the length of the crossing span as well.

The most favourable angle of crossing is 90°, while the minimum one is 45°. The maximum allowed span is 60 m. If the span of crossing is more than 60 m, the crossing shall be carried out by means of a buried cable.

With the crossing span, the following shall be taken into consideration:

- that the horizontal distance between the supporting structure of an overhead TC line and the nearest power line wire is not less than 5 m; such a condition, however, needs not be fulfilled when the level difference between the nearest wire of the two lines is at least 10 m;
- that the horizontal distance between the support of a power line and the nearest wire of an overhead TC line is not less than 2 m.

Where overhead TC lines pass under power lines, the safety distance between the lowest wire of the power line and the highest wire of the overhead TC line shall be:

- for 400 kV voltage 5.5 m,
- for 230 kV voltage 4.0 m,
- for 35 kV to 110 kV voltage 3.0 m,
- for 1 kV to 35 kV voltage 2.5 m,
- for 250 V to 1 kV voltage 2.0 m,
- for voltage less than 250 V 1.0 m.

2.2.7.3.3.3 Buried Telecommunication Line

The width and shape of the ditch for TC cables will depend on the material in the ground and the number of cables:

- in case of 1 or 2 cables, the ditch shall be 15 – 25 cm wide;
- with each additional cable, the trench width shall be increased by 5 cm.

At locations where the design specifies execution of cable couplers, a cable shaft shall be provided.

The depth of the ditch will depend on the type of cable and the material in the ground. As a rule, trenches shall be 1 m deep. When running through settlements and across arable land, the ditches shall be at least 1.2 m deep, if they do not incorporate mechanical protection of cables and there are no devices buried in the ground.

Any construction of passages under roads and across canals and bridges shall be completed prior to laying TC cables into the ditch.

As a rule, TC cables shall be laid along the middle of the ditch. The bottom of the ditch shall be covered with a slightly convex layer of non-compacted mineral aggregate 0/4 mm of 10 cm thickness.

When backfilling the ditch, the thickness of the mineral aggregate 0/4 layer above the cable shall amount to at least 10 cm, if the latter is protected, or 15 cm, if no protection is provided.

The remaining part of the ditch may be filled up with the material that has been excavated from the ditch, by placing such backfill material in layers of 15 to 20 cm in thickness. The first layer must not include pieces of brick, greater-sized stones, or other coarse-grained material, and shall be placed manually and compacted slightly. Outside settlements, where cable protection is generally not foreseen, the first layer must not be thinner than 15 cm. The subsequent layers shall be spread and compacted manually or mechanically.

The cable covering material shall be placed over the mineral aggregate 0/4 mm layer. For cable protection, PVC angles shall be used, and a plastic tape of yellow colour with an inscription “WARNING – TC CABLE” shall be laid.

Protective conduits fir buried TC cables shall be laid in the following cases:

- when such cables intersect public roads, railway tracks, and canals,
- when the minimum required distance from a particular structure cannot be ensured,
- when coming near to electric power lines and facilities, and when crossing power or TC cables.

The minimum clear distances of TC installations from nearby lines, devices, and structures are indicated in Table 7.8.

Table 7.8: Minimum clear distance between a TC line from nearby utility lines, devices, and structures

Type of utility line, device, or structure	Minimum clear distance of TC line [m] Parallel course	At Crossing
- Power cable:		
- less than10 kV	0.5	0.5
- less than 35 kV	1.0	0.5
- more than 35 kV	2.0	0.5
- Water supply (pipe diameter up to 200 mm), sewage system, hot water supply, gas conduit	1.0	0.5
- Supporting structure of contact line and traffic light	10.0	-
- Supporting structure of overhead TC line	2.0	-
- Control line of buildings in settlements	0.6	-
- Tramway track	2.0	1.0
- Toe of railway, road, and motorway fill	5.0	-
- Piping and tank with inflammable and explosive fuel	1.5	-
- TC line duct and shaft (manhole)	0.5	0.15
- Power line supporting structure:		
- 1 kV: - 1) without mechanical protection	0.8	-
- 2) with mechanical protection	0.3	-
- more than 1 kV, without direct earthing:		
- unearthed wooden supporting structures	0.8	-
- concrete and steel supporting structures	0.5	-
- more than 1 kV, direct earthing	15.0	-

A cable shall be protected by being placed into plastic conduits or semi-conduits and by applying external concrete lining. The length of the conduit on each side of such a crossing or place of approaching must not be less than 0.5 m.

When a cable runs parallel with or comes near an underground or surface structure, such spacing as specified in Table 7.8 shall be taken into consideration.

Parallel course of TC and power cables shall be avoided. However, when this is not possible, the spacing between such cables shall not be less than specified (depending on the type of power cables), and the regulations concerning protection of TC lines against the impacts of power lines shall also be complied with. When a cable route crosses an underground structure, the spacing between the two shall be 0.5 m, while in the case of TC cable ducts, which require adequate protection, it shall be 0.15 m.

When a cable crosses a road or railway track, the most suitable angle of crossing is 90°. If such an angle cannot be provided, the crossing may be carried out at another angle, which, however, must not be less than 45°. When effecting such a crossing, cables shall be protected as appropriate.

2.2.7.3.3.4 Telecommunication Cable Ducts

Cable ducts form a network of underground conduits made of plastic material and placed in groups of 1x2, 2x2, etc. in an open trench. Conduits shall be laid into a mineral aggregate mixture of 0/4 mm and backfilled with the same mixture, both in layers of 10 cm below and above the conduit edge; the remaining backfilling shall be executed with excavated material up to the top; this shall be done in compacted layers. The minimum distance from the top of the upper conduit to the ground level shall amount to 0.5 m, while it shall be 0.8 m to asphalt traffic surfaces.

Certified PVC conduits of dimensions 110/103.6 mm and PEHD pipes of dimensions 110/97.6 mm shall be used. To keep equal pipe spacing, spacers shall be foreseen. They shall be fixed in accordance with the manufacturer's instructions.

In case where distances between the upper conduit and the ground level are smaller than specified, cement concrete lining shall be applied to the conduit exterior. If this distance is less than 30 cm, the upper layer shall be executed of reinforced concrete, and conduits of greater wall thickness shall be introduced.

Where crossing the road, the upper part of the trench shall be cast using cement concrete C 8/10 in thickness of 30 cm. Above the conduits, a PVC tape of yellow colour "WARNING – TC CABLE" shall be placed (1-2 tapes, 30 cm above the conduits).

Cable ducts executed in such a manner enable quick and simple replacement of existing cables, a simple increase of the network capacity, and eventual repairs without repeated digging up the ground surfaces.

The following pipes may be used to construct cable duct network:

- PC 110 – a polyvinyl chloride pipe of external diameter 110mm,
- PC 110 - EZ a polyethylene pipe of external diameter 110 mm (smooth inner wall outer wall profiled).
- PC 125 - polyvinyl chloride pipe of external diameter 125 mm
- PC 125-EZ – polyethylene pipe of external diameter 125 mm, inner wall smooth, outer wall profiled.

The pipes shall be produced in compliance with relevant regulations and codes. In addition, they shall be in accordance with the standard DIN 8062 for pipes of non-softened polyvinyl chloride (PVC-U), and with the standards DIN 16961, DIN 8062, DIN 8074, and NFC 68-171 for polyethylene pipes (PE).

Approaching and crossing of TC ducts with other underground utility lines shall be carried out at the specified spacing and angle. The minimum admissible spacing between a TC cable duct and a power cable shall amount to:

- at approaching:
  - a LV cable 0.5 m
  - a HV cable 1.0 m
- at crossing with LV and HV cables (angle of crossing 45° - 90°):
  - 0.3 m without any protective measures.

Protective measures shall be carried out at a length of at least 0.5 m on both sides of the crossing.

The distance between the TC cable duct and a transmission line mast shall amount to at least 10 m; where such a distance cannot be ensured, a minimum distance of 1 m shall be provided in settlements for a transmission line of less than 35 kV.

Distances of TC cable ducts from other installations depend on dimensions and depth of the latter. In general they amount to:

-	from sewage system	approaching	1.0 m
		crossing	0.5 m
-	from water supply	approaching	1.0 m
		crossing	0.5 m
-	from gas conduit (1 to16 bar)	approaching	0.4 – 0.6 m
		crossing	0.4 m
-	from insulating tape	crossing	0.3 m.

2.2.7.3.3.5 Cable Shafts

In accordance with the cable ducts, cable shafts shall also be foreseen at locations where TC cables branch off, or at locations of cable couplers. The shafts serve for coupling the cables, drawing the cables into conduits, and eventual installation of cable equipment.

According to the instructions by local administration the dimensions of cable shafts depend on the number of conduits and amount to from 1x1.8x1.9 m (1.5x1.8x1.9 m) for the capacity of up to 4 conduits, to 1.8x2.5x1.9 m for the capacity of 6 to 12 conduits and above. For minor conduit capacities, or for transitional cable shafts, the dimensions can also be 1.2x1.2x1.2 m. Smaller cable shafts from cement concrete pipes of Φ60 cm and Φ80 cm may be used as auxiliary shafts.

Three types of cast-iron covers can be used: for 5 kN, 12.5 kN, and 40 kN of point loading.

Covers of 5 kN bearing capacity can only be used for shafts on green surfaces inaccessible to vehicles.

Covers of 12-5 kN bearing capacity can be used for shafts on surfaces where minor loading is expected (footways).

Covers of 40 kN bearing capacity shall be used for shafts on areas where major loading is expected (roadways).

The shaft covers shall be marked with the inscription “TELEPHONE”.

2.2.7.3.4 Quality of Execution

The contractor shall ensure adequate quality of the executed works as specified by the design, relevant regulations, and appropriate technical conditions.

In due time prior to commencement of the works, the contractor shall submit to the engineer all the evidence on quality of the materials he intends to use.

All equipment and machinery employed to execute the works shall be certified, and their capacity shall fulfil the requirements as specified by the design, relevant regulations, and technical conditions.

The contractor must not commence to perform the works until he has obtained the engineer’s approval.

2.2.7.3.5 Quality Control of Execution

2.2.7.3.5.1 Cable Ducts from PEHD Conduits of Small Diameter

After completion of construction of cable ducts and other works, the quality control of pipes of small diameter shall be carried out.

The following shall be tested:

- passing capacity,
- flatness,
- curvature,
- air tightness, and
- cleanliness of pipes.

As a rule, the quality of the executed cable duct system shall be verified by means of a calibrator.

Calibration of pipes shall be carried out between cable shafts at a length of approximately 500 m, while on other routes this shall be performed at the length of the piping.

The testing shall be executed in compliance with the German Telekom regulation ZTV-FLN 40.

2.2.7.3.5.2 Cable Ducts from PVC Smooth and Deformed Conduits

After completion of cable duct system and other construction works, the quality of the executed cable ducts, i.e their passing capacity, shall be tested.

2.2.7.3.5.3 Cable Shafts

After completion of cable shafts the execution of inlets (smoothed concrete), drainage, and protective mesh against rodents shall be checked.

2.2.7.3.5.4 Cables

After laying the power cables, loop resistance, weakening, breakdown strength, and insulation resistance shall be measured.

In optic cables weakening measurements shall be carried out by means of an OTDR measuring device.

Measurements shall be carried out in accordance with applicable technical regulations and codes. Measurements can only be performed by professional and authorized companies. A written report including all the results shall be worked out for any measurement. The report shall indicate whether the measurement results are acceptable or not. For all the reports a record shall be kept.

2.2.7.3.6 Measurement and Take-Over of Works

The executed works shall be measured in accordance with the general technical conditions and calculated in appropriate units of measure.

All the quantities shall be measured by actually executed scope and type of works within the limits of measurements specified in the design.

2.2.7.3.7 Final Account of Works

The bases for the final account of the works are specified in the general technical conditions.

All the quantities of the executed works shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a perfect completion of the works. The contractor shall have no right to claim any extra payment.

2.2.7.4 EMERGENCY CALL

General

The emergency call system is intended for drivers on motorways as well as for the maintenance personnel to establish communications between certain locations along the motorway and the motorway or its branch. In addition, safety and life of drivers on the motorway also depends on the functioning of this system. Therefore, technical solutions shall be such as to ensure perfect functioning of the emergency call system, notwithstanding different environmental conditions. The system is intended for the users, who need help in case of any kind of accident or trouble of vehicles.

For the emergency call system construction, adequate design documents shall be worked out, and approvals by the authorities shall be obtained. The telecommunication route shall be in accordance with the existing condition of different installations in the area of a public road, as well as with the specified conditions.

2.2.7.4.1 Description

2.2.7.4.1.1 Composition of the Emergency Call System

The emergency call system (ECS) is composed of the following equipment and installations with the following requirements:

- Six-conduit cable duct of PEHD conduits of diameter 50 mm (3 pipes 2x50 mm), running left from the line of the right marginal strip or in a bridge, as well as standing and installation shafts with mounted membranes, placed in the shoulder or emergency niches at suitable distance from infrastructural installations. The shafts shall be located immediately after the beginning of the niche, so that a vehicle cannot drive onto the shaft. In front of the noise barrier, the post shall be located at the inner, i.e. road side. For the needs of placing the road signalling system at passages over the central reserve, bridging shafts with steel covers of 50 kN capacity shall be foreseen. If power supply is to be provided, additional PVC pipe of Φ125 mm with separated shafts spaced at approximately 250 m shall be designed.
- The newly built communication medium (cable system) is used to connect emergency call posts with the communication centre, and for other purposes.
- The system shall be of sufficient capacity to allow a simultaneous transmission (transit and local level) of the information technology, signalling, and control of devices installed on this particular motorway section via optical cable connections.
- The technological part of the control-communication centre shall be a technological whole of the emergency call system. The design shall provide a possibility of construction in stages if this is imposed by actual needs.
- The emergency call system on this particular motorway section shall be compatible and made uniform with already built emergency call devices on the entire area of the locally authorized communication centre.
- A transfer of all the functions of the local communication centre to the higher ranked control-communication centre as well. At those centres it is obligatory to foresee the supervision of all the emergency call posts on a single working station.
- Emergency call posts with standing locations located along a motorway shall be numbered in compliance with the design.
- A power supply system ensuring two-sided (substitutive) supply shall be located at power supply points specified by the designer. Feeding sections shall not be longer than 10 km.

2.2.7.4.1.2 Environmental Conditions

An emergency call system shall be so designed and executed as to function, irrespective of normal and predictable abnormal environmental conditions, perfectly, reliably, and safely under the following conditions:

- in the temperature range of –25°C to + 60°C,
- at air relative humidity up to 98%,
- at vibrations in the frequency range of 10Hz to 150Hz (according to EN and ETSI standards),

- impact of lightning: the lightning protection system shall be selected for the entire emergency call system with regard to the frequency of strokes on the area under consideration – a colour enclosure of a iso-cheravical chart shall be a constituent part of the design. On the basis of both iso-cheravical and statistic information on the lightning action, as well as of the specific resistance of the ground on the subject area, the designer shall assess the need of probability calculations of lightning strokes, such calculations to be constituent parts of the design,
- the effect of commutation phenomena, of foreign electro-magnetic fields of high-voltage installations, and the influence of electro-static discharges,
- the effect of stray currents,
- the impact of corrosive ground.

Prior to commencement of designing the emergency call system on certain motorway section, for that particular section it is mandatory to check the types and extents of the environmental impacts in order to select optimum technical solution of the entire emergency call system.

2.2.7.4.2 Types of materials

The following materials are indispensable to carry out an emergency call system:

- conduits
- cable shafts
- cables and cable clamps
- posts
- earthing strip (25 x 4 mm FeZn).

2.2.7.4.2.1 Conduits of Small Diameter

2 x PE 50 pipes may be used, i.e. two coupled polyethylene pipes of external diameter 50 mm each.

PE pipes of small diameter can be inserted into the pipes of an existing of new telecommunication cable ducts, or laid directly into the ground. They are intended for installing telecommunication cables.

For conduits, which are laid directly into the ground, the tensile modulus of elasticity (E) measured on both product and raw material, shall not exceed 800 N/mm^2. For the conduit, however, inserted into a cable duct, it shall amount to more than 800 N/mm^2.

2.2.7.4.2.2 Cable Shafts

The following cable shafts may be used to built an emergency call system:

- installation cable shaft 210x80x80 cm
- standing cable shaft 210x120x80 cm
- auxiliary cable shaft Φ80 cm.

2.2.7.4.2.3 Cables

Cables TD 59 10x4x0.9 GM-4 kV, TD 59 5x4x0.9 GM-4 kV, and optical cable TOSM 03 6x8 II/III 0.36/0.24x3,5/17 CMAN may be used.

2.2.7.4.3 Quality of Materials

Adequate quality of the material to be placed is specified by the design, regulations, and appropriate technical conditions.

The contractor shall in due course prior to commencement of the works submit to the engineer adequate evidence on the quality of all materials he intends to introduce.

The contractor may commence to place the material only after having obtained the engineer's approval.

The quality of materials shall be verified on the basis of the technical data for the particular product, and of the accompanying documents such as form of delivery, certificates, declarations, etc.

Prior to laying the cables, the latter shall be tested on drums: measurements of insulating resistance and breakdown resistance shall be carried out.

2.2.7.4.4 Specific Requirements Concerning Emergency Call System

2.2.7.4.4.1 Requirements Concerning Emergency Call Posts

Emergency call posts shall comply with the following requirements:

- They shall be so placed as to allow the user to view perpendicularly to the traffic flow direction during calling.
- The casing of an emergency call post shall be resistant to salt water, road strewing materials, and atmospheric actions such as moisture, rain, snow, sunshine, low temperatures, etc. Upon snow ploughing there shall be no displacement of or damage to an emergency call post as possible consequence of the dynamical force of slush. The emergency call users shall also be protected from the slush hazard.
- The post casing shall be so designed and placed as to provide protection when touching the post under voltage in case of lightning stroke. The same also apples to the impacts of high-voltage installations.
- The performance of an emergency call post shall comply with the provisions of the Rulebook of electromagnetic compatibility.
- All spots, which a user may come into contact with, shall be protected against excessive touching voltage. Therefore, the emergency call earthing system, the lightning protection, the emergency call post casing structure, and the surroundings shall be suitably arranged.
- The standing place at an emergency call post shall be so protected and arranged as to prevent inadmissible step voltage upon lightning stroke into the emergency call post.
- Each post casing shall be equipped with a red key (with bilingual text), serving to establish connection with the communication centre, and with adequate light signalling as well as with the identification designation of the post.
- Emergency call posts shall be connected with the communication centre in a full duplex connection.
- Upon establishing the communication, the number of calling post shall appear on the operator’s screen at the communication centre; at the communication centre as well as on the emergency call post, both acoustic and light signal shall be released. After the operator has responded the call, an understandable and faultless speaking communication shall be established.
- The communication cut shall only be possible on the side of the operator. If an emergency call from some other post is carried out when the connection between the communication centre and the emergency call post is established, then the number of calls shall appear on the operator’s screen. The emergency call system shall be capable to register simultaneously at least four calls from different posts. The communication centre shall allow the operator to interrupt the first call, to check by speaking the waiting calls, and to re-establish the connection with the first calling post.
- All the emergency call posts shall be so marked as to make clear the user how to use the particular post (SOS mark), where the post is located (number). At night, the marking shall be visible at a distance of at least 500 m in both driving directions.
- The emergency call system shall enable a physical distance of up to 300 m between posts on the pair of the cable connecting the posts of the same pair.
- The emergency call system shall also allow a service communication between individual posts, as well as between the posts and the communication centre. This shall, however, be only accessible to the maintainers of the system.
- The locations of the emergency call posts shall particularly enable the safety of the traffic participants during calling (protection with a safety railing), and shall be harmonized with the foreseen locations of structures and facilities along the road such as resting places, inside noise barriers, before/after viaducts/bridges, at motorway splits, before tunnel and cut-and-cover portals, etc.

2.2.7.4.5 Communication Centre

2.2.7.4.5.1 Requirements Concerning Buildings

The building, where electric and electronic equipment for the emergency call system is foreseen to be installed, shall be equipped with the lightning protection system (LPS) of minimum efficiency of

98%, which corresponds to the protective class I in case of either direct or indirect lightning stroke. The LPS shall prevent damages within the building, which might arise due to the following reasons:

S1 - step voltage and touch voltage due to direct lightning strokes

S2 - fire, explosion, mechanical and chemical impacts due to direct lightning strokes

S3 - over-voltage on equipment due to direct lightning strokes

S4 - over-voltage on equipment due to indirect lightning strokes.

In view of designing the lightning protection system (LPS), the requirements concerning a emergency call post and the communicaton centre are absolutely the same, provided that all relevant regulations and standards, inclduing their supplements, are considered.

2.2.7.4.5.2 Requirements Concerning Electric/Electronic Equipment

The communication (control) centre, which shall, as a rule, be located in the building of the motorway base, shall be equipped with devices and installations that enable communication with persons standing at emergency call posts, with devices for power feeding of the system, and devices for indication of established and waiting calls. Where motorway construction in stages is foreseen, connection of sections to the existing motorway toll bases in stages shall be designed as well.

Electric parameters for signals with emergency call posts, weakening of the signal, the frequency of the calling signal, the alternative feeding voltage at the communication centre and on power supply locations shall be so specified as to allow reliable and safe operation of the emergency call system in the particular environmental conditions, i.e.:

- the maximum voltage to be used for the emergency call system power supply shall not exceed 400/230 V;
- the communication centre shall be able to perform an automatic control over the emergency call posts; any possible defect shall be immediately announced to the operator (an information on the reason of the defect and the number of the defected post should be sufficient);
- the emergency call shall release a signal at the communication centre, which shall last until the operator responds; in case of a call from an emergency call post, adequate identification appears on the post arrangement scheme, helping the operator to establish quickly the location of the calling post;
- the emergency call system of the new motorway sections shall be equal to that of the existing motorway section;
- when required by the client, the supplier of the emergency call system shall submit protocols and certificates proving a faultless functioning of the system and compatibility of that system with other systems of the traffic control, which are also situated at the communication centre;
- the communication centre shall be designed in such a manner that an operator without higher education, however adequately accustomed, can control all the necessary operations.

2.2.7.4.6 Power Supply System

2.2.7.4.6.1 Power Supply System Design

Power supply to the emergency call system shall be, in principle, arranged from an own or public low-voltage network via the communication centre, or from power supply stations to individual emergency call posts by means of the SELV system.

The power supply unit at the communication centre shall ensure continuous feeding of the central and of the control board at least 6 hours after the network voltage cut-off, and the connection to eventual existing central system of continuous power supply in the building shall be considered (quality in accordance with the IEC for Aku-batteries of class II – life time longer than 7 years). The same power supply system shall also be foreseen for a two-sided (substitutive) feeding of individual sections along the particular motorway.

All the devices and installation, i.e. the low-voltage cable, the power supply unit and connecting clamps at the emergency call posts shall comply with the applicable domestic and appropriate

European (EN) or international standards (ISO/IEC), provided that such standards are harmonized with the European ones.

2.2.7.4.6.2 Over-Voltage Protection of the Power Supply System

On sections, where preliminary checking of environmental impacts on the emergency call system show that the system is jeopardized due to over-voltage, protection from over-voltage shall be carried out on all the other components of the power supply system as well. The protection and the equipment to execute the protection from over-voltage on the entire power supply system shall be in accordance with the European (EN) or international standards (IEC), provided that such standards are harmonized with the European ones.

2.2.7.4.7 Transmission System

2.2.7.4.7.1 Requirements Concerning Copper Cable and Classification of Connections (Design, Laying, Installation, Measurements, Documents for Execution)

To ensure perfect and reliable connection between the emergency call posts and the equipment located at the communication centre, the cable structure shall be selected on the basis of preliminary checking of all the relevant environmental impacts.

The conception of the communication cable structure shall remain similar to that on existing motorway sections: at least 10 low-frequency star-quadruple cables of wire diameter 0.9 mm. The insulation of individual wire shall be of foamy polyethylene, coated with polyethylene skin, which shall ensure suitable breakdown strength core-sheath-sheath-earth, as well as adequate breakdown strength of the insulation between individual wires.

Both longitudinal and transverse water-tightness shall be ensured.

The cable structure shall be so selected as to provide sufficient protection from water penetration into the cable, from external electromagnetic fields, as well as the protection in compliance with performed calculations of environmental impact. The connections within a cable shall be classified as interurban (TD). The requirements concerning the cable shall comply with the current national-European (EN), international, or foreign national standards, those standards to be harmonized with the European ones. In addition, such standards shall specify a cable, whose performance is at least equal to those already laid along the motorway.

To ensure availability and reliability of the communications by means of cables, which comply with the abovementioned requirements, the following activities are required:

- to carry out continuity of connections in all the cable shafts by executing branches to both emergency call posts via cable clamp located in the post or on the branch clamp placed on the wall bracket below the post in the cable shaft;
- to foresee the termination of the cable by means of a separating cable clamp, which allows the separation between cables and the electronics in a post (network termination-NT);
- to protect cables behind the separating clamp by means of over-voltage protective devices (SPD-surge protection devices) in accordance with relevant standards;
- in each standing shaft, a cable spare of 3 m in both directions shall be ensured;
- in the installation shaft, where the cable clamp is located, a cable spare of approximately 2 m in both directions shall be ensured.

Designing, laying, and installation of an interurban cable shall be executed in compliance with the instructions to be provided, and technical conditions.

The constructed section of cable connections shall be in accordance with the instruction on checking the quality of the TT cables.

Measurements carried out on a completed cable system, and the as built design shall be carried out in compliance with the Instructions on the technical record of international cables, the Instructions for checking the quality of TT cables, adequate national and foreign regulations and standards, and Instructions for preparation of the underground cadastre of laid public utilities on electronic medium.

The measurements shall be executed from the beginning to the end of the cable connection, without connecting the emergency call post electronics to the pairs of cables (between NT points).

2.2.7.4.7.2 Protection of Transmission System from Environmental Impacts

All the preliminary checking the environmental impacts on the emergency call system shall be attached in writing to the building permit design and the execution design.

In specific cases such as presence of stray currents, measurements shall be carried out after completion of all the works on the road as well.

With regard to the results of checking environmental impact, protection from corrosive action of ground as well as protection from mechanical, chemical, and thermal damages to the cable shall be provided by the design. For the mechanical protection of the cable it is mandatory to foresee the construction of a cable duct using materials that complies with relevant regulations. When executing a cable duct, protection against lightning strokes in accordance with current Instruction on protection of telecommunication cables from atmospheric impacts shall be foreseen. In view of the results of checking environmental impact, protection of TC lines from atmospheric impacts, from effects of power devices at normal operation and when they are damaged, from impacts due to switching on HV power supply network, as well as from electrostatic discharges and effects of outer electromagnetic fields shall be provided, which shall be carried out at the communication centre and on all the emergency call posts. For such a protection it is also possible to work out a special design as a supplement to the basic emergency call system design. Upon conceiving the over-voltage protection it is required to pay regard to economical execution and to mending eventual defects on that protection.

For all the emergency call posts as well as for the communication centre it is obligatory – in accordance with the current national standards and technical regulations, European (EN), international, and foreign national codes – to provide an efficient earthing system, taking into consideration the degree of jeopardy.

Over-voltage protective elements and assemblies shall be selected to cover, individually or in combination, all the mentioned environmental electric impacts. All the integrated over-voltage protection components, their connections, and terminal elements shall have an adjusted electric breakdown strength and shall comply with relevant European (EN), international (ISO, IEC,) and national codes harmonized with the European ones.

It shall be indicated in the design that, after completion of the emergency call system, the as built-design is to be worked out, which shall be submitted to the client in both paper and electronic form, i.e.:

- a graphical inventory of cable ducts along the road
- a technical record on laid TC cable for the emergency call system
- measurements carried out on the TC cable of the emergency call system
- measurements carried out on the electronics in both emergency call posts and communication centre, including preparation of technical record
- checking the operation of the emergency call system
- a report on checking the emergency call system with regard to the environmental impacts, up to the terminal point (NT), including the over-voltage protection
- elaboration of the as-built design of the protection of the emergency call system against environmental impacts.

2.2.7.4.7.3 Testing of Cable Ducts

Passability and tightness of cable ducts shall be tested.

2.2.7.4.7.4 Optical System of Transmission

When planning a telecommunication scheme, the following parameters shall be considered:

- optical cables shall be laid into cable ducts on all motorway sections
- the system shall be of sufficiently high transmission capacity to enable easily the digital services, also for transmission of data and video signals
- the network shall be flexible and shall allow simple extending by the widest spectrum of possible interfaces
- the network shall so configured as to ensure the protection of transmitted information
- a possibility of application of the recent technologies shall be provided
- an integral remote supervision and control shall be ensured in accordance with the current standards and recommendations
- the design of the constructional part of the telecommunications shall be considered as well.

Toll stations, motorway bases and their branches, kajor bridges and viaducts, weather stations, traffic signalling devices, and rest places shall be linked to the optical cable.

The execution of an optical system includes laying and inserting a cable into PEHD conduits, installation, placing into structures, cable termination, connecting the cable in cable shafts at the foreseen locations, as well as measurements of parameters of the optical network.

An integral optical transmission system comprises the equipment, i.e. a cable (type, capacity, charge), couplers, distributors, FC/PC connectors, optical measurements including measurements of the cable, prior to and after laying, as well as final measurements, including preparation of a protocol on measurements carried out on the cable.

2.2.7.4.7.5 Technical Requirements Concerning an Optical Cable

An optical cable shall be a non-metal structure consisting of

- 48 optical fibres for the main transport direction,
- 24 optical fibres for branches leading from the main transport direction to essential locations, and
- 12 optical fibres serving to connect individual structures.

Nominal available cable lengths are 2,100 and 4,100 m.

The cable type shall meet the requirements of the current technical regulations.

The cable shall comply with the relevant European standards. SM fibres shall be optimized for optical windows II. and III.

On the entire motorway route, a cable of the same producer and of the same quality shall be installed. Equality or similarity to the already laid cables along the motorway shall be considered.

The bidder shall state the following geometrical, optical, and mechanical characteristics:

- cable structure and material type
- type of cable filler for moisture protection
- type of tubes
- number of tubes
- diameter of the tube
- number of fibres in the tube
- producer and type of the optical cable.

An installed cable shall meet the following requirements:

- maximum attenuattion at 1,310 nm	0.36 dB/km
- maximum attenuattion 1,550 nm	0.24 dB/km
- dispersion (1,285 – 1,330 nm)	3.5 ps/nm/km
- dispersion coefficient at 1,550 nm	17 ps/nm/km
- temperature range of operation	- 30 °C to + 80 °C

Optical fibres shall comply with the conditions indicated in the standard ITU-T G.652.D, while the colour marking with the regulation IEC 60304.

2.2.7.4.7.6 Other Requirements

In the bill of materials and works each individual working stage shall be specified. In the design all the items shall be realistically assessed.

For any material placed both design and bill of equipment shall indicated the relevant standard, and suitable certificate or statement shall be submitted for such material.

The design shall provide the minimum tolerated factor of break of the emergency call system (MTBF>3,000), and the maximum tolerated time of repairing the defects (MTTR<6h) for the system as a whole.

The system shall allow the application of remote interventions, the operation diagnostics, a peripheral extension, and the compatibility with the system already built.

The operation control shall be performed by means of a computer and standard interfaces, as well as by means of software selected by the client. In addition, a possibility of “manual” operation of the system shall be provided in any case.

The protection of the emergency call system against vandalism shall be ensured.

The guarantee (liability) period for the system and all of its components (except for the consumable material as specified by the design) shall amount to at least 3 years.

For cable ducts, the guarantee (liability) period shall be 10 years starting from the completion of successful testing.

Since attaining of the foreseen parameters shall be checked, the trial operation period amounts to at least 6 months.

2.2.7.4.8 Quality of Execution

The contractor shall ensure adequate quality of the executed works as specified by the design, relevant regulations, and appropriate technical conditions.

In due time prior to commencement of the works, the contractor shall submit to the engineer all the evidence on quality of the materials he intends to use.

All equipment and machinery employed to execute the works shall be certified, and their capacity shall fulfil the requirements as specified by the design, relevant regulations, and technical conditions.

The contractor must not commence to perform the works until he has obtained the engineer's approval.

2.2.7.4.9 Quality Control of Execution

After completion of construction of cable ducts and other works, the quality control of pipes of small diameter shall be carried out.

The following shall be tested:

- passing capacity,
- flatness,
- excessive curvature,
- air tightness, and
- cleanliness of pipes.

As a rule, the quality of the executed cable duct system shall be verified by means of a calibrator.

Calibration of pipes shall be carried out between cable shafts at a length of approximately 500 m, while on other routes this shall be performed at the length of the piping.

The testing shall be executed in compliance with the German Telekom regulation ZTV-FLN 40.

After completion of cable shafts, the execution of inlets (smoothed concrete), drainage, and protective mesh against rodents shall be checked.

During laying the power cables, resistance, breakdown strength, and insulation resistance shall be measured. The measurements shall be carried out in accordance with applicable technical regulations and codes. Measurements can only be performed by professional and authorized companies. A written report including all the results shall be worked out for any measurement. The report shall indicate whether the measurement results are acceptable or not. For all the reports a record shall be kept.

The quality of the emergency call system shall be verified in accordance with requirements indicated in the technical conditions.

Measurements shall be performed in compliance with current technical regulations and standards. Only registered companies may execute these activities. For all the measurements a written report including the results of measurements shall be prepared. From such a report it shall be evident, whether the results are acceptable or not. For all the reports a record shall be kept in writing.

2.2.7.4.10 Measurement and Take-Over of Works

The executed works shall be measured in accordance with the general technical conditions and calculated in appropriate units of measure.

All the quantities shall be measured by actually executed scope and type of works within the limits of measurements specified in the design.

2.2.7.4.11 Final Account of Work

The bases for the final account of the works are specified in the general technical conditions.

All the quantities of the executed works shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a perfect completion of the works. The contractor shall have no right to claim any extra payment.

2.2.7.5 PUBLIC LIGHTING

General

Public road lighting shall be built in compliance with appropriate design and technical documents and the requirement set in relevant approvals and permits of competent authorities.

The designed works in connection with public lighting system shall all be made to fit in with other utility lines incorporated in the road structure. All public lighting devices within the road structure shall be constructed in such a way that their repair is possible without demolishing the pavement and obstructing the carriageway maintenance.

2.2.7.5.1 Description

The building of public lighting includes the following:

- staking out,
- supply and erection of poles, mounting of lighting fixtures, light sources, equipment, power cables, including all such earthworks and other works as may be required,
- testing the quality of the accomplished work, and connection,
- any other works specified in the design or requested to be done by the engineer,
- entry into cadastral record of public utility lines.

The works in connection with public lighting shall all be executed in accordance with the requirements set in these special technical conditions, or in line with their meaning, or in compliance with such other conditions as may be specified.

Public lighting shall ensure appropriate:

- level and uniformity of luminance,
- illumination,
- glare control, and
- visual guidance.

Lighting fixtures of such a type shall fulfill all of the specified requirements and arrangement as will be suitable to a certain carriageway section and traffic density.

2.2.7.5.2 Types of Materials

Polyvinyl chloride pipes PC 110 of external diameter 110 mm my be used.

PC pipes for cable ducts shall be of circular cross-section. They shall be made of hard PVC material of adequate mechanical and other properties. The colour of the conduits shall be red.

The following types of cable shafts may be used:

- cable shaft of thermoplastic material
- cable shaft of circular cement concrete pipes
- cable shaft of square cement concrete pipes, cast in situ or prefabricated.

The dimensions of cable shafts depend on the type and number of pipes and cables respectively.

Three types of cast-iron covers can be used: for 50 kN, 125 kN, and 400 kN of point loading.

Covers of 50 kN bearing capacity can only be used for shafts on green surfaces inaccessible to vehicles.

Covers of 125 kN bearing capacity can be used for shafts on surfaces where minor loading is expected (footways).

Covers of 400 kN bearing capacity shall be used for shafts on areas where major loading is expected (roadways).

Low-voltage cables with PVC and PE insulation and with copper or aluminium wires may be used.

For public lighting, posts measuring 8 – 12 m in height, placed on standard cement concrete foundations, shall be foreseen.

For public lighting, such lamps shall be provided, which can be fixed to lighting posts. A lamp shall contain a high-pressure sodium light source of long service life, high efficiency, and reliable operation.

2.2.7.5.3 Quality of Materials

Adequate quality of the material to be placed is specified by the design, regulations, and appropriate technical conditions.

The contractor shall in due course prior to commencement of the works submit to the engineer adequate evidence on the quality of all materials he intends to introduce.

The contractor may commence to place the material only after having obtained the engineer's approval.

The quality of materials shall be verified on the basis of the technical data for the particular product, and of the accompanying documents such as form of delivery, certificates, declarations, etc.

Prior to laying the cables, the latter shall be tested on drums: measurements of insulating resistance and breakdown resistance shall be carried out.

2.2.7.5.4 Method of Execution

Public road and street lighting should enable traffic participants to become aware of any obstacle that might have adverse effect on safety and order. Its design and construction shall depend on the characteristic of the traffic, on technical features of the road, and on such obstructions as may be encountered on the road and may threaten the traffic safety.

Public road and street lighting shall be so constructed as not to act as hindrance or be dangerous to traffic participants.

In executing any piece of work within the scope of public lighting, the specifications of these special technical conditions, applying to similar or identical works, shall be complied with.

2.2.7.5.4.1 Power Supply and Control

Braches of public lighting shall be fed with three-phase current. All the branches shall be provided with adequate over-current protection. At turning-on points, equipment to control turning-on and turning-off the public lighting, as well as to control turning-on and turning-off the reduced lighting at night time between 11 p.m. and 5 a.m., or with regard to settings in the surroundings for which the public lighting is carried out.

In case that several turning-on points exist, they shall be mutually synchronized.

Power supply cables in asphalt surfaces shall be laid into cable ducts made of PVC pipes of 110 mm diameter and of cable shafts made of cement concrete pipes of Φ 60 cm with a cover of 60x60 cm, and cable shafts of 40x40 cm with a cover of 35x35 cm below the lights.

Cables in green surfaces and other non-asphalted areas may be placed directly into the ground.

2.2.7.5.4.2 Glare Control

Carriageways of motorways and other roads loaded with dense traffic shall comply with the requirements of the class 1 of the glare control, while the other carriageways with the requirements of the class 2. The limiting values of the two glare control classes, into which roads may be classified, depend on the illumination of the surroundings, lightness of the surroundings, vehicle speed, AADT (average annual daily traffic), admissible speed, etc.

Detailed specifications in connection with the allowable limiting values for controlling the glare of psychological and physiological origin are given in applicable recommendations and current standards dealing with this subject.

2.2.7.5.4.3 Visual Guidance

By systematic arrangement of lighting fixtures, safe guiding of vehicles in the dark shall be ensured, particularly when the pavement is wet.

2.2.7.5.4.4 Adaptation

By adequate transition of luminance, adaptation to the changes in the conditions on the road shall be ensured, if

- the driving speed on the road is higher than 60 km/h,
- prior to the point where road lighting is discontinued, the luminance has not been less than 1 cd/m^2,
- the ratio between luminance of two subsequent road sections is more than 10 : 1.

Adaptation time of 10 seconds shall be allowed for.

2.2.7.5.5 Quality of Execution

2.2.7.5.5.1 Luminance

Luminance, which is most important in determining visibility and visual comfort, is defined by the level of luminance L and uniformity of luminance U. The required values of mean luminance L_{mean}, and transverse and longitudinal uniformity of luminance U_{min} for public lighting in settlements depend on the illumination of surroundings, lightness of surroundings, vehicle speed, AADT, admissible speed, etc.

When designing a public lighting system, the value of 1.25 L_{mean} should be applied to allow for the effect of ageing and of dirt accumulating on their surface.

2.2.7.5.5.2 Illumination

In exceptional cases (for roadways with speed restricted to 60 km/h, and moderate traffic loading), the level of illumination E and uniformity of illumination of the road may be used instead of luminance as the most important criteria to determine the road visibility. The required values of the mean illumination and the ratio of uniformity of illumination depend on the surroundings illumination and lightness, vehicle speed, AADT, allowable speed, etc.

When designing a public lighting system, the value of 1.25 E_{mean} should be applied to allow for the effect of ageing and of dirt accumulating on their surface.

2.2.7.5.6 Quality Control of Execution

The quality of an accomplished public lighting system shall be controlled by measuring the following:

- luminance,
- illumination, and
- road surface reflectivity.

Values specified in the design shall be ensured.

The measurements shall be carried out in accordance with applicable technical regulations and codes. Measurements can only be performed by professional and authorized companies. A written report including all the results shall be worked out for any measurement. The report shall indicate whether the measurement results are acceptable or not. For all the reports a record shall be kept.

2.2.7.5.7 Measurement and Take-Over of Works

The executed works shall be measured in accordance with the general technical conditions and calculated in appropriate units of measure.

All the quantities shall be measured by actually executed scope and type of works within the limits of measurements specified in the design.

2.2.7.5.8 Final Account of Works

The bases for the final account of the works are specified in the general technical conditions.

All the quantities of the executed works shall be accounted by the contractual unit price.

The contractual unit price shall include all the services required for a perfect completion of the works. The contractor shall have no right to claim any extra payment.

2.2.7.6 WATER SUPPLY LINES

General

For the construction of water supply lines, appropriate design and technical documents shall be prepared, and relevant approvals and permits shall be obtained from competent authorities.

Prior to commencement of work, any variation that will be approved by the designer shall also be approved by the engineer.

The course of a water supply line shall be made to fit in with the existing system of utility lines within a public traffic area and to conform to the conditions set by the operators of these systems and traffic areas.

Water supply lines must not be laid under the carriageway. Unavoidable crossings and laying the pipes under the carriageway, however, shall be carried out in such a way that repair work on the water supply line can be performed without demolishing the pavement.

2.2.7.6.1 Description

The construction of a water supply line includes the following:

- staking out,
- preparation of substrate (bedding),
- supply and installation of water supply pipes and fittings,
- pressure and sanitary testing including disinfection,
- connecting to network,
- any such earth works as may be required and which shall be carried out in accordance with design specifications and requirements set in section 2.1 and 2.4 of these special technical conditions, unless specified otherwise by the engineer,
- entry into the cadastral register of underground utility lines.

2.2.7.6.2 Basic Materials

The following materials are required to construct a water supply line:

- materials for the underlay (bedding),
- materials for water supply: pipes, couplers, fittings, hydrants, and
- materials for structures.

2.2.7.6.2.1 Materials for Underlay

As a rule, the underlay (bedding layer) under water supply pipes and fittings shall be made of fine-grained mixtures of mineral grains and, exceptionally, of a cement concrete mixture as well.

2.2.7.6.2.2 Materials for Water Supply Lines

2.2.7.6.2.2.1 Pipes

Preferably, the following types of pipes shall be foreseen for the water supply lines:

- pipes of plastic materials,
- steel pipes, and
- cast-iron pipes.

The type of pipes intended for a water supply line shall be specified by the design.

2.2.7.6.2.2.2 Pipes of Plastic Materials

Hard PE pipes (for the pressure of 6 and 10 bar) should be used for water supply lines as they behave favourably under mechanical impacts and in aggressive environment, and are simple to handle and installation.

2.2.7.6.2.2.3 Steel Pipes

Seamless and seam-welded pipes that comply with the design specifications may be used to construct water supply lines.

2.2.7.6.2.2.4 Cast-Iron Pipes

Cast-iron pipes, preferably made of ductile casting, used for water supply lines, shall comply with the design requirements.

2.2.7.6.2.2.5 Couplers, Fittings, and ydrantsHydrants

All necessary pipe couplers, fittings (valves, air-vents), and hydrants for water supply lines shall be specified in the design and shall conform to these specifications.

2.2.7.6.2.2.6 Materials for Structures of Water Supply Lines

The principal structures required to construct a water supply line are:

- shafts and chambers,
- supports and anchor blocks, and
- condensate collectors.

Basic materials to build structures for water supply lines are cement concrete and reinforcing steel, which are specified in detail in sections 2.2.5.2 and 2.2.5.3 of these technical conditions.

2.2.7.6.3 Quality of Materials

Quality specifications for all the materials to be used for the construction of a water supply line shall be defined in the design. If this is not the case, applicable material quality provisions contained in these special technical, or in such technical literature issued by manufacturers as might by specified, shall apply. The validity of quality specifications shall be established by the engineer whose approval shall be obtained before any of the materials is used, particularly when the water supply line is to be constructed in special conditions.

In due time prior to commencement of work, the contractor shall submit to the engineer an evidence on the quality of all the principal materials that will be used in the water supply line construction.

Unless agreed otherwise, the quality requirements specified for the basic materials shall mean the limiting values. The maximum admitted limiting values, however, shall be determined by the engineer in compliance with the peculiarities of each individual tape of work.

2.2.7.6.4 Method of Execution

Within a road area, the water supply line shall generally be placed under the sidewalk; only exceptionally it may be placed under the carriageway.

When crossing a road, the water supply line shall be placed in a special culvert or in protective pipes made of cement concrete. Such pipes should protrude by not less than 3 m from the fill toe. At each end of such a protective duct, an inspection manhole (shaft) shall be built.

The smallest allowed clear distances between the water supply line and other utility lines, devices, and structures are given in Table 7.9.

Table 7.9: Minimum clear distance between a water supply line and other utility lines, devices, and structures

Type of utility line, device, and structure	Minimum clear distance of water supply line	
	parallel course [m]	at crossing [m]
- Power cable	0.5 to 2.0	0.5
- Telecommunication cable	1.0	0.5
- Gas conduit	0.5	0.3 to 0.6
- Hot water line	0.5	0.3 to 1.0
- Residential or industrial building	4.0	
- Main road (outside fill toe)	3.0	1.2
- Sewage system	1.5	0.4

Faecal sewage system shall be installed under water supply pipes. If this is not feasible, the water supply pipe shall be laid in a protective duct.

2.2.7.6.4.1 Obtaining Materials

In due time before commencement of works on a water supply line, the contractor shall give notice to the engineer of all the materials he intends to use, also submitting suitable evidence on the quality of such materials.

The required properties of materials shall be ensured. Materials not conforming to the requirements shall be rejected and specially marked.

2.2.7.6.4.2 Preparation of Substrate

Hard PE pipes may be placed

- directly onto suitable prepared (levelled and stabilized) excavation formation, or
- onto an underlay of mineral grains (sand).

Steel and cast-iron pipes may also be placed directly onto suitably prepared foundation ground (screened soil).

At any time of laying water supply pipes, the substrate must not be frozen.

2.2.7.6.4.3 Placing

2.2.7.6.4.3.1 Underlay

The underlay called also bedding layer of mineral aggregate mixture or cement concrete mix shall be placed uniformly to allow adequate resting of pipes. Due to the limited space, the materials for the underlay shall be placed manually.

The method and conditions for placing the underlay for the water supply line shall be specified by the engineer.

2.2.7.6.4.3.2 Pipes and Couplers

The contractor may start to lay the water supply pipes only after the engineer has taken over the spread underlay (bedding course).

For joining water supply pipes, instructions provided by the pipe manufacturer shall be considered. As a rule, water supply pipes shall be coupled as follows:

- hard PE pipes by adequate couplers or by welding,
- steel pipes by welding, and
- cast-iron pipes by couplers (sealed with hemp cord and lead), or bolted flanges sealed with appropriate rubber or other type of seal.

All water supply lines made of steel pipes shall be protected against corrosion as appropriate, mostly by cathodic protection, especially at the point of crossing other pipelines and devices. In the first place, the pipe internal coating shall comply with potable water regulations.

Before connecting a pipeline to the water supply system, the pipeline shall be cleaned by rinsing to ensure absence of any mechanical impurities, and disinfected by water with chlorine added. The approval for connecting the pipeline to the water supply system shall be obtained from relevant authorities.

2.2.7.6.4.3.3 Fittings and Hydrants

A valve shall be fitted at each point where a branch line separates from the main, and at each hydrant. Its distance from shaft (manhole) walls and bottom may not be less than 25 cm.

Hydrants shall be provided as follows:

- in settlements at a spacing of 80 m between adjacent hydrants, and
- outside settlements at a spacing of 100 – 200 m.

If hydrants are also foreseen for pipeline venting, they shall be installed at the highest points of a pipeline (like air vents).

2.2.7.6.4.3.4 Structures

All the structures for a water supply line shall be constructed in accordance with the design documents and provisions of sections 2.2.4.4 and 2.2.5 of these special technical conditions applying to such (identical or similar) works.

The shaft (manhole) size shall conform to the diameter of the main pipeline and the equipment that will be installed in the shaft. Shaft covers shall be suitable for the traffic load.

The opening through which a pipeline will pass a wall of a structure shall be widened by not less than 2.5 cm. Water supply structures must not contain other kinds of installations (such as power lines, gas conduit) unless the latter meets special safety requirements.

2.2.7.6.4.3.5 Backfilling

For backfilling the trenches of a water supply line, provisions specified in section 2.2.2.4.4 of these technical conditions shall apply. The trenches may be backfilled only after completion of the pressure test.

Up to the level of 50 cm above the top of a water supply line, backfilling shall be compacted manually (in layers of appropriate thickness). Any further compacting will be determined by the engineer in dependence on the pipeline location within the road body.

2.2.7.6.5 Quality of Execution

The quality of the executed work shall conform to the requirements indicated in sections 2.2.7.6.3 and 2.2.7.6.4 of these technical conditions and to the conditions provided by the design.

Unless agreed otherwise, the specified quality requirements shall mean the limiting values. The threshold values, however, shall be determined by the engineer.

2.2.7.6.6 Quality Control of Execution

The engineer shall specify the extent of testing within the scope of both internal and external control during the execution of works related to the water supply line. This shall be done on the basis of the documents submitted to him as requested in these technical conditions, and on the basis of work progress.

The completed water supply line that will secured as appropriate to the type of pipes used, shall be subjected to the pressure test to be ensured by the contractor.

The pressure test for the water supply line of plastic pipes shall be carried out according to the instructions provided by the manufacturer (by using water).

Pre-testing of the pipeline that has been filled with water and vented, shall be carried out in such a way as to establish the specified operating pressure, which shall be maintained for 24 hours. During this period, any defects that may be detected shall be made good.

For the purpose of the main test, such a test pressure as has been specified by the pipe manufacturer or the design shall be established. This test pressure shall exceed by approximately 50% the designed operating pressure. The duration of the main test will depend on the pipeline length, taking 30 minutes for 100 m of pipeline length. The water that will be absorbed by the pipes during the test shall be re-filled every 30 minutes.

After each pipeline section has been tested as appropriate, the same testing procedure shall be applied to the whole system. Should the test reveal any defects, the pressure test shall be interrupted, the defects made good, and the testing repeated.

A test record on pressure testing shall be kept and signed both by the engineer and the contractor’s representative.

Pressure testing of steel and cast-iron piping shall be carried out with the working pressure, which shall then be increased to the limit test pressure of 15 bar. Such a pressure shall be maintained in the pipeline for 6 hours. If the pressure drop in the 6 hours is less than 0.1 bar, the pipeline may be considered as leak proof.

The disinfection and sanitary test of a water supply line shall be carried out by a company authorized to perform such operations. The test certificate shall include the evaluation of quality of the constructed water supply line.

2.2.7.7 GAS CONDUITS

General

Conduits for natural and town gas shall be constructed in accordance with the design and on the basis of permits and approvals issued by relevant authorities. The routs of a gas conduit shall be harmonized with the existing condition of different utility lines within the public road area, and with the specified conditions.

As a rule, a gas conduit shall be placed into the ground, and only in special cases it may be installed above the ground.

A gas conduit must not be placed under the carriageway. Unavoidable crossing of the roads by gas lines, however, shall be carried out in such a way that the piping laid in the road body can be replaced without demolishing the pavement.

By their use, gas conduits can be classified in main, transmissible, feeding, and connecting ones. By the gas pressure in the pipeline, gas conduits can be classified as follows:

- low-pressure gas conduits (pressure of less than 1,000 mm water column, usually 200 – 250 mm),
- medium-pressure gas conduits (pressure of 1,000 mm water column to 1 bar), and
- high-pressure gas conduits (pressure above 1 bar to approximately 40 bar).

2.2.7.7.1 Description

The construction of a gas conduit comprises the following:

- staking-out,
- substrate preparation,
- supply and installation of all gas line apparatus and fittings,
- pressure test,
- any such earthworks as may be required and which shall be carried out in accordance with the requirements set in the design and in sections 3.2.2.1 and 3.2.2.4 of these technical conditions, unless specified otherwise by the engineer, and
- entry into the cadastral record of underground utility lines.

2.2.7.7.2 Basic Materials

When building a gas conduit, the following material will be required:

- materials for underlay (bedding layer),
- materials for gas conduit: pipes, equipment, fittings, condensate collectors, and
- materials for the structures.

2.2.7.7.2.1 Materials for Underlay

The underlay (bedding layer) below gas pipelines shall be, as a rule, of fine-grained mineral mixture.

2.2.7.7.2.2 Materials for Gas Conduit

2.2.7.7.2.2.1 Pipes

As a rule, the following pipes shall be used for gas conduits:

- steel seamless or seam-welded pipes for high-pressure and medium-pressure gas conduits,
- cast-iron pipes, and
- PVc pipes for low-pressure gas pipelines.

The pipes shall conform to the design requirements.

Steel pipes for gas conduits shall be adequately protected against corrosion, either at the factory, or, by means of machines, at the construction site.

2.2.7.7.2.2.2 Equipment

All the necessary valves and other accessories for a gas conduit shall be specified in the design and shall conform to the requirements set herein.

3.2.7.1.1.1.1 Condensate Collectors

All the collectors that are designed for collecting and draining the condensate of water vapour, gasoline, and water, if any, shall be specified in the design and shall conform to the specified requirements.

2.2.7.7.2.3 Materials for Structures

The principal structures of a gas conduit are

- shafts (with shut-off devices),
- pressure reducing stations (underground, above ground), and
- supports and anchor blocks.

The basic materials for the construction of the abovementioned structures of a gas conduit are:

- cement concrete, and
- reinforcing steel,

for which detailed specifications are given in sections 3.2.5.2 and 3.2.5.3 of these technical conditions.

2.2.7.7.3 Quality of Materials

The requirements concerning the measurements of the quantities and the quality of all the materials that are designed to be used in constructing a gas conduit shall be specified in the design, taking into consideration the site conditions and the safety factor. If not so, applicable material quality provisions contained in these technical conditions, or in such technical literature of the manufacturers as might be specified, shall apply. The validity of quality specifications shall be established by the engineer whose preliminary approval shall be obtained before any of the materials may be used, this in particular when the gas conduit is to be built in special conditions.

In due time prior to commencement of works, the contractor shall submit to the engineer evidence on the quality of all the principal materials that will be used in constructing the gas conduit. Unless agreed otherwise, the quality requirements specified for the principal materials shall mean the limiting values. The threshold values, however, shall be determined by the engineer on the basis of the peculiarities of each individual type of work.

2.2.7.7.4 Method of Execution

Within road areas, gas conduits shall be laid in the ground and placed in special protective ducts.

Such a protective duct for the gas conduit shall be sealed at both ends, and its internal diameter shall be by 10 cm greater than that of the gas conduit running through it.

The gas conduit shall cross the roads at a right angle. When running parallel with the road, the gas conduit shall be laid under carriageway sections with less traffic load such as cycle tracks, footways, bur preferably outside the area of the road body.

Along motorways, the distance between the axis of the gas conduit running parallel with the motorway, and the external edge of the carriageway must not be less than 25 m, while in case of low- and medium-pressure gas lines pipelines running along main roads and regional roads such distance shall not be less than 10 m, and in case of high-pressure gas conduits not less than 15 m.

If, exceptionally, the gas conduit needs to be laid in an overpass above the road, the clear opening between the carriageway below and the gas pipe must not be less than 4.7 m.

In tunnels that may also be used by pedestrians, gas conduits must not be laid as a rule.

Shut-off devices must not be located less than 10 m away from the edge of the carriageway, whereas exhaust and venting devices not less than 50 m.

The minimum admissible clear distance between a gas conduit and other utility lines within the area of the road body or its surroundings are indicated in Table 7.10.

Other safety distances to be observed in designing and constructing gas conduits may be found in relevant regulations.

Table 7.10: Minimum clear distance of the gas conduit from other utility lines, devices, and structures

Type of utility line device, or structure	Minimum clear distance of the gas conduit parallel course (m)	at crossing (m)
In settlements:		
- PVC gas conduit:		
- from water supply line and sewage system	0.2	0.6
- from main hot water supply line	1.0	1.0
- Metal gas conduit:		
- Water supply line, sewage system, and hot water supply line	0.2	0.3
- Power cable	1.0	0.5
- Telecommunication cable	1.0	0.5
- Pipeline for chemicals	0.2	0.6
- Petrol station	-	5.0
- Sewage system	0.2	0.3
Outside settlements:		
- Power cable	0.5	5.0
- Telecommunication cable	0.3	1.0
- Pipeline for chemicals	0.3	1.0
- Petrol station	-	30.0
- Sewage system	0.3	1.0
- Hot water supply line	0.3	1.0

2.2.7.7.4.1 Obtaining the Materials

In due time before commencement of works on agas conduit, the contractor shall give notice to the engineer of all the materials he intends to use, also submitting suitable evidence on the quality of such materials.

The required properties of materials shall be ensured. Materials not conforming to the requirements shall be rejected and specially marked.

2.2.7.7.4.2 Preparation of Substrate

Gas conduit pipes shall be laid directly onto a uniformly levelled and stabilized underlay (bedding layer) of natural or crushed mineral grains (sand). The underlay thickness shall be uniform as possible (approximately 10 cm). The underlay shall be spread over the levelled bottom of the ditch measuring 0.6 – 1.2 m in width, depending on the pipe diameter, and approximately 1.5 m in depth, to ensure that the pipes will rest on the underlay (bedding layer) as appropriate. Due to the limited space, the mineral grain mixture (sand) shall be placed manually.

At the time of laying the pipes of a gas conduit, the underlay (bedding layer) must not be frozen.

The method and conditions for preparing the bedding course for the pipes of a gas conduit shall be specified by the engineer.

2.2.7.7.4.3 Placing

2.2.7.7.4.3.1 Pipes

The contractor may commence to lay the pipes of a gas conduit only after the spread underlay (bedding layer) has been taken over by the engineer.

When laying the pipes of a gas conduit, care should be taken to avoid damage to corrosion protection coating.

Gas conduit pipes shall be joined by adequate welding, couplers, sockets, or flanges, all in compliance with the manufacturers' instructions.

All gas conduits made of steel pipes shall be adequately protected against corrosion as provided by section 2.2.5.9 of these technical conditions.

To reduce the effect of stray currents, the gas line shall be divided in several sections by means of dielectric flanges.

2.2.7.7.4.3.2 Equipment

All the necessary equipment required for a gas conduit shall be protected against corrosion and installed in accordance with detailed design drawings.

The engineer in agreement with the designer shall approve any variation with regard to the installation method.

2.2.7.7.4.3.3 Condensate Collectors

All the collectors that are designed for collecting and draining the condensate of water vapour, gasoline, and water, if any, shall be welded to the gas conduit at its lowest points (depressions).

The spacing between the condensate collectors will depend on the ground configuration, as well as on eventual underground utility lines, which shall be bypassed.

The method of draining the liquid from condensate collectors shall be specified in the design.

2.2.7.7.4.3.4 Structures

All the structures for a gas conduit shall be constructed in accordance with applicable designs and provisions of sections 2.2.4.4 and 2.2.5 of these technical conditions applying to such (identical or similar) works.

Gas conduit shafts (manholes), with shut-off devices, shall be watertight, and their size suited to gas pie diameter and the fittings and equipment to be incorporated in them. In addition to gas conduit shut-off devices, the shafts shall incorporate liquid drain pipes, a vent pipe, and a pressure gauge for checking gas pressure in the conduit. Access opening shall be provided at the top of the manhole and shall be closed by an appropriate cover.

A separate structure for a pressure reducing station will only be required in case of high-pressure gas conduits of great gas amounts. In all other cases, pressure reducing stations may be incorporated in underground shafts or mounted on external walls of adjacent structures.

All the installations in the pressure reducing stations shall be isolated from the gas conduit by means of dielectric flanges. The structure of the pressure reducing station shall be earthed as appropriate, watertight, and constructed of incombustible materials.

2.2.7.7.4.3.5 Backfilling

For backfilling the trenches of a gas conduit, the provisions specified in section 2.2.2.4.4 of these technical conditions shall apply. The trenches may be backfilled only after the welds are checked and the pressure test completed.

The backfilled material above the gas pipeline shall be compacted by means of suitable compacting equipment that will not damage the pipe protection and will ensure appropriate level of compaction of the backfill. The compaction method shall be approved by the engineer and will depend on the pipeline location in the road body.

2.2.7.7.5 Quality of Execution

The quality of the executed work shall conform to the requirements indicated in sections 2.2.7.6.3 and 2.2.7.6.4 of these technical conditions and to the conditions provided by the design.

Unless agreed otherwise, the specified quality requirements shall mean the limiting values. The threshold values, however, shall be determined by the engineer.

2.2.7.7.6 Quality Control of Execution

The extent of the external and internal control testing to be performed during the execution of the work in connection with a gas conduit shall be specified by the engineer on the basis of the documents submitted to him, as requested by these technical conditions, and on the basis of the work progress.

The contractor shall ensure that the quality of the welds is tested by radiographic method, i.e.:

- 30% of the pipe welds outside the shafts and protective ducts, and
- 100% of pipe welds inside the shafts and protective ducts.

Tightness of welds shall be checked by pressure testing with air, carried out in accordance with the design.

Prior to starting to lay the pipes of a gas conduit into the ditch, pipe insulation shall be subjected to the breakdown test with such a voltage as will be specified in the gas conduit cathodic protection design. Once the pipes are laid in the trench, and before backfilling, such testing shall be repeated.

If quality tests performed on a gas conduit reveal any defects, the test shall be interrupted, the defects made good, and the test repeated.

Testing of the completed gas conduit shall be performed in the presence of the engineer.

2.2.7.8 ROAD – RAILWAY CROSSINGS

General

When preparing design documents for a road – railway crossing, either at grade or split-level, and for the construction of road running parallel with a railway track, conditions and requirements specified by such competent railway authorities as indicated in the approval for the execution of such works shall be taken into consideration.

Any modification of the design that will be accepted by the designer and the authority shall, before commencing the work, be approved by the engineer.

In case of road – railway crossing at grade discussed in these technical conditions, the crossing shall be so constructed as to provide sufficient visibility and/or appropriate protection, ensuring that any repair work required could be carried out with the minimum obstruction to both railway and road traffic.

2.2.7.8.1 Description

Construction of road – railway crossing at grade includes the following:

- securing the traffic,
- securing the railway track (rails, sleepers, gravel ballast), and
- construction of suitable road carriageway.

Depending on the road and railway traffic density, railway crossings shall be protected with barriers of the required type (they are obligatory if the train speed at a section of railway track is 100 km/h or more), or by suitable acoustic or visual warning devices signalling the approaching train.

If a junction controlled with traffic light signals is located before a railway crossing, the operation of such traffic lights shall be coordinated with that of the barriers to avoid traffic jams on railway tracks.

2.2.7.8.2 Basic Materials

The following basic materials are used to secure railway tracks:

- protective rails (counter-rails), and
- materials for the protection of sleepers and gravel ballast.

The latter are also the basic materials ensuring appropriate quality of the carriageway in the area of the railway crossing.

Since mixtures of non-cohesive mineral materials are not watertight, they may only be used for the preparation of the carriageway in the area of railway crossing in case of the roads with moderate traffic loads. For carriageways of considerably loaded roads, such materials as may be sealed as appropriate shall be used, i.e. paving stones, cement concrete slabs, or bituminous grain mixtures.

2.2.7.8.3 Method of Execution

A road – railway crossing at grade shall ensure safety both of railway and road traffic. The angle of crossing of the road and the railway must not be less than 45°; preferably, it shall be 90°.

2.2.7.8.3.1 Carriageway

In the area of road – railway crossing at grade, carriageway inclination that will identical with the railway track slope shall be provided at a section 3 m long on each side of the (external) track axis.

At least 10 m of the carriageway on each side of the railway track axis shall be stabilized as appropriate. The possibility of adjusting the rail fixing shall be ensured.

In the area of railway crossing and outside that area, the carriageway width shall be the same.

Carriageway drainage shall be connected to the railway track drainage system.

All the works required in the road – railway crossings shall be carried out in accordance with the specifications of these technical conditions, i.e.:

- earthworks in accordance with section 3.2.2,
- pavement structure in accordance with section 3.2.3,
- drainage in accordance with section 3.2.4, and
- construction works and craftsman's works in accordance with section 3.2.5,

or, the requirements set in other technical conditions as may be agreed shall be complied with.

2.2.7.8.3.2 Railway Track

In the area of a road – railway crossing at grade, rail joints shall be shifted by at least 5 m from the external edges of the carriageway.

Protective rails (counter-rails) fitted to the inner side of the rails shall reach at least 0.5 m across the outer edges of the carriageway, and their ends shall be bent as appropriate.

2.2.7.9 TESTING

General

Appropriate tests shall be performed in due time to determine whether the quality of the materials, of the execution of works, and of the completed works complies with the requirements set in these technical conditions and in other design documents as may be agreed upon.

The method and scope of testing including both statistical and financial evaluation of the quality of the executed works are specified in detail in both general and special technical conditions.

2.2.7.9.1 Description

The tests specified in these technical conditions for the purpose of determining the quality of the materials, of the execution technology, and of completed works related to the road construction shall be carried out by:

- the contractor (internal or routine tests), and
- the client or an authorized institute (external or control tests).

In certain cases that have been agreed upon, such an institute may also perform the internal (routine) testing. The extent (and terms of payment) of such testing shall be specified by the engineer within the limits defined in these technical conditions (in principle, 1 for 2).

In cooperation with the engineer, the contractor and the institute shall prepare a quality control programme that will ensure such a quality of the executed work as to fulfil the test requirements defined in these technical conditions. Such a programme shall include:

- programme of internal and external control testing, and
- graphical presentation of the sequence of testing.

The engineer shall approve the quality control programme that will ensure appropriate quality of the executed works. During the execution of works, the engineer may modify such a quality control programme or the sequence of testing within the allowed limits specified in these technical conditions, with a written notice submitted to the contractor at least 7 days in advance.

At least one day before any of the foreseen external (control) testing, the engineer shall submit a request for such a test to the third party institute, and the institute shall commence the testing not later than a day after the receipt of such a request.

The scope of the foreseen tests shall be such as to ensure optimum technical solutions to be reached, and a detailed analysis of the characteristics of the performed work to be made.

In principle, the test shall include expert consulting services by the authorized third party institute, which include:

- consultations related to the problems arising during the construction, and
- participation in testing to be carried out by some third parties upon engineer's special request.

2.2.7.9.2 Method of Execution

Suitably skilled employees shall carry out both internal and external testing at adequately equipped site laboratories.

The requests for carrying out both internal (routine) and external (control) tests in accordance with the accepted programme, as well as the method of taking samples of the<executed works at randomly selected locations, and storage of such samples, shall be issued by the engineer. In case of earthworks, the tests shall be performed at least 80 cm from the margin of an executed work, and the tests of the incorporated layers of pavement structures at least 50 cm from the margin of a layer of incorporated material. The engineer shall select measuring points for other tests.

The results of tests that require immediate action to be taken shall be recorded on special forms (to be filled at a location specified by the engineer), and shall be submitted to the engineer:

- immediately after completing the tests on the site or at contractor's field laboratory, and
- not later than three days after having completed the tests at the third party institute's laboratory.

If a testing procedure does not require a longer period of time, it shall be completed:

- in one day, if performed at the contractor's field laboratory,
- not later than in 7 days, if performed at the third party institute's laboratory.

When it is agreed that a report on a particular test should be prepared, such a report shall be written not later than 3 days after having completed the test, and shall include the following:

- analysis of the results,
- quality evaluation, and
- proposed measures to be taken.

The quality evaluation included in such reports should enable unambiguous financial evaluation of the quality of the executed work to be made in accordance with both general and these technical conditions.

Unless agreed otherwise, periodical test reports (for every three months' period) shall be submitted:

- within 15 days in case of internal control tests,
- within 30 days in case of external control tests.

The date for submitting final quality reports relating to individual executed works shall be specified by the engineer, the reports to include the following items:

- statistical processing of test results,
- statistical evaluation of test results, and
- periodical or final evaluation of the quality of executed works.

All the reports on internal (routine) and external (control) tests shall be prepared in two copies by the contractor and submitted to the engineer or a third party institute appointed by the latter. The reports by the institute shall be prepared in three copies: two copies to be submitted to the client within a specified period of time; the third copy shall include interim or final statement of the executed works, such statement to include adequate accounting of the tests carried out.

2.2.7.9.3 Final Account of Works

The authorized third party institute shall account for all the tests carried out in the preceding month. Only reports attached to the monthly statement shall serve as a basis for final accounting of testing.

If the third party institute fails to submit the report within the time period specified in section 2.2.7.9.2 of these technical conditions, the decision on the settlement of accounts for the tests carried out will be taken by the engineer who may:

- request the statement of account to be made on the basis of unit prices valid within an agreed period of time,
- deduct from the accounted value (based on the unit prices valid within an agreed period of time) 1% for each day of delay,
- reject the entire statement of account, or
- require indemnification for the actual costs resulted from the delayed report.

2.2.7.10 SUPERVISION

In general supervision shall be provided as submitted in Volume IV of these guidelines

2.2.7.10.1 Description

Such types of supervision of road construction are discussed herein, which are beyond the competence of the engineer. Such permanent and necessary professional supervision includes particularly the following:

- designer's supervision,
- archaeological supervision and preservation of monuments, and
- miner's supervision.

The abovementioned types and extent of supervision depend on the peculiarities of the work carried out in certain conditions.

2.2.7.10.2 Method of Execution

The organization responsible for carrying out professional supervision in compliance with the provisions contained herein shall conform as much as possible to the accepted operational plan of the progress of the road construction works.

2.2.7.10.2.1 Designer's Supervision

Designer's supervision is required to ensure that all the designed work, and any additional works that might be necessary during the road construction, will be executed as specified in the design and will be made to fit with the designed works.

The scope of the designer's supervision shall be properly coordinated with all the works to ensure the foreseen work progress.

Any findings resulting from supervising activities and any amendments to the design shall be reported in adequate written form by the contractor responsible for the designer's supervision to the client's engineer.

2.2.7.10.2.2 Archaeological Supervision and Preservation of Monuments

Archaeological supervision and preservation of monuments are required during the road construction to protect such archaeological sites and cultural heritage as may be found in the area affected by road construction activities. The method and scope of protection should be agreed between road construction investor and the organization responsible for the protection of cultural heritage.

In principle, an expert body qualified to perform such work shall carry out protective and other archaeological excavations and activities for the preservation of monuments.

A report on the measures that have been taken by such an expert body in connection with the protection of archaeological sites and preservation of monuments shall be prepared by that body and shall be submitted to the engineer being the representative of the investor.

2.2.7.10.2.3 Miner's Supervision

Permanent miner's inspection will generally be required at all such locations where, during the execution of road construction works, hazardous gases may occur.

Miner's supervision shall be carried out in such a manner and extent as specified.

2.2.7.11 THIRD PARTY SERVICES – BILL OF WORKS

2.2.7.11.1 Power Lines

Item	Unit of Measure	Description of Works
72 111	pcs	Relocation of overhead LV power line as per drawing ………..
72 131	pcs	Relocation of overhead HV line as per drawing ………..
72 211	pcs	Arrangement of crossing of the road by overhead LV lines as per drawing …………
72 221	pcs	Arrangement of crossing of the road by overhead HV lines as per drawing …………
72 311	pcs	Relocation of LV power cable as per drawing ………….
72 321	pcs	Relocation of HV power cable as per drawing ………….
72 411	pcs	Arrangement of crossing of the road by LV power cable as per drawing ………….
72 421	m^1	Supply and placing PVC pipes of diameter 110 mm (PC 110)
72 422	m^1	Supply and placing PVC pipes of diameter 160 mm (PC 160)
72 431	m^1	Supply and placing PE pipes of diameter 110 mm (PC 110)
72 432	m^1	Supply and placing PE pipes of diameter 160 mm (PC 160)
72 441	m^1	Supply and placing double-wall PE pipes of external diameter 110 mm (PC 110-EZ)
72 442	m^1	Supply and placing double-wall PE pipes of external diameter 160 mm (PC 160-EZ)
72 451	pcs	Supply and placing of prefabricated cable shaft made of thermoplastic material
72 452	pcs	Supply and placing of prefabricated cable shaft made of circular concrete pipe
72 453	pcs	Supply and placing of prefabricated cable shaft made of square concrete pipe
72 461	pcs	Supply and placing of cast-iron cable shaft cover for point loading of 50 kN
72 462	pcs	Supply and placing of cast-iron cable shaft cover for point loading of 125 kN
72 463	pcs	Supply and placing of cast-iron cable shaft cover for point loading of 400 kN
72 511	pcs	Erection of self-supporting LV power cable as per drawing ………….
72 611	pcs	Erection of transformer station for LV network as per drawing …………..
72 621	pcs	Erection of transformer station for HV network as per drawing …………..
72 711	pcs	Earthing of LV power cable
72 721	pcs	Earthing of HV power cable
72 731	pcs	Installation of over-voltage protection switch
72 741	pcs	Installation of over-current protection switch
72 811	m^1	Removal of overhead LV power line
72 821	m^1	Removal of overhead HV power line
72 911	pcs	Survey of cable lines and entry into the cadastral record of public utility lines

2.2.7.11.2 Telecommunication Lines

Item	Unit of Measure	Description of Works
73 111	pcs	Relocation of self-supporting telecommunication cable line as per drawing …………
73 131	pcs	Relocation of buried telecommunication cable line as per drawing ……………
73 141	pcs	Relocation of telecommunication cable duct as per drawing ………………
73 221	pcs	Building of self-supporting communication cable line as per drawing …………
73 231	pcs	Building of buried telecommunication cable line as per drawing ……………
73 241	pcs	Building of telecommunication cable duct as per drawing ………………
73 311	m^1	Execution of cable duct of cement concrete blocks
73 312	m^1	Execution of cable duct of cement concrete pipes
73 321	m^1	Execution of cable duct of PVC pipes of 110 mm diameter (PC 110)
73 322	m^1	Execution of cable duct of PVC pipes of 160 mm diameter (PC 160)
73 331	m^1	Execution of cable duct of PE pipe of 40 mm diameter (PE HD 40)
73 332	m^1	Execution of cable duct of PE pipe of 50 mm diameter (PE HD 50)
73 333	m^1	Execution of cable duct of PE pipe of 110 mm diameter (PE HD 110)
73 334	m^1	Execution of cable duct of PE pipe of 125 mm diameter (PE HD 125)
73 341	m^1	Execution of cable duct of coupled double PE pipes of 2 x 50 mm diameter (2 x PE HD 50)
73 351	m^1	Execution of cable duct of double-wall PE pipes of 110 mm external diameter (PC 110-EZ)
73 352	m^1	Execution of cable duct of double-wall PE pipes of 125 mm external diameter (PC 125-EZ)
73 361	m^1	Execution of cable duct of ……pipes made of ……. of ……. mm diameter
73 371	m^1	Supply and placing of plastic pipes of 80 mm diameter into footway cement concrete
73 372	m^1	Supply and placing of plastic pipes of 100 mm diameter into footway cement concrete
73 373	m^1	Supply and placing of plastic pipes of 125 mm diameter into footway cement concrete
73 374	m^1	Supply and placing of plastic pipes of ... mm diameter into footway cement concrete
73 411	pcs	Execution of shaft for cable duct of cement concrete (as per drawing), inner dimensions 120/120/120 cm
73 412	pcs	Execution of shaft for cable duct of cement concrete (as per drawing), inner dimensions 120/150/190 cm
73 413	pcs	Execution of shaft for cable duct of cement concrete (as per drawing), inner dimensions 150/200/190 cm

Item	Unit of Measure	Description of Works
73 414	pcs	Execution of shaft for cable duct of cement concrete (as per drawing), inner dimensions 150/250/190 cm
73 415	pcs	Execution of shaft for cable duct of cement concrete (as per drawing), inner dimensions …./…../….. cm
73 421	pcs	Execution of passable inspection shaft of cement concrete, with cement concrete cover, for pipes placed into footway, external dimensions of the shaft cross-section 72/137 cm, depth 75 cm
73 422	pcs	Execution of passable inspection shaft of cement concrete, with cement concrete cover, for pipes placed into footway, external dimensions of the shaft cross-section …../…… cm, depth …… cm
73 426	pcs	Execution of passable inspection shaft of cement concrete, with metal cover, for pipes placed into footway, external dimensions of the shaft cross-section 72/137 cm, depth 75 cm
73 427	pcs	Execution of passable inspection shaft of cement concrete, with metal cover, for pipes placed into footway, external dimensions of the shaft cross-section ../... cm, depth .. cm
73 431	pcs	Execution of passable inspection shaft of cement concrete, with cement concrete cover, for three pipes, placed into edge beam, external dimensions of the shaft cross-section 95/135 cm, depth 100 cm
73 432	pcs	Execution of passable inspection shaft of cement concrete, with cement concrete cover, for three pipes, placed into edge beam, external dimensions of the shaft cross-section ../... cm, depth ... cm
73 436	pcs	Execution of passable inspection shaft of cement concrete, with cement concrete cover, for six pipes, placed into edge beam, external dimensions of the shaft cross-section 100/135 cm, depth 85 cm
73 437	pcs	Execution of passable inspection shaft of cement concrete, with cement concrete cover, for six pipes, placed into edge beam, external dimensions of the shaft cross-section .../... cm, depth .. cm
73 441	pcs	Execution of inspection shaft for cable duct in footway or edge beam, with cement concrete cover (as per drawing), internal dimensions of the shaft cross-section 42/107 cm, depth 19 cm
73 444	pcs	Execution of inspection shaft for cable duct in footway or edge beam, with metal cover (as per drawing), internal dimensions of the shaft cross-section 60/60 cm, depth 19 cm
73 451	pcs	Execution of inspection shaft for cable duct in footway or edge beam, with .... cover (as per drawing), internal dimensions of the shaft cross-section ../.. cm, depth ......
73 461	pcs	Supply and placing of prefabricated shaft for cable duct of thermoplastic material as per drawing, internal dimensions …./…/… cm
73 464	pcs	Supply and placing of prefabricated shaft for cable duct of thermoplastic material as per drawing, shaft dimensions …./…/… cm
73 471	pcs	Supply and placing of cast-iron cover of shaft for point loading 50 kN
73 472	pcs	Supply and placing of cast-iron cover of shaft for point loading 125 kN
73 473	pcs	Supply and placing of cast-iron cover of shaft for point loading 400 kN

Item	Unit of Measure	Description of Works
73 511	m^1	Supply of telecommunication cable for local connection (TK 59, TD 59)
73 521	m^1	Supply of telecommunication optical cable with 12 optical fibres
73 522	m^1	Supply of telecommunication optical cable with 24 optical fibres
73 523	m^1	Supply of telecommunication optical cable with 48 optical fibres
73 611	m^1	Manual inserting of telecommunication cable into duct
73 612	m^1	Machine inserting of telecommunication cable into duct
73 711	pcs	Electric measurement of cable of copper wires on drum
73 712	pcs	Electric measurement of laid cable of copper wires
73 721	pcs	Measurement of optical cable on drum
73 722	pcs	Measurement of laid optical cable
73 811	pcs	Survey of telecommunication cable lines and entry into the cadastral record of public utility lines

2.2.7.11.3 Emergency Call

Item	Unit of Measure	Description of Works
74 111	m^1	Execution of cable duct below motorway emergency lane: excavation of cable trench in subgrade and fill or foundation ground, of 80 cm depth, 55 cm width, levelling the trench bottom with sand layer of 10 cm thickness, and backfilling the trench
74 112	m^1	Transverse trench below motorway for the need of emergency call posts: excavation of cable trench in subgrade and fill or foundation ground, of 80 cm depth, 40 cm width, levelling the trench bottom with sand layer of 10 cm thickness, laying 2xPVC pipes of 125 mm diameter, application of concrete lining, inserting pipes 2 x (2 x Φ 50/3.7mm), and backfilling the trench
74 113	m^1	Transverse or longitudinal trench below motorway for the need of bridging shafts or road signalling devices: excavation of cable trench in subgrade and fill or foundation ground, of 80 cm depth, 40 cm width, levelling the trench bottom with sand layer of 10 cm thickness, laying ...xPVC pipes of ... mm diameter, inserting pipes ... x (2 x Φ 50/3.7mm), and backfilling the trench
74 121	pcs	Marking the transitions of cable duct from emergency lane to standing, installation, or bridging shaft (with sprayed red paint)
74 131	pcs	Preparatory works and protection of site
74 211	pcs	Supply and placing of installation cable shafts of dimensions L x W x H = 210 x 80 x 80 cm onto concrete underlay; shaft covers equipped with stainless steel handles (Prokron 11); shaft elements of cement concrete
74 212	pcs	Supply and placing of installation cable shafts of dimensions L x W x H = 210 x 120 x 80 cm onto concrete underlay; shaft covers equipped with stainless steel handles (Prokron 11); shaft elements of cement concrete
74 213	pcs	Supply and placing cable shafts for the need of light signalling: cement concrete pipe of Φ 80 cm, length 165 cm, with cast-iron frame and cover 60 x 60 cm, on C 8/10 concrete underlay, and air-entrained cement concrete C 25/30 for frame foundation
74 221	pcs	Earthing of standing shaft: excavation of trench of at least 60 cm depth, approximately 4 x 35 m on each side of the emergency call post, supply and laying (140 m^1) of rolled strip FeZn 25 x 4 mm into excavated trench, and connecting with both safety barrier and protective mesh
74 311	m^1	Supply and placing pipes of small diameter 3 x PE 02 2 x Φ 50/3.7
74 321	pcs	Supply and installation of metal plates of 60 x 100 cm for protection of PE pipes of small diameter where the cable duct passes below emergency lane to shafts
74 331	pcs	Pressure test of tightness and passability of PE pipes of small diameter
74 411	pcs	Preparatory work for installation of emergency call post: excavation, additional fill, asphalting, including cover of standing shaft
74 421	pcs	Supply and erection of emergency call post, which comprises: post casing with electronics (speaking set, connecting unit to terminate cables including over-voltage protection, terminal, illumination, connection of earthing busbar)
74 431	pcs	Supply of hot dip galvanized protective mesh (as per drawing), as well as

Item	Unit of Measure	Description of Works
		fabrication and placing cement concrete foundations for supports and protective mesh
74 441	pcs	Supply and placing survey pin of suitable shape and material (stainless steel) into asphalt above the point of crossing of cable duct and PE pipe of small diameter
74 451	pcs	Preparation of execution design for cable duct (at scale 1 : 1,000), including survey of underground cadastre, with shafts and places to fix emergency call posts, as well as entry of data into cadastral register of public utility lines
74 511	m^1	Supply and laying of telecommunication cable TD59M 5x4x0.9mm, which comprises terminations of the emergency call post cable onto cable clamps WDTR 2.5 WE (20 clamps), a cable on each side of the post, and execution of cable clamps
74 521	pcs	Supply and installation of power supply cabinet including power supply unit (continuous power supply) on the motorway route (at every 10 km, AC/DC 230 V/110 V)
74 531	pcs	Electric measurements of copper cable on drum prior to laying, preparation of report
74 532	pcs	Electric measurements of copper cable after laying, preparation of report
74 541	pcs	Measurements of stray currents, and preparation of report
74 551	pcs	Measurements of earthing resistance of locations where emergency call posts are mounted, and preparation of report
74 611	m^1	Supply and laying of telecommunication optical cable TOSM 03(6x8)xII/IIIx 0.36/0.24x3.5/17 CMAN
74 621	pcs	Supply and execution of optical cable clamp for 48 fibres, including execution of optical connections by welding
74 626	m^1	Supply and installation of metal casing to protect the clamp in cable shafts
74 631	pcs	Measurements of optical cable on drum prior to laying, and preparation of report
74 641	m^1	Supply and placing protective pipe against rodents, and provision of spare in a form of coil
74 651	pcs	Execution of measurements of optical cable and working out technical documents (as-built design)
74 711	pcs	Supply of central for the emergency call system, including hardware and software for the central at the communication (control) centre.
74 721	pcs	Supply and installation of 19" or ETSI cabinet (OD48T or OR 400), equipped with 40 connectors and terminal cables at individual locations to carry out branches and termination
74 731	pcs	Inserting of optical cable from the inserting cable shaft to the optical distributor at the motorway base, in a form of coil of approximately 25 m, including marking the cable (WARNING – LASER), and execution of internal sealing

2.2.7.11.4 Public Lighting

Item	Unit of Measure	Description of Works
75 111	pcs	Relocation of public road lighting as per drawing …………..
75 211	pcs	Execution of public road lighting as per drawing …………..
75 215	pcs	Execution of public lighting of the bridge carriageway as per drawing ...……..
75 218	pcs	Execution of public lighting to illuminate the bridge as per special drawing ......…..
75 221	pcs	Erection of public lighting post with anchor plate measuring 300/300/5mm
75 222	pcs	Erection of public lighting post with anchor plate measuring .../.../.. mm
75 311	m^1	Execution of cable duct of PVC pipes of 110 mm diameter (PC 110)
75 411	pcs	Supply and placing of prefabricated cable shaft of thermoplastic pipes
75 412	pcs	Supply and placing of prefabricated cable shaft of circular cement concrete pipes
75 413	pcs	Supply and placing of prefabricated cable shaft of square cement concrete pipes
75 421	pcs	Supply and placing of cast-iron cover of cable shaft for point loading 50 kN
75 422	pcs	Supply and placing of cast-iron cover of cable shaft for point loading 125 kN
75 423	pcs	Supply and placing of cast-iron cover of cable shaft for point loading 400 kN
75 511	pcs	Testing mean luminance of carriageway surface
75 521	pcs	Testing mean illumination of carriageway surface
75 531	pcs	Testing mean reflectivity of carriageway surface
75 611	pcs	Survey of public lighting and entry into the cadastral record of public utility lines

2.2.7.11.5 Water Supply Lines

Item	Unit of Measure	Description of Works
76 111	pcs	Relocation of water supply line as per drawing …………….
76 211	pcs	Execution of water supply line as per drawing ……………..
76 311	m^1	Execution of water supply line of hard PVC pipes of ... mm diameter
76 321	m^1	Execution of water supply line of PE pipes of ... mm diameter
76 331	m^1	Execution of water supply line of .... pipes of ... mm diameter
76 341	m^1	Execution of water supply line of seamless steel pipes, protected from corrosion, of ... mm diameter
76 351	m^1	Execution of water supply line of seam-welded steel pipes, protected from corrosion, of ... mm diameter
76 361	m^1	Execution of water supply line of cast-iron pipes, protected from corrosion, of ... mm diameter
76 371	pcs	Supply and installation of supports of water supply pipes, of corrosion resistant material
76 411	pcs	Supply and installation of pipe coupler …………….
76 421	pcs	Supply and installation of valve …………….
76 431	pcs	Supply and installation of vent …………….
76 441	pcs	Supply and installation of hydrant …………….
76 511	pcs	Execution of shaft for water supply line (as per drawing), cross-sectional dimensions 120/120 cm, depth … cm
76 512	pcs	Execution of shaft for water supply line (as per drawing), cross-sectional dimensions 120/170 cm, depth … cm
76 513	pcs	Execution of shaft for water supply line (as per drawing), cross-sectional dimensions 170/200 cm, depth … cm
76 514	pcs	Execution of shaft for water supply line (as per drawing), cross-sectional dimensions .../... cm, depth … cm
76 611	pcs	Pressure test of pipeline water-tightness – preliminary test
76 621	pcs	Pressure test of pipeline water-tightness – main test
76 631	pcs	Pressure test of pipeline water-tightness – entire network
76 711	pcs	Rinsing of water supply line
76 721	pcs	Disinfection and sanitary testing of water supply line
76 811	pcs	Survey of water supply line and entry into the cadastral record of public utility lines

2.2.7.11.6 Gas Conduits

Item	Unit of Measure	Description of Works
77 111	pcs	Relocation of gas conduit as per drawing …………..
77 211	pcs	Execution of low-pressure gas conduit as per drawing …………..
77 221	pcs	Execution of medium-pressure gas conduit as per drawing …………..
77 231	pcs	Execution of high-pressure gas conduit as per drawing ..…………...
77 311	m^1	Supply and installation of steel seamless pipe, protected from corrosion, for medium-pressure gas conduit
77 312	m^1	Supply and installation of steel seamless pipe, protected from corrosion, for high-pressure gas conduit
77 321	m^1	Supply and installation of steel seam-welded pipe, protected from corrosion, for medium-pressure gas conduit
77 322	m^1	Supply and installation of steel seam-welded pipe, protected from corrosion, for high-pressure gas conduit
77 331	m^1	Supply and installation of cast-iron pipe, protected from corrosion, for medium-pressure gas conduit
77 332	m^1	Supply and installation of cast-iron pipe, protected from corrosion, for high-pressure gas conduit
77 341	m^1	Supply and placing of PVC pipe for low-pressure gas conduit
77 411	pcs	Ultrasonic testing of pipe welds
77 421	pcs	Testing gas conduit pipe protective coating for breakdown
77 431	pcs	Testing gas conduit pipe welds for leakage by air pressure test
77 351	pcs	Supply and installation of supports of gas conduit pipes, of corrosion resistant material
77 511	pcs	Survey of gas conduit and entry into the cadastral record of public utility lines

2.2.7.11.7 Road – Railway Crossings

Item	Unit of Measure	Description of Works
78 111	pcs	Execution of road – railway crossing at grade as per drawing …………..

2.2.7.11.8 Testing

Item	Unit of Measure	Description of Works
79 111		A detailed description of all the tests required with individual works in connection with road construction is included in corresponding sections “Quality Control of Execution” in these technical conditions.
79 211	pcs	Execution of additional geotechnical tests as per programme .... ………………..
79 221	pcs	Execution of dynamical testing of a pile
79 231	pcs	Execution of load testing of a bridge of length up to 50 m
79 232	pcs	Execution of load testing of a bridge of length 51 – 100 m
79 233	pcs	Execution of load testing of a bridge of length 101 - 200 m
79 234	pcs	Execution of load testing of a bridge of length 201 - 500 m
79 235	pcs	Execution of load testing of a bridge of length more than 500 m

2.2.7.11.9 Supervison

Item	Unit of Measure	Description of Works
710 111	hrs	Designer’s supervision
710 121	pcs	Archaeological supervision as per programme …………..
710 131	pcs	Preservation of monuments as per programme ……………
710 141	pcs	Miner’s inspection as per programme …………….
710 151	pcs	Geotechnical supervision ……………..