

**GUIDELINES FOR ROAD DESIGN,
CONSTRUCTION, MAINTENANCE AND
SUPERVISION**

Volume I: DESIGNING

Section 2: DESIGNING BRIDGES

DESIGN GUIDELINES (DG 1.2.2)

Part 2: EDGE BEAMS, KERBS AND WALKWAYS

INTRODUCTION

Edge beams are lateral ends of bridges ensuring traffic safety. They are designed to withstand aggressive environment acting on exposed outer edges of the bridge superstructure.

Adequate materials for edge beams shall be selected to ensure the bridge durability as well as to enable maintenance and reconstruction of individual elements.

All the elements for designing kerbs and walkways on bridges on motorways as well as on main, regional, and local roads are indicated in this design guideline.

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1. SUBJECT OF DESIGN GUIDELINES

The intention of this DG 1.2.2 is to define and work out the methods of designing edge beams, kerbs and walkways for all possible bridge cross sections indicated in DG 1.2.1. Typified solutions of edge beams, kerbs and walkways are shown in the characteristic sketches for all feasible combinations for bridges on motorways, highways, main roads, regional roads, and local roads.

2. REFERENCE REGULATIONS

For the present design guidelines the following regulations have been adopted:

- Slovenian standard TSC 07.102 Edge beams, kerbs and walkways on bridges, 2001
- RAS-L Guidelines for road equipment, 1995 (*Richtlinien für die Anlagen von Straßen*)
- RAS-Q 96 Guidelines for road equipment, 1996 (*Richtlinien für die Anlagen von Straßen*)
- Directive drawings for bridges and other civil engineering structures issued by the Federal Ministry for Traffic, Road Construction Department, 1994 and 1995 (*Richtzeichnungen für Brücken und andere Ingenieurbauwerke*).

3. EXPLANATION OF TERMS

Edge beam is a safety and architectural element placed on the outer longitudinal edges of bridge superstructures.

Edge beam with walkway is an element of width 50 cm or more serving for pedestrians or cyclists.

Kerb is the edge beam end at the carriageway.

Notch on the edge beam is a measure foreseen to prevent soaking of the concrete surface.

Brushed concrete is a concrete which is at the beginning of its setting superficially treated with a brush in its fall direction.

4. GENERAL INSTRUCTIONS

In the road bridge cross section an edge beam represents an edge end ensuring mechanical safety of the traffic. A wheel missing the carriageway is caught and directed back to the carriageway. For this purpose, basic geometrical characteristics of the cross section are determined: the edge beam terracing at the carriageway amounts to 7 cm and the cross fall of the surface is uniform amounting to minimum 4%. Onto the edge beam a steel safety barrier is fastened. Instead of the latter, a concrete safety barrier can be foreseen as well. The surface of the load bearing structure below the edge beam, which represents a base for the waterproofing layer, shall be in any case inclined by minimum 2.5% towards the carriageway.

- 4.1 The fundamental shape of the edge beam for a particular normal profile can be found in the DG 1.2.1.
- 4.2 On regional and urban roads, edge beams with a walkway without a safety barrier are generally carried through, as major surfaces for footpaths and cycle tracks are required on bridges. A sufficient mechanical safety of the traffic is achieved by granite kerb raised by 18 cm. Since the vehicle speeds in the urban traffic are commonly much lower than on roads out of settlements, a jump of a vehicle over the kerb is practically impossible.
- 4.3 Ducts for communal installations are built-in into the edge beams of motorway bridges only exceptionally. When the edge beams and walkways are thicker, such ducts can be installed, however on condition that a protective concrete layer of minimum 4.5 cm is ensured. In case that the ducts for communal installations suspended below the bridge cantilever have to be put out of sight, the height of the vertical end of edge beam can be increased up to 1.0 m.
- 4.4 A detail of fastening of railing is shown in the DG 1.2.3.
- 4.5 The detail of fastening of the edge beam in the central reserve shall always be designed in such a way that a cross fall of minimum 2.5% of the waterproofing below the edge beam towards the carriageway is ensured.

4.6 An edge beam hides deficiencies in the bridge cantilevers due to the formwork inaccuracies, settling of the false-work supports, and overlapping of the transverse pre-stressing tendon anchor head. Irrespective of the geometrical imperfections of the structure, the edge beam shall retain the designed levels of the outer contour.

4.7 By the mechanical securing of the traffic, a safe passage of vehicles over bridges should be ensured. In particular the following shall be prevented:

- falling of vehicles from bridges,
- jumping-over of vehicles to the opposite traffic lane (securing of the central reserve).

Securing of vehicles is carried through by means of a steel safety barrier with a spacer, or a concrete safety barrier. The steel safety barrier transfers the loading via prop and reinforcement to the superstructure cantilever, and from here to the main girder via suitable reinforcement.

Design calculation of elements of the steel safety barrier is not required as the latter takes the energy of the vehicle impact by a plastic deformation, thus calculation of the substitutive static load becomes unreasonable. The vehicle impact at the point of the dynamical loading imposed by a sliding vehicle shall be taken into consideration by the substitutive static load acting 5 cm above the kerb upper edge. Load distribution at an angle of 45° shall be taken into account in the design calculation.

Impact moment:

$$M_i = H \cdot h$$

$$h = a + c + d/2$$

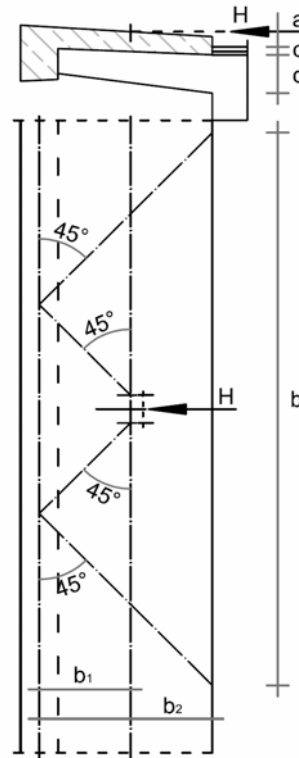
Influence width:

$$b_0 = 20 \text{ cm}$$

$$b_1 = b_0 + 2 \cdot b_1 + 2 \cdot b_2$$

$$m_H = M_u / b_1$$

$$b_H = H / b_1$$



a – distance from the point of application of force to the top of asphalt

c – asphalt thickness

For dimensioning the load case of bending with axial tension and safety factor $\gamma = 1.0$ is relevant.

In extreme load cases caused by vehicle impact on the steel safety barrier it cannot be excluded that one wheel of the vehicle will drive over the safety barrier line. Such static loading arising from the dynamic impact represents a load imposed by one wheel in the space between the railing and the steel safety barrier. Therefore, a wheel load of 50 kN acting on the area of 0.20 m x 0.30 m shall be taken into consideration. Load distribution at an angle of 45° shall be considered in this case as well. The superstructure cantilever shall be verified for the following load cases:

- dead load + traffic,
- dead load + individual wheel,
- dead load + traffic + impact on kerb ($\gamma = 1.0$).

4.8 Concrete

Edge beams are exclusively made of monolithic concrete of minimum grade MB 30. The concrete shall be resistant to freezing and of de-icing salts. The concrete upper surface shall be brushed.

4.9 Reinforcement

As the edge beams are considerably loaded due to shrinkage, they shall be reinforced with steel reinforcement amounting to minimum 0.9% of concrete cross section in the longitudinal direction. The steel reinforcement grade shall be RA 400/500-2. The longitudinal reinforcement is generally ϕ 10 mm. It is placed at spacing of 6.5 cm above and 11.5 cm below. The transverse reinforcement is ϕ 10 mm at spacing of 20 cm. The edge beam end is adjusted to the superstructure cantilever having a minimum thickness of 22 cm at its end and closed anchors of ϕ 12 mm at spacing of \leq 40 cm. The loading of edge beams in longitudinal direction can be reduced by transverse joints placed at intervals of up to 12 m on the locations of gullies if feasible. In case of smaller thicknesses of concrete the closed stirrups can be overturned thus achieving the prescribed protective concrete cover over the steel reinforcement.

4.10 Kerbs

Kerbs are made of natural stone such as granite or similar. The standard kerb length amounts to 1.0 m. The kerb cross section for motorway bridges amounts to 13 cm x 20 cm, whereas it is 20 cm x 23 cm for bridges on other roads. In the longitudinal direction the joint is sealed with durable elastic putty. The surface of pedestrian walkways shall be rough and the exposed edge shall be cut slantwise of minimum 5.0 mm.

4.11 The detail of anchoring of edge beams does not allow for the wind action on protective panels above railway track or motorway, as well as on noise barriers in settlements. For those loads the forces shall be calculated and taken with adequate anchors.

4.12 An edge beam with auxiliary walkway is generally foreseen for motorway bridges longer than 50 m.

4.13 The distance between edge beams in the central reserve of higher bridges is determined on the basis of transversal displacements due to the seismic action.

5. DRAWINGS

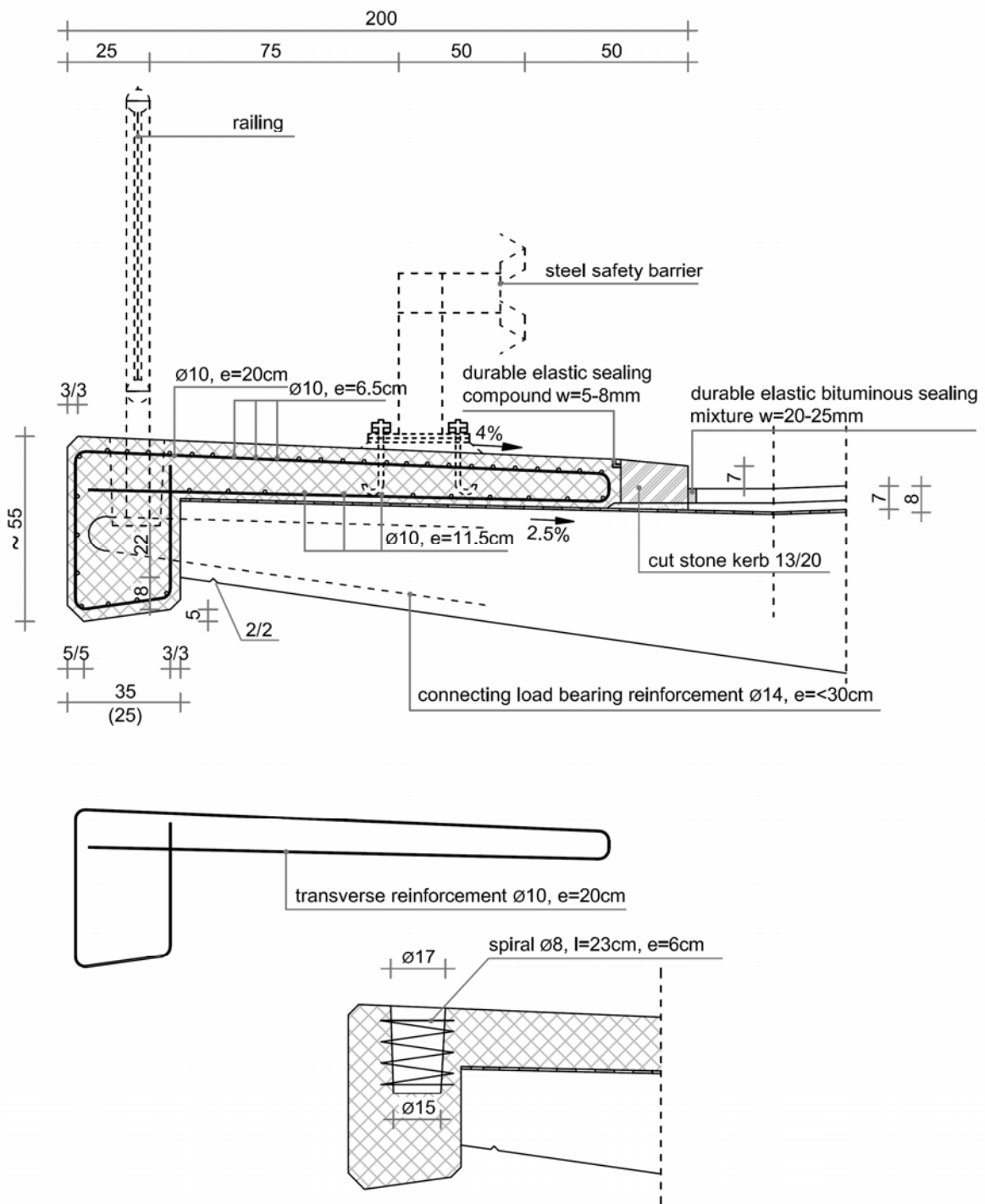


Figure 5.1 Edge beam with auxiliary walkway along outer edge on bridges on motorways and highways

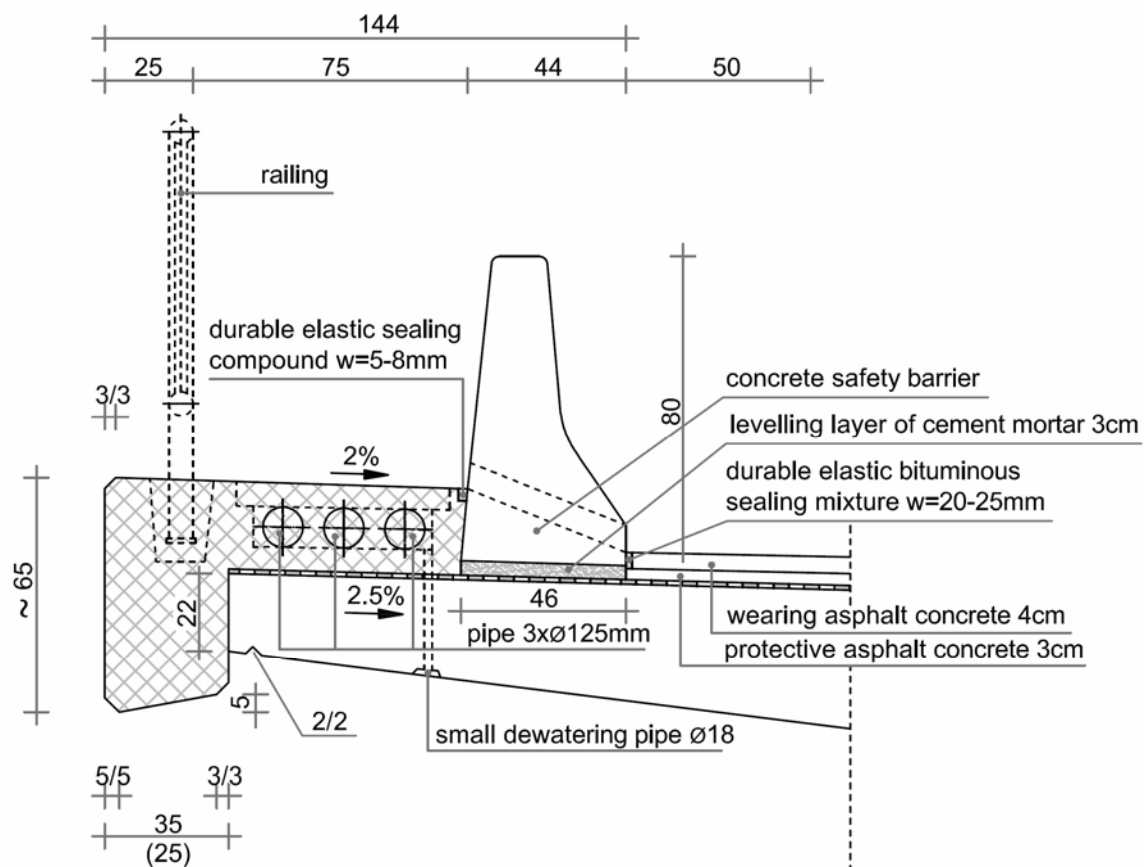


Figure 5.2: Edge beam with auxiliary walkway along outer edge with auxiliary walkway and concrete safety barrier on bridges on motorways and highways

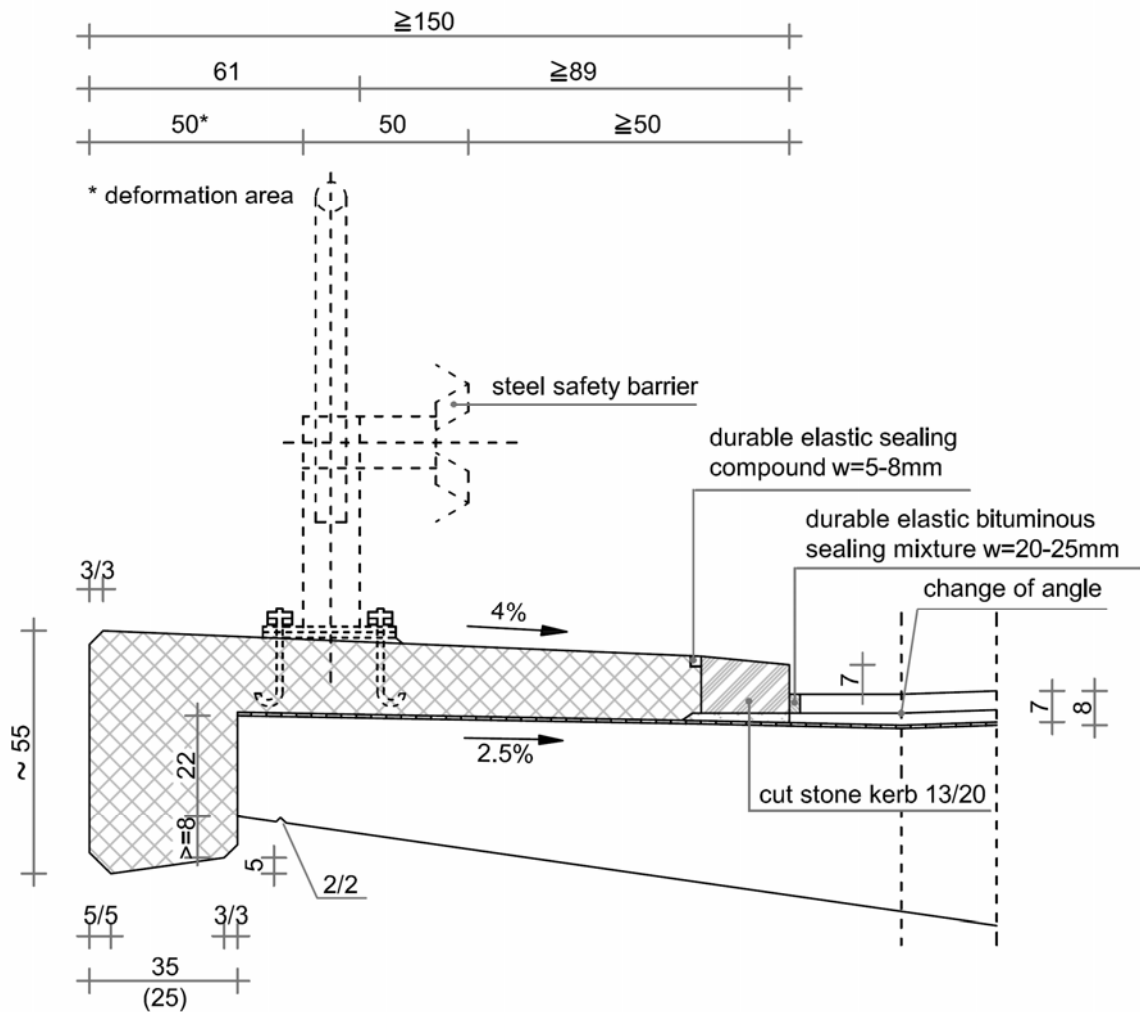


Figure: 5.3: Edge beam without auxiliary walkway along outer edge on bridges on motorways, highways, main roads, regional roads, and local roads
(The detail is relevant for bridge lengths up to 40 m and heights < 7.00 m)

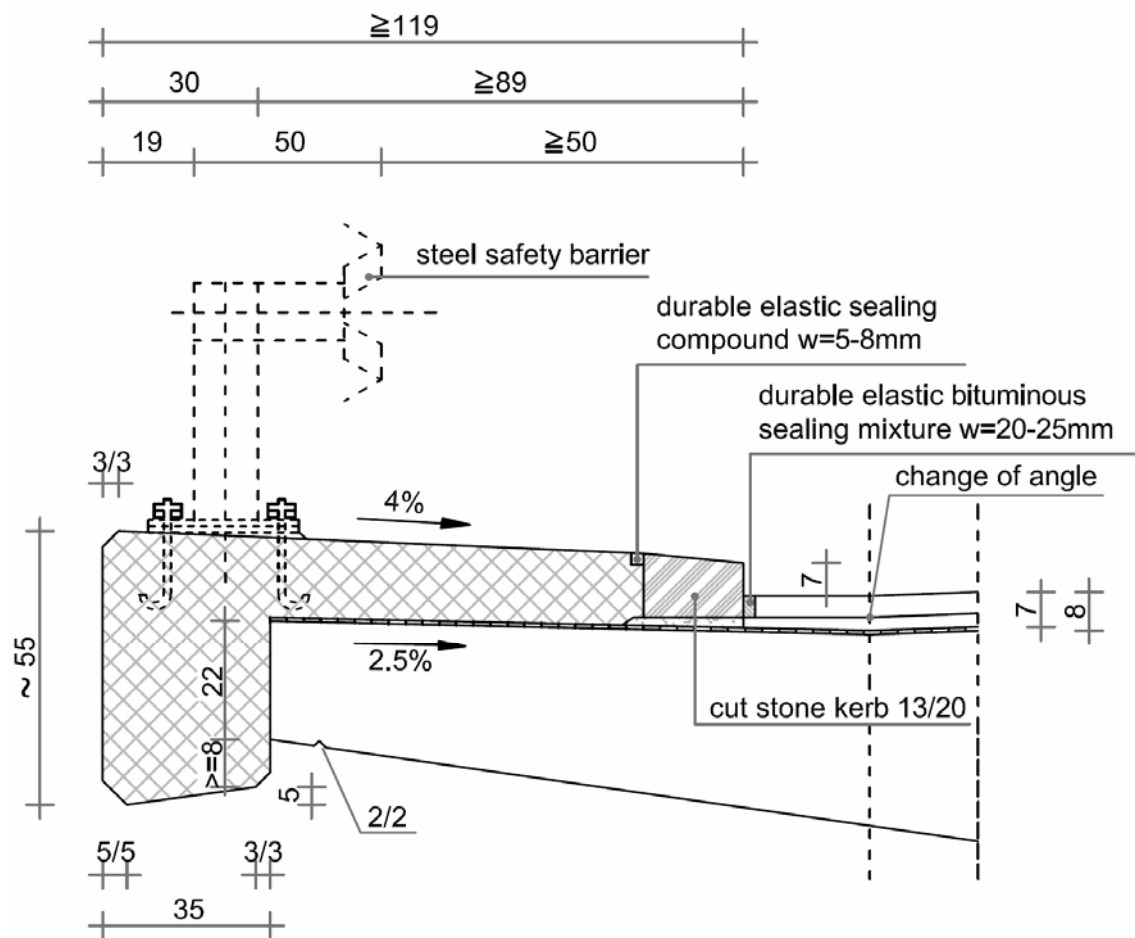


Figure 5.4: Edge beam without auxiliary walkway along outer edge on bridges on motorways, highways, main roads, regional roads, and local roads out of settlements (The detail is relevant for bridge lengths up to 20 m and heights < 3.00 m)

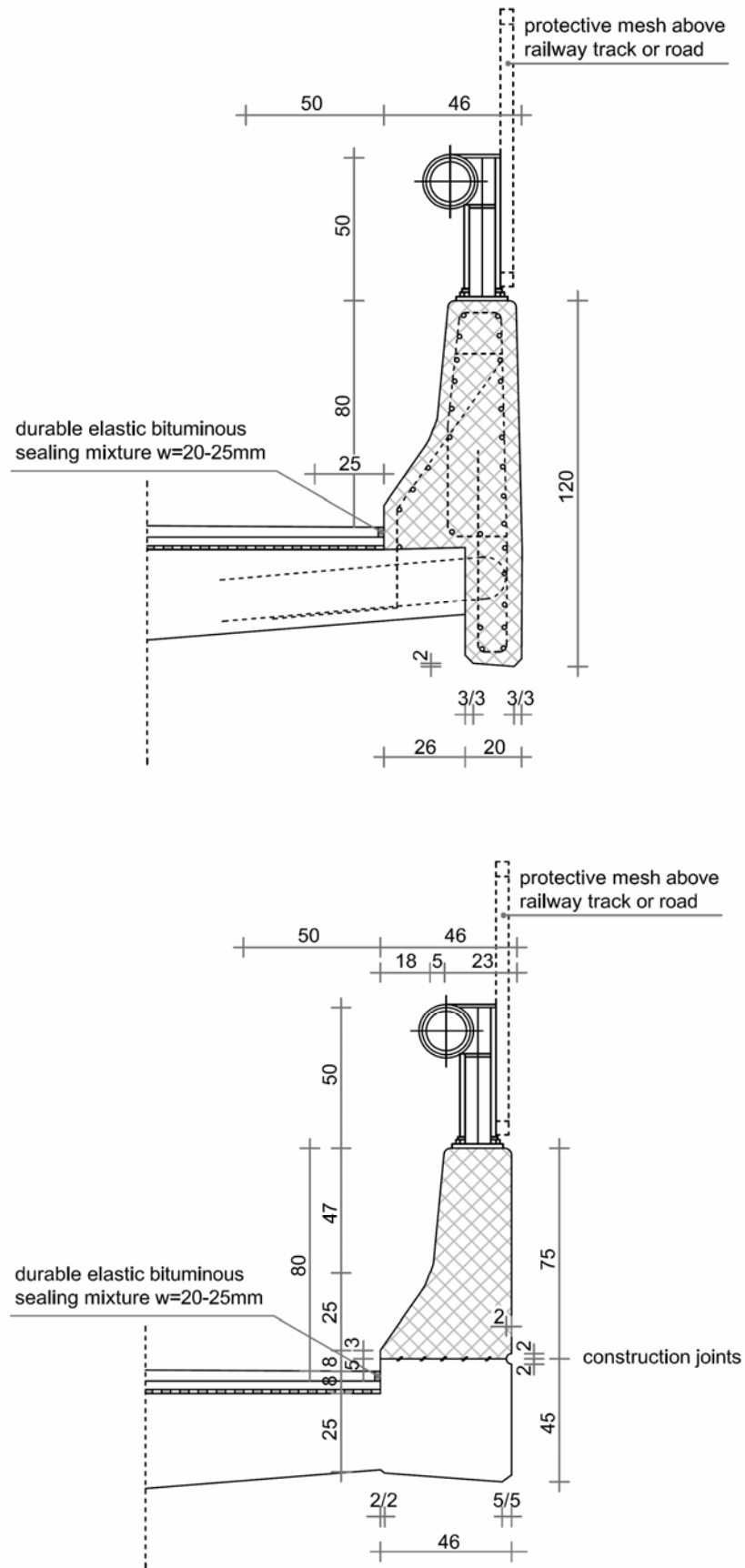


Figure 5.5: Edge beam without walkway and concrete safety barrier along outer edge on bridges on motorways and highways

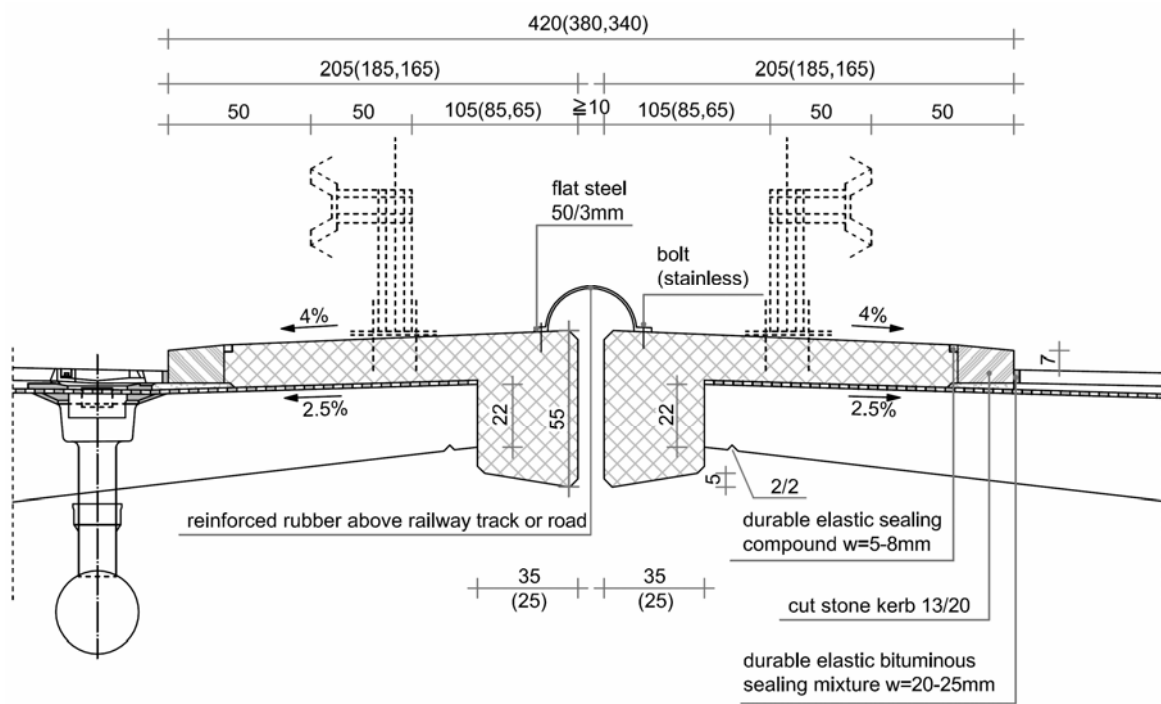


Figure 5.6: Edge beam with steel safety barrier along central reserve on bridges on motorways

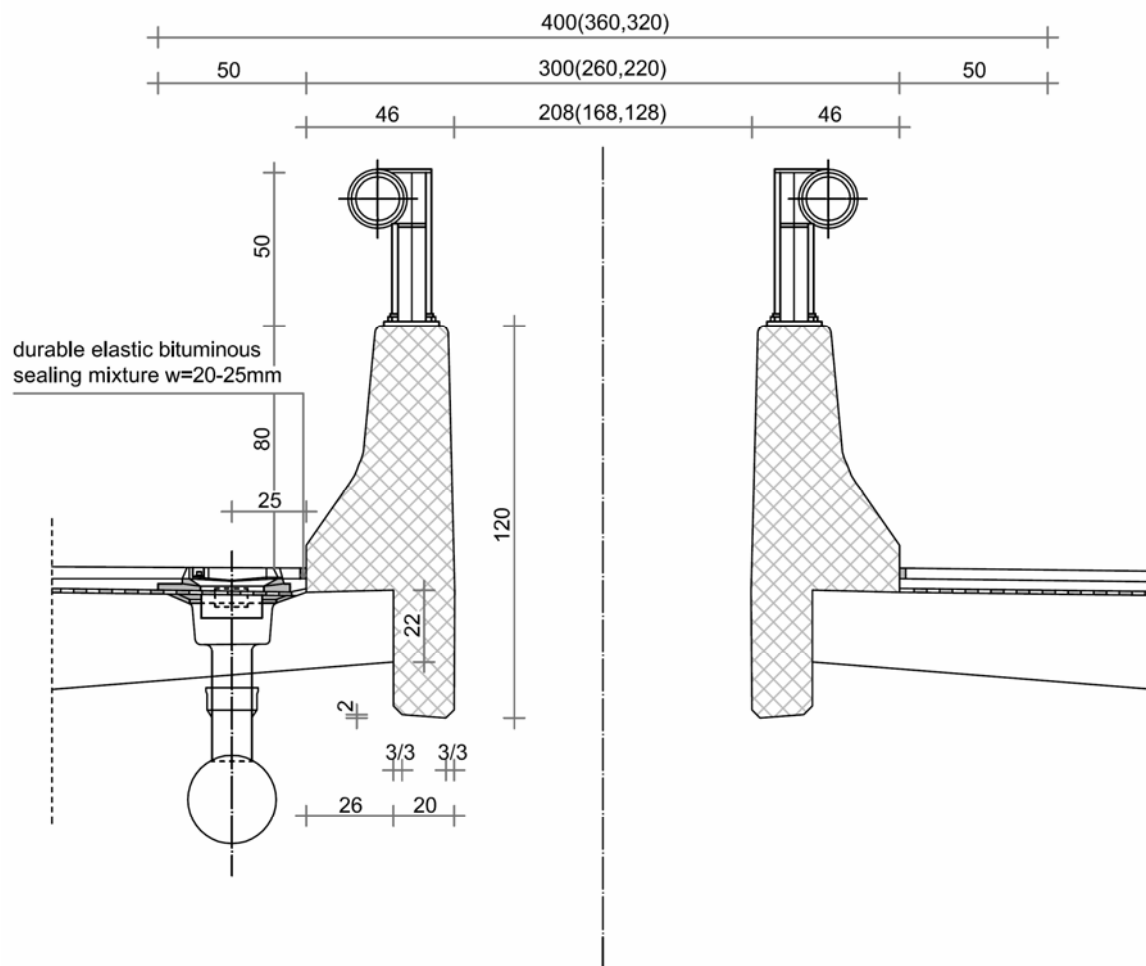


Figure 5.7: Edge beam with concrete safety barrier along the central reserve on bridges on motorways

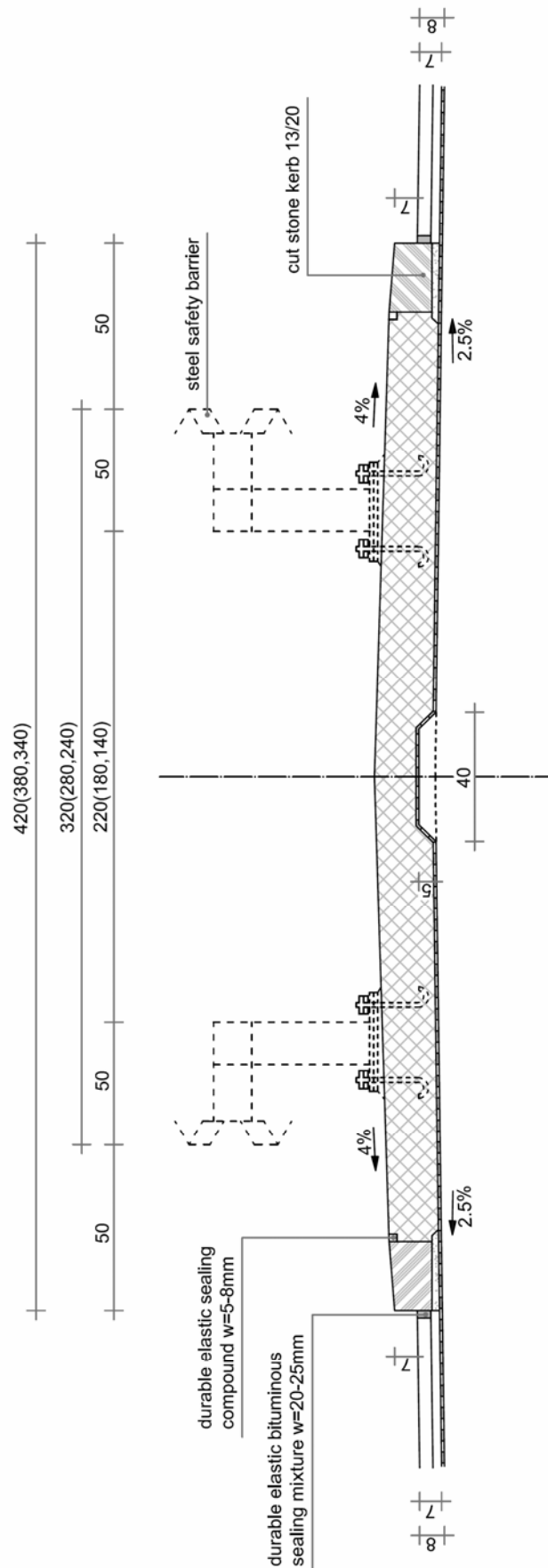


Figure 5.8: Edge beam along central reserve on bridges on motorways – alternative for longitudinally non-separated bridges

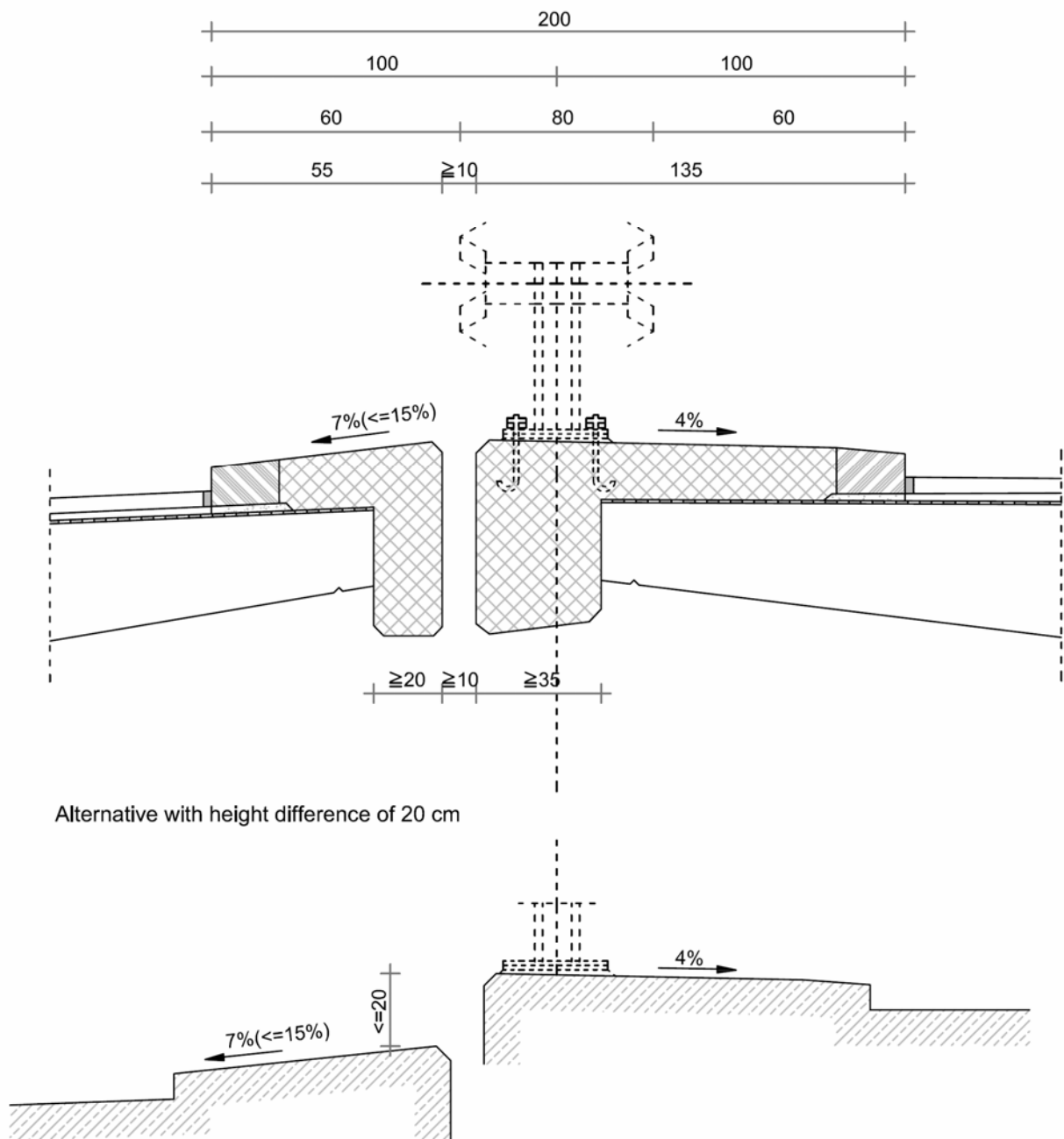


Figure 5.9: Edge beam along central reserve of 2.00 m width on bridges on motorways and highways

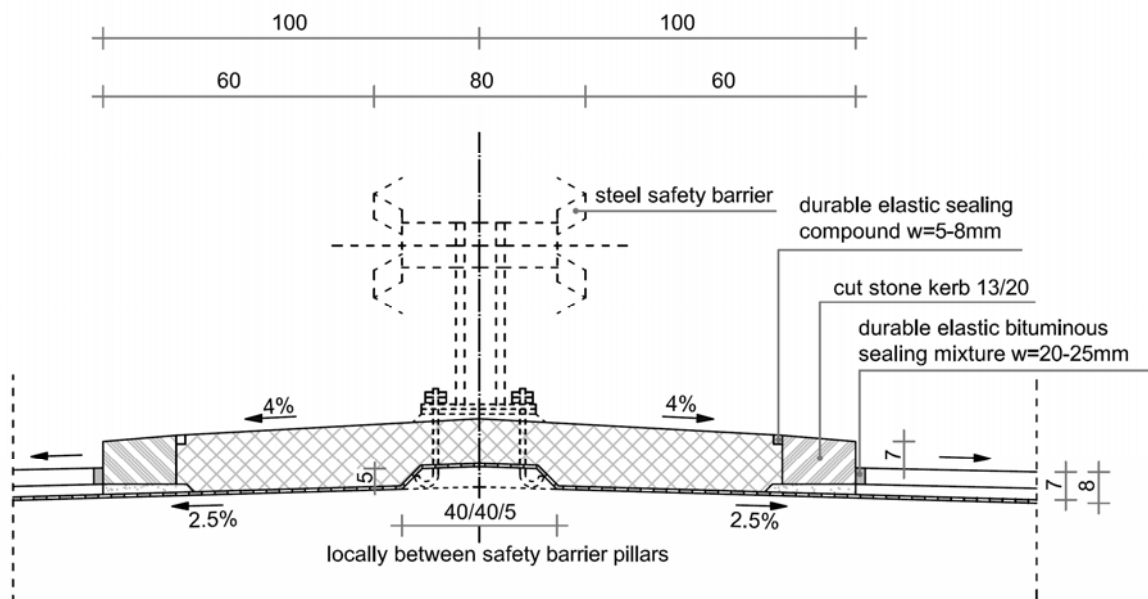


Figure 5.10: Edge beam along central reserve of 2.00 m width on bridges on motorways and highways– alternative for longitudinally non-separated bridges

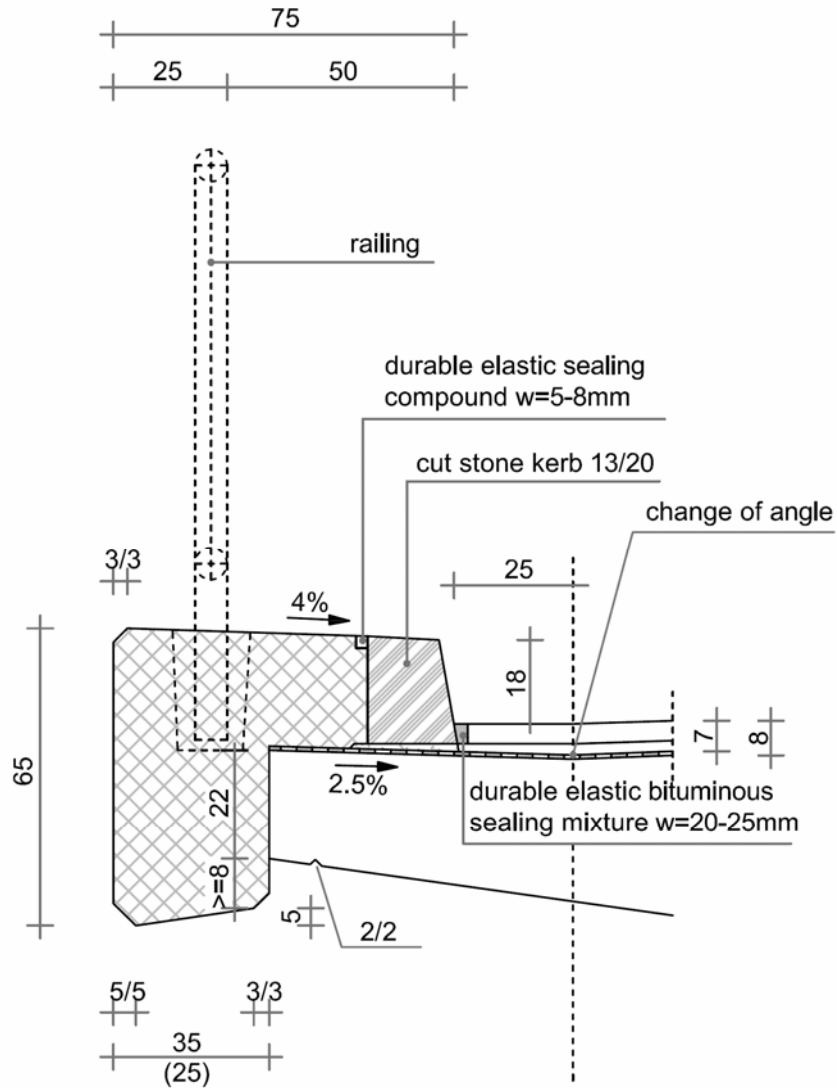


Figure 5.11: Edge beam along outer edge on bridges on two-lane (one-lane) public roads

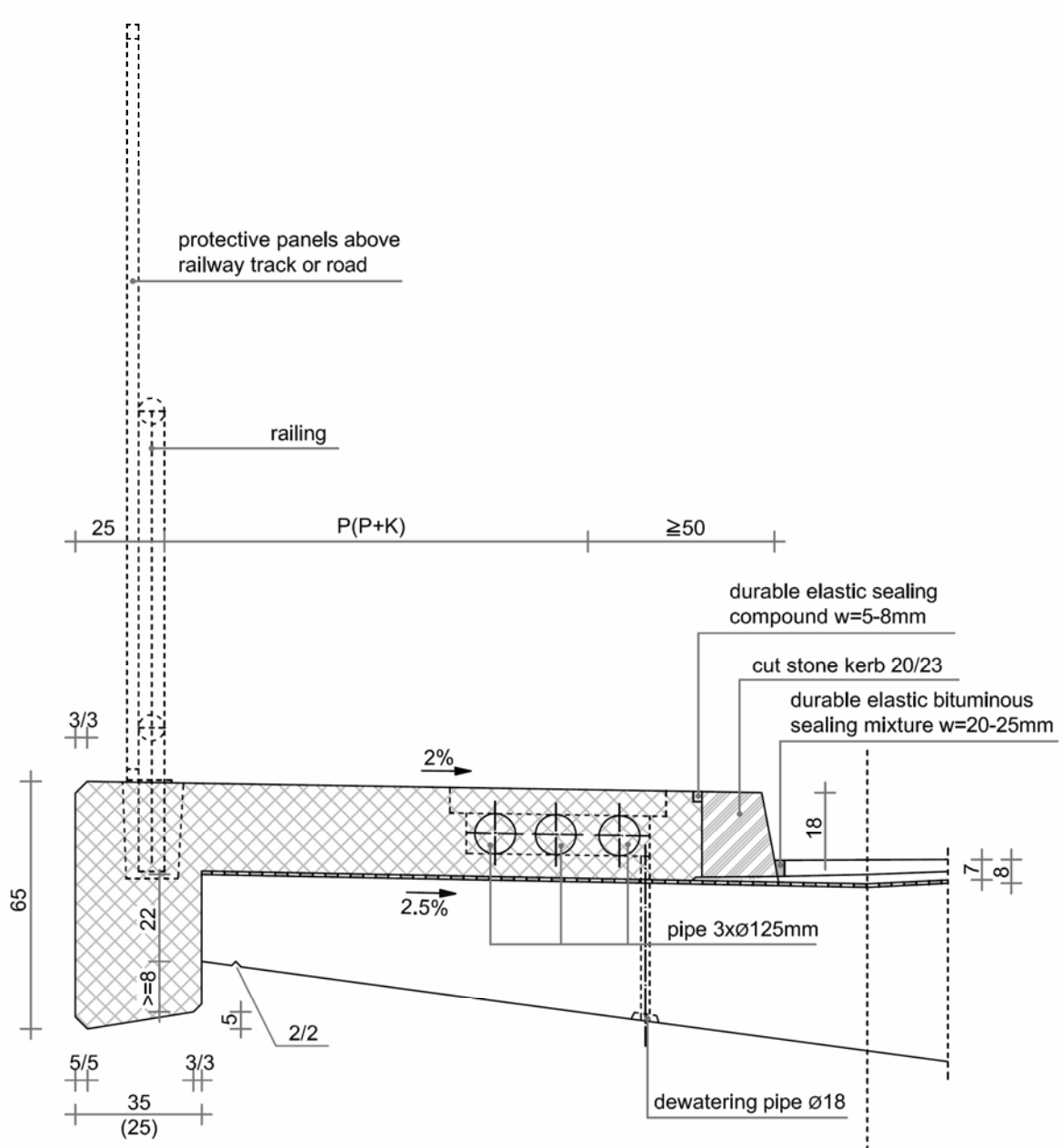


Figure 5.12: Edge beam along outer edge on bridges on main roads, regional roads, and local roads in settlements ($v \leq 50$ km/h)

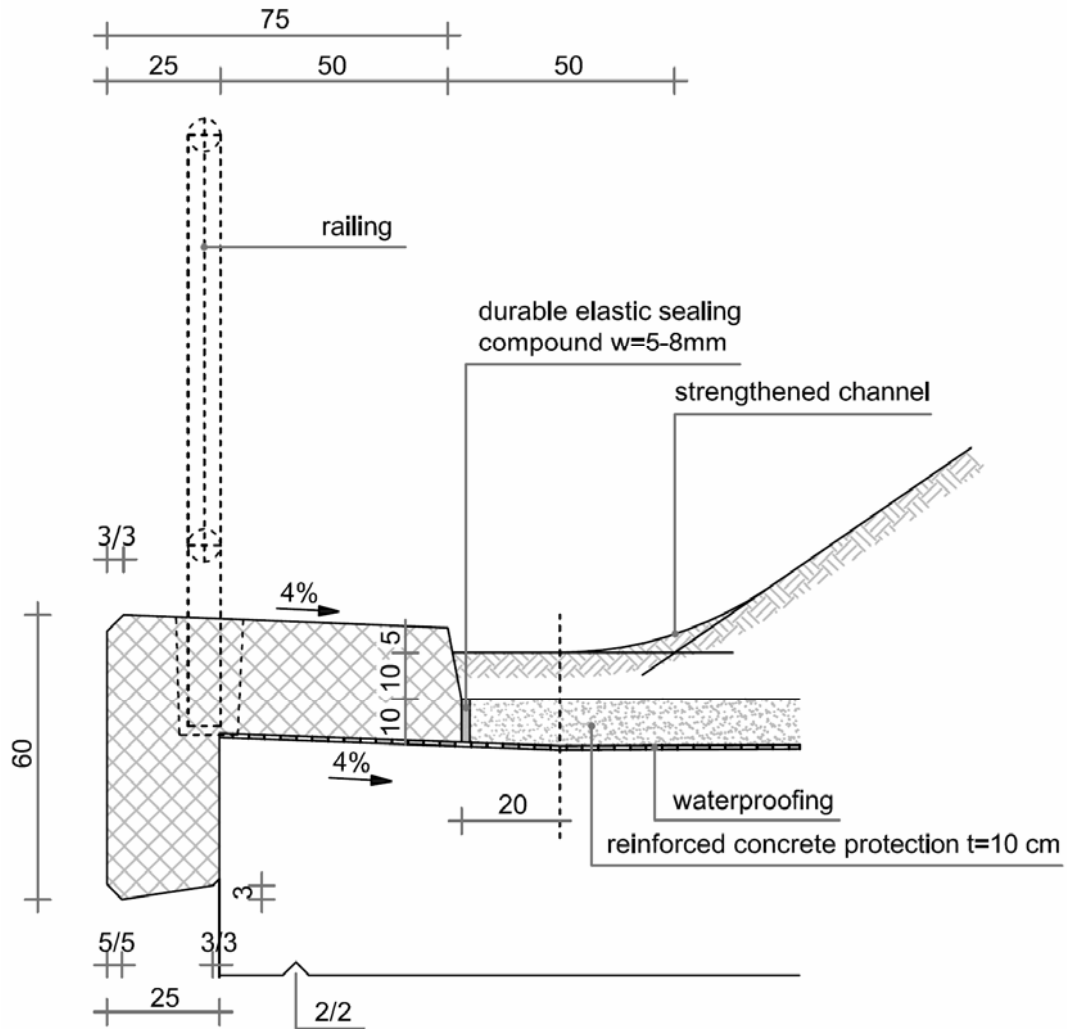


Figure 5.13: Edge beam on bridges below fills

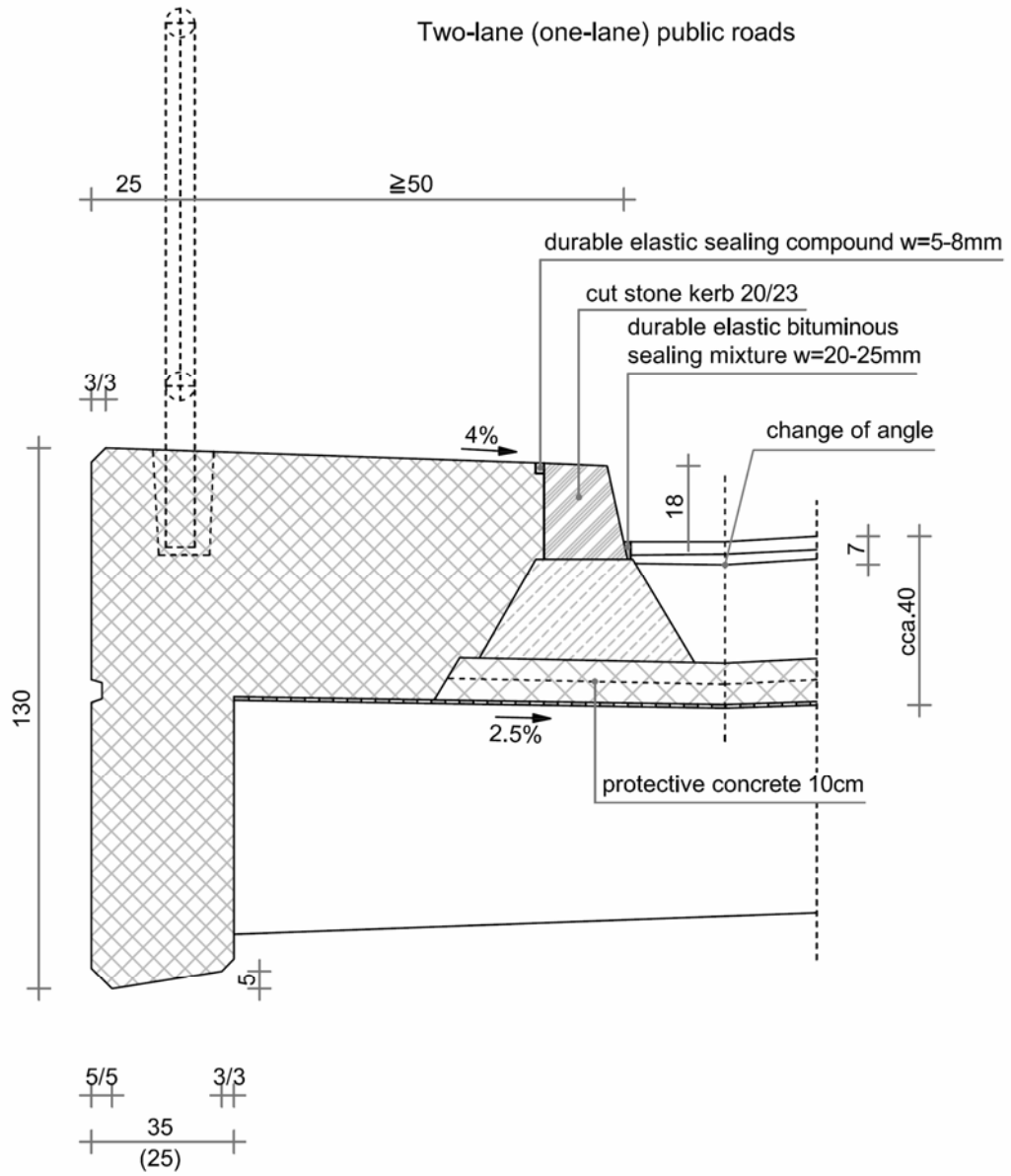


Figure 5.14: Edge beam on bridges with pavement structure of approx. 40 cm

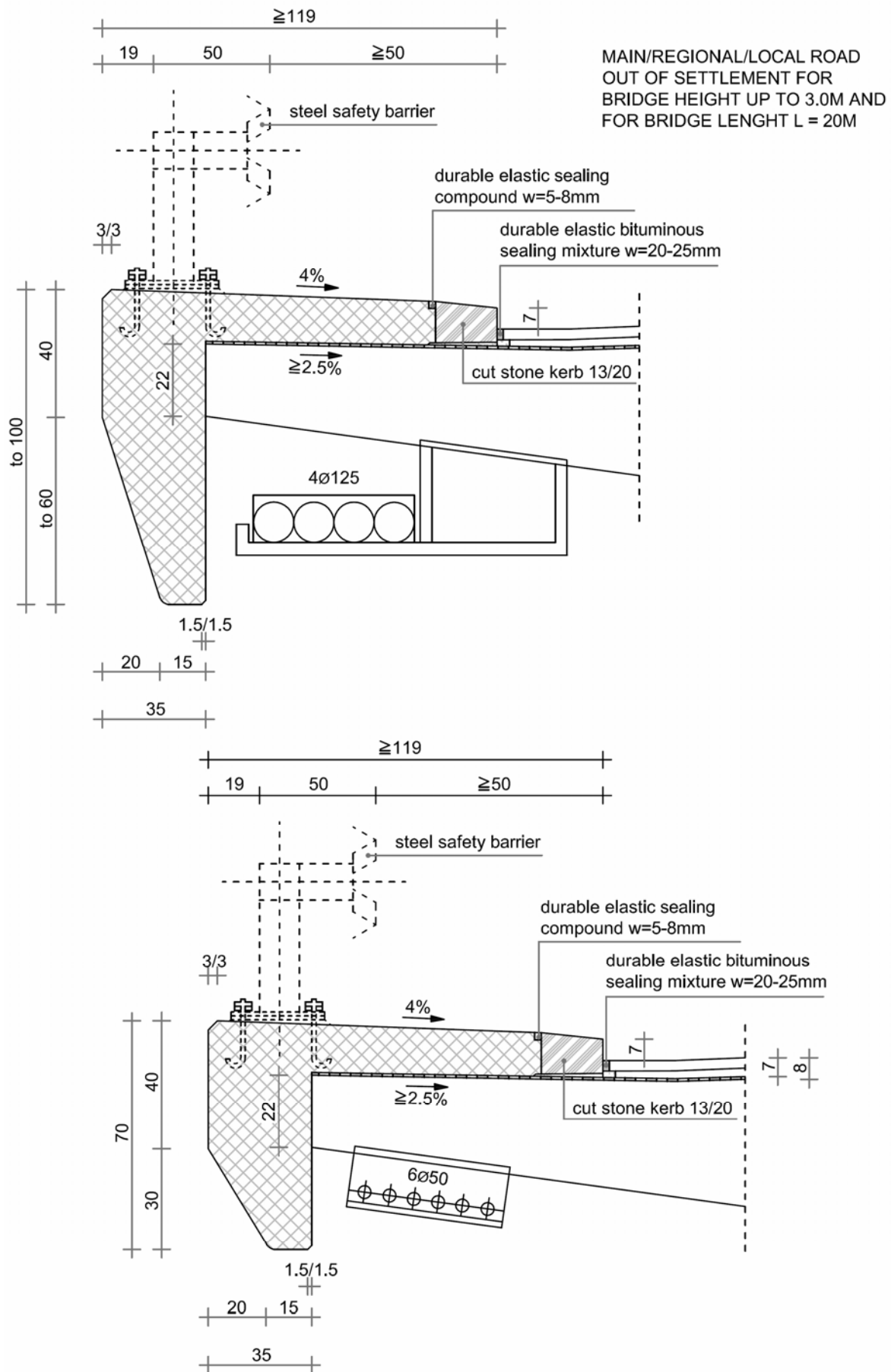


Figure 5.15: Edge beam with communal installations below cantilever on bridges of up to 3.00 m height

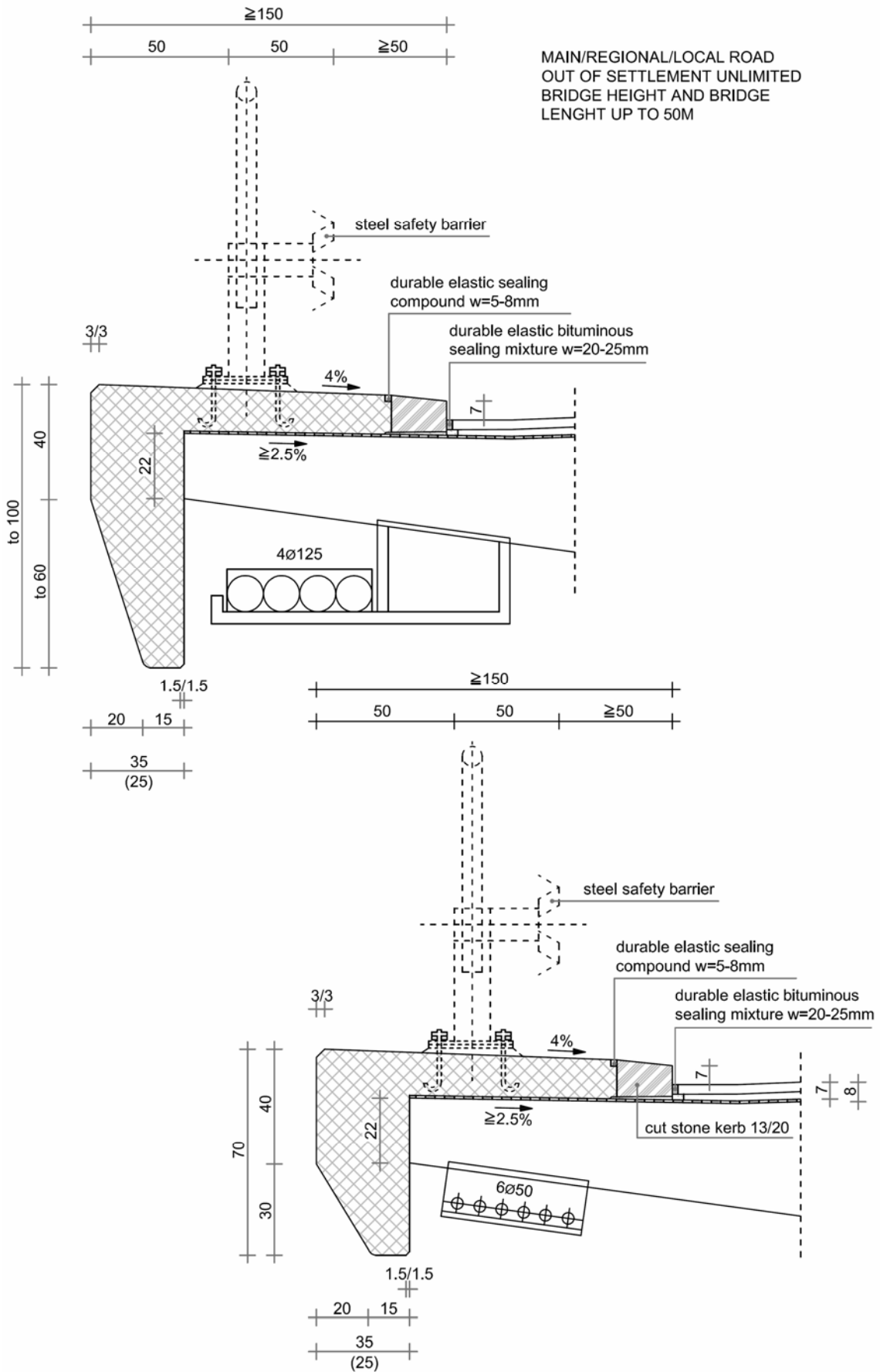


Figure 5.16: Edge beam with communal installations below cantilever on bridges on main roads, regional roads, and local road

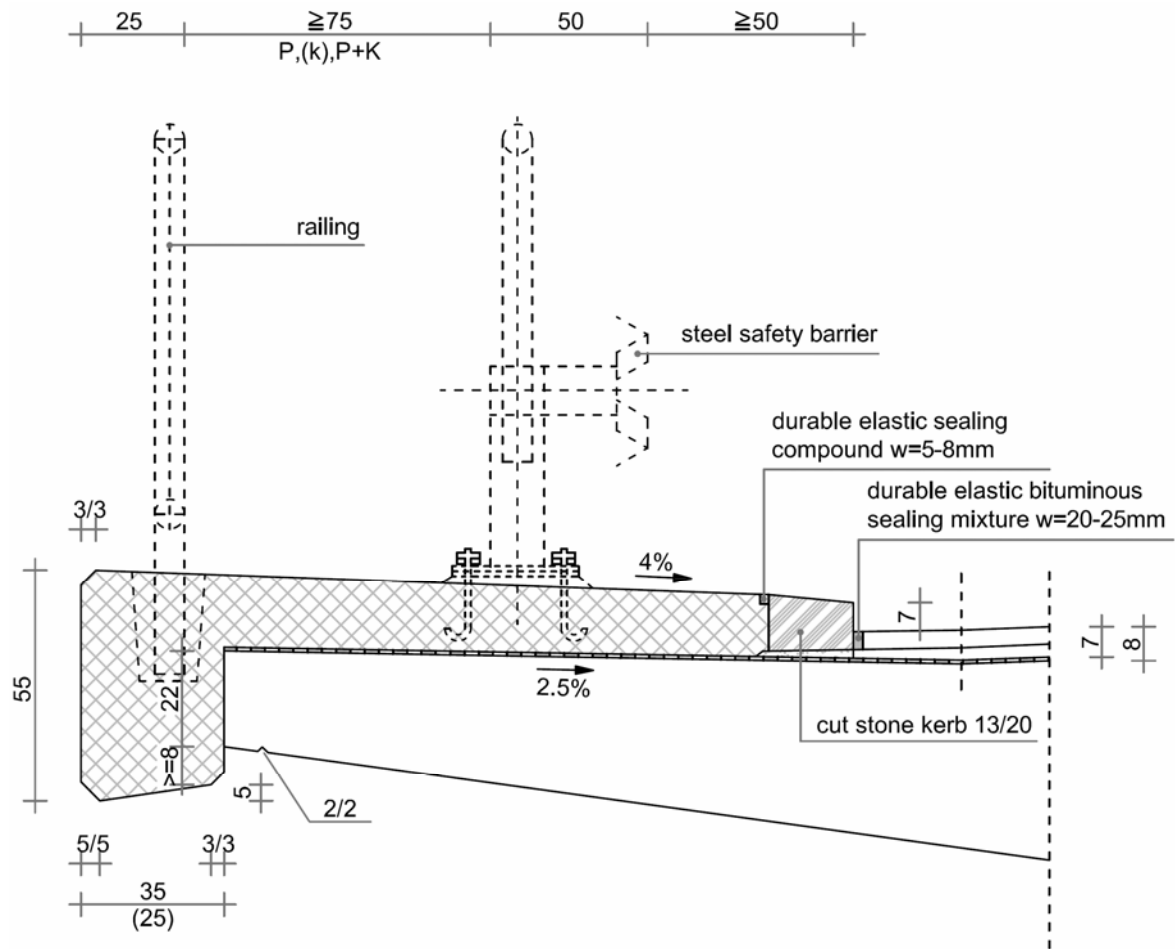


Figure 5.17: Edge beam with walkway along outer edge on bridges on main roads, regional roads, and local roads (out of settlements with footpaths and cycle tracks irrespective of bridge height and length)

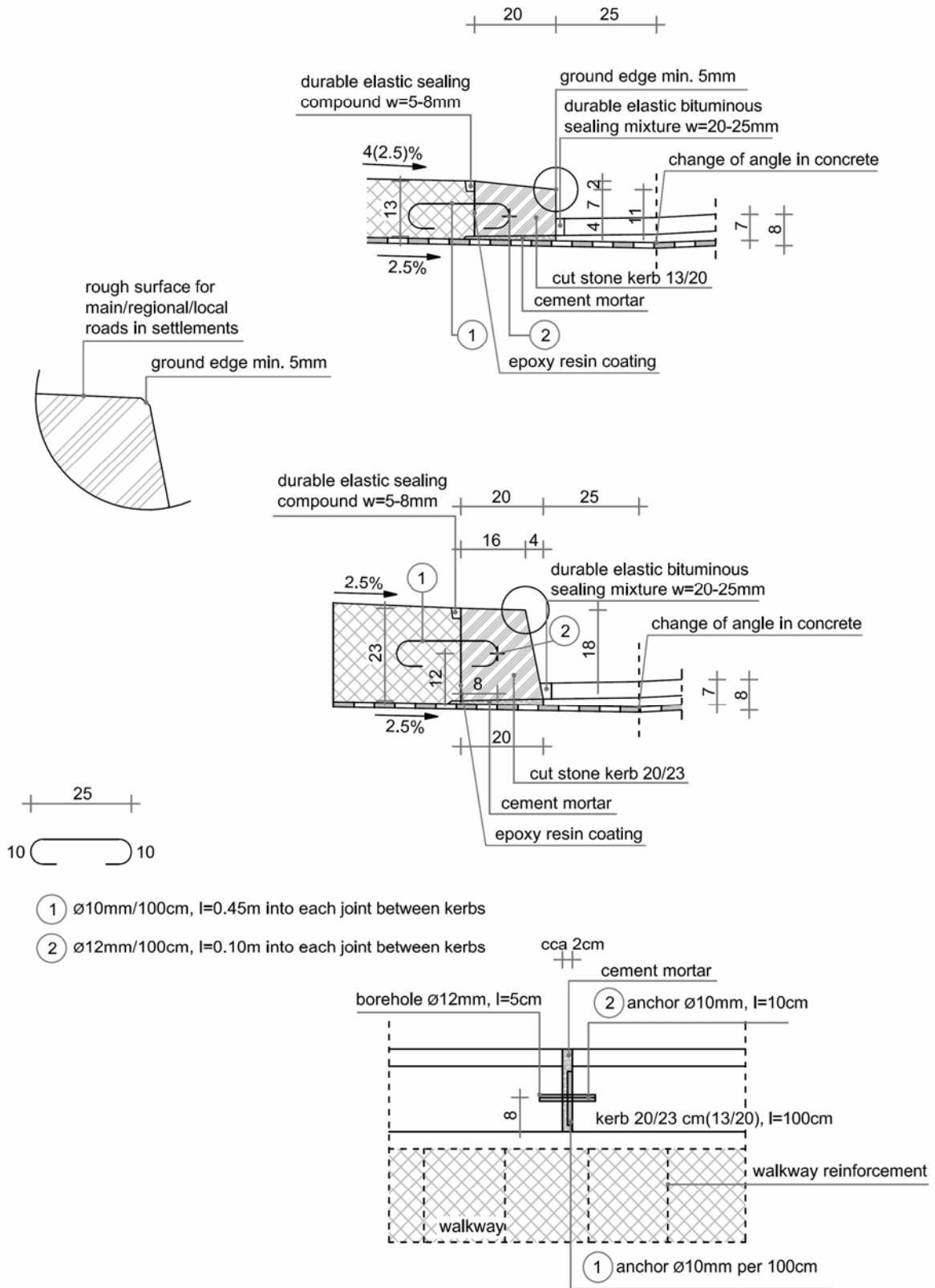


Figure 5.18: Detail of kerb