

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

**Volume I: DESIGNING**

**Section 2: DESIGNING BRIDGES**

**DESIGN GUIDELINES (DG 1.2.10)**

**Part 10: FORMWORK, FINISHING AND FACING OF  
CONCRETE SURFACES**



## INTRODUCTION

The final appearance of each concrete structure is a result of the quality and finishing of concrete surfaces. Exposed surfaces shall be solid and smooth. The most essential element having influence on the final performance of exposed concrete surfaces is the formwork, which gives the concrete its shape and appearance. Therefore, a special accuracy is required when selecting and arranging the formwork.

Finishing of exposed concrete surfaces can be carried out by moulding of fresh concrete mixture in the formwork already prepared, by subsequent painting or by stonecutting.

Individual bridge elements can be faced with stone when it is intended to increase their aesthetic value, particularly when the bridge is located in a region where the stone appears as a traditional material.

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## 1 SUBJECT OF DESIGN GUIDELINES

The present Design Guidelines cover the problems arising when exposed concrete surfaces are to be carried out on bridges. The goal of these Design Guidelines is to provide durable, quality and aesthetically acceptable bridges.

The subject of the present Design Guidelines is finishing of concrete surfaces after hardening by a mechanical treatment, as well as facing of exposed (visible) surfaces with stone.

## 2 REFERENCE REGULATIONS

The following European Norms for the design of concrete structures are included in the present Design Guidelines:

- EN 1992-1-1 Part 1-1 General Rules and Rules for Buildings
- EN 1992-1-2 Part 1-2 General Rules – Structural Fire Design
- EN 1992-1-3 Part 1-3 General Rules – Pre-cast Concrete Elements and Structures
- EN 1992-1-4 Part 1-4 General Rules – Lightweight Aggregate Concrete with Closed Structure
- EN 1992-1-5 Part 1-5 General Rules – Structures with Un-bonded and External Pre-stressing Tendons
- EN 1992-1-6 Part 1-6 General Rules – Concrete Structures
- EN 1992 Part 2 Concrete Bridges
- EN 206-1:2000 Part 1 Specification, Performance, Production and Conformity

## 3 EXPLANATION OF TERMS

**Quarry-stone** is a piece of stone won at a quarry by breaking or blasting. The shape of quarry-stones is irregular. They can be built-in without any additional treatment.

**Stone facing** is an external wall (e.g. cement concrete wall) revetment made of suitably shaped quarry-stone.

**Packed rock-fill** is a retaining structure made of cubic or flat quarry-stones of suitable size placed in dry.

### Facing

Treatment/protection of exposed structural surfaces by shot cement concrete, other

cement concrete type, pre-cast elements or other suitable material.  
Pavement surfacing applied in certain cases (on a bridge, with slabs)

**Bridge deck surfacing** is composed of a waterproofing sealing and a wearing course. Being able to take the loading, it acts as a pavement structure and protects the bridge deck from the surface water action.

**Freeze resistance** is a material (compound, mixture) soundness assessed by the test of alternating freezing – thawing cycles.

**Freeze and thawing salt resistance** is a resistance of hardened cement concrete or its products being soaked and exposed to alternating freezing – thawing cycles accompanied by a simultaneous thawing salt action.

**Protective concrete cover** is a cement concrete layer above the outer edge of the steel reinforcing bars. In this way, corrosion protection of re-bars is provided 4,5cm (5,0cm).

## 4 FORMWORK FOR EXPOSED CONCRETE SURFACES

### 4.1 General

The term “exposed concrete” relates to concrete or concrete elements, which, by their appearance, influence the aesthetic value of a particular structure. This applies to both civil engineering structures and buildings. Particularly to the latter, the exposed concrete is important, since residential, business and other buildings are subject to critical eyes of passers. However, it does not mean that in civil engineering structures such as bridges, the exposed concrete surfaces can be ignored.

With regard to the required durability of concrete, the surfaces should be solid and smooth.

One of the most essential elements affecting the final performance of concrete surfaces is positively the formwork giving the concrete its shape and appearance, unless, of course, the exposed surfaces are covered. Therefore, a special accuracy is required when selecting and arranging the formwork.

The present technology of execution of exposed concrete surfaces employs the following formwork materials: timber, steel and plastic.

Timber is the most widespread material to manufacture formworks used to carry out exposed concrete surfaces. Due to a relatively attractive price and favourable mechanical properties (bearing capacity, specific gravity, workability), timber is the most popular material. It can be practically used for all types of structures. The basic deficiency of timber is the fact that the formwork gets damaged at repeated application, thus it becomes unsuitable for further use.

A subsequent repair of new exposed concrete surfaces is not permitted.

For the fabrication of precast concrete elements, steel formwork is commonly used. A protective coating shall be applied to steel formwork prior to casting. The coat that might remain on the exposed concrete surface shall not affect the final appearance of the latter.

When a concrete surface is curved, the formwork can also be made of plastic modular elements. The local stability and the supporting system of those elements shall be ensured.

As the formwork is an important element, the formwork drawings shall include all the requirements and directives to be considered by the contractor.

#### 4.2 Joints

Inaccurate and shifted joints of formwork elements affect the appearance of exposed concrete surfaces. Even for surfaces to be additionally finished at a later stage, such joints can be disturbing.

The number of joints between formwork panels shall be reduced as much as possible.

Therefore, when placing the formwork for exposed concrete surfaces, the joints shall be generally arranged in accordance with a special drawing, notwithstanding a subsequent finishing of those surfaces. The joints shall be distributed uniformly and simply as much as possible. Any imitation of masonry joints as well as shifting of joints is not allowed.

On surfaces interconnected at an optional angle, the joint arrangement shall remain the same, and the joints shall be continuous.

#### 4.3 Formwork Timber Elements

Distinction is made between a formwork made of boards and a formwork made of panels. For the latter, a perfect smoothness without any edging is required. It is recommended to apply only one formwork type to a particular structural element, such as abutment, pier, etc.

The dimensions of formwork timber panels amount to 50/200/2.5 cm. The panels shall be so coupled as to prevent shifting of joints. When boards are used to erect a formwork, their dimensions of all shall be the same. The formwork panels shall be of the same shape and size. The same formwork material shall be applied to the ends as well. The direction of placing the formwork shall also be kept. The corner edges shall be executed slantwise.

#### 4.4 Colour of Exposed Concrete Elements

It is generally requested that exposed concrete surfaces keep the appearance of natural concrete. The colour of these surfaces shall be uniform and without stains. Adequate coating materials shall be used to protect the formwork elements in order to avoid stains on and a non-uniform colour shade of exposed concrete surfaces.

#### 4.5 Formwork Anchoring and Strutting

During casting certain horizontal forces act on the formwork walls (dead weight of concrete mixture). These forces shall be taken by means of anchors serving to fasten together the formwork walls. The anchors are fixed on the formwork outer side. After striking the formwork, visible spots remain on the concrete surfaces, where the formwork was linked together. This cannot be avoided even by a subsequent finishing of the exposed side. Therefore, the anchor locations shall be uniformly distributed preliminarily, which shall be indicated in detail in the formwork drawing.

**The number of anchors and struts shall be reduced as much as possible. No steel anchors or their constituent parts subject to corrosion must remain on the surface.**

The voids that remain after removal of the anchors shall be filled up with the same concrete mixture as it has been used to cast the structural element itself.

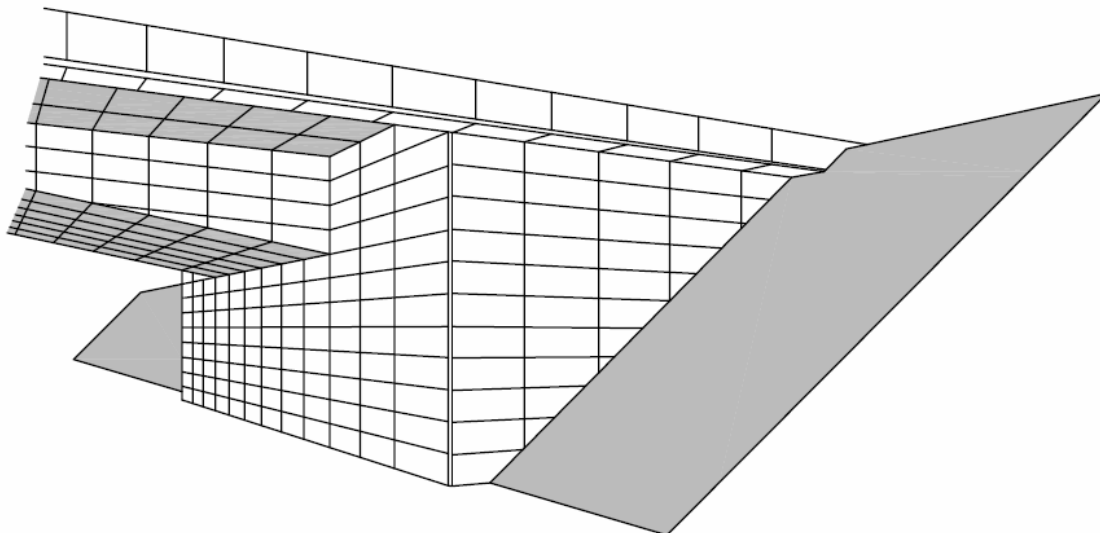
Should the anchors remain in the concrete, their points shall be hidden below the concrete surface.

Not only anchors but also spacers and propping material for steel reinforcement shall be uniformly distributed which shall be foreseen in advance. Namely, after striking the formwork, these elements remain visible. It is obligatory to use concrete spacers made of the same concrete mixture as it has been used to cast the structural element itself.

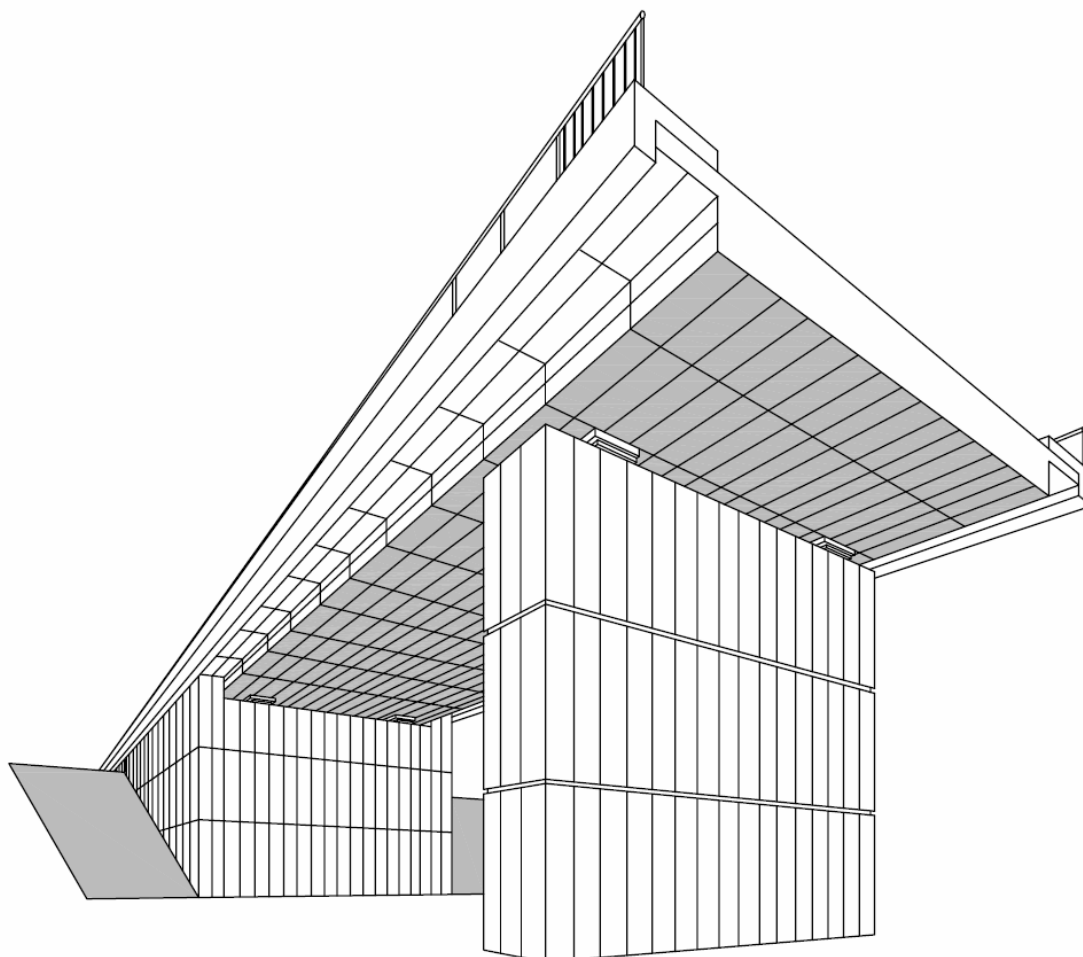
#### **4.6 Casting Concrete**

The quality of casting the concrete mixture also affects the final performance and appearance of concrete surfaces. The most uniform distribution of the concrete mixture is achieved by a constant vibrating using vibrating tables. However, this method is only applicable to fabricate precast elements in workshops. On construction sites, pin vibrators are commonly used.

For the precast elements, but also in general, the edges shall be executed slantwise. In this way, a non-uniform crumbling of exposed spots on the concrete surface is prevented. Such shaping of edges is carried out by means of inserting triangular fillets into the formwork. The fillet dimension is selected in view of the concrete element dimensions; however, the fillet shall not be smaller than 1.5/1.5 cm. It can be made either of wood or plastic. Steel formwork used to fabricate precast elements, usually require plastic fillets.

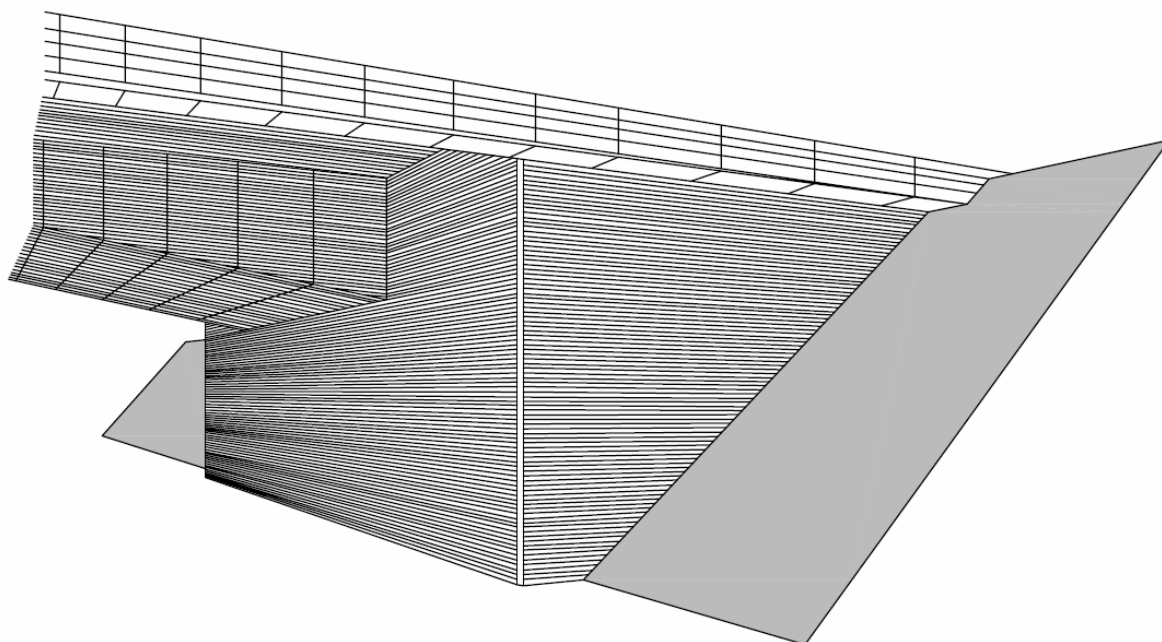


*Fig. 4.1: Arrangement of formwork composed of panels to construct a frame reinforced concrete structure*

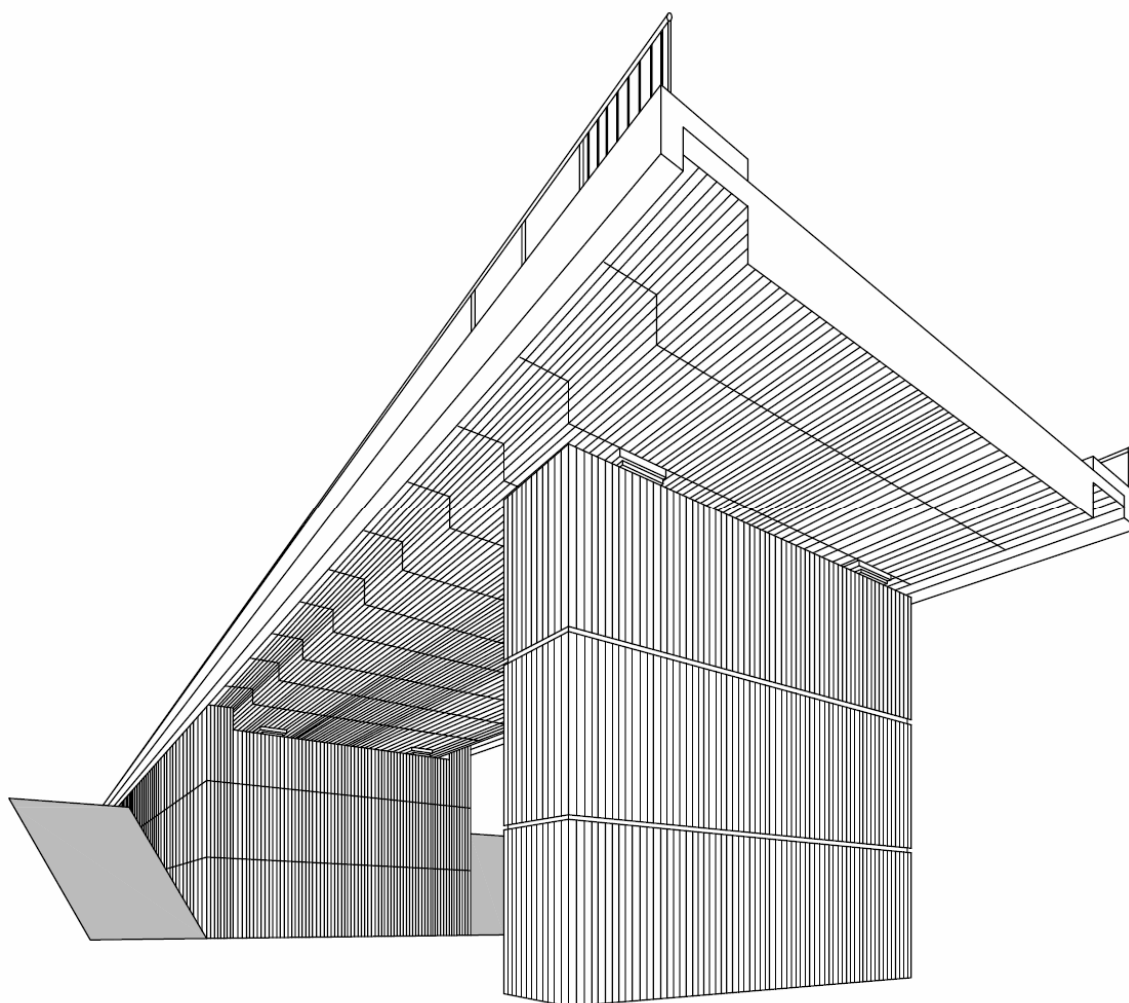


*Fig. 4.2: Arrangement of formwork composed of panels to construct a beam reinforced concrete structure*





*Fig. 4.3: Arrangement of formwork composed of boards to construct a frame reinforced concrete structure*



*Fig. 4.4: Arrangement of formwork composed of boards to construct a beam reinforced concrete structure*

## 5 FINISHING OF EXPOSED CONCRETE SURFACES

### 5.1 General

Finishing of exposed concrete surfaces can be carried out by moulding of fresh concrete mixture in the formwork already prepared, by subsequent painting or by stonecutting.

### 5.2 Protective Concrete Cover

The load bearing capacity of any concrete elements depends on the cross-section of both the steel reinforcement and the concrete within the reinforcement, whereas its durability depends on the concrete cover to the reinforcement, protecting the latter from external aggressive actions. All these aggressive impacts, including the climate and the environment, act on the concrete from the outside. Therefore, the durability of concrete is predominantly dependent on the composition and properties of the upper layer consisting of the following layers:

- cement skin of a thickness approx. 0.1 mm,
- fine mortar layer of a thickness approx. 4 mm,
- concrete layer of a thickness approx. 30 mm.

The quality of the surface concrete is lower than the quality of the concrete in the structural element interior and of the laboratory specimen due to the following reasons: wall effect at the formwork, concrete anisotropy as a consequence of sedimentation and segregation after compaction, different conditions of surface finishing and different conditions of curing. All this leads to major variations in water/cement ratios, in aggregate/cement ratios, in aggregate fineness modulus, and to a greater porosity of the surface layers in comparison with the concrete interior. A greater porosity allows an easier penetration of aggressive substances from the air or solutions, and contributes to an increase of extension under freezing-thawing conditions, particularly in the presence of de-icing salt.

Each intervention such as impregnation, application of protective coating etc., introduced to improve the concrete element resistance, requires the cement skin and, sometimes, the concrete layer to be removed.

The European Norms for the design of reinforced concrete structures specify minimum concrete cover to the reinforcement

depending on the environmental aggressiveness rate. The Eurocode 2 defines the minimum concrete covers within a range of 10 to 40 mm, plus additional 5 to 10 mm with regard to the quality control performed.

The practice has shown that the concrete covers recommended by different regulations are rather insufficient under extremely severe conditions. This particularly applies to the maritime environment or to the roads where de-icing salt is used. In such cases the concrete cover should be determined on the basis of the calculated penetration rate of aggressive substances, or of the assumed mechanism of concrete decay. A thicker concrete cover ensures a better adhesion of the concrete to the steel reinforcement, and a better protection from moisture and fire. It also enables the application of aggregate of major grain size.

The design concrete cover or the distance between the reinforcement and the formwork shall be ensured by means of placing washers, spacers or lineal props at suitable spacing. In aggressive surroundings, the material of spacers shall enable a good adhesion to concrete. The spacer geometry shall ensure the stability in the position foreseen.

To both the thickness and the quality of the concrete, special attention shall be paid during casting works as well. The achieving of design properties being of an extreme importance to the concrete cover quality and durability is essentially affected by an adequate compaction and a thorough after-treatment of concrete. A deficient after-treatment (curing) can increase the concrete cover permeability even by a factor of one hundred.

**For bridges, the concrete cover on the external side shall be minimum 4.5 cm, whereas on the internal side it shall be minimum 3.5 cm. For structural elements in contact with soil, the concrete cover shall amount to at least 5.0 cm.**

To ensure a correct concrete cover, a spacer shown in Fig. 5.1 shall be placed. By its shape, such spacer is able to provide a concrete cover either of 4.5 cm or 3.5 cm, depending on the particular requirement. In the spacer centre there is a hole of 2.5 mm, enabling fastening of the spacer to an adjoining rebar.

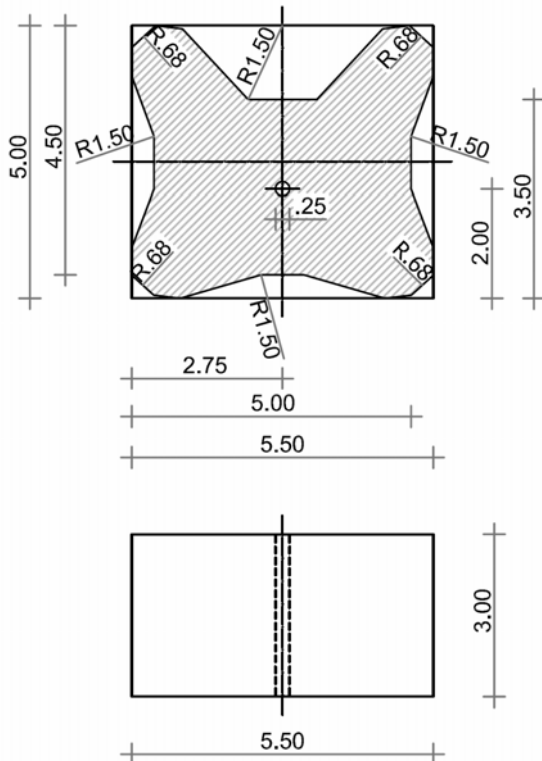


Fig. 5.1: Spacer to achieve the specified concrete cover

A spacer shall be made of a concrete mixture consisting of sandy aggregate of 0-4 mm grain size, cement PC 45, water, acrylate, and 1 kg/m<sup>3</sup> of polypropylene fibres. Spacers shall be arranged as shown in Fig. 5.2, i.e. at spacing of 50d in all directions, where d is the nominal diameter of the rebar located closest to the formwork. However, the spacing shall not be less than 50 cm. By means of a wire, a spacer shall be so firmly fastened to the rebar located closest to the formwork as to ensure the stability of the reinforcement and the specified concrete cover.

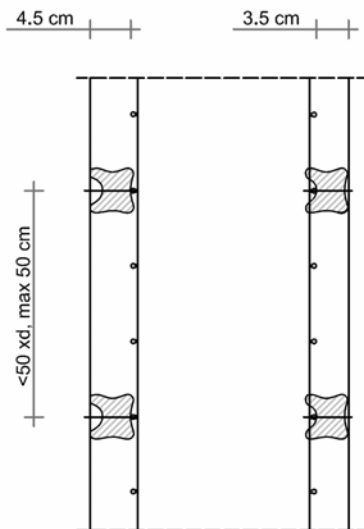


Fig. 5.2: Method of placing spacers

The minimum concrete cover is determined in dependence on the structural type, the environmental aggressiveness rate, the concrete grade, the rebar diameter and the casting method.

Where the specified concrete cover to reinforcement exceeds 5 cm, it shall be reinforced with a thin mesh. The distance between the mesh reinforcement in the concrete cover and the concrete external surface shall not be less than 2.0 cm.

### 5.3 Finishing of Exposed Concrete Surfaces in Formwork

Exposed concrete surfaces in the formwork are finished by means of inserting fillets into the prepared formwork, depending on the specified grooves.

The proposed horizontal grooves are spaced at 80 to 120 cm.

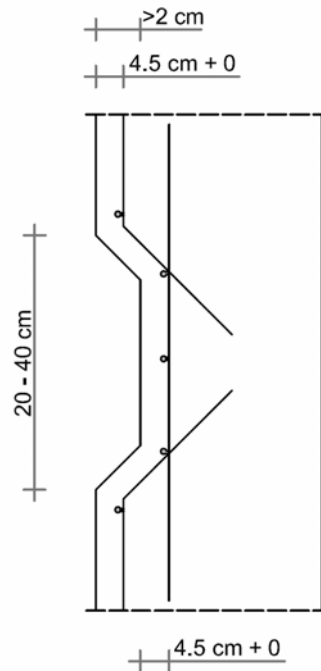


Fig. 5.3: Finishing of horizontal grooves of a depth > 2 cm

Horizontal grooves of a maximum depth of 2 cm can be carried out without any intervention in the concrete reinforcement. In case that grooves deeper than 2 cm are foreseen, they shall be adequately reinforced as shown in Fig. 5.3.

### 5.4 Finishing of New Exposed Concrete Surfaces after Striking the Formwork

A subsequent finishing of new exposed concrete surfaces shall be reduced as much as possible. The final appearance of new exposed concrete surfaces shall already be designed at the stage of preparation of the formwork drawings.

A subsequent finishing with stonecutting tools shall be limited to decorative concrete parapets, edge beams and wing walls. The concrete cover shall not be less than 5 cm.

A subsequent finishing of new concrete surfaces in aggressive environments is prohibited as the compactness of the concrete surface is disrupted.

After removal of the formwork, new exposed concrete surfaces can also be painted with a suitable paint. However, this is only recommended when the resistance of concrete to aggressive surroundings is increased by this operation.

Recently, a method has been developed where a fresh concrete mixture is finished by paint application, and a stone texture is impressed simultaneously. However, both the paint and the stone texture are applied to horizontal surfaces only. In this way, the colour stability is ensured, and there is no harmful effect on the concrete.

When determining the stone colour and the texture pattern, the natural environment shall be taken into account.

Finishing of road bridge surfaces with such a material is suitable to walkways surfaces and access paths.

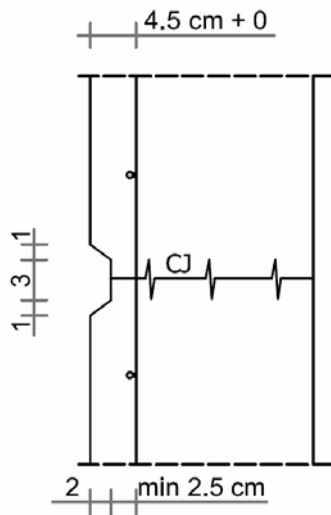


Fig. 5.4: Finishing of horizontal grooves of a depth up to 2 cm

When concreting with a horizontal joint is carried out, it is recommended to finish the construction joint is such a way that the latter is concealed in the groove deepening. By this means, an incorrect joining of the old and the new concrete is avoided.

The final appearance of concrete surfaces is also affected by the treatment of edges. As they are sensitive, they are prone to damages, so they require a special treatment. When the angle of one side to the adjacent one amounts to  $90^\circ$ , the edge shall be executed slantwise by 2 cm on each side, which can be achieved by placing a wooden angle fillet.

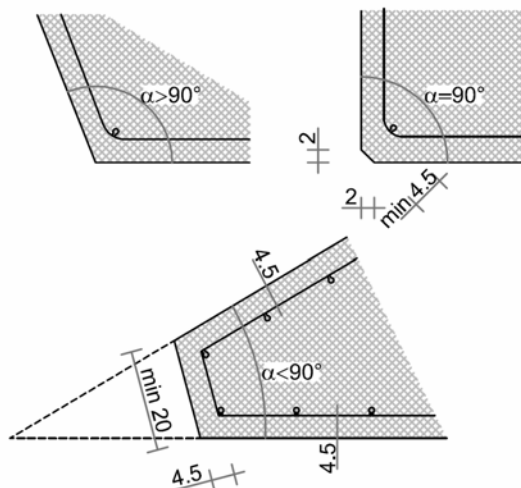


Fig. 5.5: Treatment of edges

The treatment of sharp edges shall already be foreseen at the design stage of a structural element. The surface treated slantwise shall not be less than 20 cm. For such a surface, the same reinforcing principles apply as to the adjacent surfaces.

## 5.5 Finishing of Exposed Concrete Surfaces on Underpasses

### 5.5.1 Underpasses with Parallel Wings

The underpass wings are parallel. The connecting slopes are of a conical shape.

Horizontal grooves of 7 cm width and 2 cm depth at a spacing of 80-100 cm are proposed for the surfaces of the underpass supporting walls (Fig. 5.6).

A “deepening” of the front part of the carriageway slab above the underpass entry is proposed by means of a cantilevered structure to a depth of 35 cm. In this way, an impression of a portal is given with a minimum of architectural arrangements, and the concern for aesthetical design is emphasized (Fig. 5.6 and 5.7).

The portal can also be pointed out by a “deepening” of the entire portal, i.e. of the carriageway slab and the vertical walls.

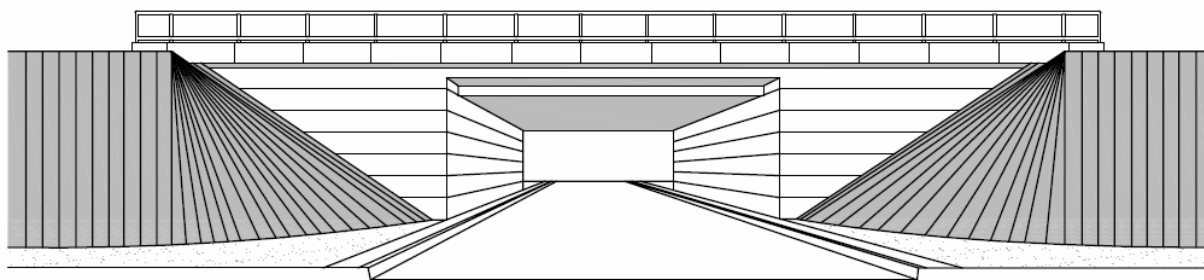


Fig. 5.6: Underpass with parallel wings with a portal partly pointed out

### 5.5.2 Underpasses with Oblique Wings

The underpass wings are oblique, and the connecting slope ends at the wing.

Horizontal grooves of 7 cm width and 2 cm depth at a spacing of 80-100 cm are proposed for the surfaces of the underpass supporting walls (Fig. 5.6). A “deepening” of

the front part of the carriageway slab above the underpass entry is proposed by means of a cantilevered structure to a depth of 35 cm. In this way, an impression of a portal is given with a minimum of architectural arrangements, and the concern for aesthetical design is emphasized.

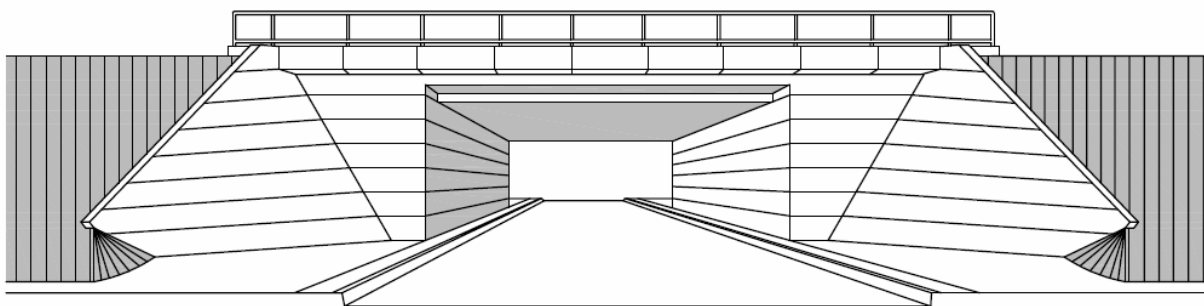


Fig. 5.7: Underpass with oblique wings with a portal partly pointed out

### 5.5.3 Underpasses with Cylindrical Wing Walls

At the underpass entry, a vertical declination of semicircular walls is proposed. Vertical grooves of 15 cm width and 2 cm depth spaced at 80 cm should be to the wall surfaces.

Horizontal grooves of 7 cm width and 2 cm depth at a spacing of 80-100 cm are

proposed for the surfaces of the underpass supporting walls.

At the underpass entry, a double portal is proposed by foreseeing a 40 cm wide and 35 cm deep frame, sectioned by means of horizontal joints, as a continuation of the grooved wall (Fig. 5.8).

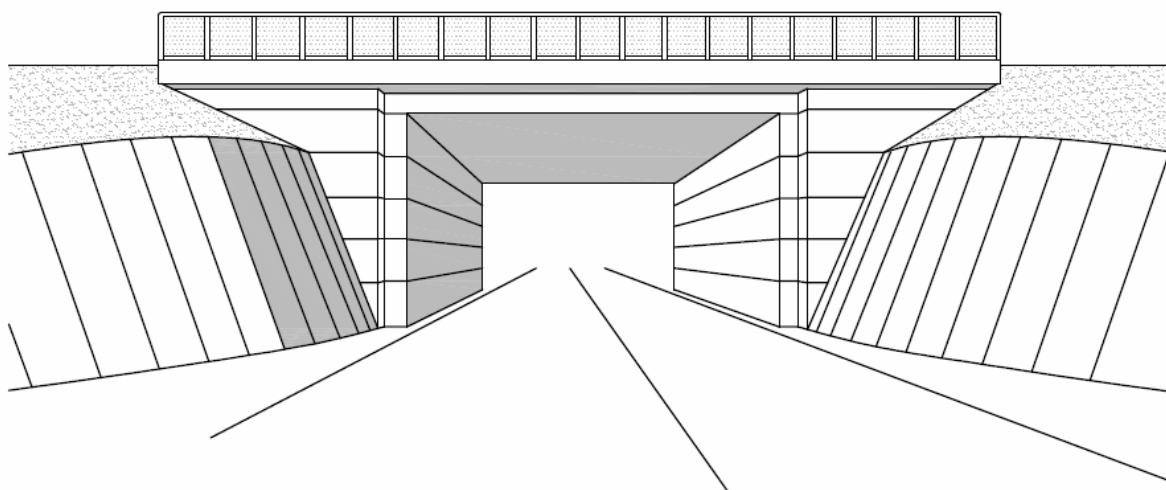


Fig. 5.8: Underpass with cylindrical wing walls and with a portal pointed out

### 5.6 Finishing of Exposed Concrete Surfaces on Overpasses

#### 5.6.1 Single-span Overpasses

This alternative is neutral in view of shaping. The superstructure is designed as a slight arch providing the structure with a suitable elegance. By having a look below the overpass, an impression of an intentionally distorted landscape image is offered. Such a solution is recommended particularly for overpasses across the roads running in cuts.

Bridges on motorways are particularly engineering structures. Their beauty is

ensured by a proper selection of the structure and a harmony of dimensions, which should be taken into consideration by structural designers. Any element on such structures, which has no functional character, acts tastelessly. However, it does not mean that all those structures shall be equal.

Following the abovementioned considerations the only reasonable way to design such structures is to devote a bit more attention to designing of the exposed surfaces of abutments.

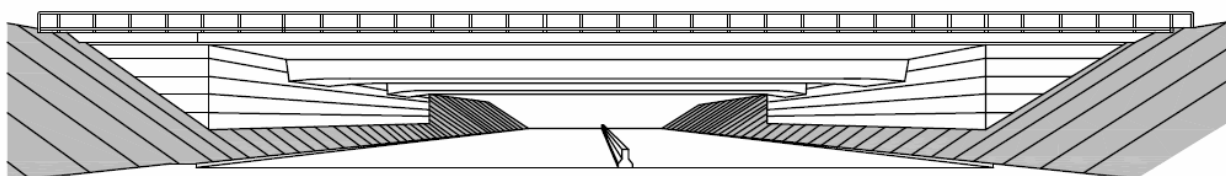


Fig. 5.9: Single-span overpass

### 5.6.2 Two-span Overpasses

Two-span overpasses are foreseen, above all, where a motorway runs on a nearly flat ground or in a semi-cut. In Fig. 5.10 an overpass with precast prestressed girders (composite cross-section) is shown. All other overpass structural elements are monolithic.

The design of such overpasses is only reasonable by selecting a structure being the most appropriate to the particular environment. It is only recommended to emphasize and, in view of the composition, to treat large concrete surfaces, i.e. those of abutments and piers.

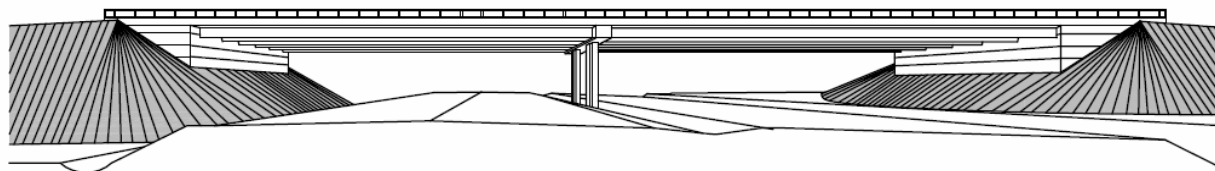


Fig. 5.10: Two-span overpass

Horizontal grooves of 7 cm width and 2 cm depth at a spacing of 80-100 cm are proposed for the surfaces of the overpass abutments and piers.

If required, vertical grooves of 30x30 cm can also be foreseen for the abutments. In such a groove, the vertical drainage pipe can be put out of sight.

The pier(s) of such an overpass can also be designed in a different way, depending on the designer's imagination.

in embankments, and when the width of the motorway central reserve is relatively small.

The motorway runs below the overpass central span being longer than both side spans, which are of an equal length. A straight or curved superstructure is supported with piers of different shapes. By means of such a design solution, a visually open profile of the road space is created and a transparency ensured. The structure composed in accordance with static and constructive conditions is both economical and harmonic. An execution of horizontal lines spaced at 80-120 cm is proposed on the piers and abutments.

### 5.6.3 Three-span Overpasses

Three-span overpasses are designed particularly in cases where they are located

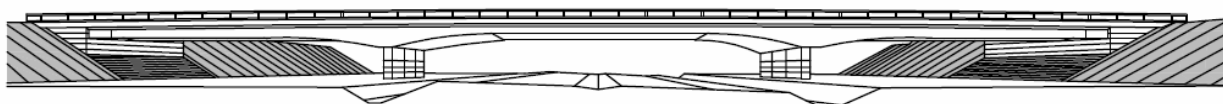


Fig. 5.11: Three-span overpass

### 5.6.4 Four-span Overpasses

Four-span overpasses are foreseen in cases where the motorway central reserve is wide or the motorway consists of three traffic lanes in each direction. They are also designed when there are only two traffic lanes in each

direction, but the space should be provided for an eventual future third lane.

To the four-span overpasses all the abovementioned considerations apply. The superstructures can be of various types. The concrete surface finishing is identical as for the overpasses described above.

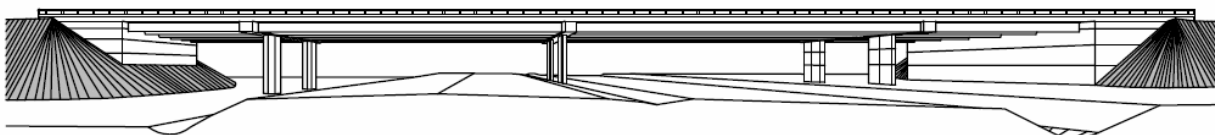


Fig. 5.12: Four-span overpass, composite or monolithic

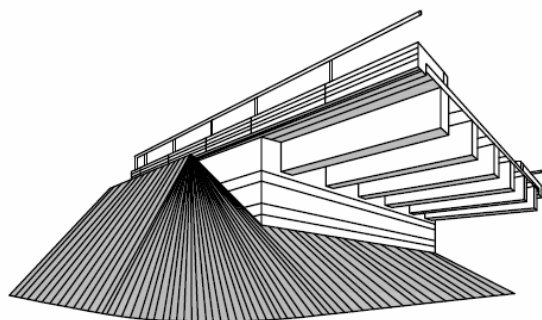


Fig. 5.13: Abutment and composite deck

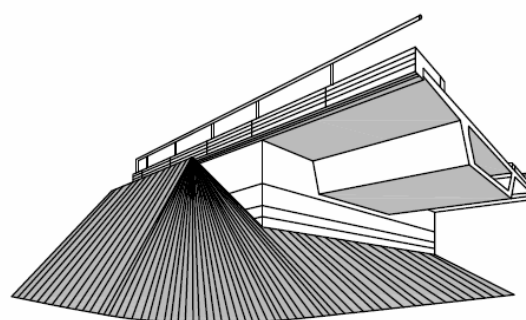


Fig. 5.14: Abutment and monolithic deck

## 6 FACING APPLIED TO CONCRETE SURFACES

### 6.1 General

Parts of bridges, especially abutments and piers, can be faced with stone when it is intended to increase their aesthetic value, particularly when the bridge is located in a region where the stone appears as a traditional material. In addition, by facing structural elements, their resistance to external impacts is increased.

The general appearance of exposed surfaces faced with stone depends on the stone type, quality, size, shape and colour, on the ratio of bigger stones to smaller ones, on the method of finishing the surfaces, and on the way how to carry through the joints.

The following rules shall be considered in stone facing design:

- the stone shall be finished in such a way as to emphasize its structure as much as possible and to reduce the visible traces of tools to the minimum extent;
- bigger stones shall be placed to the lower rows of the wall; individual stones shall be longer than higher, they shall be overlapped by at least 20 cm;
- the joints in the wall shall be approximately of the same width; on the wall face the mortar shall not be unnecessarily visible; the deficiencies shall not be levelled with mortar; no false joints shall be made in the mortar;
- the general appearance of the wall shall not resemble to tiling.

Exposed concrete surfaces can also be faced with prefabricated concrete slabs when the latter serve as formwork panels.

### 6.2 Facing Made of Irregularly Arranged Stone – Cyclopic Walls

Facings or walls made of irregularly arranged stones, i.e. cyclopic walls are generally applied to retaining walls on roads. However, they are not recommended for bridges.

The cyclopic walls are not characterized by the stone size, but by the polygonal shape of their faces.

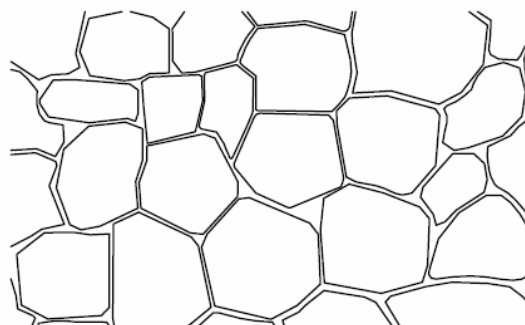


Fig. 6.1: Appearance of a part of cyclopic wall

The stones intended to execute such a wall or a facing shall have at least three bearing planes. Individual stones shall extend to the wall depth by at least 20 cm. At reasonable spacing, some bigger stone blocks shall be embedded extending to the concrete mass by 40 cm minimum.

The size of an individual stone of a cyclopic wall shall amount to 40-60 cm. The number of sides of a stone shall not exceed five (pentagon). The width of joints between adjacent stones on the wall face shall be within the limits of 20-40 mm.

### 6.3 Facing Made of Quarry-stone

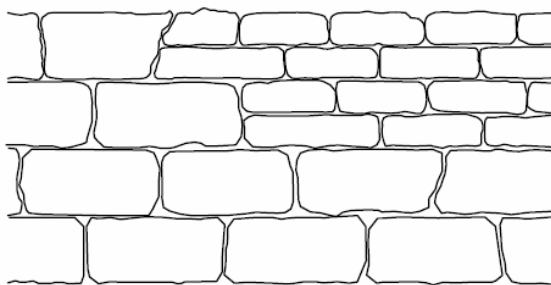


To execute a quarry-stone facing, stones with natural or artificially made bearing planes shall be used. The joint width shall amount to 15-30 mm. The layer heights in the same wall can be different, but the adjacent vertical joints shall be shifted by at least 10 cm.

Individual stones shall be placed in such a way that the resulting load, i.e. the pressure force acts vertically to the direction of the stone layer.

To the quarry-stone walls the same rules and principles apply as to the cyclopic walls. The only difference is, that the shaping of the wall face is more regular in facing with quarry-stones.

The stones are of a rectangular shape and of dimensions of (20-40)/(40-80) cm.



*Fig. 6.2: Appearance of a part of quarry-stone wall*

Depending on the shape of a block built-in, the wall face can be of different appearances:

- the layers are of the same dimensions, or they differ in height;
- thicker and thinner layers alternate regularly;
- individual blocks are bigger, extending over two or three layers;
- the layers are not accentuated;
- the exposed surface is not finished (relief surface).

#### 6.4 Facing Made of Cut Stones

Cut stones are finished by approx. 15 cm in depth. Horizontal joints shall be continuous, whereas the vertical ones shall run perpendicularly to the bearing joints.

The heights of individual facing layers shall be different. The ratio of the height to the length varies from 1:1.2 for slate to 1:1 for hard stones.

Concrete walls can be faced in two ways. The stone facing can serve as formwork for

casting concrete, or it is carried out after concreting. In the first case, the cut stones shall be fastened by means of steel clamps or anchors on every second or third joint behind the wall mass. At other joints usual clamps are built-in for an interconnection of stones. When the walls are already cast and the stone facing is carried out subsequently, the surfaces to be faced shall be roughened to ensure a good adhesion between the facing and the wall. The connection between the wall and the facing is also achieved by means of steel clamps. The void between the wall and the stone facing shall be filled up with cement mortar or concrete containing fine aggregate.

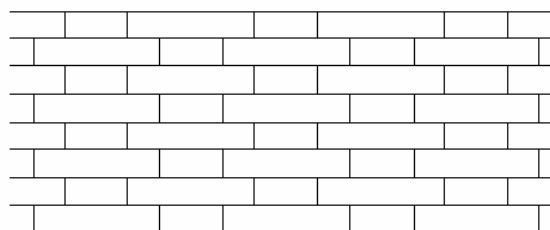
Finishing of joints has a strong influence on the appearance of the wall face. The better the finishing of the stone, the thinner can be the joints, and vice versa. The joint thicknesses can vary from 3 to 20 mm. For thinner joints, mortar containing finer sand is used, and inversely, for thicker joints, the mortar shall be made of sand of bigger grain size. After the facing is completed, i.e. the wall mass has settled definitively, the exposed portions of the joints shall be finished. The colour of the mortar to be applied to the joint shall be selected according to the foreseen appearance of the wall face.

The exposed surface of a joint can:

- be levelled with the stone face,
- be deepened within the joint, or
- extend out of the wall face.

The appearance of the wall face depends on the method of placing stones, which can be arranged in layers in different ways.

The method of arranging cut stones where the horizontal layers are the same on the entire wall face, and the stones are placed in a shape of a cross (Fig. 6.3) is called the gothic bond. The stones of two vertically adjoining layers overlap by one fourth.



*Fig. 6.3: Appearance of a wall portion in a gothic bond*

Stones in different layers need not be of the same height. However, it is required to place

bigger stones in lower layers. The stones shall overlap by at least 10 cm.

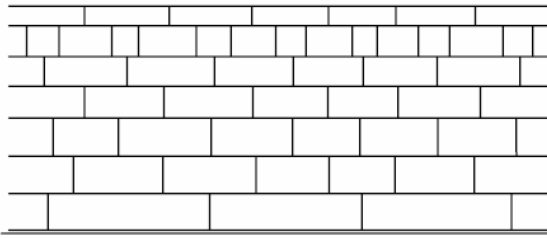


Fig. 6.4: Appearance of a wall portion of an ordinary combination

Stones can also be arranged in irregular combination. There are no horizontal layers in such a wall. However, a contact of three corners of different stones in a single point shall be avoided. The stones shall overlap by at least 10 cm, as it applies to the gothic bond as well.

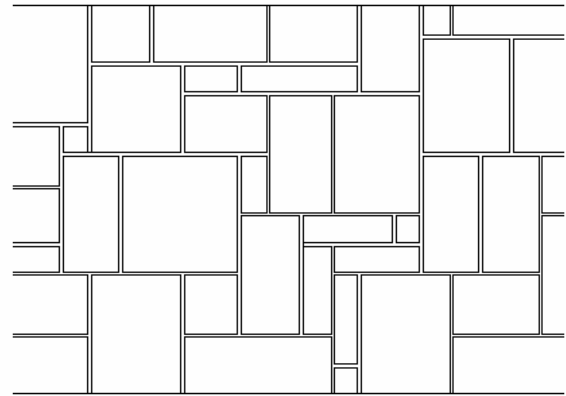


Fig. 6.5: Appearance of a wall portion of an irregular combination

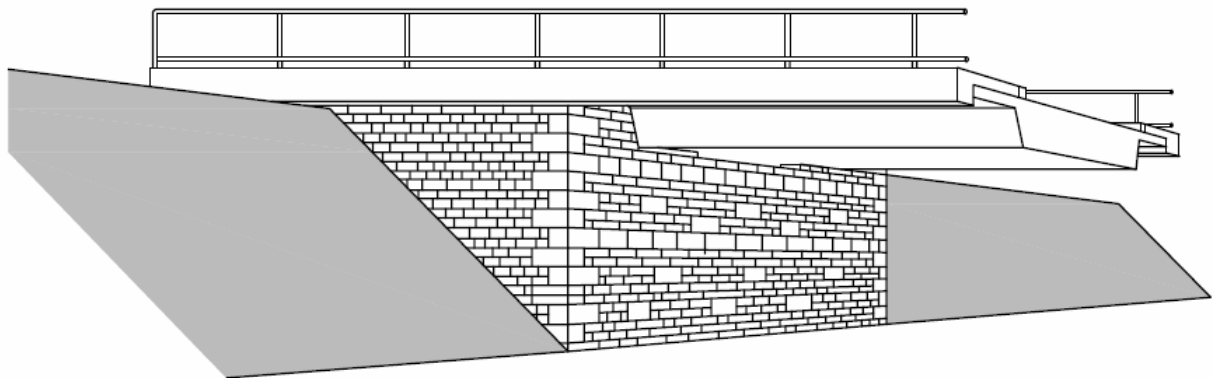


Fig. 6.6: Abutment with facing of cut stones

In road bridges it is reasonable to apply stone facing to abutments, provided that they are located in an environment allowing this, or when the abutment durability is increased. In exceptional cases, piers, when located in river streams, can also be faced with stone. By this means, piers are protected from harmful water actions.