

# ISOPRO<sup>®</sup> Thermal insulation elements

Technical information

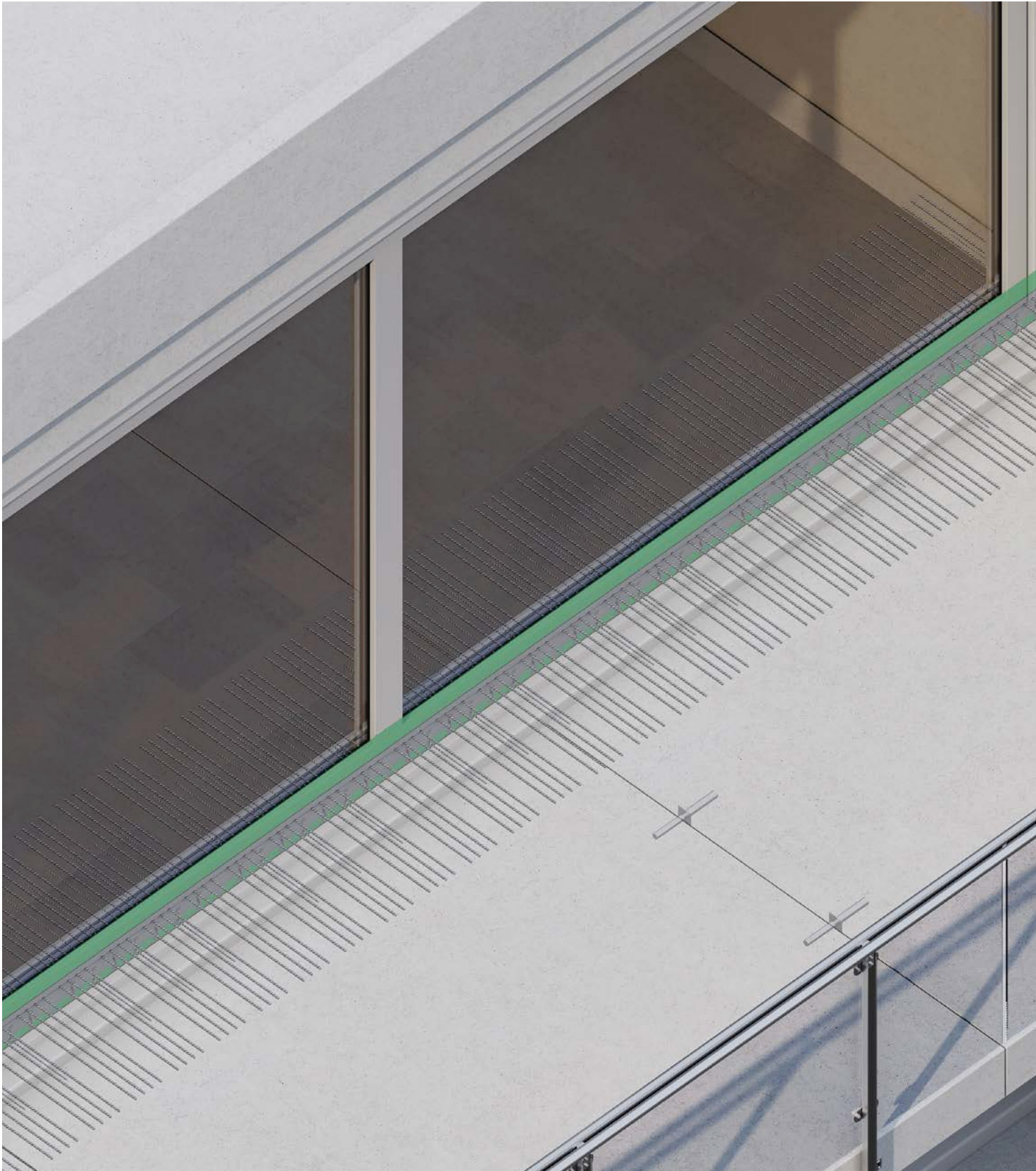




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# Balcony solutions







### PohlCon solutions for balconies

A balcony should enhance the comfort of your home, but not add to your energy bills. To ensure that your balcony is securely anchored and that adjacent rooms lose as little heat as possible, we have revolutionised balcony construction - from load-bearing thermal insulation elements to railing attachment methods. Our optimised solutions reduce energy loss and hold components securely in place. We can also provide you with the expert advice you need and a tailor-made software solution for structural design. This allows you to design even architecturally complex balconies quickly, easily and safely.

### ISOPRO®

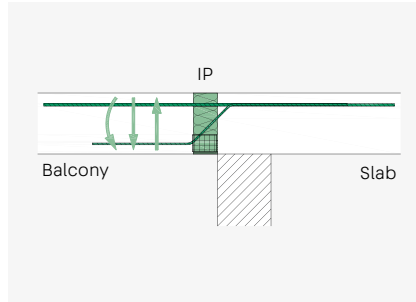
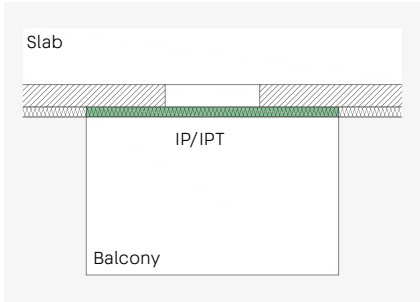
The ISOPRO® load-bearing thermal insulation element provides a friction-locked connection to external building components. It consists of five main components, all designed to provide reliable force transmission coupled with the lowest possible thermal conductivity.

### Balcony solutions – Product categories

- Thermal insulation
- Mounting technology
- Connection technology
- Façade connection systems

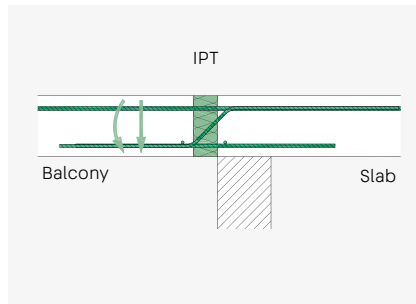
# ISOPRO® Type overview

## Cantilevered constructions



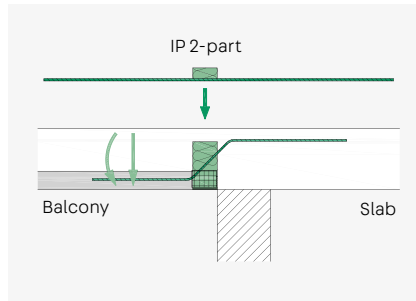
### ISOPRO® IP

- Transfers negative moments and positive shear forces
- IP QX design version transfers negative moments and positive and negative shear forces
- Version with concrete thrust bearings
- Page 32



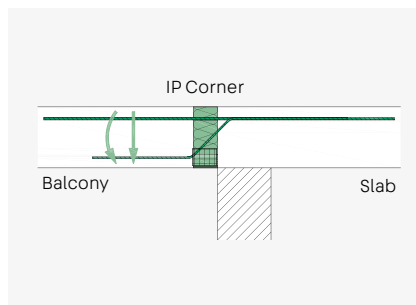
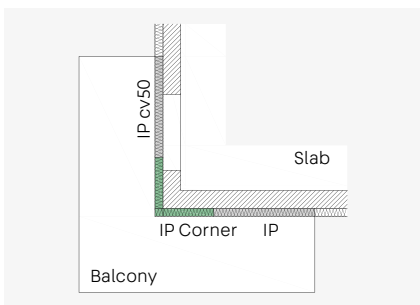
### ISOPRO® IPT

- Transfers negative moments and positive shear forces
- Version with steel compression struts
- Page 32



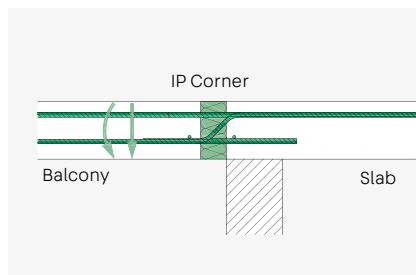
### ISOPRO® IP 2-part

- Transfers negative moments and positive shear forces
- Version with concrete thrust bearings
- 2-part version for precast slabs
- Page 46

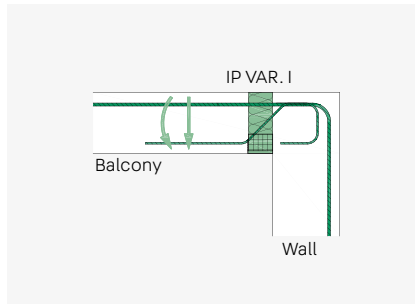
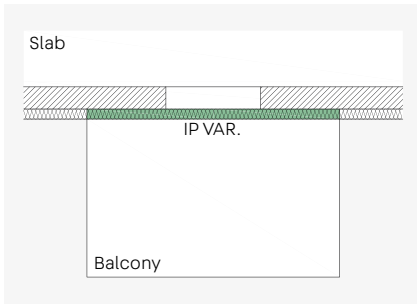


### ISOPRO® IP Corner, IPT Corner

- Transfers negative moments and positive shear forces
- IP version with concrete thrust bearings
- IPT version with steel compression struts
- Solution for corner balconies
- Page 58

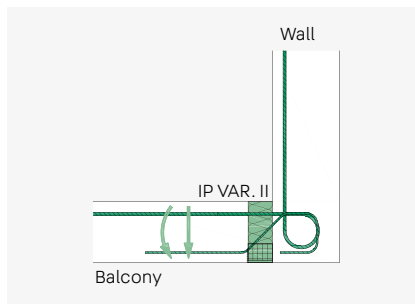


## Cantilevered constructions for wall connections/vertically offset slabs



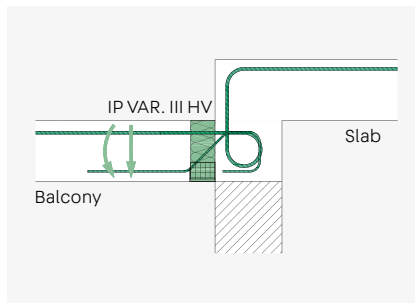
### ISOPRO® IP VAR. I

- Transfers negative moments and positive shear forces
- Version with concrete thrust bearings
- Connection to a wall leading downwards
- Page 50



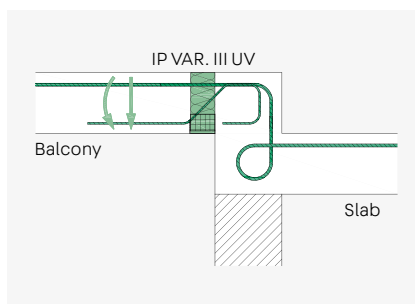
### ISOPRO® IP VAR. II

- Transfers negative moments and positive shear forces
- Version with concrete thrust bearings
- Connection to a wall leading upwards
- Page 50



### ISOPRO® IP VAR. III HV

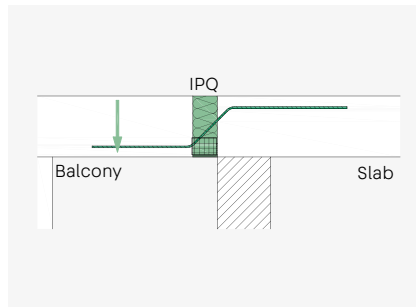
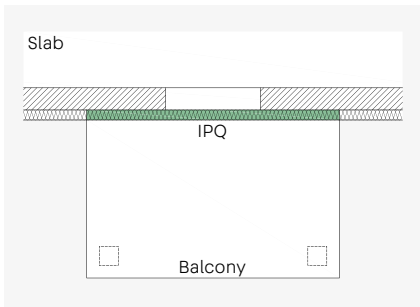
- Transfers negative moments and positive shear forces
- Version with concrete thrust bearings
- Connection to a slab with an upwards vertical offset
- Page 50



### ISOPRO® IP VAR. III UV

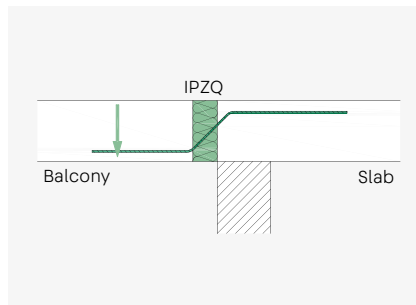
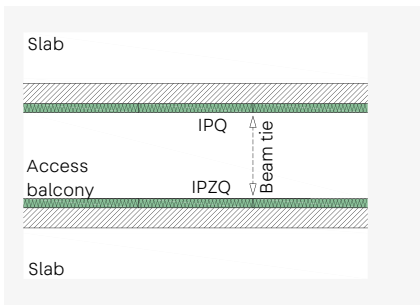
- Transfers negative moments and positive shear forces
- Version with concrete thrust bearings
- Connection to a slab with a downwards vertical offset
- Page 50

## Supported constructions



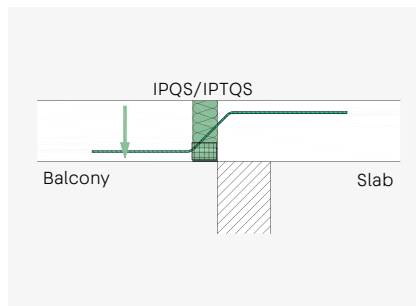
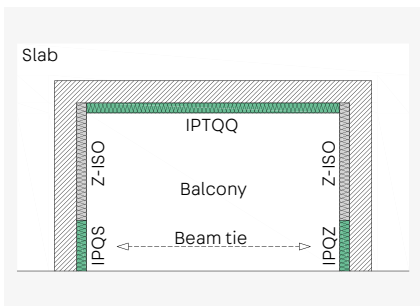
### ISOPRO® IPQ

- Transfers positive shear forces
- Version with concrete thrust bearings
- Page 68



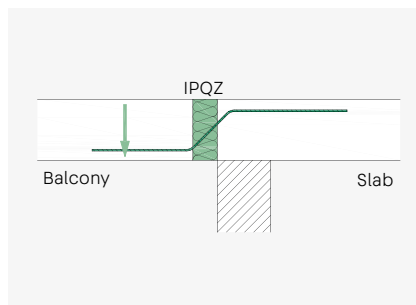
### ISOPRO® IPZQ

- Transfers positive shear forces
- Version without thrust bearings for tension-free connections
- Page 68



### ISOPRO® IPQS/IPTQS

- Transfers positive shear forces
- IPQS version with concrete thrust bearings
- IPTQS version with steel compression struts
- Short element for point load transfer
- Page 68

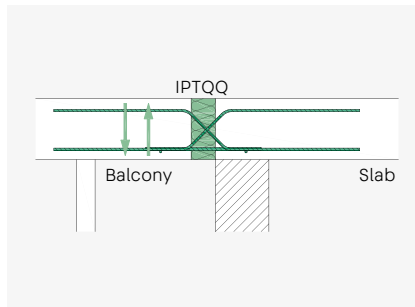
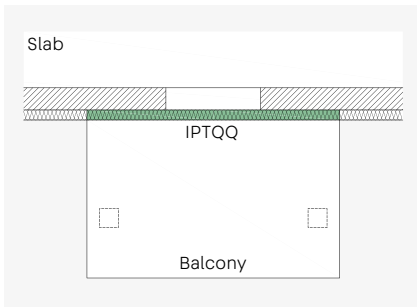


### ISOPRO® IPQZ

- Transfers positive shear forces
- Version without thrust bearings for tension-free connections
- Short element for point load transfer
- Page 68

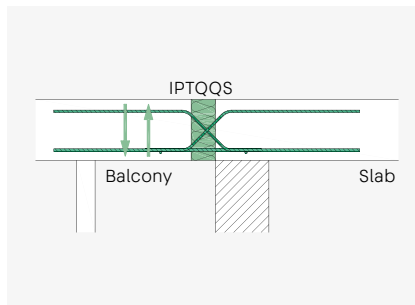
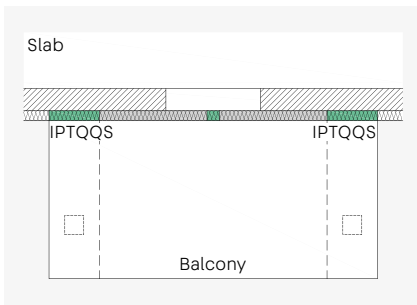


## Supported constructions with lifting loads



### ISOPRO® IPTQQ

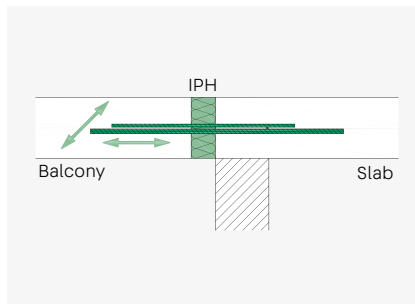
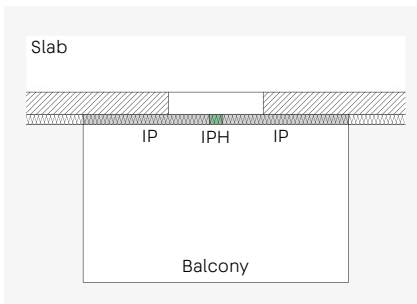
- Transfers negative and positive shear forces
- Version with steel compression struts
- Page 76



### ISOPRO® IPTQQS

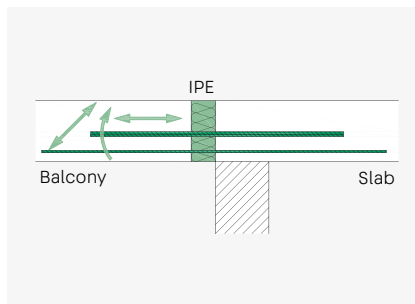
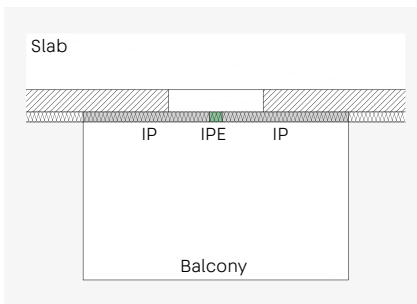
- Transfers negative and positive shear forces
- Version with steel compression struts
- Short element for point load transfer
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## Horizontal loads and seismic loads



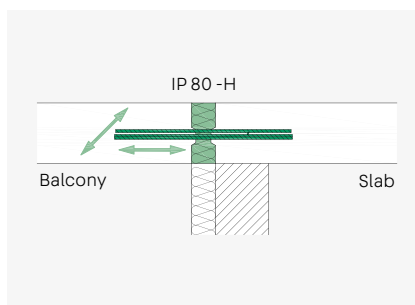
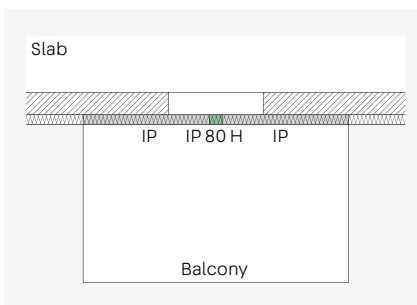
### ISOPRO® IPH

- Transfers horizontal forces parallel and/or perpendicular to the insulation layer
- Page 92



### ISOPRO® IPE

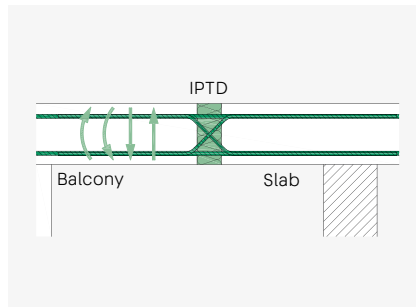
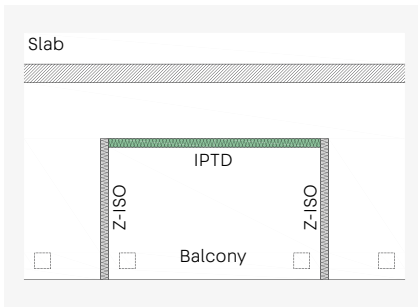
- Transfers horizontal forces parallel and perpendicular to the insulation layer
- In combination with ISOPRO® elements IP, IPT and IPTD: Transfers positive moments
- Earthquake-resistant structures
- Page 96



### ISOPRO® IP 80-H

- Transfers horizontal forces parallel and/or perpendicular to the insulation layer
- Page 100

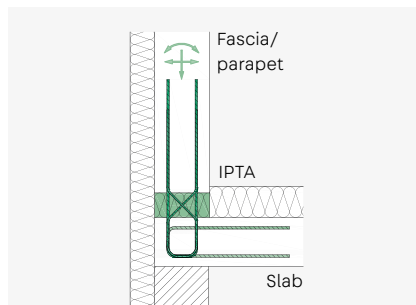
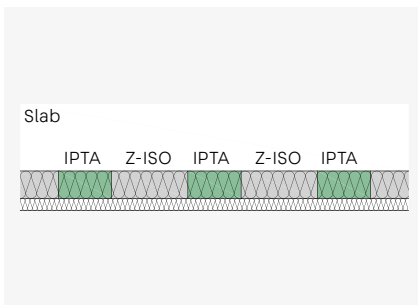
## Continuous slabs



### ISOPRO® IPTD

- Transfers positive and negative moments and shear forces
- Version with steel tie bars/compression struts
- Page 84

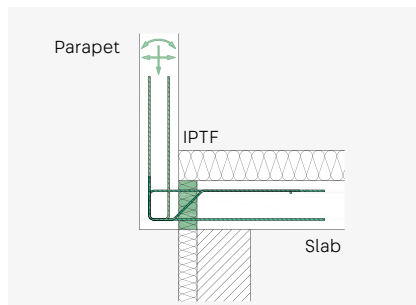
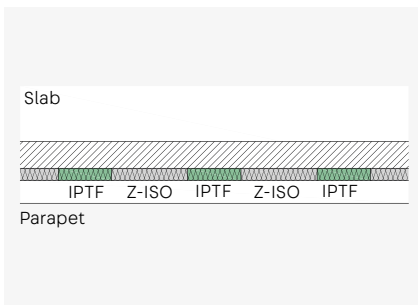
## Attached fascias and parapets



### ISOPRO® IPTA

- Transfers moments, axial forces and horizontal forces
- For use at specific points
- Page 104

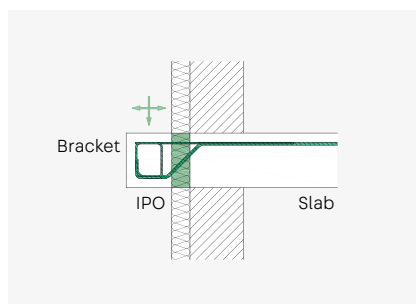
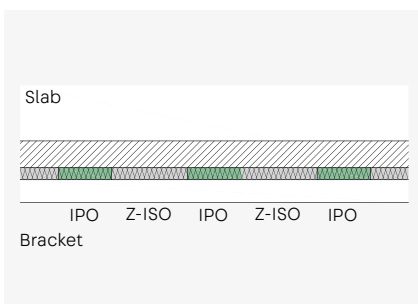
## Protruding parapet



### ISOPRO® IPTF

- Transfers moments, shear forces and horizontal forces
- For use at specific points
- Page 108

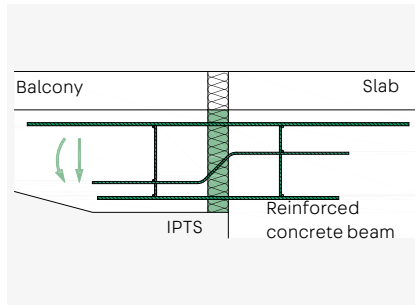
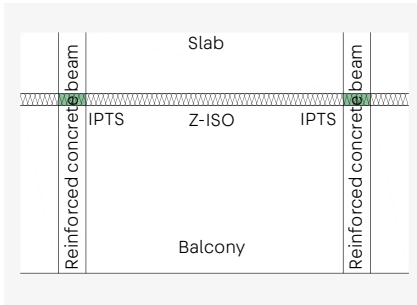
## Bracket



### ISOPRO® IPO

- Transfers shear and horizontal forces
- For use at specific points
- Page 112

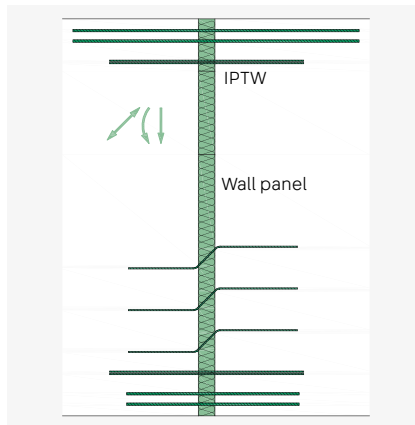
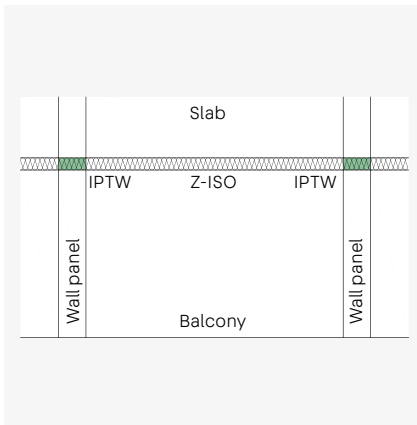
## Beams



### ISOPRO® IPTS

- Transfers negative moments and positive shear forces
- Version with compression struts
- Page 116

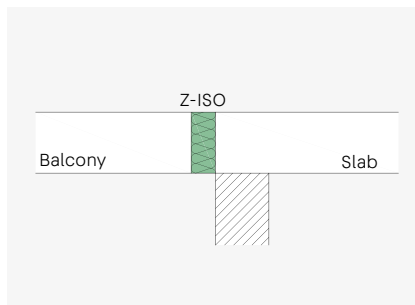
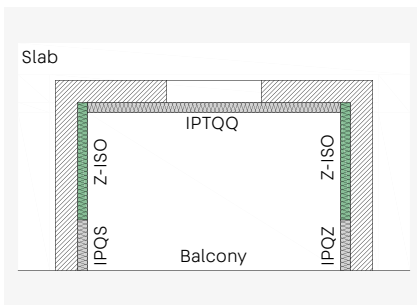
## Walls



### ISOPRO® IPTW

- Transfers negative moments, positive shear forces and horizontal forces
- Version with compression struts
- Page 120

## Intermediate insulation



### ISOPRO® Z-ISO

- No structural function
- Intermediate insulation for support at specific points
- Page 128

# Product information

## Function of the ISOPRO® element

ISOPRO® is a load-bearing thermal insulation element that performs the following functions:

- Thermal separation of reinforced concrete components to resolve structural design problems at transitions between internal and external components
- Friction-locked connection of the reinforced concrete components across the insulating joint

The load is transferred across the joint by tie bars, shear bars and a compression component. Depending on the type of ISOPRO® element, the compression component is designed as a thrust bearing made of special concrete (IP elements) or as a compression strut made of steel (IPT elements). Reinforcement elements in the area of the insulating body are made of stainless steel to protect against corrosion reduce thermal transmittance through the structural components. Stainless steel is welded to structural steel using a special process. In standard elements, the tie bars in the area of the insulation are made of stainless steel and have smaller diameters than the connected structural steel.

The ISOPRO® element is available with different load-bearing capacities. Elements with different load-bearing capacities have varying numbers of tie bars, shear bars and compression components with different diameters. For bars with larger diameters, structural connectors are attached to the slab to increase stability. The elements are generally available starting from a height of 160 mm. However, the minimum height may be restricted depending on the diameter of the shear bars used.

During installation, it is essential to observe the installation direction indicated on the label. The installation direction is clearly marked on every element by the word "up" and by an arrow pointing in the direction of the balcony side (cold area).

## Materials of the ISOPRO® element

Tie bars, shear bars,  
compression struts:

reinforcing steel B500B,  
non-rusting ribbed rebar  
according to  
national technical approval,  
material no. 1.4571, 1.4362  
or 1.4482

Thrust bearing:

high-performance special  
concrete

Insulating body:

Neopor®\* rigid polystyrene  
foam,  $\lambda = 0.031$  W/mK

Fire protection panels:

fibre cement boards of  
building material class A1

## Proof of usability

ISOPRO® IP:

ETA -17/0466, DIBt  
in conjunction with general type  
certification Z-15.7-354, DIBt

ISOPRO® IPT:

Z-15.7-243, DIBt

## Materials of adjoining components

Concrete:

normal concrete in line  
with DIN 1045-1 or DIN EN 206-1  
with a gross density of 2000 to  
2600 kg/m<sup>3</sup>.

Concrete strength classes:

exterior components  $\geq$  C25/30  
interior components  $\geq$  C20/25

Reinforcing steel:

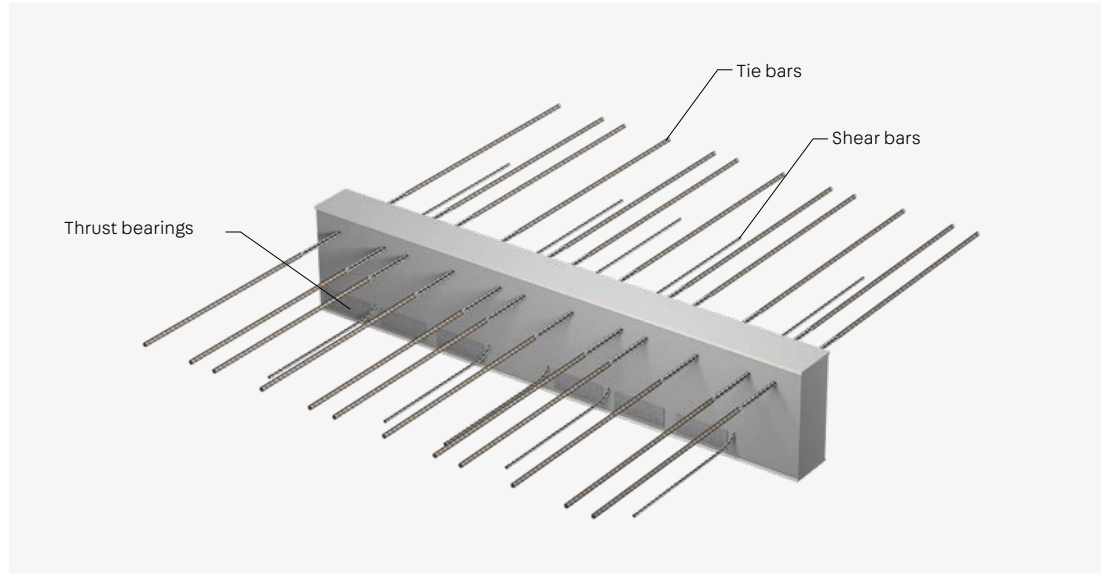
B500

## On-site reinforcement

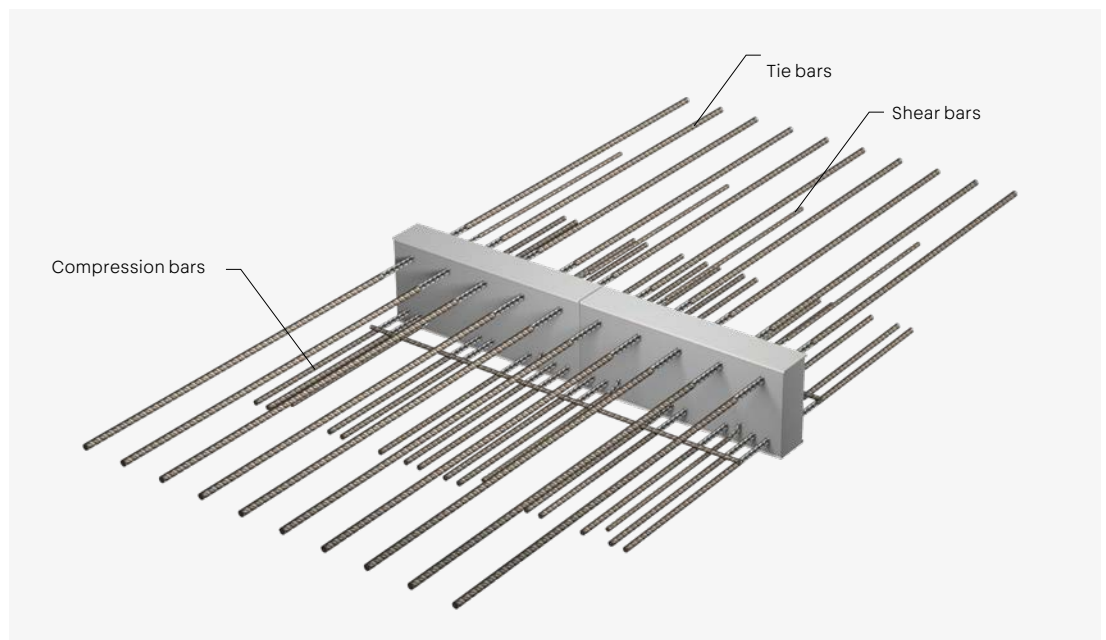
The reinforcement of the structural elements adjoining ISOPRO® elements is carried out according to the specifications of the structural engineer on the basis of the structurally required reinforcement.

# Product components

## ISOPRO® IP



## ISOPRO® IPT



# Concrete cover

## Exposure class and concrete cover

The minimum concrete strength for components adjacent to ISOPRO® elements and the required concrete cover (cv) for the ISOPRO® elements are determined on the basis of the exposure class and approval. The higher minimum concrete strength class is definitive.

Reinforcement corrosion		Minimum concrete strength class			Concrete cover mm		
		DIN EN 1992-1-1	DIN EN 1992-1-1/NA	Approval of interior components	Approval of exterior components	Components $C_{nom}$	ISOPRO® cv
<b>XC3</b>	Moderate moisture, exterior components, damp rooms		C20/25	C20/25	C25/30	35	30
<b>XC4</b>	Alternating wet and dry, exterior components with direct rain exposure		C25/30	C20/25	C25/30	40	35
<b>XD1</b>	Moderate moisture, mist spray zone of traffic areas		C30/37	C20/25	C25/30	55	50
<b>XS1</b>	Salty air, exterior components near the coast		C30/37	C20/25	C25/30	55	50
<b>XD1</b>	Moderate moisture, mist spray zone of traffic areas		C30/37	C20/25	C25/30	55	50
<b>XS1</b>	Salty air, exterior components near the coast		C30/37	C20/25	C25/30	55	50

## ISOPRO® concrete cover

- The cv dimension of ISOPRO® elements may be reduced by  $\Delta c_{dev} = 5$  mm if suitable quality measures are applied during production in accordance with DIN EN 1992-1-1/NA.
- For ISOPRO® elements IP/IP 2-part/IPT/IP VAR., cv35 or cv50 can be selected for the concrete cover of the tie bars.
- The ISOPRO® elements IP Corner and IPT Corner are available with a concrete cover of cv35/cv50 for the tie bars.
- For shear force elements, the concrete cover at the top is cv35 to cv85 depending on the element height.
- The concrete cover of the compression struts and the shear bars at the bottom is generally cv30 (usually lower exposure compared to the top side of the balcony).
- ISOPRO® IPTD elements have a concrete cover of cv30 at the bottom if the top concrete cover is cv35 and a concrete cover of cv50 at the bottom if the top concrete cover is cv50.



# Structural design principles

## General information

### Structural design

- A structural engineer verifies the reinforced concrete components adjacent to the ISOPRO® elements.
- If the adjacent components are made of different grades of concrete (e.g. balcony C25/30; slab C20/25), the lower concrete grade is decisive for the structural design of the ISOPRO® elements.
- The specified rated values apply to concrete grades  $\geq$  C25/30. Values for C20/25 available on request.
- The table values given for the on-site reinforcement apply to fully loaded ISOPRO® elements. A reduction of  $m_{Ed}/m_{Rd}$  or  $v_{Ed}/V_{Rd}$  is permissible.
- The specified minimum heights depending on the shear force load-bearing capacity apply to a concrete cover of cv35. For cv50 concrete coverings, the minimum heights must be correspondingly increased by 20 mm.
- The short elements IPH or IPE can be used to absorb planned horizontal forces.
- In the case of cantilevered constructions without a live load and with a planned moment from a load that does not increase the shear force, the ISOPRO® IP elements must be verified separately by our application engineering department.
- It is vital to consider the casting properties when designing the reinforcement. This applies in particular to ISOPRO® elements with a high reinforcement ratio.

### Special elements

- In addition to the standard elements listed in this documentation, we offer custom constructions adapted to the building project, the internal forces and the component geometry. Special constructions are planned, designed and produced in compliance with the requirements of the approvals and with DIN EN 1992-1-1 and DIN EN 1992-1-1/NA.

### Handling and installation on site

- When using ISOPRO® elements with concrete thrust bearings, it must be ensured that the frictional connection between the thrust bearing and the concrete of the element is guaranteed. When using precast slabs, an in-situ concrete strip or grouting strip at least 100 mm wide must be provided.
- When using ISOPRO® elements with steel compression struts and slab-side precast slabs at the same time, make sure that the width of the in-situ concrete strip matches the length of the compression struts.
- When using ISOPRO® elements with R 90/REI 120 fire protection, take care not to damage the fire protection panels.
- Subsequent bending of the reinforcement bars on the construction site will invalidate the approval and warranty by H-BAU Technik GmbH.
- The ISOPRO® metre elements can be divided on site. Reduced load-bearing capacity and minimum edge clearances of the ISOPRO® components must be observed.
- In highly reinforced structural elements (e.g. downstand beams), the position of the ISOPRO® element must be considered before the on-site reinforcement.



### Consultation

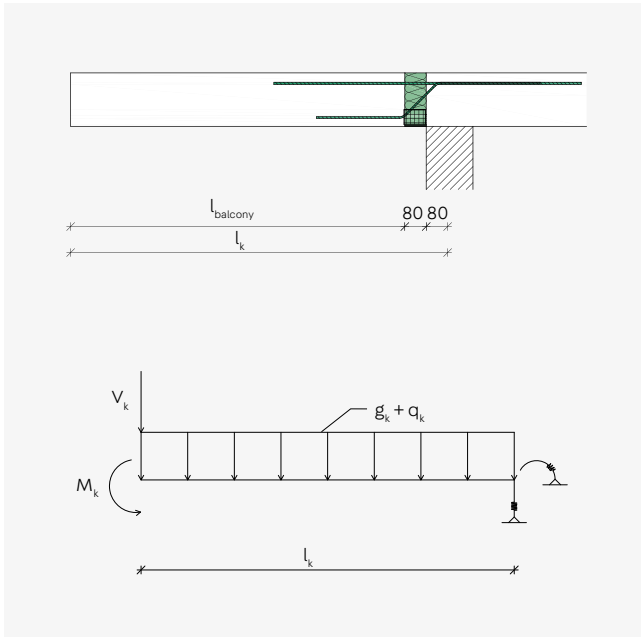
Our Application Technology department will be happy to assist you with further solutions:

T +49 7742 9215-300  
technik-hbau@pohlcon.com

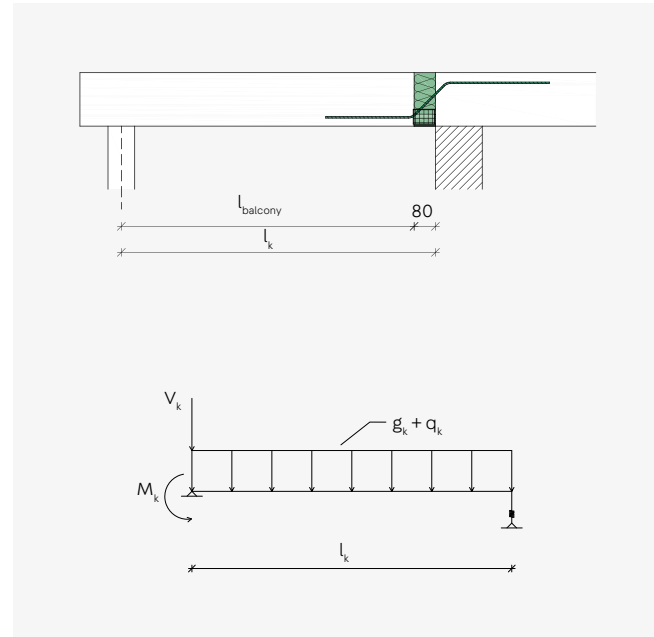
# Sizing

## Sizing of ISOPRO® elements – FEM calculation/manual calculation

### System calculation



Cantilevered balcony / model



Supported balcony / Model

### Bearing conditions

Manual calculation:

Restrained      Articulated

### FEM calculation:

Torsion spring: 10,000 kNm/rad/m

Torsion spring: –

Retractable spring:

250,000 kN/m/m      Retractable spring:

250,000 kN/m/m

### Load assumptions:

$g_k$ : permanent loads (dead load + imposed load)

$q_k$ : live load

$V_k$ : edge load (railing, parapet, plinth etc.)

$M_k$ : edge moment (due to horizontal load on railing, parapet etc.)

### Procedure for FEM calculation

- Calculate the balcony slab as a system separate from the load-bearing structure of the building.
- Define supports in the connection area using the aforementioned stiffness values
- Determine internal forces using linear elasticity
- Select ISOPRO® elements
- Apply the internal forces determined as an edge load to the load-bearing structure of the building

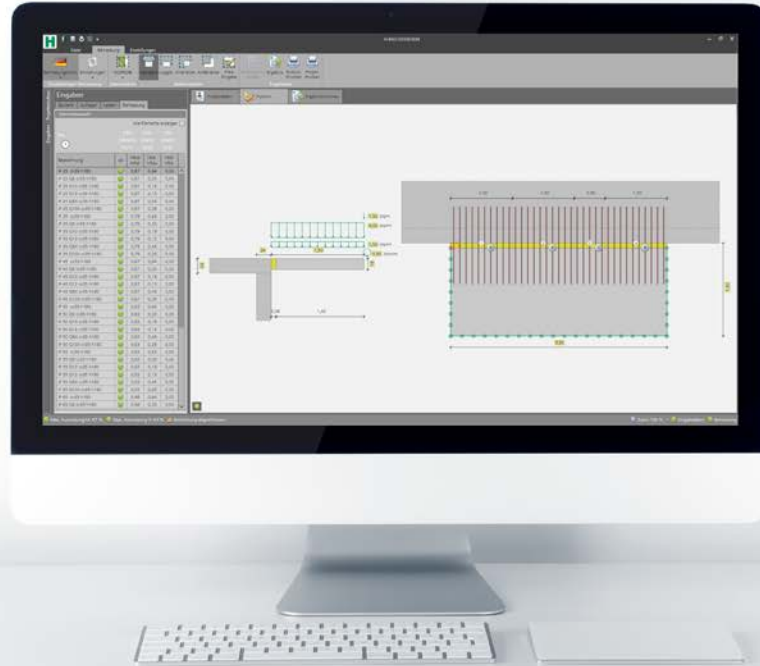


### Notes

If the stiffness ratios vary greatly along the edge of the slab (e.g. columns along the edge of the slab and no continuous wall), the balcony slab should not be calculated as a system separate from the building.

In this case, a joint line should be defined along the edge of the balcony slab with the stiffness values given above. The ISOPRO® elements can be determined by means of the joint forces.

# ISODESIGN design software



## Sizing ISOPRO® elements

Our ISODESIGN design program makes our years of experience in designing ISOPRO® thermal insulation elements for the most common balcony systems available to you.

You can choose between the following balcony systems: cantilevered balcony, balcony on supports, loggia, inner corner balcony and outer corner balcony. Alternatively, you can enter unusual geometries in the free input fields. After entering the geometric data and the loads acting on the various components, you can select the corresponding ISOPRO® elements.

The feasibility of your layout and geometric characteristics of the ISOPRO® elements can be checked in floor plan and cross-section views. A structural analysis printout and a parts list are available for following work.



## Benefits

- All common balcony systems can be selected
- Calculation with FEM-Modul software
- Printout of log and verification



## Consultation

Our Application Technology department will be happy to assist you with further solutions:

T +49 7742 9215-300  
technik-hbau@pohlcon.com

# Proof of serviceability

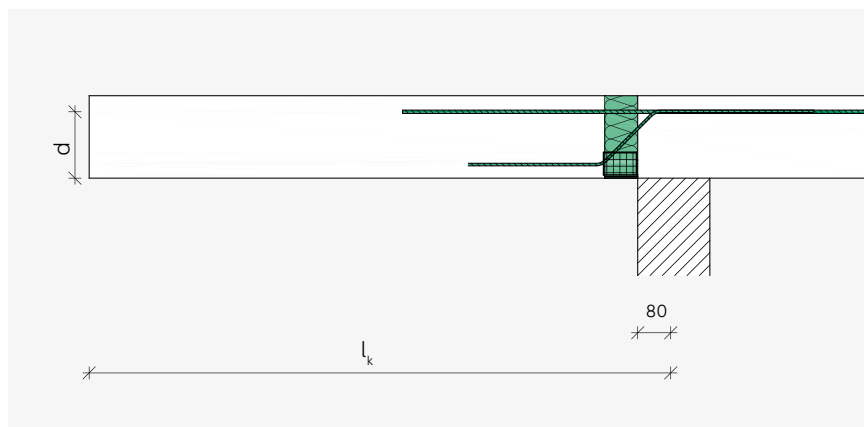
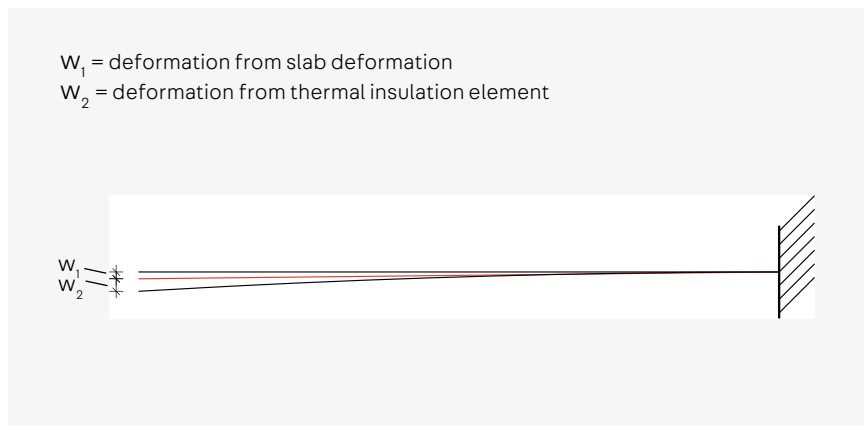
## Precamber and flexural aspect ratio

### Precamber

A cantilever slab under load deforms with the maximum deformation occurring at the cantilever end. If a cantilever slab is connected with an ISOPRO® element, the proportion of deformation from the slab itself must be imposed on that of the ISOPRO® element to determine the maximum deformation. In this case, the ISOPRO® tension and compression components behave approximately similar to a spring system being stretched or compressed. The resulting angle of rotation  $\alpha$  is used to determine the maximum deformation of the ISOPRO® element. We recommend performing

verification in the serviceability limit state using the quasi-permanent combined load. To determine the required precamber of the cantilevered slab, the deformation should be rounded up or down according to the direction of the planned drainage.

To determine the deformation, see the individual chapters for the ISOPRO® types.



ISOPRO® IP - Structural system

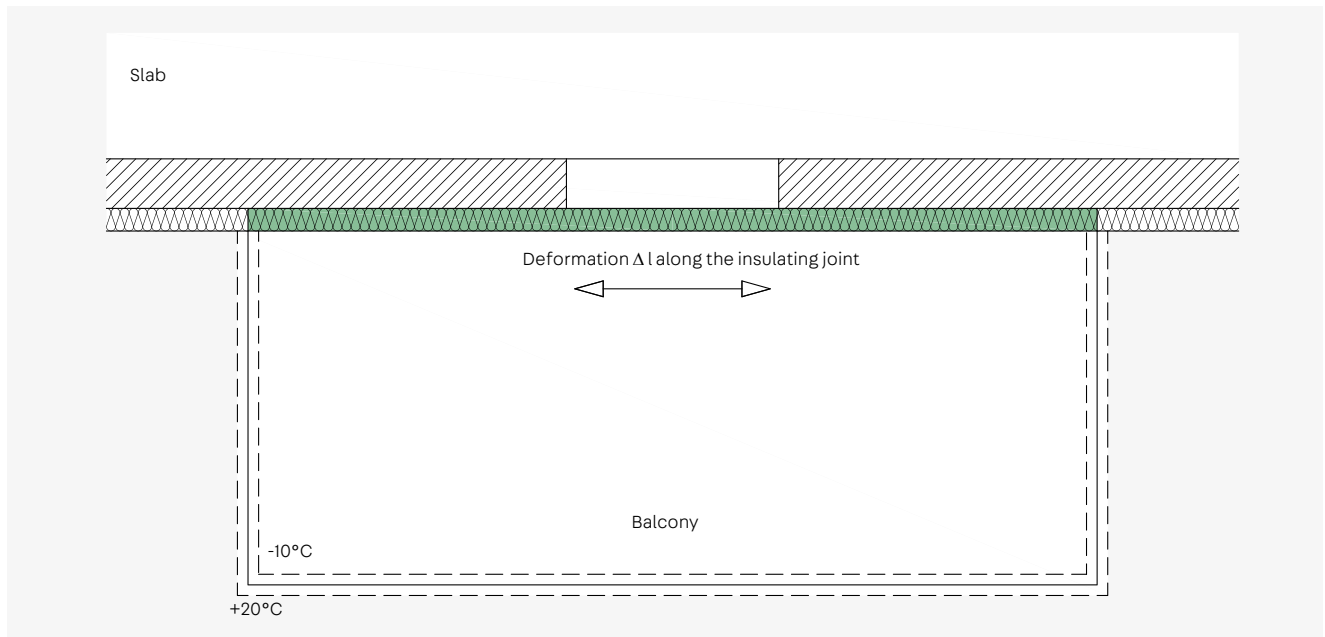
### Flexural aspect ratio

The flexural aspect ratio is defined as the ratio of the structural height  $d$  of the balcony slab to the cantilever length  $l_k$ . The flexural aspect ratio of a slab has an effect on its vibration behaviour. Therefore, we recommend limiting the flexural aspect ratio. Limit values for the flexural aspect ratio are given on page 49.

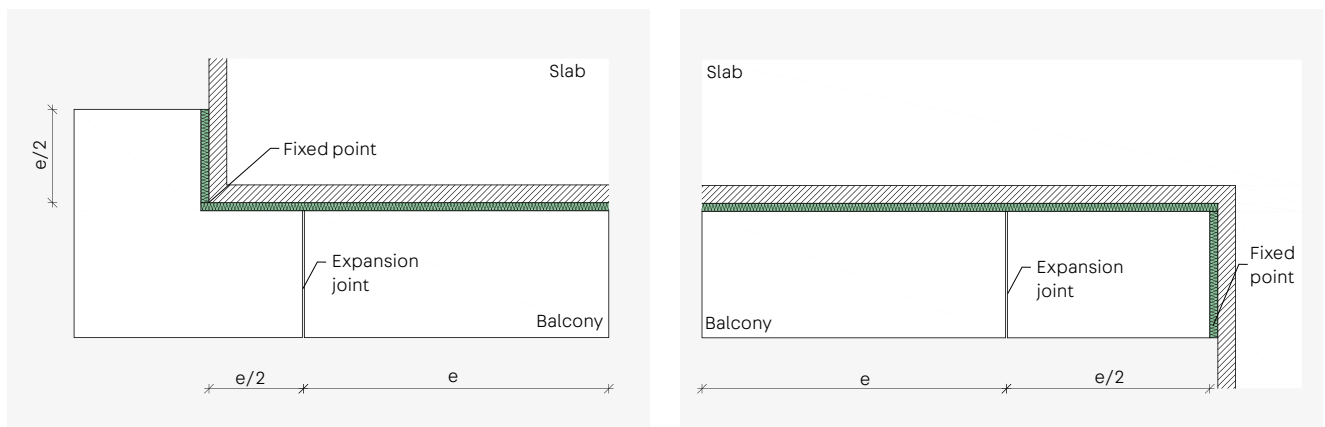
## Expansion joint spacing

The effects of temperature on exterior building components such as balconies or canopies cause deformation of reinforced concrete components. These expand when heated and contract when they cool down. If the reinforced concrete

components are thermally separated using ISOPRO® elements, the ISOPRO® components are deflected parallel to the insulating joint when the reinforced concrete slab deforms.



Balcony slab under the influence of temperature



Expansion joint arrangement for different balcony systems

Very long reinforced concrete components must be separated by expansion joints to limit the stress on the ISOPRO® elements due to temperature effects. The maximum permissible expansion joint spacing  $e$  is specified in the approval. The expansion joint spacing  $e$  depends on the rebar diameter and thus on the ISOPRO® type used (details can be found in the respective product information). Fixed points, such as supports that run around corners, or the use of ISOPRO® IPH or

IPE elements result in increased stress forces. This means that the maximum permissible expansion joint spacing must be reduced to  $e/2$ .

To prevent components separated by expansion joints from being unevenly compressed, they can be connected with longitudinally displaceable shear dowels of type HED.

# Construction physics

## Thermal insulation

### Definition of thermal bridges

Thermal bridges are weak points in the heat-transferring building envelope that have a higher rate of heat loss compared to standard cross-sections. In general, a distinction is made between geometric and material-related thermal bridges. Geometric thermal bridges occur when the area on the interior side is smaller than the area on the outside. This applies, for example, to outer corners of buildings (figure 1.1). Material-related thermal bridges are areas within the construction that are characterised by a change in thermal conductivity within the structural component, for example reinforced concrete columns in the exterior wall (figure 1.2). Structures often exhibit a combination of both effects. For example, bargeboard junctions are a superposition of geometric and material-related thermal bridge effects (figure 1.3).

A distinction is also made between point-shaped and linear thermal bridges. A point thermal bridge is a disruption in the thermal envelope limited to a small area, for example at supports or dowels that pierce the insulation. The point thermal transmittance coefficient  $\chi$  (chi) describes the energy losses in cases such as these. Linear thermal bridges, on the other hand, are disruptions in the building envelope that occur along a certain length, for example along slab supports, window reveals or balcony connections. The energy losses of linear thermal bridges are described by the linear thermal transmittance coefficient  $\Psi$  (psi).

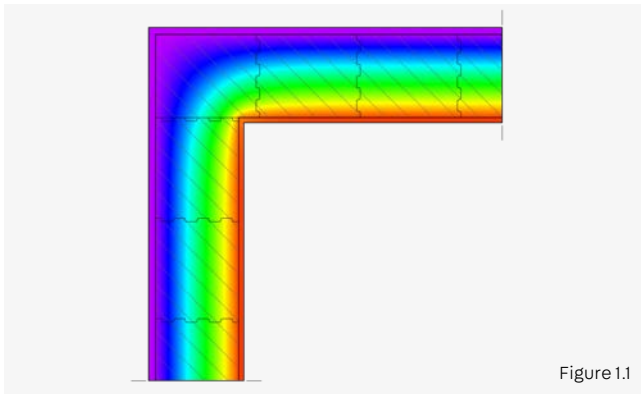


Figure 1.1

Geometric thermal bridge

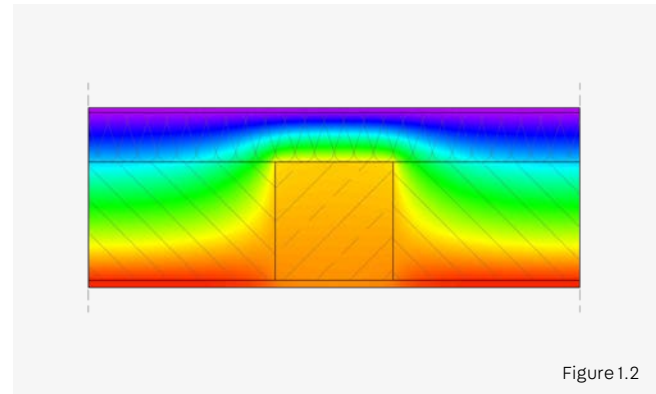


Figure 1.2

Material-related thermal bridge

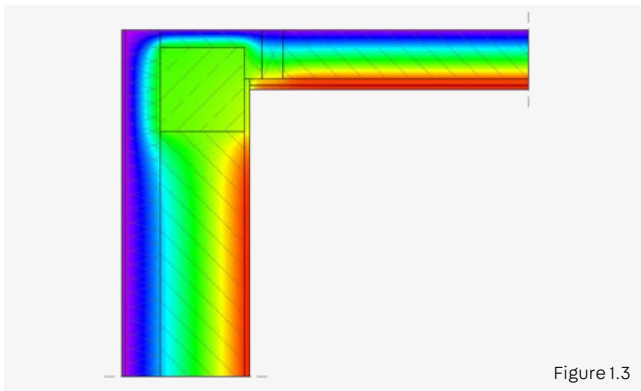


Figure 1.3

Example of a thermal bridge caused by both geometry and materials



## Effects of thermal bridges

Thermal bridges have a significantly higher heat flow compared to the rest of the building envelope's surface. Due to the greater heat flow, the internal surface temperature in this area drops, which means more energy is required for heating. If, in addition, the temperature falls below the dew point at this point, moisture in the room air precipitates out as condensation. This results in damage to the surface of the building component on the interior side. Even at a relative humidity of only 80%, it can

also lead to the formation of mould, which can be harmful to health. For this reason, minimum thermal insulation requirements are in place for areas with thermal bridges. These are described using the temperature factor  $f_{Rsi}$  and must comply with a value of 0.7. This corresponds to a permissible surface temperature of at least 12.6°C. The temperature factor can only be determined using thermal bridge calculations and is calculated as follows:

$$f_{Rsi} = \frac{\theta_{si} - \theta_e}{(\theta_{int} - \theta_e)}$$

Where

$\theta_{si}$  in °C is the temperature at the point of the inner surface ( $\theta$ - theta)

$\theta_e$  in °C is the outdoor air temperature

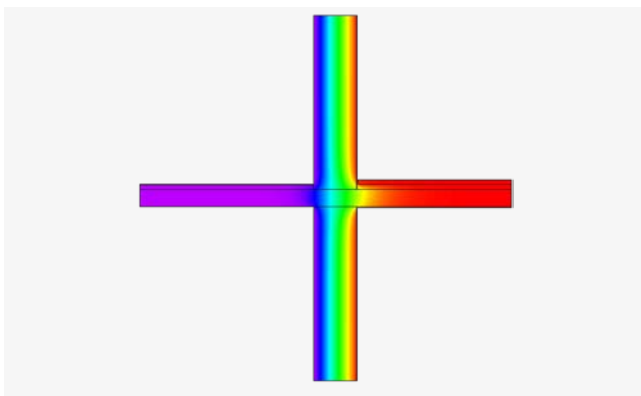
$\theta_{int}$  in °C is the indoor air temperature

To calculate the temperature factor, the indoor air temperature is assumed to be 20°C and the outdoor air temperature -5°C. The temperature at the point of the interior surface is determined using thermal bridge calculations.

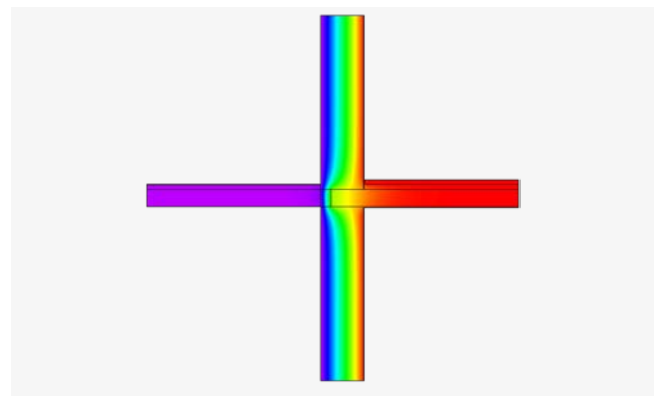
## Thermal bridges on balconies

A balcony as a cantilevered reinforced concrete slab is the classic example of a linear thermal bridge. If a highly thermally conductive reinforced concrete slab penetrates the thermal insulation layer of the building as a continuous concrete balcony, the effects of the geometric thermal bridges are compounded by the large external surface and the effects of the material-related thermal bridge. The consequences are low surface temperatures on the interior side. When

ISOPRO® thermal insulation elements are used in the connection areas between reinforced concrete slabs and buildings, thermal bridges are reduced to a technically possible and physically necessary minimum. For example, the following pictures show colour gradients representing the temperatures in a balcony connection. We can see that the connection without thermal separation has significantly lower surface temperatures.



Temperature distribution of continuous reinforced concrete slab without thermal separation



Temperature distribution of thermally separated reinforced concrete slab

## Thermal insulation and the consideration of thermal bridges

Heat losses due to thermal bridges are factored into the energy balance of buildings using a fixed thermal bridge correction factor  $\Delta U_{WB}$ . This is multiplied by the area of the heat-transferring enclosing surface and yields the heat

transfer coefficient for transmission via two-dimensional thermal bridges. This is described by the following equation:

$$H_{T,WB} = \Delta U_{WB} \sum A_j$$

Where

$\Delta U_{WB}$  is the thermal bridge correction

$A_j$  is the area of a building component j that separates the building zone from the outside air, from unheated or uncooled zones, or from the ground.

Without verification,  $\Delta U_{WB} = 0.10 \text{ W}/(\text{m}^2 \cdot \text{K})$  generally applies; for external building components with an internal insulation layer and an integrated solid slab,  $\Delta U_{WB} = 0.15 \text{ W}/(\text{m}^2 \cdot \text{K})$  applies. With verification and observing equivalence with the design examples of DIN 4108 Supplement 2, the following method can be followed:

- If the characteristics and criteria according to category B are fulfilled for all connections, the thermal bridge correction can be assumed as  $\Delta U_{WB} = 0.03 \text{ W}/(\text{m}^2 \cdot \text{K})$ .

- In all other cases of DIN 4108 Supplement 2, the thermal bridge correction may be assumed to be  $\Delta U_{WB} = 0.05 \text{ W}/(\text{m}^2 \cdot \text{K})$ .
- Alternatively, the thermal bridge effect can be determined on a project-specific basis and factored in by using an individual thermal bridge correction  $\Delta U_{WB}$ .

### Overview of the methods for factoring thermal bridges into the energy balance

	Method 1	Method 2	Method 3
<b>Description</b>	Thermal bridges are not verified. Only the minimum thermal insulation in line with DIN 4108-2:2013-02 must be complied with.	The thermal bridges of the building are designed in accordance with DIN 4108 Supplement 2:2019-06.	Determination of a project-related individual thermal bridge correction.
<b>Verification</b>	Without further verification.	Proof of equivalence according to supplement 2 of DIN 4108:2019-06; if necessary, adjustment according to DIN V 18599-2:2018-09.	Verified by a detailed two-dimensional thermal bridge calculation.
<b>Factor calculation</b>	Fixed: $\Delta U_{WB} = 0.10 \text{ W}/(\text{m}^2 \cdot \text{K})$ or $\Delta U_{WB} = 0.15 \text{ W}/(\text{m}^2 \cdot \text{K})$	Fixed: $\Delta U_{WB} = 0.05 \text{ W}/(\text{m}^2 \cdot \text{K})$ or $\Delta U_{WB} = 0.03 \text{ W}/(\text{m}^2 \cdot \text{K})$	$\Delta U_{WB} = (\sum \Psi_i \cdot li)/A$

## Thermal insulation data

The risk of condensation or risk of the component structure temperature falling below the dew point must be assessed to verify the usability of ISOPRO®. In this case, the verification must be calculated in line with DIN 4108-2, section 6.2.

The temperature factor at the most unfavourable point must be verified for the minimum requirement of  $f_{RSI} \geq 0.7$  and  $\theta_{si} \geq 12.6^\circ\text{C}$  in line with DIN EN ISO 10211-2.

## Adjusting the thermal bridge correction

If an equivalence cannot be established with one or more of the category A or B construction principles shown in the

supplement, the fixed thermal bridge correction  $\Delta U_{WB}$  can be adjusted as follows:

$$\Delta U_{WB} = \sum (\Delta \Psi_i \cdot l_i) / A + 0.05 \quad \text{or} \quad \Delta U_{WB} = \sum (\Delta \Psi_i \cdot l_i) / A + 0.03$$

Where

$\Delta \Psi_i$  is the difference between project-related temperature-weighted  $\Psi$  value and the respective  $\Psi$  reference value shown in the supplement;

$l_i$  is the length of the relevant connection;

$A$  is the heat-transferring enclosure area of the building.

However, the adjustment described above may only be applied if the calculated  $\Psi$  value is greater than the respective corresponding reference value.

If thermal bridges not included in the supplement are factored in, the thermal bridge correction in line with DIN V 18599-2:2018-09 must also be adjusted. In this case, it is not the

difference of the project-related temperature-weighted  $\Psi$  value that is taken into account, but the temperature-weighted  $\Psi$  value of the connection in question.

### Examples of thermal bridge correction adjustment

If it is not possible to establish equivalence to one or more of the design principles presented in the supplement, an adjustment of the fixed thermal bridge correction  $\Delta U_{WB}$  can be applied.

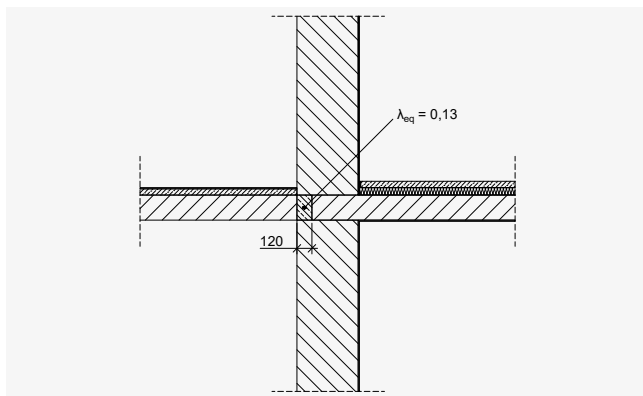
If a thermally insulating balcony connection element does not meet the requirements for the equivalent thermal conductivity  $\lambda_{eq} \leq 0.13 \text{ W/(m}\cdot\text{K)}$  due to high structural loads, either the thermal bridge correction  $\Delta U_{WB} = 0.10 \text{ W/(m}^2\cdot\text{K)}$  can be applied or the fixed thermal bridge correction  $\Delta U_{WB}$  can be adjusted. For this purpose, the thermal bridge calculation must be based on DIN EN ISO 10211:2018-03 to determine the  $\Psi$  value for the connection that deviates from the specifications of

Supplement 2. Based on this and the calculated difference from the specified reference value, the adjustment of the fixed thermal bridge correction  $\Delta U_{WB}$  can be determined by multiplying the value by the existing length with reference to the thermal envelope area of the building.

The example shows a calculation of the adjusted  $\Delta U_{WB}$  value for a sample connection. Here, the connection in question is assumed to have a length of  $l = 20 \text{ m}$  with a thermal envelope area of the building  $A = 350 \text{ m}^2$ .

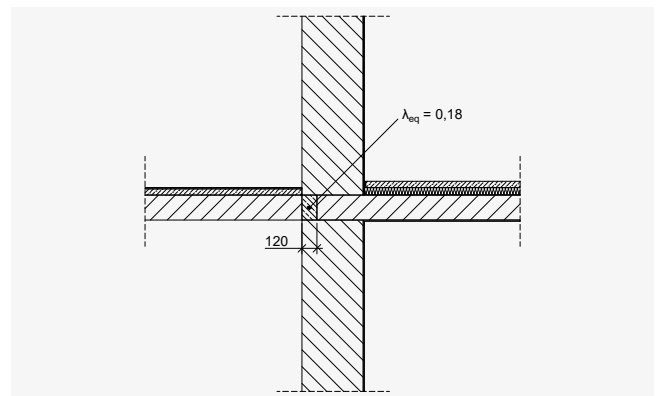
### Example for the adjustment of $\Delta U_{WB} = 0.03 \text{ W/(m}^2\cdot\text{K)}$ :

#### Reference design according to Supplement 2



$$\Psi_{Ref} = 0.17 \text{ W/(m}\cdot\text{K)}$$

#### Actual design



$$\Psi_{exist} = 0.204 \text{ W/(m}\cdot\text{K)}$$

Determining the adjusted thermal bridge correction:

$$\Delta U_{WB} = (\Psi - \Psi_{Ref}) \cdot l / A + 0.03 = (0.204 - 0.17) \cdot 20 / 350 + 0.03 = 0.032$$

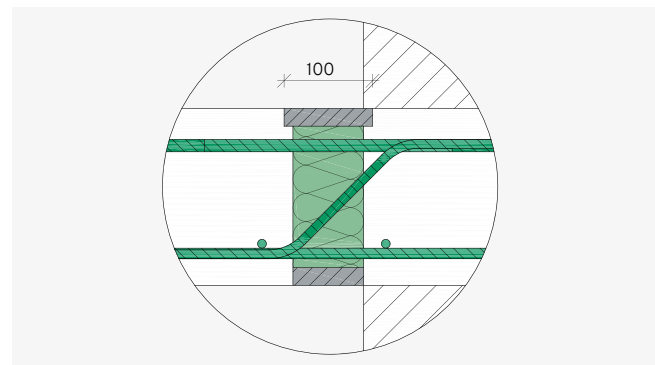
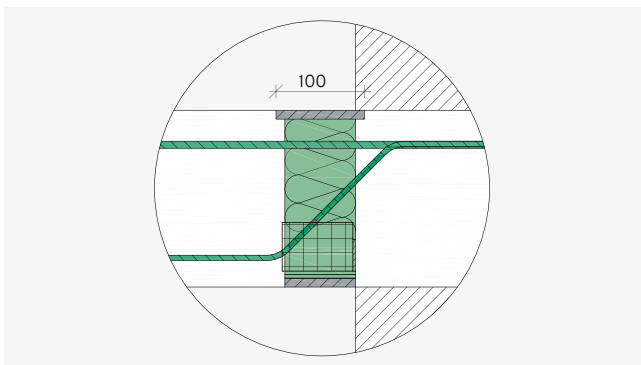
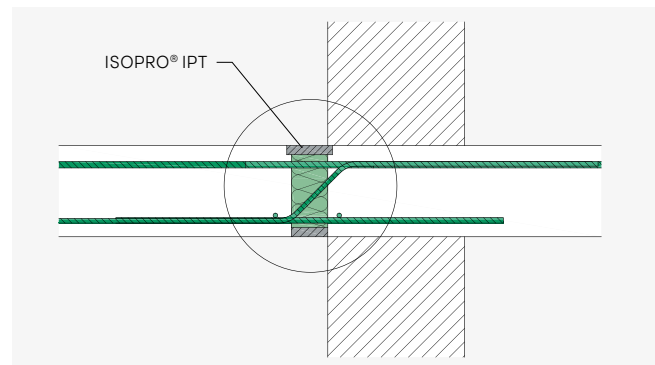
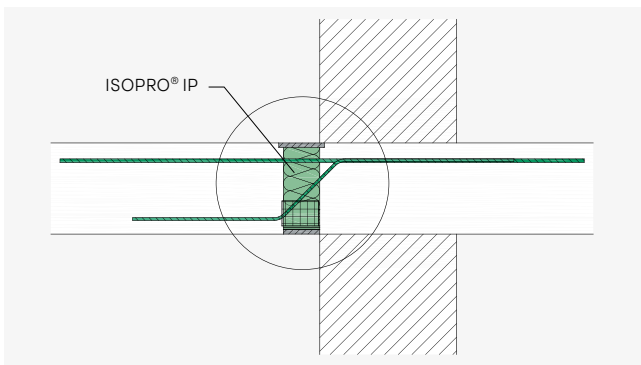
# Fire protection

## Fire protection classes R 90/REI 120

All ISOPRO® elements with concrete thrust bearings are available in fire resistance class REI 120 and all ISOPRO® elements with a steel pressure plane are available in fire resistance class R 90 to fulfil fire protection requirements for the fire resistance class of building components.

For this purpose, ISOPRO® elements are equipped with fire protection panels on the top and bottom in the factory. The short elements IPQS / IPQZ / IPTQQS / IPTA / IPTF / IPO and the elements for beams and walls IMTS and IMTW are manufactured with all-round fire protection panels in the factory.

A prerequisite for classification as R 90/REI 120 is that the adjacent building components meet the requirements for the respective fire resistance class. If a physical barrier (E) and thermal shielding (I) are also required in the event of fire, note that ISOPRO® Z-ISO FP1 of type EI 120 must be used as intermediate insulation when ISOPRO® elements are used at specific points.



ISOPRO® element with concrete thrust bearings of type REI 120: Version with fire protection panels protruding at the top, flush at the bottom

ISOPRO® element with steel compression struts of type R 90: Version with fire protection panels protruding at the top, flush at the bottom

## Fire protection classes

Components with ISOPRO® elements can achieve the following fire protection classes:

**IP, IP 2-part, IP Corner, IP VAR.,  
 IPQ, IPZQ, IPQS, IPQZ,  
 IPH, IPE, IPO**

**IPT, IPT Corner,  
 IPTQS, IPTQQ, IPTQQS,  
 IPTD, IPTA, IPTF, IPTS, IPTW**

**IP Z-ISO FP1**

<b>Fire protection class</b>	REI 120	R 90	EI 120
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### Fire protection regulations for balconies

DIN EN 13501-2:2010-02 (1a) defines balconies as load-bearing building components without a space-enclosing function. No specific fire protection requirements are specified for balconies in section 31 of the Model Building Code (MBO). Consequently, the fire protection requirements must be individually checked in each particular case.

### Fire protection regulations for access balconies

DIN EN 13501-2:2010-02 (1a) defines access balconies as load-bearing building components without a space-enclosing function. As long as access balconies do not function as a "necessary corridor", no specific fire protection requirements apply according to section 31 of the Model Building Code. Depending on the building class, necessary corridors must be either fire-resistant, highly fire-retardant or fire-retardant. The question of whether the thermal insulation connection must form a physical barrier enclosing the space must be individually checked in each particular case.

### Requirements for access balconies as necessary corridors

Building class according to section 2 of the Model Building Code	Section 31 of the Model Building Code	DIN EN 13501-2	DIN 4102-2
1	Load-bearing and space-enclosing	Not specified	Not specified
2	Load-bearing, space-enclosing, fire-retardant	REI 30	F 30-B
3	Load-bearing, space-enclosing, fire-retardant	REI 30	F 30-AB (space-enclosing)
4	Load-bearing, space-enclosing, highly fire-retardant	REI 60	F 60-AB (space-enclosing)
5	Load-bearing, space-enclosing, fire-resistant	REI 90	R 90-AB (space-enclosing)

### Fireproof barrier\*

Buildings that are more than 3 storeys high must have fireproof barriers and an ETICS made of EPS insulation materials more than 100 mm thick on every second storey. This is achieved by completely interrupting the insulation horizontally. Balconies, loggias and access balconies that completely interrupt an ETICS horizontally can function as a fire barrier. It is then not necessary to install an additional fireproof barrier in these areas. However, the fireproof barrier must connect laterally to

the cantilever slabs to ensure that the interruption of the insulation for fire protection is continuous. ISOPRO® elements in fire protection versions REI 120 or R 90 must be used in the situation described.

\*Source: Technische Systeminformation WDVS und Brandschutz (Technical system information: ETICS and fire protection) Fachverband Wärmedämm-Verbundsysteme, March 2016



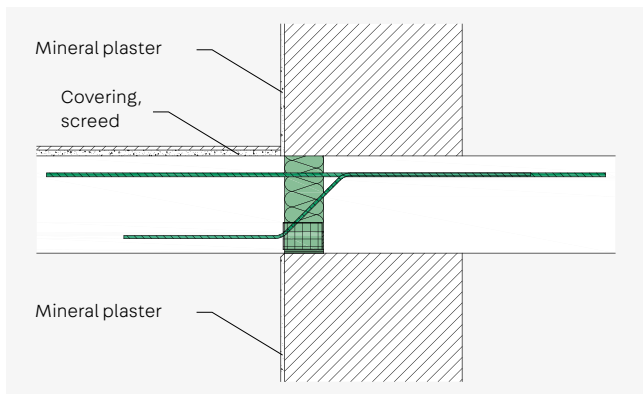
### Notes

To satisfy fire protection requirements, it must be ensured that any insulation between individual ISOPRO® elements also meets the fire protection requirements. ISOPRO® Z-ISO FPI of type EI 120 can be used for this purpose.

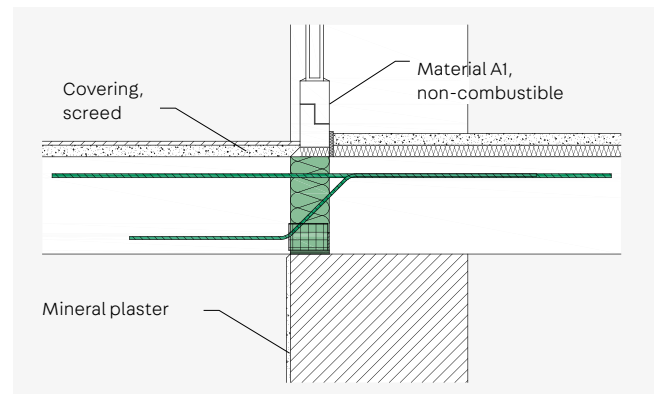
### Fire protection class REI 30

Building components with ISOPRO® IP standard elements can be classified under fire resistance class REI 30 if the following requirements for the overall construction are met:

- The components adjacent to the ISOPRO® element are clad on the surface by means of mineral protective coatings, and
- The ISOPRO® element is embedded in the overall construction and protected against direct flames from above and below.

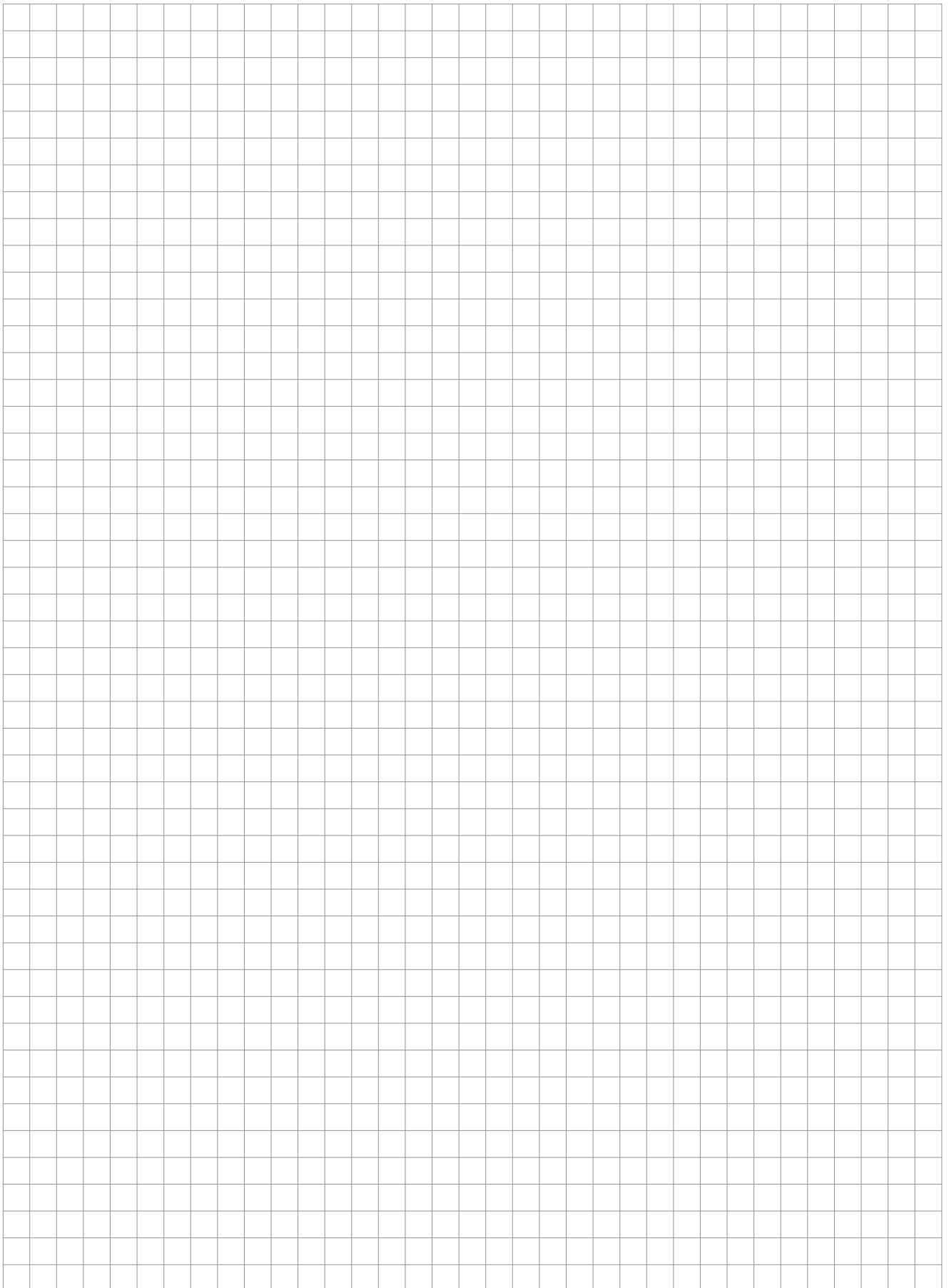


REI 30 layout in a wall area



REI 30 layout in a door area

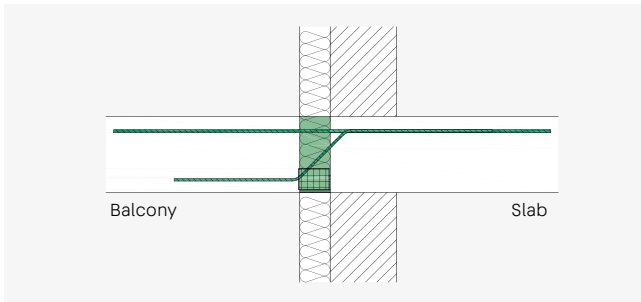




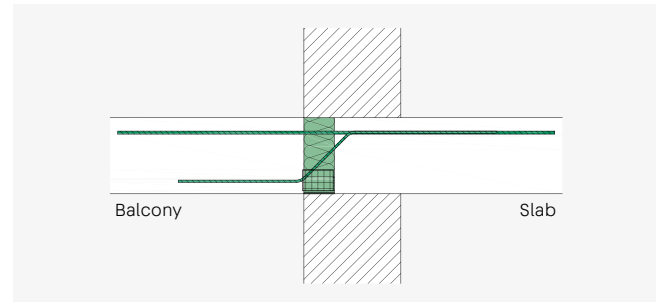
# Installation instructions

## Position in the building component

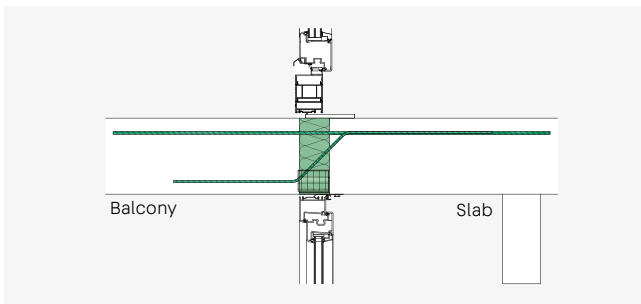
The ISOPRO® elements are installed in the insulation layer to reliably prevent thermal bridges.



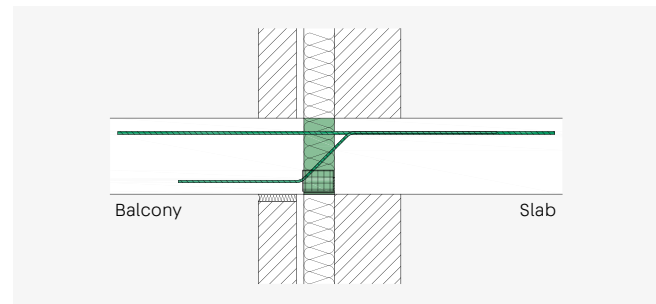
ISOPRO® IP - Installation cross-section, external thermal insulation composite system



ISOPRO® IP - Installation cross-section, solid wall



ISOPRO® IP - Installation cross-section, glass façade

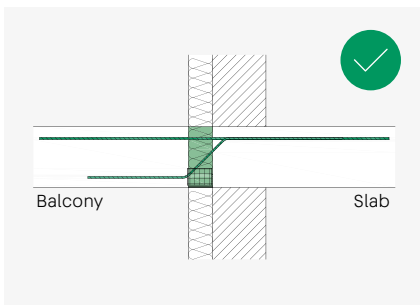


ISOPRO® IP - Installation cross-section, cavity wall

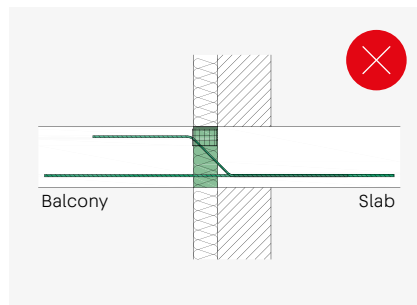
## Installation direction

During installation, the correct installation direction for the balcony side/slab side and top/bottom must be observed. When installed correctly, the tie bars are at the top and the thrust bearings/compression struts are at the bottom. The

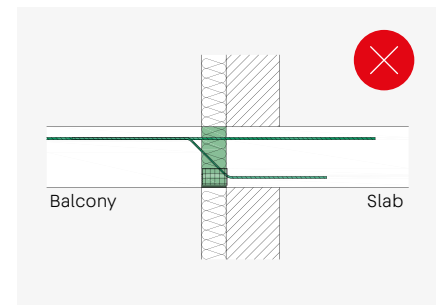
shear bar runs diagonally through the ISOPRO® element starting at the bottom on the balcony side and ends at the top on the slab side.



ISOPRO® IP - Correct installation



ISOPRO® IP - Incorrect installation, tie bar must be at the top



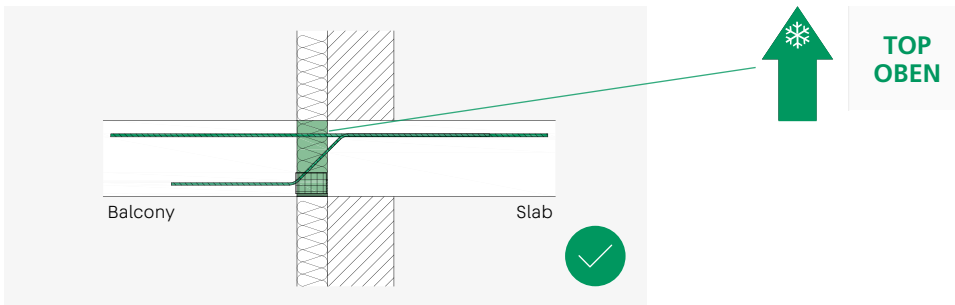
ISOPRO® IP - Incorrect installation, shear bar must be at the bottom on the balcony side

# Compression instructions – Compression joint

## Installation direction

During installation, it is essential to observe the installation direction indicated on the label. The installation direction is

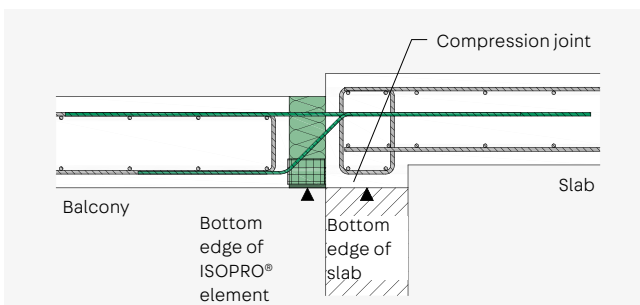
clearly marked on each element by the word "up" and by an arrow in the direction of the balcony side (cold area).



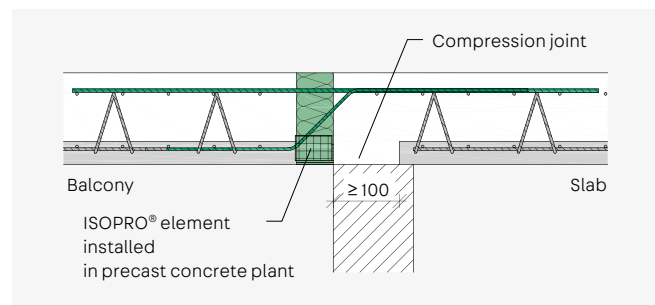
ISOPRO®IP – Correct installation

## Compression joint

- During installation, ensure that there is a positive fit between the thrust bearing and the fresh concrete. To do so, install a compression joint of  $\geq 100$  mm and select suitable casting section boundaries.
- An in-situ concrete strip or grouting strip of  $\geq 100$  mm must be provided between ISOPRO® elements, precast elements and precast slabs.



ISOPRO® elements for in-situ concrete construction and ceiling slabs with offset heights



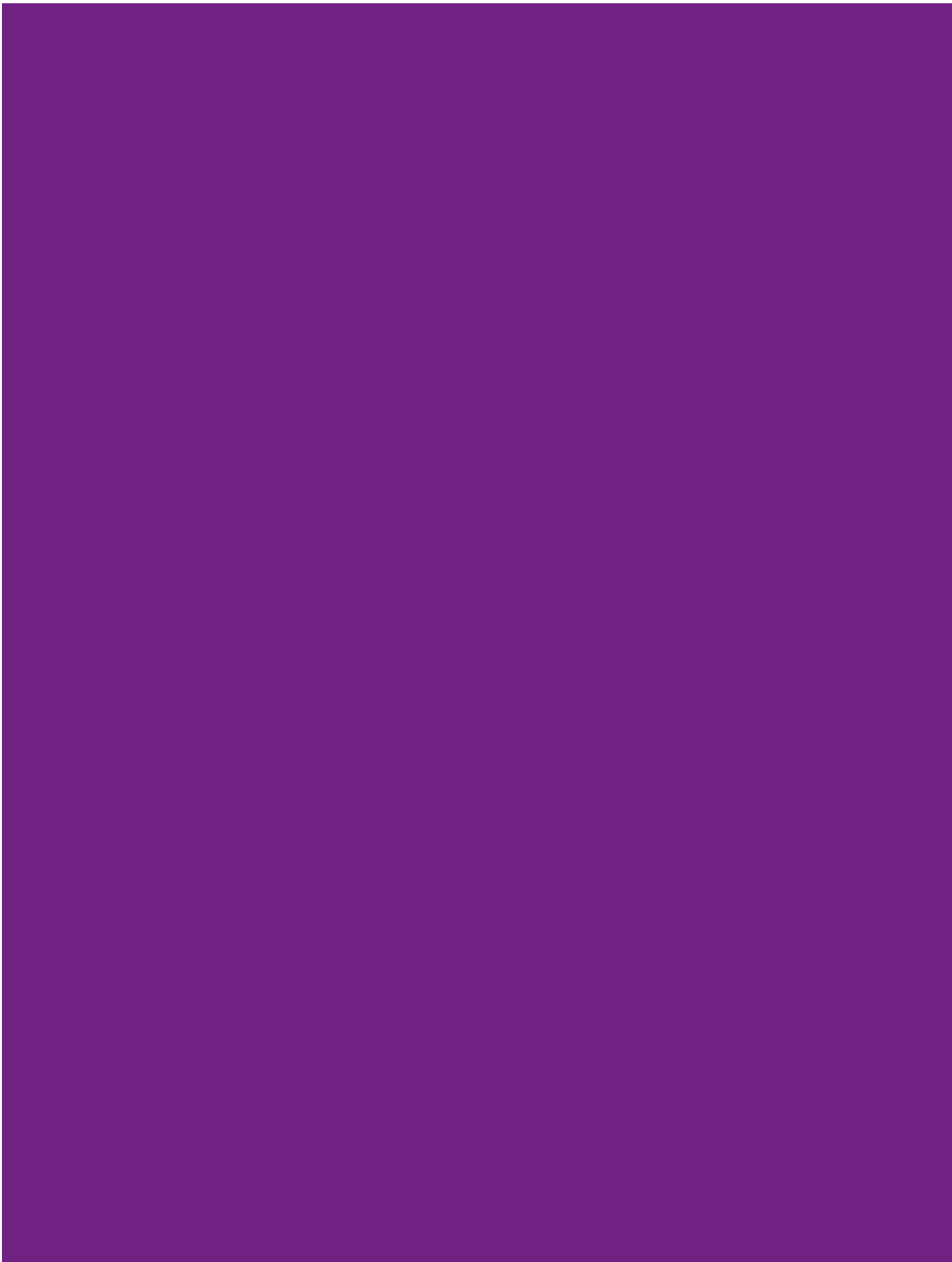
ISOPRO® elements in combination with precast slabs



## Consultation

Our Application Technology department will be happy to assist you with further solutions:

T +49 7742 9215-300  
technik-hbau@pohlcon.com



# Cantilevered components

# ISOPRO® IP and IPT

## Elements for cantilevered balconies



### ISOPRO® IP

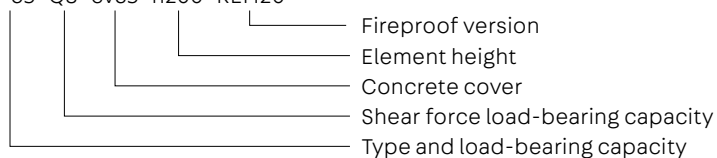
- For transferring negative moments and positive and negative shear forces depending on the design (QX)
- Concrete thrust bearings in pressure plane
- Load-bearing capacities: IP 10 to IP 100
- Shear force load-bearing capacities: standard, Q8, Q10, Q12, Q8X and Q10X
- Tie bar concrete cover: cv35 or cv50
- Element heights depending on the shear force load-bearing capacity:  $h_{\min}$  from 160 mm
- Fire resistance class REI 120 available

### ISOPRO® IPT

- Pressure plane with steel compression struts
- Load-bearing capacities: IPT 110 and IPT 150
- Shear force load-bearing capacities: Q10, Q12 and Q14
- Tie bar concrete cover: cv35 or cv50
- Element heights depending on the shear force load-bearing capacity:  $h_{\min}$  from 180 mm
- Fire resistance class R 90 available

### Type designation

IP 65 Q8 cv35 h200 REI120

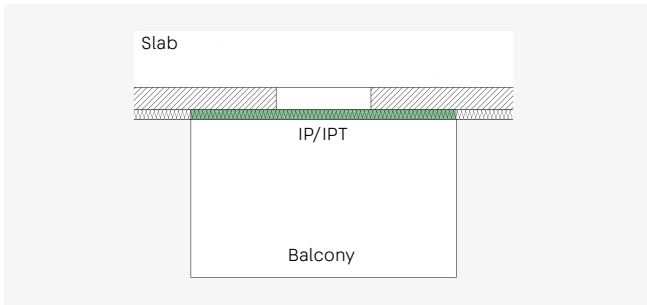




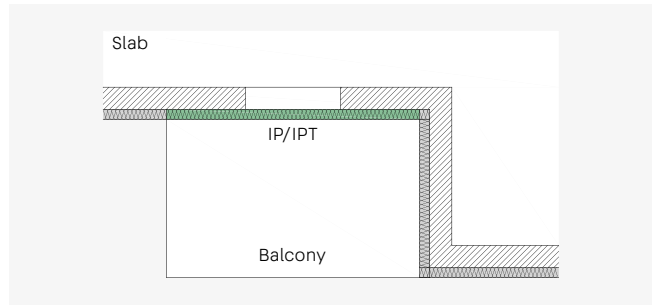
## Application – Element layout



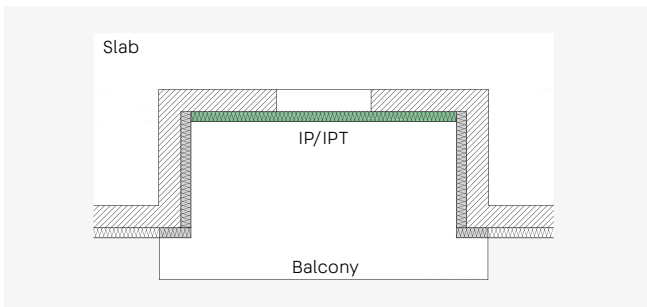
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



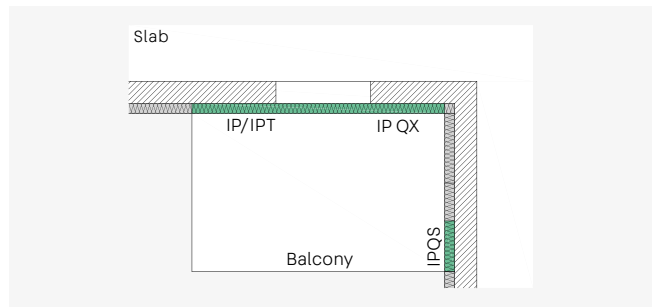
ISOPRO®IP/IPT - Cantilevered balconies



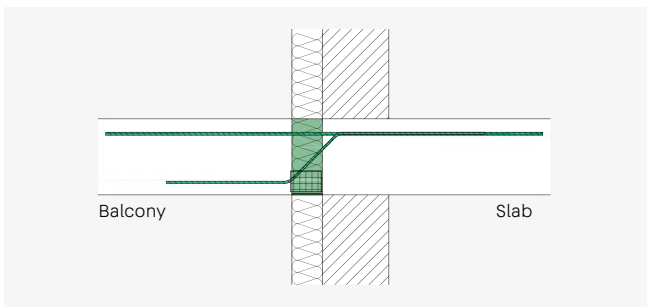
ISOPRO®IP/IPT - Cantilevered balconies in façade projections



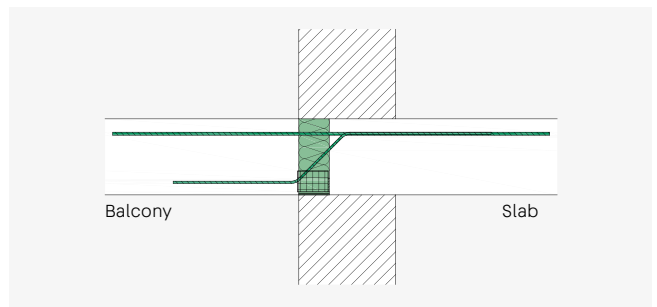
ISOPRO®IP/IPT - Cantilevered balconies in façade recesses



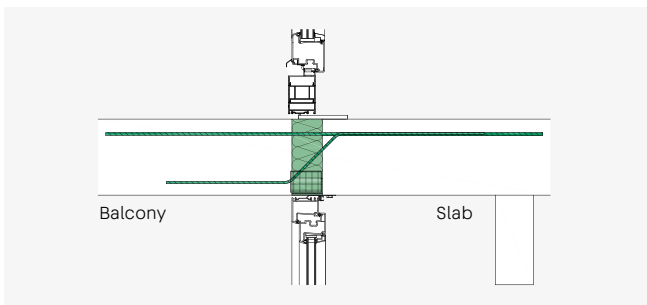
ISOPRO®IP/IPT in combination with IP QX and IPQS for inner corner balconies



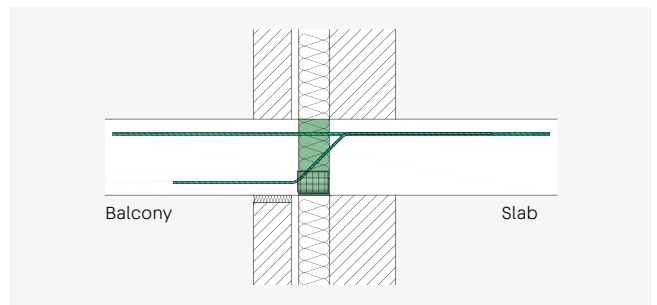
ISOPRO®IP - Installation cross-section, external thermal insulation composite system



ISOPRO®IP - Installation cross-section, solid wall



ISOPRO®IP - Installation cross-section, glass façades



ISOPRO®IP - Installation cross-section, cavity wall

## Measurement table for concrete $\geq$ C25/30

Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm/m

Element height mm depending on $c_v$ mm		Concrete $\geq$ C25/30					
35	50	IP 10	IP 15	IP 20	IP 25	IP 35	IP 45
160	–	9.0	13.2	15.4	21.7	23.8	28.0
–	180	9.5	14.0	16.2	22.9	25.1	29.5
170	–	10.0	14.8	17.1	24.1	26.5	31.1
–	190	10.5	15.5	18.0	25.3	27.8	32.7
180	–	11.1	16.3	18.9	26.6	29.2	34.3
–	200	11.6	17.1	19.8	27.8	30.5	35.9
190	–	12.2	17.9	20.7	29.1	31.9	37.5
–	210	12.7	18.6	21.6	30.3	33.3	39.1
200	–	13.3	19.4	22.5	31.6	34.7	40.7
–	220	13.8	20.2	23.4	32.9	36.0	42.3
210	–	14.4	21.0	24.3	34.2	37.5	44.0
–	230	14.9	21.8	25.2	35.4	38.8	45.6
220	–	15.5	22.6	26.2	36.8	40.3	47.3
–	240	16.0	23.4	27.1	38.0	41.7	48.9
230	–	16.6	24.3	28.1	39.4	43.1	50.6
–	250	17.2	25.1	29.0	40.6	44.5	52.2
240	–	17.8	25.9	30.0	42.0	46.0	53.9
250	–	18.9	27.6	31.9	44.7	48.9	57.3

Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m

Load-bearing capacity	$h_{min}$ mm	IP 10	IP 15	IP 20	IP 25	IP 35	IP 45
Standard	160	34.8	34.8	34.8	43.5	43.5	43.5
Q8	160	92.7	92.7	92.7	92.7	92.7	92.7
Q10	170	144.9	144.9	144.9	144.9	144.9	144.9
Q12	180	208.6	208.6	208.6	208.6	208.6	208.6
Q8X	160	+61.8/-46.4	+61.8/-46.4	+61.8/-46.4	+61.8/-46.4	+61.8/-46.4	+61.8/-46.4
Q10X	170	+96.6/-72.5	+96.6/-72.5	+96.6/-72.5	+96.6/-72.5	+96.6/-72.5	+96.6/-72.5

Dimensions and configuration

	IP 10	IP 15	IP 20	IP 25	IP 35	IP 45
Element length mm	1000	1000	1000	1000	1000	1000
Tie bars	4 $\emptyset$ 8	6 $\emptyset$ 8	7 $\emptyset$ 8	10 $\emptyset$ 8	11 $\emptyset$ 8	13 $\emptyset$ 8
Tie bars QX	5 $\emptyset$ 8	7 $\emptyset$ 8	8 $\emptyset$ 8	12 $\emptyset$ 8	13 $\emptyset$ 8	15 $\emptyset$ 8
Thrust bearings	4	4	4	4	5	5
Shear bars, standard	4 $\emptyset$ 6	4 $\emptyset$ 6	4 $\emptyset$ 6	5 $\emptyset$ 6	5 $\emptyset$ 6	5 $\emptyset$ 6
Shear bars Q8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8
Shear bars Q10	6 $\emptyset$ 10	6 $\emptyset$ 10	6 $\emptyset$ 10	6 $\emptyset$ 10	6 $\emptyset$ 10	6 $\emptyset$ 10
Shear bars Q12	6 $\emptyset$ 12	6 $\emptyset$ 12	6 $\emptyset$ 12	6 $\emptyset$ 12	6 $\emptyset$ 12	6 $\emptyset$ 12
Shear bars Q8X	4 $\emptyset$ 8/3 $\emptyset$ 8	4 $\emptyset$ 8/3 $\emptyset$ 8	4 $\emptyset$ 8/3 $\emptyset$ 8	4 $\emptyset$ 8/3 $\emptyset$ 8	4 $\emptyset$ 8/3 $\emptyset$ 8	4 $\emptyset$ 8/3 $\emptyset$ 8
Shear bars Q10X	4 $\emptyset$ 10/ 3 $\emptyset$ 10	4 $\emptyset$ 10/ 3 $\emptyset$ 10	4 $\emptyset$ 10/ 3 $\emptyset$ 10	4 $\emptyset$ 10/ 3 $\emptyset$ 10	4 $\emptyset$ 10/ 3 $\emptyset$ 10	4 $\emptyset$ 10/3 $\emptyset$ 10

**Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm/m**

Element height mm depending on $c_v$ mm		Concrete ≥ C25/30					Concrete ≥ C30/37
35	50	IP 50	IP 55	IP 65	IP 75	IP 90	IP 100
160	–	30.1	36.3	39.5	–	–	–
–	180	31.7	38.3	41.7	–	–	–
170	–	33.4	40.4	44.0	47.6	51.1	57.1
–	190	35.1	42.4	46.2	49.9	53.6	60.0
180	–	36.8	44.6	48.5	52.4	56.1	63.0
–	200	38.5	46.6	50.7	54.8	58.6	65.9
190	–	40.3	48.7	53.0	57.3	61.2	68.9
–	210	42.0	50.8	55.3	59.7	63.7	71.8
200	–	43.7	52.9	57.6	62.2	66.2	74.7
–	220	45.5	55.0	59.8	64.7	68.8	77.6
210	–	47.2	57.2	62.2	67.2	71.3	80.4
–	230	49.0	59.2	64.4	69.6	73.8	83.3
220	–	50.8	61.4	66.8	72.2	76.3	86.1
–	240	52.5	63.5	69.1	74.6	78.9	89.0
230	–	54.3	65.7	71.5	77.2	81.4	91.8
–	250	56.1	67.8	73.8	79.7	83.9	94.7
240	–	57.9	70.1	76.1	82.3	86.5	97.5
250	–	61.5	74.4	80.5	87.4	91.5	103.2

**Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m**

Load-bearing capacity	$h_{min}$ mm	IP 50	IP 55	IP 65	IP 75	IP 90	IP 100
Standard	160	43.5	43.5	43.5	–	–	–
Q8	160	92.7	92.7	92.7	–	–	–
Q10	170	144.9	144.9	144.9	144.9	144.9	144.9
Q12	180	208.6	208.6	208.6	208.6	208.6	208.6
Q8X	160	+61.8/-46.4	+61.8/-46.4	+61.8/-46.4	–	–	–
Q10X	170 180	+96.6/-72.5	+96.6/-72.5	+96.6/-72.5	+139.0/ -72.5	+139.0/ -72.5	+139.0/-72.5

**Dimensions and configuration**

	IP 50	IP 55	IP 65	IP 75	IP 90	IP 100
Element length mm	1000	1000	1000	1000	500 + 500 (QX elements 1000 mm)	
Tie bars	14 Ø 8	11 Ø 10	12 Ø 10	13 Ø 10	10 Ø 12	12 Ø 12
Tie bars QX	16 Ø 8	12 Ø 10	13 Ø 10	14 Ø 10	11 Ø 12	12 Ø 12
Thrust bearings	6	7	7	8	8	8
Shear bars, standard	5 Ø 6	5 Ø 6	5 Ø 6	–	–	–
Shear bars Q8	6 Ø 8	6 Ø 8	6 Ø 8	–	–	–
Shear bars Q10	6 Ø 10	6 Ø 10	6 Ø 10	6 Ø 10	6 Ø 10	6 Ø 10
Shear bars Q12	6 Ø 12	6 Ø 12	6 Ø 12	6 Ø 12	6 Ø 12	6 Ø 12
Shear bars Q8X	4 Ø 8/3 Ø 8	4 Ø 8/3 Ø 8	4 Ø 8/3 Ø 8	–	–	–
Shear bars Q10X	4 Ø 10/ 3 Ø 10	4 Ø 10/ 3 Ø 10	4 Ø 10/ 3 Ø 10	4 Ø 12/ 3 Ø 10	4 Ø 12/ 3 Ø 10	4 Ø 12/ 3 Ø 10

**Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm/m**

Element height mm  
 depending on  $c_v$  mm

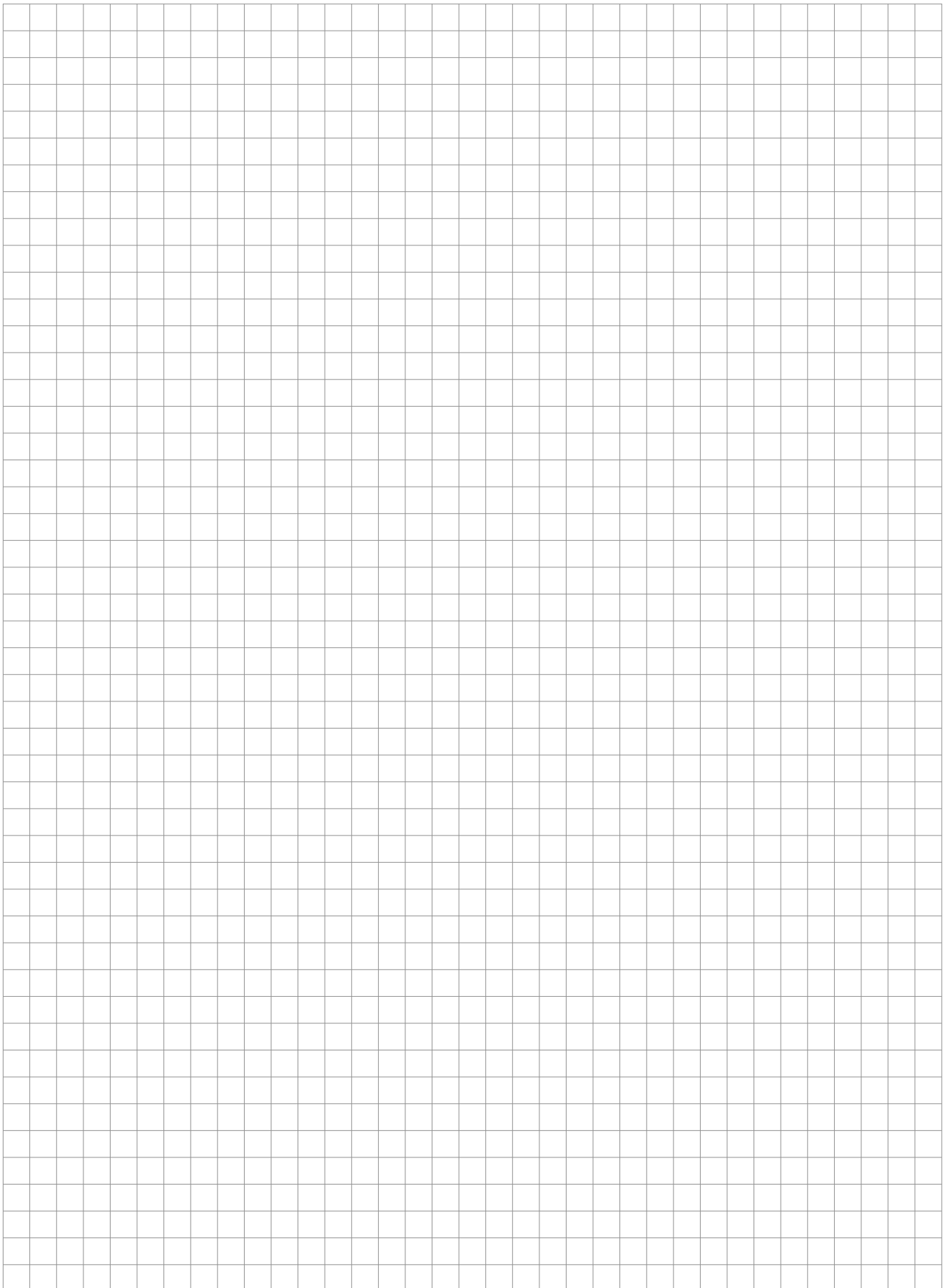
35	50	IPT 110	IPT 150
180	–	68.3	89.2
–	200	71.6	93.6
190	–	75.0	98.0
–	210	78.3	102.4
200	–	81.7	106.7
–	220	85.0	111.1
210	–	88.3	115.5
–	230	91.7	119.8
220	–	95.0	124.2
–	240	98.4	128.6
230	–	101.7	133.0
–	250	105.1	137.3
240	–	108.4	141.7
250	–	115.1	150.5

**Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m**

Load-bearing capacity	$h_{min}$ mm		IPT 110	IPT 150
Q10	170		96.6	96.6
Q12	170	180	144.9	139.1
Q14	180	190	208.6	189.3

**Dimensions and configuration**

	IPT 110	IPT 150
Element length mm	500 + 500	500 + 500
Tie bars	10 $\emptyset$ 14	14 $\emptyset$ 14
Compression struts	14 $\emptyset$ 12	18 $\emptyset$ 12
Shear bars Q10	4 $\emptyset$ 10	4 $\emptyset$ 10
Shear bars Q12	6 $\emptyset$ 10	4 $\emptyset$ 12
Shear bars Q14	6 $\emptyset$ 12	4 $\emptyset$ 14



# Deformation and precamber

## Deformation

Cantilevered reinforced concrete structures are precambered during their construction to allow for any expected deformation. If these structures are thermally separated with ISOPRO® elements, the deformation due to the ISOPRO® element itself is superimposed on the deformation due to slab curvature in line with DIN EN 1992-1-1/NA to calculate the precamber. Note that the required precamber will need to be rounded up or down depending on the planned drainage direction.

If drainage takes place at the building façade, the value must be rounded up; if drainage takes place at the end of the cantilever, the value must be rounded down. We recommend performing verification in the serviceability limit state for the quasi-permanent combined load ( $\gamma_G = 1.0, \gamma_Q = 1.0, \psi^2 = 0.3$ ). The tables below show the deformation factors  $\tan \alpha$  for calculating deformation due to ISOPRO®.

## Deformation due to ISOPRO® cantilever connection

$$w = \tan \alpha \cdot (m_{Ed}/m_{Rd}) \cdot l_k \cdot 10$$

Where:

- w = deformation at the end of the cantilever mm
- $\tan \alpha$  = deformation factor, see product information
- $m_{Ed}$  = bending moment for the calculating the precamber due to the ISOPRO® element. The design engineer determines the definitive load combination in the serviceability limit state.
- $m_{Rd}$  = section modulus of the ISOPRO® element, see product information
- $l_k$  = system length m

## Deformation factor $\tan \alpha$ for concrete $\geq$ C 25/30

Type	Concrete cover cv mm	Element height h mm									
		160	170	180	190	200	210	220	230	240	250
IP 10 to IP 50	35	0.94	0.85	0.79	0.72	0.67	0.63	0.59	0.56	0.53	0.50
	50	–	–	0.89	0.81	0.75	0.70	0.65	0.61	0.57	0.54
IP 55 to IP 90	35	1.12	1.01	0.93	0.85	0.79	0.74	0.69	0.65	0.61	0.58
	50	–	–	1.06	0.97	0.89	0.82	0.76	0.71	0.67	0.63
IPT 110, IPT 150	35	–	–	1.70	1.55	1.42	1.32	1.22	1.15	1.08	1.00
	50	–	–	–	–	1.62	1.48	1.37	1.27	1.18	1.15

## Deformation factor $\tan \alpha$ for concrete $\geq$ C 30/37

Type	Concrete cover cv mm	Element height h mm									
		160	170	180	190	200	210	220	230	240	250
IP 100	35	–	1.04	0.95	0.87	0.81	0.75	0.70	0.66	0.62	0.58
IP 100	50	–	–	1.09	0.99	0.91	0.84	0.78	0.72	0.68	0.64

# Flexural aspect ratio – Expansion joint spacing

## Flexural aspect ratio

The flexural aspect ratio is defined as the ratio of the structural height  $d$  of the balcony slab to the cantilever length  $l_k$ . The flexural aspect ratio of a slab has an effect on its vibration behaviour. Therefore, it is advisable to limit the flexural aspect

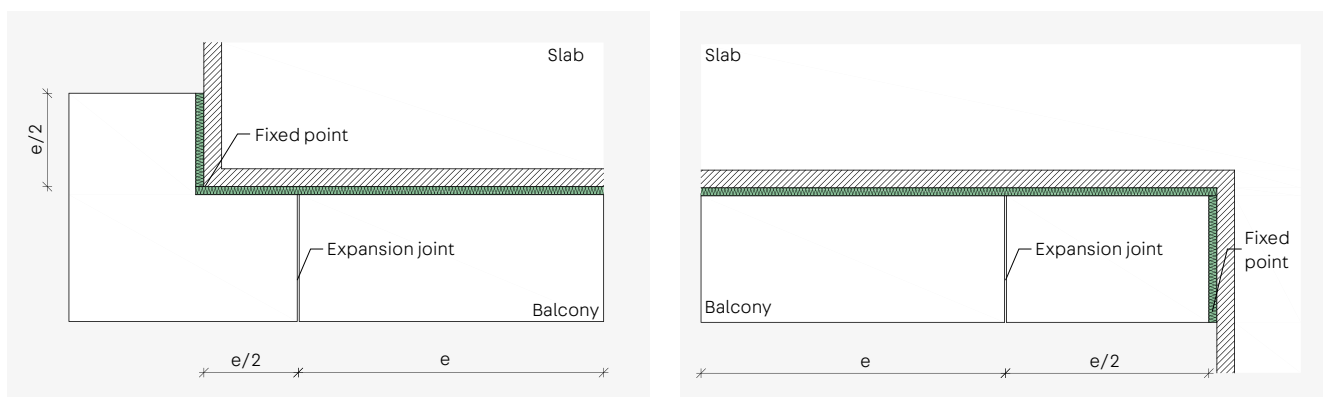
ratio for cantilevered reinforced concrete constructions according to DIN EN 1992-1-1 to a maximum value of  $l_k/d = 14$ . This results in the recommended maximum cantilever lengths  $l_k$ :

Concrete cover	Recommendation for max. $l_k$ m based on element height $h$ mm									
	160	170	180	190	200	210	220	230	240	250
cv35	1.68	1.82	1.96	2.10	2.24	2.38	2.52	2.66	2.80	2.94
cv50	1.47	1.61	1.75	1.89	2.03	2.17	2.31	2.45	2.59	2.73

## Expansion joint spacing

If the component dimensions exceed the maximum permissible expansion joint spacing, expansion joints must be aligned perpendicular to the insulation layer. The maximum permissible expansion joint spacing  $e$  depends on the maximum bar diameter across the expansion joint, and thus depends on the type.

Fixed points, such as supports that run around corners, or the use of ISOPRO® IPH or IPE elements result in increased stress forces. This means that the maximum permissible expansion joint spacing must be reduced to  $e/2$ . Half the maximum expansion joint distance is always measured from the fixed point.



Expansion joint arrangement for different balcony systems

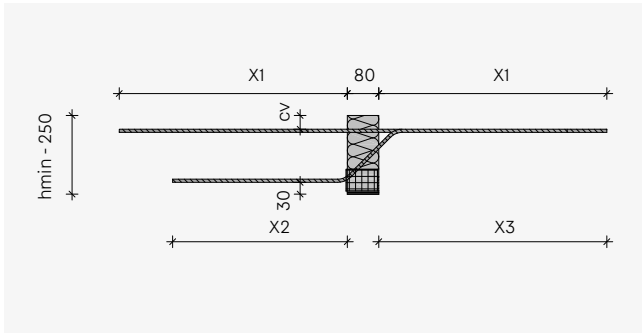
## Maximum permissible expansion joint spacing

		IP 10 to IP 65	IP 75 to IP 100	IPT 110, IPT 150		
Shear force load-bearing capacity	Standard, Q8, Q10, Q8X, Q10X	Q12	Q10	Q12, Q10X	Q10, Q12, Q14	
Joint spacing $e$ m		13.0	11.3	13.0	11.3	10.1



# Element design

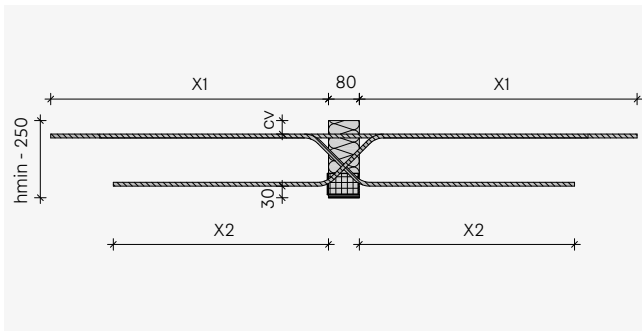
## ISOPRO® IP 10 to IP 100 – Positive shear forces



Length of tie bar mm	Length of shear bar mm		
	IP 10 – IP 50	IP 55 – IP 75	IP 90 – IP 100
<b>X1</b>	580	720	840

Length of shear bar mm	Shear force load-bearing capacity			
	Standard	Q8	Q10	Q12
<b>X2</b>	330	450	560	670
<b>X3</b>	≤ 475	≤ 530	≤ 640	≤ 745
<b>hmin</b>	160	160	170	180

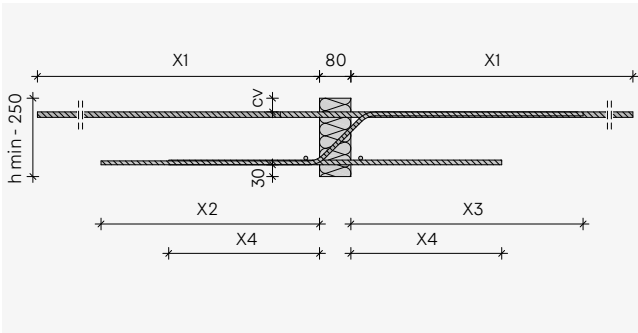
## ISOPRO® IP 10 to IP 100 – Positive and negative shear forces



Length of tie bar mm	Length of shear bar mm		
	IP 10 – IP 50	IP 55 – IP 75	IP 90 – IP 100
<b>X1</b>	580	720	840

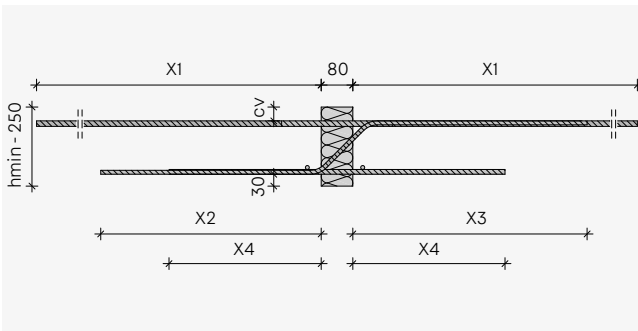
Length of shear bar mm	Shear force load-bearing capacity	
	Q8X	Q10X
<b>X2</b>	≤ 450	≤ 670
<b>hmin</b>	160	170

## ISOPRO® IPT 110



Length of tie bar and compression strut mm	IPT 110	Shear force load-bearing capacity		
		Q10	Q12	Q14
<b>Tie bar X1</b>	960			
<b>Compression strut X4</b>	385			
<b>X2</b>		560	560	670
<b>X3</b>		≤ 640	≤ 640	≤ 745
<b>hmin</b>		170	170	180

## ISOPRO® IPT 150

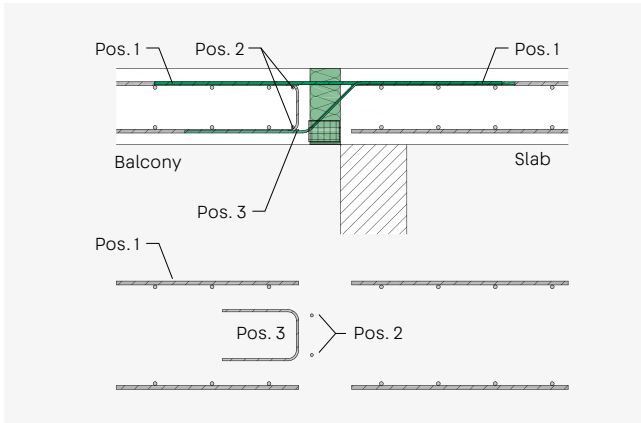


Length of tie bar and compression strut mm	IPT 150	Shear force load-bearing capacity		
		Q10	Q12	Q14
<b>Tie bar X1</b>	960			
<b>Compression strut X4</b>	385			
<b>X2</b>		560	670	780
<b>X3</b>		≤ 640	≤ 745	≤ 860
<b>hmin</b>		170	180	190

# On-site reinforcement

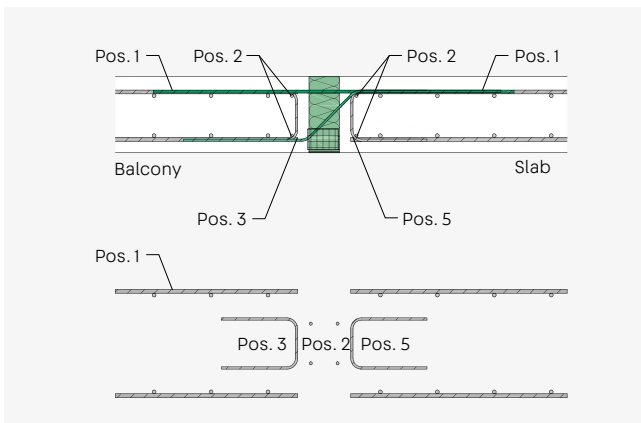
## ISOPRO® IP10 to IP100

### Direct support



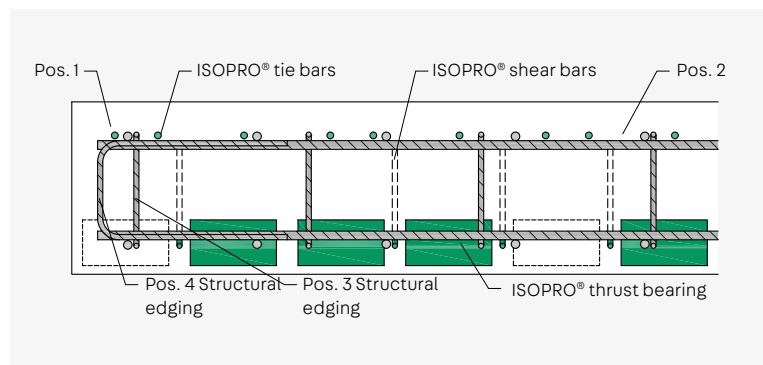
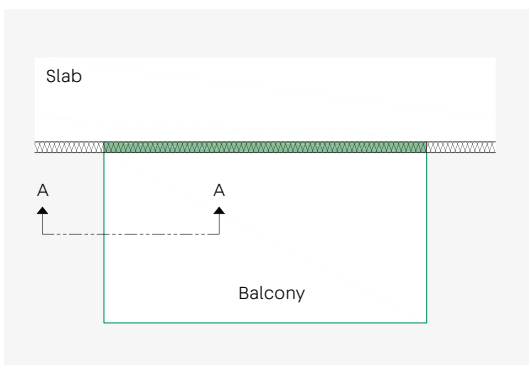
- Pos. 1: Connection reinforcement for the ISOPRO® element – page 48
- Pos. 2: Distribution bar 2 Ø 8 balcony side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)

### Indirect support



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 48
- Pos. 2: Distribution bar 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)
- Pos. 5: Edge or suspension reinforcement – page 48

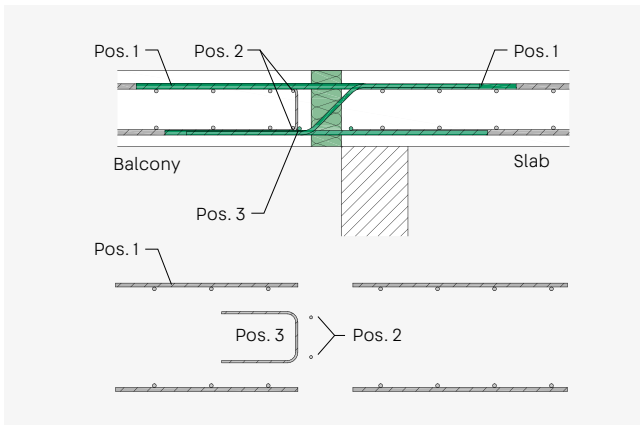
### Edging on free balcony edge



ISOPRO® IP – Cross section A-A

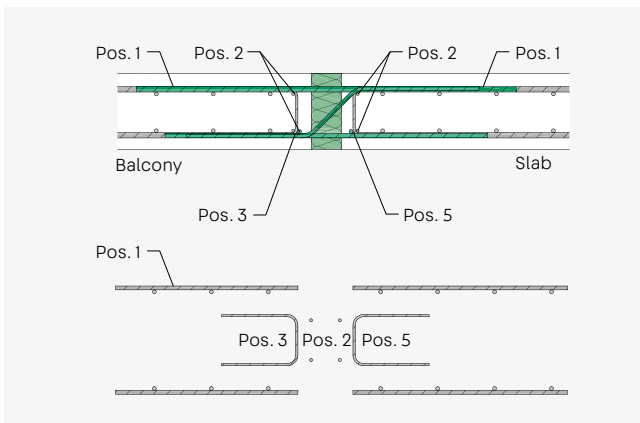
## ISOPRO® IPT 110 to IPT 150

### Direct support



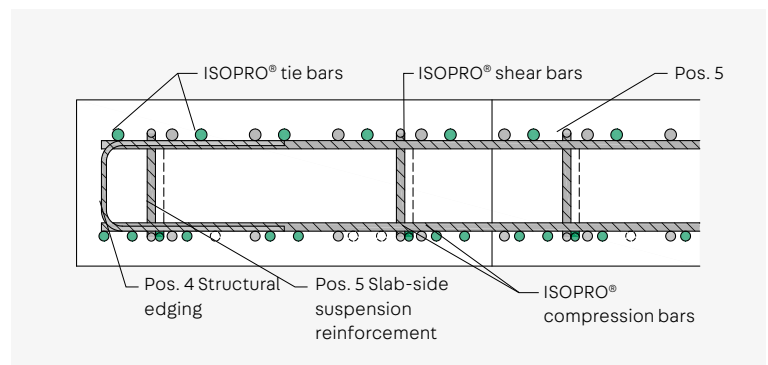
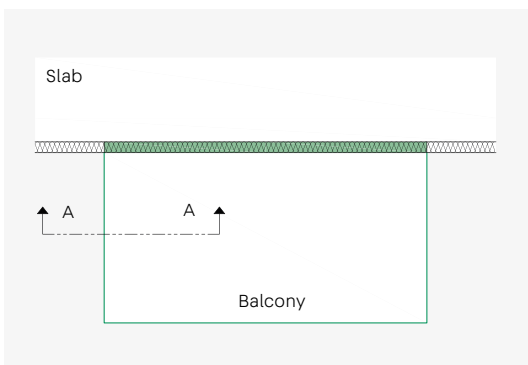
- Pos. 1: Connection reinforcement for the ISOPRO® element – page 48
- Pos. 2: Distribution bar 2 Ø 8 balcony side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)

### Indirect support



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 48
- Pos. 2: Distribution bar 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)
- Pos. 5: Edge or suspension reinforcement – page 48

### Edging on free balcony edge



ISOPRO® IPT – Cross section A-A

## Connection reinforcement Pos. 1

### ISOPRO® IP 10 to IP 100 and IPT 110 to IPT 150

ISOPRO®	$a_{s,erf}$ cm <sup>2</sup> /m	Recommendation Reinforcing steel B500
IP 10	2.37	5 Ø 8
IP 15	3.47	7 Ø 8
IP 20	4.00	8 Ø 8
IP 25	5.62	12 Ø 8
IP 35	6.14	13 Ø 8
IP 45	7.20	15 Ø 8
IP 50	7.73	16 Ø 8
IP 55	9.40	12 Ø 10
IP 65	10.17	13 Ø 10
IP 75	11.04	14 Ø 10
IP 90	11.62	11 Ø 12
IP 100	13.11	12 Ø 12
IPT 110	15.39	10 Ø 14
IPT 150	20.10	14 Ø 14

## Edge or suspension reinforcement with indirect support Pos. 5

### ISOPRO® IP 10 to IP 100, IPT 110 AND IPT 150

Shear force load-bearing capacity	IP 10 to IP 20	IP 25 to IP 65	IP 75 to IP 100	IPT 110	IPT 150
	$a_{s,erf}$ cm <sup>2</sup> /m	$a_{s,erf}$ cm <sup>2</sup> /m	$a_{s,erf}$ cm <sup>2</sup> /m	$a_{s,erf}$ cm <sup>2</sup> /m	$a_{s,erf}$ cm <sup>2</sup> /m
Standard	1.13	1.00	–	–	–
Q8	2.13	2.13	–	–	–
Q10	3.33	3.33	3.33	2.22	2.22
Q12	4.79	4.79	4.79	3.33	3.20
Q14	–	–	–	4.79	4.35
Q8X	1.42	1.42	–	–	–
Q10X	2.22	2.22	3.20	–	–

# Calculation example

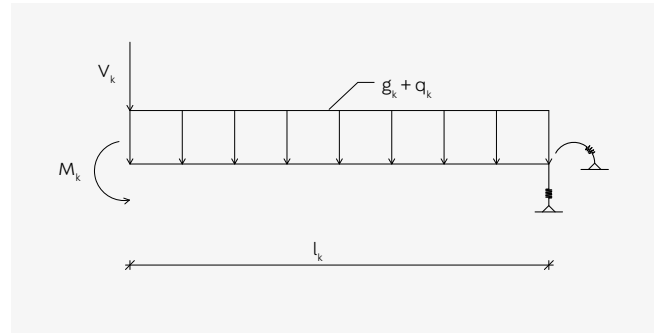
## Element selection, deformation and precamber

### System:

Cantilever overhang  
 Cantilever length  $l_k$  = 2.0 m  
 Balcony slab thickness = 180 mm  
 Concrete cover cv35  
 Balcony and slab C25/30 concrete

### Load assumptions:

Dead weight  $g_k$  = 4.50 kN/m<sup>2</sup>  
 Imposed load/covering  $g_k$  = 1.50 kN/m<sup>2</sup>  
 Live load  $q_k$  = 4.00 kN/m<sup>2</sup>  
 Edge load  $V_k$  = 1.50 kN/m  
 Edge moment  $M_k$  = 0.00 kNm/m



### Internal forces:

$$m_{Ed} = (g_k \cdot 1.35 + q_k \cdot 1.5) \cdot l_k^2 / 2 + (G_k \cdot 1.35) \cdot l_k$$

$$V_{Ed} = (g_k \cdot 1.35 + q_k \cdot 1.5) \cdot l_k + (G_k \cdot 1.35)$$

$$m_{Ed} = (6.00 \cdot 1.35 + 4.00 \cdot 1.5) \cdot 2.00^2 / 2 + (1.5 \cdot 1.35) \cdot 2.00 = \underline{32.25 \text{ kNm/m}}$$

$$V_{Ed} = (6.00 \cdot 1.35 + 4.00 \cdot 1.5) \cdot 2.00 + (1.5 \cdot 1.35) = \underline{30.23 \text{ kN/m}}$$

### Calculation:

Selected: IP 50, cv35, h = 180 mm  
 $m_{Rd} = 36.80 \text{ kNm/m} \geq 32.25 \text{ kNm/m}$  (see page 39)  
 $V_{Rd} = 43.50 \text{ kN/m} \geq 30.23 \text{ kN/m}$

### Deformation due to thermal insulation element:

Quasi-permanent load combination  $\Psi_2 = 0.30, \gamma_G = 1.00, \gamma_Q = 1.00$

$$m_{Ed,perm} = m_{gk} + m_{qk} \cdot \Psi_2$$

$$m_{Ed,perm} = (g_k + q_k \cdot \Psi_2) \cdot l_k^2 / 2 + G_k \cdot l_k$$

$$m_{Ed,perm} = (6.00 + 4.00 \cdot 0.3) \cdot 2.00^2 / 2 + 1.50 \cdot 2.00 = \underline{17.40 \text{ kNm/m}}$$

$$w_1 = \tan \alpha \cdot (m_{Ed,perm} / m_{Rd}) \cdot l_k \cdot 10$$

$$\tan \alpha = 0.79 \text{ (see page 42)}$$

$$w_1 = 0.79 \cdot (17.40 / 36.80) \cdot 2.00 \cdot 10 = \underline{7.47 \text{ mm} \text{ (} \sim 7.00 \text{ mm)}}^*$$

\* Deformation due to thermal insulation element. To the deformation at the end of the cantilever, the structural engineer must add the deformation arising from slab curvature  $w_2$ . The deformation from slab curvature  $w_2$  is usually much smaller than the deformation from the thermal insulation elements (rule of thumb  $w_2 \sim 0.25 \cdot w_1$ ).

### Precamber:

**Case 1)** Drainage in the direction of the cantilever selected:

Precamber 7.00 mm (**rounded up**)

**Case 2)** Drainage in the direction of the building side selected:

Precamber 10.00 mm (**rounded up**)

# ISOPRO® IP 2-part

## Elements for cantilevered balconies

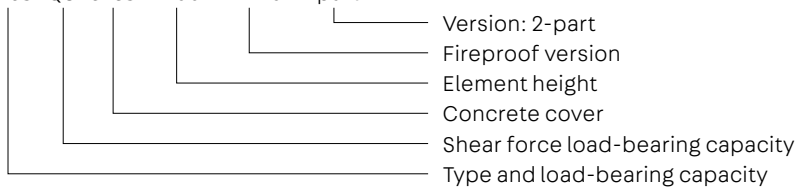


### ISOPRO® IP 2-part

- 2-part elements for installing the lower part of precast slabs in the precast concrete plant and positioning the upper part on the construction site
- Transfers negative moments and positive shear forces
- Concrete thrust bearings in pressure plane
- Load-bearing capacities: IP 10 2-part to IP 100 2-part
- Shear force load-bearing capacities: standard, Q8, Q10, Q12
- Tie bar concrete cover: cv35 or cv50
- Element heights depending on the shear force load-bearing capacity: from 160 mm
- Fire resistance class REI 120 available

### Type designation

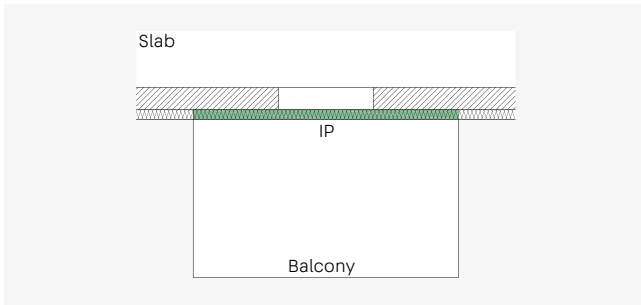
IP 65 Q8 cv35 h200 REI120 2-part



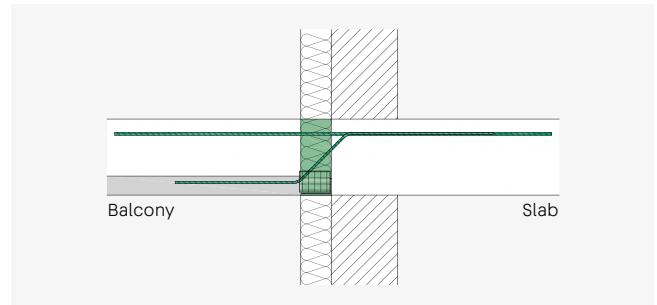
# Application – Element design



This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.

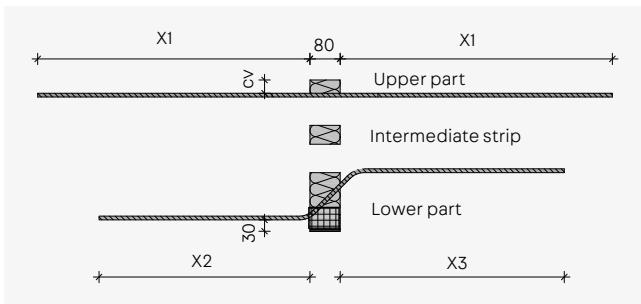


ISOPRO® IP 2-part – Cantilevered balconies



ISOPRO® IP 2-part – Installation cross-section, external thermal insulation composite system

## Element design ISOPRO® IP 10 2-part to IP 100 2-part



Length of tie bar mm	IP 10 – IP 50	IP 55 – IP 75	IP 90 – IP 100
<b>X1</b>	580	720	840

Length of shear bar mm	Shear force load-bearing capacity			
	Standard	Q8	Q10	Q12
<b>X2</b>	330	450	560	670
<b>X3</b>	≤ 475	≤ 530	≤ 640	≤ 745
<b>hmin</b>	160	160	170	180

### Calculation and design of the 2-part elements

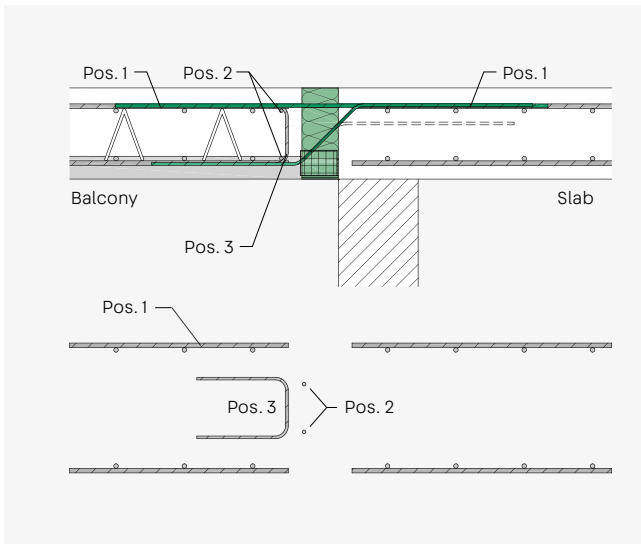
- Calculation and design of the elements is identical to the corresponding one-part elements – pages 38 – 40
- Design of the insulating body consists of a lower part and an upper part
- Precast concrete plants have the option of ordering elements in conventional heights and doubling them up to create taller elements by inserting intermediate strips if required. The shear bar is designed for the originally selected element height and does not lie in the tension plane of the element when doubled up.
- Precamber, flexural aspect ratio, and maximum permissible expansion joint spacing – pages 42 – 43



# On-site reinforcement

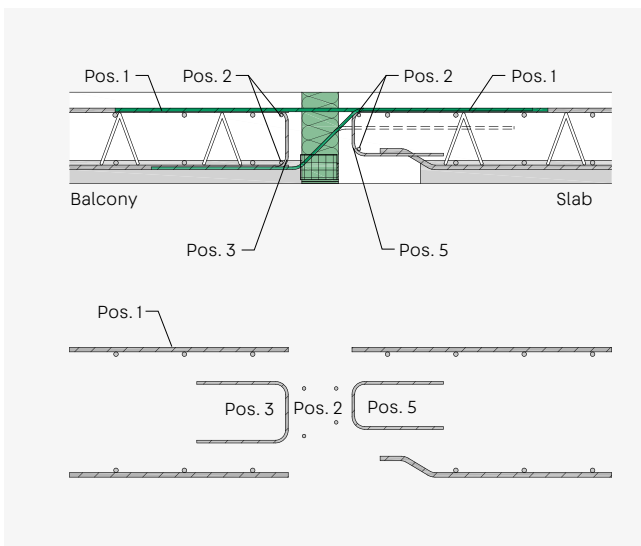
## ISOPRO® IP 10 2-part to IP 100 2-part

### Direct support



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 53
- Pos. 2: Distribution bar 2 Ø 8 balcony side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)

### Indirect support



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 53
- Pos. 2: Distribution bar 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)
- Pos. 5: Edge or suspension reinforcement – page 53

## ISOPRO® IP 10 2-part to IP 100 2-part

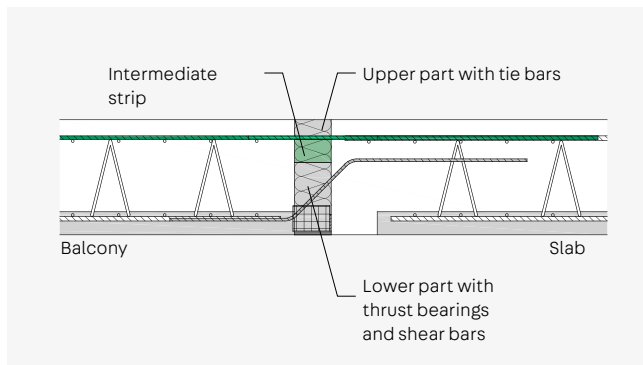
### Connection reinforcement Pos. 1

Type	$a_{s,erf}$ cm <sup>2</sup> /m	Recommendation Reinforcing steel B500
IP 10	2.37	5 Ø 8
IP 15	3.47	7 Ø 8
IP 20	4.00	8 Ø 8
IP 25	5.62	12 Ø 8
IP 35	6.14	13 Ø 8
IP 45	7.20	15 Ø 8
IP 50	7.73	16 Ø 8
IP 55	9.40	12 Ø 10
IP 65	10.17	13 Ø 10
IP 75	11.04	15 Ø 10
IP 90	11.62	11 Ø 12
IP 100	13.11	12 Ø 12

### Edge or suspension reinforcement pos. 5

Shear force load-bearing capacity	IP 10 to IP 20	IP 25 to IP 65	IP 75 to IP 100
	$a_{s,erf}$ cm <sup>2</sup> /m	$a_{s,erf}$ cm <sup>2</sup> /m	$a_{s,erf}$ cm <sup>2</sup> /m
Standard	1.13	1.00	–
Q8	2.13	2.13	–
Q10	3.33	3.33	3.33
Q12	4.79	4.79	4.79

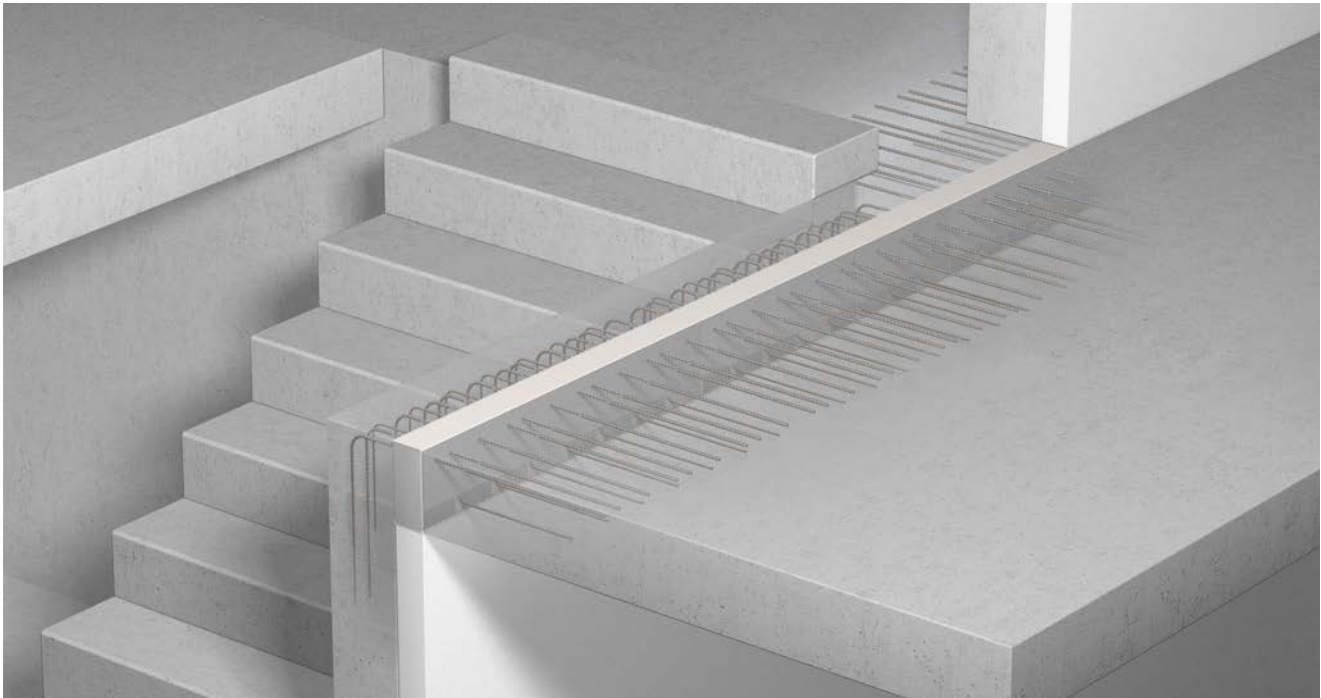
### Installation of upper part



- The 2-part ISOPRO® element consists of a lower part and an upper part. The bottom part is cast in the precast slab in the precast concrete plant.
- The upper part is installed on site.
- The upper and lower parts are labelled so that they can be combined correctly. Attention must be paid to combining the parts correctly on the construction site.
- When fitting the upper part, make sure that it is fitted facing in the correct direction.
- Without the upper part, the connection will not have the specified load-bearing capacity.

# ISOPRO® IP variants

## Elements for cantilevered balconies



### ISOPRO® IP VAR.

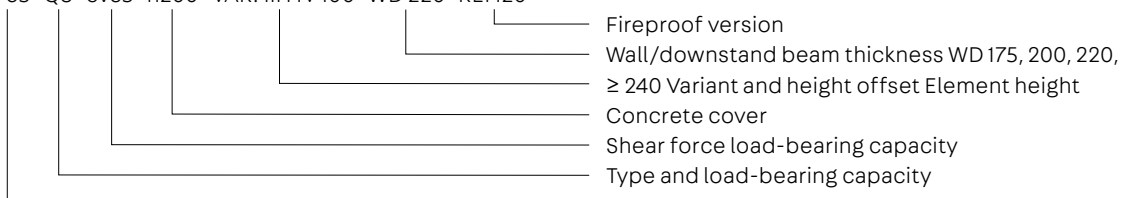
- Transfers negative moments and positive shear forces
- Concrete thrust bearings in pressure plane
- Load-bearing capacities IP 20 VAR. to IP 75 VAR.
- Shear force load-bearing capacities: standard and Q8
- Tie bar concrete cover: cv35 or cv50
- Element heights depending on the shear force load-bearing capacity:  $h_{min}$  from 160 mm
- Wall thicknesses: WD 175, 200, 220 and  $\geq 240$
- Fire resistance class REI 120 available

### Connection geometry

- VAR. I – Connection to a wall leading downwards
- VAR. II – Connection to a wall leading upwards
- VAR. III HV – Connection to a slab that is vertically offset upwards
- VAR. III UV – Connection to a slab that is vertically offset downwards

### Type designation

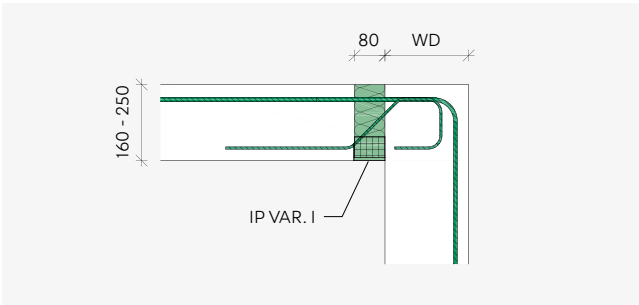
IP 65 Q8 cv35 h200 VAR. III HV 100 WD 220 REI 120



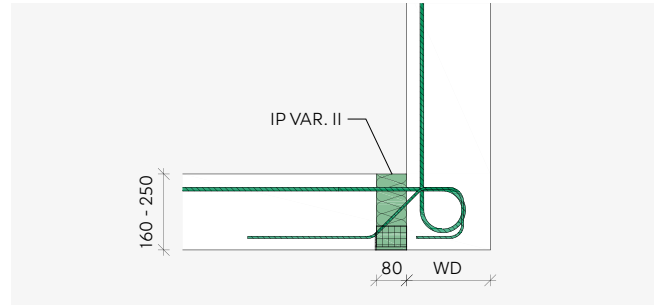
# Application

## Connection to a wall

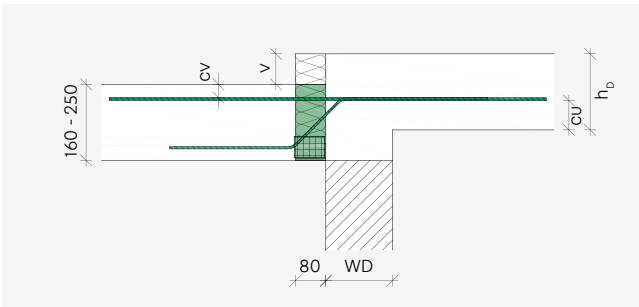
### Wall connection downwards – IP VAR. I



### Wall connection upwards – IP VAR. II



## Connection to a slab with a slight height offset with a standard ISOPRO® Element



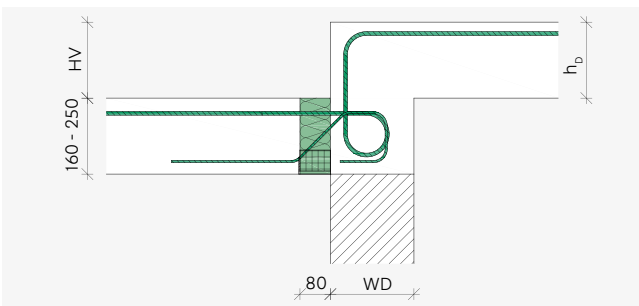
$$v \leq h_b - cv - d_s - cu$$

Where:

- v - is the height offset
- $h_b$  - is the slab thickness
- cv - is the concrete cover of the tie bars of the ISOPRO® element
- $d_s$  - is the diameter of the tie bars of the ISOPRO® element
- cu - is the concrete cover of the tie bars of the ISOPRO® element on the bottom edge of the slab

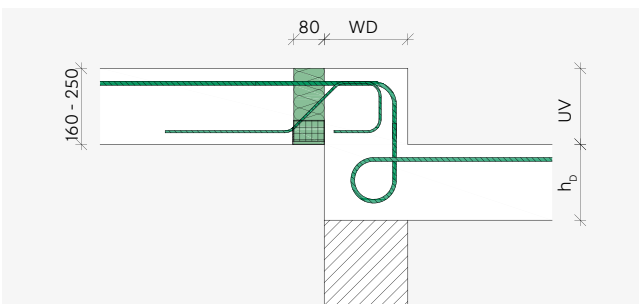
## Connection to slabs with an offset of 90 to 240 mm

### Higher slabs – IP VAR. III HV



VAR. III HV	Height offset mm
HV 100	90 - 149
HV 150	150 - 199
HV 200	200 - 240

### Lower slabs – IP VAR. III UV



VAR. III UV	Height offset mm	VAR. III UV	Height offset mm
UV 80	≤ 80	UV150	141 to ≤ 150
UV 90	81 to ≤ 90	UV160	151 to ≤ 160
UV100	91 to ≤ 100	UV170	161 to ≤ 170
UV110	101 to ≤ 110	UV180	171 to ≤ 180
UV120	111 to ≤ 120	UV190	181 to ≤ 190
UV130	121 to ≤ 130	UV200	191 to ≤ 200
UV140	131 to ≤ 140		

## Measurement table for concrete $\geq$ C25/30

Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm/m

Element height mm depending on cv mm		IP 20 VAR.	IP 25 VAR.	IP 30 VAR.	IP 45 VAR.
35	50				
160	–	15.4	21.7	23.4	26.6
–	180	16.2	22.9	24.7	28.1
170	–	17.1	24.1	26.1	29.7
–	190	18.0	25.3	27.4	31.2
180	–	18.9	26.6	28.8	32.7
–	200	19.8	27.8	30.1	34.2
190	–	20.7	29.1	31.5	35.8
–	210	21.6	30.3	32.8	37.3
200	–	22.5	31.6	34.2	38.9
–	220	23.4	32.9	35.6	40.4
210	–	24.3	34.2	37.0	42.1
–	230	25.2	35.4	38.4	43.6
220	–	26.2	36.8	39.8	45.2
–	240	27.1	38.0	41.2	46.8
230	–	28.1	39.4	42.6	48.4
–	250	29.0	40.6	44.0	50.5
240	–	30.0	42.0	45.5	51.6
250	–	31.9	44.7	48.3	54.9

Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m

Load-bearing capacity	$h_{min}$ mm	IP 20 VAR.	IP 25 VAR.	IP 30 VAR.	IP 45 VAR.
Standard	160	52.2	52.2	52.2	52.2
Q8	160	92.7	92.7	92.7	92.7

Dimensions and configuration

	IP 20 VAR.	IP 25 VAR.	IP 30 VAR.	IP 45 VAR.
Element length mm	1000	1000	1000	1000
Tie bars	7 $\emptyset$ 8	10 $\emptyset$ 8	7 $\emptyset$ 10	8 $\emptyset$ 10
Thrust bearings	4	4	5	5
Shear bars, standard	6 $\emptyset$ 6	6 $\emptyset$ 6	6 $\emptyset$ 6	6 $\emptyset$ 6
Shear bars Q8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8



This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.

**Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm/m**

Element height mm  
 depending on  $c_v$  mm

35	50	IP 50 VAR.	IP 55 VAR.	IP 65 VAR.	IP 75 VAR.
160	–	29.8	33.1	39.5	42.7
–	180	31.5	34.9	41.7	45.1
170	–	33.2	36.8	44.0	47.6
–	190	34.9	38.7	46.2	49.9
180	–	36.7	40.6	48.5	52.4
–	200	38.4	42.5	50.7	54.8
190	–	40.1	44.4	53.0	57.3
–	210	41.8	46.3	55.3	59.7
200	–	43.6	48.3	57.6	62.2
–	220	45.3	50.2	59.8	64.7
210	–	47.1	52.1	62.2	67.2
–	230	48.8	54.0	64.4	69.6
220	–	50.6	56.0	66.8	72.2
–	240	52.4	58.0	69.1	74.6
230	–	54.2	60.0	71.5	77.2
–	250	55.9	61.9	73.8	79.7
240	–	57.8	63.9	76.1	82.3
250	–	61.4	67.9	80.5	87.4

**Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m**

Load-bearing capacity	$h_{min}$ mm	IP 50 VAR.	IP 55 VAR.	IP 65 VAR.	IP 75 VAR.
Standard	160	52.2	52.2	52.2	52.2
Q8	160	92.7	92.7	92.7	92.7

**Dimensions and configuration**

	IP 50 VAR.	IP 55 VAR.	IP 65 VAR.	IP 75 VAR.
Element length mm	1000	1000	1000	1000
Tie bars	9 $\emptyset$ 10	10 $\emptyset$ 10	12 $\emptyset$ 10	13 $\emptyset$ 10
Thrust bearings	6	6	7	8
Shear bars, standard	6 $\emptyset$ 6	6 $\emptyset$ 6	6 $\emptyset$ 6	6 $\emptyset$ 6
Shear bars Q8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8	6 $\emptyset$ 8

# Deformation and precamber

## Deformation

Cantilevered reinforced concrete structures are precambered during their construction to allow for any expected deformation. If these structures are thermally separated with ISOPRO® elements, the deformation due to the ISOPRO® element itself is superimposed on the deformation due to slab curvature in line with DIN EN 1992-1-1/NA to calculate the precamber. Note that the required precamber will need to be rounded up or down depending on the

planned drainage direction. If drainage takes place at the building façade, the value must be rounded up; if drainage takes place at the end of the cantilever, the value must be rounded down. We recommend performing verification in the serviceability limit state for the quasi-permanent combined load ( $\gamma_G = 1.0, \gamma_Q = 1.0, \psi_2 = 0.3$ ). The tables below show the deformation factors  $\tan \alpha$  for calculating deformation due to ISOPRO®.

## Deformation due to ISOPRO® cantilever connection

$$w = \tan \alpha \cdot (m_{Ed} / m_{Rd}) \cdot l_k \cdot 10$$

Where:

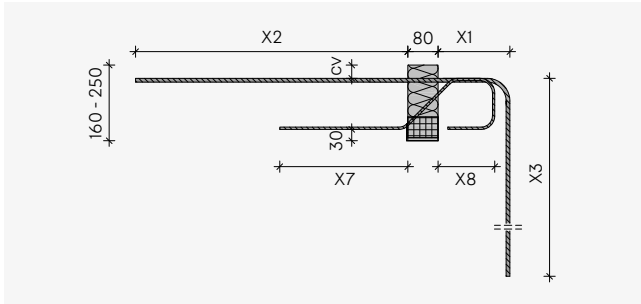
- w = deformation at the end of the cantilever mm
- $\tan \alpha$  = deformation factor, see product information
- $m_{Ed}$  = bending moment for the calculating the precamber due to the ISOPRO® element. The design engineer determines the definitive load combination in the serviceability limit state.
- $m_{Rd}$  = section modulus of the ISOPRO® element, see product information
- $l_k$  = system length m

## Deformation factor $\tan \alpha$ for concrete $\geq$ C 25/30

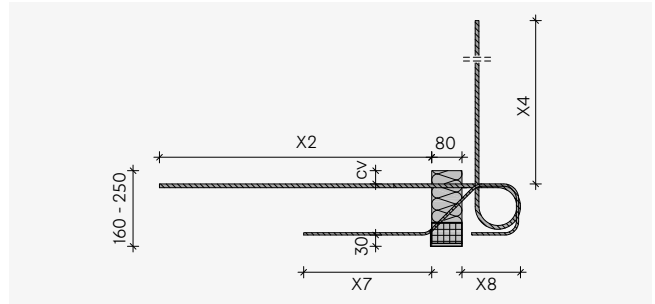
Type	Concrete cover cv mm					Element height h mm					
	160	170	180	190	200	210	220	230	240	250	
IP 20 VAR. to IP 25 VAR.	35	0.63	0.57	0.53	0.49	0.45	0.42	0.40	0.37	0.35	0.34
	50	–	–	0.60	0.55	0.50	0.47	0.44	0.41	0.38	0.36
IP 30 VAR. to IP 75 VAR.	35	0.73	0.66	0.61	0.56	0.52	0.48	0.45	0.43	0.40	0.38
	50	–	–	0.69	0.63	0.58	0.54	0.50	0.47	0.44	0.42

# Element design

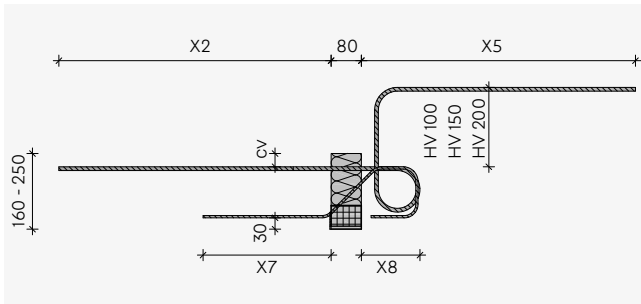
IP VAR. I



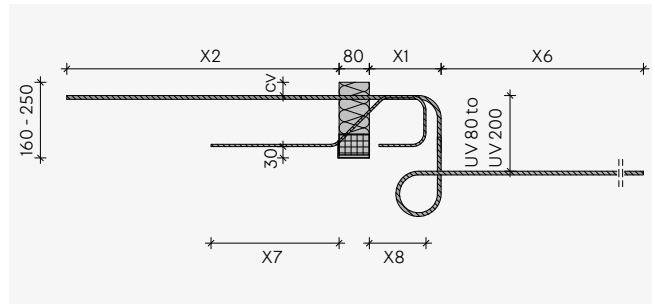
IP VAR. II



IP VAR. III HV



IP VAR. III UV



## Tie bar dimensions in mm

WD	IP 20 + IP 25				IP 30 to IP 75			
	175	200	220	≥ 240	175	200	220	≥ 240
X1	155	170	190	210	–	170	190	210
X2	620	620	620	620	760	760	760	760
X3	589	589	589	589	794	794	794	794
X4	482	482	482	482	616	616	616	616
X5	≤744	≤744	≤744	≤744	≤854	≤854	≤854	≤854
X6	≤584	≤584	≤584	≤584	≤705	≤705	≤705	≤705

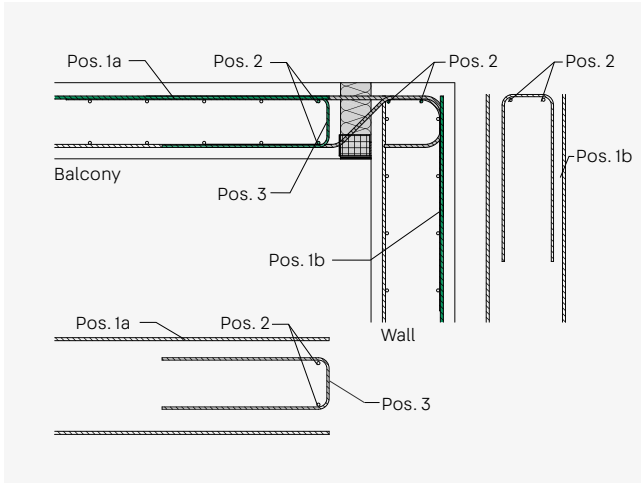
## Shear bar dimensions in mm

Shear force load-bearing capacity	Standard		Q8		
	WD	175	≥ 200	WD	≥ 200
X7		344	344	383	383
X8		150	150	155	170



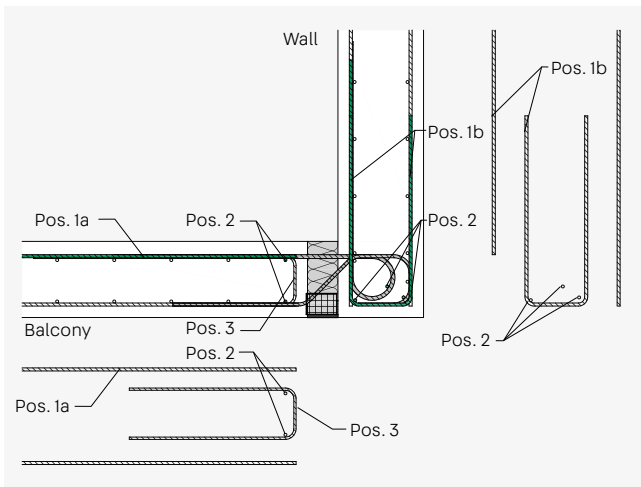
# On-site reinforcement

## Connection to a wall leading downwards – IP VAR. I



- Pos. 1a: Balcony-side connection reinforcement for the ISOPRO® element – see table
- Pos. 1b: Ceiling-side connection reinforcement to absorb the connection moment in the wall according to the specifications of the structural engineer.
- Pos. 2: Distribution bar 2 Ø 8 balcony side, 2 Ø 8 wall side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Slab and wall reinforcement and structural edging at the free slab edge in line with DIN EN 1992-1-1, min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)
- The ISOPRO® element should ideally be installed before the wall reinforcement.

## Connection to a wall leading upwards – IP VAR. II

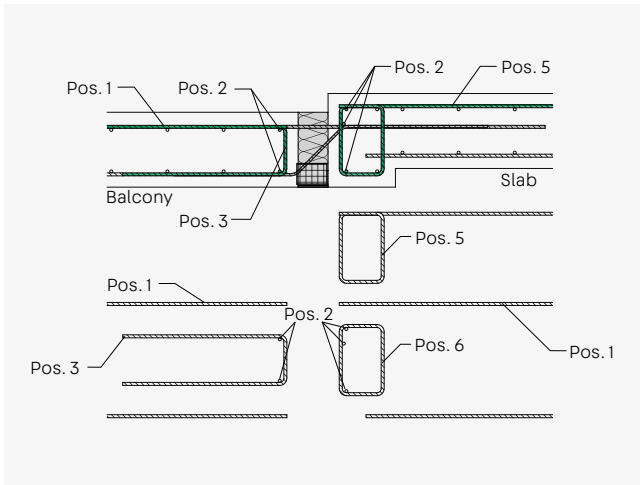


- Pos. 1a: Balcony-side connection reinforcement for the ISOPRO® element – see table
- Pos. 1b: Ceiling-side connection reinforcement to absorb the connection moment and the shear force in the wall according to the specifications of the structural engineer.
- Pos. 2: Distribution bar 2 Ø 8 balcony side, 3 Ø 8 wall side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Slab and wall reinforcement and structural edging at the free slab edge in line with DIN EN 1992-1-1, min. Ø 6/250 or according to the specifications of the structural engineer (not shown here)
- The ISOPRO® element should ideally be installed before the wall reinforcement.

### Connection reinforcement POS. 1

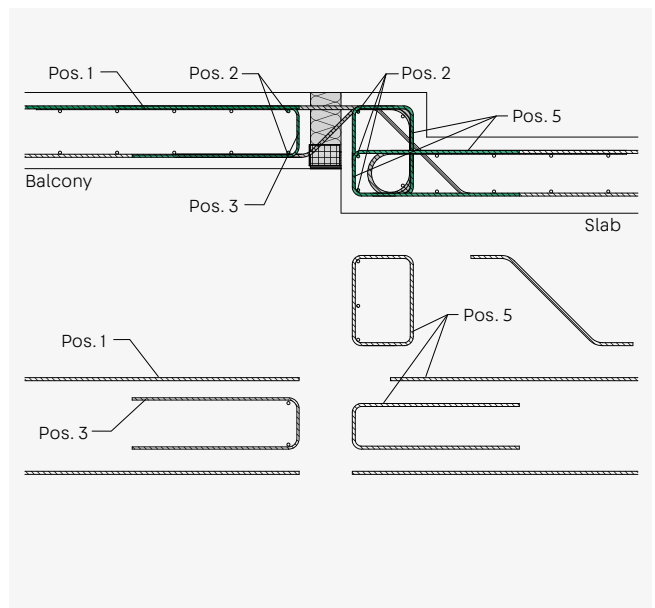
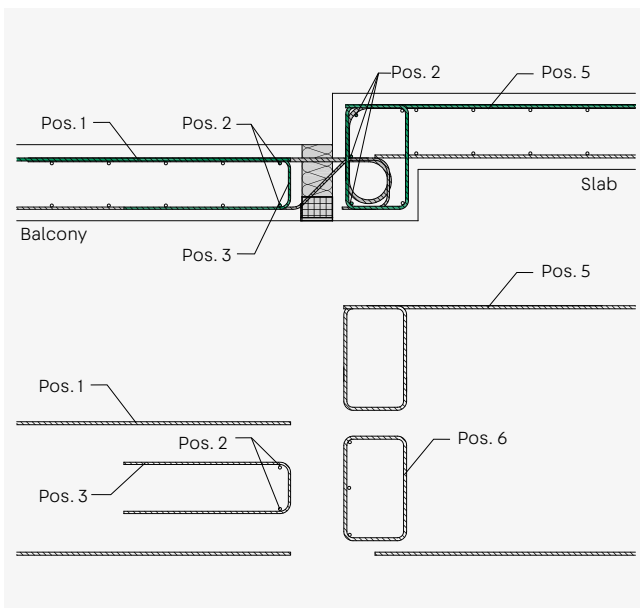
	IP 20 VAR.	IP 25 VAR.	IP 30 VAR.	IP 45 VAR.	IP 50 VAR.	IP 55 VAR.	IP 65 VAR.	IP 75 VAR.
$a_{s,erf}$ cm <sup>2</sup> /m	3.79	5.36	5.84	6.65	7.46	8.26	9.87	13.60
<b>Recommendation</b>	8 Ø 8	11 Ø 8	8 Ø 10	9 Ø 10	10 Ø 10	11 Ø 10	13 Ø 10	14 Ø 10

## Connection to a slab with a slight height offset with a standard IP element



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 48
- Pos. 2: Distribution bar 2 Ø 8 balcony side, 3 Ø 8 slab side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Slab reinforcement and structural edging at the free slab edge in line with DIN EN 1992-1-1, min. Ø 6/250 according to the specifications of the structural engineer (not shown here)
- Pos. 5: Stirrup reinforcement for redirecting tensile forces in the downstand beam into the upper tensile reinforcement according to the specifications of the structural engineer. The stirrup and tensile reinforcement must overlap substantially.
- Pos. 6: Shear force reinforcement of the downstand beam according to the specifications of the structural engineer.

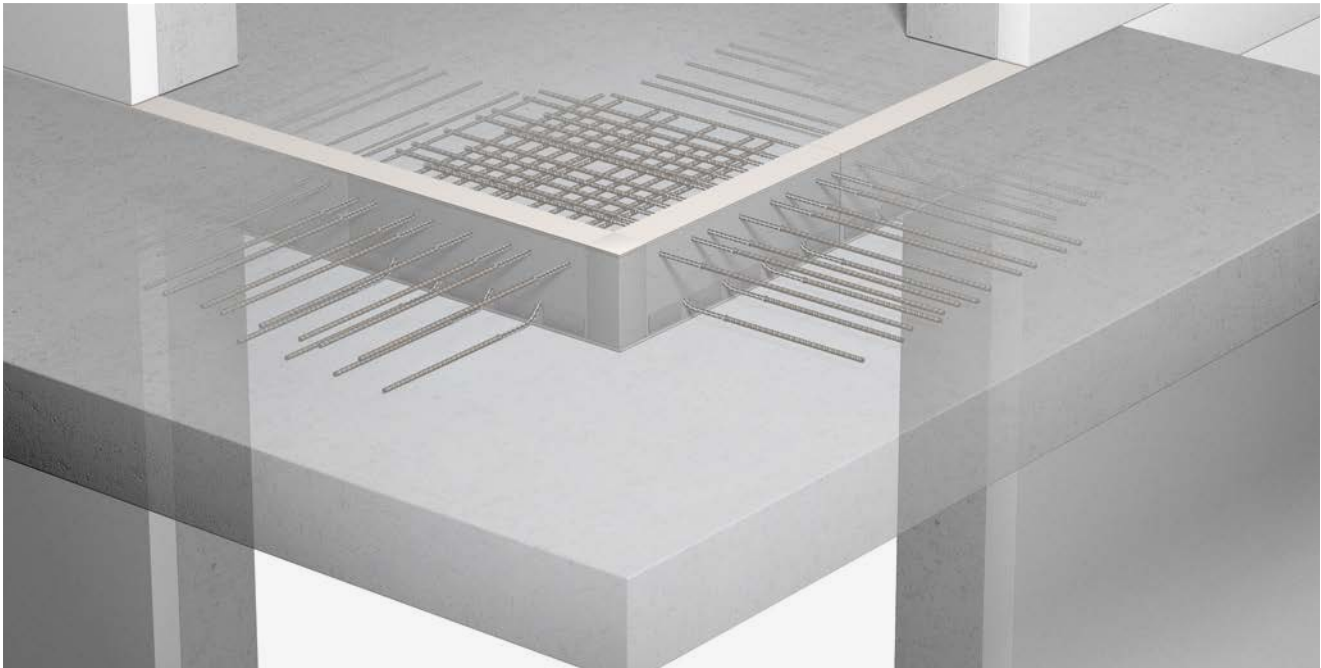
## Connection to a slab with a height offset – IP VAR. III



- Pos. 1: Connection reinforcement for the ISOPRO® element – see table page 60
- Pos. 2: Distribution bar 2 Ø 8 balcony side, 3 Ø 8 slab side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown)
- Pos. 5: Connection reinforcement to absorb the connection moment and for redirecting tensile forces in the downstand beam into the upper tensile reinforcement of the slab according to the specifications of the structural engineer. The stirrup and tensile reinforcement must overlap substantially.
- Pos. 6: Shear force reinforcement of the downstand beam according to the specifications of the structural engineer.
- The ISOPRO® element should ideally be installed before the downstand beam reinforcement.

# ISOPRO® IP Corner and IPT Corner

Elements for cantilevered corner balconies



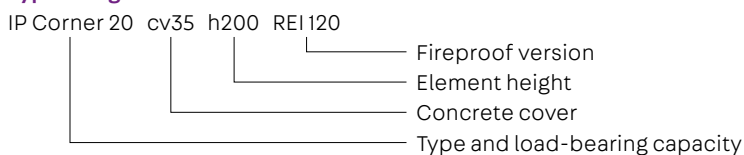
## ISOPRO® IP Corner and IPT Corner

- IP Corner – Pressure plane with concrete thrust bearings
- IPT Corner – Pressure plane with steel compression struts
- Shear force load-bearing capacity: standard
- A corner element consists of one EL element (left corner) in cv35, one ER element (right corner) in cv50 and a 80 x 80 mm corner insulating body
- Element heights from 180 mm
- Fire resistance classes: IP Corner available in REI 120, IPT Corner available in R 90

## ISOPRO® IP(T) partial element EL/ER

- IP EL/ER partial element – Pressure plane with concrete thrust bearings
- IPT EL/ER partial element – Pressure plane with steel compression struts
- Shear force load-bearing capacity: standard
- Tie bar concrete cover: cv35 (EL) or cv50 (ER)
- Element heights from 180 mm
- Fire resistance classes: IP EL and IP ER available in REI 120, IPT EL and IPT ER available in R 90

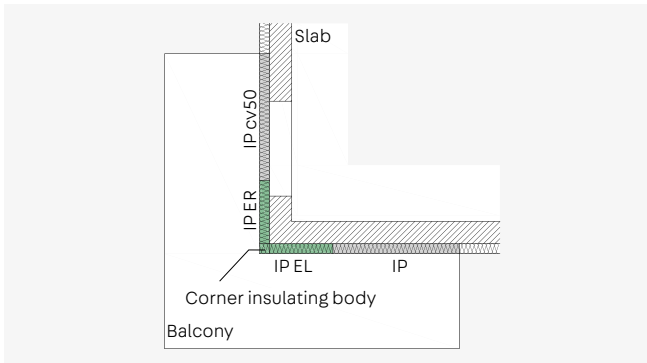
## Type designation



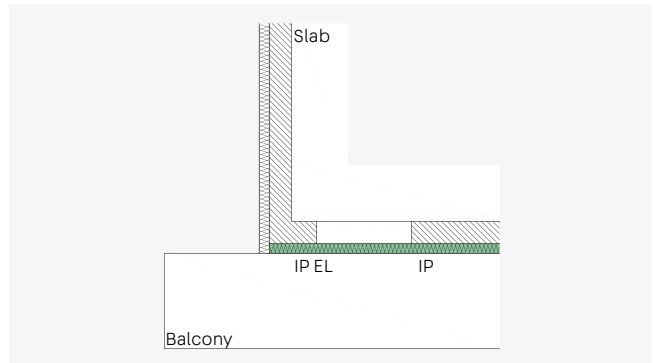
# Application – Element layout



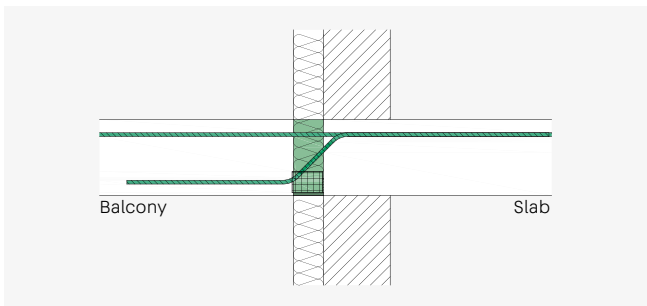
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



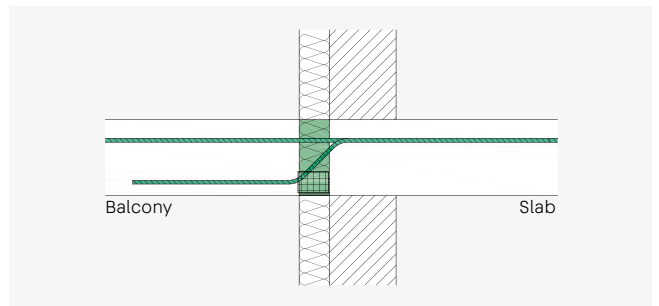
ISOPRO®IP Corner – Cantilevered outer corner balcony



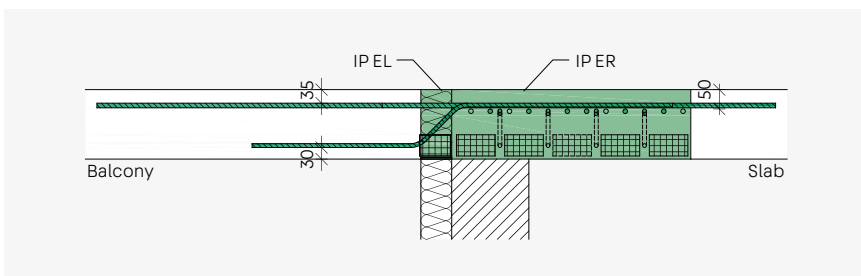
ISOPRO®IP EL – Cantilevered balcony with slab overhanging the support



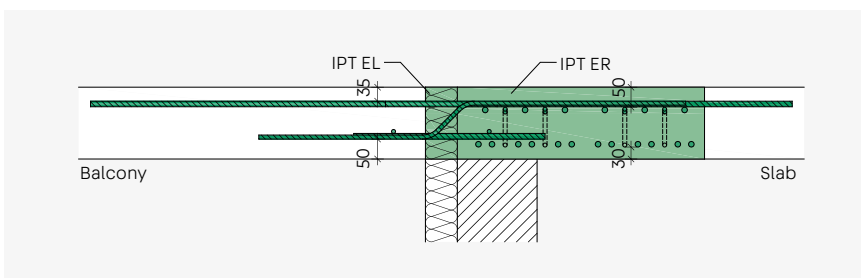
ISOPRO®IP EL/ER – Installation cross-section cv35



ISOPRO®IP EL/ER – Installation cross-section cv50



ISOPRO®IP Corner – Cross-section of corner situation



ISOPRO®IPT Corner – Cross-section of corner situation

## Measurement table for concrete ≥ C25/30

Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm by each EL/ER partial element

Element height mm depending on cv mm	IP Corner 20	IP Corner 30	IPT Corner 50
180	17.9	30.1	32.3
190	19.9	33.4	36.2
200	21.9	36.7	40.1
210	23.9	39.8	44.1
220	25.9	43.0	48.0
230	27.9	46.1	51.9
240	29.8	49.3	55.9
250	31.7	52.5	59.8

Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m by each EL/ER partial element

Shear force	IP Corner 20	IP Corner 30	IPT Corner 50
h = 180-190 mm	46.4	96.6	96.6
h = 200 -250 mm	46.4	139.1	139.1

### Dimensions and configuration

Type	Element length mm	Tie bars	Thrust bearing TB/ Compression struts CS	Shear bars h = 180 - 190 mm	Shear bars h = 200 - 250 mm
IP Corner 20	500 + 500	2x 5 Ø 10	2x 3 TB	2x 3 Ø 8	2x 3 Ø 8
IP Corner 30	620 + 620	2x 6 Ø 12	2x 5 TB	2x 4 Ø 10	2x 4 Ø 12
IPT Corner 50	620 + 620	2x 6 Ø 14	CS 2x 12 Ø 14	2x 4 Ø 10	2x 4 Ø 12



#### Notes

- For small cantilever lengths, a combination of a standard ISOPRO® IP element in cv35 and an ISOPRO® IP element in cv50 can be used instead of the ISOPRO® IP Corner/IPT Corner element.
- Sections of corner elements are also available individually for use in applications where high torque loads and shear forces occur at specific points.
- In the case of an ISOPRO® IP Corner/IPT Corner, the EL element is always designed in cv35 and the ER element in cv50. Positioned to the left and right looking from the slab.
- When using a corner element, an ISOPRO® IP element in cv50 is required adjacent to the ER element. Afterwards, it is possible to continue in cv35 or cv50. In certain cases, continuing in cv50 may simplify the layout of reinforcement.

# Deformation – Expansion joint spacing

## Deformation

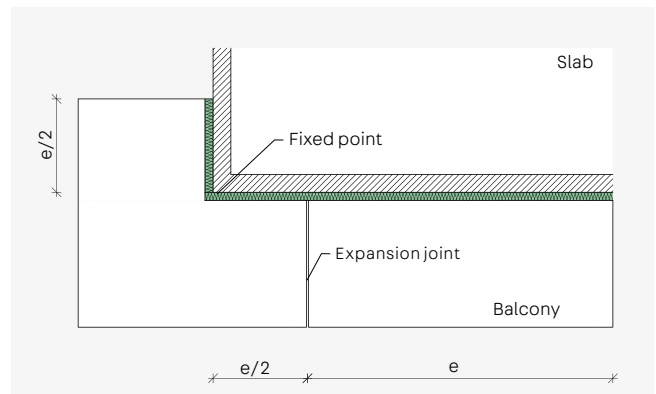
The required precamber of the reinforced concrete components is calculated in the same way as for ISOPRO® elements page 42 using the deformation factors below.

### Deformation factor $\tan \alpha$ for concrete $\geq C 25/30$

Type	Concrete cover cv mm	Element height h mm							
		180	190	200	210	220	230	240	250
IP Corner 20	35/50	1.10	1.00	0.92	0.85	0.79	0.74	0.70	0.65
IP Corner 30	35/50	1.10	1.00	0.92	0.85	0.78	0.73	0.68	0.64
IPT Corner 50	35/50	1.76	1.56	1.41	1.28	1.18	1.09	1.01	0.94

## Expansion joint spacing

For balconies that go around a corner, it must be taken into account that the corner represents a fixed point. This reduces the maximum permissible expansion joint spacing to  $e/2$ . If the component dimensions exceed the maximum permissible expansion joint spacing, expansion joints must be aligned perpendicular to the insulation layer.



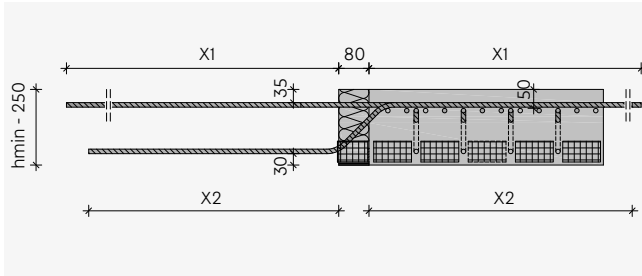
Expansion joint arrangement for corner balconies

### Maximum permissible expansion joint spacing

	IP Corner 20	IP Corner 30	IPT Corner 50
Joint spacing $e/2$ m	6.50	5.65	5.05

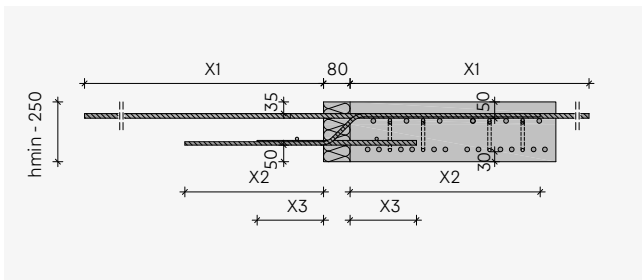
# Element design

## ISOPRO® IP Corner



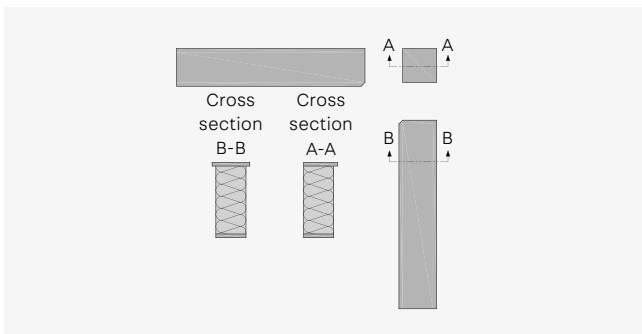
Length of tie bar mm	IP Corner 20	IP Corner 30
<b>X1</b>	720	860
Length of shear bar mm	IP Corner 20	IP Corner 30
<b>h=180 - 190mm, X2</b>	450	560
<b>h=200 - 250mm, X2</b>	450	670

## ISOPRO® IPT Corner



Length of tie bar mm	IPT Corner 50
<b>X1</b>	980
Length of shear bar mm	IPT Corner 50
<b>h=180 - 190mm, X2</b>	560
<b>h=200 - 250mm, X2</b>	670
Length of compression strut mm	IPT Corner 50
<b>X3</b>	200

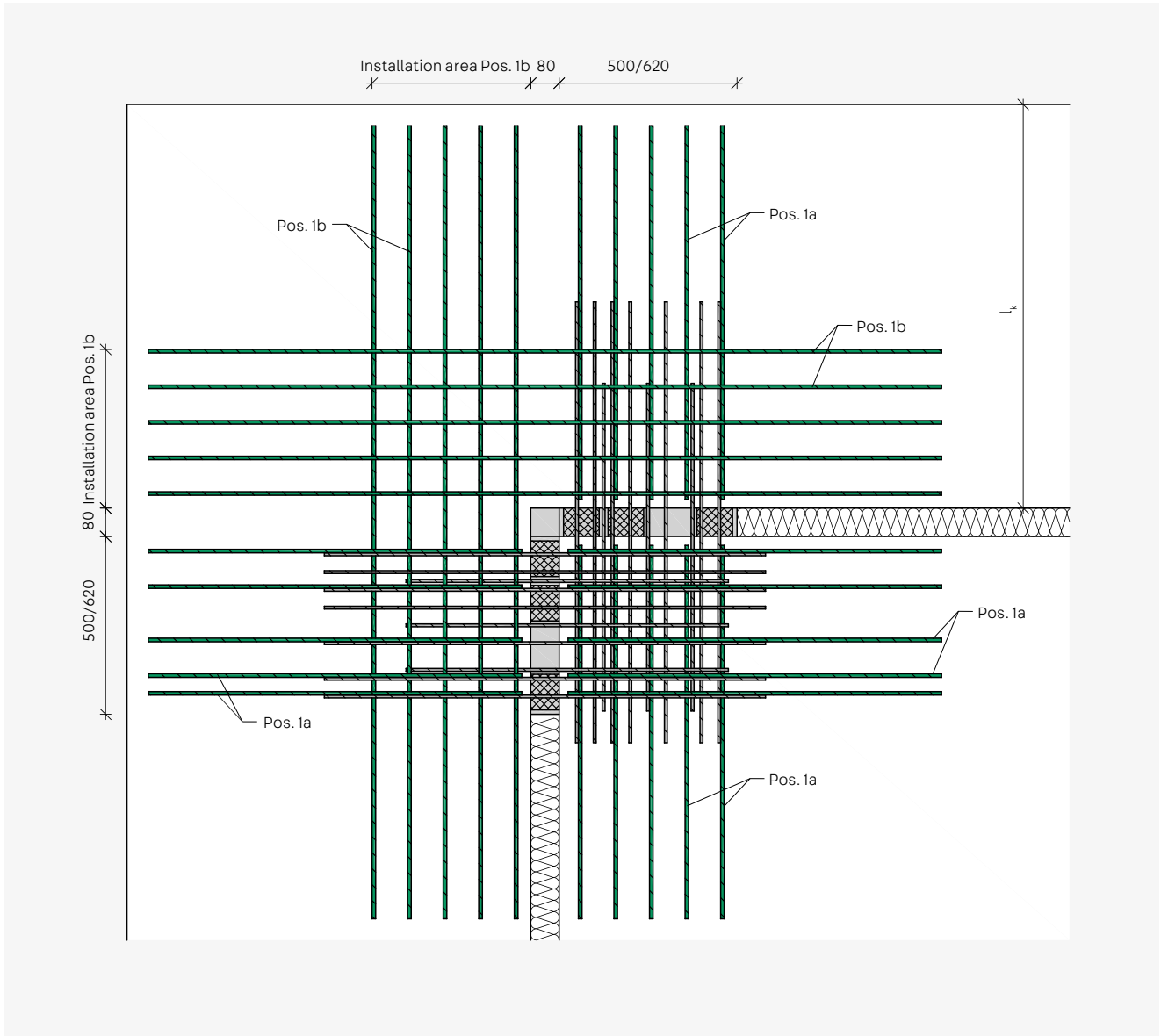
## ISOPRO® IP Corner fire protection version



ISOPRO® IP Corner – Fireproof version, diagram of insulating body

# On-site reinforcement

## ISOPRO® IP Corner and IPT Corner

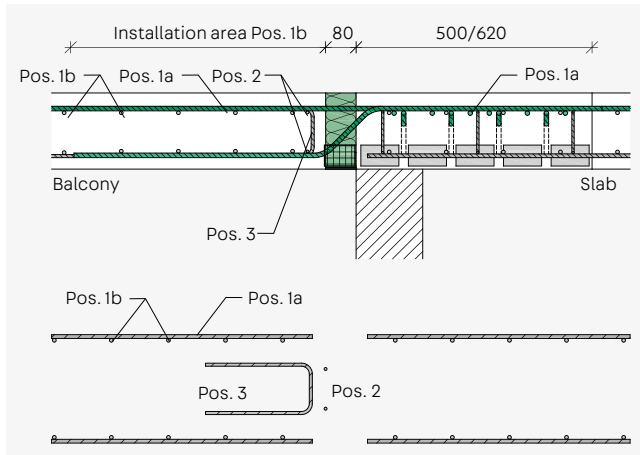


ISOPRO® IP Corner - Plan view of on-site reinforcement



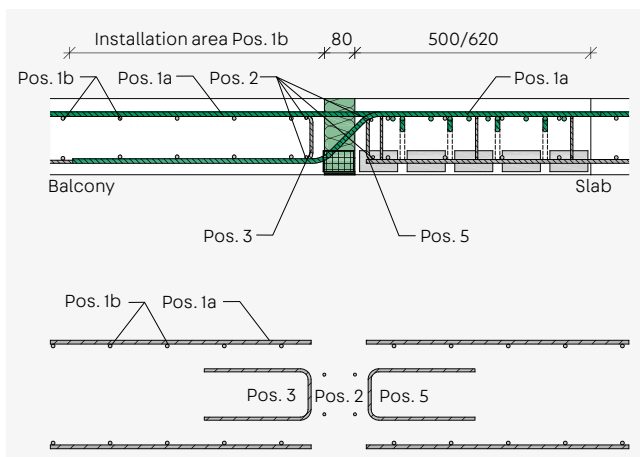
## ISOPRO® IP Corner and IPT Corner

### Direct support



- Pos. 1a: Connection reinforcement and Pos. 1b supplementary reinforcement for the ISOPRO® element – see table
- Pos. 2: Distribution bar 2 Ø 8 balcony side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown)

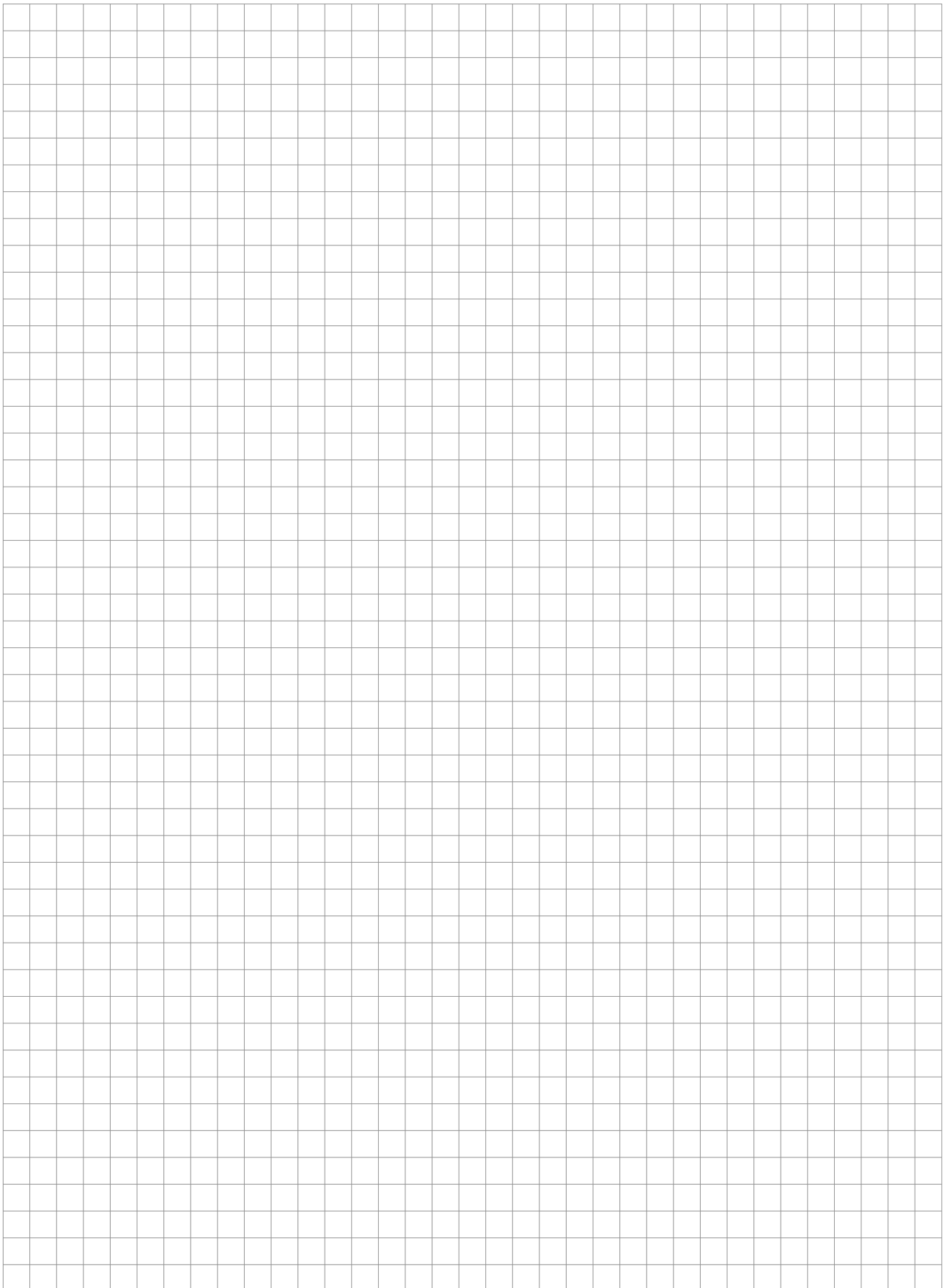
### Indirect support

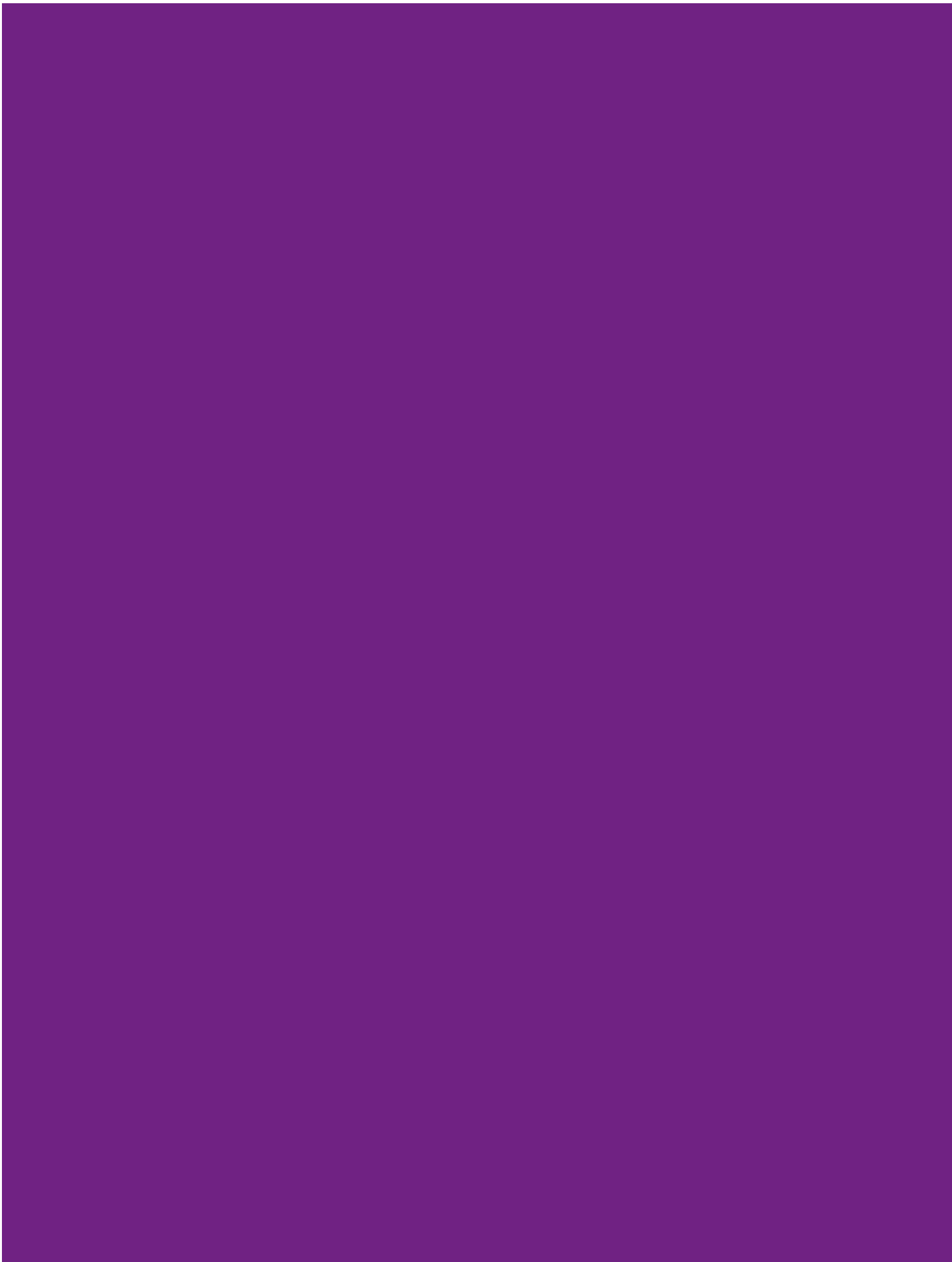


- Pos. 1a: Connection reinforcement and Pos. 1b supplementary reinforcement for the ISOPRO® element – see table
- Pos. 2: Distribution bar 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown)
- Pos. 5: Suspension reinforcement for the ISOPRO® element – see table

### Connection and supplementary reinforcement

	IP Corner 20	IP Corner 30	IPT Corner 50
<b>Connection reinforcement Pos. 1a</b>	5 Ø 10	6 Ø 12	5 Ø 14
<b>Bar length Pos. 1a</b>	$l_k - 70$	$l_k - 70$	$l_k - 70$
<b>Supplementary reinforcement Pos. 1b</b>	2 x 5 Ø 10/100	2 x 6 Ø 12/100	2 x 5 Ø 14/100
<b>Bar length Pos. 1b</b>	2 x $l_k$	2 x $l_k$	2 x $l_k$
<b>Installation area Pos. 1b</b>	460	570	460
<b>Suspension reinforcement Pos. 5</b>	3 Ø 8	4 Ø 12	4 Ø 12

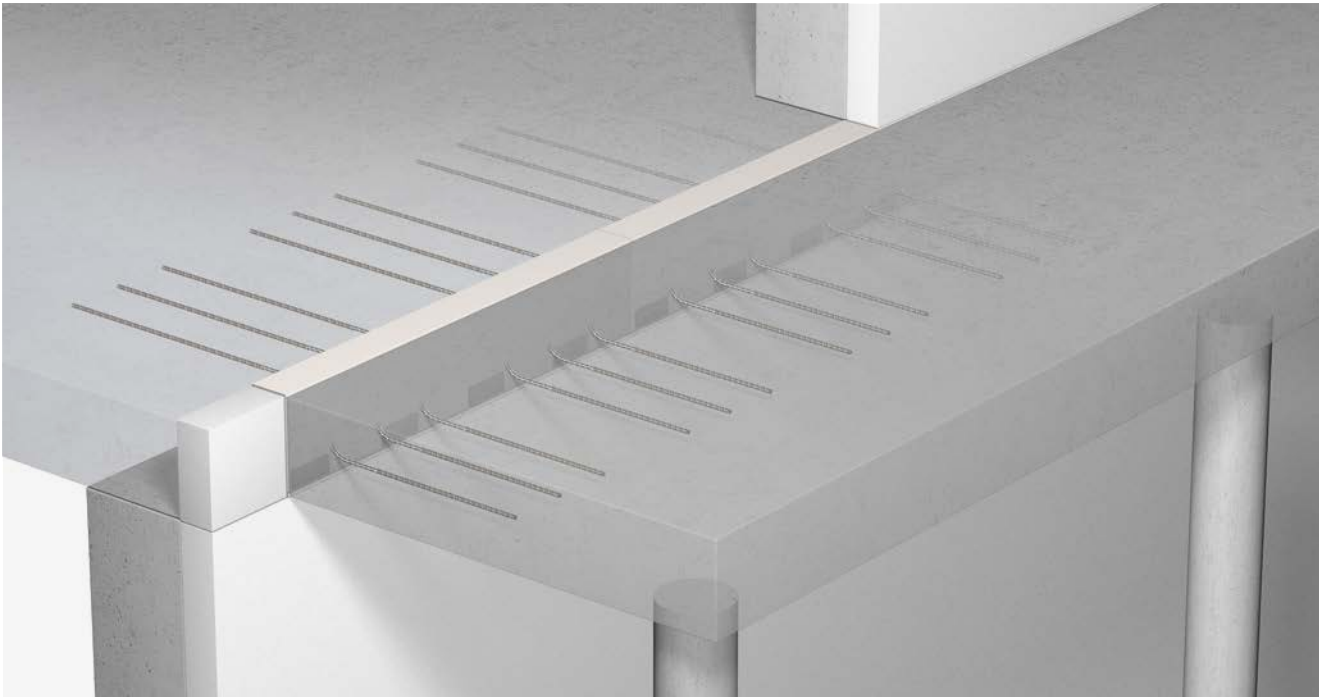




# Supported components

# ISOPRO® IPQ and IPZQ, IPQS/IPTQS and IPQZ

Elements for supported balconies



## ISOPRO® IPQ, IPZQ

- For transferring positive shear forces
- Element length: 1.0 m
- ISOPRO® IPQ pressure plane with concrete thrust bearings
- ISOPRO® IPZQ for tension-free support without pressure component
- Element heights depending on the load-bearing capacity: from 160 mm
- Fire resistance class REI 120 available

## ISOPRO® IPQS/IPTQS, IPQZ

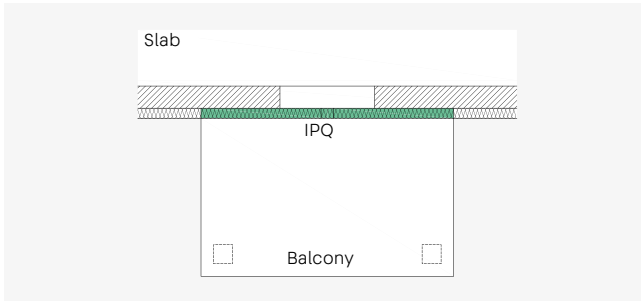
- Short elements for peak load at specific points
- Element length depending on load-bearing capacity: 0.3 m, 0.4 m or 0.5 m
- ISOPRO® IPQS pressure plane with concrete thrust bearings
- ISOPRO® IPTQS pressure plane with steel compression struts
- ISOPRO® IPQZ for tension-free support without pressure component
- Element heights depending on the load-bearing capacity: from 160 mm
- Fire resistance class: IPQS and IPQZ available in REI 120, IPTQS available in R 90

## Type designation

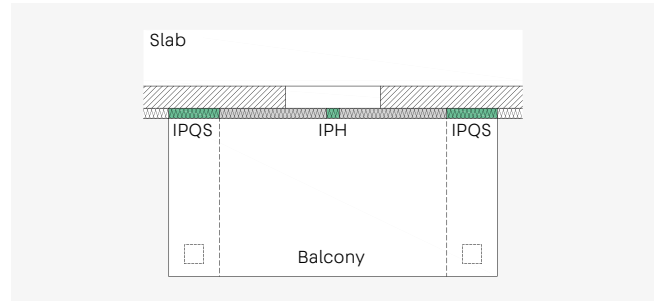
IPQ 20 h200 REI 120

— Fireproof version  
— Element height  
— Type and load-bearing capacity

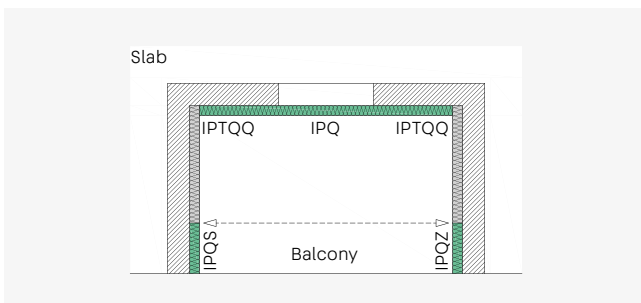
## Application – Element layout



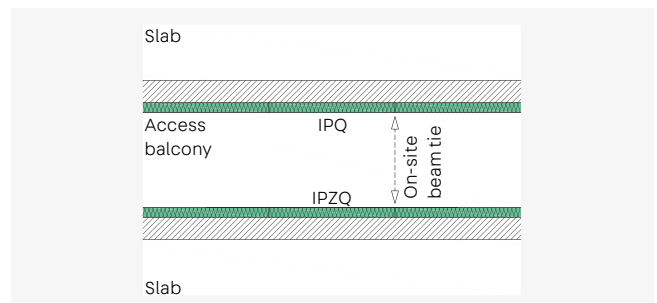
ISOPRO® IPQ – Supported balcony



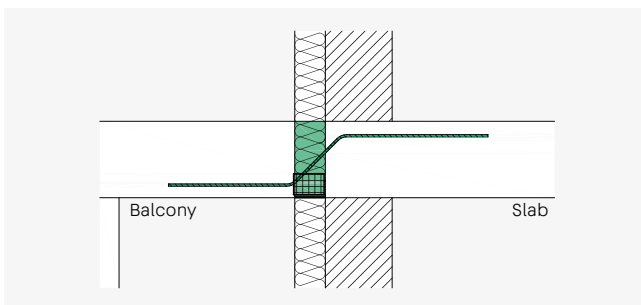
ISOPRO® IPQS – Supported balcony with downstand beams and support at specific points with ISOPRO® IPQS elements



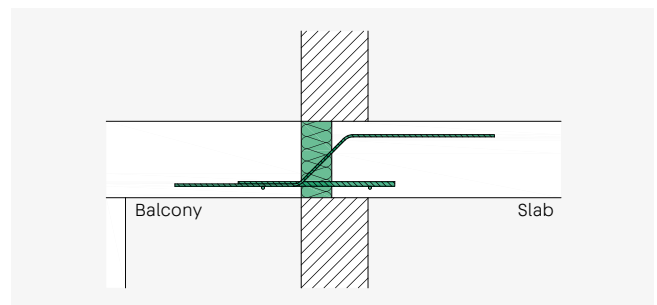
ISOPRO® IPQ, IPTQQ, IPQS/IPTQS, IPQZ – Loggia balcony with peak loads at specific points and tension-free support at the front



ISOPRO® IPQ, IPZQ – Access balcony with tension-free support

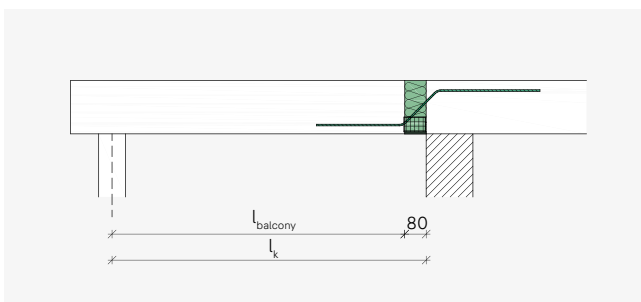


ISOPRO® IPQ, IPQS – Installation cross-section, external thermal insulation composite system



ISOPRO® IPTQS – Installation cross-section, solid wall

### Structural system



ISOPRO® IPQ – Structural system



### Notes

In the case of balconies connected with shear force elements, appropriate support must be ensured during all construction stages. Temporary supports must not be removed until the permanent supports, which may be installed at a later date, have sufficient load-bearing capacity and are connected to the balcony in a friction-locked manner.

## Measurement table for concrete ≥ C25/30

ISOPRO® IPQ – Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m

Type	Shear force $V_{Rd}$ kN/m	Element height mm	Element length mm	Shear bars	Thrust bearings
				Configuration	Configuration
IPQ 10	34.8	≥ 160	1000	4 Ø 6*	4 TB
IPQ 20	43.5	≥ 160	1000	5 Ø 6*	4 TB
IPQ 30	52.2	≥ 160	1000	6 Ø 6*	4 TB
IPQ 40	69.5	≥ 160	1000	8 Ø 6*	4 TB
IPQ 50	86.9	≥ 160	1000	10 Ø 6*	4 TB
IPQ 70	92.7	≥ 160	1000	6 Ø 8	4 TB
IPQ 80	108.2	≥ 160	1000	7 Ø 8	4 TB
IPQ 85	123.6	≥ 160	1000	8 Ø 8	4 TB
IPQ 90	154.5	≥ 160	1000	10 Ø 8	4 TB
IPQ 100	193.2	≥ 170	1000	8 Ø 10	4 TB
IPQ 110	217.3	≥ 170	1000	9 Ø 10	4 TB
IPQ 120	241.5	≥ 170	1000	10 Ø 10	4 TB

ISOPRO® IPZQ – Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m

Type	Shear force $V_{Rd}$ kN/m	Element height mm	Element length mm	Shear bars	Thrust bearings
				Configuration	Configuration
IPZQ 10	34.8	≥ 160	1000	4 Ø 6*	–
IPZQ 20	43.5	≥ 160	1000	5 Ø 6*	–
IPZQ 30	52.2	≥ 160	1000	6 Ø 6*	–
IPZQ 40	69.5	≥ 160	1000	8 Ø 6*	–
IPZQ 50	86.9	≥ 160	1000	10 Ø 6*	–
IPZQ 70	92.7	≥ 160	1000	6 Ø 8	–
IPZQ 80	108.2	≥ 160	1000	7 Ø 8	–
IPZQ 85	123.6	≥ 160	1000	8 Ø 8	–
IPZQ 90	154.5	≥ 160	1000	10 Ø 8	–
IPZQ 100	193.2	≥ 170	1000	8 Ø 10	–
IPZQ 110	217.3	≥ 170	1000	9 Ø 10	–
IPZQ 120	241.5	≥ 170	1000	10 Ø 10	–



This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.

**ISOPRO® IPQS – Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN**

Type	Shear force $V_{Rd}$ kN	Element height mm	Element length mm	Shear bars	Thrust bearings/ compression struts
				Configuration	Configuration
IPQS 5	26.1	$\geq 160$	400	3 $\emptyset 6^*$	2 TB
IPQS 10	30.9	$\geq 160$	300	2 $\emptyset 8$	1 TB
IPQS 15	34.8	$\geq 160$	500	4 $\emptyset 6^*$	2 TB
IPQS 20	46.4	$\geq 160$	400	3 $\emptyset 8$	2 TB
IPQS 30	61.8	$\geq 160$	500	4 $\emptyset 8$	2 TB
IPQS 40	48.3	$\geq 170$	300	2 $\emptyset 10$	1 TB
IPQS 50	72.4	$\geq 170$	400	3 $\emptyset 10$	2 TB
IPQS 55	96.6	$\geq 170$	500	4 $\emptyset 10$	2 TB
IPTQS 60	69.5	$\geq 180$	300	2 $\emptyset 12$	CS 3 $\emptyset 14$
IPQS 70	104.3	$\geq 180$	400	3 $\emptyset 12$	2 TB
IPQS 75	139.1	$\geq 180$	500	4 $\emptyset 12$	3 TB
IPTQS 80	94.7	$\geq 190$	300	2 $\emptyset 14$	CS 4 $\emptyset 14$
IPTQS 90	142.0	$\geq 190$	400	3 $\emptyset 14$	CS 6 $\emptyset 14$

**ISOPRO® IPQZ – Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN**

Type	Shear force $V_{Rd}$ kN	Element height mm	Element length mm	Shear bars	Thrust bearings
				Configuration	Configuration
IPQZ 5	26.1	$\geq 160$	400	3 $\emptyset 6^*$	–
IPQZ 10	30.9	$\geq 160$	300	2 $\emptyset 8$	–
IPQZ 15	34.8	$\geq 160$	500	4 $\emptyset 6^*$	–
IPQZ 20	46.4	$\geq 160$	400	3 $\emptyset 8$	–
IPQZ 30	61.8	$\geq 160$	500	4 $\emptyset 8$	–
IPQZ 40	48.3	$\geq 170$	300	2 $\emptyset 10$	–
IPQZ 50	72.4	$\geq 170$	400	3 $\emptyset 10$	–
IPQZ 55	96.6	$\geq 170$	500	4 $\emptyset 10$	–
IPQZ 60	69.5	$\geq 180$	300	2 $\emptyset 12$	–
IPQZ 70	104.3	$\geq 180$	400	3 $\emptyset 12$	–
IPQZ 75	139.1	$\geq 180$	500	4 $\emptyset 12$	–
IPQZ 80	94.7	$\geq 190$	300	2 $\emptyset 14$	–
IPQZ 90	142.0	$\geq 190$	400	3 $\emptyset 14$	–

\* Elements with  $\emptyset 6$  shear bars have a looped bar on the slab side. For all other elements, the shear bar on the slab side is straight (see also page 77).



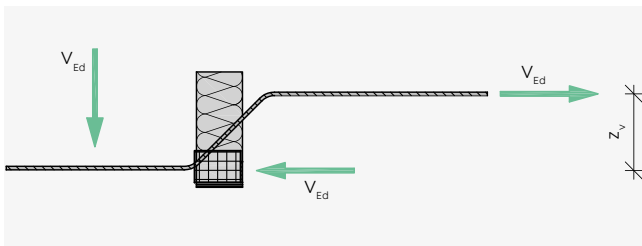
# Calculation – Expansion joints

## Moments caused by eccentric connection

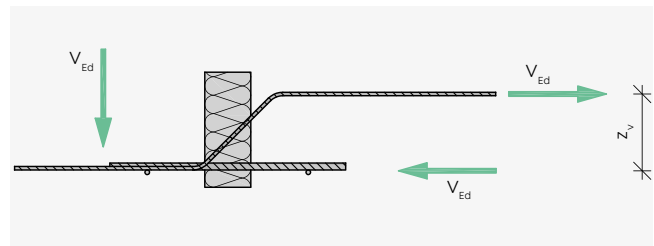
Additional moment from eccentric connections must be factored in when calculating the slab-side connection reinforcement of ISOPRO® shear force elements. If the leading sign is the same, the additional moment must be

superimposed on the moment from the planned load. The moment  $\Delta M_{Ed}$  is calculated under the assumption that the elements are fully loaded.

$$\Delta M_{Ed} = V_{Ed} \cdot z_v$$



ISOPRO® IPQ, IPQS - Elements with concrete thrust bearings  
 $z_v$  - Lever arm for determining the eccentric moment



ISOPRO® IPTQS - Elements with steel compression struts  
 $z_v$  - Lever arm for determining the eccentric moment

### Eccentric moments ISOPRO® IPQ, IPZQ

Type	$\Delta m_{Ed}$ kNm/m	
	$h < 200$ mm	$h \geq 200$ mm
IPQ/IPZQ 10	3.3	4.7
IPQ/IPZQ 20	4.1	5.8
IPQ/IPZQ 30	4.9	7.0
IPQ/IPZQ 40	6.5	9.3
IPQ/IPZQ 50	8.2	11.6
IPQ/IPZQ 70	8.6	12.3
IPQ/IPZQ 80	10.1	14.4
IPQ/IPZQ 85	11.5	16.4
IPQ/IPZQ 90	14.4	20.6
IPQ/IPZQ 100	17.8	25.5
IPQ/IPZQ 110	20.0	28.7
IPQ/IPZQ 120	22.2	31.9

### Eccentric moments ISOPRO® IPQS/IPTQS, IPQZ

Type	$\Delta M_{Ed}$ kNm	
	$h < 200$ mm	$h \geq 200$ mm
IPQS/IPQZ 5	2.5	3.5
IPQS/IPQZ 10	2.9	4.1
IPQS/IPQZ 15	3.3	4.7
IPQS/IPQZ 20	4.3	6.2
IPQS/IPQZ 30	5.7	8.2
IPQS/IPQZ 40	4.4	6.4
IPQS/IPQZ 50	6.7	9.6
IPQS/IPQZ 55	8.9	12.7
IPTQS/IPQZ 60	7.1	8.5
IPQS/IPQZ 70	9.5	13.7
IPQS/IPQZ 75	12.7	18.2
IPTQS/IPQZ 80	10.5	11.5
IPTQS/IPQZ 90	15.8	17.2

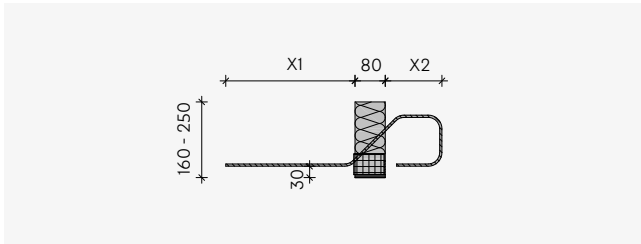
### Maximum permissible expansion joint spacing

Joint spacing $e$ m	IPQ/IPZQ 10 to 120 IPQS/IPQZ 5 to 40, 50, 55	IPQS/IPQZ 45, 70, 75	IPTQS/IPQZ 60, 80, 90
		13.0	11.3

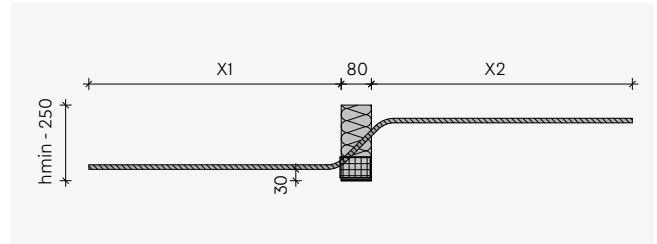
# Element design

## ISOPRO® IPQ, IPQS, IPZQ\*, IPQZ\*

### Shear bar $\varnothing 6$

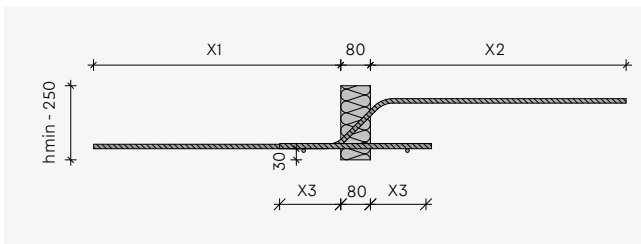


### Shear bar $\geq \varnothing 8$



## ISOPRO® IPTQS

### Shear bar $\geq \varnothing 12$



### Dimensions in mm

Length of shear bar mm	IPQ 10 - IPQ 50	IPQ 70 - 90	IPQ 100 - 120	IPQS 70 - 75	IPQZ 80 - 90	IPTQS 60	
	IPZQ 10 - IPZQ 50	IPZQ 70 - 90	IPZQ 100 - 120	IPQZ 60 - 75	IPTQS 80 - 90	IPTQS 80 - 90	
	50	IPQS 10 - 30	IPQS 40 - 55	IPTQS 60			
	IPQS 5, IPQS 15	IPQZ10 - 30	IPQZ 40 - 55				
		$\varnothing 6$	$\varnothing 8$	$\varnothing 10$	$\varnothing 12$	$\varnothing 14$	Compression strut $\varnothing 14$
<b>X1</b>	340	450	560	670	780	-	
<b>X2</b>	150	$\leq 530$	$\leq 640$	$\leq 745$	$\leq 855$	-	
<b>X3</b>	-	-	-	-	-	165	
<b>hmin</b>	160	160	170	180	190	-	



### Notes

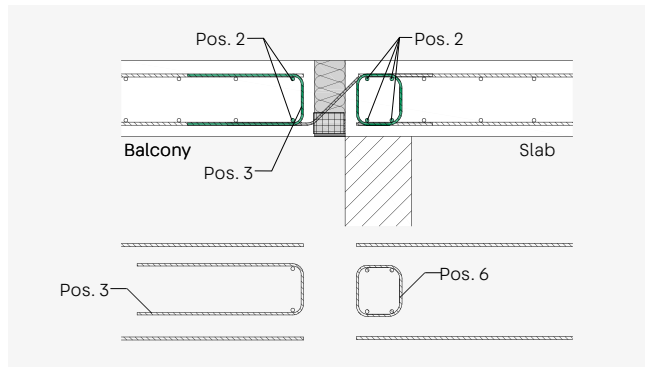
The concrete cover of the compression struts and the shear bars at the bottom is generally 30 mm. The concrete cover of the shear bars at the top is from cv35 to cv85 depending on the element height and bar diameter.

\* IPZQ and IPQZ elements have no pressure plane

# On-site reinforcement

## ISOPRO® IPQ, IPZQ, IPQS, IPQZ with shear bar Ø 6 – looped on slab side

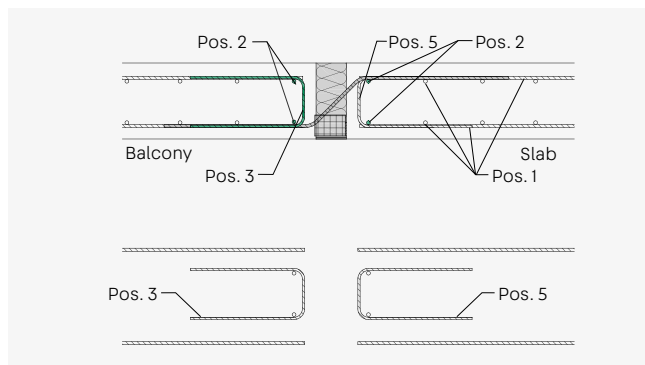
### Direct support



- Pos. 1: Slab reinforcement in line with DIN EN 1992-1-1 according to the specifications of the structural engineer (not shown in detail)
- Pos. 2: Distribution bar 2 Ø 8 balcony side, 4 Ø 8 slab side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown)
- Pos. 6: Stirrup (edge beam) Ø 6/200
- In the case of indirect support, additional suspension reinforcement must be provided on the slab side - see table Pos. 5

## ISOPRO® IPQ, IPZQ, IPQS/IPTQS, IPQZ – Shear bar, slab side, straight

### Indirect support



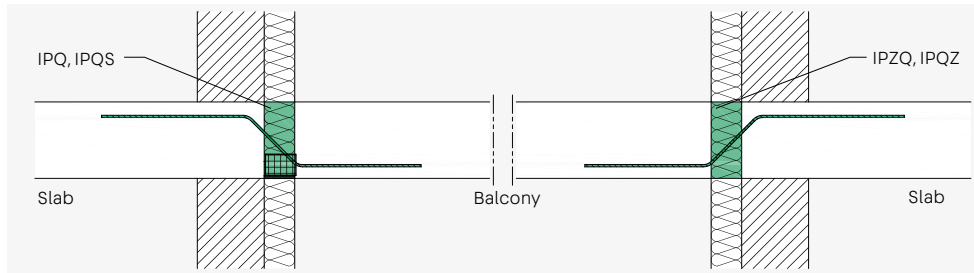
- Pos. 1: Slab reinforcement in line with DIN EN 1992-1-1 according to the specifications of the structural engineer
- Pos. 2: Distribution bar 2 x 2 Ø 8 balcony side and slab side
- Pos. 3: Structural edging parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown)
- Pos. 5: Slab-side suspension reinforcement with indirect support - see table

### Suspension reinforcement for concrete ≥ C25/30

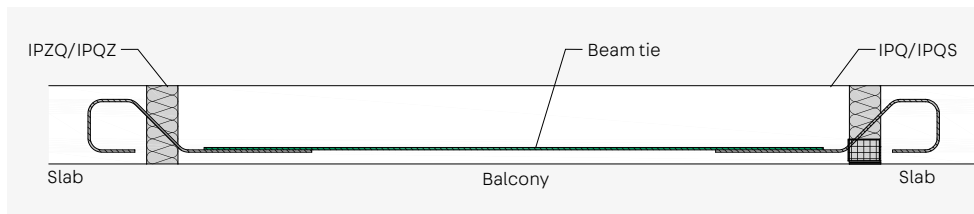
Type	Suspension reinforcement Pos. 5 $A_{s,erf}$ cm <sup>2</sup>
IPQ/IPZQ 10	0.80
IPQ/IPZQ 20	1.00
IPQ/IPZQ 30	1.20
IPQ/IPZQ 40	1.60
IPQ/IPZQ 50	2.00
IPQ/IPZQ 70	2.13
IPQ/IPZQ 80	2.49
IPQ/IPZQ 85	2.84
IPQ/IPZQ 90	3.55
IPQ/IPZQ 100	4.44
IPQ/IPZQ 110	5.00
IPQ/IPZQ 120	5.55

Type	Suspension reinforcement Pos. 5 $A_{s,erf}$ cm <sup>2</sup>
IPQS/IPQZ 5	0.60
IPQS/IPQZ 10	0.71
IPQS/IPQZ 15	0.80
IPQS/IPQZ 20	1.07
IPQS/IPQZ 30	1.42
IPQS/IPQZ 40	1.11
IPQS/IPQZ 50	1.66
IPQS/IPQZ 55	2.22
IPTQS/IPQZ 60	1.60
IPQS/IPQZ 70	2.40
IPQS/IPQZ 75	3.20
IPTQS/IPQZ 80	2.18
IPTQS/IPQZ 90	3.26

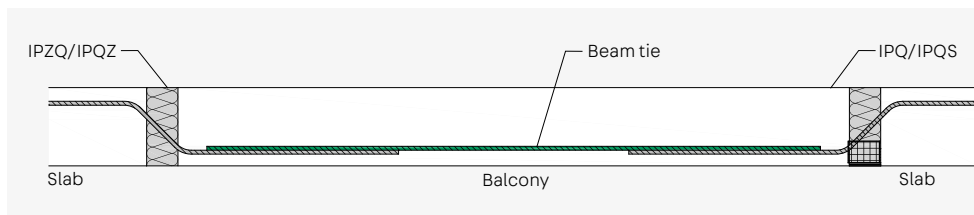
## On-site reinforcement with tension-free support



ISOPRO® IPQ/IPZQ, IPQS/IPQZ – Installation cross-section with opposing types of the same load-bearing capacity



ISOPRO® IPZQ/IPQ, IPQZ/IPQS – On-site beam tie in the lower reinforcement layer – Looped shear bar  $\varnothing 6$  on slab side



ISOPRO® IPZQ/IPQ, IPQZ/IPQS – On-site beam tie in the lower reinforcement layer – Straight shear bar on slab side

For tension-free support with an ISOPRO® IPZQ or IPQZ element, a corresponding IPQ or IPQS/IPTQS element must be used on the opposing side. A beam tie corresponding to the

shear force reinforcement of the ISOPRO® elements must be positioned between the two elements.

### ISOPRO® IPZQ beam tie

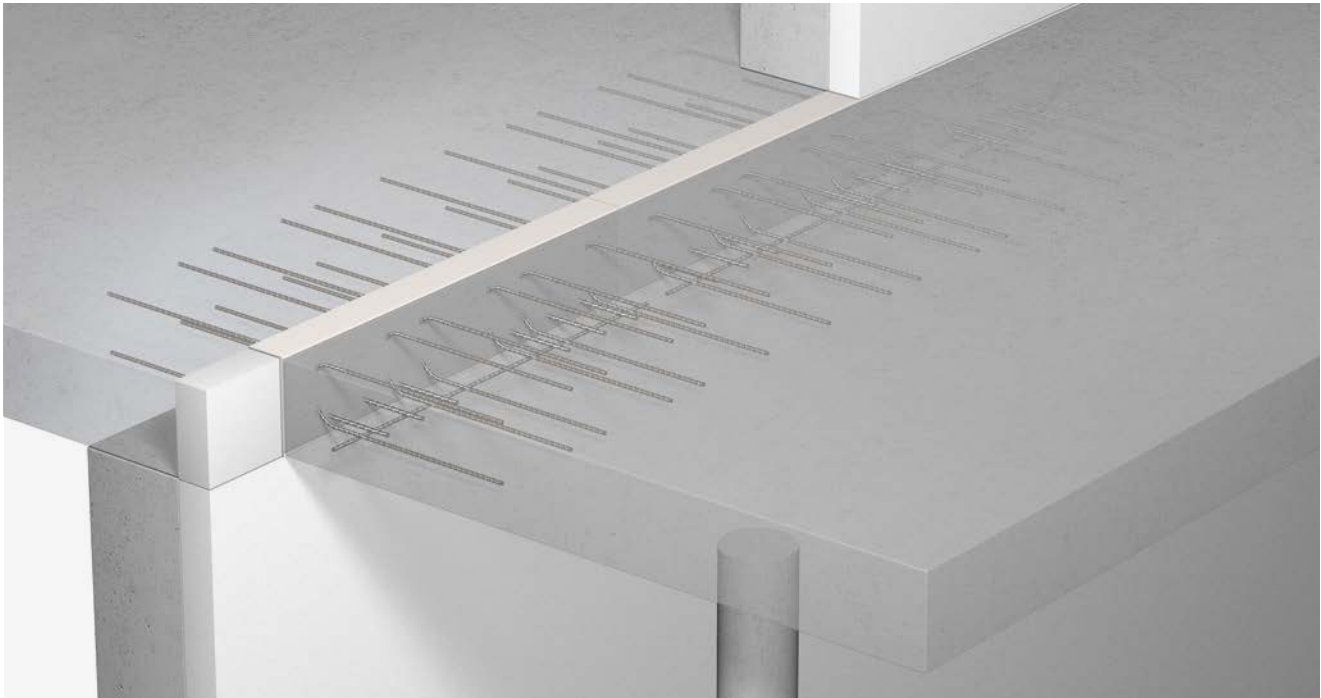
Type	Beam tie
IPZQ 10	4 $\varnothing 6$
IPZQ 20	5 $\varnothing 6$
IPZQ 30	6 $\varnothing 6$
IPZQ 40	8 $\varnothing 6$
IPZQ 50	10 $\varnothing 6$
IPZQ 70	6 $\varnothing 8$
IPZQ 80	7 $\varnothing 8$
IPZQ 85	8 $\varnothing 8$
IPZQ 90	10 $\varnothing 8$
IPZQ 100	8 $\varnothing 10$
IPZQ 110	9 $\varnothing 10$
IPZQ 120	10 $\varnothing 10$

### ISOPRO® IPQZ beam tie

Type	Beam tie
IPQZ 5	3 $\varnothing 6$
IPQZ 10	2 $\varnothing 8$
IPQZ 15	4 $\varnothing 6$
IPQZ 20	3 $\varnothing 8$
IPQZ 30	4 $\varnothing 8$
IPQZ 40	2 $\varnothing 10$
IPQZ 50	3 $\varnothing 10$
IPQZ 55	4 $\varnothing 10$
IPQZ 60	2 $\varnothing 12$
IPQZ 70	3 $\varnothing 12$
IPQZ 75	4 $\varnothing 12$
IPQZ 80	2 $\varnothing 14$
IPQZ 90	3 $\varnothing 14$

# ISOPRO® IPTQQ and IPTQQS

Elements for supported balconies with lifting loads



## ISOPRO® IPTQQ

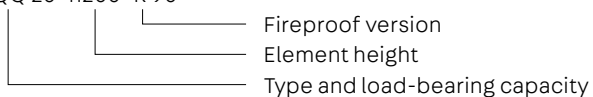
- For transmitting positive and negative shear forces, element length 1.0 m
- Pressure plane with steel compression struts
- Load-bearing capacities IPTQQ 10 to IPTQQ 110
- IPZQQ elements without compression struts are also available for tension-free support
- Element heights depending on the bar diameter: from 160 mm
- Fire resistance class R 90 available

## ISOPRO® IPTQQS

- Element length depending on load-bearing capacity: 0.3 m, 0.4 m or 0.5 m
- Pressure plane with steel compression struts
- Load-bearing capacities IPTQQS 10 to IPTQQS 90
- IPQZQ elements without compression struts are also available for tension-free support
- Element heights depending on the bar diameter: from 160 mm
- Fire resistance class R 90 available

## Type designation

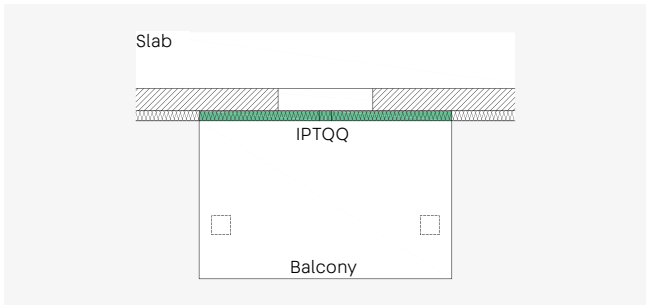
IPTQQ 20 h200 R 90



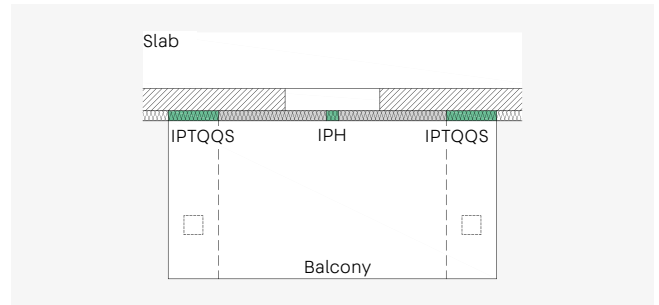
## Application – Element layout



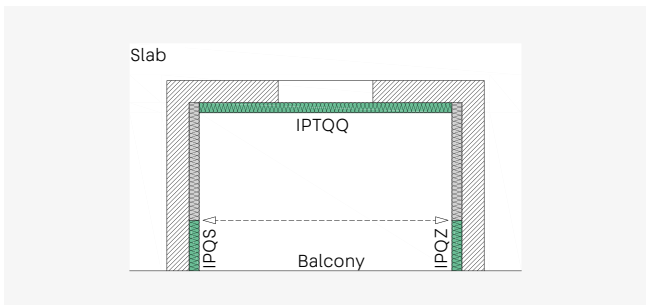
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



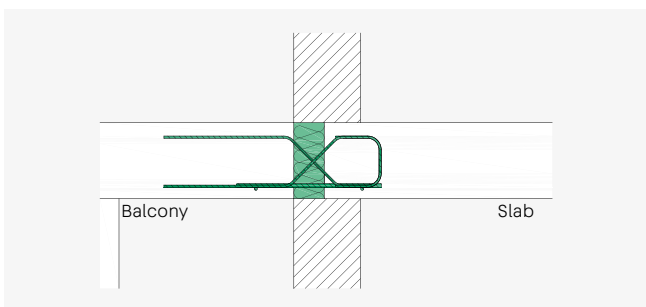
ISOPRO® IPTQQ – Supported balcony with laterally offset supports



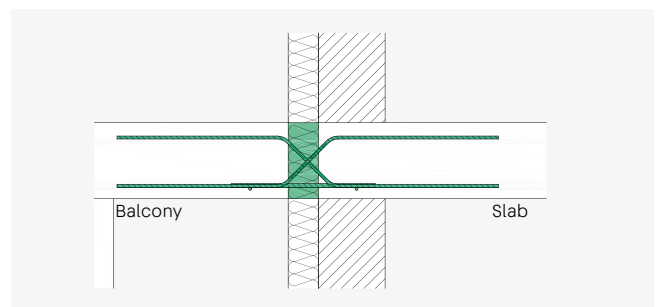
ISOPRO® IPTQQS – Supported balcony with downstand beams and support at specific points with ISOPRO® IPTQQS elements



ISOPRO® IPTQQ, IPQS, IPQZ – Loggia balcony with peak loads at specific points in the front and lifting loads in the rear corner area



ISOPRO® IPTQQ – Installation cross-section, solid wall – shear bar looped on slab side



ISOPRO® IPTQQ, IPTQQS – Installation cross-section, external thermal insulation composite system – shear bar straight on slab side



### Notes

In the case of balconies connected with shear force elements, appropriate support must be ensured during all construction stages. Temporary supports must not be removed until the permanent supports, which may be installed at a later date, have sufficient load-bearing capacity and are connected to the balcony in a friction-locked manner.

## Measurement table for concrete $\geq$ C25/30

ISOPRO® IPTQQ – Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m

Type	Shear force $V_{Rd}$ kN/m	Element height mm	Element length mm	Shear bars	Compression struts
				Configuration	Configuration
<b>IPTQQ 10</b>	$\pm 34.8$	$\geq 160$	500 + 500	2 x 4 $\emptyset 6^*$	4 $\emptyset 10$
<b>IPTQQ 30</b>	$\pm 52.2$	$\geq 160$	500 + 500	2 x 6 $\emptyset 6^*$	4 $\emptyset 10$
<b>IPTQQ 40</b>	$\pm 69.5$	$\geq 160$	500 + 500	2 x 8 $\emptyset 6^*$	6 $\emptyset 10$
<b>IPTQQ 50</b>	$\pm 86.9$	$\geq 160$	500 + 500	2 x 10 $\emptyset 6^*$	6 $\emptyset 10$
<b>IPTQQ 70</b>	$\pm 92.7$	$\geq 160$	500 + 500	2 x 6 $\emptyset 8$	6 $\emptyset 10$
<b>IPTQQ 90</b>	$\pm 144.9$	$\geq 170$	500 + 500	2 x 6 $\emptyset 10$	8 $\emptyset 10$
<b>IPTQQ 110</b>	$\pm 208.6$	$\geq 180$	500 + 500	2 x 6 $\emptyset 12$	12 $\emptyset 10$

\* Elements with  $\emptyset 6$  shear bars have a looped bar on the slab side. For all other elements, the shear bar on the slab side is straight (see also page 84).

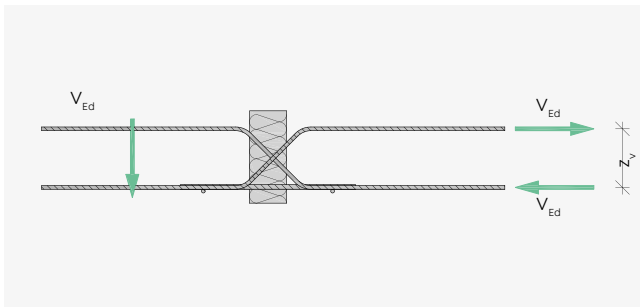
ISOPRO® IPTQQS – Rated values of the shear forces that can be absorbed  $V_{Rd}$  kN

Type	Shear force $V_{Rd}$ kN	Element height mm	Element length mm	Shear bars	Compression struts
				Configuration	Configuration
<b>IPTQQS 10</b>	$\pm 30.9$	$\geq 160$	300	2 x 2 $\emptyset 8$	2 $\emptyset 10$
<b>IPTQQS 20</b>	$\pm 46.4$	$\geq 160$	400	2 x 3 $\emptyset 8$	3 $\emptyset 10$
<b>IPTQQS 40</b>	$\pm 48.3$	$\geq 170$	300	2 x 2 $\emptyset 10$	3 $\emptyset 10$
<b>IPTQQS 50</b>	$\pm 72.4$	$\geq 170$	400	2 x 3 $\emptyset 10$	4 $\emptyset 10$
<b>IPTQQS 60</b>	$\pm 69.5$	$\geq 180$	300	2 x 2 $\emptyset 12$	4 $\emptyset 10$
<b>IPTQQS 70</b>	$\pm 104.3$	$\geq 180$	400	2 x 3 $\emptyset 12$	6 $\emptyset 10$
<b>IPTQQS 80</b>	$\pm 94.7$	$\geq 190$	300	2 x 2 $\emptyset 14$	4 $\emptyset 14$
<b>IPTQQS 90</b>	$\pm 142.0$	$\geq 190$	400	2 x 3 $\emptyset 14$	6 $\emptyset 14$

# Moments due to eccentric connections

Additional moments from eccentric connections must be factored in when designing the slab-side connection reinforcement of the ISOPRO® shear force elements ISOPRO® IPTQQ and IPTQQS. If the leading sign is the same, the

additional moment must be superimposed on the moment from the planned load. The moment  $\Delta M_{Ed}$  is calculated under the assumption that the elements are fully loaded.



$$\Delta M_{Ed} = V_{Ed} \cdot z_v$$

ISOPRO® IPTQQ, IPTQQS – Elements with steel compression struts  
 $z_v$  – Lever arm for determining the eccentric moment

## Eccentric moments ISOPRO® IPTQQ

Type	$\Delta m_{Ed}$ kNm/m	
	$h < 200$ mm	$h \geq 200$ mm
IPTQQ 10	3.0	4.4
IPTQQ 30	4.5	6.6
IPTQQ 40	6.1	8.8
IPTQQ 50	7.6	11.0
IPTQQ 70	8.0	11.7
IPTQQ 90	13.8	18.1
IPTQQ 110	19.8	26.1

## Eccentric moments ISOPRO® IPTQQS

Type	$\Delta M_{Ed}$ kNm	
	$h < 200$ mm	$h \geq 200$ mm
IPTQQS 10	2.7	3.9
IPTQQS 20	4.0	5.9
IPTQQS 40	4.6	6.0
IPTQQS 50	6.9	9.1
IPTQQS 60	7.2	8.6
IPTQQS 70	10.9	12.9
IPTQQS 80	10.5	11.5
IPTQQS 90	15.8	17.2

## Maximum permissible expansion joint spacing

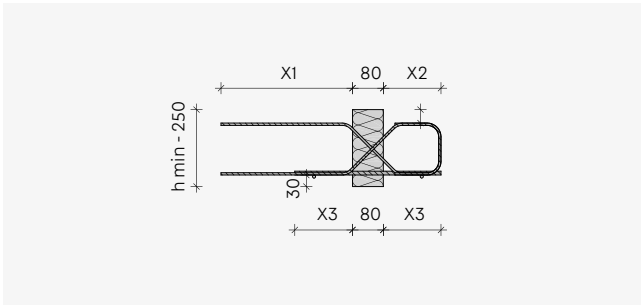
	IPTQQ 10 to 90 IPTQQS 10 to 50	IPTQQ 110 IPTQQS 60 to 70	IPTQQS 80 to 90
Joint spacing $e$ m	13.0	11.3	10.1



# Element design

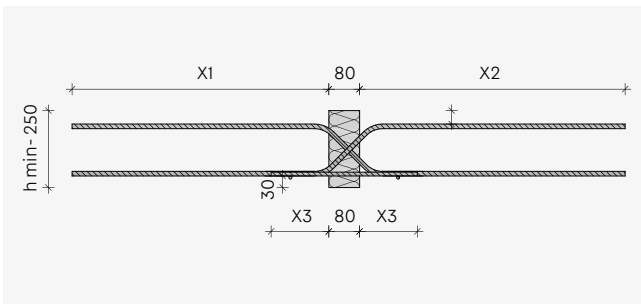
## ISOPRO® IPTQQ

### Shear bar $\varnothing 6$



## ISOPRO® IPTQQ, IPTQQS

### Shear bar $\geq \varnothing 8$



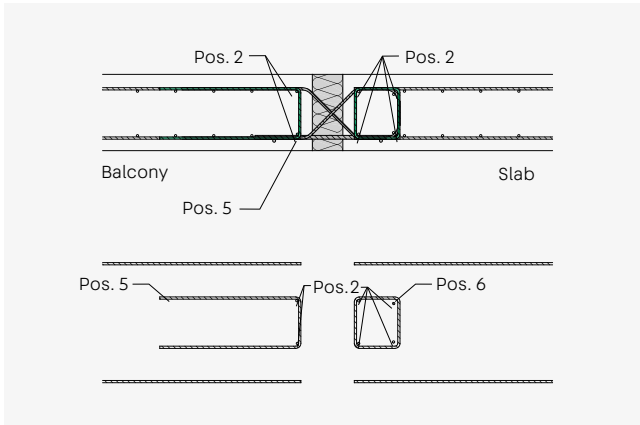
### Dimensions in mm

Length of shear bar mm	IPTQQ	IPTQQ	IPTQQ 70	IPTQQ 90	IPTQQ 110	IPTQQS 80	IPTQQ	IPTQQS
	10 – 50	10 – 50	IPTQQS 10	IPTQQS 40	IPTQQS 60	IPTQQS 90	70 – 110	80 – 90
			IPTQQS 20	IPTQQS 50	IPTQQS 70		IPTQQS	
							10 – 70	
	Compression $\varnothing 6$	Compression strut $\varnothing 10$	$\varnothing 8$	$\varnothing 10$	$\varnothing 12$	$\varnothing 14$	Compression strut $\varnothing 10$	Compression strut $\varnothing 14$
<b>X1</b>	340	–	450	560	670	780	–	–
<b>X2</b>	150	–	$\leq 530$	$\leq 640$	$\leq 745$	$\leq 855$	–	–
<b>X3</b>	–	150	–	–	–	–	150	165
<b>hmin</b>	160	–	160	170	180	190	–	–

The concrete cover of the compression struts and the shear bars at the bottom is generally 30 mm.  
 The concrete cover of the shear bars at the top is cv35 to cv85 depending on the element height.

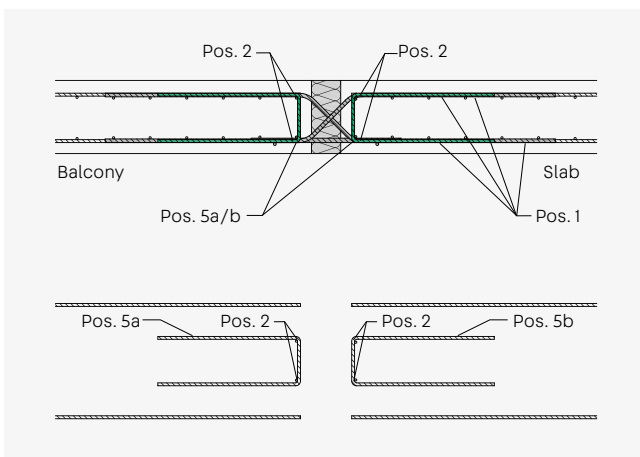
## On-site reinforcement

### ISOPRO® IPTQQ 10 to 50 with shear bar $\varnothing 6$ – looped on slab side



- Pos. 1: Slab reinforcement according to the specifications of the structural engineer
- Pos. 2: Distribution bar 2  $\varnothing 8$  balcony side, 4  $\varnothing 8$  slab side
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min.  $\varnothing 6/250$  or according to the specifications of the structural engineer (not shown)
- Pos. 5: Suspension reinforcement on balcony side – see table
- Pos. 6: Stirrup (edge beam)  $\varnothing 6/200$

### ISOPRO® IPTQQ 70 to 110, IPTQQS 10 to 90 – shear bar straight on slab side

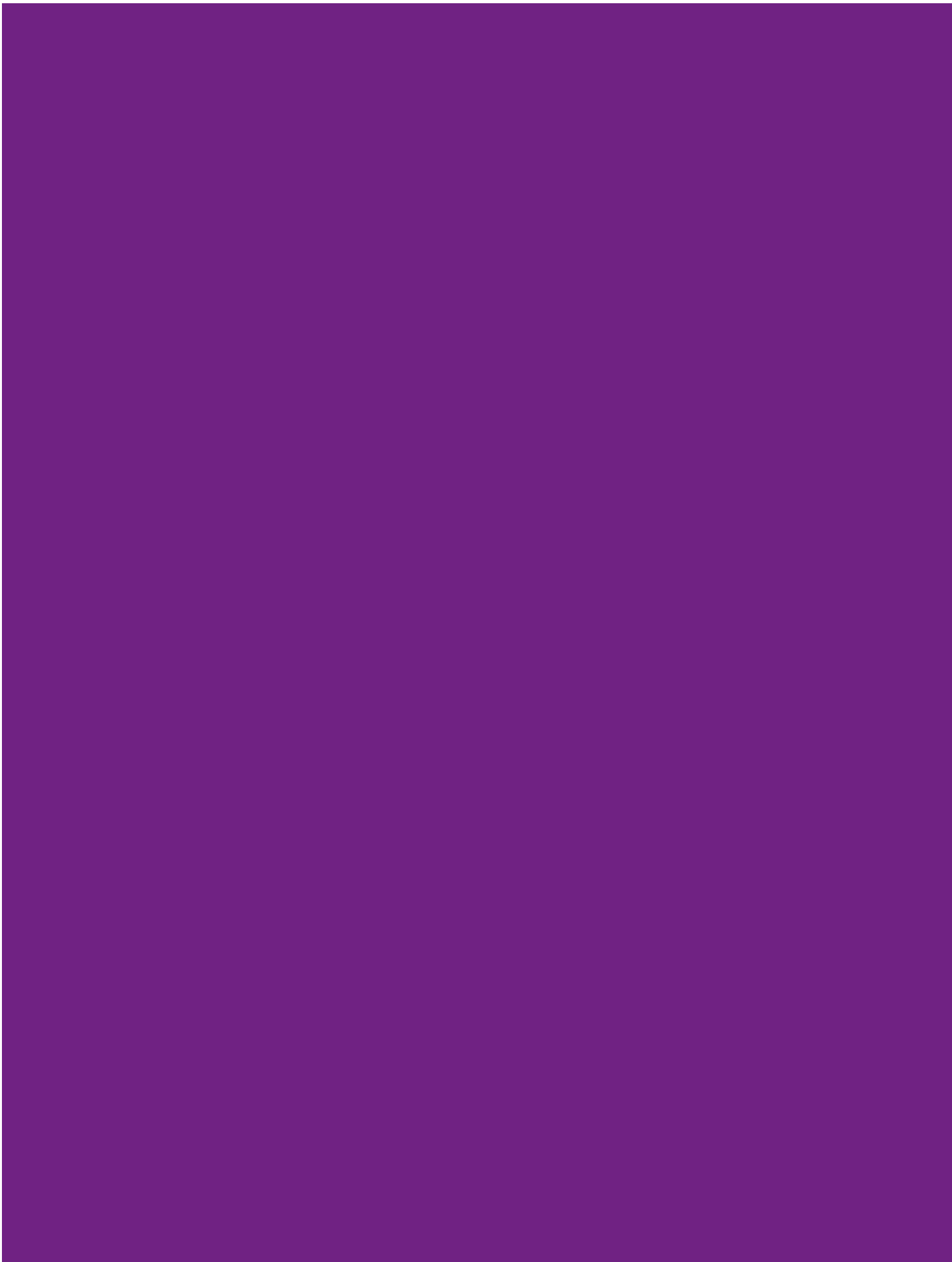


- Pos. 1: Slab reinforcement according to the specifications of the structural engineer
- Pos. 2: Distribution bar 2 x 2  $\varnothing 8$  balcony and slab side
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min.  $\varnothing 6/250$  or according to the specifications of the structural engineer (not shown)
- Pos. 5a: Suspension reinforcement on balcony side
- Pos. 5b: Slab-side suspension reinforcement with indirect support – see table

#### Suspension reinforcement for concrete $\geq c25/30$

Type	Suspension reinforcement Pos. 5, $a_{s,erf}$ cm <sup>2</sup> /m
<b>IPTQQ 10</b>	0.80
<b>IPTQQ 30</b>	1.20
<b>IPTQQ 40</b>	1.60
<b>IPTQQ 50</b>	2.00
<b>IPTQQ 70</b>	2.13
<b>IPTQQ 90</b>	3.33
<b>IPTQQ 110</b>	4.80

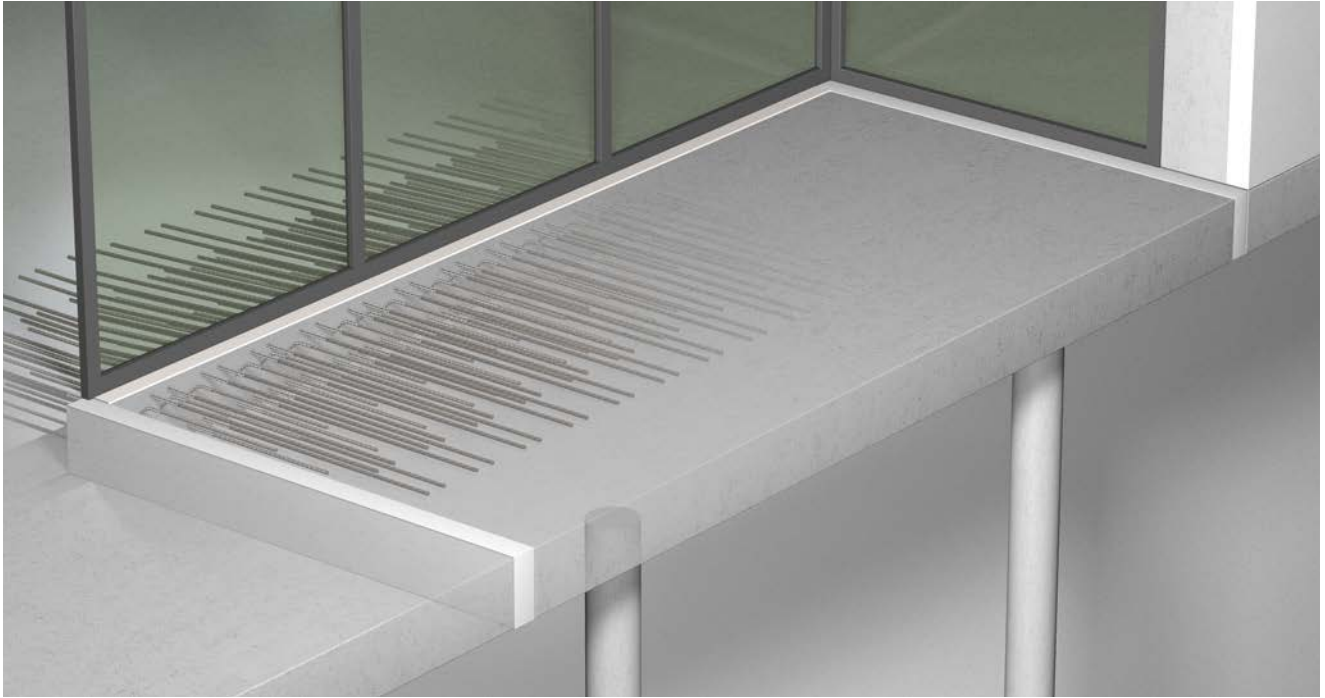
Type	Suspension reinforcement Pos. 5, $a_{s,erf}$ cm <sup>2</sup>
<b>IPTQQS 10</b>	0.71
<b>IPTQQS 20</b>	1.07
<b>IPTQQS 40</b>	1.11
<b>IPTQQS 50</b>	1.66
<b>IPTQQS 60</b>	1.60
<b>IPTQQS 70</b>	2.40
<b>IPTQQS 80</b>	2.18
<b>IPTQQS 90</b>	3.26



# Continuous elements

# ISOPRO® IPTD

## Elements for continuous slabs

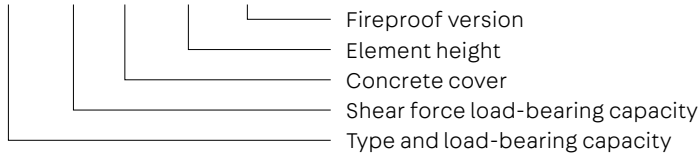


### ISOPRO® IPTD

- Transfers negative and positive moments and positive and negative shear forces
- Tension and compression plane with steel bars
- Load-bearing capacities: IPTD 20 to IPTD 100
- Standard shear force load-bearing capacities: Q8, Q10
- Tie bar concrete cover at the top: cv35 or cv50
- Concrete cover of the compression struts at the bottom: 30 mm for cv35 and 50 mm for cv50
- Element heights depending on the shear force load-bearing capacity: from 160 mm
- Fire resistance class R 90 available

### Type designation

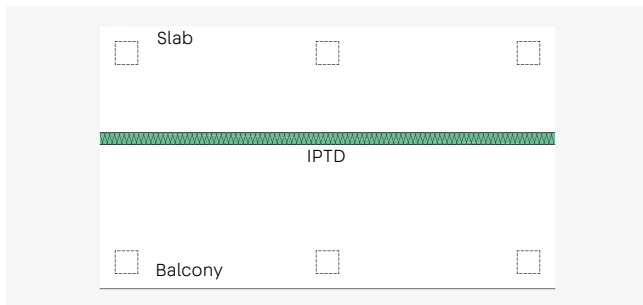
IPTD 50 Q8 cv35 h200 R 90



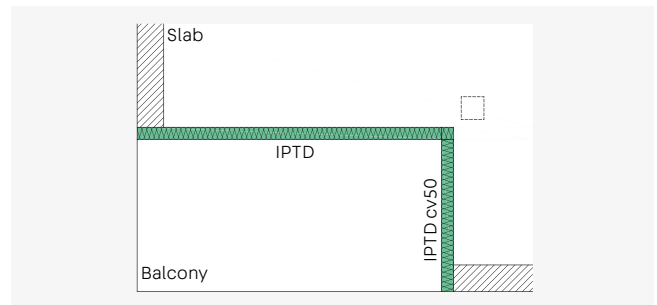
## Application – Element layout



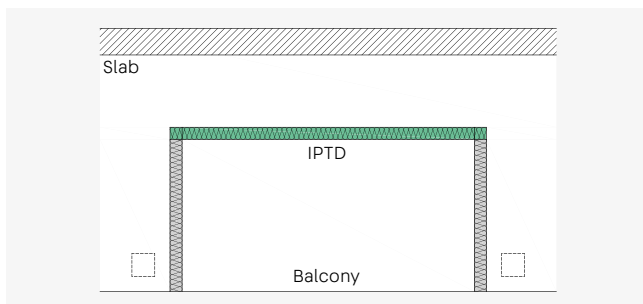
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



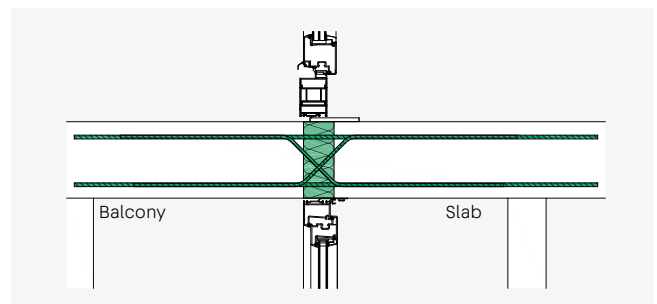
ISOPRO®IPTD – Continuous slab with one glass façade



ISOPRO®IPTD – Inner corner balcony with large dimensions and loads



ISOPRO®IPTD – Recessed balcony with glass façade without direct support

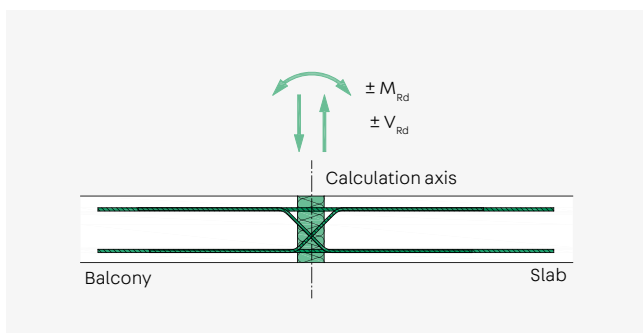


ISOPRO®IPTD – Installation cross-section, glass façade



### Notes on calculations

- The joint between the balcony and the ceiling slab must be factored in to calculations performed in the FEM software.
- ISOPRO®IPTD elements can only transmit only bending moments perpendicular to the insulating joint.
- When determining the internal forces, the torsion spring stiffness of the ISOPRO® elements must be included in the calculation iteratively. First, the torsional spring stiffness of the thermal insulation elements is assumed. An element is then selected on the basis of the resulting internal forces. In the next step, the actual torsion spring stiffness of the selected element is factored in to the calculation. Another iterative step may be necessary to arrive at the final result.
- IPTD elements can be combined with ISOPRO® IPE elements to transmit perpendicular and parallel forces across the joint.



ISOPRO®IPTD – Structural system

## Measurement table for concrete $\geq$ C25/30

Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm/m

Element height mm  
 depending  
 on cv mm

35	50	IPTD 20	IPTD 20 Q8	IPTD 20 Q10	IPTD 30	IPTD 30 Q8	IPTD 30 Q10	IPTD 50	IPTD 50 Q8	IPTD 50 Q10
160	–	± 14.6	± 13.0	–	± 22.0	± 20.4	–	± 30.1	± 28.5	–
–	200	± 15.5	± 13.7	–	± 23.3	± 21.6	–	± 31.9	± 30.2	–
170	–	± 16.3	± 14.5	± 12.5	± 24.7	± 22.8	± 20.8	± 33.7	± 31.9	± 29.9
–	210	± 17.2	± 15.3	± 13.1	± 26.0	± 24.1	± 22.0	± 35.5	± 33.6	± 31.5
180	–	± 18.1	± 16.0	± 13.8	± 27.3	± 25.3	± 23.1	± 37.3	± 35.3	± 33.1
–	220	± 18.9	± 16.8	± 14.4	± 28.6	± 26.5	± 24.2	± 39.1	± 37.0	± 34.7
190	–	± 19.8	± 17.5	± 15.1	± 30.0	± 27.8	± 25.3	± 40.9	± 38.7	± 36.3
–	230	± 20.7	± 18.3	± 15.7	± 31.3	± 29.0	± 26.4	± 42.8	± 40.5	± 37.9
200	–	± 21.5	± 19.1	± 16.4	± 32.6	± 30.2	± 27.6	± 44.6	± 42.2	± 39.5
–	240	± 22.4	± 19.8	± 17.0	± 33.9	± 31.4	± 28.7	± 46.4	± 43.9	± 41.1
210	–	± 23.2	± 20.6	± 17.7	± 35.3	± 32.7	± 29.8	± 48.2	± 45.6	± 42.7
–	250	± 24.1	± 21.4	± 18.4	± 36.6	± 33.9	± 30.9	± 50.0	± 47.3	± 44.3
220	–	± 25.0	± 22.1	± 19.0	± 37.9	± 35.1	± 32.0	± 51.8	± 49.0	± 45.9
230	–	± 26.7	± 23.7	± 20.3	± 40.6	± 37.6	± 34.3	± 55.4	± 52.4	± 49.2
240	–	± 28.4	± 25.2	± 21.6	± 43.2	± 40.0	± 36.5	± 59.1	± 55.9	± 52.4
250	–	± 30.1	± 26.7	± 22.9	± 45.9	± 42.5	± 38.8	± 62.7	± 59.3	± 55.6

Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m

	IPTD 20	IPTD 20 Q8	IPTD 20 Q10	IPTD 30	IPTD 30 Q8	IPTD 30 Q10	IPTD 50	IPTD 50 Q8	IPTD 50 Q10
Shear force $V_{Rd}$ kN/m	± 53.0	± 92.0	± 135.0	± 53.0	± 92.0	± 135.0	± 53.0	± 92.0	± 135.0

Dimensions and configuration

	IPTD 20	IPTD 20 Q8	IPTD 20 Q10	IPTD 30	IPTD 30 Q8	IPTD 30 Q10	IPTD 50	IPTD 50 Q8	IPTD 50 Q10
Element length mm			500 + 500			500 + 500			500 + 500
Tie bars/com- pression struts			6 Ø 10			6 Ø 12			8 Ø 12
Shear bars	2 x 4 Ø 8	2 x 6 Ø 8	2 x 6 Ø 10	2 x 4 Ø 8	2 x 6 Ø 8	2 x 6 Ø 10	2 x 4 Ø 8	2 x 6 Ø 8	2 x 6 Ø 10

**Rated values of the moments that can be absorbed  $m_{Rd}$  in kNm/m**

Element height mm  
 depending  
 on cv mm

35	50	IPTD 70	IPTD 70 Q8	IPTD 70 Q10	IPTD 90	IPTD 90 Q8	IPTD 90 Q10	IPTD 100	IPTD 100 Q8	IPTD 100 Q10
160	–	± 38.1	± 36.5	–	± 46.2	± 44.6	–	± 49.8	–	–
–	200	± 40.4	± 38.7	–	± 49.0	± 47.3	–	± 52.9	–	–
170	–	± 42.7	± 40.9	± 38.9	± 51.8	± 50.0	± 48.0	± 56.0	± 54.0	–
–	210	± 45.0	± 43.1	± 41.0	± 54.6	± 52.6	± 50.5	± 59.1	± 57.0	–
180	–	± 47.3	± 45.3	± 43.1	± 57.3	± 55.3	± 53.1	± 62.1	± 60.0	± 57.7
–	220	± 49.6	± 47.5	± 45.2	± 60.1	± 58.0	± 55.7	± 65.2	± 62.9	± 60.5
190	–	± 51.9	± 49.7	± 47.3	± 62.9	± 60.7	± 58.3	± 68.3	± 65.9	± 63.4
–	230	± 54.2	± 51.9	± 49.4	± 65.7	± 63.4	± 60.9	± 71.4	± 68.9	± 66.3
200	–	± 56.5	± 54.1	± 51.5	± 68.5	± 66.1	± 63.4	± 74.4	± 71.8	± 69.1
–	240	± 58.8	± 56.3	± 53.6	± 71.3	± 68.8	± 66.0	± 77.5	± 74.8	± 72.0
210	–	± 61.1	± 58.5	± 55.7	± 74.0	± 71.4	± 68.6	± 80.6	± 77.8	± 74.8
–	250	± 63.4	± 60.7	± 57.8	± 76.8	± 74.1	± 71.2	± 83.7	± 80.7	± 77.7
220	–	± 65.7	± 62.9	± 59.8	± 79.6	± 76.8	± 73.7	± 86.7	± 83.7	± 80.5
230	–	± 70.3	± 67.3	± 64.0	± 85.2	± 82.2	± 78.9	± 92.9	± 89.6	± 86.3
240	–	± 74.9	± 71.7	± 68.2	± 90.7	± 87.6	± 84.1	± 99.0	± 95.6	± 92.0
250	–	± 79.5	± 76.1	± 72.4	± 96.3	± 92.9	± 89.2	± 105.2	± 101.5	± 97.7

**Rated values of the shear forces that can be absorbed  $V_{Rd}$  in kN/m**

	IPTD 70	IPTD 70 Q8	IPTD 70 Q10	IPTD 90	IPTD 90 Q8	IPTD 90 Q10	IPTD 100	IPTD 100 Q8	IPTD 100 Q10
Shear force $V_{Rd}$ kN/m	± 53.0	± 92.0	± 135.0	± 53.0	± 92.0	± 135.0	± 92.0	± 135.0	± 180.0

**Dimensions and configuration**

	IPTD 70	IPTD 70 Q8	IPTD 70 Q10	IPTD 90	IPTD 90 Q8	IPTD 90 Q10	IPTD 100	IPTD 100 Q8	IPTD 100 Q10
Element length mm		500 + 500			500 + 500			500 + 500	
Tie bars/com- pression struts		10 Ø 12			12 Ø 12			12 Ø 14	
Shear bars	2 x 4 Ø 8	2 x 6 Ø 8	2 x 6 Ø 10	2 x 4 Ø 8	2 x 6 Ø 8	2 x 6 Ø 10	2 x 4 Ø 8	2 x 6 Ø 10	2 x 6 Ø 12



# Expansion joint spacing – Element design

## Expansion joint spacing

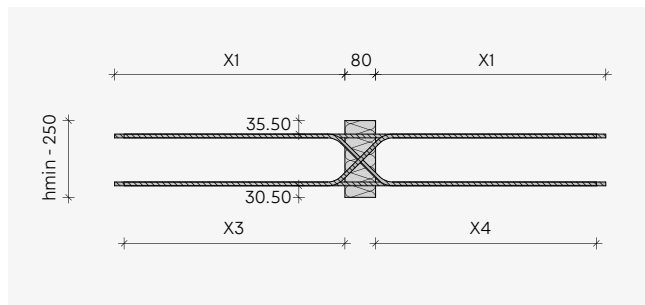
If the component dimensions exceed the maximum permissible expansion joint spacing, expansion joints must be aligned perpendicular to the insulation layer. The maximum permissible expansion joint spacing  $e$  depends on the maximum bar diameter across the expansion joint, and thus depends on the type.

Fixed points, such as supports that run around corners, or the use of ISOPRO® IPH or IPE elements result in increased stress forces. This means that the maximum permissible expansion joint spacing must be reduced to  $e/2$ . Half the maximum expansion joint distance is always measured from the fixed point.

## Maximum permissible expansion joint spacing

	IPTD 20	IPTD 30 to IPTD 90	IPTD 100
Joint spacing $e$ m	13.0	11.3	10.1

## Element design ISOPRO® IPTD

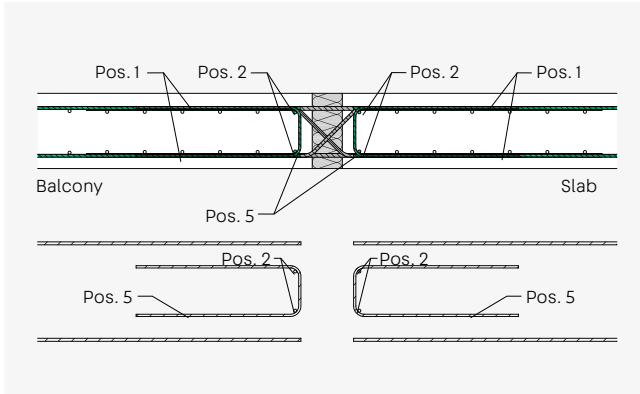


Length of tie bar / Length of compression strut mm	IPTD 20	IPTD 30	IPTD 50	IPTD 70	IPTD 90	IPTD 100
<b>X1</b>	740	860	860	860	860	980

Length of shear bar mm	IPTD 20 to IPTD 90 Shear force load-bearing capacity			IPTD 100 Shear force load-bearing capacity		
	Standard	Q8	Q10	Standard	Q8	Q10
<b>X3</b>	450	450	560	450	560	670
<b>X4</b>	≤ 530	≤ 530	≤ 640	≤ 530	≤ 640	≤ 750
<b>hmin</b>	160	160	170	160	170	180

# On-site reinforcement

## ISOPRO® IPTD



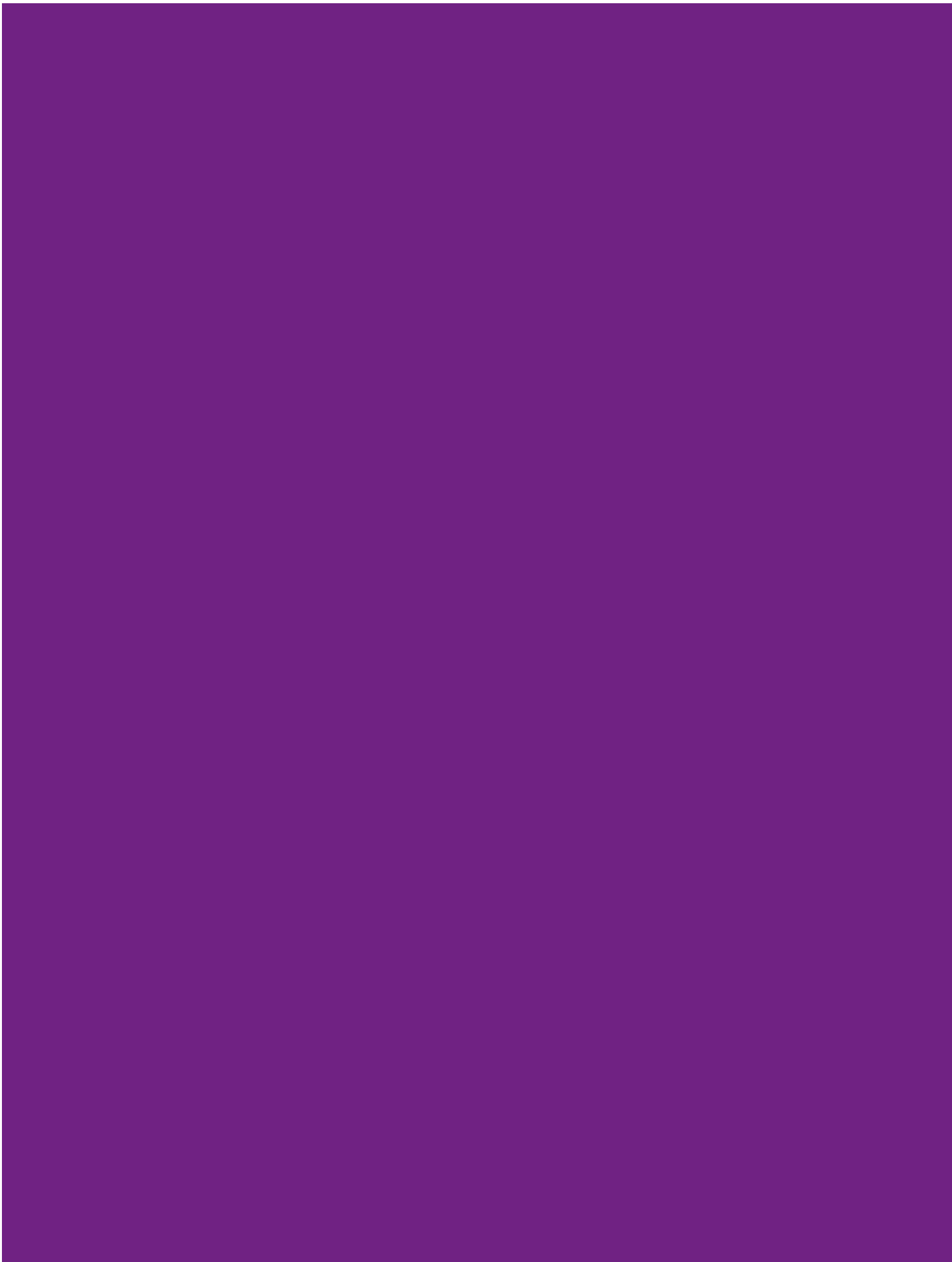
- Pos. 1: Connection reinforcement for the ISOPRO® element  
 – above for negative moments, below for positive moments  
 – see table below
- Pos. 2: Distribution bar 2 x 2 Ø 8 balcony and slab side
- Pos. 4: Structural edging at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer (not shown)
- Pos. 5: Suspension reinforcement on balcony side and slab side – see table

### Connection reinforcement POS. 1

	IPTD 20	IPTD 30	IPTD 50	IPTD 70	IPTD 90	IPTD 100
<b>a<sub>s,eff</sub> cm<sup>2</sup>/m</b>	4.71	6.79	9.05	11.31	13.57	18.47
<b>Recommendation</b>	6 Ø 10	6 Ø 12	8 Ø 12	10 Ø 12	12 Ø 12	12 Ø 14

### Suspension reinforcement Pos. 5

	IPTD 20 to IPTD 90			IPTD 100		
	Standard	Q8	Q10	Standard	Q8	Q10
<b>a<sub>s,eff</sub> cm<sup>2</sup>/m</b>	1.21	2.13	3.10	2.13	3.10	4.14
<b>Recommendation</b>	Ø 6/200	Ø 8/200	Ø 10/200	Ø 8/200	Ø 10/200	Ø 10/150



# Elements for special loads

# ISOPRO® IPH

Elements for planned horizontal loads

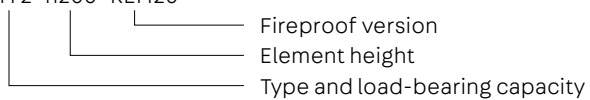


## ISOPRO® IPH

- Load-bearing capacities IPH 1, IPH 2, IPH 3
- ISOPRO® IPH 1 for transmitting horizontal forces parallel to the insulating joint
- ISOPRO® IPH 2 for transmitting horizontal forces perpendicular to the insulating joint
- ISOPRO® IPH 3 for transmitting horizontal forces parallel and perpendicular to the insulating joint
- Concrete cover is fixed, see product details
- Element heights: from 160 mm
- Fire resistance class REI 120 available

## Type designation

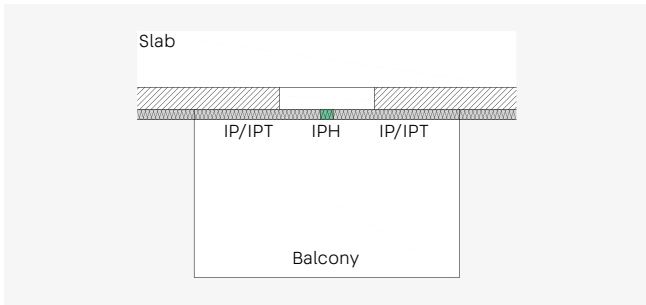
IPH 2 h200 REI 120



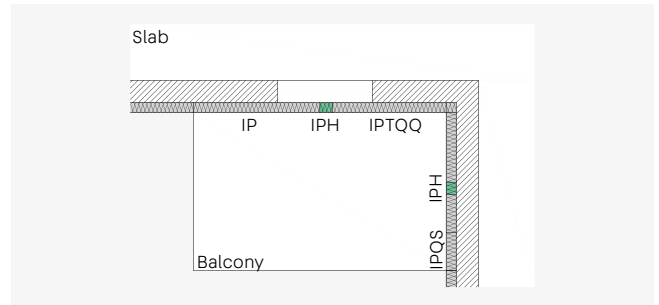
## Application – Element layout



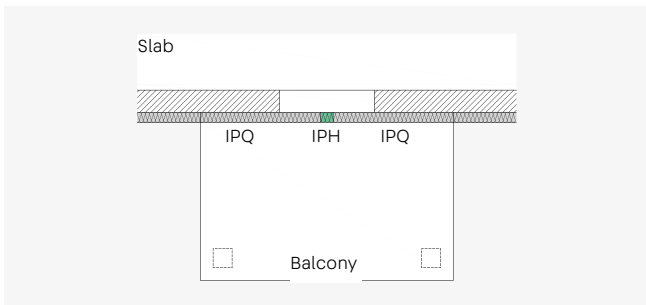
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



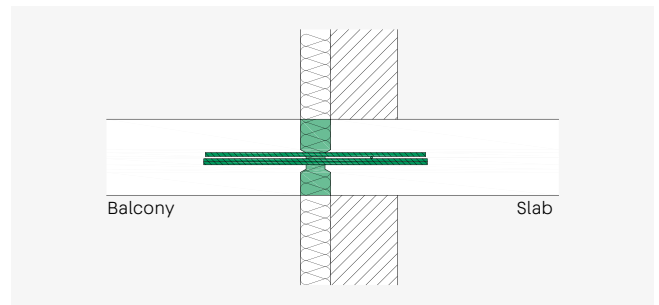
ISOPRO® IPH - Cantilevered balcony with planned horizontal loads



ISOPRO® IPH - Inner corner balcony with planned horizontal loads



ISOPRO® IPH - Balcony on articulated supports with structural IPH elements

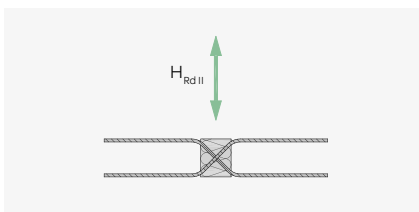


ISOPRO® IPH 3 - Installation cross-section, external thermal insulation composite system

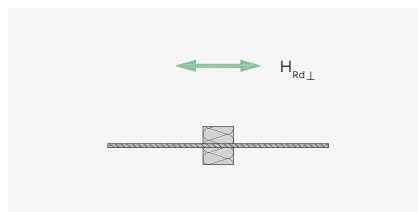
## Measurement table for concrete $\geq$ C25/30

Rated values of the horizontal forces that can be absorbed  $H_{Rd}$  kN

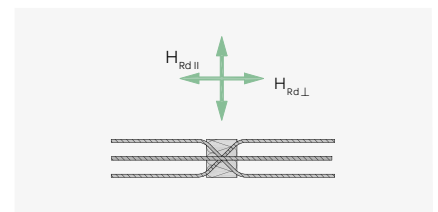
	IPH 1	IPH 2	IPH 3
Horizontal force, parallel $H_{Rd  }$ kN	$\pm 8.6$	–	$\pm 8.6$
Horizontal force, perpendicular $H_{Rd\perp}$ kN	–	$\pm 20.9$	$\pm 20.9$



IPH 1



IPH 2



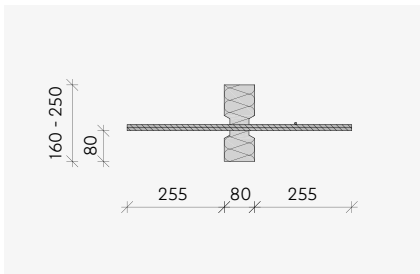
IPH 3

# Calculation – Expansion joint spacing

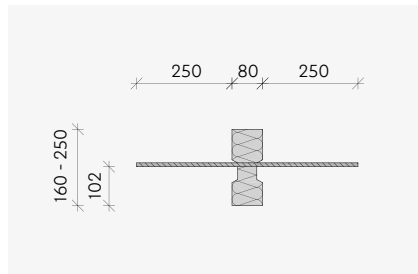
## Notes on calculation:

- The number and position of ISOPRO® IPH elements are chosen according to the specifications of the structural engineer.
- When using ISOPRO® IPH elements, it must be ensured that the length and thus the load-bearing capacity of the linear connection is reduced by the proportion of IPH elements used.
- The bars of the ISOPRO® IPH elements are anchored on both sides of the insulating joint. No connection reinforcement is required for the IPH elements.

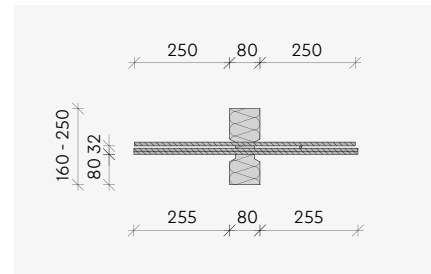
## ISOPRO® IPH element design



IPH 1



IPH 2



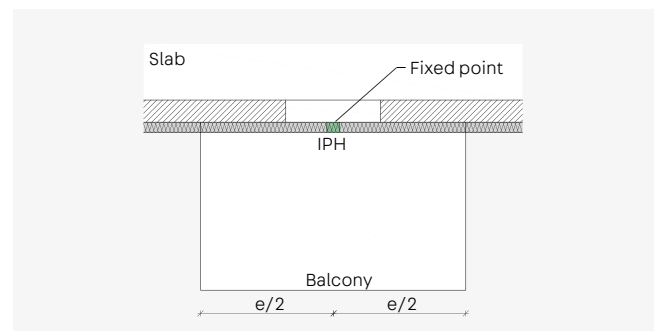
IPH 3

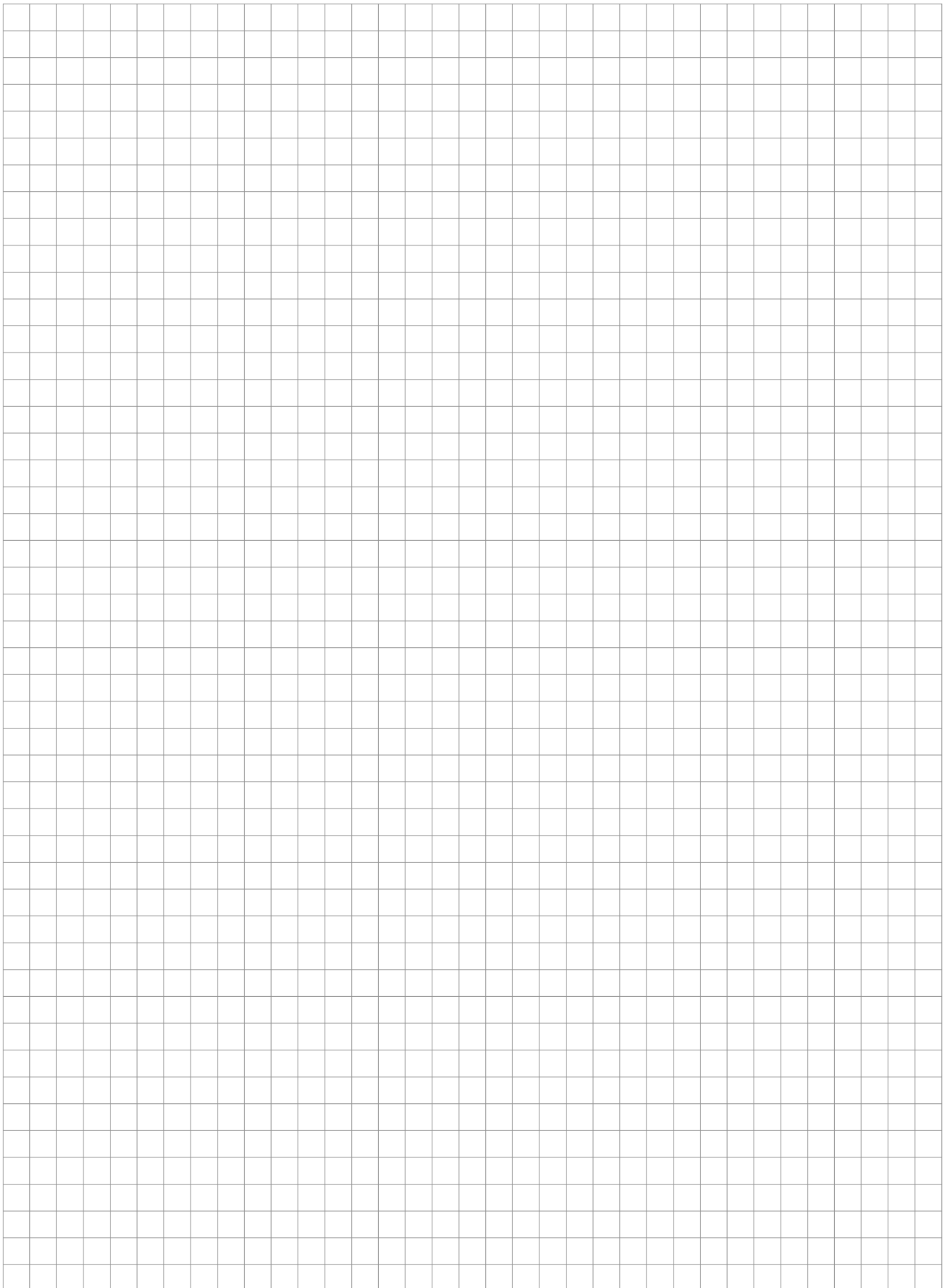
## Element length and configuration

	IPH 1	IPH 2	IPH 3
<b>Element length mm</b>	100	100	100
<b>Shear bars</b>	2 x 1 Ø 8	–	2 x 1 Ø 8
<b>Tie bars/compression struts</b>	–	1 Ø 10	1 Ø 10

## Expansion joint spacing

The use of IPH elements creates a fixed point, which results in increased stress forces. This reduces the maximum permissible expansion joint spacing to  $e/2$  when using IPH elements. Half the maximum expansion joint distance is always measured from the fixed point.







# ISOPRO® IPE

Elements for absorbing seismic loads

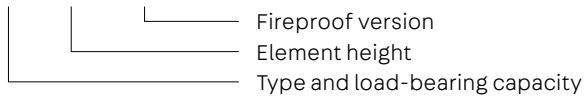


## ISOPRO® IPE

- For cantilevered, continuous or supported slabs as a supplement to elements with moment and/or shear load bearing capacity
- For transmitting horizontal forces parallel and perpendicular to the insulating joint and lifting (positive) moments in combination with an ISOPRO® IP, IPT element
- Load-bearing capacities: IPE 1, IPE 2
- Concrete cover is fixed, see measurement table
- Element heights: from 160 mm
- Fire resistance class REI 120 available

## Type designation

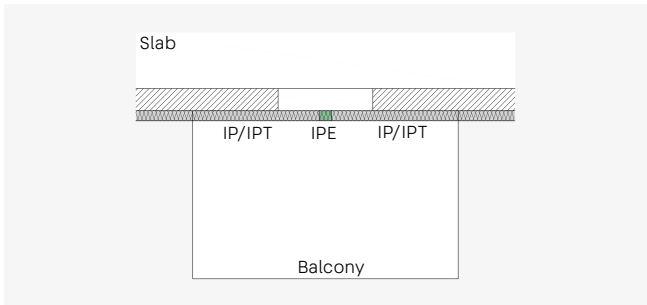
IPE 2 h200 REI120



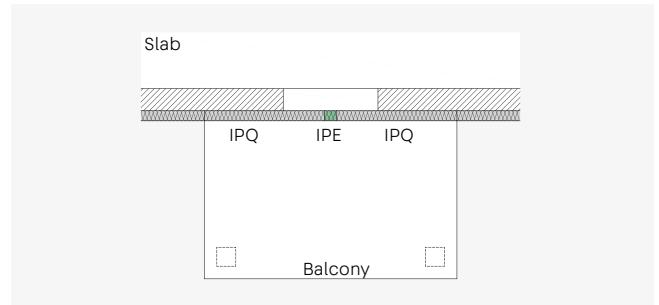
# Application – Element layout



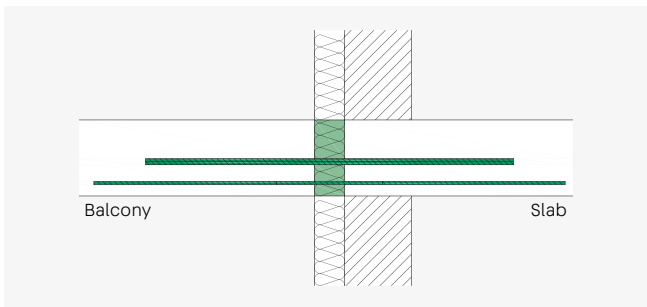
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



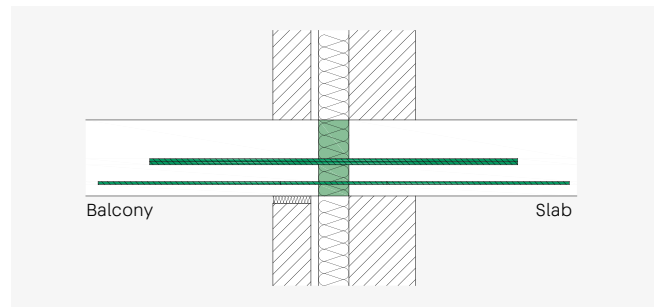
ISOPRO® IPE - Cantilevered balcony with lifting moments



ISOPRO® IPE - Supported balcony with high horizontal forces

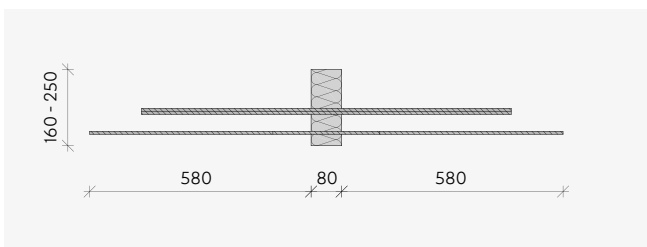


ISOPRO® IPE - Installation cross-section, external thermal insulation composite system

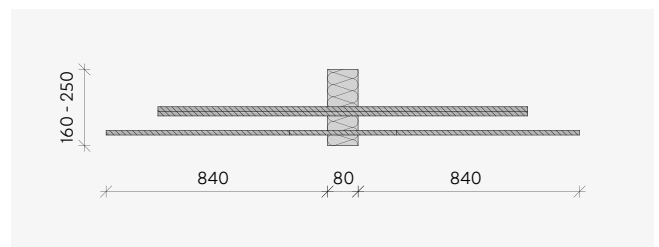


ISOPRO® IPE - Installation cross-section, cavity wall

## Element design



ISOPRO® IPE 1

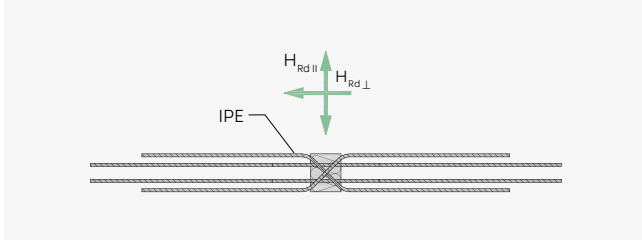


ISOPRO® IPE 2

## Dimensions and configuration

	IPE 1	IPE 2
<b>Element length mm</b>	100	100
<b>Shear bars</b>	2 x 1 Ø 8	2 x 1 Ø 12
<b>Tie bars</b>	2 Ø 8	2 Ø 12

## Measurement table for concrete ≥ C25/30



### Rated values of the horizontal forces that can be absorbed $H_{Rd}$ kN

	IPE 1	IPE 2
Horizontal load, parallel $H_{Rd,II}$ kN	± 15.4	± 34.7
Horizontal force, perpendicular $H_{Rd,\perp}$ kN for $M_{Rd} = 0$	± 40.6	± 97.2

### Rated values of the lifting moments that can be absorbed $m_{Rd}$ kNm

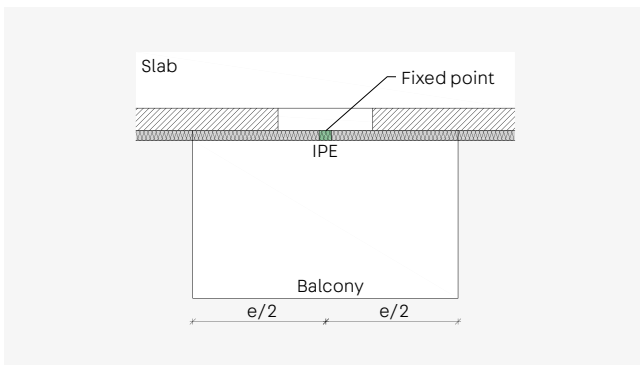
Element height mm depending on cv mm		ISOPRO®	
35	50	IPE 1	IPE 2
160	–	3.7	8.2
–	180	3.9	8.7
170	–	4.1	9.1
–	190	4.4	9.6
180	–	4.6	10.1
–	200	4.8	10.6
190	–	5.0	11.1
–	210	5.2	11.6
200	–	5.5	12.1
–	220	5.7	12.6
210	–	5.9	13.1
–	230	6.1	13.6
220	–	6.3	14.1
–	240	6.5	14.6
230	–	6.8	15.0
–	250	7.0	15.5
240	–	7.2	16.0
250	–	7.6	17.0

# Calculation – Expansion joint spacing

## Notes on calculation:

- Moments can only be transmitted in connection with directly adjacent ISOPRO® IP or IPT elements.
- The tie bars in the ISOPRO® IP or IPT elements adjacent to the ISOPRO® IPE element are activated as compression struts to transmit the positive moments given in the table. It is advisable to employ the following adjacent elements at the very least to ensure that this effect is produced:
  - When using IPE 1, at least ISOPRO® IP35
  - When using IPE 2, at least ISOPRO® IP55
- Either  $H_{RdL}$  or  $M_{Rd}$  can be applied for the purpose of calculation, i.e. either a tensile force or a moment can be transmitted by the element. But not both at the same time.
- The number and position of ISOPRO® IPE elements is selected according to the specifications of the structural engineer.
- When using ISOPRO® IPE elements, it must be ensured that the length and thus the load-bearing capacity of the linear connection is reduced by the proportion of IPE elements.
- The use of ISOPRO® IPE elements creates fixed points. The maximum permissible expansion joint spacing must be taken into account.
- The tie bars at the bottom must overlap with bars of the same diameter. The shear bars are anchored and do not require any further connection reinforcement.

## Expansion joint spacing



If the component dimensions exceed the maximum permissible expansion joint spacing, expansion joints must be aligned perpendicular to the insulation layer. The maximum permissible expansion joint spacing  $e$  depends on the maximum bar diameter across the expansion joint, and thus depends on the type. The maximum permissible expansion joint spacing for ISOPRO® elements can be found in the relevant sections.

The use of ISOPRO® IPE elements creates a fixed point, which results in increased stress forces. This reduces the maximum permissible expansion joint spacing to  $e/2$  when using ISOPRO® IPE elements. Half the maximum expansion joint distance is always measured from the fixed point.

# ISOPRO® IP 80-H

Elements for planned horizontal loads



## IP 80-H

- ISOPRO® 80 H X for transmitting horizontal forces perpendicular to the insulating joint
- ISOPRO® 80 H XY for transmitting horizontal forces perpendicular and parallel to the insulating joint
- Load-bearing capacity: X1, X2, X1Y1, X2Y2
- Concrete cover is fixed (see product details)
- Element heights: from 160 mm
- Fire resistance class REI 120 available

## Type designation

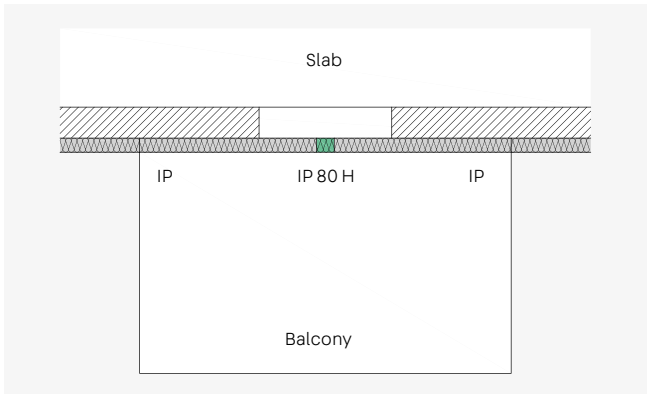
H X1 h200 REI120

— Fireproof version  
— Element height  
— Load-bearing capacity  
— Type

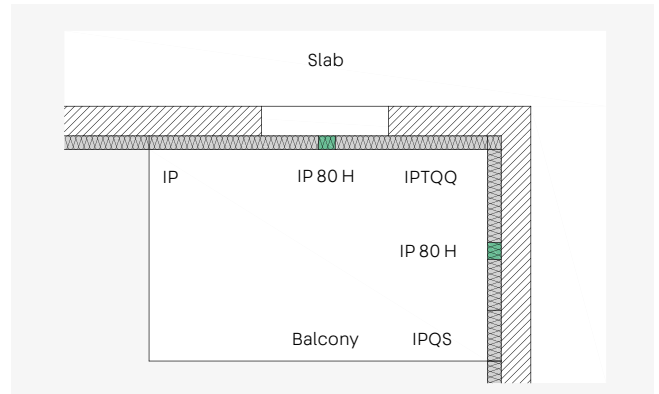
## Application – Element layout



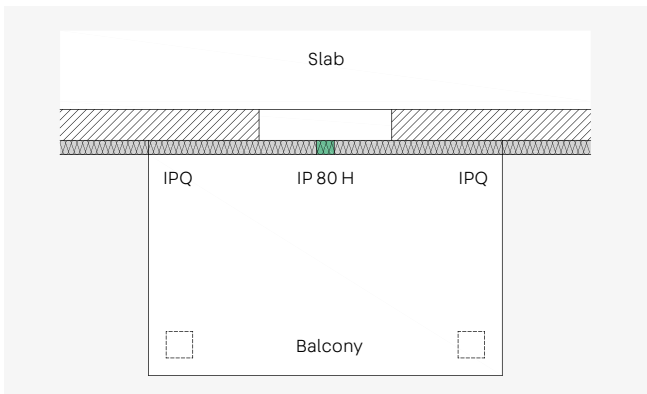
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



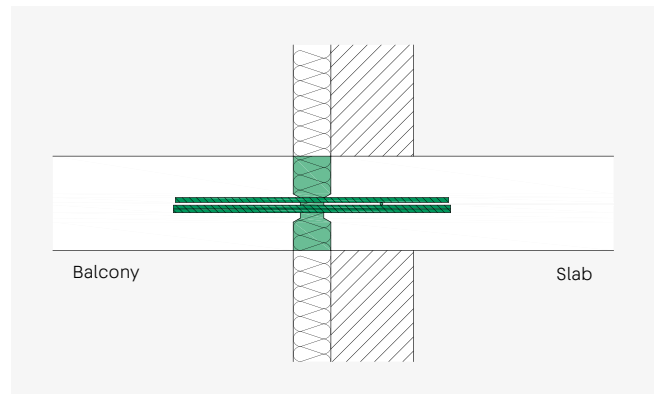
ISOPRO® 80 H - Cantilevered balcony with planned horizontal forces



ISOPRO® 80 H - Inner corner balcony with planned horizontal forces



ISOPRO® 80 H - Balcony on articulated supports with structurally anchored horizontal forces



ISOPRO® 80 H - Installation cross-section, external thermal insulation composite system

# Measurement table for concrete $\geq$ C25/30

## Rated values of the forces that can be absorbed in kN

	H X1	H X2	H X1Y1	H X2Y2
Shear force $V_{Rd,y}$	–	–	$\pm 10.30$	$\pm 34.80$
Normal force $N_{Rd,x}$	$\pm 11.50$	$\pm 55.90$	$\pm 11.50$	$\pm 55.90$

## Dimensions and configuration

	H X1	H X2	H X1Y1	H X2Y2
Tie bars/compression struts	1 $\varnothing$ 10	1 $\varnothing$ 14	1 $\varnothing$ 10	1 $\varnothing$ 14
Shear bars	–	–	2 x 1 $\varnothing$ 10	2 x 1 $\varnothing$ 12
Element length in mm	150	150	150	150

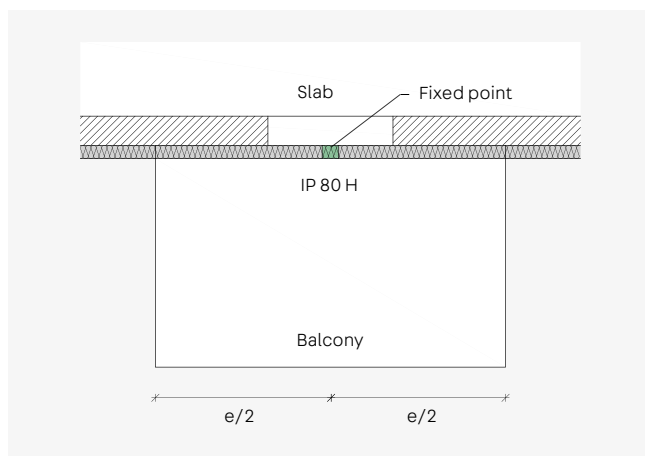
## Notes on calculations

- The number and position of ISOPRO® 80 H is chosen according to the specifications of the structural engineer.
- When using ISOPRO® 80 H, it must be ensured that the length and thus the load-bearing capacity of the linear connection is reduced by the proportion of H elements used.
- The use of ISOPRO® 80 H creates fixed points. This must be taken into account when selecting the maximum permissible expansion joint spacing.
- The bars of ISOPRO® 80 H are anchored on both sides of the insulating joint. No connection reinforcement is required for the H elements.

## Expansion joint spacing

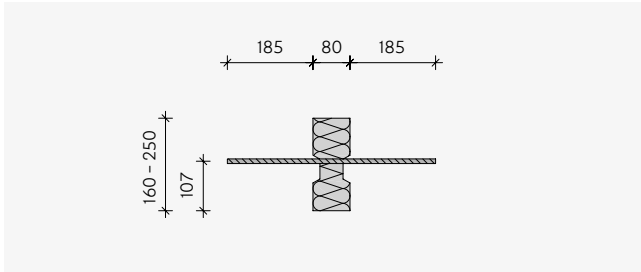
The use of ISOPRO® 80 H creates a fixed point, which results in stress forces. This reduces the maximum permissible expansion joint spacing to  $e/2$  when using ISOPRO® 80 H. Half

the maximum expansion joint distance is always measured from the fixed point.



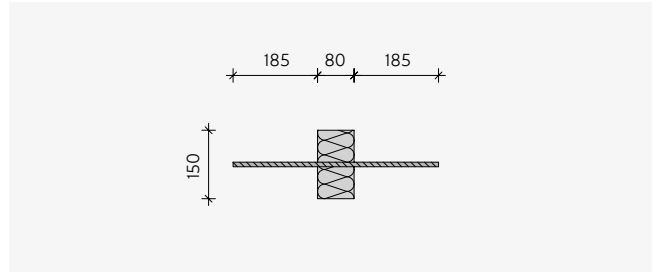
# Element dimensions

## Front view

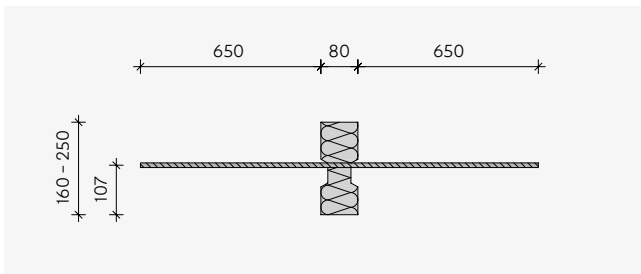


ISOPRO® 80 H X1

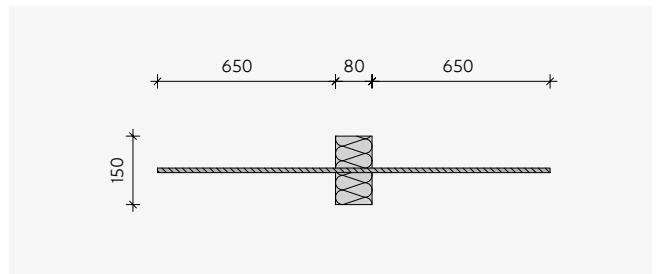
## Top view



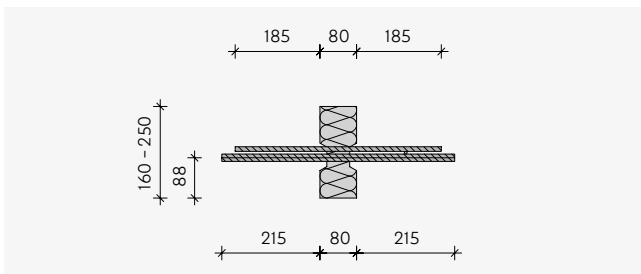
ISOPRO® 80 H X1



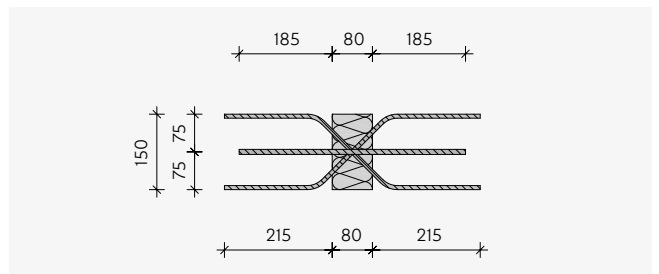
ISOPRO® 80 H X2



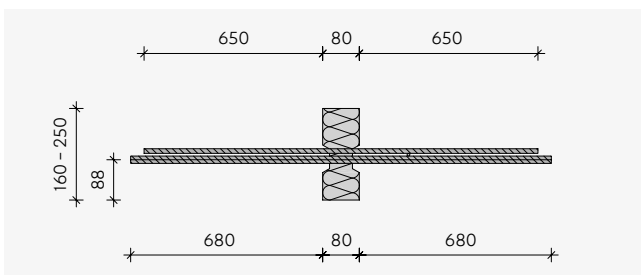
ISOPRO® 80 H X2



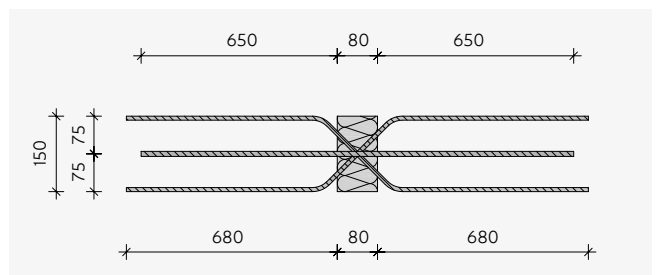
ISOPRO® 80 H XIY1



ISOPRO® 80 H XIY1



ISOPRO® 80 H X2Y2

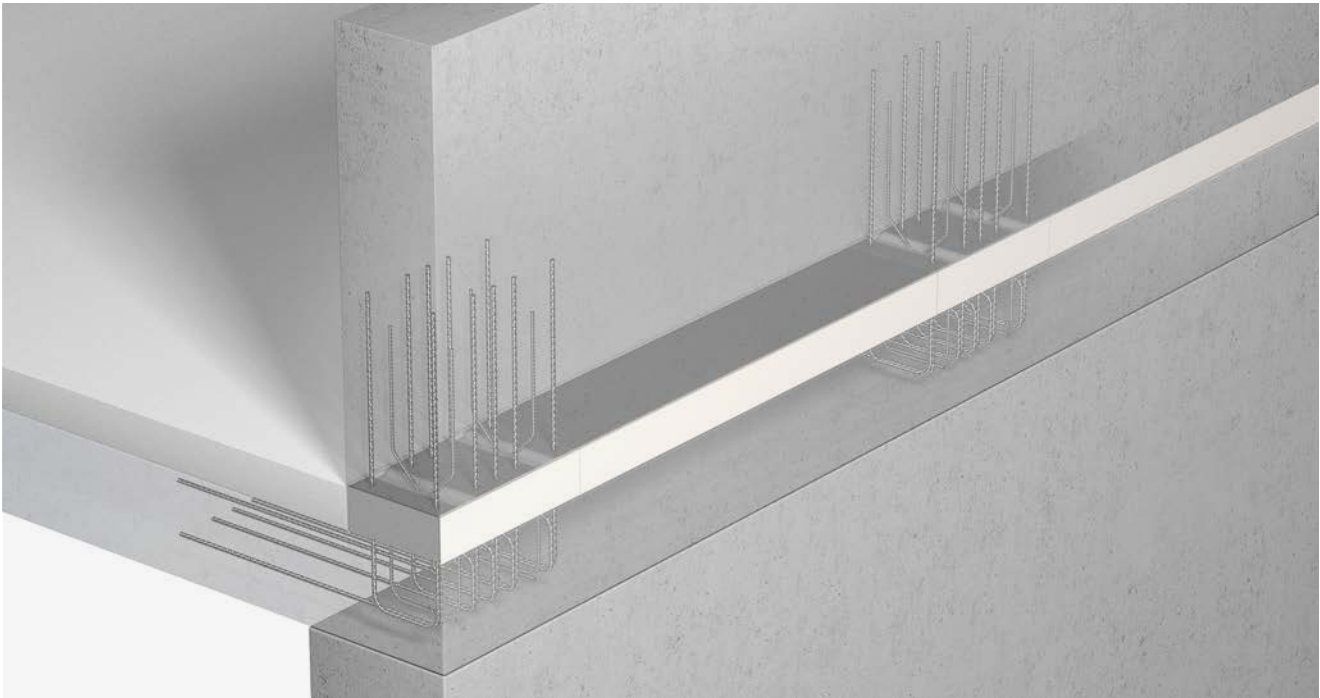


ISOPRO® 80 H X2Y2



# ISOPRO® IPTA

## Elements for fascias and parapets

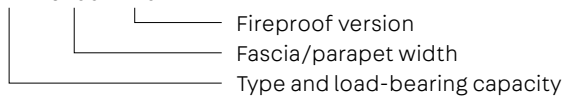


### ISOPRO® IPTA

- For transferring axial forces, positive and negative moments and horizontal forces
- Load-bearing capacities: IPTA1 and IPTA 2
- Element length: 350 mm
- Fascia/parapet width: 150 to 250 mm
- Concrete cover varies depending on the fascia thickness - see element structure
- Slab thickness: from 160 mm
- Insulation thickness: 80 mm (60 mm optionally possible)
- Fire resistance class R 90 available

### Type designation

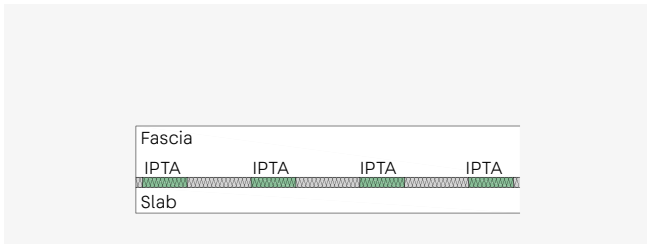
IPTA1 b200 R90



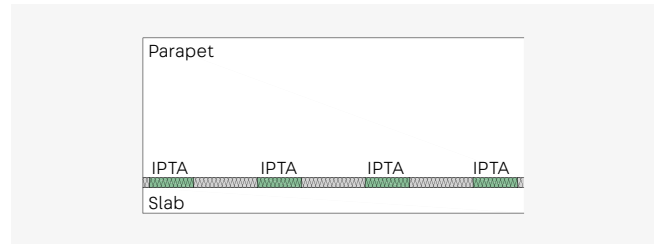
# Application – Element layout



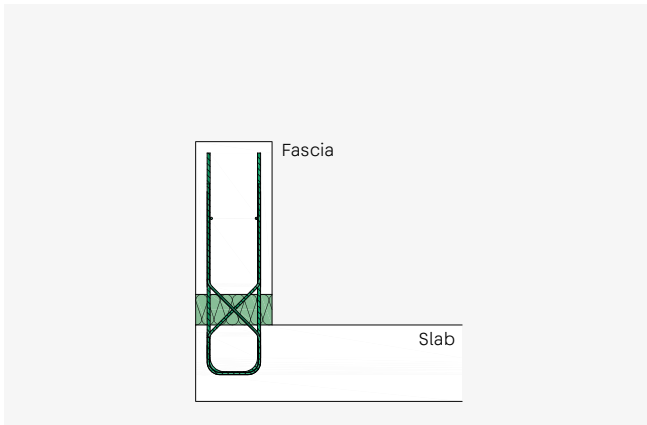
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



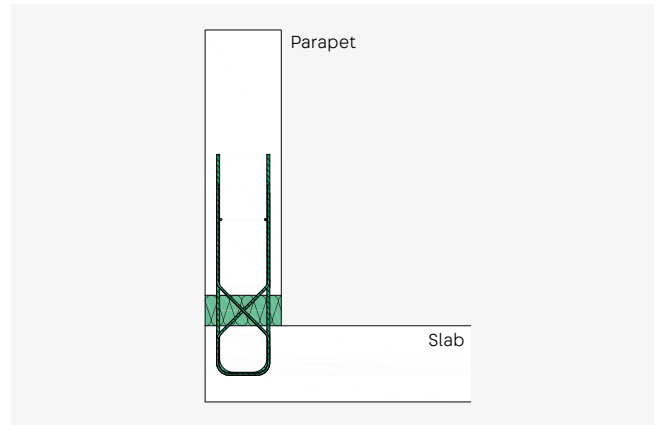
ISOPRO® IPTA – View of attached fascia



ISOPRO® IPTA – View of attached parapet

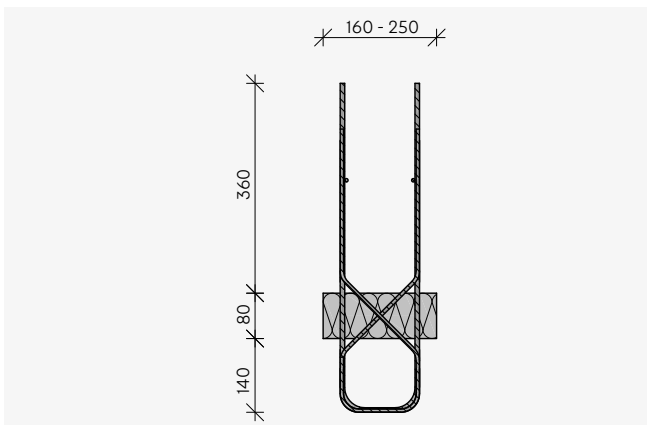


ISOPRO® IPTA – Cross-section of attached fascia

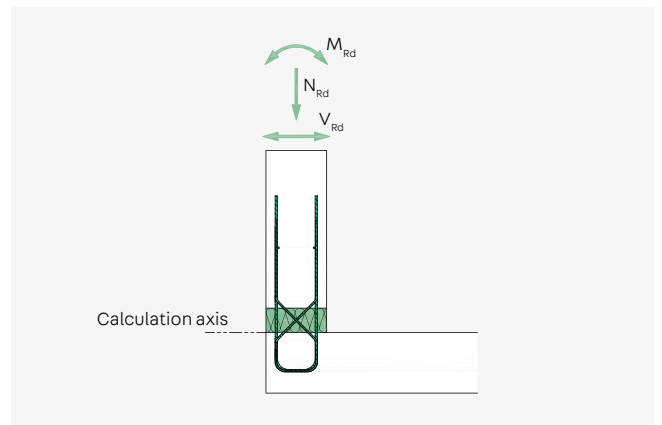


ISOPRO® IPTA – Cross-section of attached parapet

## Element design



## Sign conventions/structural system



# Calculation – Element design

Measurement table ISOPRO® IPTA 1 for concrete  $\geq$  C25/30

		IPTA 1 – b < 200 mm	IPTA 1 – b $\geq$ 200 mm
<b>Moment <math>M_{Rd}</math> kNm</b>	$N_{Ed} = 0$ kN	$\pm 1.75$	$\pm 2.5$
	$N_{Ed} > 0$ kN	$\pm(1.75 - N_{Ed}/2 \cdot 0.092)$	$\pm(2.5 - N_{Ed}/2 \cdot 0.132)$
<b>Normal force <math>N_{Rd}</math> kN</b>	$M_{Ed} = 0$ kNm	38.0	38.0
	$M_{Ed} \neq 0$ kNm	$38.0 -  M_{Ed} /0.092 \cdot 2$	$38.0 -  M_{Ed} /0.132 \cdot 2$
<b>Horizontal force <math>N_{Rd}</math> kN</b>		$\pm 12.0$	$\pm 12.0$

Measurement table ISOPRO® IPTA 2 for concrete  $\geq$  C25/30

		IPTA 2 – b < 200 mm	IPTA 2 – b $\geq$ 200 mm
<b>Moment <math>M_{Rd}</math> kNm</b>	$N_{Ed} = 0$ kN	$\pm 4.4$	$\pm 6.3$
	$N_{Ed} > 0$ kN	$\pm(4.4 - N_{Ed}/2 \cdot 0.092)$	$\pm(6.3 - N_{Ed}/2 \cdot 0.132)$
<b>Normal force <math>N_{Rd}</math> kN</b>	$M_{Ed} = 0$ kNm	95.0	95.0
	$M_{Ed} \neq 0$ kNm	$95.0 -  M_{Ed} /0.092 \cdot 2$	$95.0 -  M_{Ed} /0.132 \cdot 2$
<b>Horizontal force <math>N_{Rd}</math> kN</b>		$\pm 12.0$	$\pm 12.0$

## Concrete cover

Fascia/parapet width b mm	Concrete cover cv mm
150	25
160	30
170	35
180	40
190	45
200	30
210	35
220	40
230	45
240	50
250	55

## Configuration and dimensions

	IPTA 1	IPTA 2
<b>Element length mm</b>		350
<b>Fascia/parapet width b mm</b>		150 – 250
<b>Tie bars/compression struts</b>	2 $\varnothing$ 8	5 $\varnothing$ 8
<b>Horizontal force bars</b>	2 x 2 $\varnothing$ 6	2 x 2 $\varnothing$ 6



### Notes on calculations

Only one compressive force can be transmitted as a normal force. The normal force  $N_{Rd}$  given in the table corresponds to the maximum transmittable compressive force depending on the type and concrete quality.

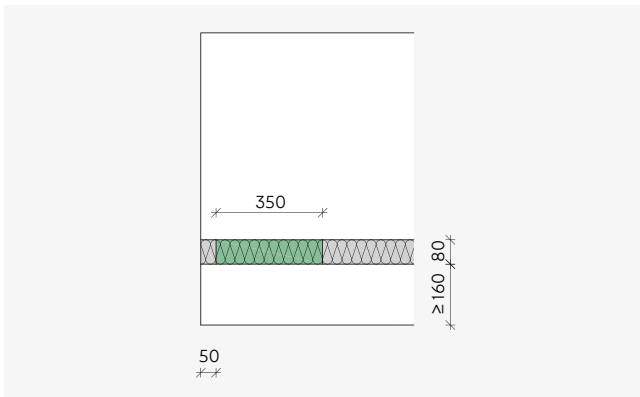
# Expansion joint spacing – On-site reinforcement

## Maximum permissible expansion joint spacing

### IPTA 1 and IPTA 2

Joint spacing $e$ m	13.0
---------------------	------

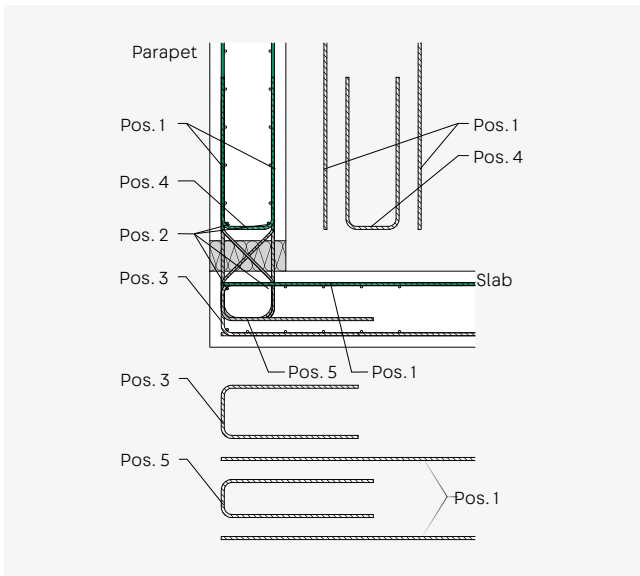
## Edge clearance



The following edge clearances must be maintained at the slab and parapet edges and at expansion joints:

- No edge clearance is required in the area of the parapet.
- An edge clearance of 50 mm must be maintained in the slab area.

## ISOPRO® IPTA



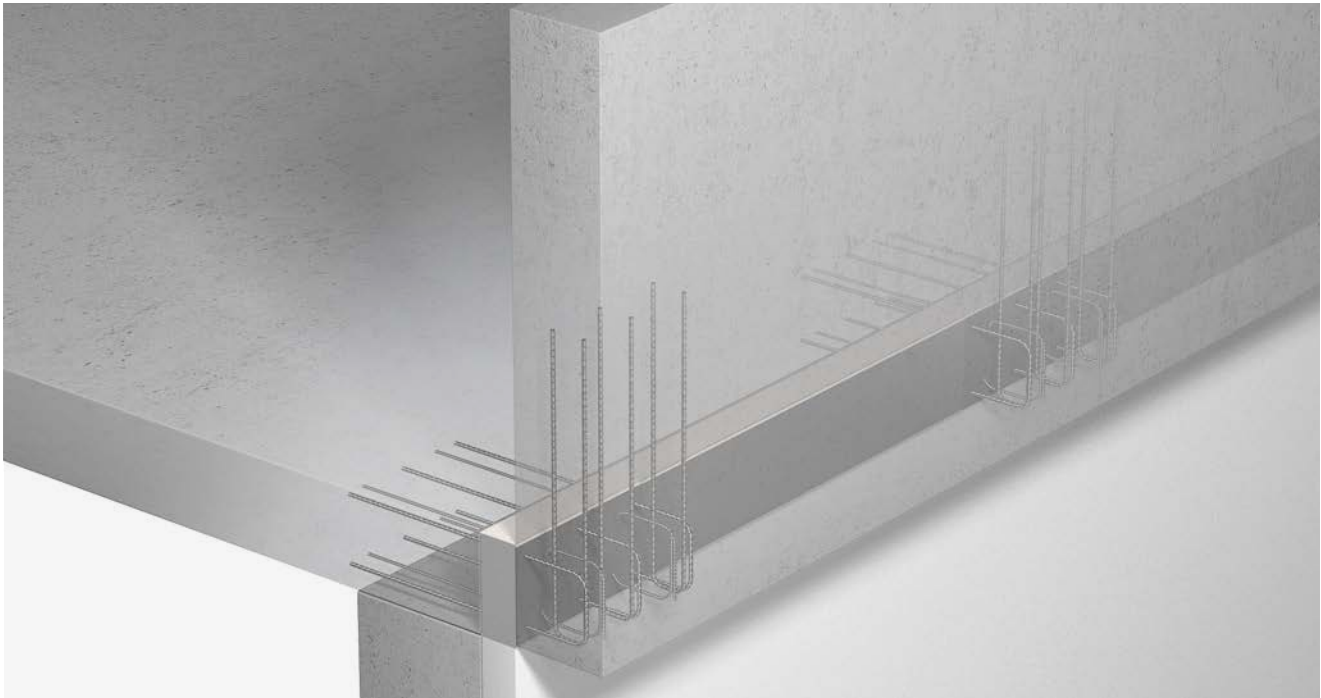
- Pos. 1: Connection reinforcement for the ISOPRO® element in the parapet and in the slab – see table
- Pos. 2: Distribution bar  $2 \times 2 \text{ } \varnothing 8$  parapet and slab side
- Pos. 3: Structural edging in line with DIN EN 1992-1-1 min.  $\varnothing 6/250$  or according to the specifications of the structural engineer
- Pos. 4: Suspension reinforcement for the ISOPRO® element in the parapet – see table below
- Pos. 5: Factory-supplied connection stirrups
- For IPTA elements with widths of 150, 160 and 200 mm, the on-site reinforcement of the attic/parapet must be positioned within the element reinforcement as these have a concrete cover of  $< 35$  mm.

## Connection and suspension reinforcement

	Connection reinforcement Pos. 1		Suspension reinforcement Pos. 4
	IPTA 1	IPTA 2	IPTA 1 and IPTA 2
$a_{s,erf}$ cm <sup>2</sup> /m	0.50	1.10	0.30
Recommendation	2 $\varnothing 8$	4 $\varnothing 8$	$\varnothing 6/250$

# ISOPRO® IPTF

Elements for protruding parapets

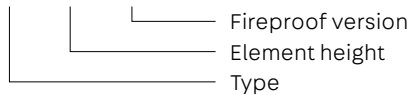


## ISOPRO® IPTF

- For transferring positive and negative shear forces, positive and negative moments and horizontal forces
- Element length: 350 mm
- Element height: 160 to 250 mm
- Concrete cover varies depending on the element height - see element structure
- Parapet width: from 150 mm
- Insulation thickness: 80 mm (60 mm optionally possible)
- Fire resistance class R 90 available

## Type designation

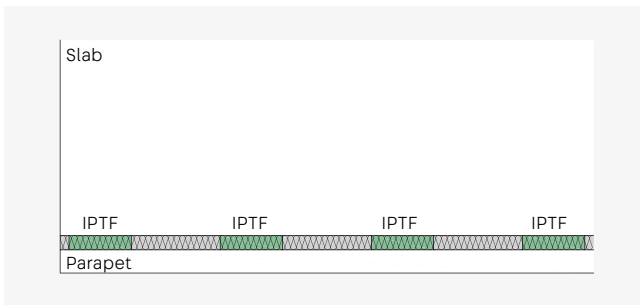
IPTF h200 R 90



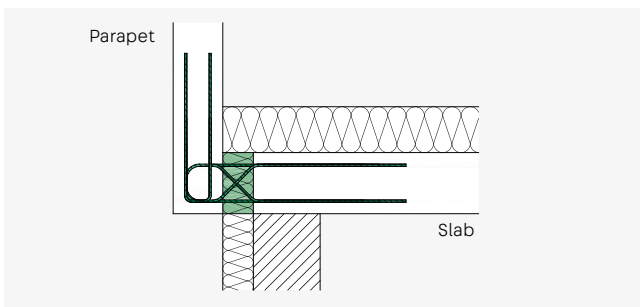
## Application – Element layout



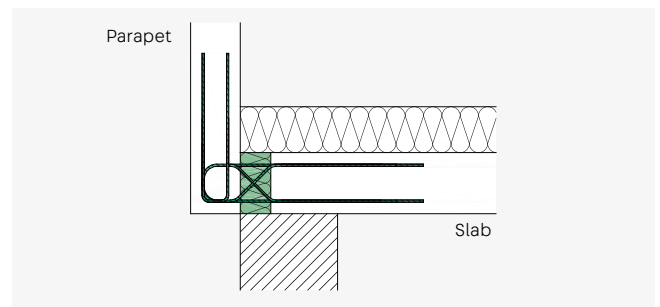
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



ISOPRO® IPTF – top view of protruding parapet



ISOPRO® IPTF – Installation cross-section of a protruding parapet with external thermal insulation composite system

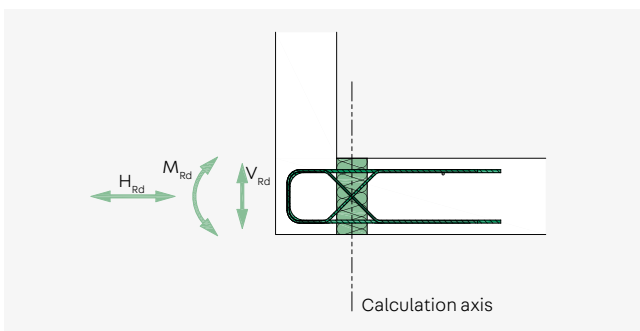


ISOPRO® IPTF – Installation cross-section of a protruding parapet with a solid wall

### Measurement table for concrete $\geq$ C25/30

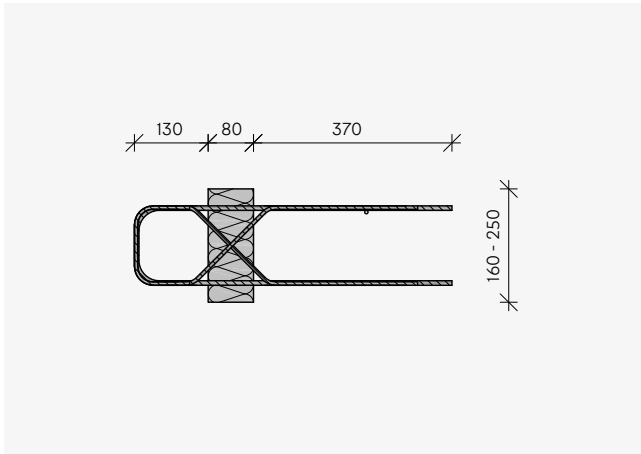
	IPTF h < 200 mm	IPTF h $\geq$ 200 mm
<b>Moment <math>M_{Rd}</math> kNm</b>	$\pm 2.1$	$\pm 3.0$
<b>Horizontal force <math>N_{Rd}</math> kN</b>	$\pm 3.5$	$\pm 3.5$
<b>Shear force <math>V_{Rd}</math> kN</b>	$\pm 12.0$	$\pm 12.0$

### Sign conventions/structural system



# Element design – Expansion joint spacing

## Element design ISOPRO® IPTF



### Configuration and dimensions

	IPTF
Element length mm	350
Element height h mm	160 - 250
Tie bars/compression struts	3 Ø 8
Shear bars	2 Ø 6

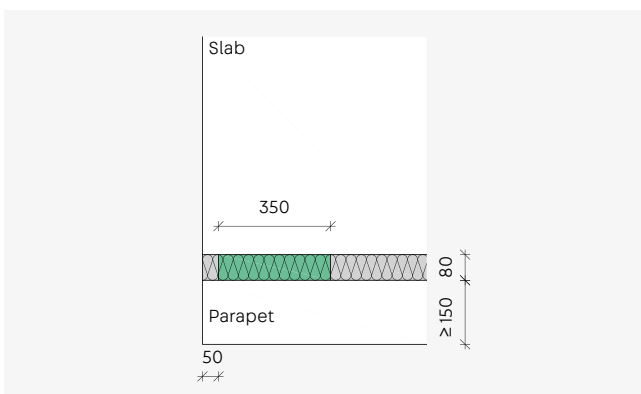
### Maximum permissible expansion joint spacing

	IPTF
Joint spacing e m	13.0

### Concrete cover

Element height h mm	Concrete cover cv mm
160	30
170	35
180	40
190	45
200	30
210	35
220	40
230	45
240	50
250	55

### Edge clearance

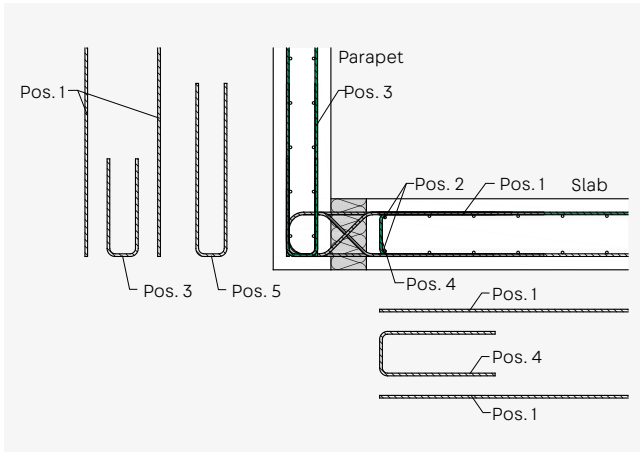


The following edge clearances must be maintained at the slab and parapet edges and at expansion joints:

- An edge clearance of 50 mm must be maintained in the parapet area.
- No edge clearance is required in the area of the slab.

# On-site reinforcement

## ISOPRO® IPTF



- Pos. 1: Connection reinforcement for the ISOPRO® element in the parapet and in the slab – see table
- Pos. 2: Distribution bar 2 x 2 Ø 8 parapet and slab side
- Pos. 3: Connection stirrup for the ISOPRO® element in the parapet – see table below
- Pos. 4: Suspension reinforcement for the ISOPRO® element
- Pos. 5: Factory-supplied connection stirrups 3 Ø 8

### Connection and suspension reinforcement

	Connection reinforcement Pos. 1	Connection reinforcement stirrup Pos. 3	Suspension reinforcement Pos. 4
$a_{s,eff}$ cm <sup>2</sup> /m	0.60	1.51	1.13
<b>Recommendation</b>	3 Ø 8	3 Ø 8	Ø 6/250



#### Notes

When designing the reinforcement and selecting the distances between the ISOPRO® IPTF elements, it is important to consider the casting properties. For ISOPRO® IPTF elements with widths ranging from 160 to 190 mm, Pos. 3 can be omitted as it is covered by Pos. 5.



#### Consultation

Our Application Technology department will be happy to assist you with further solutions:

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 technik-hbau@pohlcon.com



# ISOPRO® IPO

## Elements for brackets

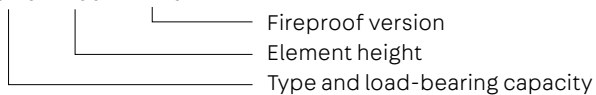


### ISOPRO® IPO

- For brackets that serve as supports for masonry or precast sections
- For transferring positive shear forces and the resulting negative moments and horizontal forces
- Load-bearing capacities: IPO 16 and IPO 20
- Element length: 350 mm
- Element height 180 to 250 mm
- Concrete cover varies depending on the element height - see element structure
- Bracket width: IPO 16 from 160 mm - IPO 20 from 200 mm
- Insulation thickness: 80 mm (60 mm optionally possible)
- Fire resistance class REI 120 available

### Type designation

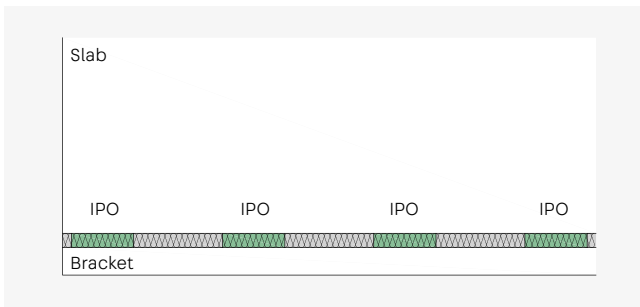
IPO 20 h200 REI 120



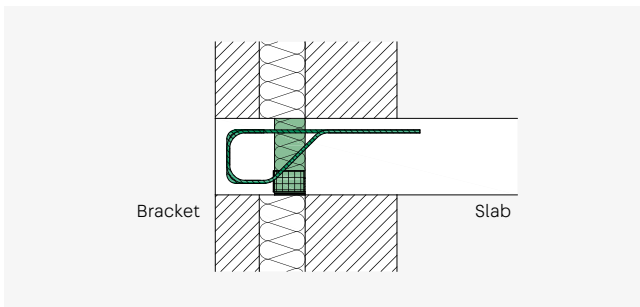
## Application – Element layout



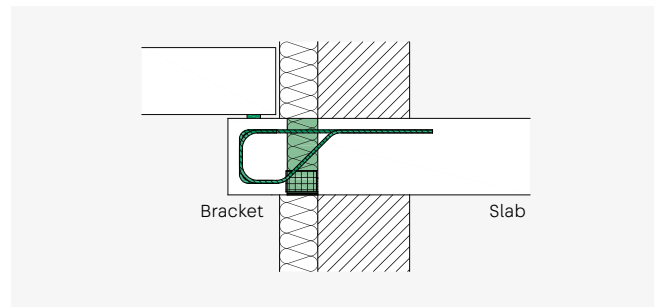
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



ISOPRO® IPO – Bracket top view

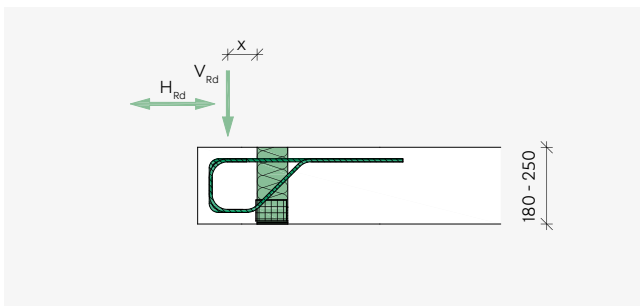


ISOPRO® IPO – Bracket with facing masonry



ISOPRO® IPO – Bracket as support for a precast element, support with centring bearing

### Sign conventions/structural system



# Calculation – Element design

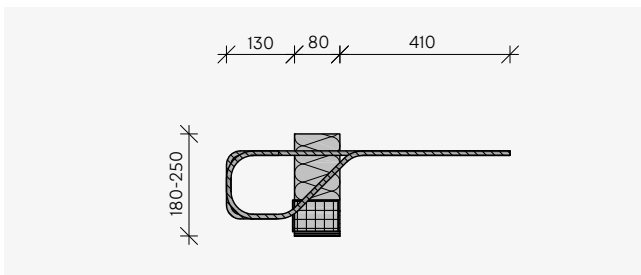
Measurement table ISOPRO® IPO 16 for concrete  $\geq$  C25/30

		<b>IPO 16</b>			
<b>Load application point x mm</b>		60 - 90	100	110	
	180	26.9	25.9	17.3	
<b>Shear force <math>V_{Rd}</math> kN depending on element height h mm</b>	200	26.9	26.9	20.3	
	220	26.9	26.9	23.3	
	240	26.9	26.9	23.1	
	250	26.9	26.9	22.9	
<b>Horizontal force HRd kN</b>		$\pm 2.5$	$\pm 2.5$	$\pm 2.5$	

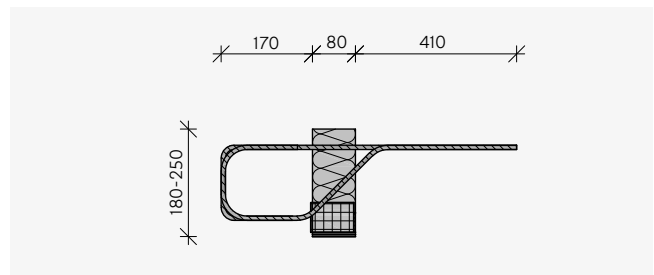
Measurement table ISOPRO® IPO 20 for concrete  $\geq$  C25/30

		<b>IPO 20</b>				
<b>Load application point x mm</b>		60 - 120	130	140	150	
	180	29.1	25.2	18.5	12.7	
<b>Shear force <math>V_{Rd}</math> kN depending on element height h mm</b>	200	29.1	29.1	21.7	14.9	
	220	29.1	29.1	24.9	17.1	
	240	29.1	29.1	24.8	16.9	
	250	29.1	29.1	24.6	16.8	
<b>Horizontal force HRd kN</b>		$\pm 2.5$	$\pm 2.5$	$\pm 2.5$	$\pm 2.5$	

Element design ISOPRO® IPO 16



Element design ISOPRO® IPO 20



Configuration and dimensions

	<b>IPO 16 and IPO 20</b>
<b>Element length mm</b>	350
<b>Element height h mm</b>	180 - 250
<b>Tie bars</b>	2 $\varnothing$ 8
<b>Shear bars</b>	3 $\varnothing$ 8
<b>Thrust bearings</b>	2

Concrete cover

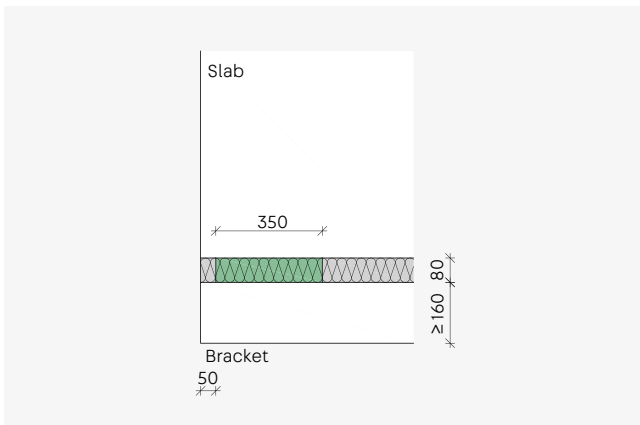
<b>Element height h mm</b>	<b>Concrete cover, top <math>c_{v, top}</math> mm</b>	<b>Concrete cover, bottom <math>c_{v, bottom}</math> mm</b>
<b>180</b>	30	30
<b>190</b>	40	30
<b>200</b>	30	30
<b>210</b>	40	30
<b>220</b>	30	30
<b>230</b>	40	30
<b>240</b>	40	40
<b>250</b>	50	40

# Expansion joints – On-site reinforcement

## Maximum permissible expansion joint spacing

	IPO
Joint spacing e m	13.0

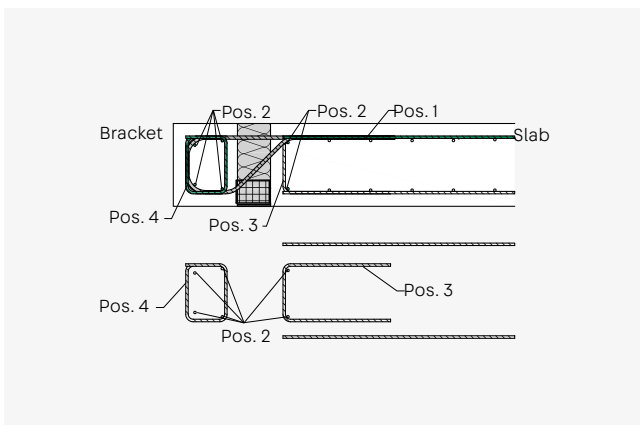
## Edge clearance



The following edge clearances must be maintained to the slab and bracket edges and to expansion joints:

- An edge clearance of 50 mm must be maintained in the area of the bracket.
- No edge clearance is required in the area of the slab.

## ISOPRO® IPO on-site reinforcement



- Pos. 1: Connection reinforcement for ISOPRO® element 3 Ø 8
- Pos. 2: Distribution bar 2 Ø 8 slab side - min. 4 Ø 8 in the bracket
- Pos. 3: Structural edging in line with DIN EN 1992-1-1 min. Ø 6/250
- Pos. 4: Closed stirrup in the bracket according to the specifications of the structural engineer



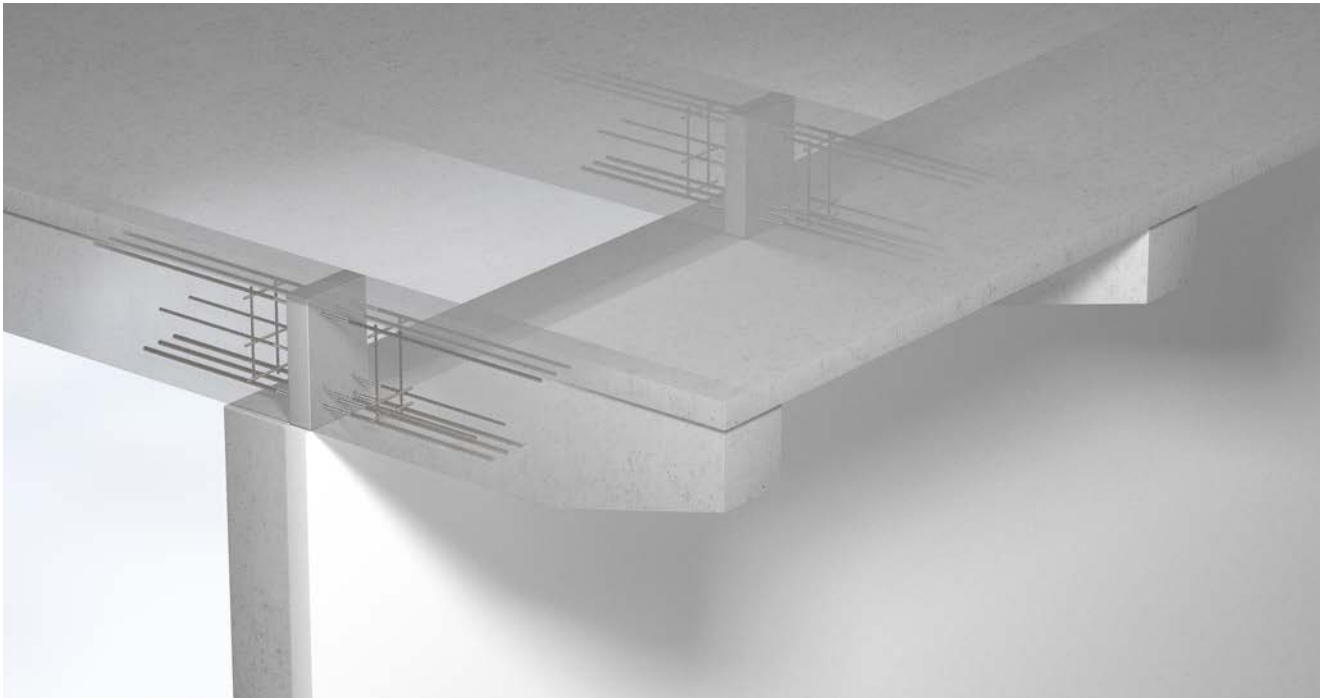
### Consultation

Our Application Technology department will be happy to assist you with further solutions:

T +49 7742 9215-300  
 technik-hbau@pohlcon.com

# ISOPRO® IPTS

Elements for cantilevered downstand beams

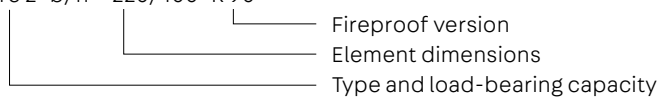


## ISOPRO® IPTS

- Transfers negative moments and positive shear forces
- Load-bearing capacities IPTS 1 to IPTS 4
- Element widths 220 to 300 mm
- Element heights 300 to 600 mm
- Concrete cover  $cv50$  above, below, and on sides
- Fire resistance class R 90 available

## Type designation

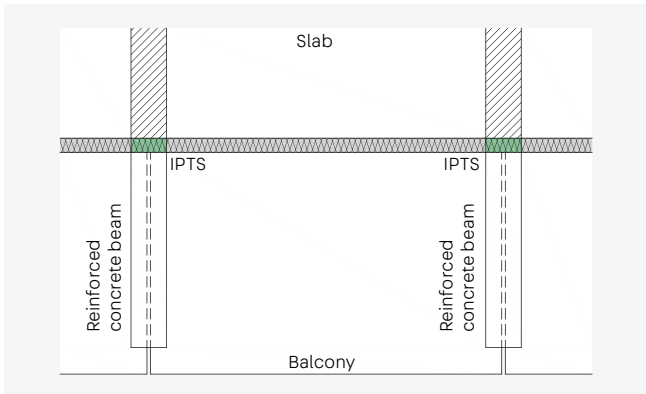
IPTS 2 b/h = 220/400 R 90



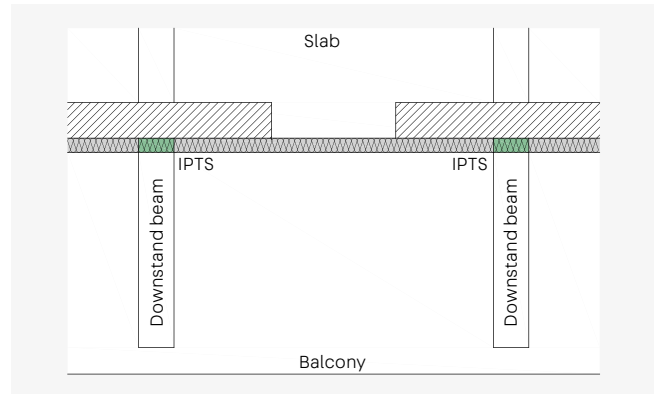
## Application – Element layout



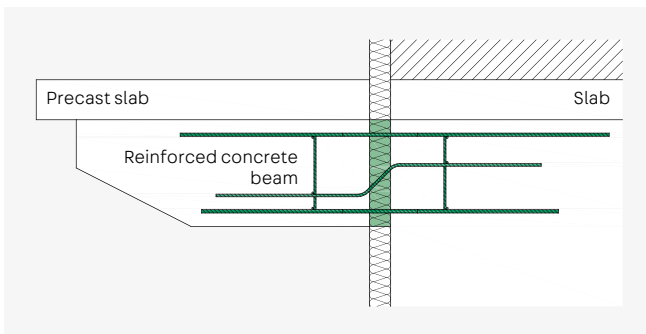
This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



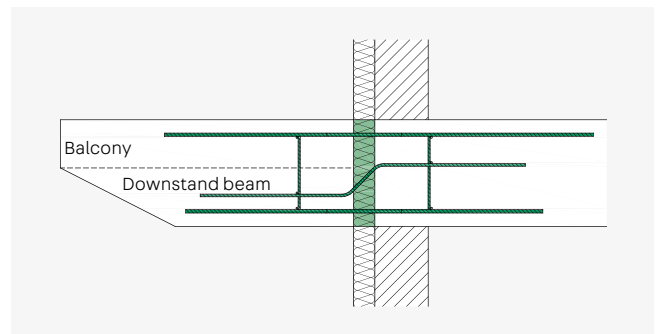
ISOPRO® IPTS – Balcony construction with precast slabs that are not structurally connected and load-bearing reinforced concrete beams



ISOPRO® IPTS – Balcony construction with downstand beams that are monolithically connected to the balcony slab



ISOPRO® IPTS – Installation cross-section with precast slabs



ISOPRO® IPTS – Installation cross-section with downstand beams that are monolithically connected to the balcony slab

# Measurement table for concrete $\geq$ C25/30

## Rated values of the moments that can be absorbed $M_{Rd}$ in kNm

Element height mm	IPTS 1	IPTS 2	IPTS 3	IPTS 4
300	19.4	26.4	36.1	47.7
350	24.5	33.5	45.9	60.8
400	29.6	40.5	55.7	73.9
600	50.1	68.8	94.7	126.4

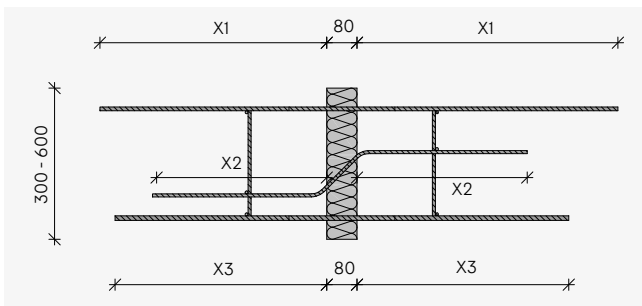
## Rated values of the shear forces that can be absorbed $V_{Rd}$ kN

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
Shear force $V_{Rd}$ kN	30.9	48.3	69.5	94.6

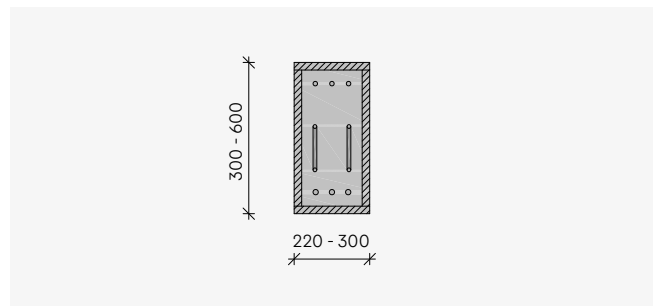
## Dimensions and configuration

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
Element width mm	220 - 300	220 - 300	220 - 300	220 - 300
Element height mm	300 - 600	300 - 600	300 - 600	300 - 600
Tie bars	3 $\varnothing$ 10	3 $\varnothing$ 12	3 $\varnothing$ 14	3 $\varnothing$ 16
Shear bars	2 $\varnothing$ 8	2 $\varnothing$ 10	2 $\varnothing$ 12	2 $\varnothing$ 14
Compression struts	3 $\varnothing$ 12	3 $\varnothing$ 14	3 $\varnothing$ 16	3 $\varnothing$ 20

## Element design



ISOPRO® IPTS



ISOPRO® IPTS - Version with fire protection panels - R 90

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
Length of tie bar* X1	750	860	980	1,270
Length of shear bar X2	460	575	680	790
Length of compression strut X3	580	650	785	955

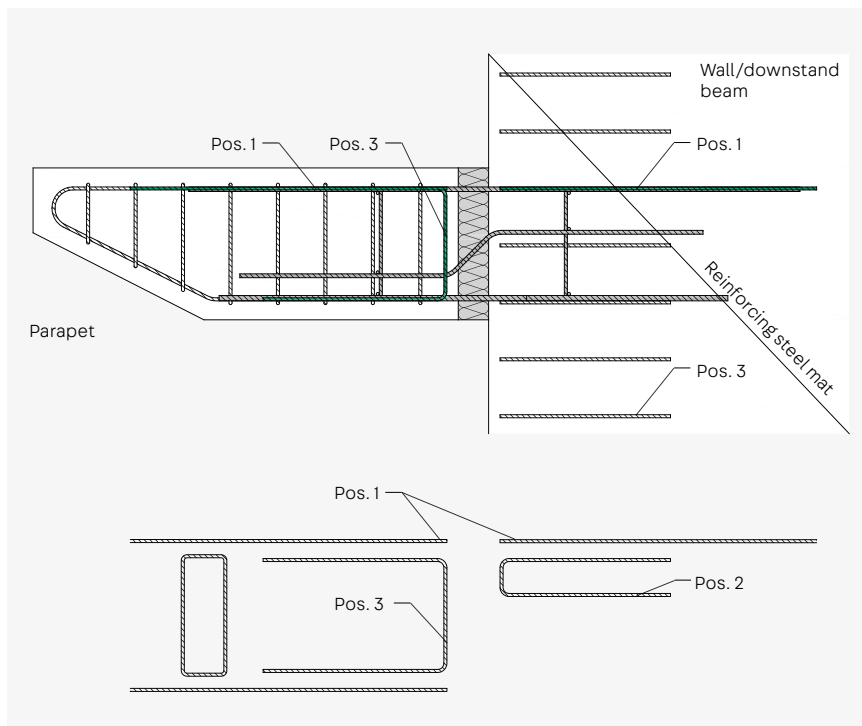
\* The anchorage length of the tie bars is designed to achieve bond range 1 "good bond conditions". Upon request, the anchorage length of the tie bars can also be designed for bond range 2 "adequate bond conditions".

# Expansion joints – On-site reinforcement

## Maximum permissible expansion joint spacing

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
Joint spacing $e$ m	11.3	10.1	9.2	8.0

## ISOPRO® IPTS on-site reinforcement



- Pos. 1 Connection reinforcement for the ISOPRO® element – see table
- Pos. 2: Structural edging in line with DIN EN 1992-1-1 min.  $\varnothing$  6/250
- Pos. 3 Suspension reinforcement for the ISOPRO® element – see table

### Connection reinforcement Pos. 1

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
$a_{s,erf}$ cm <sup>2</sup> /m	2.35	3.39	4.61	6.03
<b>Recommendation</b>	3 $\varnothing$ 10	3 $\varnothing$ 12	3 $\varnothing$ 14	3 $\varnothing$ 16

### Suspension reinforcement Pos. 3

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
$a_{s,erf}$ cm <sup>2</sup> /m	0.71	1.11	1.59	2.17
<b>Recommendation</b>	2 $\varnothing$ 8	2 $\varnothing$ 10	2 $\varnothing$ 10	2 $\varnothing$ 12



### Consultation

Our Application Technology department will be happy to assist you with further solutions:

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# ISOPRO® IPTW

## Elements for cantilevered reinforced concrete walls

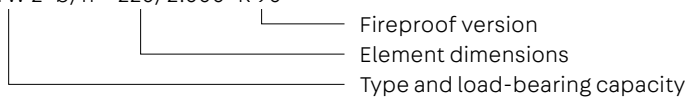


### ISOPRO® IPTW

- For transferring negative moments, positive shear forces and horizontal forces
- Load-bearing capacities: IPTW 1 to IPTW 4
- Element widths: 150 to 250 mm
- Element heights: 1500 to 3500 mm
- Anchorage length of the tie bars for bond range 2 - "adequate bond conditions".
- Concrete cover  $cv50$  at top and bottom and  $cv25$  to  $cv50$  on sides depending on element widths
- Fire resistance class R 90 available
- Elements delivered split into at least 3 sections - lower section with compression struts and shear bars, intermediate section and upper section with tie bars. Additional intermediate sections are added to create taller elements.

### Type designation

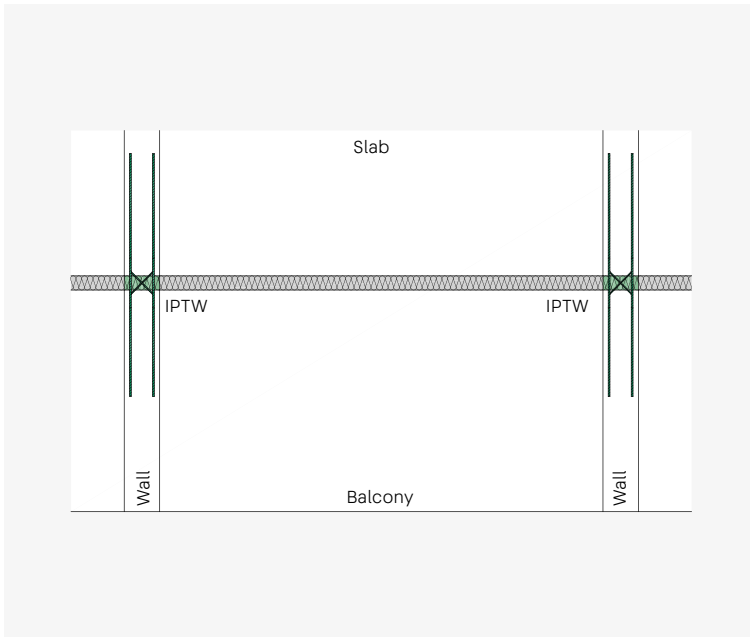
IPTW 2 b/h = 220/2.000 R 90



## Application – Element layout



This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, thermal insulation and fire protection, installation on site etc. on pages 12 – 29 must also be taken into account.



ISOPRO® IPTW – Floor plan of elements in combination with a balcony slab



ISOPRO® IPTW – Installation cross-section with wall panel monolithically connected to the balcony slab

## Measurement table for concrete $\geq$ C25/30

### Rated values of the moments that can be absorbed $M_{Rd}$ in kNm

Element height mm	IPTW 1	IPTW 2	IPTW 3	IPTW 4
$\geq 1500$	64.7	115.3	178.7	178.7
$\geq 1750$	76.6	136.8	212.7	212.7
$\geq 2000$	88.4	158.4	246.8	246.8
$\geq 2250$	100.3	179.9	280.8	280.8
$\geq 2500$	112.1	201.4	314.8	314.8
$\geq 2750$	124.0	222.9	348.8	348.8
$\geq 3000$	135.8	244.4	382.9	382.9

### Rated values of the shear forces $V_{Rd}$ in kN and horizontal forces $H_{Rd}$ in kN that can be absorbed

	IPTW 1	IPTW 2	IPTW 3	IPTW 4
Shear force $V_{Rd}$ kN	52.1	92.7	154.5	241.3
Horizontal force $H_{Rd}$ kN	$\pm 17.4$	$\pm 17.4$	$\pm 17.4$	$\pm 17.4$

### Dimensions and configuration

	IPTW 1	IPTW 2	IPTW 3	IPTW 4
Element width mm	150 - 250	150 - 250	150 - 250	150 - 250
Element height mm	1500 - 3500	1500 - 3500	1500 - 3500	1500 - 3500
Tie bars	2 $\emptyset$ 10	4 $\emptyset$ 10	4 $\emptyset$ 12	4 $\emptyset$ 12
Shear bars	6 $\emptyset$ 6	6 $\emptyset$ 8	10 $\emptyset$ 8	10 $\emptyset$ 10
Horizontal bars	2 x 2 $\emptyset$ 6	2 x 2 $\emptyset$ 6	2 x 2 $\emptyset$ 6	2 x 2 $\emptyset$ 6
Compression struts	4 $\emptyset$ 10	4 $\emptyset$ 10	6 $\emptyset$ 12	6 $\emptyset$ 14



#### Notes on calculations

The anchorage length of the tie bars is designed for bond range 2 "adequate bond conditions". Moments from wind loads perpendicular to the wall panel cannot be absorbed by the ISOPRO® IPTW element. These are absorbed by the bracing effect of the monolithically connected balcony slabs. If this is not possible, the ISOPRO® IPTW element can be supplemented with an ISOPRO® IPTD element. This replaces the intermediate piece.



#### Consultation

Our Application Technology department will be happy to assist you with further solutions:

T +49 7742 9215-300  
 technik-hbau@pohlcon.com

# Expansion joint spacing – Element design

## Expansion joint spacing

If the component dimensions exceed the maximum permissible expansion joint spacing, expansion joints must be aligned perpendicular to the insulation layer. The maximum permissible expansion joint spacing  $e$  depends on the maximum bar diameter across the expansion joint, and thus depends on the type. Fixed points, such as supports that run around corners, result in increased stress forces. This means

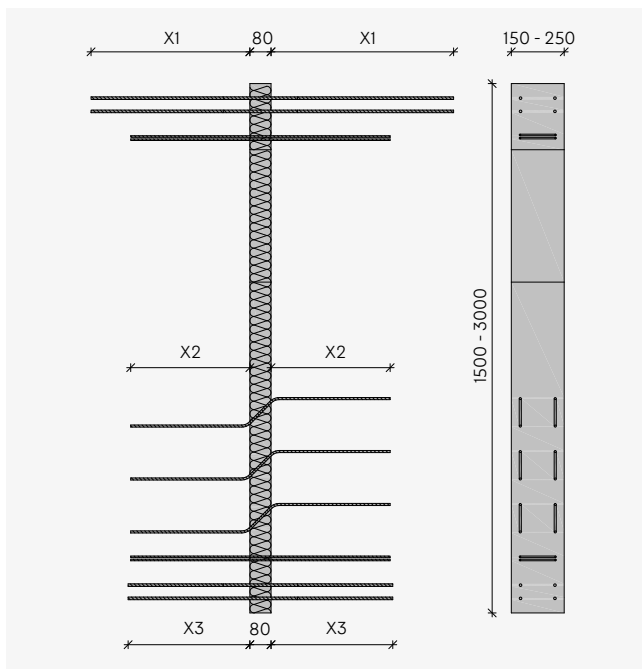
that the maximum permissible expansion joint spacing must be reduced to  $e/2$ . Half the maximum expansion joint distance is always measured from the fixed point.

If walls connected via ISOPRO® IPTW are rigidly connected to long balcony slabs, the maximum expansion joint distances given below apply.

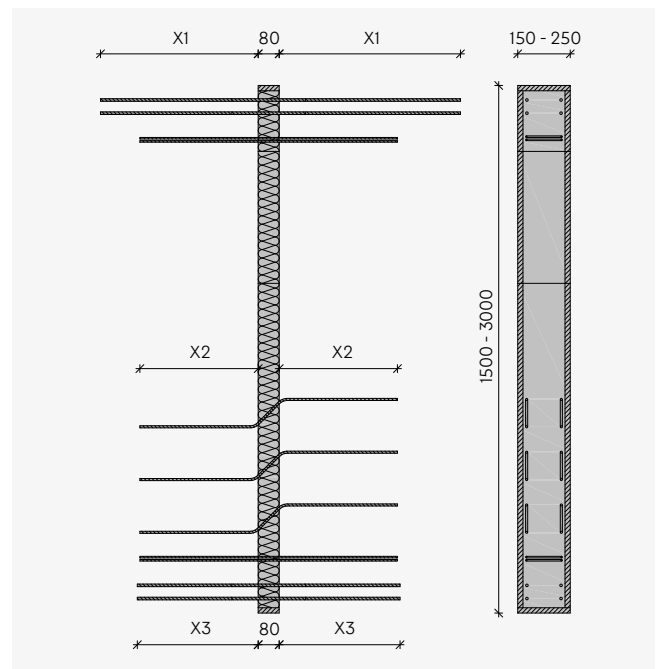
## Maximum permissible expansion joint spacing

	IPTW 1/IPTW 2	IPTW 3	IPTW 4
Joint spacing $e$ m	13.0	11.3	10.1

## Element design ISOPRO® IPTW



ISOPRO® IPTW

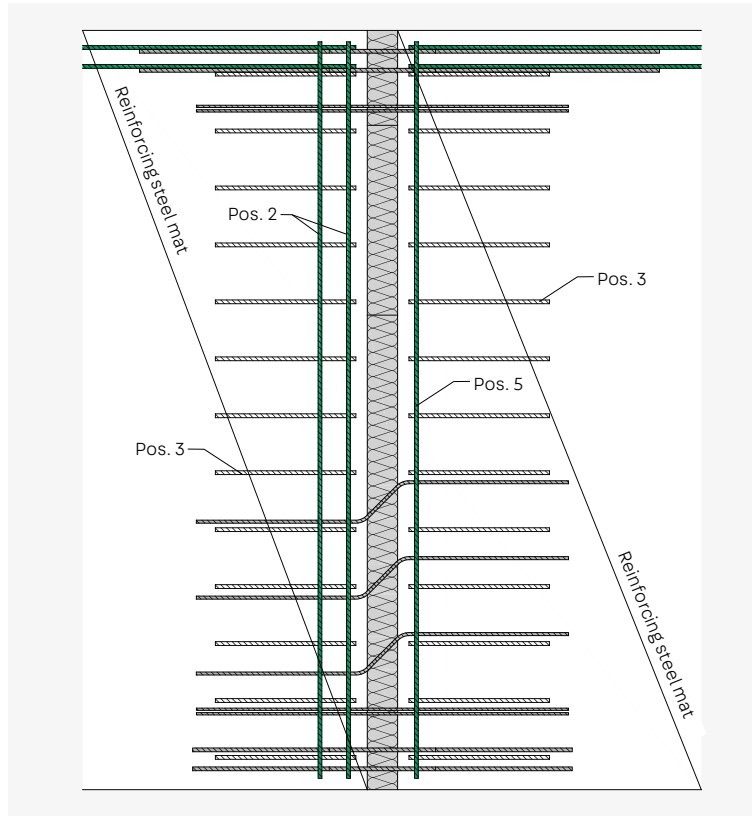


ISOPRO® IPTW - Version with fire protection panels - R 90

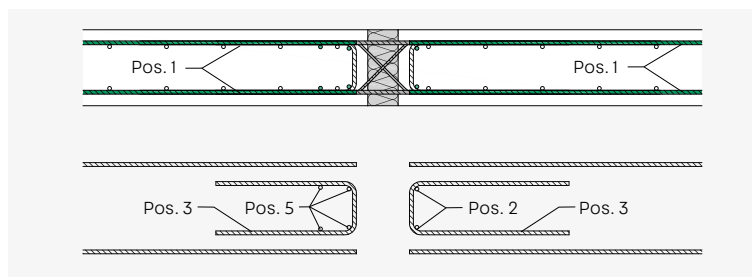
	IPTW 1	IPTW 2	IPTW 3	IPTW 4
Length of tie bar X1	740	740	860	860
Length of shear bar X2	350/410	460	460	575
Length of shear bar, horizontal	450	450	450	450
Length of compression strut X3	480	480	570	650

# On-site reinforcement

## ISOPRO® IPTW



- Pos. 1 Connection reinforcement for the ISOPRO® element – see table
- Pos. 2 distribution bars 2 Ø 8
- Pos. 3: Structural edging according to the specifications of the structural engineer
- Pos. 5 Suspension reinforcement for the ISOPRO® element anchored with stirrups – see table
- When casting the concrete, ensure that both sides are filled and compacted evenly and that the rebar is securely positioned.

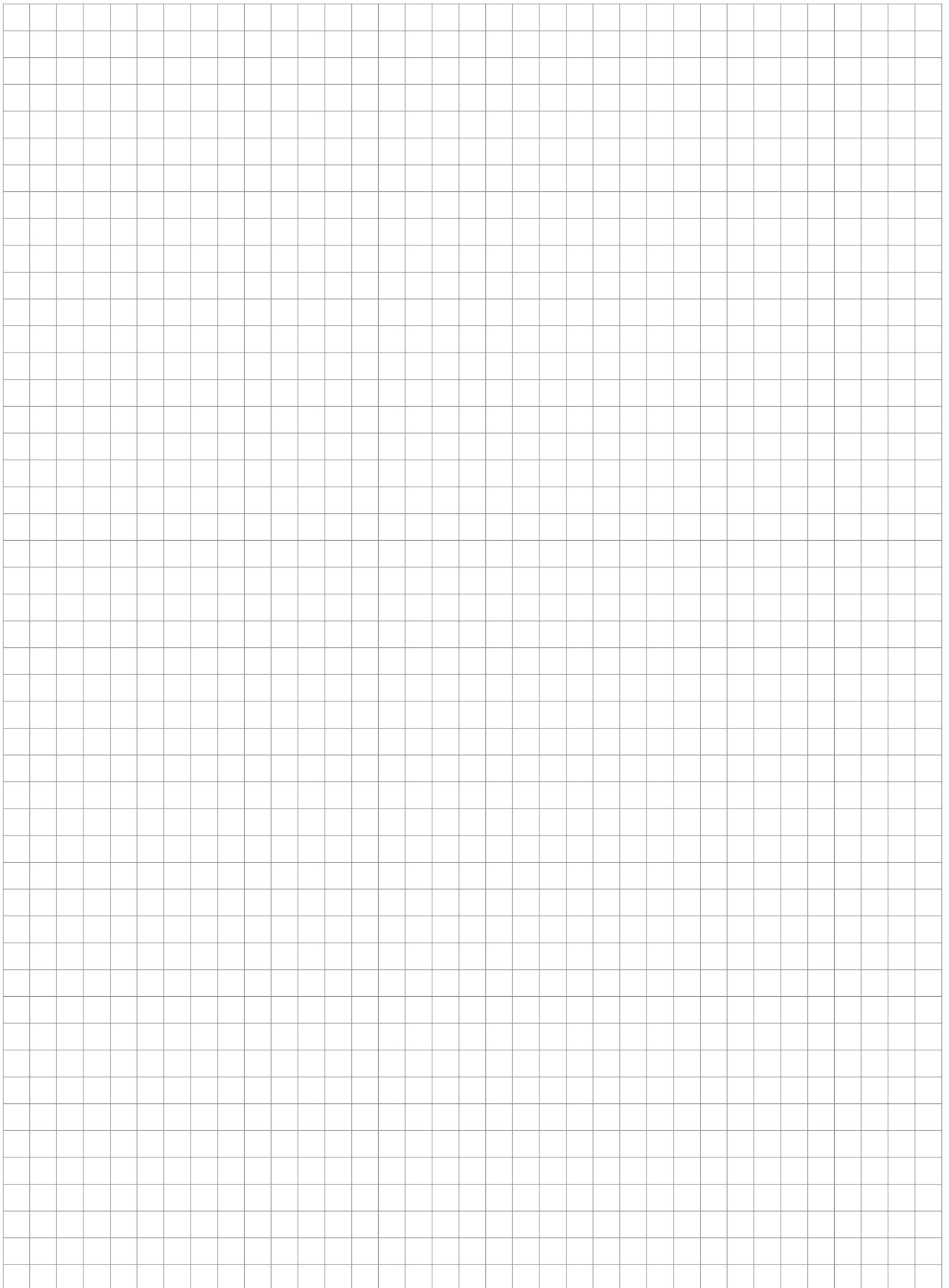


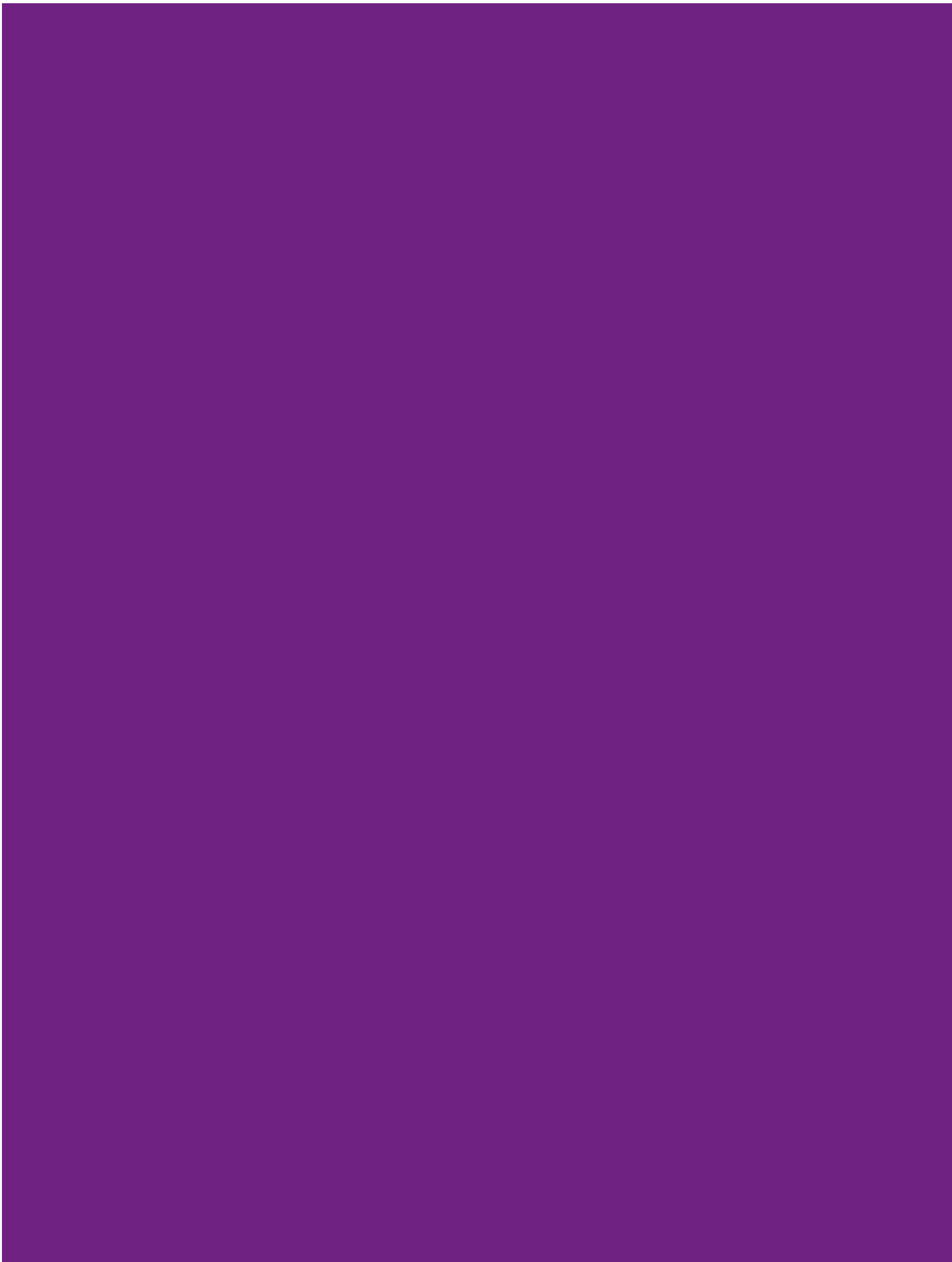
### Connection reinforcement Pos. 1

	IPTW 1	IPTW 2	IPTW 3	IPTW 4
$a_{s,erf}$ cm <sup>2</sup> /m	1.57	3.14	4.5	4.5
<b>Recommendation</b>	2 Ø 10	4 Ø 10	4 Ø 12	4 Ø 12

### Suspension reinforcement Pos. 5

	IPTW 1	IPTW 2	IPTW 3	IPTW 4
$a_{s,erf}$ cm <sup>2</sup> /m	1.19	2.13	3.55	5.54
<b>Recommendation</b>	2 x 2 Ø 8	2 x 2 Ø 10	2 x 2 Ø 12	2 x 2 Ø 14



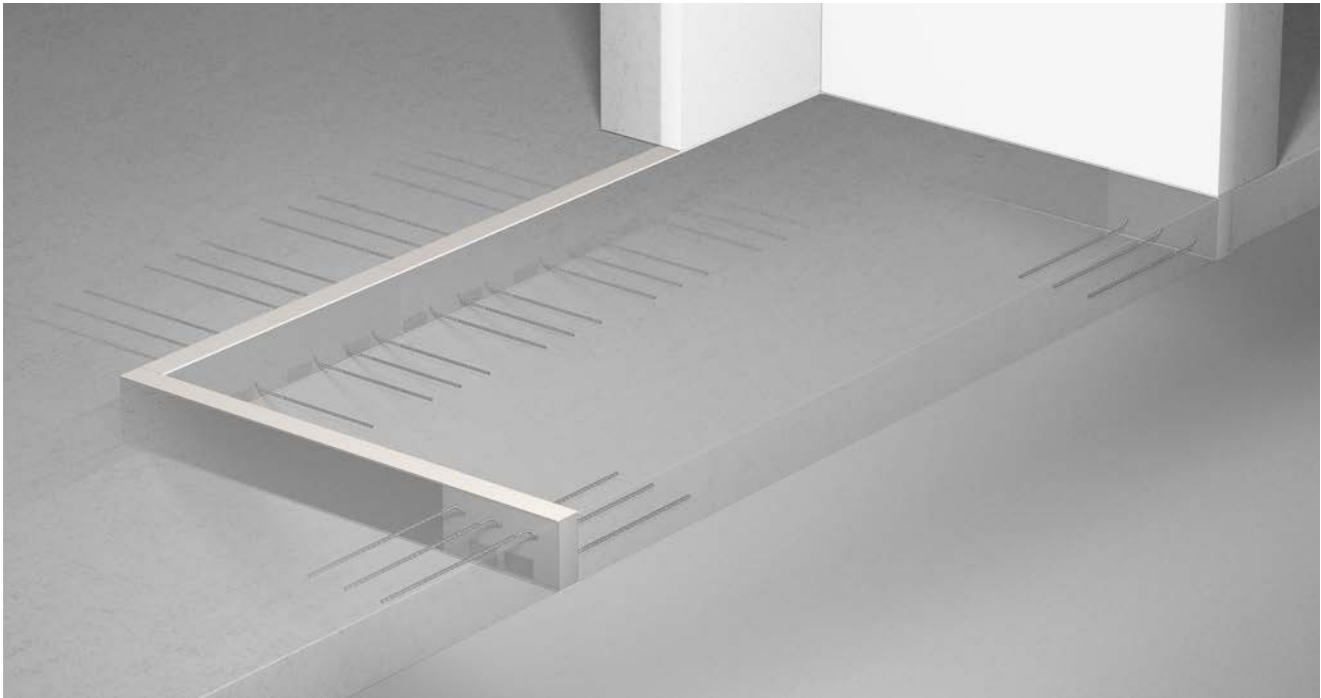


# **Insulating elements without structural functions**



# ISOPRO® Z-ISO

Elements used as intermediate insulation



## ISOPRO® Z-ISO

- Intermediate insulation without a structural function
- Length: 1.0 m
- Element heights: from 160 mm
- Short elements available on request
- Fire resistance class EI 120 (FP 1) with fire protection panels

## Type designation

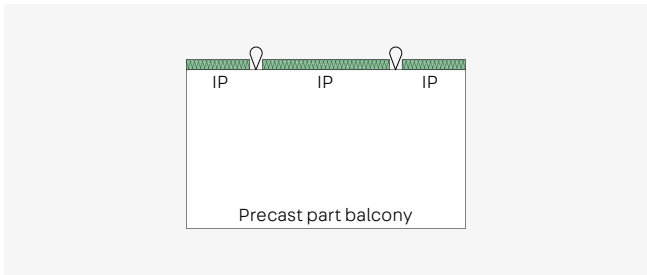
IP Z-ISO h200 FP1

└── Fireproof version  
└── Element height  
└── Type and load-bearing capacity

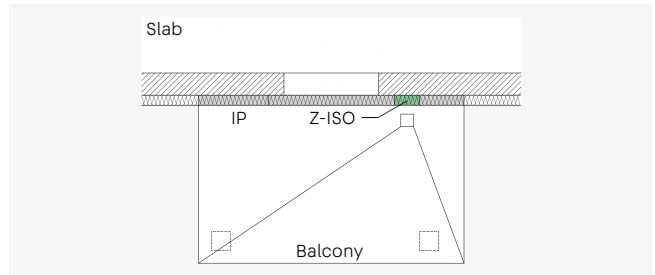
# Application – Element layout



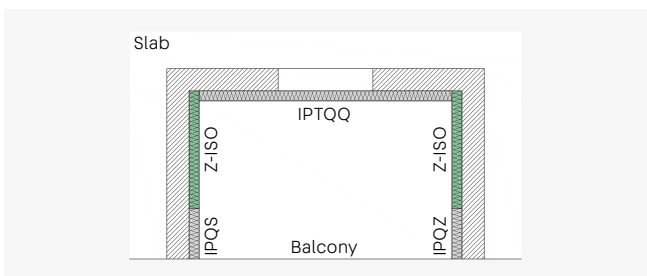
When using ISOPRO® Z-ISO elements, please note that the length and consequently the load-bearing capacity of the linear connection is reduced by the percentage of the length of the Z-ISO elements compared to the total connection length. The fire protection class of the Z-ISO FPI element corresponds to the maximum fire protection class of the structurally load-bearing ISOPRO® elements used in the linear connection. E.g. Z-ISO combined with ISOPRO® IP – REI 120; Z-ISO combined with ISOPRO® IPT – R 90.



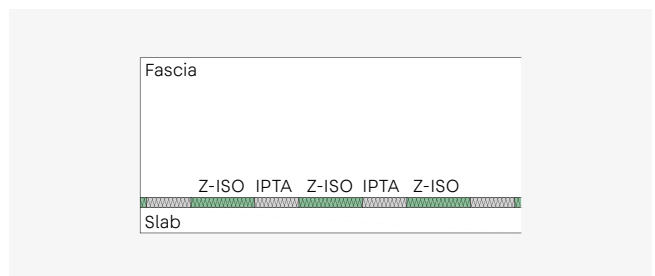
ISOPRO® Z-ISO – Balcony as precast part with transport anchors – the Z-ISO elements are added on the construction site



ISOPRO® Z-ISO – Balcony on supports – Z-ISO elements in the recess area for drainage

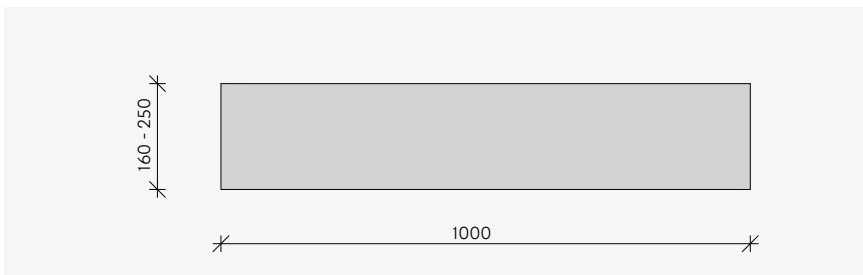


ISOPRO® Z-ISO – Loggia supported at specific points with IPQS/IPQZ

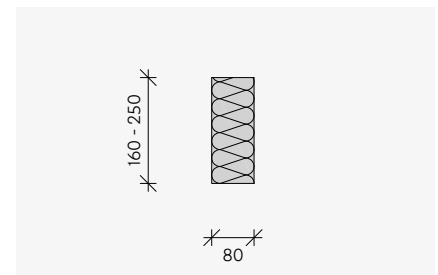


ISOPRO® Z-ISO – Use of ISOPRO® IPTA fascia elements at specific points

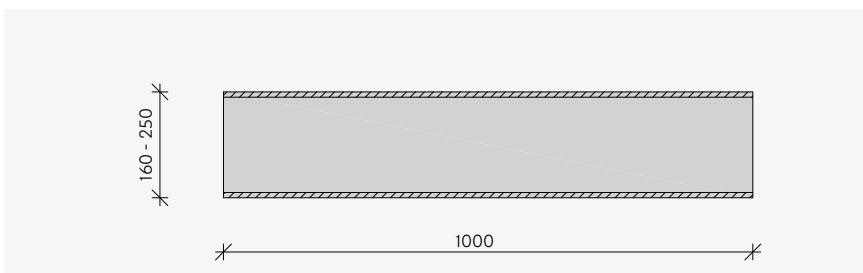
## Element design



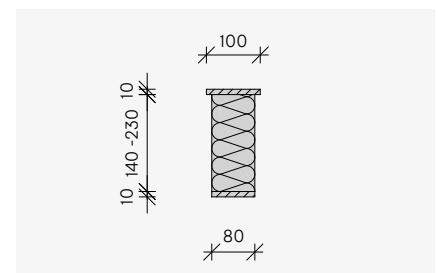
ISOPRO® Z-ISO – Product front view



ISOPRO® Z-ISO – Product cross-section



ISOPRO® Z-ISO FPI – Product front view with fire protection panels top and bottom



ISOPRO® Z-ISO FPI – Product cross-section

# Our synergy concept for your benefit

**With us, you can take advantage of the collective experience of three established manufacturers that combine products and expertise in one comprehensive offer. That is the PohlCon synergy concept.**



## **Full service consulting**

Our extensive network of consultants is available to answer all of your questions about our products on site. From planning to deployments, enjoy personal support from our qualified professionals.



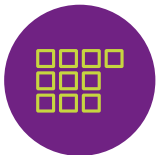
## **Digital solutions**

Our digital offerings offer targeted support in planning with our products. From tender texts through CAD details and BIM data to modern software solutions, we offer you tailored support for your planning.



## **7 areas of application**

We think in holistic solutions, which is why we have grouped our products into seven areas of application for you where you can benefit from the synergy of the PohlCon product portfolio.



## **10 product categories**

To help you find the right product in our extensive range even faster, the products are grouped into ten product categories so you can navigate clearly between our products.



## **Individual special solutions**

There's no mass produced-product on the market that is suitable for your project? We master extraordinary challenges with the many years of expertise of our three manufacturing brands in the sector of individual solutions, allowing us to realize your unique construction projects together.



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