PohlCon

ISOPRO®
Thermal insulation elements

Technical information

Table of contents

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®

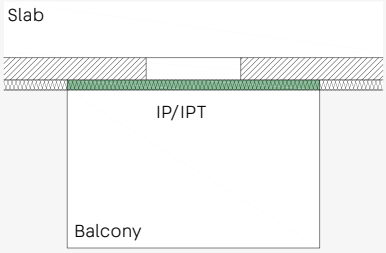
The ISOPRO® load-bearing thermal insulation element provides a friction-locked connection to external building components. It consists of five main components, all designed to provide reliable force transmission coupled with the lowest possible thermal conductivity.

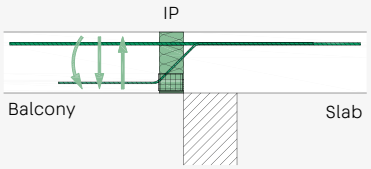
Balcony solutions – Product categories

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

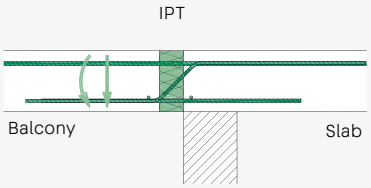
ISOPRO® Type overview

Cantilevered constructions

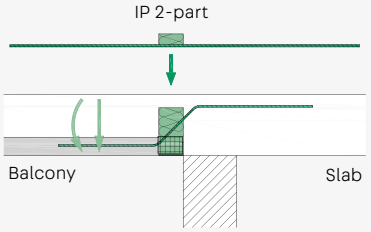




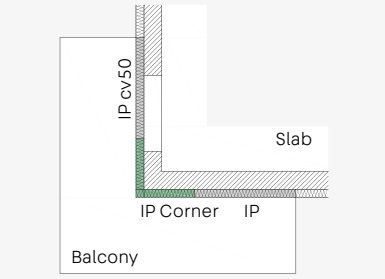
ISOPRO® IP
- Transfers negative moments and positive shear forces
- IP QX version transfers negative moments and positive and negative shear forces
- Version with concrete compression bearings
- page 26

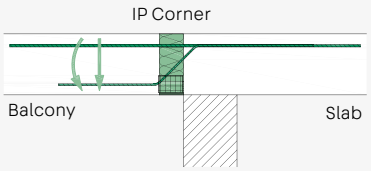


ISOPRO® IPT
- Transfers negative moments and positive shear forces
- Version with steel compression bars
- page 26

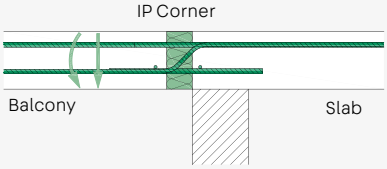


ISOPRO® IP 2-part
- Transfers negative moments and positive shear forces
- Version with concrete compression bearings
- 2-part version for precast slabs
- page 40

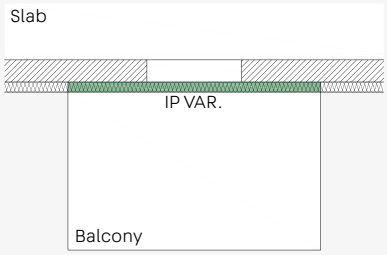


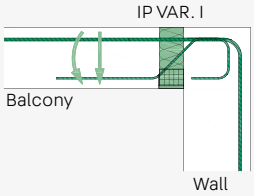


ISOPRO® IP Corner, IPT Corner
- Transfers negative moments and positive shear forces
- IP version with concrete compression bearings
- IPT version with steel compression bars
- Solution for corner balconies
- page 52

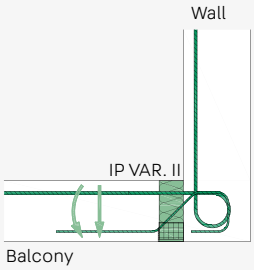


Cantilevered constructions for wall connections/vertically offset slabs

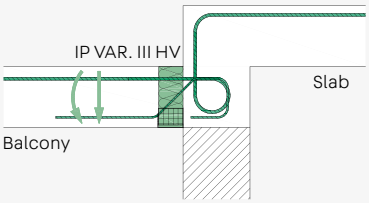




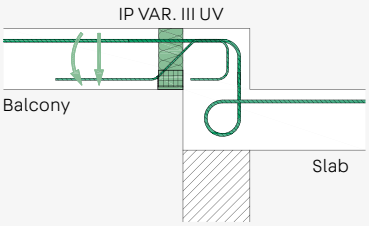
ISOPRO® IP VAR. I
- Transfers negative moments and positive shear forces
- Version with concrete compression bearings
- Connection to a wall leading downwards
- page 44



ISOPRO® IP VAR. II
- Transfers negative moments and positive shear forces
- Version with concrete compression bearings
- Connection to a wall leading upwards
- page 44

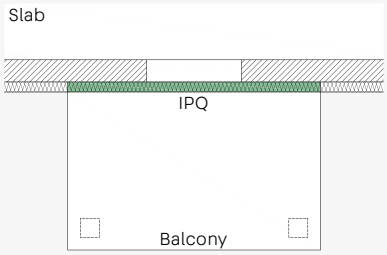


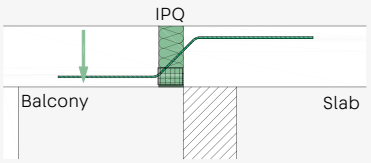
ISOPRO® IP VAR. III HV
- Transfers negative moments and positive shear forces
- Version with concrete compression bearings
- Connection to a slab with an upwards vertical offset
- page 44



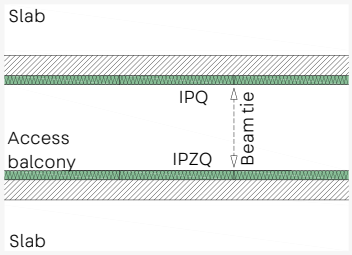
ISOPRO® IP VAR. III UV
- Transfers negative moments and positive shear forces
- Version with concrete compression bearings
- Connection to a slab with a downwards vertical offset
- page 44

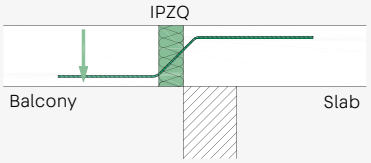
Supported constructions



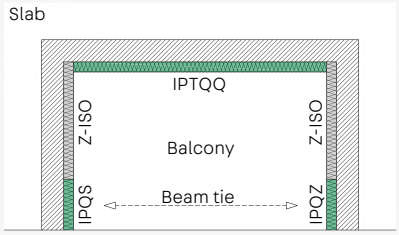


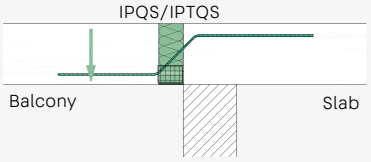
ISOPRO® IPQ
- Transfers positive shear forces
- Version with concrete compression bearings
- page 62



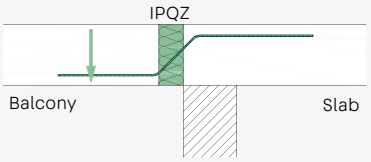


ISOPRO® IPZQ
- Transfers positive shear forces
- Version without compression bearings for tension-free connections
- page 62



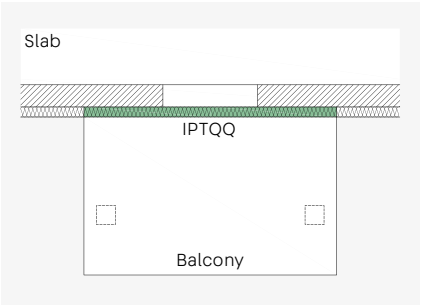


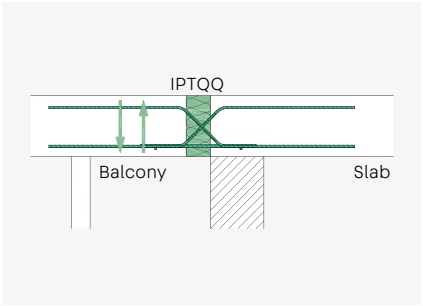
ISOPRO® IPQS/IPTQS
- Transfers positive shear forces
- IPQS version with concrete compression bearings
- IPTQS version with steel compression bars
- Short element for point load transfer
- page 62



ISOPRO® IPQZ
- Transfers positive shear forces
- Version without compression bearings for tension-free connections
- Short element for point load transfer
- page 62

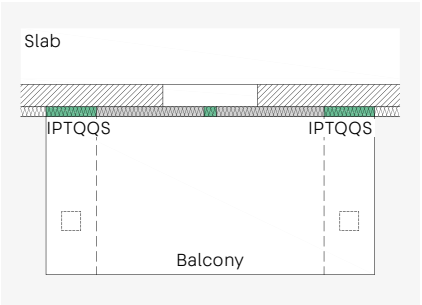
Supported constructions with uplilft loads

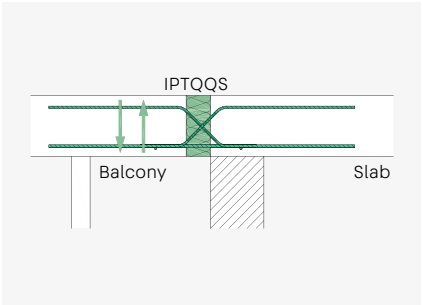




ISOPRO® IPTQQ

- Transfers negative and positive shear forces
- Version with steel compression bars
- page 70

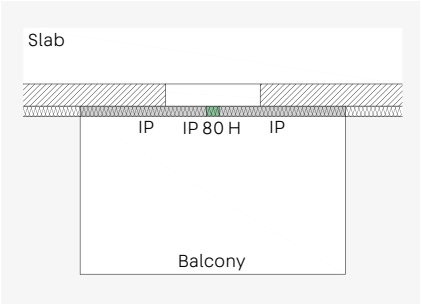


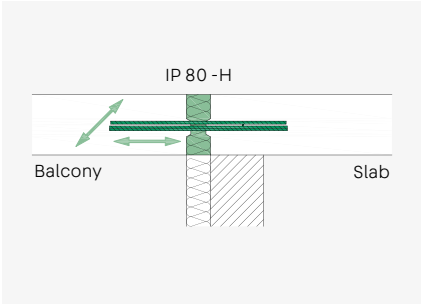


ISOPRO® IPTQQS

- Transfers negative and positive shear forces
- Version with steel compression bars
- Short element for point load transfer
- page 70

Horizontal loads and seismic loads

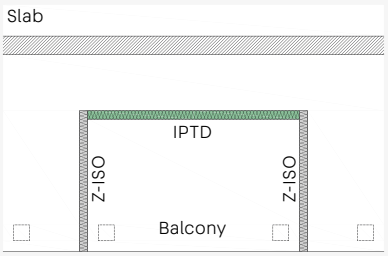


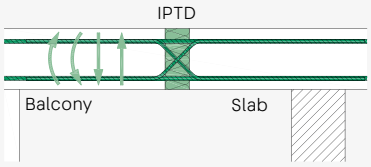


ISOPRO® IP 80 H

- Transfers horizontal forces parallel and/or perpendicular to the insulation layer
- page 86

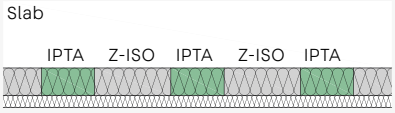
Continuous slabs

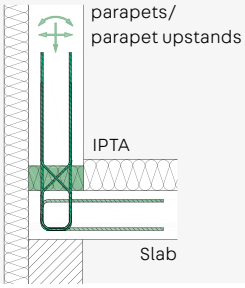




ISOPRO® IPTD
- Transfers positive and negative moments and shear forces
- Version with steel tie bars/ compression bars
- page 78

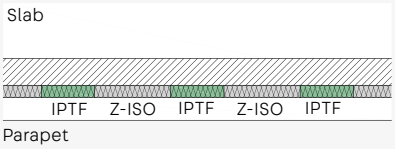
Attached parapets and parapet upstands

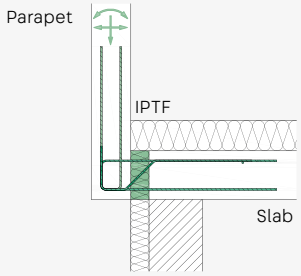




ISOPRO® IPTA
- Transfers moments, axial forces and horizontal forces
- For use at specific points
- page 90

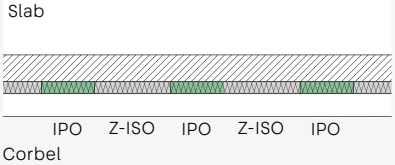
Protruding parapet

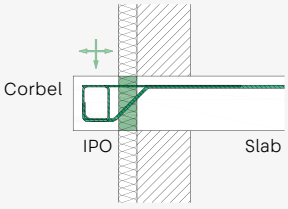




ISOPRO® IPTF
- Transfers moments, shear forces and horizontal forces
- For use at specific points
- page 94

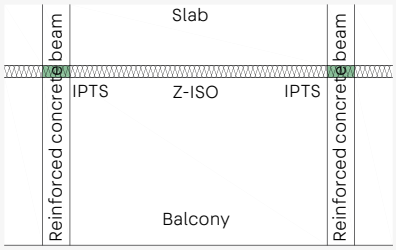
Corbels

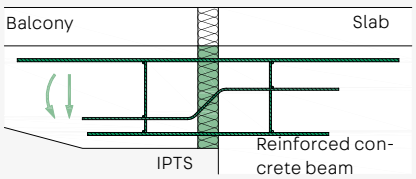




ISOPRO® IPO
- Transfers shear and horizontal forces
- For use at specific points
- page 98

Beams

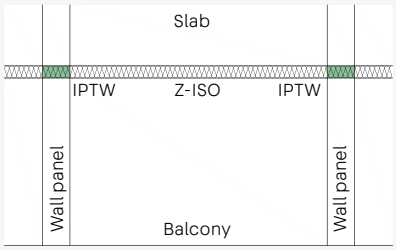


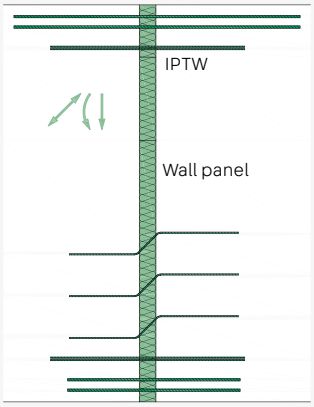


ISOPRO® IPTS

- Transfers negative moments and positive shear forces
- Version with compression bars
- page 102

Walls

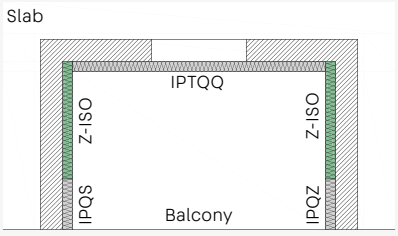


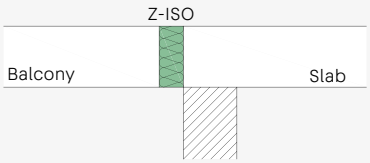


ISOPRO® IPTW

- Transfers negative moments, positive shear forces and horizontal forces
- Version with compression bars
- page 106

Infill insulation





ISOPRO® Z-ISO

- No load-bearing function
- Infill insulation for support at specific points
- page 114

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 compression bearing made of special concrete (IP elements) or as a compression bearing made of steel compression bars (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 bars:	reinforcing steel B500B, non-rusting ribbed rebar
Concrete compression bearing:	high-performance special concrete
Insulating body:	Neopor®* rigid polystyrene foam, λ = 0.031 W/mK
Fire protection panels:	fibre cement boards of building material class A1

Proof of usability

ISOPRO®:	ETA -17/0466, DIBt

Materials of adjoining components

Concrete:	normal concrete in line with DIN 1045-1 or DIN EN 206-1 with a gross density of 2,000 to 2,600 kg/m³.
Concrete strength classes:	exterior components ≥ C25/30 interior components ≥ C20/25
Reinforcing steel:	B500

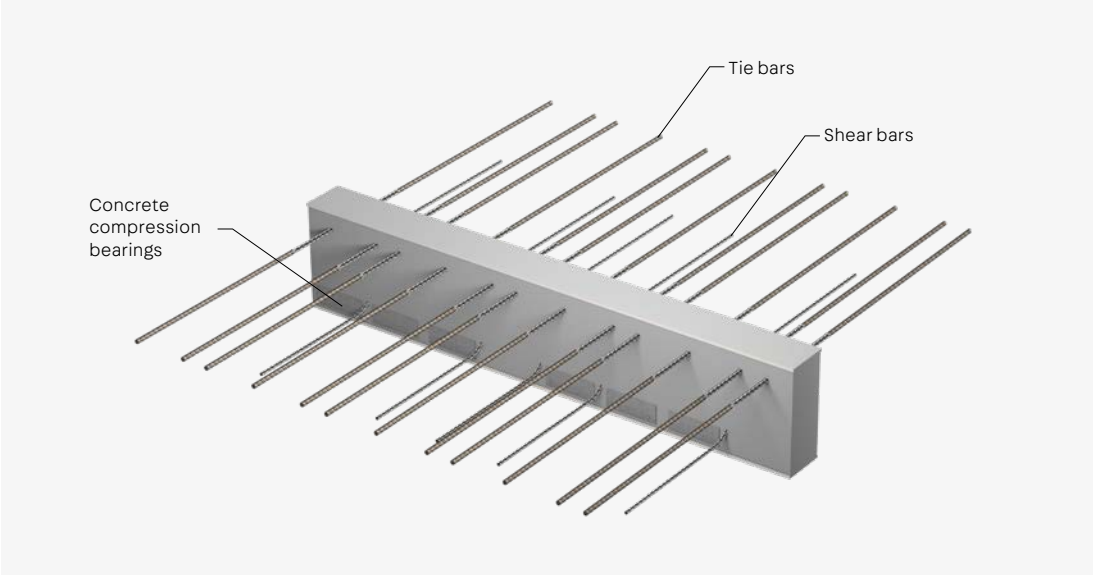
On-site reinforcement

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.

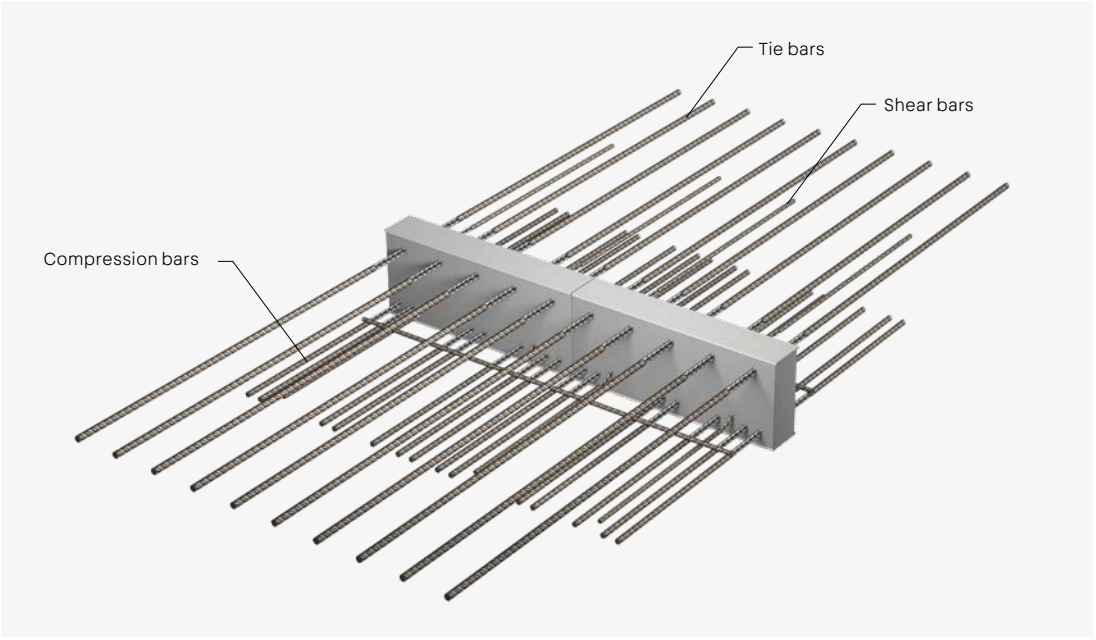
*Neopor® is a registered trademark of BASF, Ludwigshafen, Germany.

Product components

ISOPRO® IP



ISOPRO® IPT



Concrete cover

Exposure classes 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 decisive.

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
XC3	Moderate moisture, exterior components, damp rooms	C20/25	C20/25	C25/30	35	30
XC4	Alternating wet and dry, exterior components with direct rain exposure	C25/30	C20/25	C25/30	40	35
XD1	Moderate moisture, mist spray zone of traffic areas	C30/37	C20/25	C25/30	55	50
XS1	Salty air, exterior components near the coast	C30/37	C20/25	C25/30	55	50
XD1	Moderate moisture, mist spray zone of traffic areas	C30/37	C20/25	C25/30	55	50
XS1	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 bars 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 ≥ C25/30.
- 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 IP80 H can be used to absorb planned horizontal forces.
- In the case of cantilevered constructions without an imposed 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 compression bearings, it must be ensured that the frictional connection between the compression 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 bars 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 bars.
- When using ISOPRO® elements with REI 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 PohlCon 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.

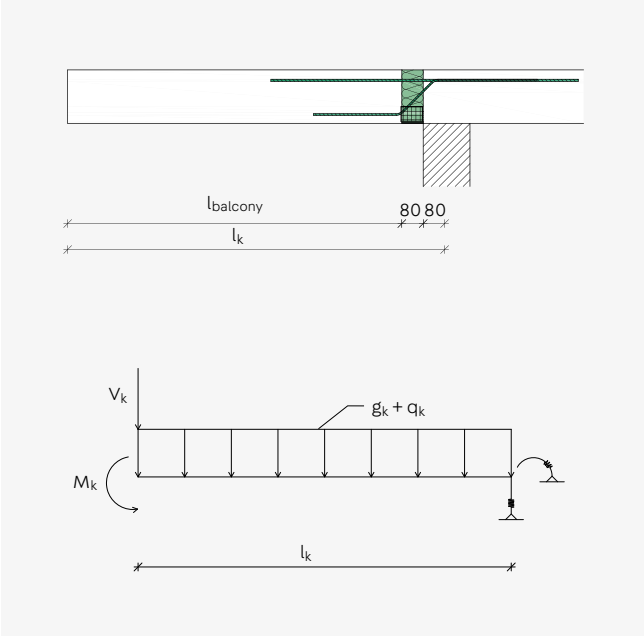
Consultation
Our Application Technology department will be happy to assist you with further solutions:

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

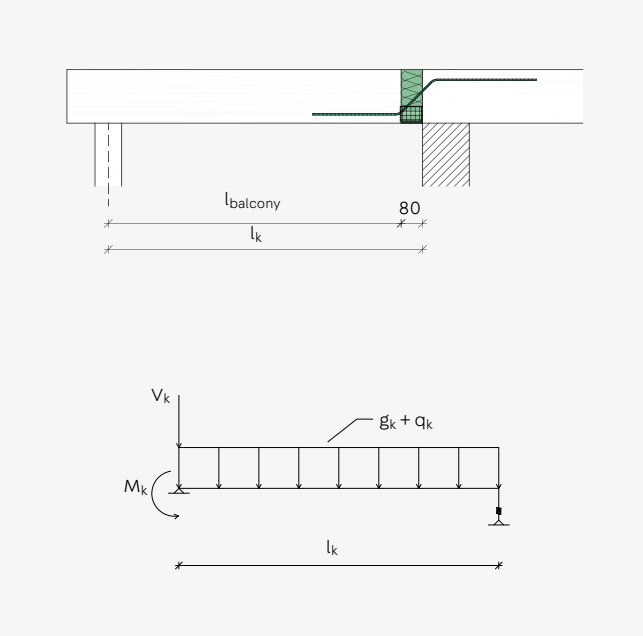
Sizing

Sizing of ISOPRO® elements – FEM design/manual design

System design



Cantilevered balcony / model



Supported balcony / model

Bearing conditions

Manual design:	Restrained	Articulated

FEM design:

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 load
q_k: imposed load
V_k: edge load (railing, parapet, plinth etc.)
M_k: edge moment (due to horizontal load on railing, parapet etc.)

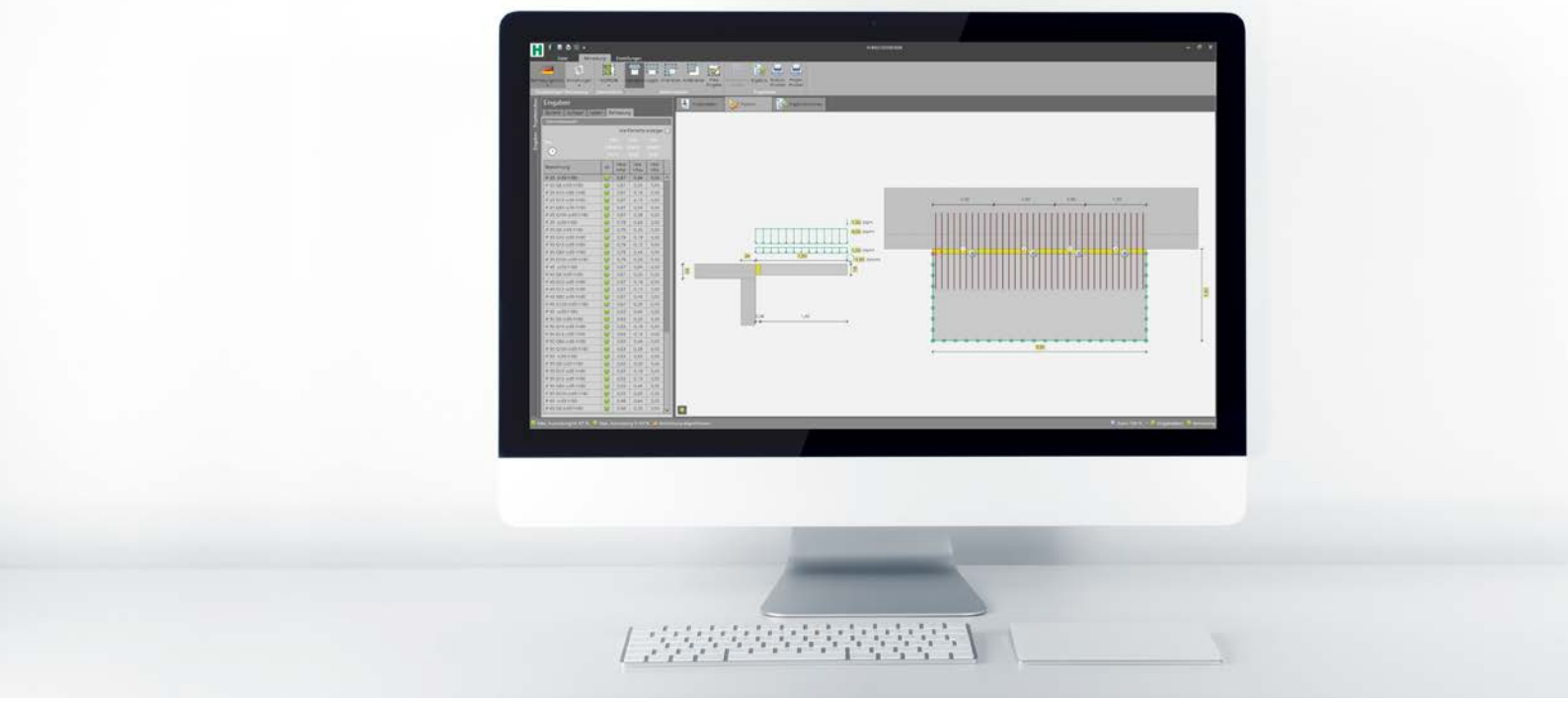
Procedure for FEM design

- 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



Dimensioning 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

- In addition to the standard balcony systems there is now also a "Custom input" option
- Design with FEM 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

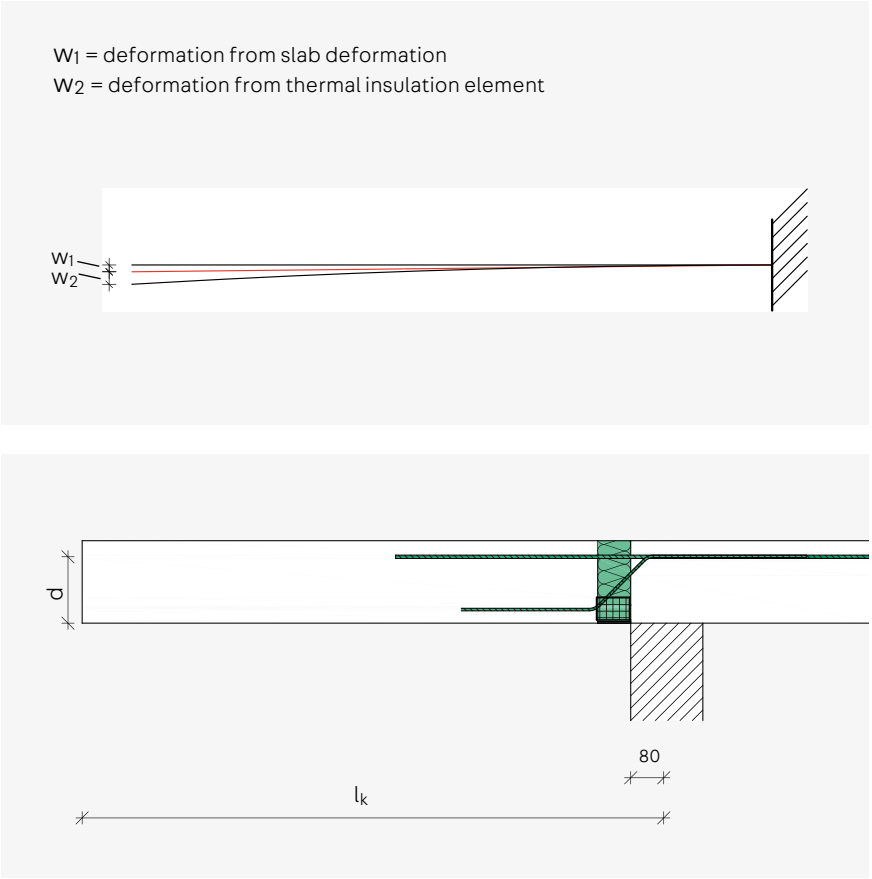
Proof of serviceability

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 α 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.



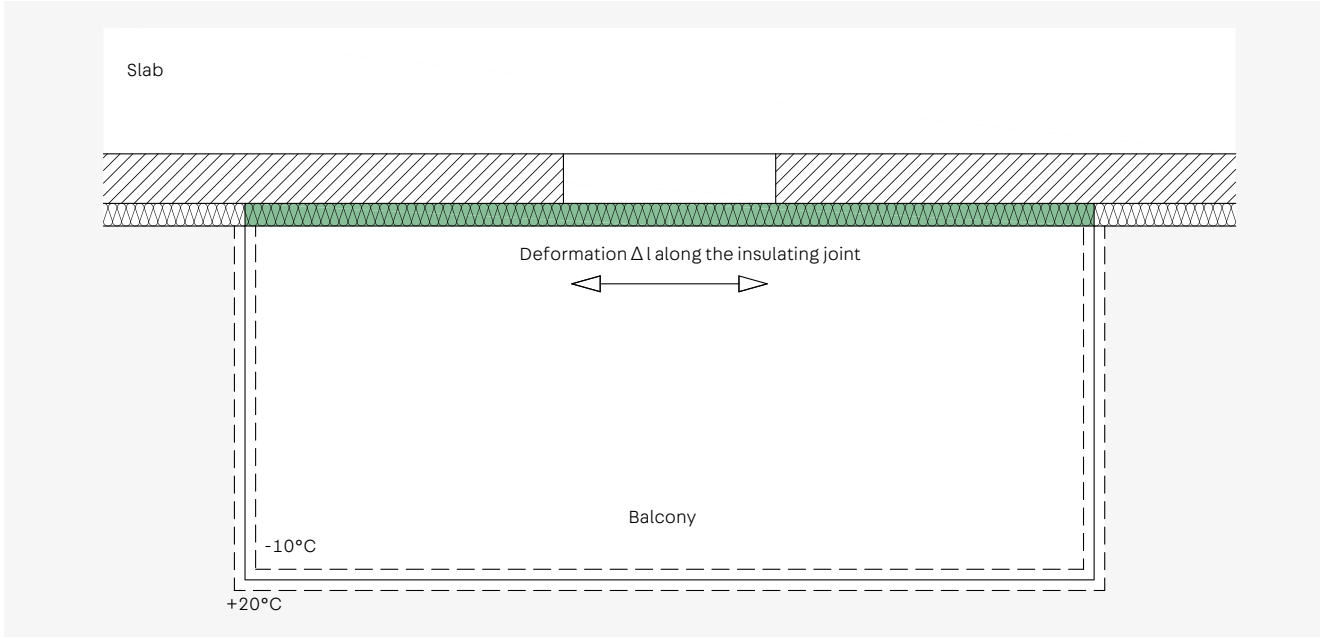
ISOPRO® IP – Structural system

Flexural aspect ratio

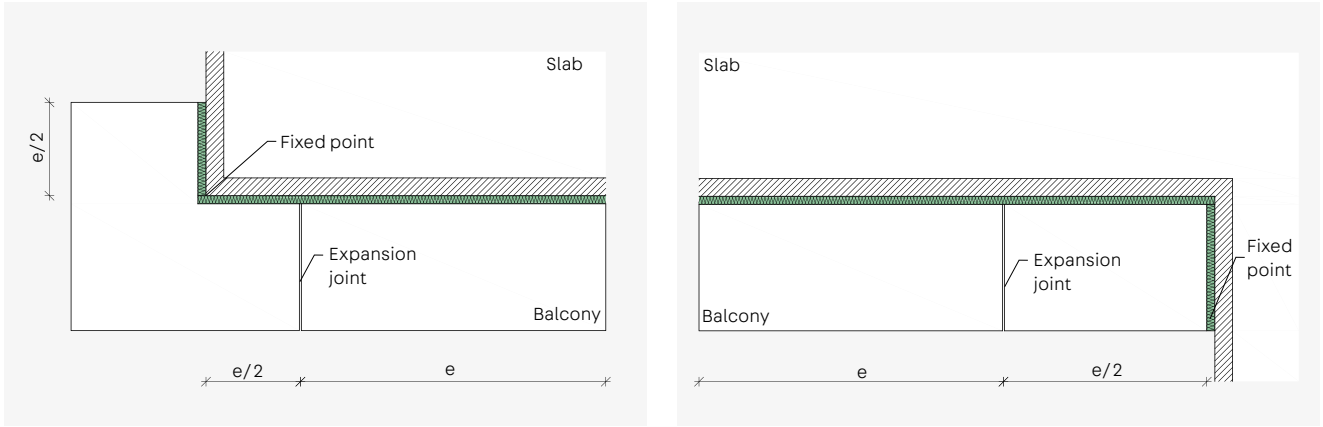
The flexural aspect ratio is defined as the ratio of the structural height d of the balcony slab to the cantilever length l_k. The flexural aspect ratio of a slab has an effect on its vibration behaviour. Therefore, we recommend limiting the flexural aspect ratio. Limit values for the flexural aspect ratio are given on page 33.

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® IP80 H elements result in increased stress forces. This means that the maximum permissible expansion joint spacing must be reduced to e/2.

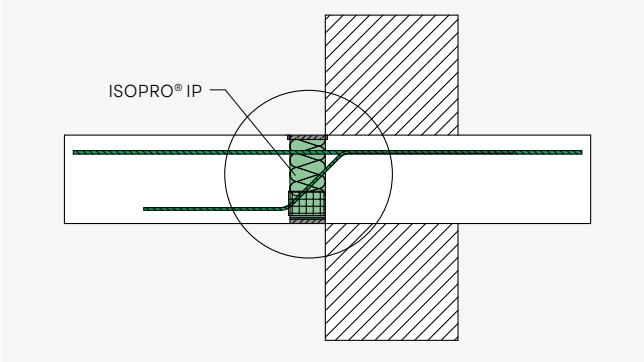
To prevent components separated by expansion joints from being unevenly compressed, they can be connected with longitudinally displaceable shear dowels of type HED.

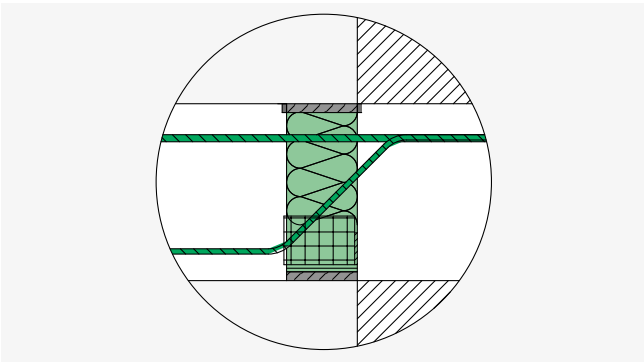
Fire protection

Fire protection classes REI 90/REI 120

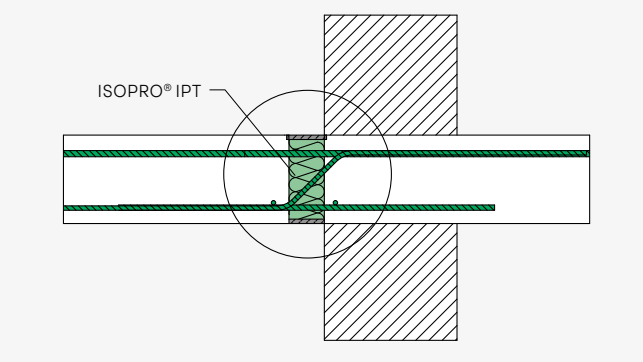
Where there are requirements regarding the fire resistance class of building components, all ISOPRO® elements with concrete compression bearings are available in fire resistance class REI 120 and all ISOPRO® elements with compression bars are available in fire resistance class REI 90 (fulfills REI 120 planned with an utilization of maximum 85% in ULS).

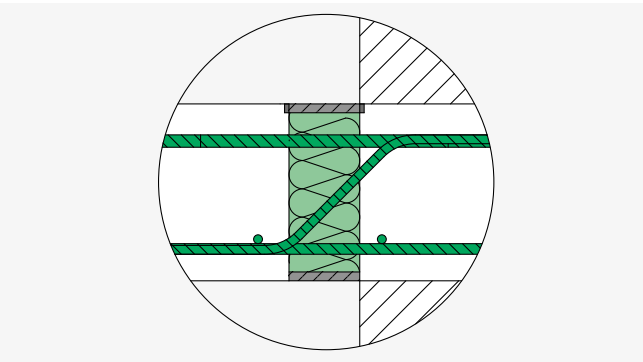
For this purpose, ISOPRO® elements are equipped with fire protection panels on the top and bottom in the factory. The short elements IPQS / IPQZ / IPTQQS / IPTA / IPTF / IPO and the elements for beams and walls IMTS and IMTW are manufactured with all-round fire protection panels in the factory. A prerequisite for classification as REI 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 infill insulation when ISOPRO® elements are used at specific points.





ISOPRO® element with concrete compression bars of type REI 120: version with fire protection panels at the top and the bottom





ISOPRO® element with steel compression bars of type REI 120: version with fire protection panels at the top and the bottom

Fire resistance classification of the ISOPRO® types with fire protection in accordance with DIN EN 13501

DIN EN 13501-2 describes the fire resistance classes of building components in accordance with the European standard. The performance criteria 'R' (load-bearing capacity), 'E' (room enclosure) and/or 'I' (thermal insulation) must be maintained over a defined period of time in the event of fire. With REI 120, this applies to all three criteria for a period of at least 120 minutes.

The fire resistance classes of ISOPRO® are regulated in each case by the technical approval.

	ISOPRO type	Fire protection type	Fire resistance classes (with fire separating function of the construction)
Cantilevered components	IP	REI 120	REI 120
	IPT	REI 90	REI 90 (REI 120 with ≤85% utilization ULS)
	IP 2-part	REI 120	REI 120
	IP VAR. I	REI 120	REI 120
	IP VAR. II	REI 120	REI 120
	IP VAR. III HV	REI 120	REI 120
	IP VAR. III UV	REI 120	REI 120
	IP Corner	REI 120	REI 120
	IPT Corner	REI 90	REI 90 (REI 120 with ≤85% utilization ULS)
Supported components	IPQ	REI 120	REI 120
	IPZQ	REI 120	REI 120
	IPQS	REI 120	REI 120
	IPTQS	REI 90	REI 90 (REI 120 with 85% utilization ULS)
	IPQZ	REI 120	REI 120
	IPTQQ	REI 90	REI 90 (REI 120 with 85% utilization ULS)
	IPTQQS	REI 90	REI 90 (REI 120 with 85% utilization ULS)
Continuous elements	IPTD	REI 90	REI 90 (REI 120 with 85% utilization ULS)
Elements for special loads	IP80 H	REI 120	REI 120
	IPTA	REI 90	REI 90 (REI 120 with 85% utilization ULS)
	IPTF	REI 90	REI 90 (REI 120 with 85% utilization ULS)
	IPO	REI 120	REI 120
	IPTS	REI 90	REI 90 (REI 120 with 85% utilization ULS)
	IPTW	REI 90	REI 90 (REI 120 with 85% utilization ULS)
Insulating elements without structural functions	IP Z-ISO	FP 1	EI 90 / EI 120 – according to the ISOPRO load-bearing elements used

Notes

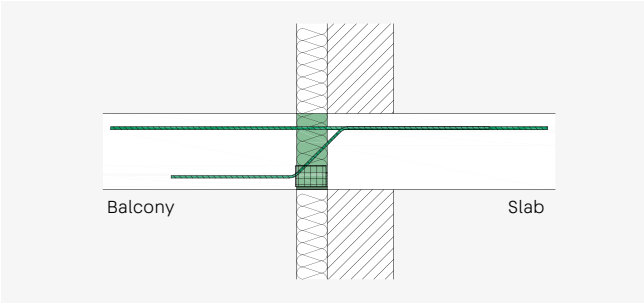
For the ISOPRO with fire protection and steel compression bars the fire protection class is REI 90 when the reaction coefficient η_{fi} (in accordance with DIN EN 1992-1-2, section 2.4.2) is reduced to 0.6 – this corresponds to an utilization of ≤ 85% in ULS (ultimate limit state).

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 FP1 of type EI 120 can be used for this purpose.

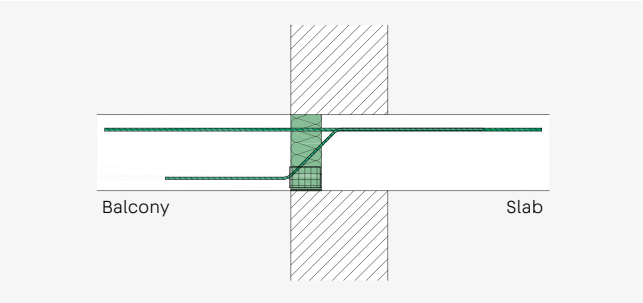
Installation instructions

Position in the building component

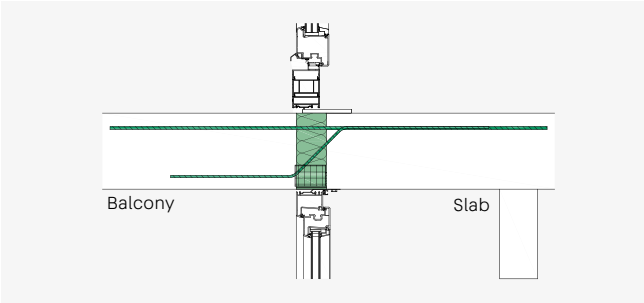
The ISOPRO® elements are installed in the insulation layer to reliably prevent thermal bridges.



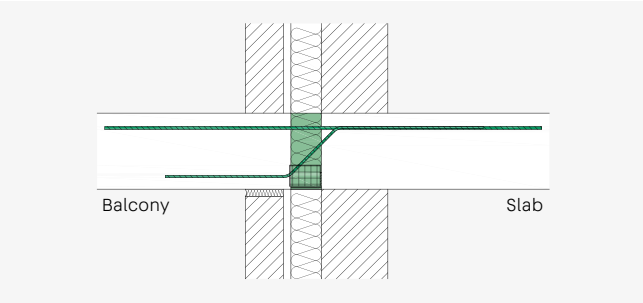
ISOPRO® IP – Installation cross-section, external thermal insulation composite system



ISOPRO® IP – Installation cross-section, solid wall



ISOPRO® IP – Installation cross-section, glass façade

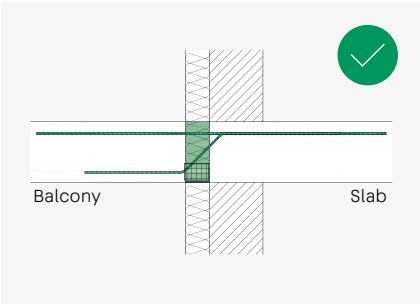


ISOPRO® IP – Installation cross-section, cavity wall

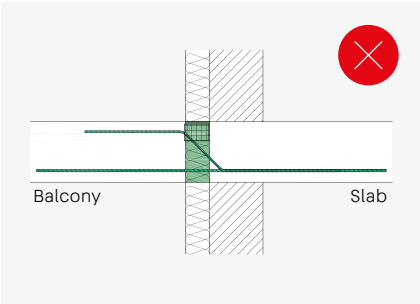
Installation direction

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 compression bearings/compression bars are at the bottom.

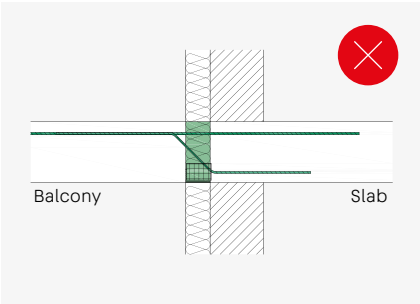
The shear bars runs diagonally through the ISOPRO® element starting at the bottom on the balcony side and ends at the top on the slab side.



ISOPRO® IP – Correct installation



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

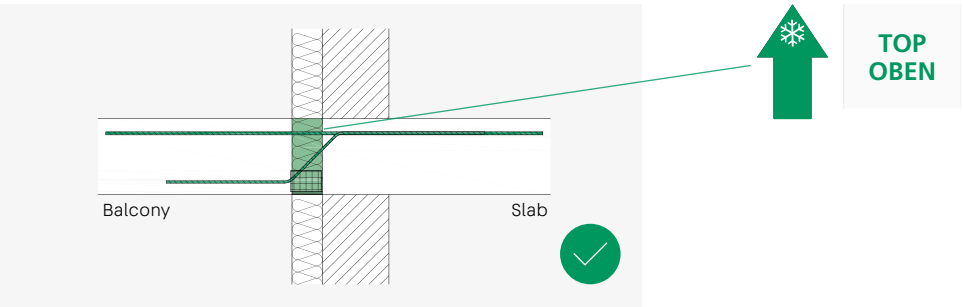


ISOPRO® IP – Incorrect installation, shear bar must be at the bottom on the balcony side

Installation instructions – Compression joint

Installation direction

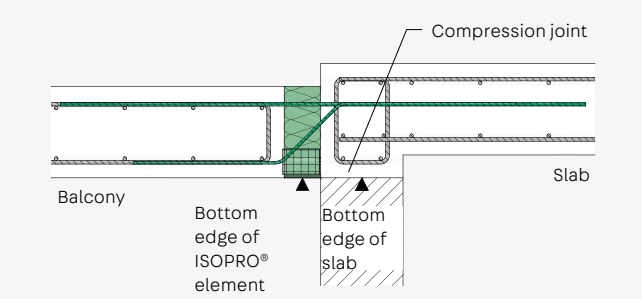
During installation, it is essential to observe the installation direction indicated on the label. The installation direction is clearly marked on each element by the word "up" and by an arrow in the direction of the balcony side (cold area).



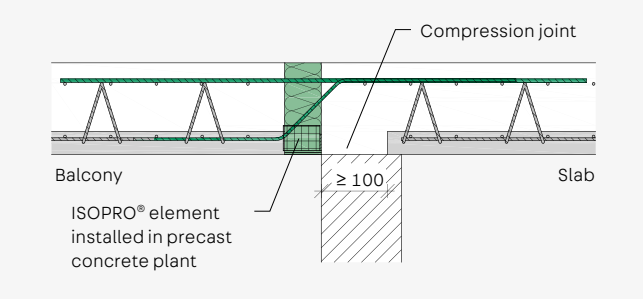
ISOPRO® IP – Correct installation

Compression joint

- During installation, ensure that there is a positive fit between the compression bearing and the fresh concrete. To do so, install a compression joint of ≥ 100 mm and select suitable casting section boundaries.
- An in-situ concrete strip or grouting strip of ≥ 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

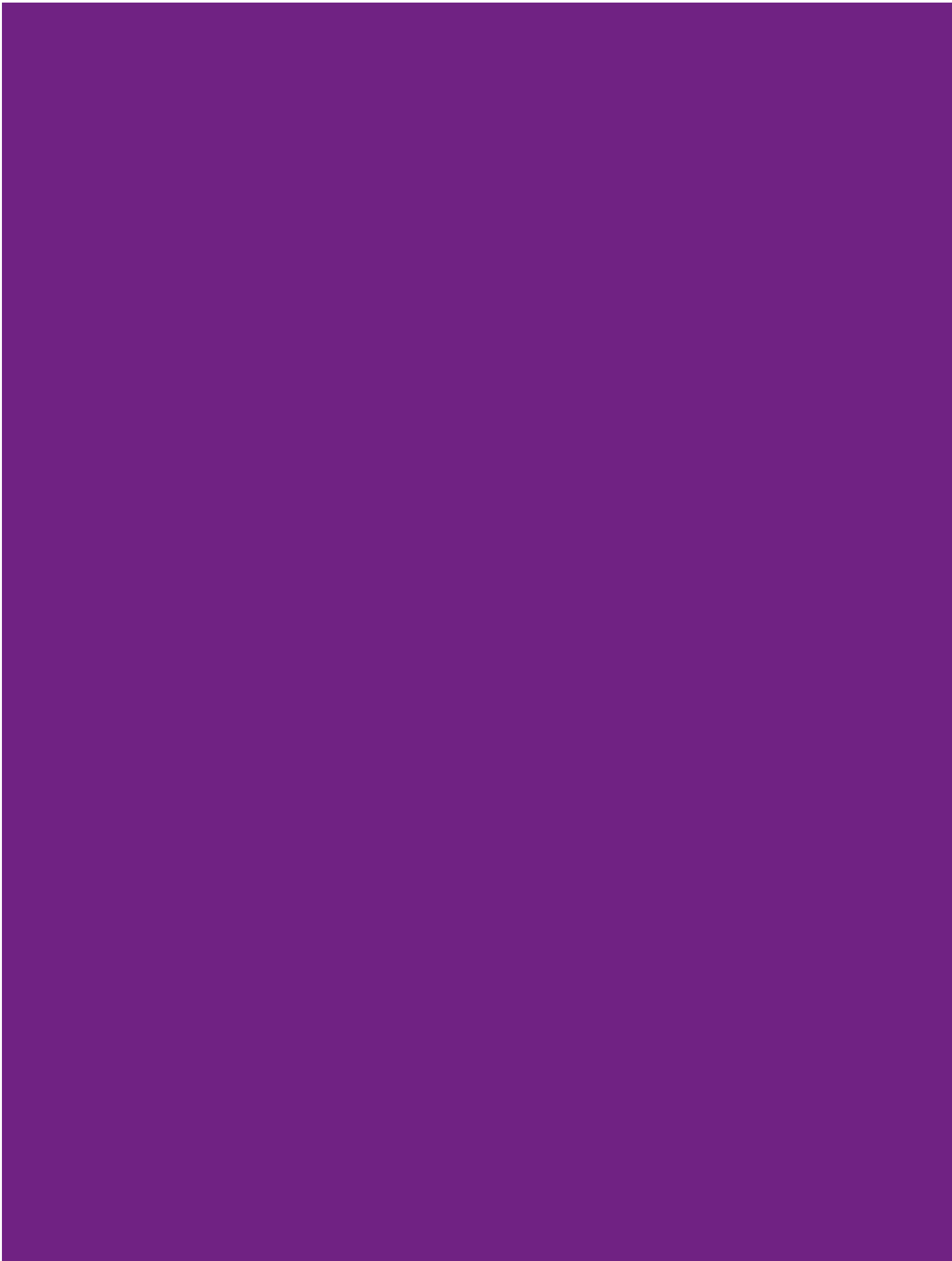


ISOPRO® elements in combination with precast slabs

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 depending on the design (QX) positive and negative shear forces
- Concrete compression 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 bars
- 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 REI 90 available (REI 120 with an utilization of ≤ 85% in ULS)

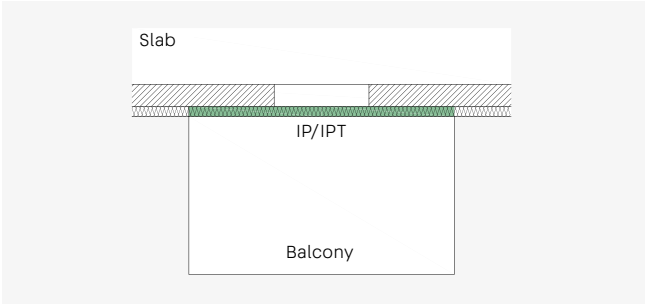
Type designation

IP 65 Q8 cv35 h200 REI 120

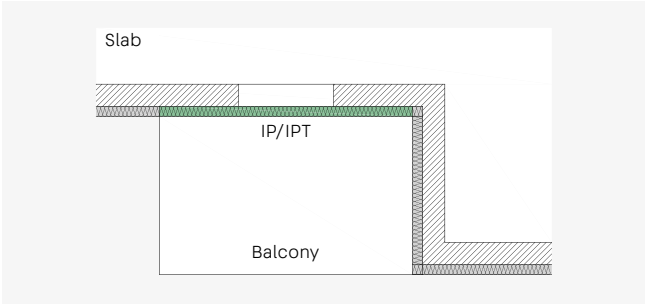
- REI 120 — Fire protection type
- h200 — Element height
- cv35 — Concrete cover
- Q8 — Shear force load-bearing capacity
- IP 65 — Type and load-bearing capacity

Application – Element layout

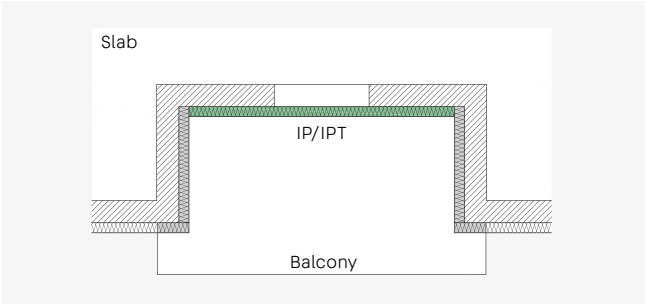
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



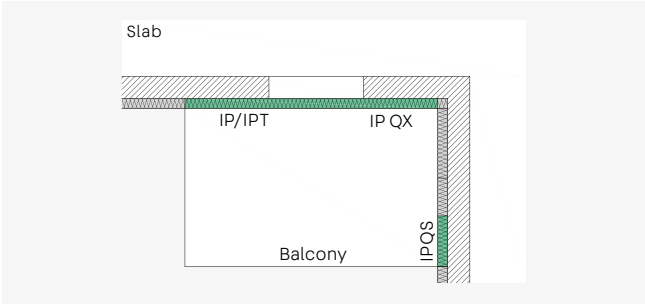
ISOPRO® IP/IPT – Cantilevered balconies



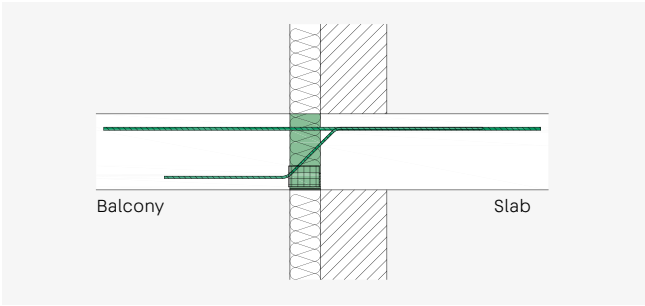
ISOPRO® IP/IPT – Cantilevered balconies in façade projections



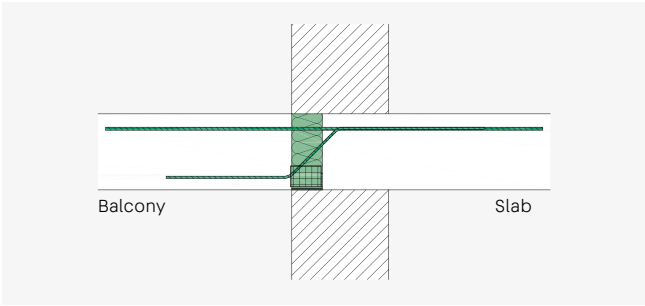
ISOPRO® IP/IPT – Cantilevered balconies in façade recesses



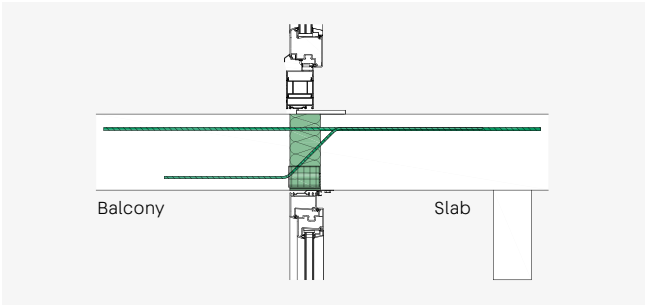
ISOPRO® IP/IPT in combination with IP QX and IPQS for inner corner balconies



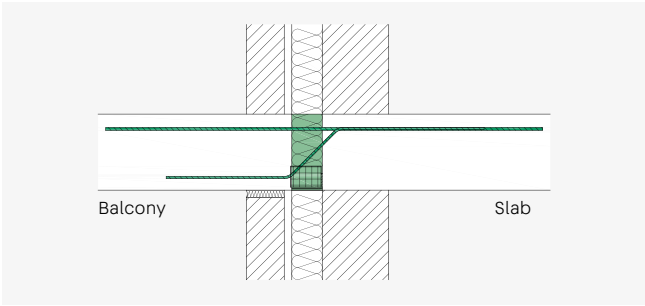
ISOPRO® IP – Installation cross-section, external thermal insulation composite system



ISOPRO® IP – Installation cross-section, solid wall



ISOPRO® IP – Installation cross-section, glass façades



ISOPRO® IP – Installation cross-section, cavity wall

Dimensioning table for concrete ≥ C25/30

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

Element height mm
depending on cv mm

Concrete ≥ 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 transferred 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	1,000	1,000	1,000	1,000	1,000	1,000
Tie bars	4 Ø 8	6 Ø 8	7 Ø 8	10 Ø 8	11 Ø 8	13 Ø 8
Tie bars QX	5 Ø 8	7 Ø 8	8 Ø 8	12 Ø 8	13 Ø 8	15 Ø 8
Compression bearings	4	4	4	4	5	5
Shear bars, standard	4 Ø 6	4 Ø 6	4 Ø 6	5 Ø 6	5 Ø 6	5 Ø 6
Shear bars Q8	6 Ø 8	6 Ø 8	6 Ø 8	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	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 10/3 Ø 10	4 Ø 10/3 Ø 10	4 Ø 10/3 Ø 10

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

Element height mm depending on cv 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 transferred 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	1,000	1,000	1,000	1,000	500 + 500 (QX elements 1,000 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
Compression 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 transferred m_{Rd} in kNm/m

Element height mm depending on **cv** 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 transferred 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 Ø 14	14 Ø 14
Compression bars	14 Ø 12	18 Ø 12
Shear bars Q10	4 Ø 10	4 Ø 10
Shear bars Q12	6 Ø 10	4 Ø 12
Shear bars Q14	6 Ø 12	4 Ø 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 α 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 α = 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 α for concrete ≥ 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 α for concrete ≥ 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

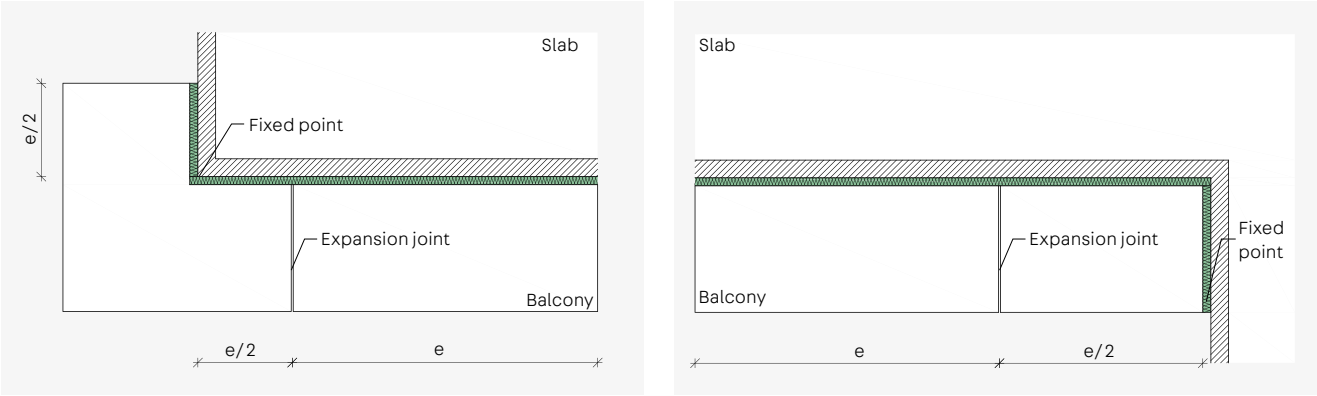
The flexural aspect ratio is defined as the ratio of the structural height d of the balcony slab to the cantilever length l_k. The flexural aspect ratio of a slab has an effect on its vibration behaviour. Therefore, it is advisable to limit the flexural aspect ratio for cantilevered reinforced concrete 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® IP80 H 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.



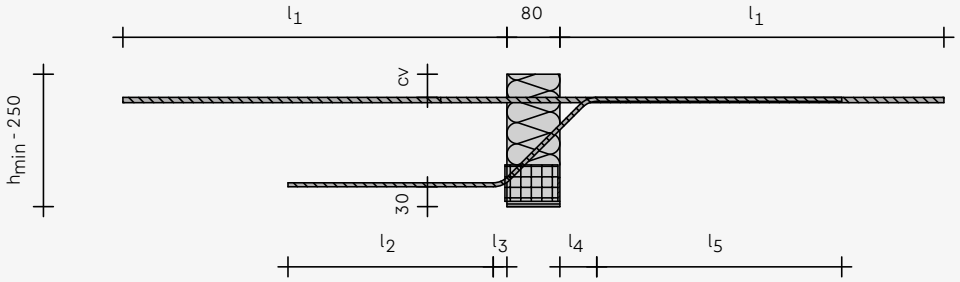
Expansion joint arrangement for different balcony systems

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 dimensions

ISOPRO® IP 10 to IP 100 – Positive shear forces

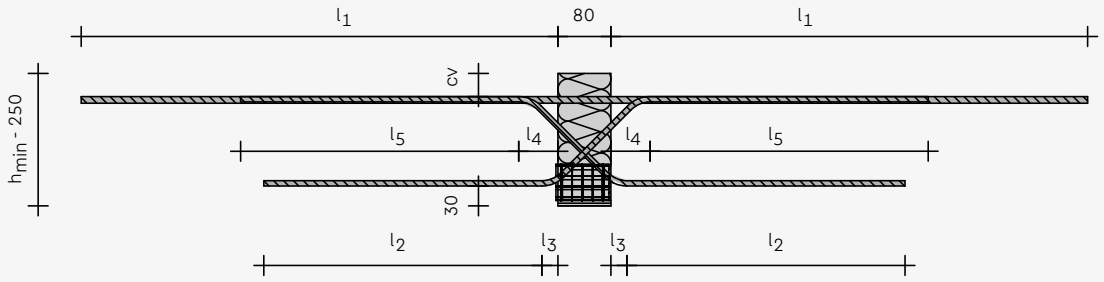


Length of tie bar mm	IP 10 – IP 50	IP 55 – IP 75	IP 90 – IP 100
l_1	520	630	730

Length of shear bar mm	Shear force load-bearing capacity			
	Standard	Q6/ Q8	Q10	Q12
l_2	250	420	530	630
l_3	24	28	33	42
l_4*	13-93	15-95	28-98	35-95
l_5	320	420	530	630
h_{min}	160	160	170	180

* depending on the height

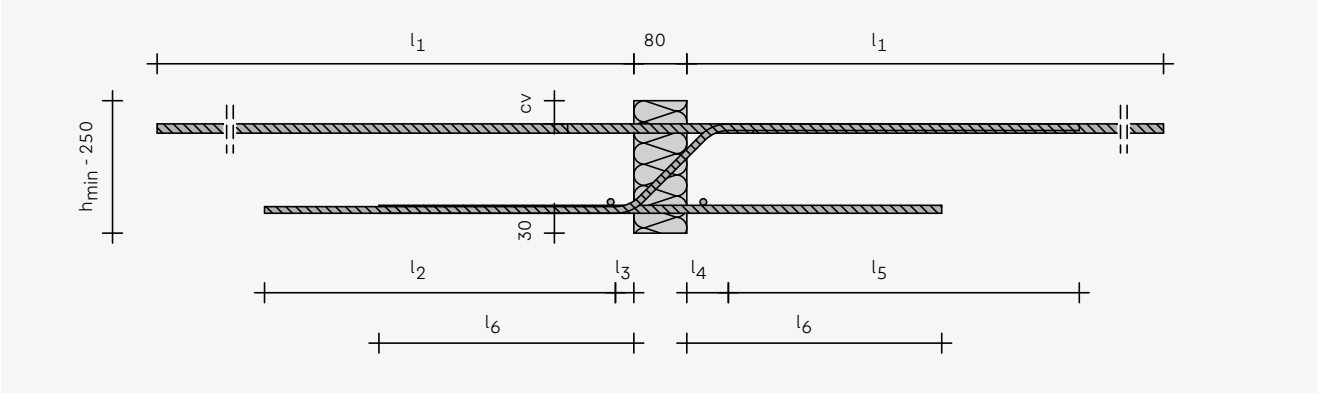
ISOPRO® IP 10 to IP 100 – Positive and negative shear forces



Length of tie bar mm	IP 10 – IP 50	IP 55 – IP 75	IP 90 – IP 100
l_1	520	630	730

Length of shear bar mm	Shear force load-bearing capacity	
	Q8X	Q10X
l_2	420	530
l_3	28	33
l_4*	15-95	28-98
l_5	420	530
h_{min}	160	170

* depending on the height



ISOPRO® IPT 110

Length of tie bar and compression strut mm	IPT 110
Tie bar l_1	860
Compression strut l_6	405

Length of shear bar mm	Shear force load-bearing capacity	
	Q 10/Q 12	Q 14
l_2	530	630
l_3	33	42
l_4*	530	630
l_5	28-98	35-95
h_{min}	170	180

* depending on the height

ISOPRO® IPT 150

Length of tie bar and compression strut mm	IPT 150
Tie bar l_1	860
Compression strut l_6	405

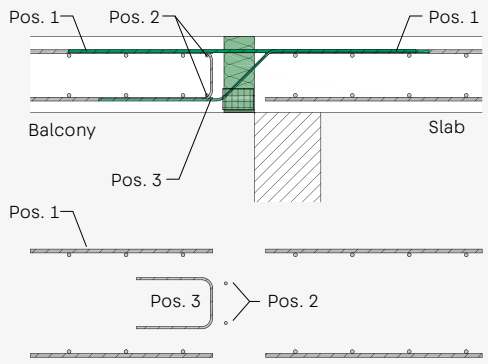
Length of shear bar mm	Shear force load-bearing capacity		
	Q 10	Q 12	Q14
l_2	530	630	740
l_3	33	42	47
l_4*	530	630	740
l_5	28-98	35-95	58-98
h_{min}	170	180	200

* depending on the height

On-site reinforcement

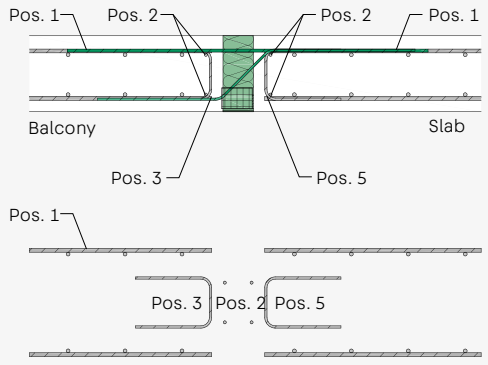
ISOPRO® IP 10 to IP 100

Direct support



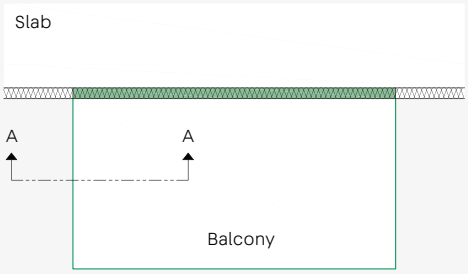
- Pos. 1: Connection reinforcement for the ISOPRO® element – page 38
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side
- Pos. 3: Horizontal U-bar parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Horizontal U-bar 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)

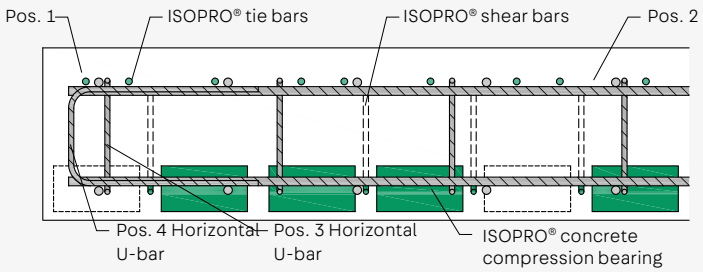
Indirect support



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 38
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Horizontal U-bar 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: Horizontal U-bar 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 38

Supplementary edge reinforcement

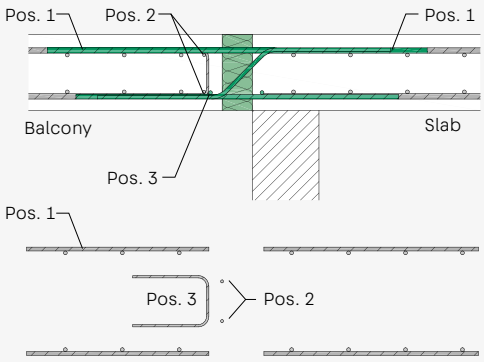




ISOPRO® IP – Cross section A-A

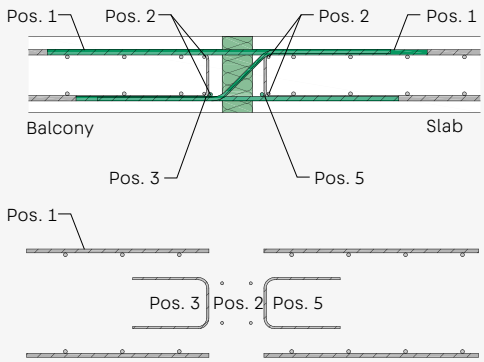
ISOPRO® IPT 110 to IPT 150

Direct support



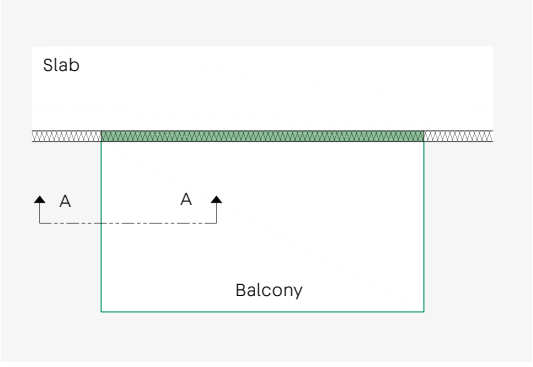
- Pos. 1: Connection reinforcement for the ISOPRO® element – page 38
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side
- Pos. 3: Horizontal U-bar parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Horizontal U-bar 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)

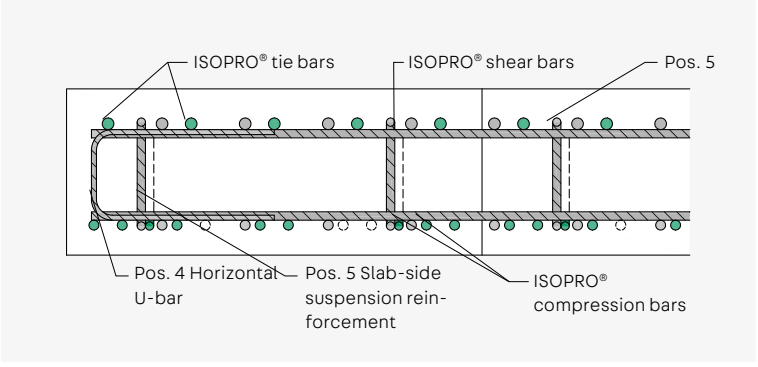
Indirect support



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 38
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Horizontal U-bar 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: Horizontal U-bar 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 38

Supplementary edge reinforcement





ISOPRO® IPT – Cross section A-A

Connection reinforcement Pos. 1

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

ISOPRO®	$a_{s,erf}$ cm²/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

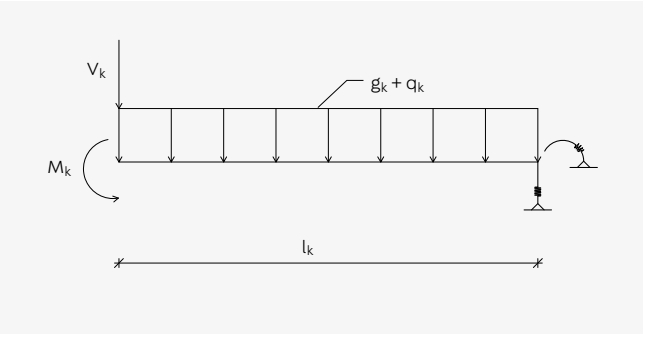
Edge or suspension reinforcement with indirect support Pos. 5

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
	$a_{s,erf}$ cm²/m	$a_{s,erf}$ cm²/m	$a_{s,erf}$ cm²/m	$a_{s,erf}$ cm²/m	$a_{s,erf}$ cm²/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	–	–

Design example

Element selection, deformation and precamber



System:
Projecting cantilever
System length cantilever l_k = 2.0 m
Balcony slab thickness = 180 mm
Concrete cover cv35
Balcony and slab C25/30 concrete

Load assumptions:
Self weight g_k = 4.50 kN/m²
Surcharge/surface g_k = 1.50 kN/m²
Imposed load q_k = 4.00 kN/m²
Edge load V_k = 1.50 kN/m
Edge moment M_k = 0.00 kNm/m

Applied forces:
$m_{Ed} = (g_k \cdot 1.35 + q_k \cdot 1.5) \cdot l_k^2 / 2 + (G_k \cdot 1.35) \cdot l_K$
$v_{Ed} = (g_k \cdot 1.35 + q_k \cdot 1.5) \cdot l_k + (G_k \cdot 1.35)$
$m_{Ed} = (6.00 \cdot 1.35 + 4.00 \cdot 1.5) \cdot 2.00^2 / 2 + (1.5 \cdot 1.35) \cdot 2.00 =$ <u>32.25 kNm/m</u>
$v_{Ed} = (6.00 \cdot 1.35 + 4.00 \cdot 1.5) \cdot 2.00 + (1.5 \cdot 1.35) =$ <u>30.23 kN/m</u>

Design:
Selected: IP 50, cv35, h = 180 mm
m_{Rd} = 36.80 kNm/m ≥ 32.25 kNm/m (page 29)
V_{Rd} = 43.50 kN/m ≥ 30.23 kN/m

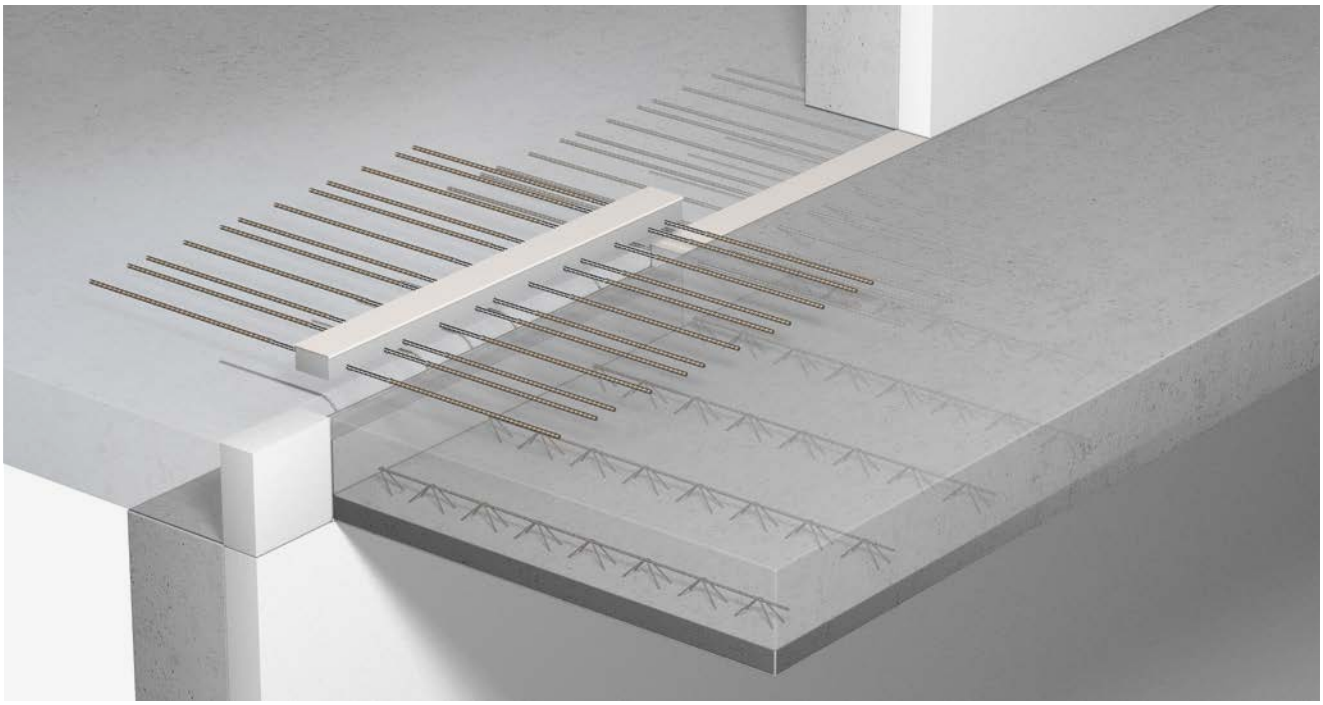
Deformation due to thermal insulation element:
Quasi-permanent load combination $\Psi_2 = 0.30$, $\gamma_G = 1.00$, $\gamma_Q = 1.00$
$m_{Ed,perm} = m_{gk} + m_{qk} \cdot \Psi_2$
$m_{Ed,perm} = (g_k + q_k \cdot \Psi_2) \cdot l_k^2 / 2 + G_k \cdot l_K$
$m_{Ed,perm} = (6.00 + 4.00 \cdot 0.3) \cdot 2.00^2 / 2 + 1.50 \cdot 2.00 =$ <u>17.40 kNm/m</u>
$w_1 = \tan\alpha \cdot (m_{Ed,perm}/m_{Rd}) \cdot l_k \cdot 10$
$\tan\alpha$ = 0.79 (page 32)
$w_1 = 0.79 \cdot (17.40 / 36.80) \cdot 2.00 \cdot 10 =$ <u>7.47 mm (~ 7.00 mm)</u>*

*) 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 compression 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

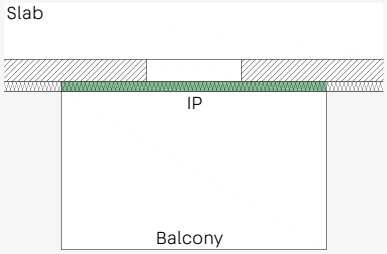
Type designation

IP 65 Q8 cv35 h200 REI 120 2-part

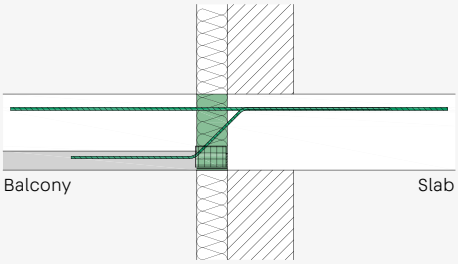
- 2-part: Version: 2-part
- REI 120: Fire protection type
- h200: Element height
- cv35: Concrete cover
- Q8: Shear force load-bearing capacity
- IP 65: Type and load-bearing capacity

Application – Element design

This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.

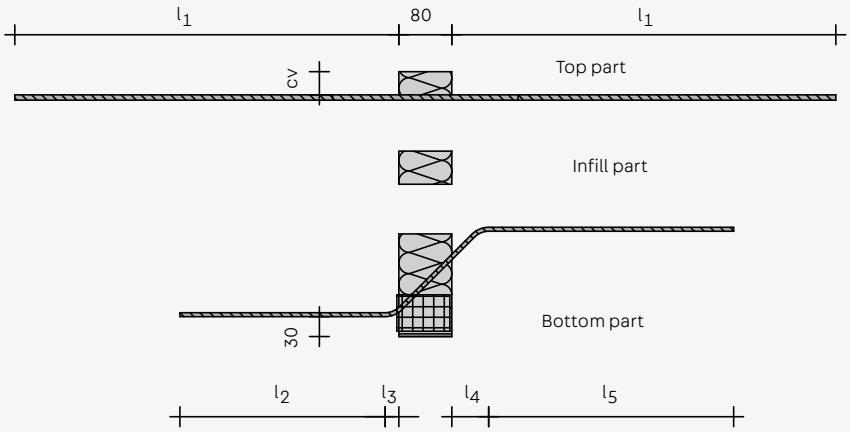


ISOPRO® IP 2-part – Cantilevered balconies



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
l_1	520	630	730

Length of shear bar mm	Shear force load-bearing capacity			
	Standard	Q8	Q10	Q12
l_2	250	420	530	630
l_3	24	28	33	42
l_4	13-93	15-95	28-98	35-95
l_3	320	420	530	630
h_{min}	160	160	170	180

* depending on the height

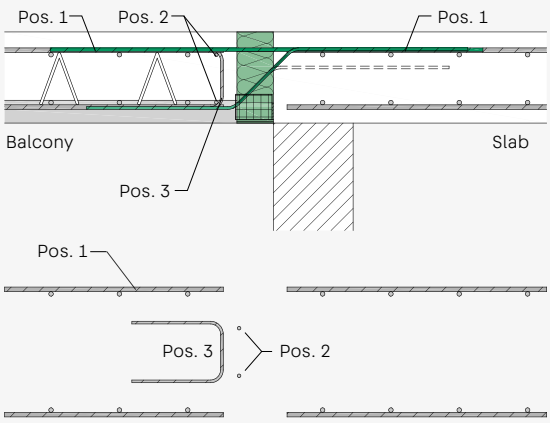
Dimensioning and design of the 2-part elements

- Dimensioning and design of the elements is identical to the corresponding one-part elements -page 28 - 30
- 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 infill 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 - page 32 - 33

On-site reinforcement

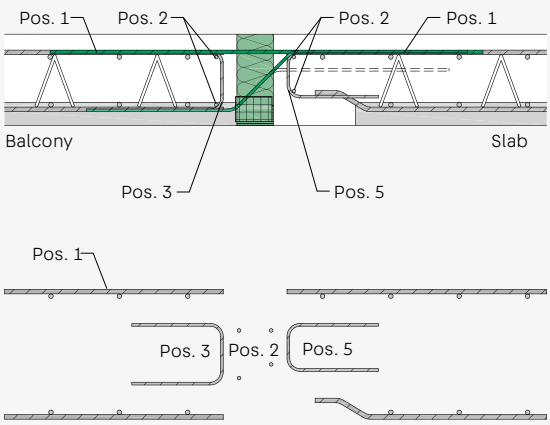
ISOPRO® IP 10 2-part to IP 100 2-part

Direct support



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 43
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side
- Pos. 3: Horizontal U-bar 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: Horizontal U-bar 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 43
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Horizontal U-bar 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: Horizontal U-bar 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 43

ISOPRO® IP 10 2-part to IP 100 2-part

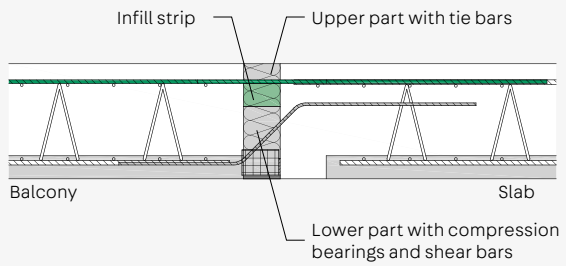
Connection reinforcement Pos. 1

Type	$a_{s,erf}$ cm²/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
	$a_{s,erf}$ cm²/m	$a_{s,erf}$ cm²/m	$a_{s,erf}$ cm²/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

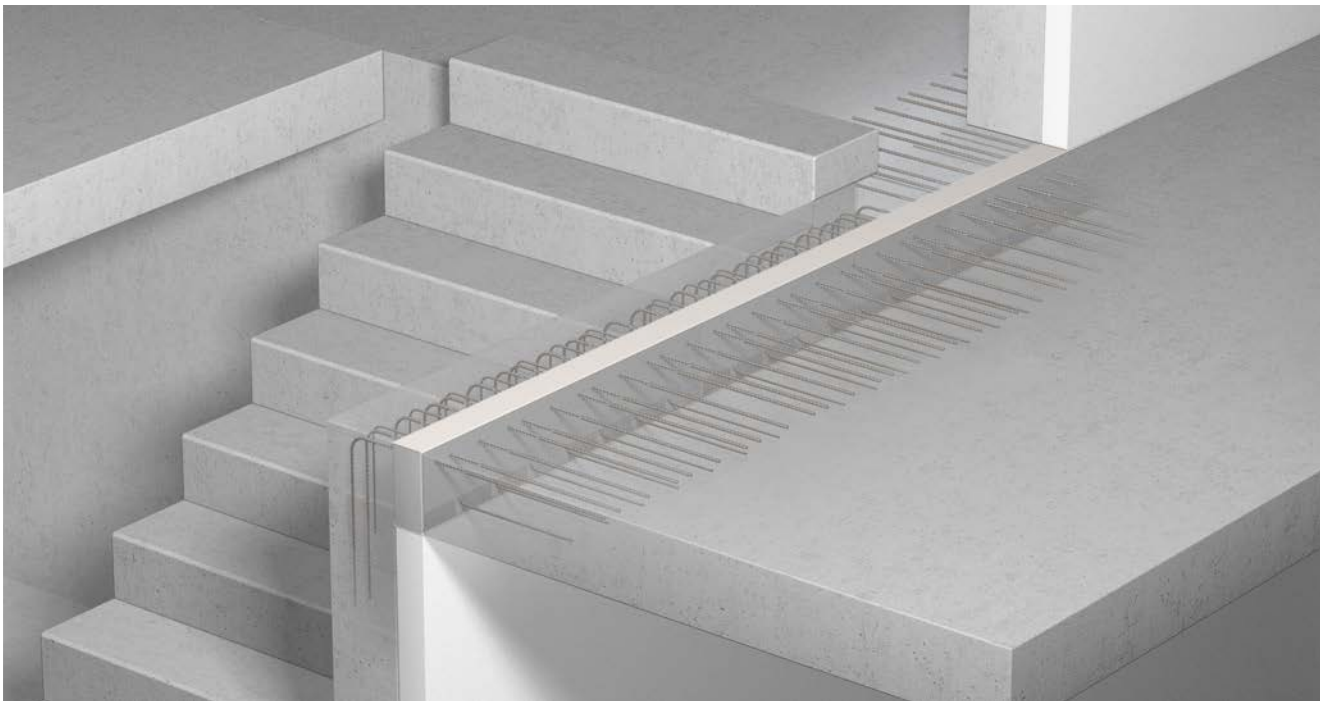
Installation of upper part



- The 2-part ISOPRO® element consists of a lower part and an upper part. The bottom part is cast in the precast 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 compression 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 ≥ 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

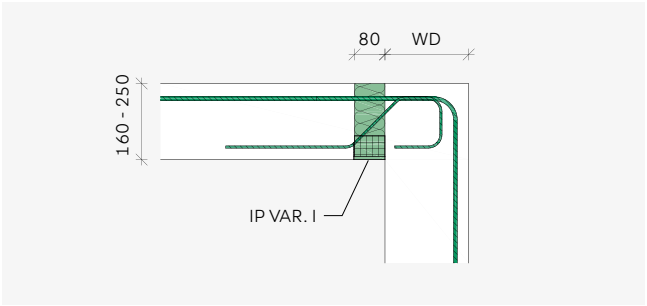
IP 65 Q8 cv35 h200 VAR. III HV 100 WD 220 REI 120

- REI 120 – Fire protection type
- WD 220 – Wall/downstand beam thickness WD 175, 200, 220, ≥ 240
- VAR. III HV 100 – Variant and height offset
- h200 – Element height
- cv35 – Concrete cover
- Q8 – Shear force load-bearing capacity
- IP 65 – Type and load-bearing capacity

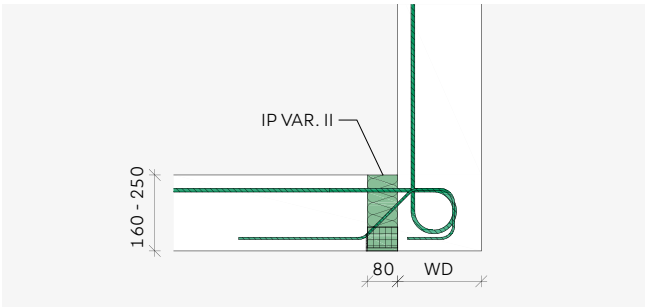
Application

Connection to a wall

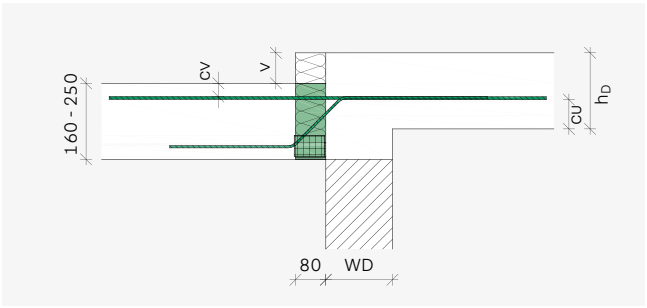
Wall connection downwards – IP VAR. I



Wall connection upwards – IP VAR. II



Connection to a slab with a slight height offset with a standard ISOPRO® element



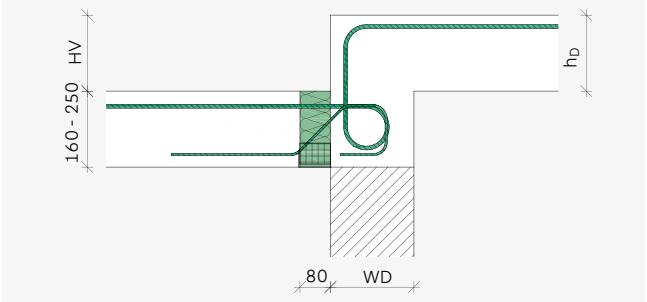
$v \leq h_D - cv - d_s - cu$

Where:

- v – is the height offset
- h_D – 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

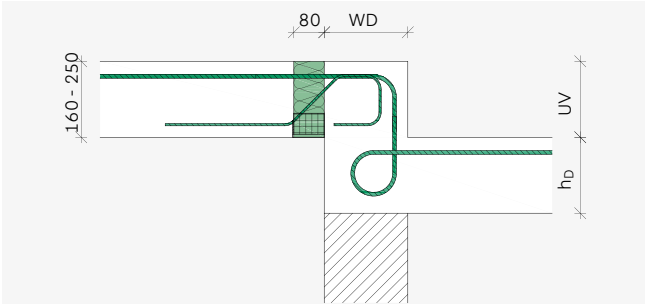
Connection to slabs with an offset of 90 to 240 mm

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
UV 80	≤ 80
UV 90	81 to ≤ 90
UV100	91 to ≤ 100
UV110	101 to ≤ 110
UV120	111 to ≤ 120
UV130	121 to ≤ 130
UV140	131 to ≤ 140

VAR. III UV	Height offset mm
UV150	141 to ≤ 150
UV160	151 to ≤ 160
UV170	161 to ≤ 170
UV180	171 to ≤ 180
UV190	181 to ≤ 190
UV200	191 to ≤ 200

Dimensioning table for concrete ≥ C25/30

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

Element height mm depending on cv mm					
35	50	IP 20 VAR.	IP 25 VAR.	IP 30 VAR.	IP 45 VAR.
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 transferred 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	1,000	1,000	1,000	1,000
Tie bars	7 Ø 8	10 Ø 8	7 Ø 10	8 Ø 10
Compression bearings	4	4	5	5
Shear bars, standard	6 Ø 6	6 Ø 6	6 Ø 6	6 Ø 6
Shear bars Q8	6 Ø 8	6 Ø 8	6 Ø 8	6 Ø 8

This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.

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

Element height mm depending on cv 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 transferred 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	1,000	1,000	1,000	1,000
Tie bars	9 Ø 10	10 Ø 10	12 Ø 10	13 Ø 10
Compression bearings	6	6	7	8
Shear bars, standard	6 Ø 6	6 Ø 6	6 Ø 6	6 Ø 6
Shear bars Q8	6 Ø 8	6 Ø 8	6 Ø 8	6 Ø 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 α 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:

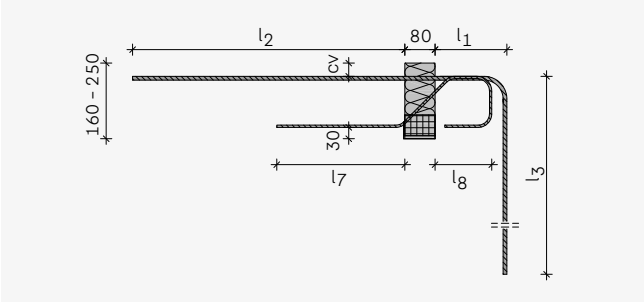
w = deformation at the end of the cantilever mm
tan α = deformation factor, see product information
m_{Ed} = bending moment for the calculating the precamber due to the ISOPRO® element. The design engineer determines the definitive load combination in the serviceability limit state.
m_{Rd} = moment of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

Deformation factor tan α for concrete ≥ C 25/30

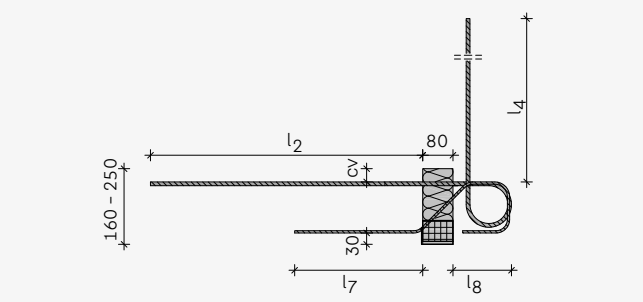
	Concrete cover cv mm									**Element height h** mm	
Type		**160**	**170**	**180**	**190**	**200**	**210**	**220**	**230**	**240**	**250**
IP 20 VAR. to IP 25 VAR.	35	0.63	0.57	0.53	0.49	0.45	0.42	0.40	0.37	0.35	0.34
	50	–	–	0.60	0.55	0.50	0.47	0.44	0.41	0.38	0.36
IP 30 VAR. to IP 75 VAR.	35	0.73	0.66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

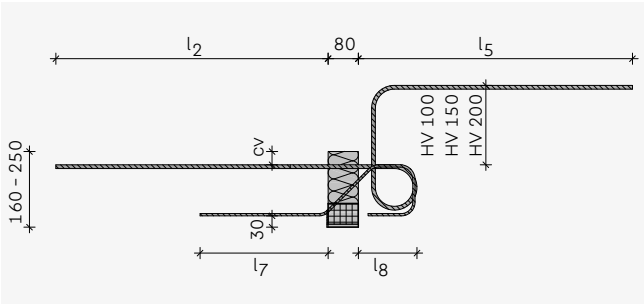
IP VAR. I



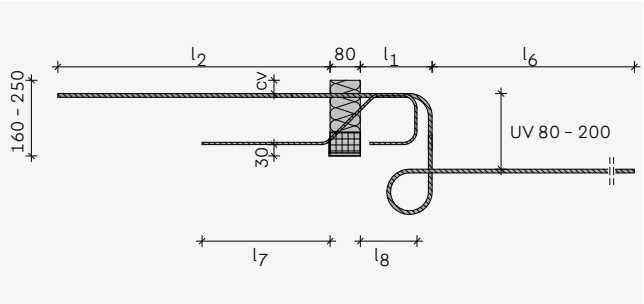
IP VAR. II



IP VAR. III HV



IP VAR. III UV



Tie bar dimensions in mm

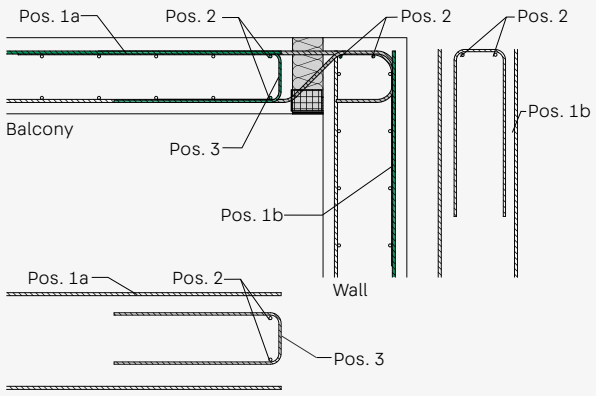
	IP 20 + IP 25				IP 30 – 75			
WD	**175**	**200**	**220**	**≥ 240**	**175**	**200**	**220**	**≥ 240**
l_1	155	170	190	210	–	170	190	210
l_2 (max.)	≤ 615	≤ 615	≤ 615	≤ 615	710	710	710	710
l_3	577	577	577	577	764	764	764	764
l_4	422	422	422	422	526	526	526	526
l_5 (max.)	623	623	623	623	774	774	774	774
l_6	534	534	534	534	635	635	635	635

Shear bar dimensions in mm

	Shear force load-bearing capacity			
	Standard		Q8	
WD	**175**	**≥ 200**	**175**	**≥ 200**
l_7	344	344	378	378
l_8	150	150	155	170

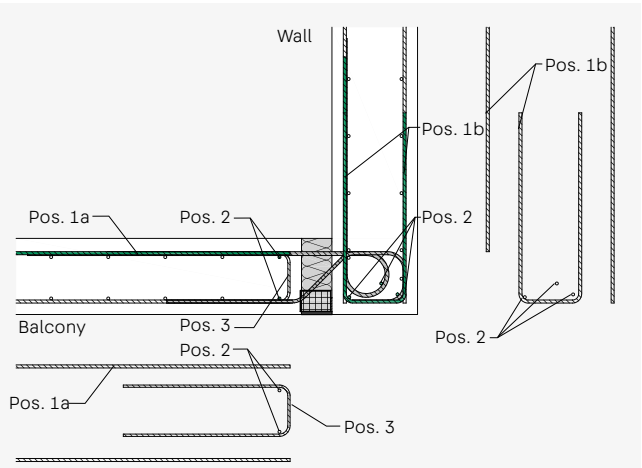
On-site reinforcement

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: Longitudinal reinforcement 2 Ø 8 balcony side, 2 Ø 8 wall side
- Pos. 3: Horizontal U-bar 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 horizontal U-bar 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

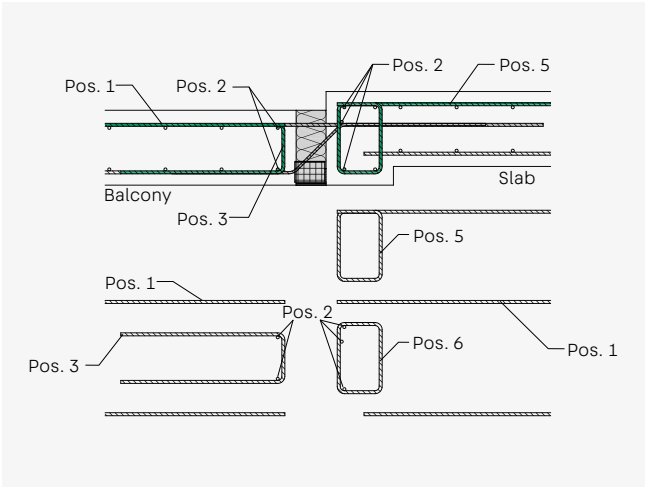


- Pos. 1a: Balcony-side connection reinforcement for the ISOPRO® element – see table
- Pos. 1b: Ceiling-side connection reinforcement to absorb the connection moment and the shear force in the wall according to the specifications of the structural engineer.
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side, 3 Ø 8 wall side
- Pos. 3: Horizontal U-bar 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 horizontal U-bar 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

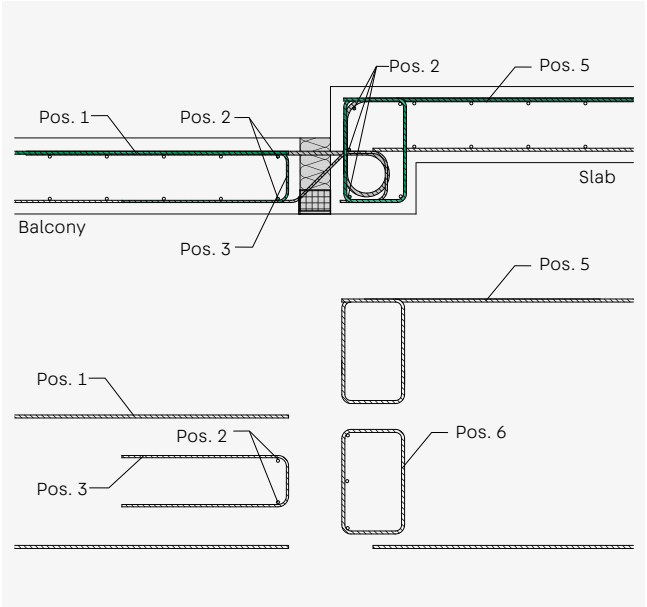
	IP 20 VAR.	IP 25 VAR.	IP 30 VAR.	IP 45 VAR.	IP 50 VAR.	IP 55 VAR.	IP 65 VAR.	IP 75 VAR.
$a_{s,erf}$ cm²/m	3.79	5.36	5.84	6.65	7.46	8.26	9.87	13.60
Recommendation	8 Ø 8	11 Ø 8	8 Ø 10	9 Ø 10	10 Ø 10	11 Ø 10	13 Ø 10	14 Ø 10

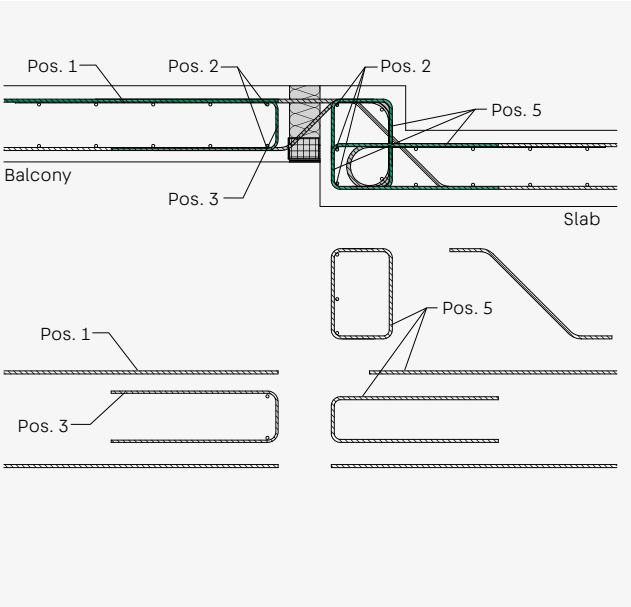
Connection to a slab with a slight height offset with a standard IP element



- Pos. 1: Connection reinforcement for the ISOPRO® element – page 38
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side, 3 Ø 8 slab side
- Pos. 3: Horizontal U-bar 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 horizontal U-bar 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

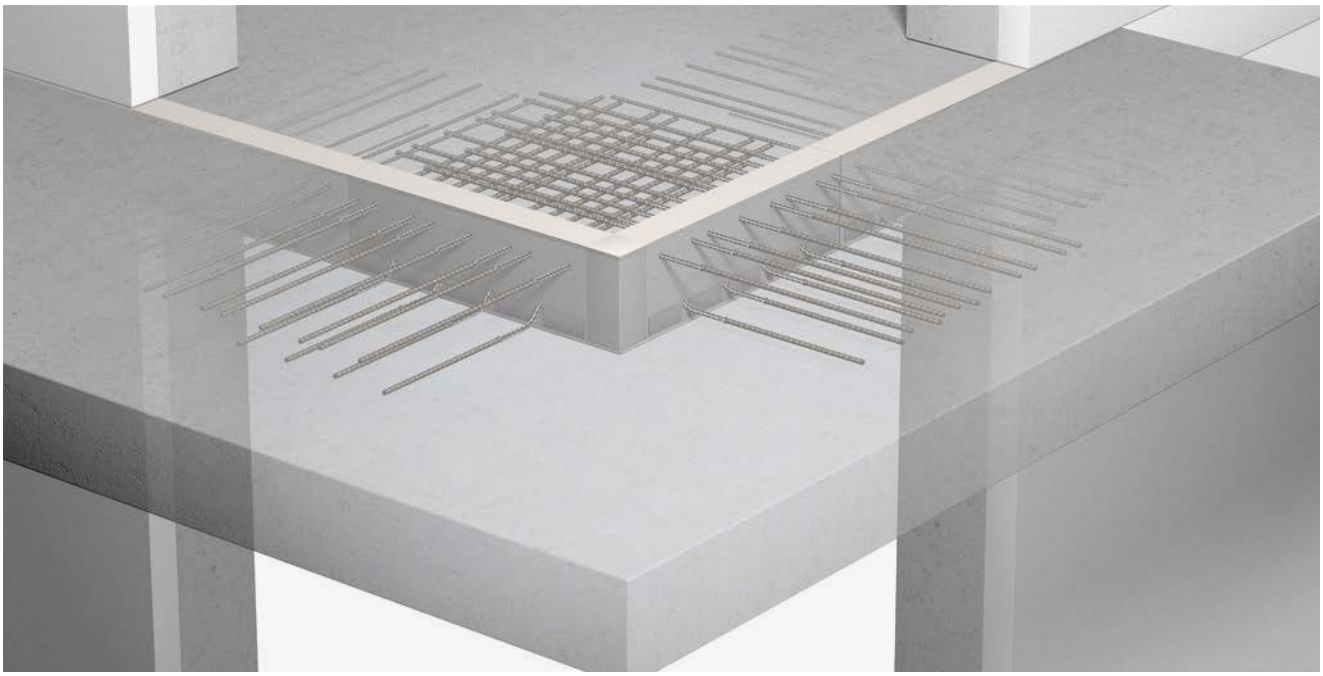




- Pos. 1: Connection reinforcement for the ISOPRO® element – see table page 50
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side, 3 Ø 8 slab side
- Pos. 3: Horizontal U-bar parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Horizontal U-bar 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 compression bearings
- IPT Corner – Pressure plane with steel compression bars
- 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 REI 90 (REI 120 with an utilization of ≤ 85% in ULS)

ISOPRO® IP(T) partial element EL/ER

- IP EL/ER partial element – Pressure plane with concrete compression bearings
- IPT EL/ER partial element – Pressure plane with steel compression bars
- 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 REI 90 (REI 120 with an utilization of ≤ 85% in ULS)

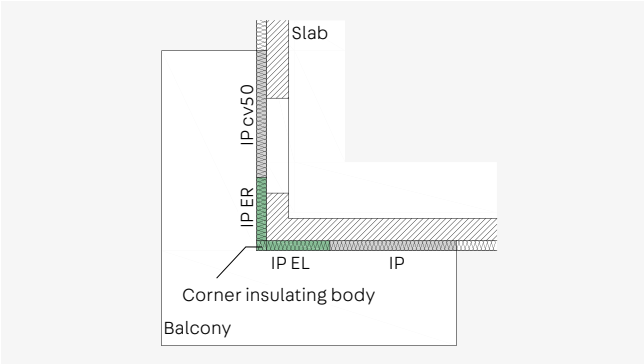
Type designation

IP Corner 20 cv35 h200 REI 120

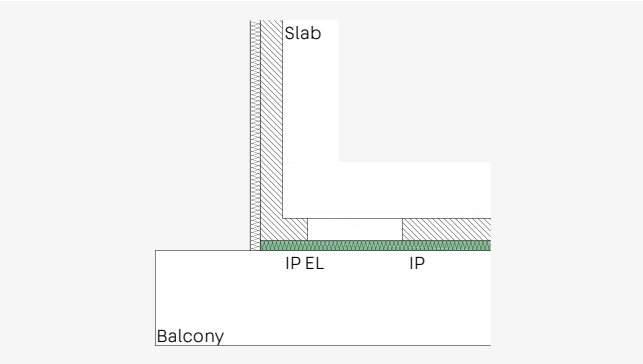
- REI 120 – Fire protection type
- h200 – Element height
- cv35 – Concrete cover
- IP Corner 20 – Type and load-bearing capacity

Application – Element layout

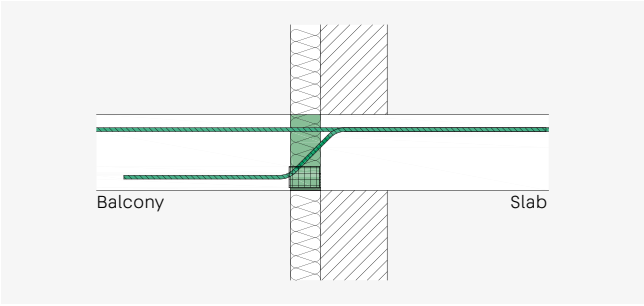
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



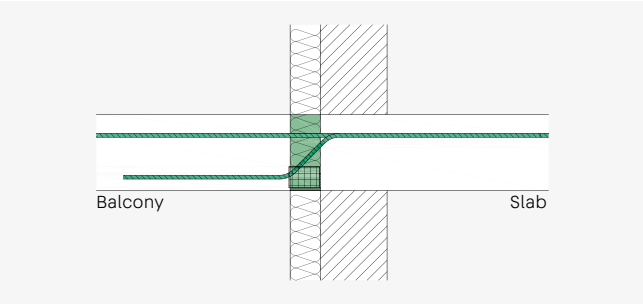
ISOPRO® IP Corner – Cantilevered outer corner balcony



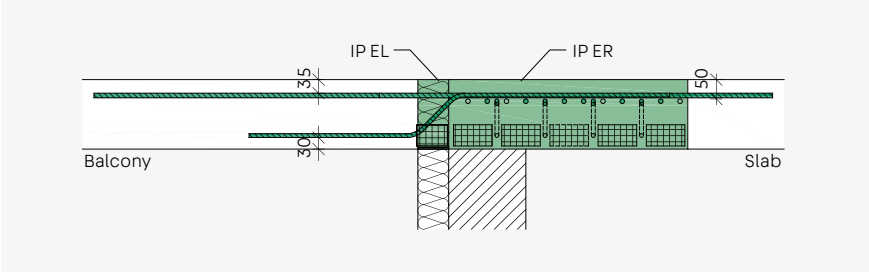
ISOPRO® IP EL – Cantilevered balcony with slab overhanging the support



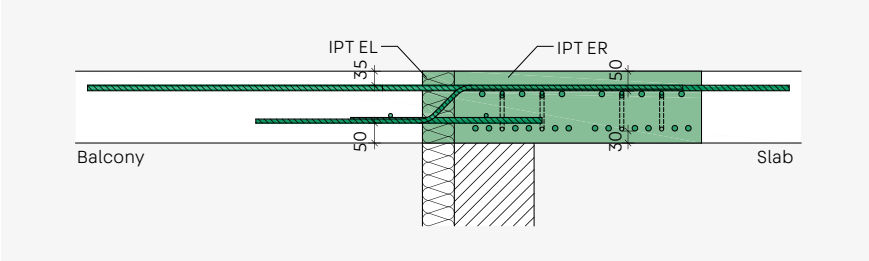
ISOPRO® IP EL/ER – Installation cross-section cv35



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



ISOPRO® IP Corner – Cross-section of corner situation



ISOPRO® IPT Corner – Cross-section of corner situation

Dimensioning table for concrete ≥ C25/30

Rated values of the moments that can be transferred 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 transferred 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	Compression bearing DL/ Compression bar DS	Shear bars h = 180 - 190 mm	Shear bars h = 200 - 250 mm
IP Corner 20	500 + 500	2x 5 Ø 10	2x 3 DL	2x 3 Ø 8	2x 3 Ø 8
IP Corner 30	620 + 620	2x 6 Ø 12	2x 5 DL	2x 4 Ø 10	2x 4 Ø 12
IPT Corner 50	620 + 620	2x 6 Ø 14	DS 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

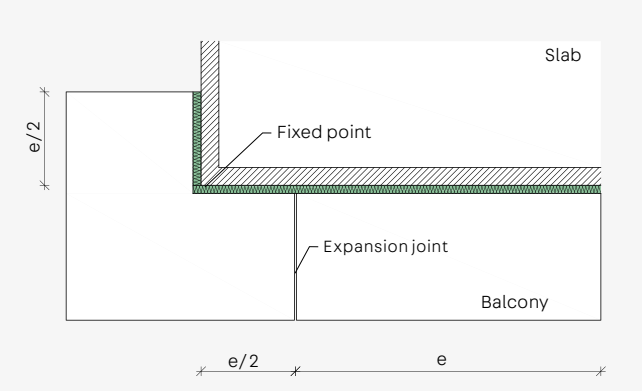
The required precamber of the reinforced concrete components is calculated in the same way as for ISOPRO® elements (page 32) using the deformation factors below.

Deformation factor tan α for concrete ≥ C 25/30

	Concrete cover cv mm							**Element height h** mm	
Type		**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.



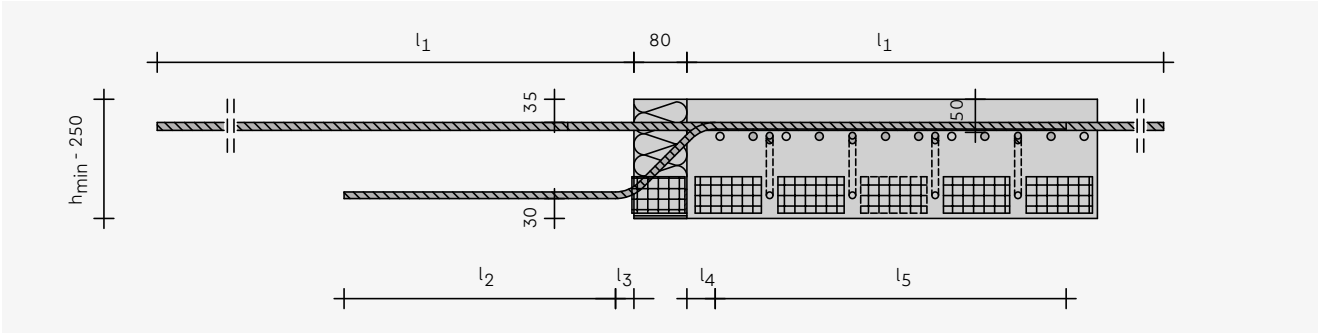
Expansion joint arrangement for corner balconies

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 dimensions

ISOPRO® IP Corner

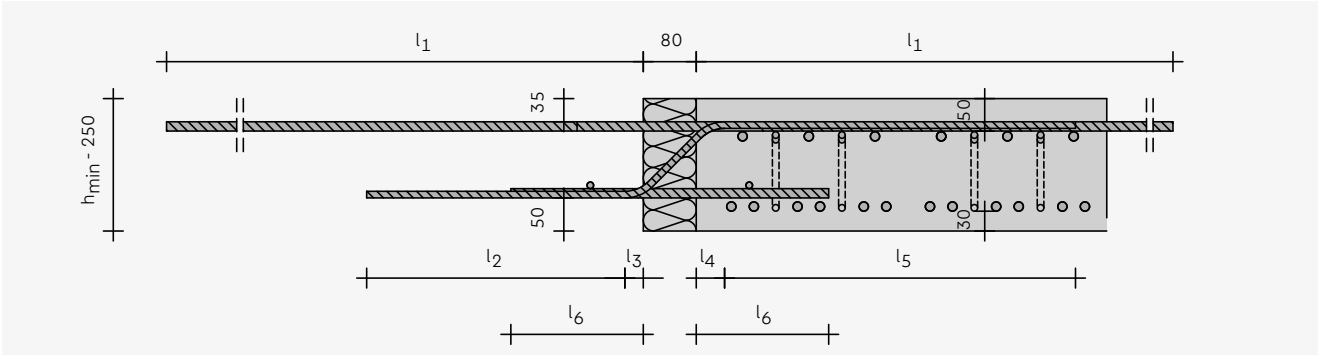


Length of tie bar mm	IP Corner 20	IP Corner 30
l_1	630	730

Length of shear bar mm	IP Corner 20 h180 – 190	IP Corner 20 h200 – 250	IP Corner 30 h180 – 190	IP Corner 30 h200 – 250
l_2	420	420	530	630
l_3	28	28	33	42
l_4*	30	45-95	35	47-98
l_5	420	420	530	630

* depending on the height

ISOPRO® IPT Corner



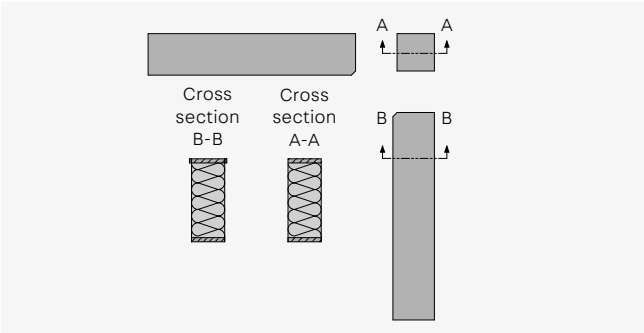
Length of tie bar mm	IPT Corner 50
l_1	840

Length of shear bar mm	IPT Corner 50 h180 – 190	IPT Corner 50 h200 – 250
l_2	530	630
l_3	33	42
l_4*	35	47-95
l_5	530	630

* depending on the height

Length of compression strut mm	IPT Corner 50
l_6	200

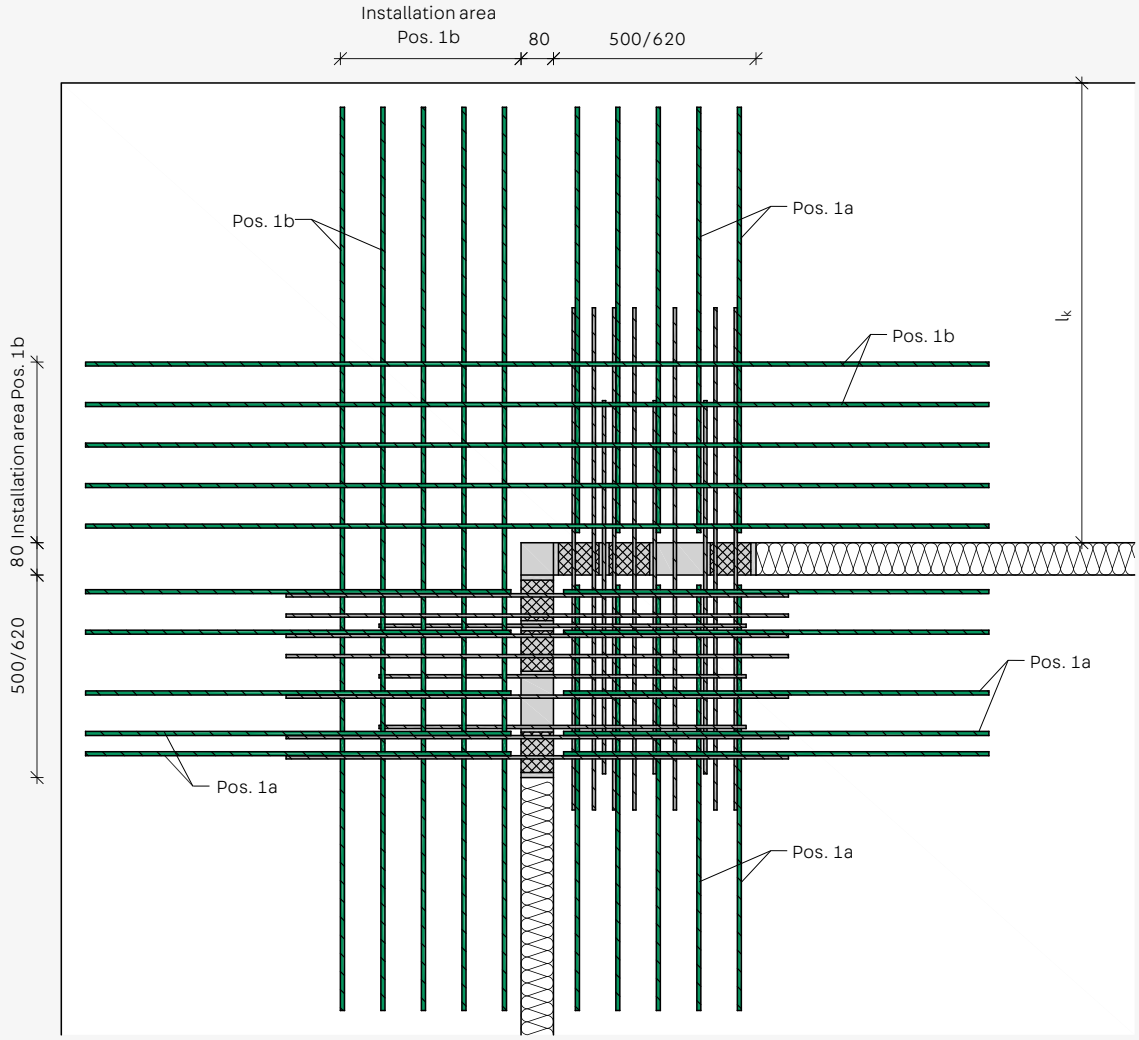
ISOPRO® IP Corner fire protection version



ISOPRO® IP Corner – Fire protection version, diagram of insulating body

On-site reinforcement

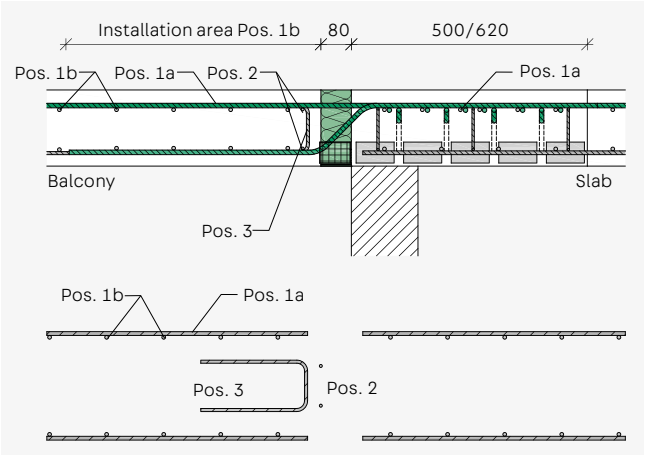
ISOPRO® IP Corner and IPT Corner



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

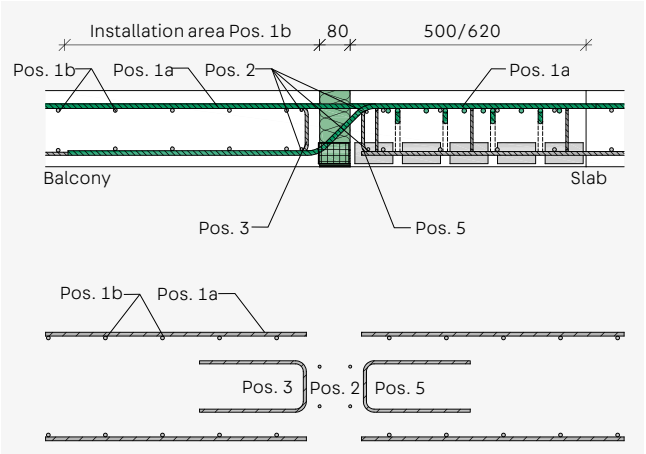
ISOPRO® IP Corner and IPT Corner

Direct support



- Pos. 1a: Connection reinforcement and Pos. 1b supplementary reinforcement for the ISOPRO® element – see table
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side
- Pos. 3: Horizontal U-bar 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: Horizontal U-bar 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)

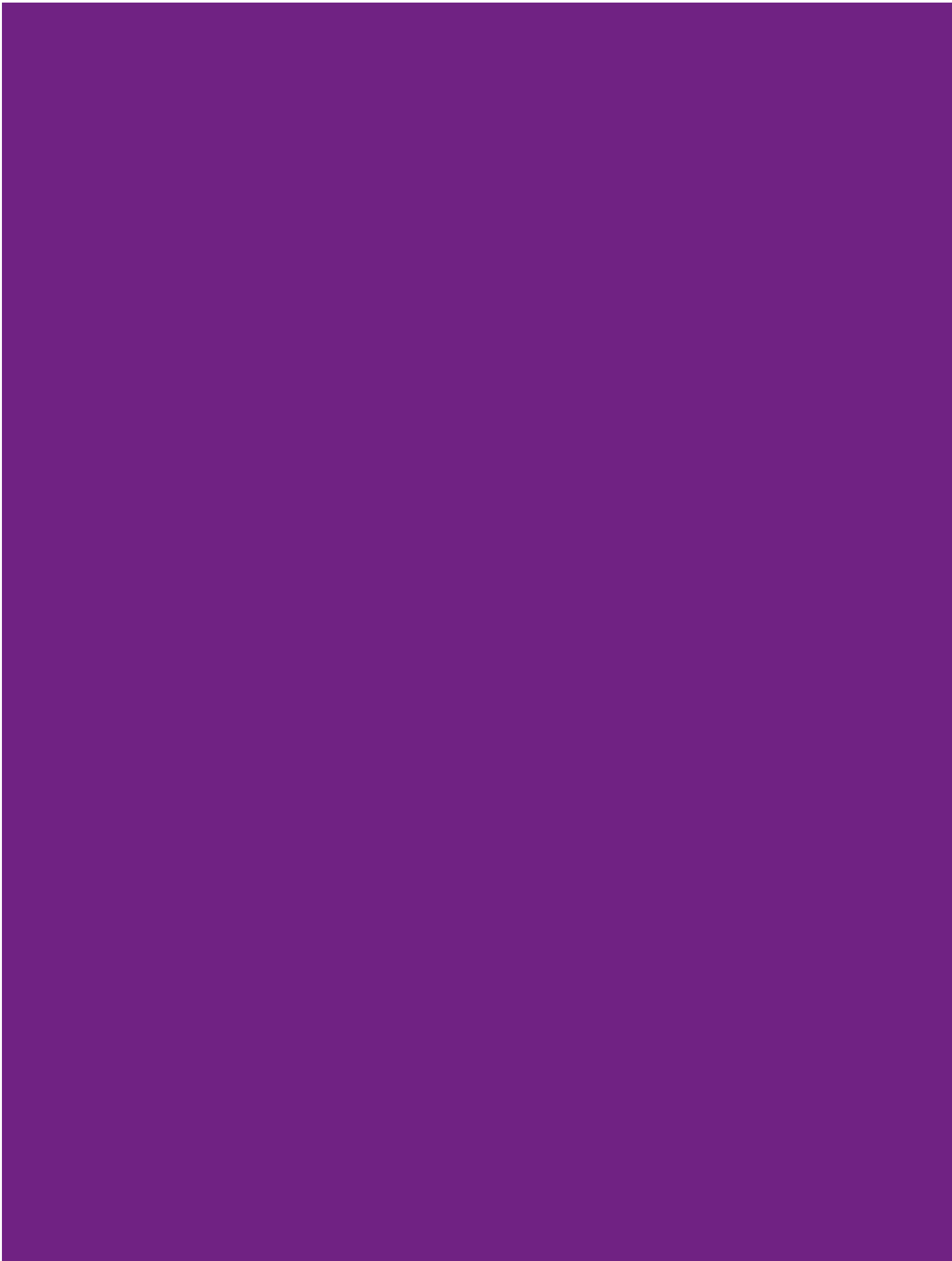
Indirect support



- Pos. 1a: Connection reinforcement and Pos. 1b supplementary reinforcement for the ISOPRO® element – see table
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 balcony and slab side
- Pos. 3: Horizontal U-bar 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: Horizontal U-bar 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

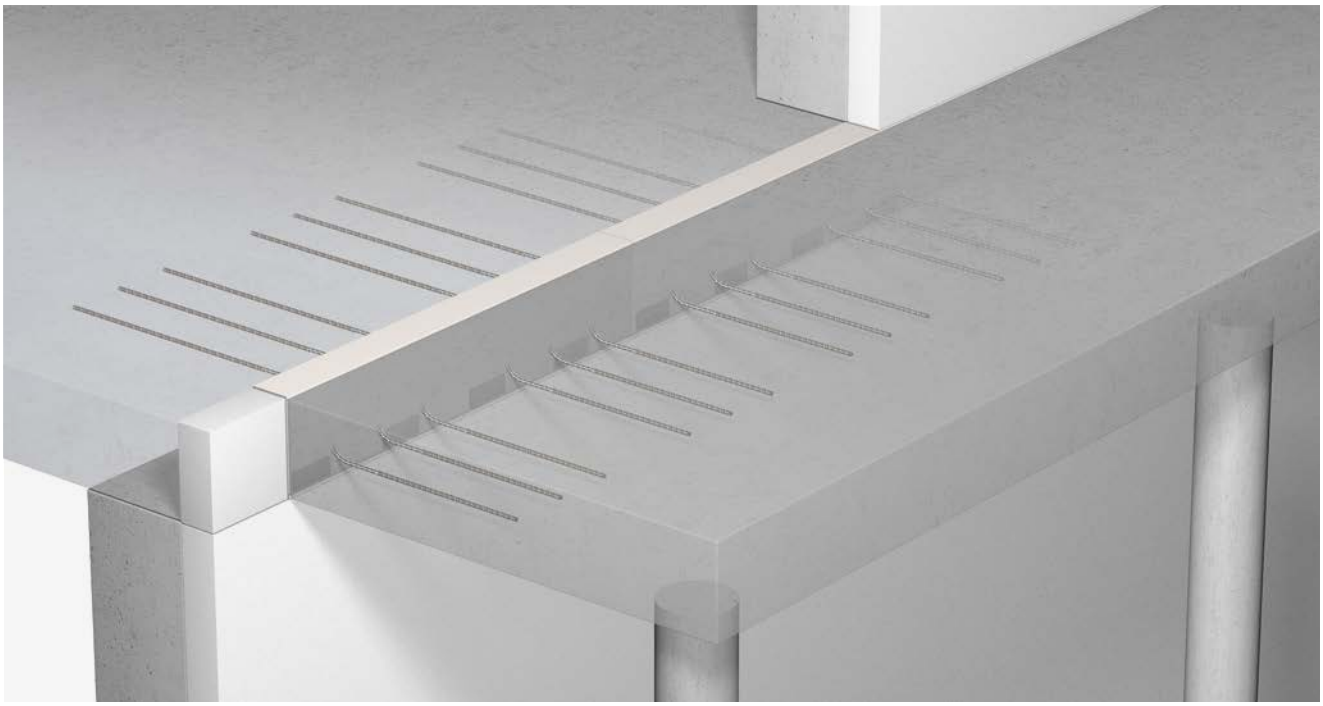
	IP Corner 20	IP Corner 30	IPT Corner 50
Connection reinforcement Pos. 1a	5 Ø 10	6 Ø 12	5 Ø 14
Bar length Pos. 1a	l_k - 70	l_k - 70	l_k - 70
Supplementary reinforcement Pos. 1b	2 x 5 Ø 10/100	2 x 6 Ø 12/100	2 x 5 Ø 14/100
Bar length Pos. 1b	2 x l_k	2 x l_k	2 x l_k
Installation area Pos. 1b	460	570	460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

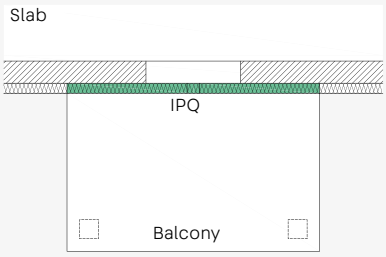
- Short elements for peak load at specific points
- Element length depending on load-bearing capacity: 0.3 m, 0.4 m or 0.5 m
- ISOPRO® IPQS pressure plane with concrete compression bearings
- ISOPRO® IPTQS pressure plane with steel compression bars
- ISOPRO® IPQZ for tension-free support without pressure 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 REI 90 (REI 120 with an utilization of ≤ 85% in ULS)

Type designation

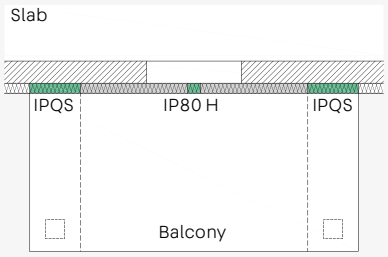
IPQ 20 h200 REI 120

- REI 120 — Fire protection type
- h200 — Element height
- IPQ 20 — Type and load-bearing capacity

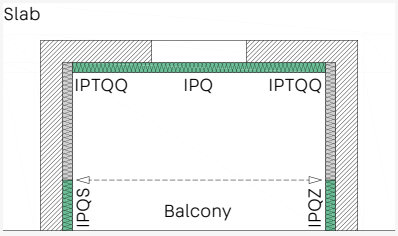
Application – Element layout



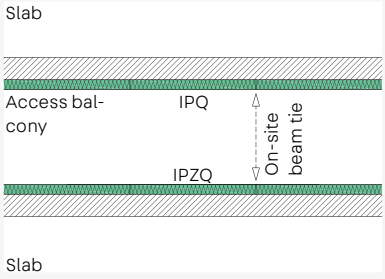
ISOPRO® IPQ – Supported balcony



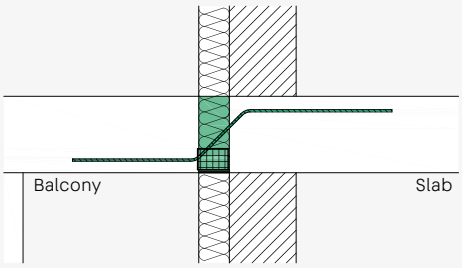
ISOPRO® IPQS – Supported balcony with downstand beams and support at specific points with ISOPRO® IPQS elements



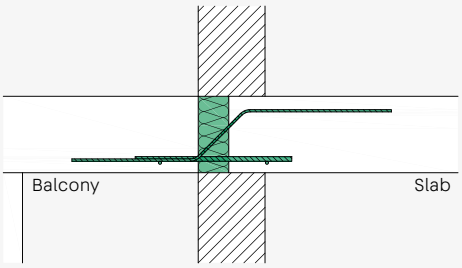
ISOPRO® IPQ, IPTQQ, IPQS/IPTQS, IPQZ – Loggia balcony with peak loads at specific points and tension-free support at the front



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

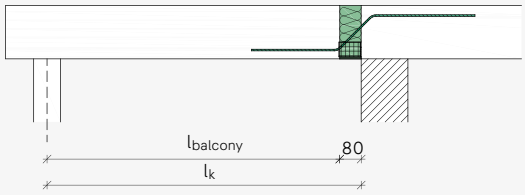


ISOPRO® IPQ, IPQS – Installation cross-section, external thermal insulation composite system



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.

Dimensioning table for concrete ≥ C25/30

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

Type	Shear force V_{Rd} kN/m	Element height mm	Element length mm	Shear bars	Compression bearings
				Configuration	Configuration
IPQ 10	34.8	≥ 160	1,000	4 Ø 6*	4 TB
IPQ 20	43.5	≥ 160	1,000	5 Ø 6*	4 TB
IPQ 30	52.2	≥ 160	1,000	6 Ø 6*	4 TB
IPQ 40	69.5	≥ 160	1,000	8 Ø 6*	4 TB
IPQ 50	86.9	≥ 160	1,000	10 Ø 6*	4 TB
IPQ 70	92.7	≥ 160	1,000	6 Ø 8	4 TB
IPQ 80	108.2	≥ 160	1,000	7 Ø 8	4 TB
IPQ 85	123.6	≥ 160	1,000	8 Ø 8	4 TB
IPQ 90	154.5	≥ 160	1,000	10 Ø 8	4 TB
IPQ 100	193.2	≥ 170	1,000	8 Ø 10	4 TB
IPQ 110	217.3	≥ 170	1,000	9 Ø 10	4 TB
IPQ 120	241.5	≥ 170	1,000	10 Ø 10	4 TB

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

Type	Shear force V_{Rd} kN/m	Element height mm	Element length mm	Shear bars	Compression bearings
				Configuration	Configuration
IPZQ 10	34.8	≥ 160	1,000	4 Ø 6*	–
IPZQ 20	43.5	≥ 160	1,000	5 Ø 6*	–
IPZQ 30	52.2	≥ 160	1,000	6 Ø 6*	–
IPZQ 40	69.5	≥ 160	1,000	8 Ø 6*	–
IPZQ 50	86.9	≥ 160	1,000	10 Ø 6*	–
IPZQ 70	92.7	≥ 160	1,000	6 Ø 8	–
IPZQ 80	108.2	≥ 160	1,000	7 Ø 8	–
IPZQ 85	123.6	≥ 160	1,000	8 Ø 8	–
IPZQ 90	154.5	≥ 160	1,000	10 Ø 8	–
IPZQ 100	193.2	≥ 170	1,000	8 Ø 10	–
IPZQ 110	217.3	≥ 170	1,000	9 Ø 10	–
IPZQ 120	241.5	≥ 170	1,000	10 Ø 10	–

This section contains planning aids and specific information on this product. In addition, the general notes on materials, structural design, fire protection, installation on site etc. on pages 12 – 23 must also be taken into account.

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

Type	Shear force V_{Rd} kN	Element height mm	Element length mm	Shear bars	Compression bearings/compression bars
				Configuration	Configuration
IPQS 5	26.1	≥ 160	400	3 Ø 6*	2 TB
IPQS 10	30.9	≥ 160	300	2 Ø 8	1 TB
IPQS 15	34.8	≥ 160	500	4 Ø 6*	2 TB
IPQS 20	46.4	≥ 160	400	3 Ø 8	2 TB
IPQS 30	61.8	≥ 160	500	4 Ø 8	2 TB
IPQS 40	48.3	≥ 170	300	2 Ø 10	1 TB
IPQS 50	72.4	≥ 170	400	3 Ø 10	2 TB
IPQS 55	96.6	≥ 170	500	4 Ø 10	2 TB
IPTQS 60	69.5	≥ 180	300	2 Ø 12	CS 3 Ø 14
IPQS 70	104.3	≥ 180	400	3 Ø 12	2 TB
IPQS 75	139.1	≥ 180	500	4 Ø 12	3 TB
IPTQS 80	94.7	≥ 190	300	2 Ø 14	CS 4 Ø 14
IPTQS 90	142.0	≥ 190	400	3 Ø 14	CS 6 Ø 14
IPTQS 100	189,3	≥ 190	500	4 Ø 14	DS 8 Ø 14

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

Type	Shear force V_{Rd} kN	Element height mm	Element length mm	Shear bars	Compression bearings
				Configuration	Configuration
IPQZ 5	26.1	≥ 160	400	3 Ø 6*	–
IPQZ 10	30.9	≥ 160	300	2 Ø 8	–
IPQZ 15	34.8	≥ 160	500	4 Ø 6*	–
IPQZ 20	46.4	≥ 160	400	3 Ø 8	–
IPQZ 30	61.8	≥ 160	500	4 Ø 8	–
IPQZ 40	48.3	≥ 170	300	2 Ø 10	–
IPQZ 50	72.4	≥ 170	400	3 Ø 10	–
IPQZ 55	96.6	≥ 170	500	4 Ø 10	–
IPQZ 60	69.5	≥ 180	300	2 Ø 12	–
IPQZ 70	104.3	≥ 180	400	3 Ø 12	–
IPQZ 75	139.1	≥ 180	500	4 Ø 12	–
IPQZ 80	94.7	≥ 190	300	2 Ø 14	–
IPQZ 90	142.0	≥ 190	400	3 Ø 14	–
IPQZ 100	189,3	≥ 190	500	4 Ø 14	–

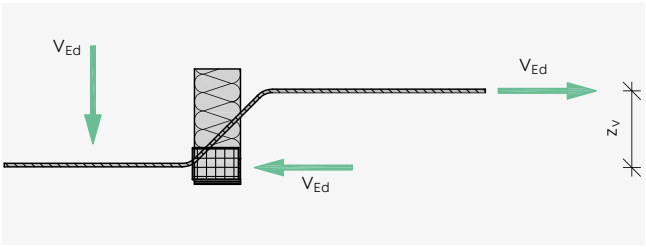
* Elements with Ø 6 shear bars have a looped bar on the slab side. For all other elements, the shear bar on the slab side is straight (see also page 67).

Dimensioning – Expansion joints

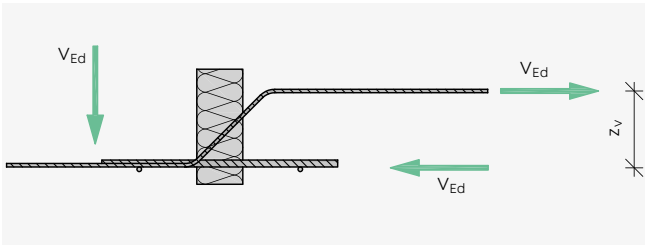
Moments caused by eccentric connection

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 ΔM_{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 compression bearings z_v – Lever arm for determining the eccentric moment



ISOPRO® IPTQS – Elements with steel compression bars z_v – Lever arm for determining the eccentric moment

Eccentric moments ISOPRO® IPQ, IPZQ

	Δm_{Ed} kNm/m	
Type	**h < 200** mm	**h ≥ 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

	ΔM_{Ed} kNm	
Type	**h < 200** mm	**h ≥ 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
IPTQS/IPQZ 100	21,1	22,9

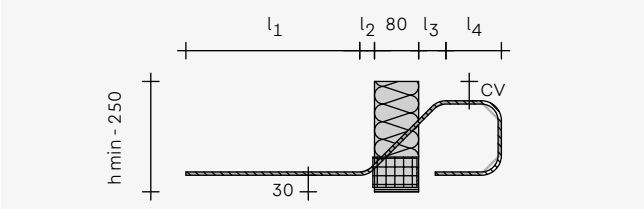
Maximum permissible expansion joint spacing

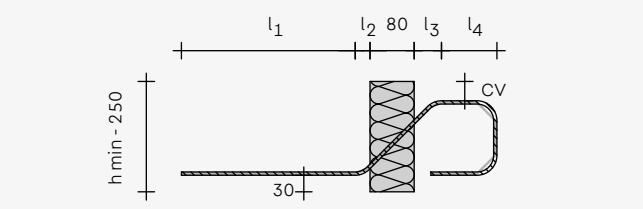
	IPQ/IPZQ 10 to 120 **IPQS/IPQZ 5 to 40, 50, 55**	**IPQS/IPQZ 45, 70, 75**	**IPTQS/IPQZ 60, 80, 90**
Joint spacing e m	13.0	11.3	10.1

Element dimensions

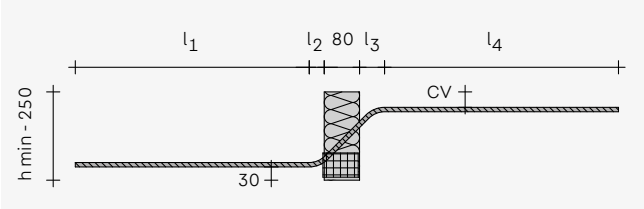
ISOPRO® IPQ, IPQS, IPTQS, IPZQ*, IPQZ*

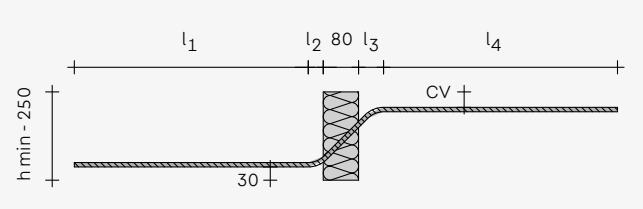
Shear bar Ø 6



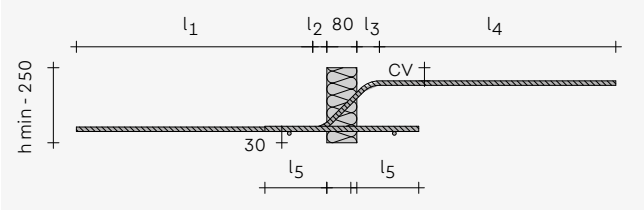


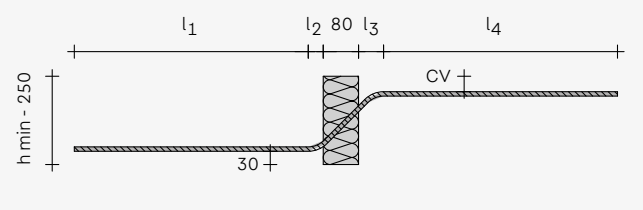
Shear bar ≥ Ø 8 – 12





Shear bar ≥ Ø 12 – 14





Dimensions in mm

IPQ	10 – 50	70 – 90	100 – 120	–	–	–
IPZQ	10 – 50	70 – 90	100 – 120	–	–	–
IPQS	5, 15	10 – 30	40 – 55	70 – 75	–	–
IPQZ	5, 15	10 – 30	40 – 55	60 – 75	80 – 100	–
IPTQS	–	–	–	60	80 – 100	60, 80 – 100
Ø bar	**Ø 6**	**Ø 8**	**Ø 10**	**Ø 12**	**Ø 14**	**Ø 14**
				Length of shear bar mm		Length compression bar mm
l_1	320	420	530	630	740	-
l_2	24	28	33	42	47	-
l_3*	150[1]	420	530	630	740	-
l_4	150[1]	15-95	28-98	35-95	58-98	-
l_5	-	-	-	-	-	185
h_{min}	160	160	170	180	200	-

* depending on the height
[1] l_3+l_4 fix 150

Concrete cover

Element height h mm	Concrete cover cv mm
160	35
170	45
180	35
190	45
200	35
210	45
220	35
230	45
240	55
250	65

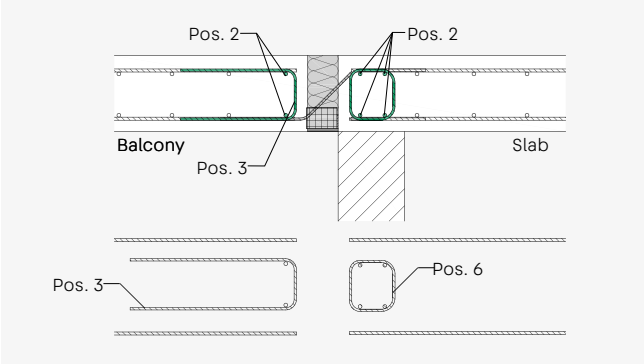
Notes
The concrete cover of the compression bars and the shear bars at the bottom is generally 30 mm. The concrete cover of the shear bars at the top is from cv35 to cv85 depending on the element height and bar diameter.

* IPZQ and IPQZ elements have no pressure plane

On-site reinforcement

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

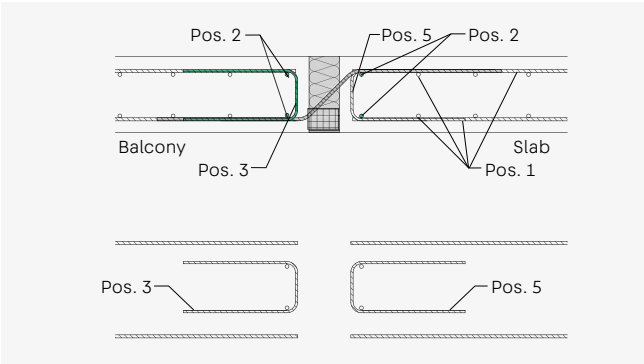
Direct support



- 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: Longitudinal reinforcement 2 Ø 8 balcony side, 4 Ø 8 slab side
- Pos. 3: Horizontal U-bar 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: Horizontal U-bar 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 – Straight shear bar on the slab side

Indirect support



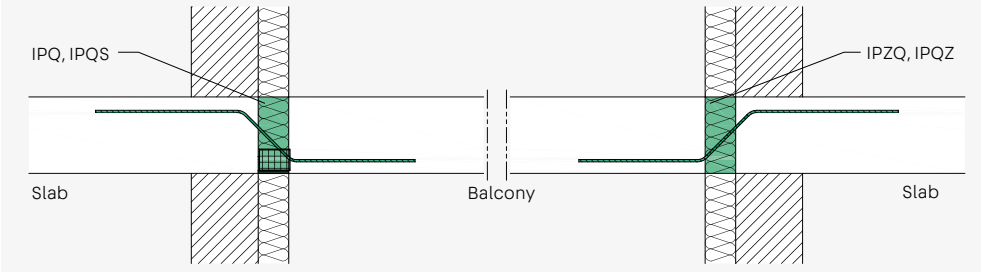
- Pos. 1: Slab reinforcement in line with DIN EN 1992-1-1 according to the specifications of the structural engineer
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 balcony side and slab side
- Pos. 3: Horizontal U-bar parallel to the insulation element in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- Pos. 4: Horizontal U-bar 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

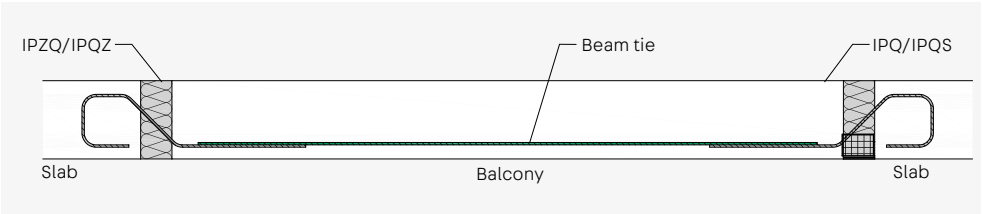
Type	Suspension reinforcement Pos. 5 $A_{s,erf}$ cm²
IPQ/IPZQ 10	0.80
IPQ/IPZQ 20	1.00
IPQ/IPZQ 30	1.20
IPQ/IPZQ 40	1.60
IPQ/IPZQ 50	2.00
IPQ/IPZQ 70	2.13
IPQ/IPZQ 80	2.49
IPQ/IPZQ 85	2.84
IPQ/IPZQ 90	3.55
IPQ/IPZQ 100	4.44
IPQ/IPZQ 110	5.00
IPQ/IPZQ 120	5.55

Type	Suspension reinforcement Pos. 5 $A_{s,erf}$ cm²
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
IPTQS/IPQZ 100	4,34

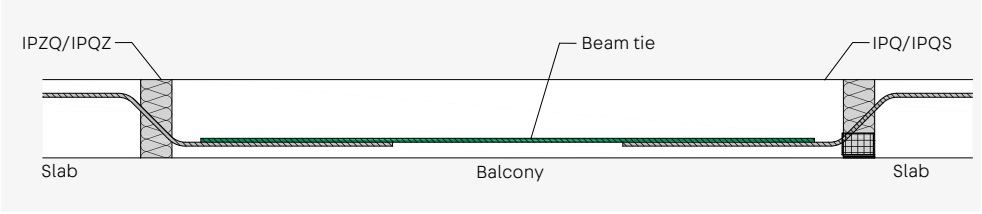
On-site reinforcement with tension-free support



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 Ø 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

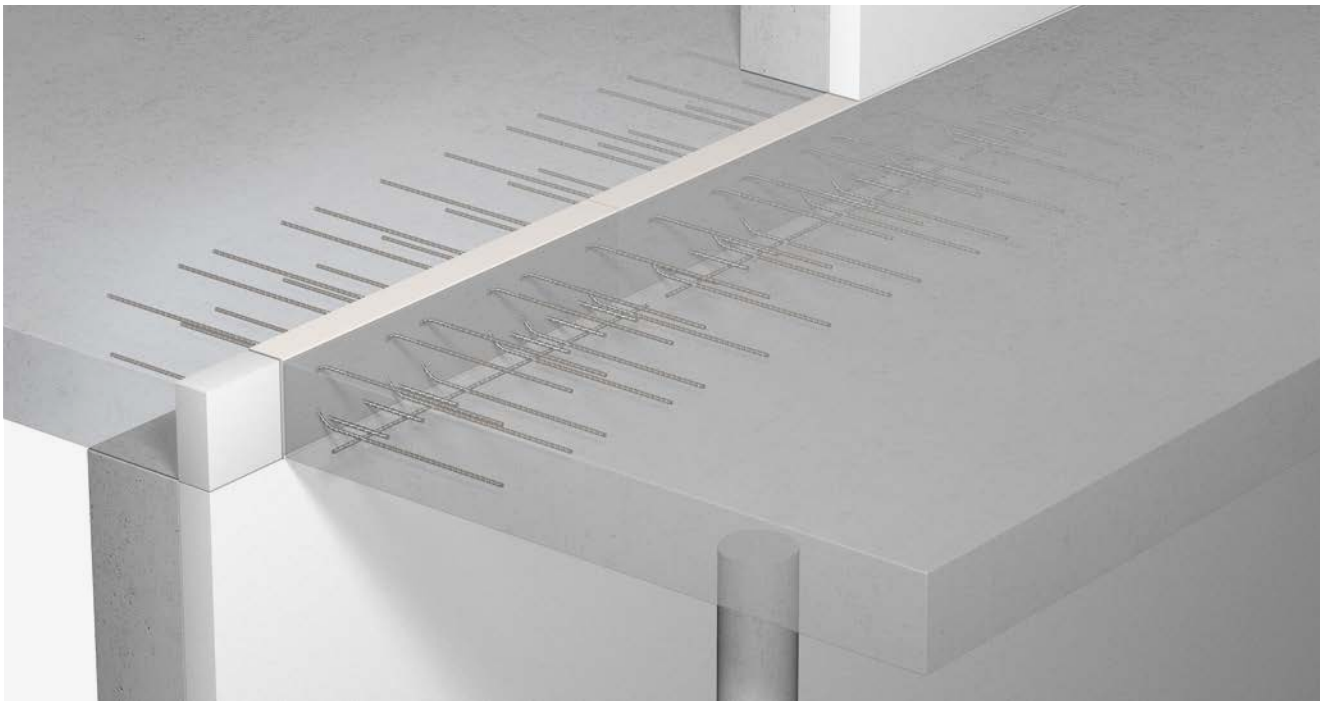
Type	Beam tie
IPZQ 10	4 Ø 6
IPZQ 20	5 Ø 6
IPZQ 30	6 Ø 6
IPZQ 40	8 Ø 6
IPZQ 50	10 Ø 6
IPZQ 70	6 Ø 8
IPZQ 80	7 Ø 8
IPZQ 85	8 Ø 8
IPZQ 90	10 Ø 8
IPZQ 100	8 Ø 10
IPZQ 110	9 Ø 10
IPZQ 120	10 Ø 10

ISOPRO® IPQZ beam tie

Type	Beam tie
IPQZ 5	3 Ø 6
IPQZ 10	2 Ø 8
IPQZ 15	4 Ø 6
IPQZ 20	3 Ø 8
IPQZ 30	4 Ø 8
IPQZ 40	2 Ø 10
IPQZ 50	3 Ø 10
IPQZ 55	4 Ø 10
IPQZ 60	2 Ø 12
IPQZ 70	3 Ø 12
IPQZ 75	4 Ø 12
IPQZ 80	2 Ø 14
IPQZ 90	3 Ø 14
IPQZ 100	4 Ø 14

ISOPRO® IPTQQ and IPTQQS

Elements for supported balconies with uplift loads



ISOPRO® IPTQQ

- For transmitting positive and negative shear forces, element length 1.0 m
- Pressure plane with steel compression bars
- Load-bearing capacities IPTQQ 10 to IPTQQ 110
- IPZQQ elements without compression bars are also available for tension-free support
- Element heights depending on the bar diameter: from 160 mm
- Fire resistance class REI 90 available (REI 120 with an utilization of ≤ 85% in ULS)

ISOPRO® IPTQQS

- Element length depending on load-bearing capacity: 0.3 m, 0.4 m or 0.5 m
- Pressure plane with steel compression bars
- Load-bearing capacities IPTQQS 10 to IPTQQS 100
- IPQQZ elements without compression bars are also available for tension-free support
- Element heights depending on the bar diameter: from 160 mm
- Fire resistance class REI 90 available (REI 120 with an utilization of ≤ 85% in ULS)

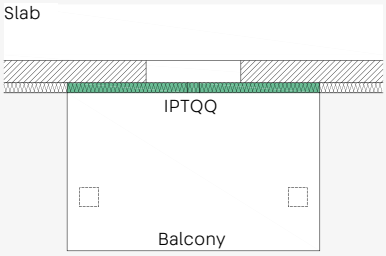
Type designation

IPTQQ 20 h200 REI 90

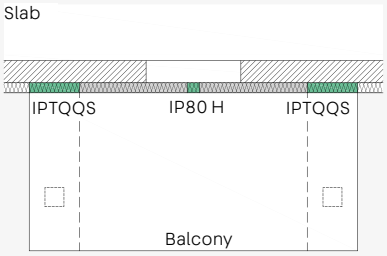
- REI 90 — Fire protection type
- h200 — Element height
- IPTQQ 20 — Type and load-bearing capacity

Application – Element layout

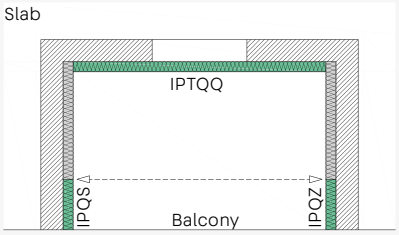
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



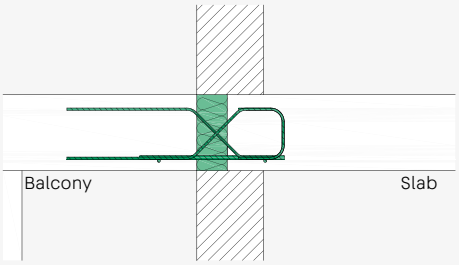
ISOPRO® IPTQQ – Supported balcony with laterally offset columns



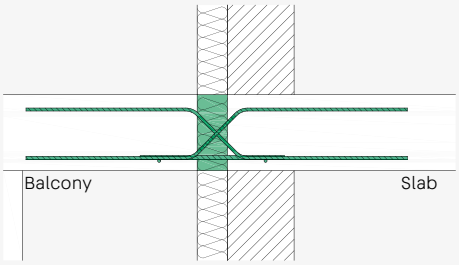
ISOPRO® IPTQQS – Supported balcony with downstand beams and columns at specific points with ISOPRO® IPTQQS elements



ISOPRO® IPTQQ, IPQS, IPQZ – Loggia balcony with peak loads at specific points in the front and uplilft 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.

Dimensioning table for concrete ≥ C25/30

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

Type	Shear force V_{Rd} kN/m	Element height mm	Element length mm	Shear bars	Compression bars
				Configuration	Configuration
IPTQQ 10	± 34.8	≥ 160	500 + 500	2 x 4 Ø 6*	4 Ø 10
IPTQQ 30	± 52.2	≥ 160	500 + 500	2 x 6 Ø 6*	4 Ø 10
IPTQQ 40	± 69.5	≥ 160	500 + 500	2 x 8 Ø 6*	6 Ø 10
IPTQQ 50	± 86.9	≥ 160	500 + 500	2 x 10 Ø 6*	6 Ø 10
IPTQQ 70	± 92.7	≥ 160	500 + 500	2 x 6 Ø 8	6 Ø 10
IPTQQ 90	± 144.9	≥ 170	500 + 500	2 x 6 Ø 10	8 Ø 10
IPTQQ 110	± 208.6	≥ 180	500 + 500	2 x 6 Ø 12	12 Ø 10

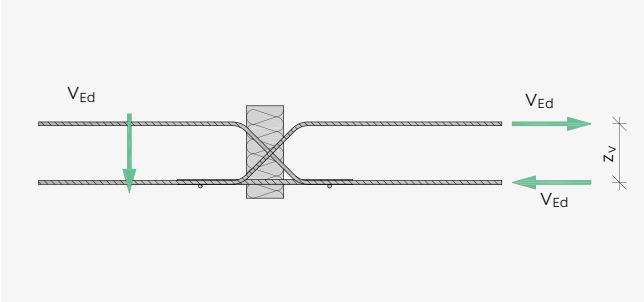
* Elements with Ø 6 shear bars have a looped bar on the slab side. For all other elements, the shear bar on the slab side is straight (see also page 74).

ISOPRO® IPTQQ – Rated values of the shear forces that can be transferred V_{Rd} kN

Type	Shear force V_{Rd} kN	Element height mm	Element length mm	Shear bars	Compression bars
				Configuration	Configuration
IPTQQS 10	± 30.9	≥ 160	300	2 x 2 Ø 8	2 Ø 10
IPTQQS 20	± 46.4	≥ 160	400	2 x 3 Ø 8	3 Ø 10
IPTQQS 40	± 48.3	≥ 170	300	2 x 2 Ø 10	3 Ø 10
IPTQQS 50	± 72.4	≥ 170	400	2 x 3 Ø 10	4 Ø 10
IPTQQS 60	± 69.5	≥ 180	300	2 x 2 Ø 12	4 Ø 10
IPTQQS 70	± 104.3	≥ 180	400	2 x 3 Ø 12	6 Ø 10
IPTQQS 80	± 94.7	≥ 190	300	2 x 2 Ø 14	4 Ø 14
IPTQQS 90	± 142.0	≥ 190	400	2 x 3 Ø 14	6 Ø 14
IPTQQS 100	± 189,3	≥ 190	500	2 x 4 Ø 14	8 Ø 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 ΔM_{Ed} is calculated under the assumption that the elements are fully loaded.



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

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

Eccentric moments ISOPRO® IPTQQ

Type		Δm_{Ed} kNm/m
	h < 200 mm	h ≥ 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		ΔM_{Ed} kNm
	h < 200 mm	h ≥ 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
IPTQQS 100	21,1	22,9

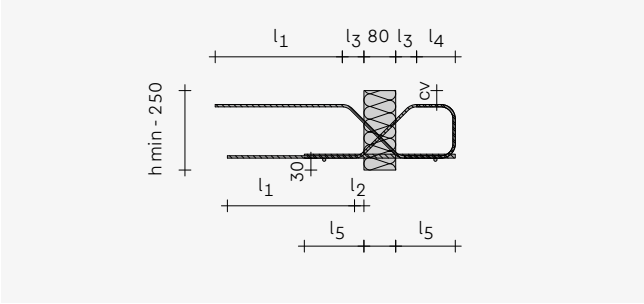
Maximum permissible expansion joint spacing

	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

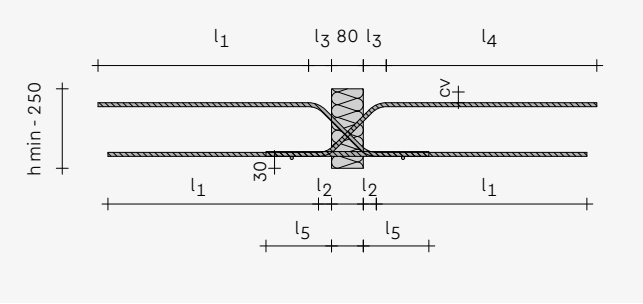
Element dimensions

ISOPRO® IPQ, IPQS, IPTQS, IPZQ, IPQZ

Shear bar Ø 6



Shear bar ≥ Ø 8 – 14



Dimensions in mm

IPTQQ	10 – 50	70	90	110	–	10 – 110	–
IPTQQS	–	10 – 20	40 – 50	60 – 70	80 – 100	10 – 70	80 – 100
Ø bar	Ø 6	Ø 8	Ø 10	Ø 12	Ø 14	Ø 10	Ø 14
					length Shear bar mm	length Compression bars mm	
l_1	320	420	530	630	740	-	-
l_2	24	28	33	42	47	-	-
l_3	150[1]	420	530	630	740	-	-
l_4	150[1]	15-95	28-98	35-95	58-98	-	-
l_5	-	-	-	-	-	150	185
h_{min}	160	160	170	180	200	-	-

The concrete cover of the compression bars 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.

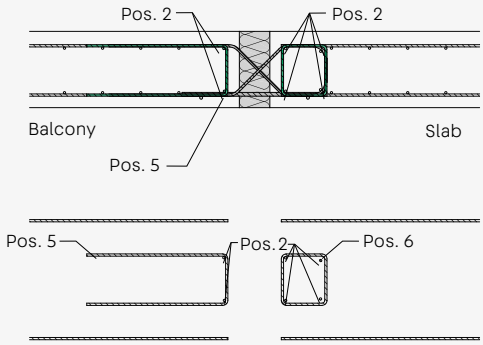
Concrete cover

Element height h mm	Concrete cover cv Shear bar Ø 6 mm	Concrete cover cv Shear bar Ø 8 – 14 mm
160	35	35
170	45	45
180	35	35
190	45	45
200	35	35
210	45	45
220	55	35
230	65	45
240	75	55
250	85	65

h_{min} must be observed

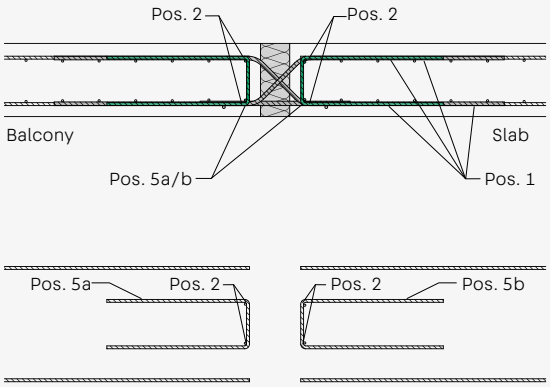
On-site reinforcement

ISOPRO® IPTQQ 10 to 50 with shear bar Ø 6 – looped on the slab side



- Pos. 1: Slab reinforcement according to the specifications of the structural engineer
- Pos. 2: Longitudinal reinforcement 2 Ø 8 balcony side, 4 Ø 8 slab side
- Pos. 4: Horizontal U-bar 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 – see table
- Pos. 6: Stirrup (edge beam) Ø 6/200

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

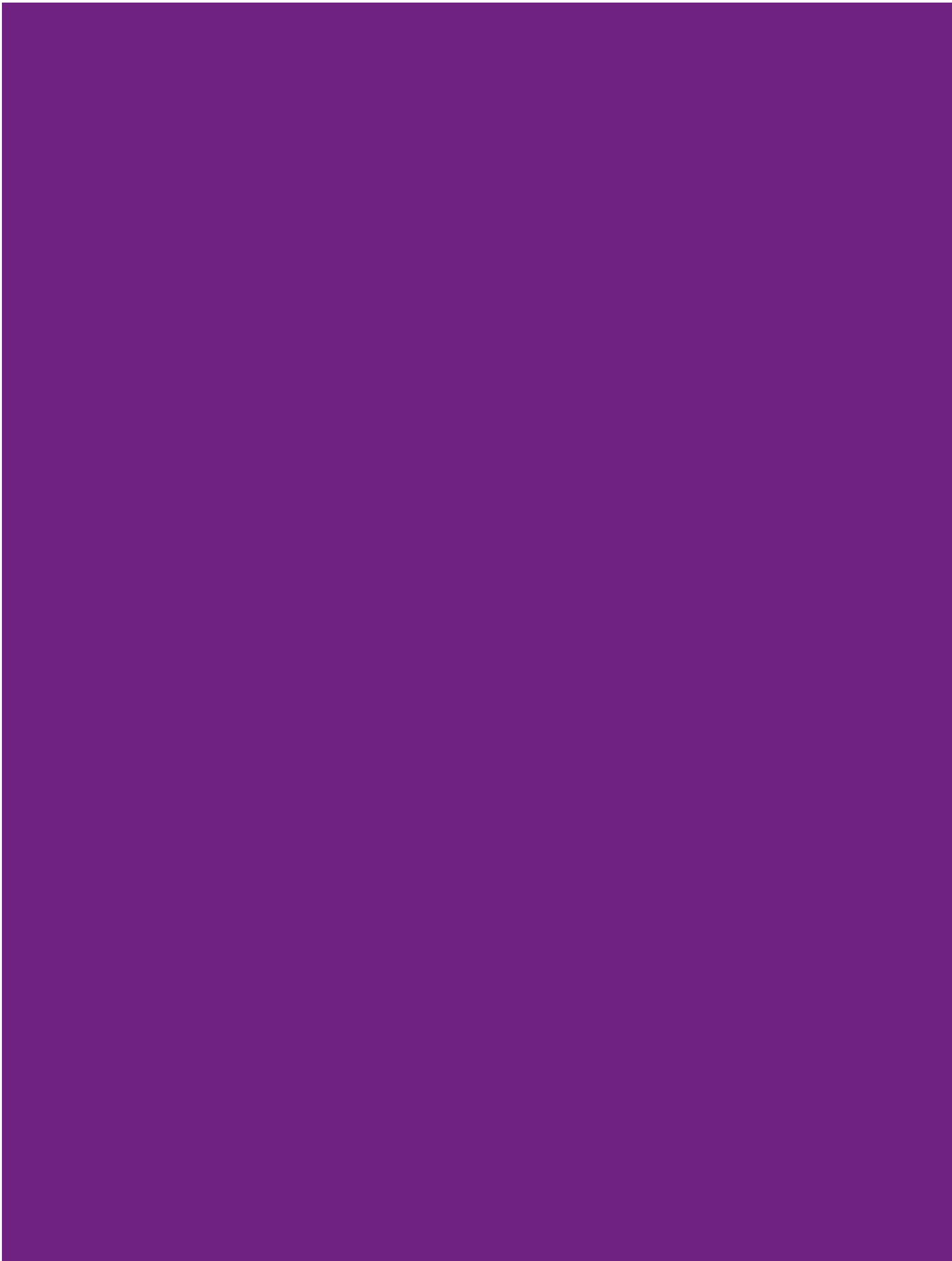


- Pos. 1: Slab reinforcement according to the specifications of the structural engineer
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 balcony and slab side
- Pos. 4: Horizontal U-bar at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural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

Suspension reinforcement for concrete ≥ c25/30

Type	Suspension reinforcement Pos. 5, $a_{s,erf}$ cm²/m
IPTQQ 10	0.80
IPTQQ 30	1.20
IPTQQ 40	1.60
IPTQQ 50	2.00
IPTQQ 70	2.13
IPTQQ 90	3.33
IPTQQ 110	4.80

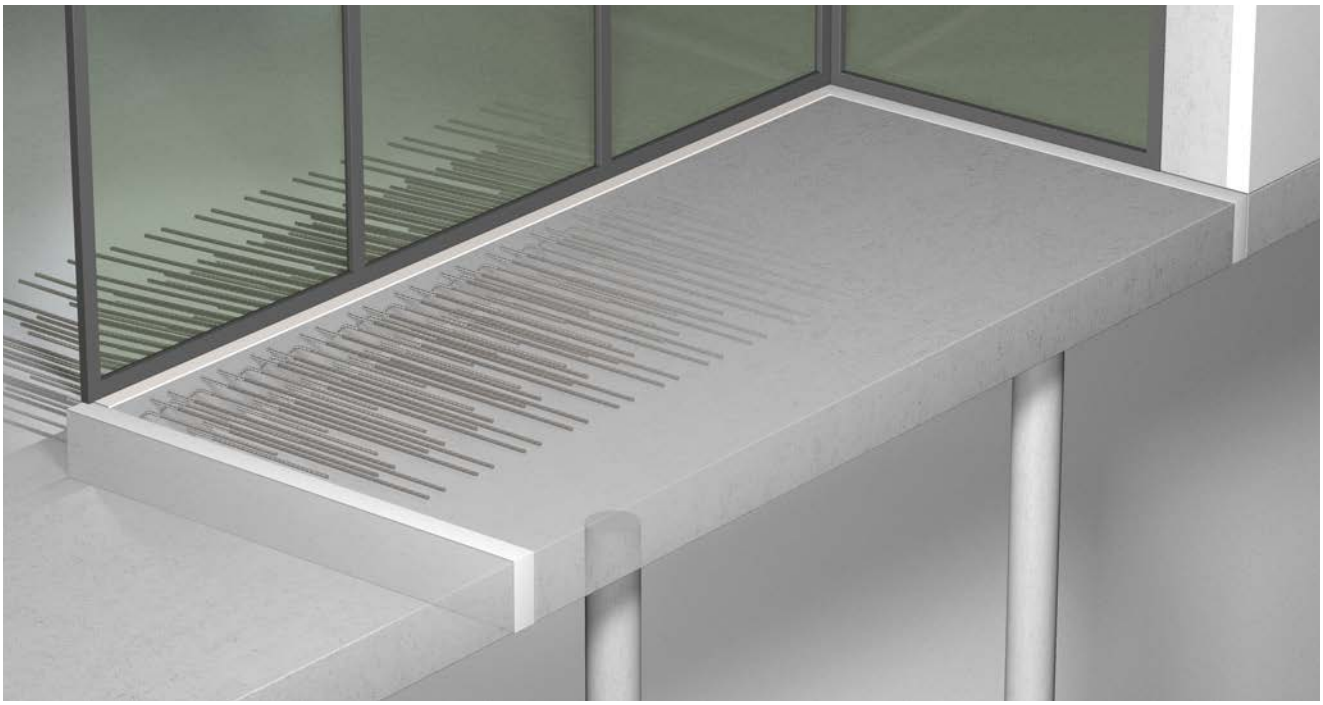
Type	Suspension reinforcement Pos. 5, $a_{s,erf}$ cm²
IPTQQS 10	0.71
IPTQQS 20	1.07
IPTQQS 40	1.11
IPTQQS 50	1.66
IPTQQS 60	1.60
IPTQQS 70	2.40
IPTQQS 80	2.18
IPTQQS 90	3.26
IPTQQS 100	4,34



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 bars 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 REI 90 available (REI 120 with an utilization of ≤ 85% in ULS)

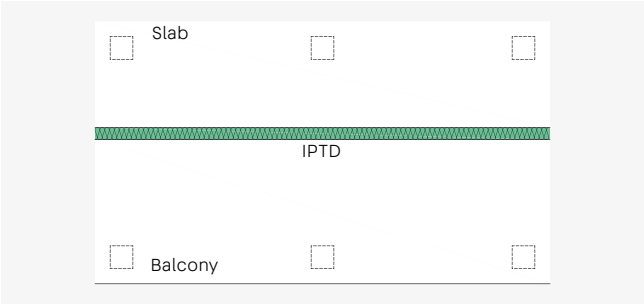
Type designation

IPTD 50 Q8 cv35 h200 REI 90

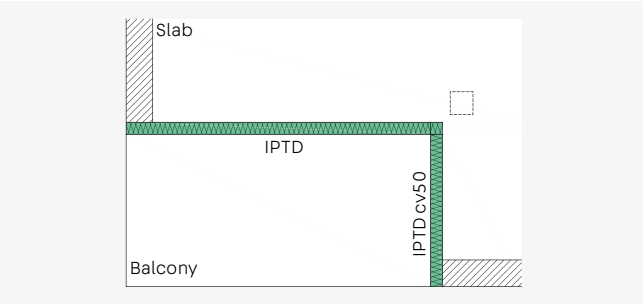
- REI 90 — Fire protection type
- h200 — Element height
- cv35 — Concrete cover
- Q8 — Shear force load-bearing capacity
- IPTD 50 — Type and load-bearing capacity

Application – Element layout

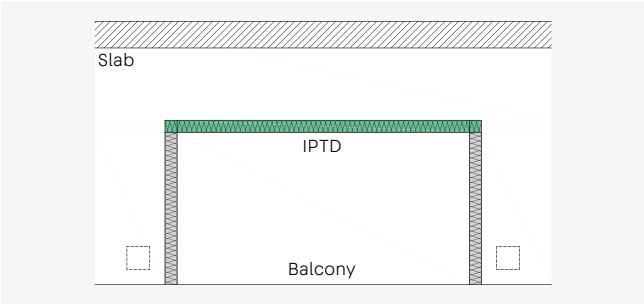
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



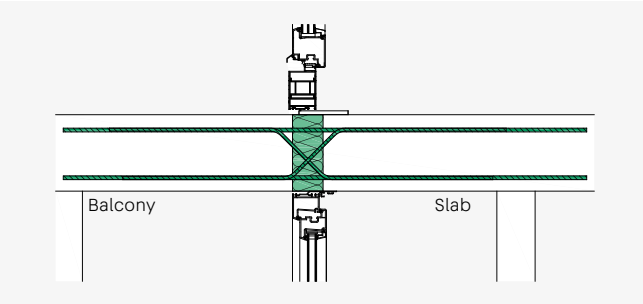
ISOPRO® IPTD – Continuous slab with one glass façade



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



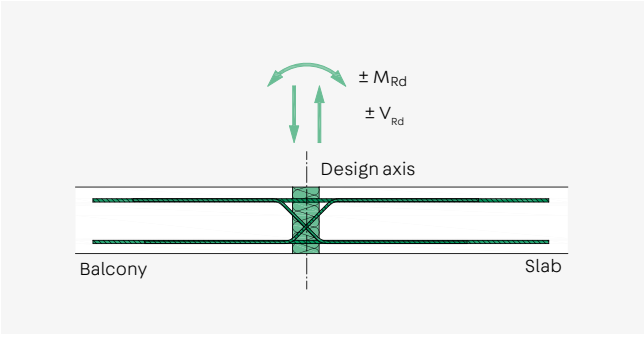
ISOPRO® IPTD – Recessed balcony with glass façade without direct support



ISOPRO® IPTD – Installation cross-section, glass façade

Notes on dimensioning

- The joint between the balcony and the ceiling slab must be factored in to design performed in the FEM software.
- ISOPRO® IPTD elements can only transmit bending moments perpendicular to the insulating joint.
- When determining the applied forces, the torsional spring stiffness of the ISOPRO® elements must be included in the design 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 design. Another iterative step may be necessary to arrive at the final result.
- IPTD elements can be combined with ISOPRO® IP 80 H elements to transmit perpendicular and parallel forces across the joint.



ISOPRO® IPTD – Structural system

Dimensioning table for concrete ≥ C25/30

Rated values of the moments that can be transferred 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 transferred 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/compression bars			6 Ø 10			6 Ø 12			8 Ø 12
Shear bars	2 x 4 Ø 8	2 x 6 Ø 8	2x6 Ø 10	2 x 4 Ø 8	2 x 6 Ø 8	2x6 Ø 10	2 x 4 Ø 8	2 x 6 Ø 8	2x6 Ø 10

Rated values of the moments that can be transferred 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 transferred 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/compression bars			10 Ø 12			12 Ø 12			12 Ø 14
Shear bars	2 x 4 Ø 8	2 x 6 Ø 8	2x6 Ø 10	2 x 4 Ø 8	2 x 6 Ø 8	2x6 Ø 10	2 x 4 Ø 8	2x6 Ø 10	2x6 Ø 12

Expansion joint spacing – Element dimensions

Expansion joint spacing

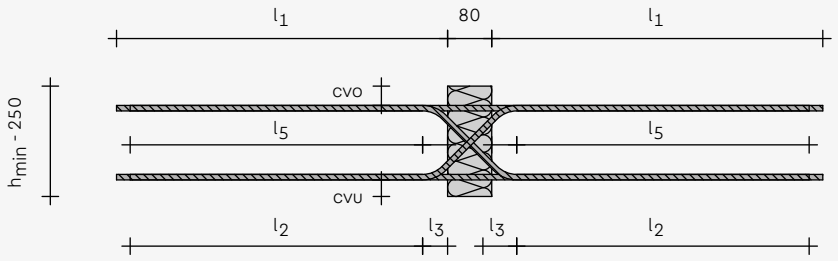
If the component dimensions exceed the maximum permissible expansion joint spacing, expansion joints must be aligned perpendicular to the insulation layer. The maximum permissible expansion joint spacing e depends on the maximum bar diameter across the expansion joint, and thus depends on the type.

Fixed points, such as supports that run around corners, or the use of ISOPRO® IP 80 H 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 dimensions ISOPRO® IPTD



cvo: 35/50 | cvu: 30/50 | Element length: 500+500

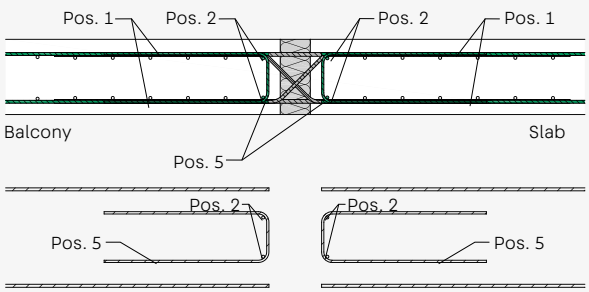
Length of tie bar / Length of compression strut mm	IPTD 20	IPTD 30	IPTD 50	IPTD 70	IPTD 90	IPTD 100
l_1	650	750	750	750	750	860

Length of shear bar mm	IPTD 20 – 90			IPTD 100		
	Standard	Q8	Q10	Standard	Q8	Q10
l_2	420	420	530	420	530	630
l_3	28	28	33	28	33	42
l_4	15-95	15-95	28-98	15-95	28-98	35-95
l_5	420	420	530	420	530	630
h_{min}	160	160	170	160	170	180

* depending on the height

On-site reinforcement

ISOPRO® IPTD



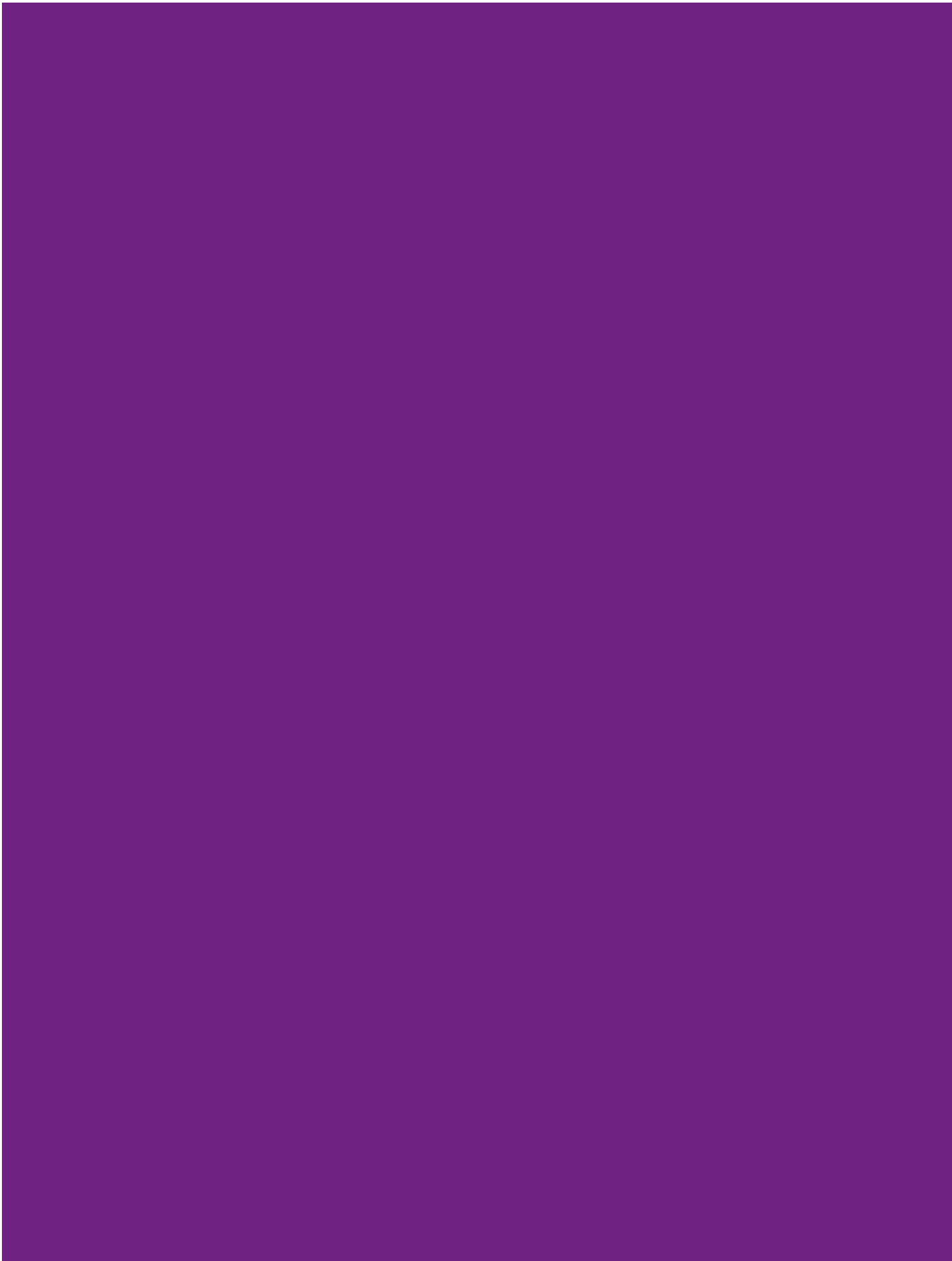
- Pos. 1: Connection reinforcement for the ISOPRO® element – above for negative moments, below for positive moments – see table below
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 balcony and slab side
- Pos. 4: Horizontal U-bar at the free balcony edge in line with DIN EN 1992-1-1 min. Ø 6/250 or according 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
$a_{s,erf}$ cm²/m	4.71	6.79	9.05	11.31	13.57	18.47
Recommendation	6 Ø 10	6 Ø 12	8 Ø 12	10 Ø 12	12 Ø 12	12 Ø 14

Suspension reinforcement Pos. 5

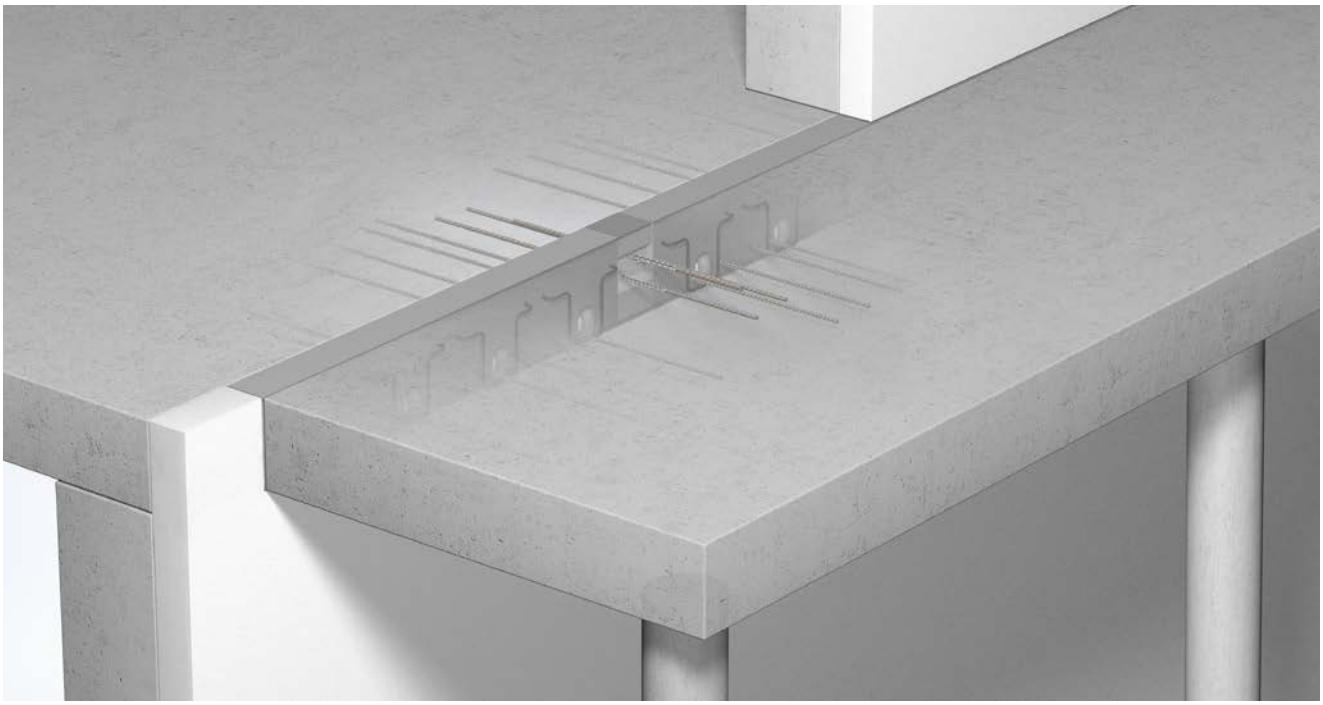
	IPTD 20 to IPTD 90			IPTD 100		
	Standard	Q8	Q10	Standard	Q8	Q10
$a_{s,erf}$ cm²/m	1.21	2.13	3.10	2.13	3.10	4.14
Recommendation	Ø 6/200	Ø 8/200	Ø 10/200	Ø 8/200	Ø 10/200	Ø 10/150



Elements for special loads

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

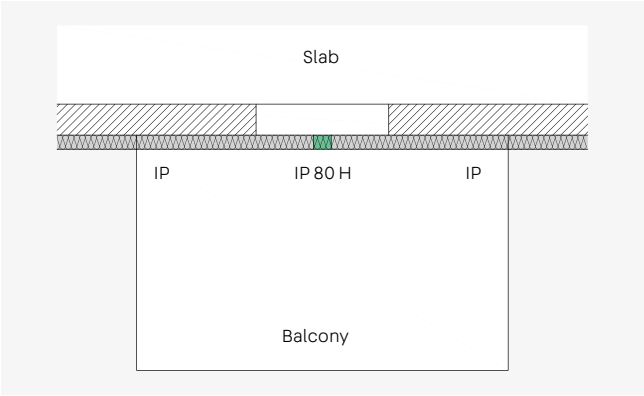
Type designation

H X1 h200 REI120

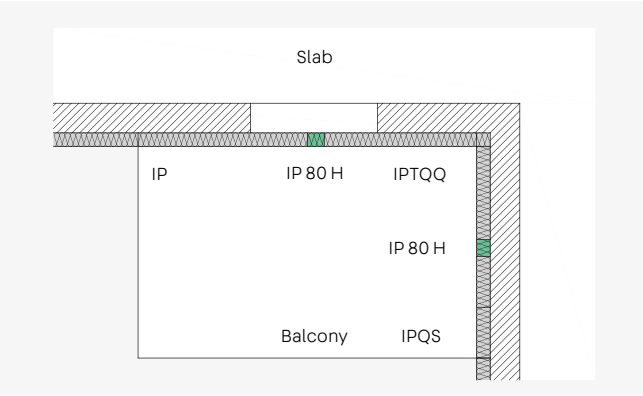
- REI120 — Fire protection type
- h200 — Element height
- X1 — Load-bearing capacity
- H — Type

Application – Element layout

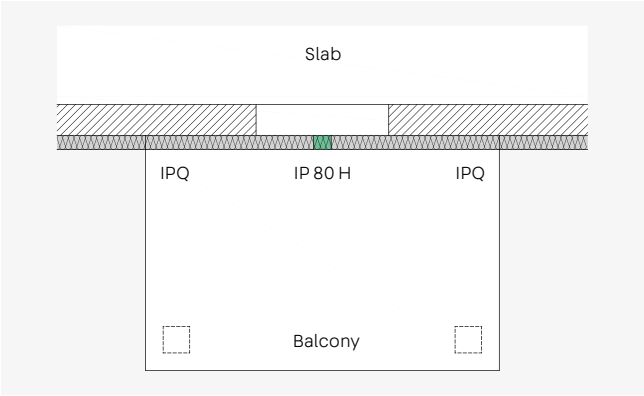
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



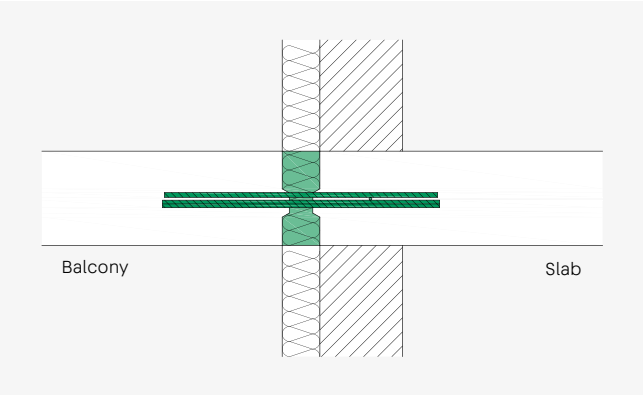
ISOPRO® 80 H – Cantilevered balcony with planned horizontal forces



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

Dimensioning table for concrete ≥ C25/30

Rated values of the forces that can be transferred in kN

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

Dimensions and configuration

	H-X1	H-X2	H-X1Y1	H-X2Y2
Tie bars/compression bars	1 Ø 10	1 Ø 14	1 Ø 10	1 Ø 14
Shear bars	–	–	2 x 1 Ø 10	2 x 1 Ø 12
Element length in mm	150	150	150	150

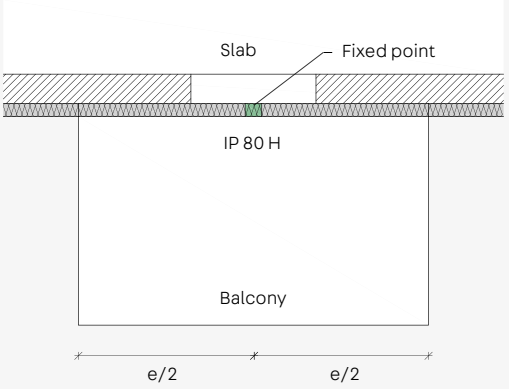
Notes on design

- 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

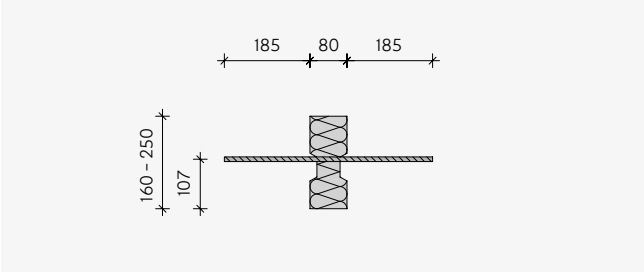
The use of ISOPRO® 80 H creates a fixed point, which results in stress forces. This reduces the maximum permissible expansion joint spacing to e/2 when using ISOPRO® 80 H.

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

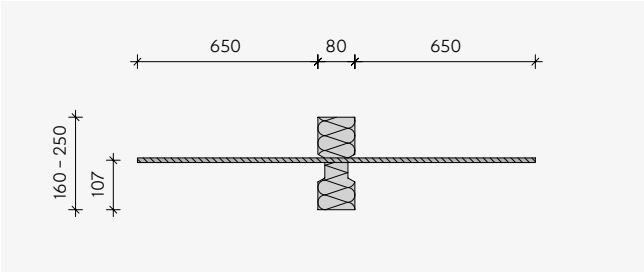


Element dimensions

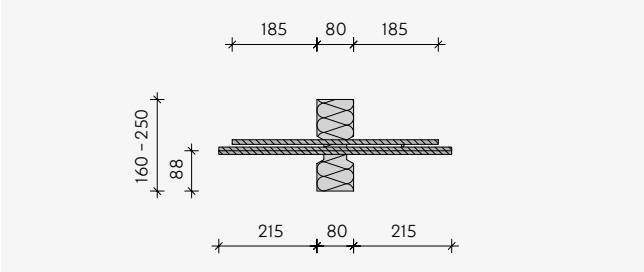
Front view



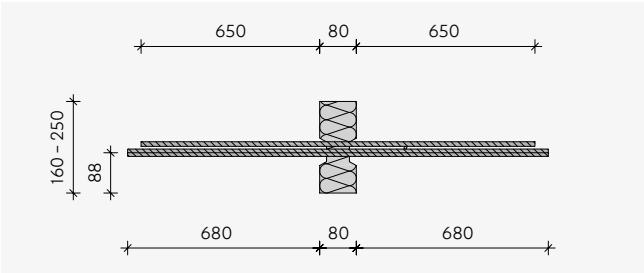
ISOPRO® 80 H-X1



ISOPRO® 80 H-X2

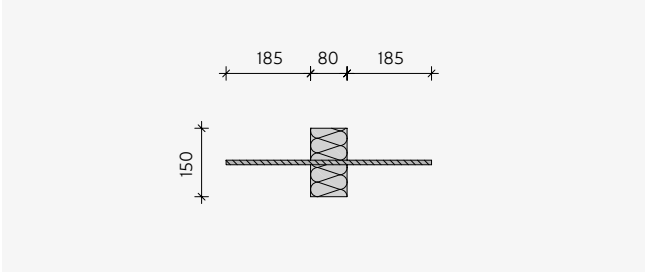


ISOPRO® 80 H-X1Y1

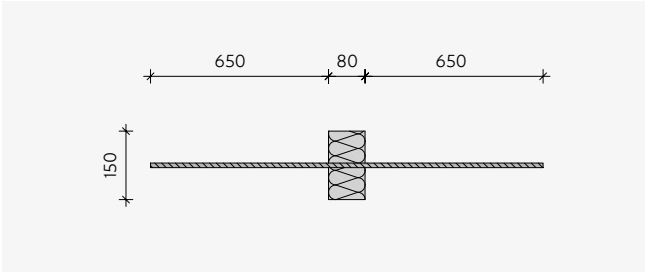


ISOPRO® 80 H-X2Y2

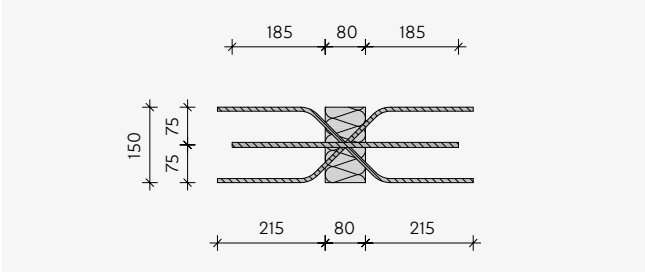
Top view



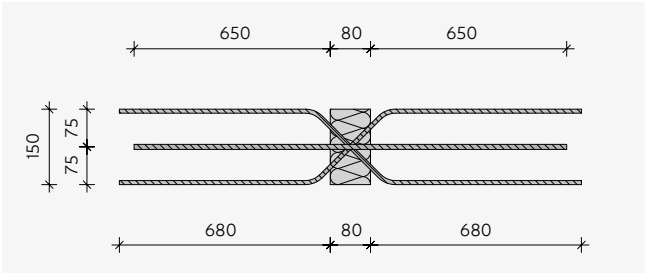
ISOPRO® 80 H-X1



ISOPRO® 80 H-X2



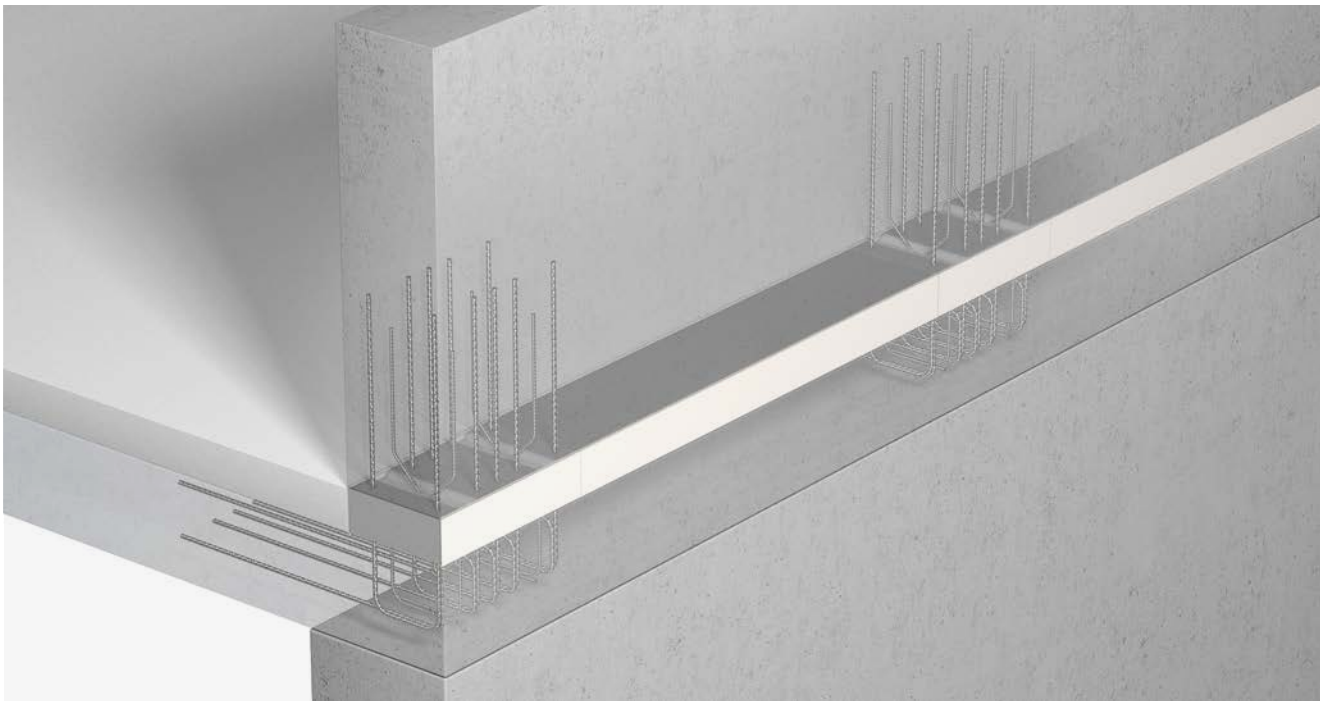
ISOPRO® 80 H-X1Y1



ISOPRO® 80 H-X2Y2

ISOPRO® IPTA

Elements for parapets and parapet upstands



ISOPRO® IPTA

- For transferring axial forces, positive and negative moments and horizontal forces
- Load-bearing capacities: IPTA 1 and IPTA 2
- Element length: 350 mm
- Parapet/parapet upstand width: 150 to 250 mm
- Concrete cover varies depending on the parapet/parapet upstand thickness - see element structure
- Slab thickness: from 160 mm
- Insulation thickness: 80 mm (60 mm optionally possible)
- Fire resistance class REI 90 available (REI 120 with an utilization of ≤ 85% in ULS)

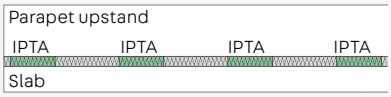
Type designation

IPTA 1 b200 REI 90

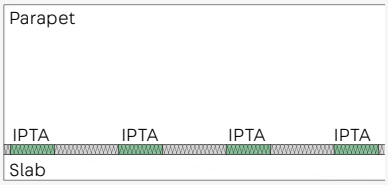
- Fire protection type
- Parapet/parapet upstand width
- Type and load-bearing capacity

Application – Element layout

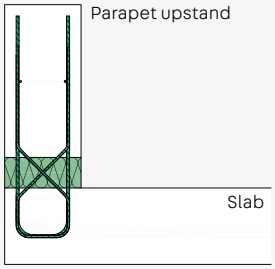
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



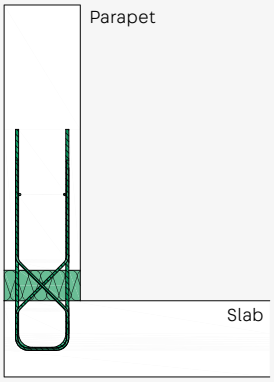
ISOPRO® IPTA – View of attached parapet upstand



ISOPRO® IPTA – View of attached parapet

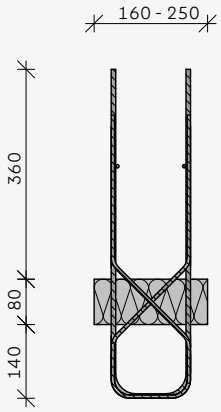


ISOPRO® IPTA – Cross-section of attached parapet upstand

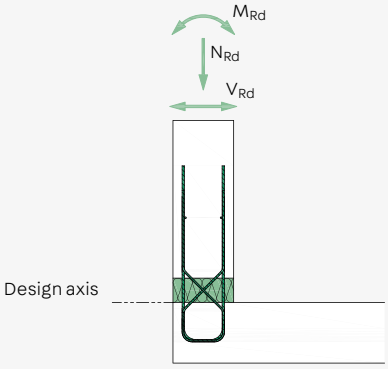


ISOPRO® IPTA – Cross-section of attached parapet

Element dimensions



Structural system



Dimensioning – Element design

Dimensioning table ISOPRO® IPTA 1 for concrete ≥ C25/30

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

Dimensioning table ISOPRO® IPTA 2 for concrete ≥ C25/30

		IPTA 2 – b < 200 mm	IPTA 2 – b ≥ 200 mm
Moment M_{Rd} kNm	$N_{Ed} = 0$ kN	± 4.4	± 6.3
	$N_{Ed} > 0$ kN	$\pm(4.4 - N_{Ed}/2 \cdot 0.092)$	$\pm(6.3 - N_{Ed}/2 \cdot 0.132)$
Normal force N_{Rd} kN	$M_{Ed} = 0$ kNm	95.0	95.0
	$M_{Ed} \neq 0$ kNm	$95.0 - \lvert M_{Ed} \rvert / 0.092 \cdot 2$	$95.0 - \lvert M_{Ed} \rvert / 0.132 \cdot 2$
Horizontal force N_{Rd} kN		± 12.0	± 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
Element length mm		350
Parapet/parapet upstand width b mm		150 – 250
Tie bars/compression bars	2 Ø 8	5 Ø 8
Horizontal force bars	2 x 2 Ø 6	2 x 2 Ø 6

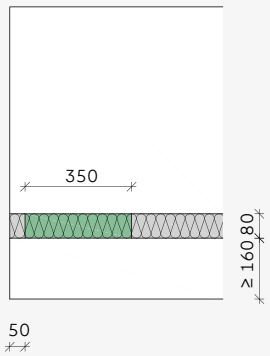
Notes on dimensioning
Only one compressive force can be transmitted as a normal force. The normal force N_{Rd} given in the table corresponds to the maximum transmittable compressive force depending on the type and concrete quality.

Expansion joint spacing – On-site reinforcement

Maximum permissible expansion joint spacing

	IPTA 1 and IPTA 2
Joint spacing e m	13.0

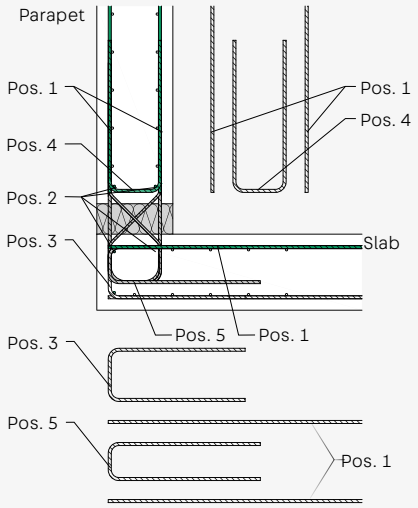
Edge clearance



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



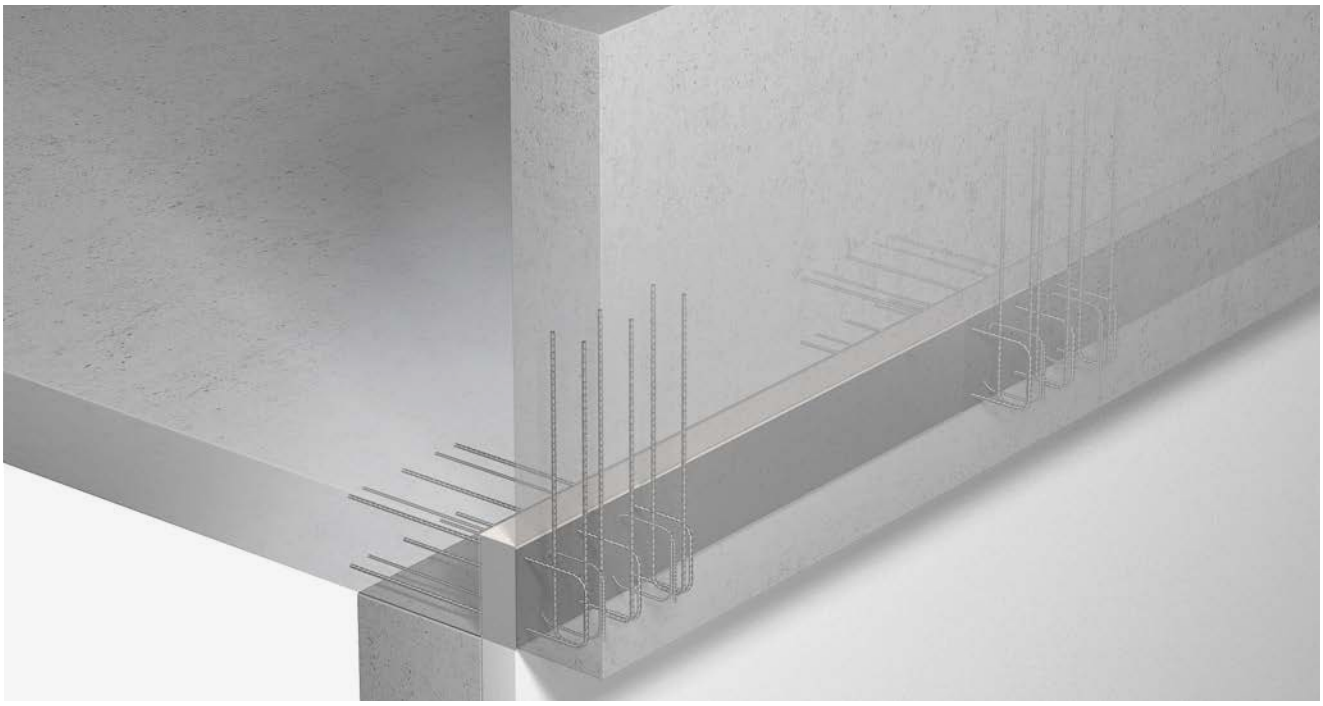
- Pos. 1: Connection reinforcement for the ISOPRO® element in the parapet and in the slab – see table
- Pos. 2: Longitudinal reinforcement 2 x 2 Ø 8 parapet and slab side
- Pos. 3: Horizontal U-bar in line with DIN EN 1992-1-1 min. Ø 6/250 or according to the specifications of the structural engineer
- 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
$a_{s,erf}$ cm²/m	0.50	1.10	0.30
Recommendation	2 Ø 8	4 Ø 8	Ø 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: available in REI 90 (REI 120 with an utilization of ≤ 85% in ULS)

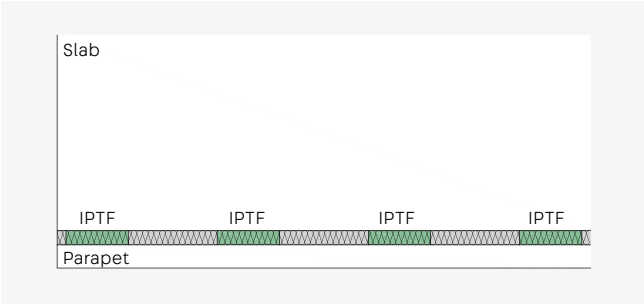
Type designation

IPTF h200 REI 90

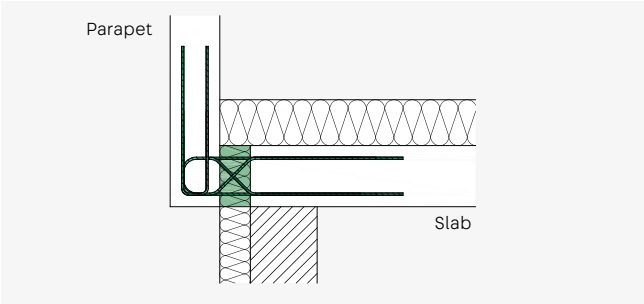
- REI 90 — Fire protection type
- h200 — Element height
- IPTF — Type

Application – Element layout

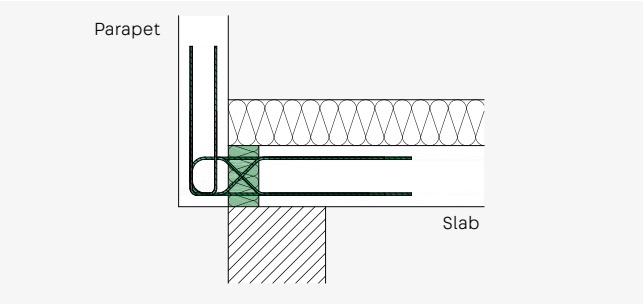
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



ISOPRO® IPTF – top view of protruding parapet



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

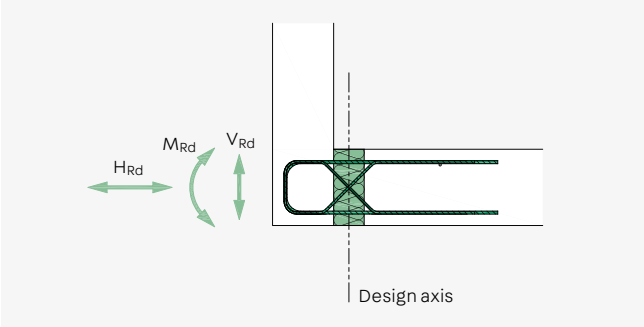


ISOPRO® IPTF – Installation cross-section of a protruding parapet with a solid wall

Dimensioning table for concrete ≥ C25/30

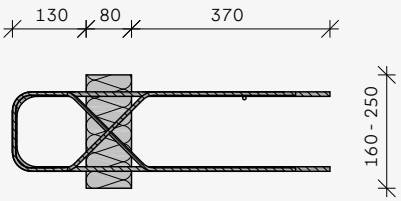
	IPTF h < 200 mm	**IPTF h ≥ 200** mm
Moment M_{Rd} kNm	± 2.1	± 3.0
Horizontal force N_{Rd} kN	± 3.5	± 3.5
Shear force V_{Rd} kN	± 12.0	± 12.0

Structural system



Element dimensions – Expansion joint spacing

Element dimensions ISOPRO® IPTF



Configuration and dimensions

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

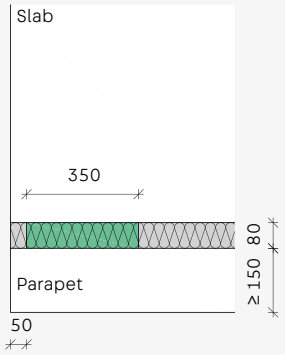
Maximum permissible expansion joint spacing

	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

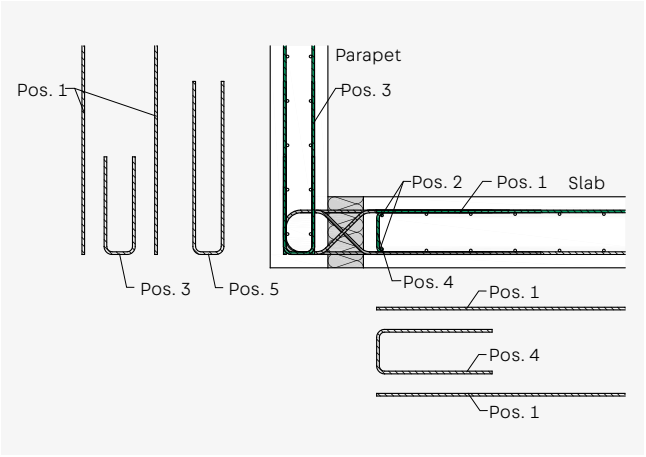


The following edge clearances must be maintained at the slab and parapet edges and at expansion joints:

- 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: Longitudinal reinforcement 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
$a_{s,erf}$ cm²/m	0.60	1.51	1.13
Recommendation	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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ISOPRO® IPO

Elements for corbels

ISOPRO® IPO

- For corbels 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
- Corbel 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

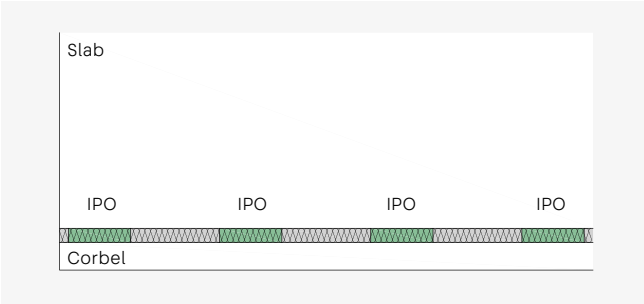
Type designation

IPO 20 h200 REI 120

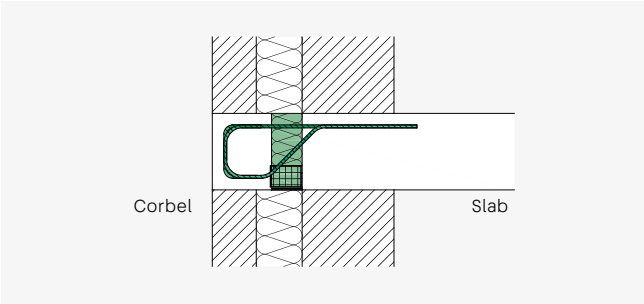
- REI 120 — Fire protection type
- h200 — Element height
- IPO 20 — Type and load-bearing capacity

Application – Element layout

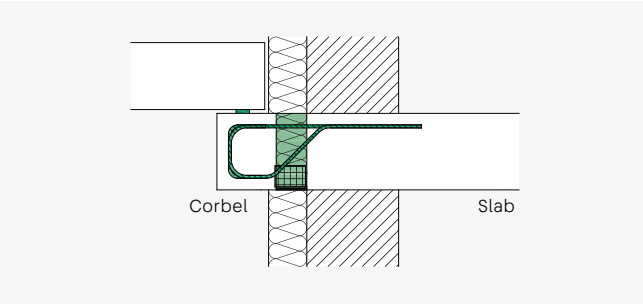
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



ISOPRO® IPO – Corbel top view

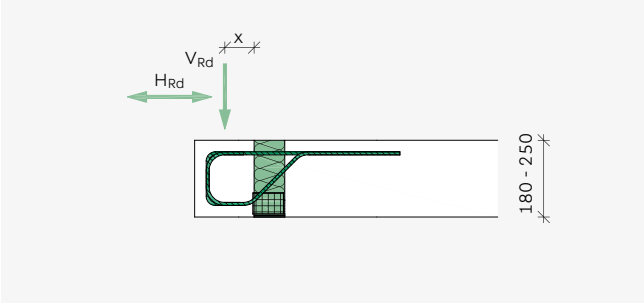


ISOPRO® IPO – Corbel with facing masonry



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

Structural system



Dimensioning – Element design

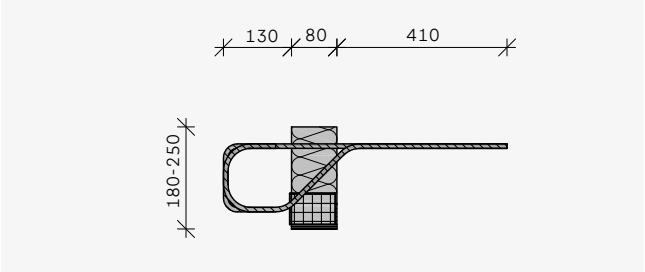
Dimensioning table ISOPRO® IPO 16 for concrete ≥ C25/30

		IPO 16		
Load application point x mm		60 - 90	100	110
Shear force V_{Rd} kN **depending on element height h** mm	180	26.9	25.9	17.3
	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
Horizontal force H_{Rd} kN		± 2.5	± 2.5	± 2.5

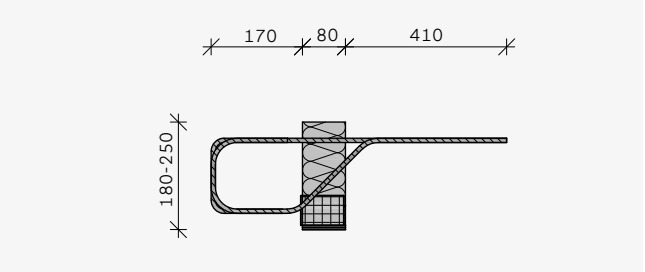
Dimensioning table ISOPRO® IPO 20 for concrete ≥ C25/30

		IPO 20			
Load application point x mm		60 - 120	130	140	150
Shear force V_{Rd} kN **depending on element height h** mm	180	29.1	25.2	18.5	12.7
	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
Horizontal force H_{Rd} kN		± 2.5	± 2.5	± 2.5	± 2.5

Element dimensions ISOPRO® IPO 16



Element dimensions ISOPRO® IPO 20



Configuration and dimensions

	IPO 16 and IPO 20
Element length mm	350
Element height h mm	180 - 250
Tie bars	2 Ø 8
Shear bars	3 Ø 8
Compression bearings	2

Concrete cover

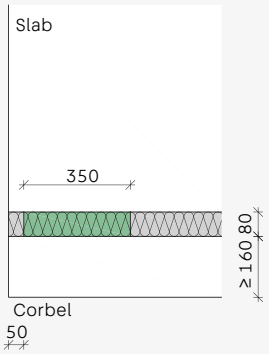
Element height h mm	Concrete cover, top cv mm	Concrete cover, bottom cv_u mm
180	30	30
190	40	30
200	30	30
210	40	30
220	30	30
230	40	30
240	40	40
250	50	40

Expansion joints – On-site reinforcement

Maximum permissible expansion joint spacing

	IPO
Joint spacing e m	13.0

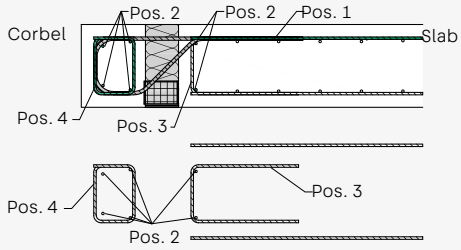
Edge clearance



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

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

ISOPRO® IPO on-site reinforcement



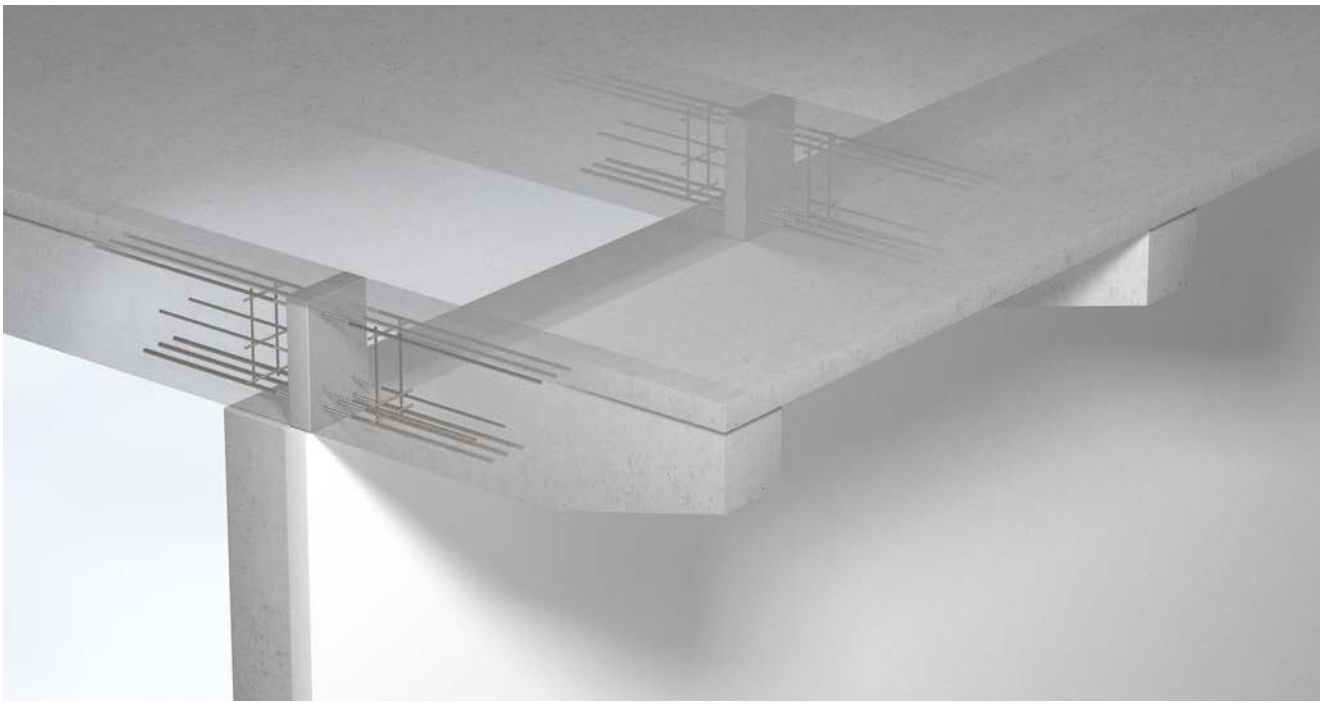
- Pos. 1: Connection reinforcement for ISOPRO® element 3 Ø 8
- Pos. 2: Longitudinal reinforcement 2 Ø 8 slab side – min. 4 Ø 8 in the corbel
- Pos. 3: Horizontal U-bar in line with DIN EN 1992-1-1 min. Ø 6/250
- Pos. 4: Closed stirrup in the corbel according to the specifications of the structural engineer

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 REI 90 available (REI 120 with an utilization of ≤ 85% in ULS)

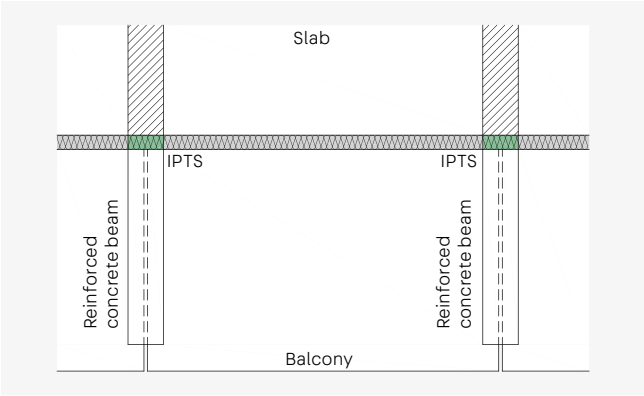
Type designation

IPTS 2 b/h = 220/400 REI 90

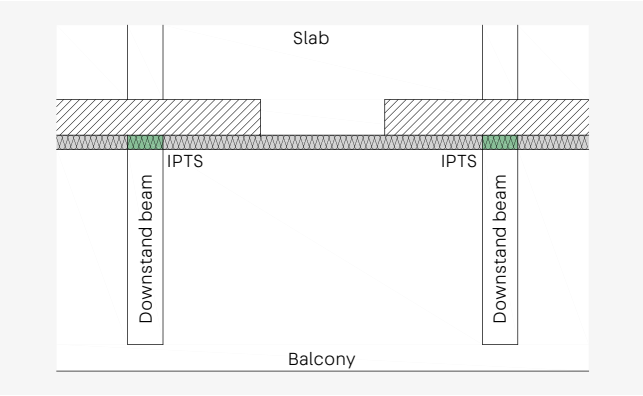
- REI 90 — Fire protection type
- b/h = 220/400 — Element dimensions
- IPTS 2 — Type and load-bearing capacity

Application – Element layout

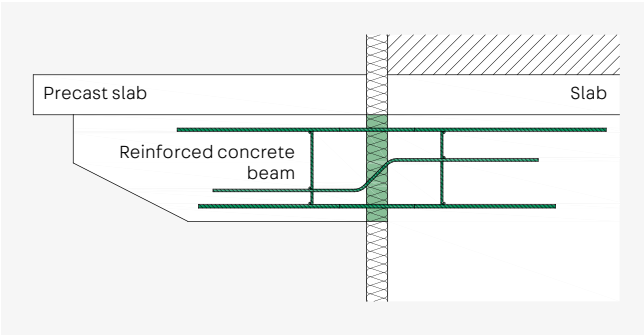
This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. must also be taken into account.



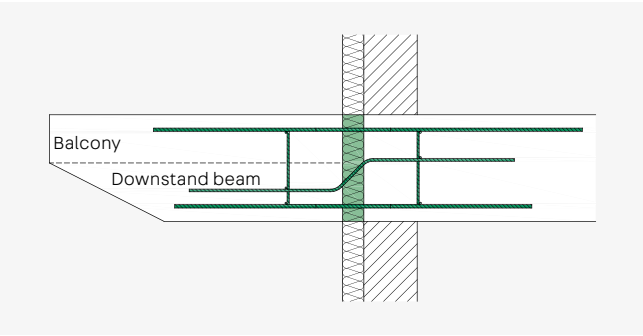
ISOPRO® IPTS – Balcony construction with precast slabs that are not structurally connected and load-bearing reinforced concrete beams



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

Dimensioning table for concrete ≥ C25/30

Rated values of the moments that can be transferred 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

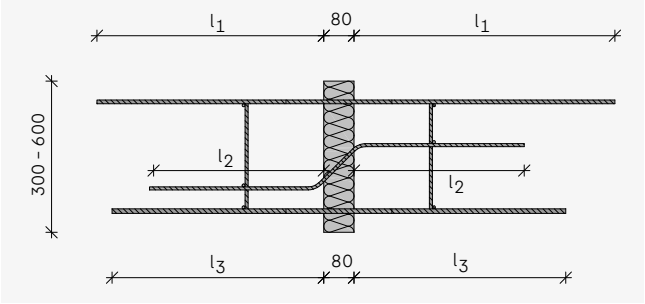
Rated values of the shear forces that can be transferred V_{Rd} kN

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

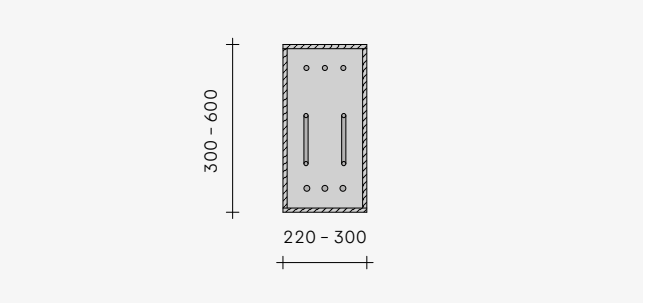
Dimensions and configuration

	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 Ø 10	3 Ø 12	3 Ø 14	3 Ø 16
Shear bars	2 Ø 8	2 Ø 10	2 Ø 12	2 Ø 14
Compression bars	3 Ø 12	3 Ø 14	3 Ø 16	3 Ø 20

Element dimensions



ISOPRO® IPTS



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

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
Length of tie bar* l_1	860	1.030	1.180	1.890
Length of shear bar l_2	460	575	680	790
Length of compression strut l_3	550	650	785	955

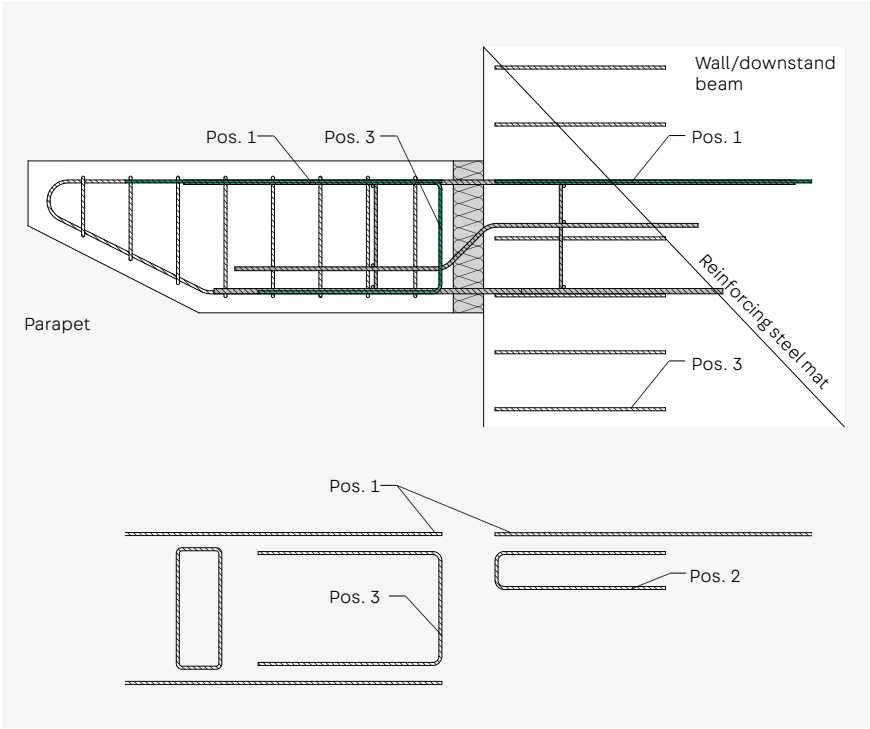
* The anchorage length of the tie bars is designed for bond range 2 "adequate bond conditions".

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: Horizontal U-bar in line with DIN EN 1992-1-1 min. Ø 6/250
- Pos. 3 Suspension reinforcement for the ISOPRO® element – see table

Connection reinforcement Pos. 1

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
$a_{s,erf}$ cm²/m	2.35	3.39	4.61	6.03
Recommendation	3 Ø 10	3 Ø 12	3 Ø 14	3 Ø 16

Suspension reinforcement Pos. 3

	IPTS 1	IPTS 2	IPTS 3	IPTS 4
$a_{s,erf}$ cm²/m	0.71	1.11	1.59	2.17
Recommendation	2 Ø 8	2 Ø 10	2 Ø 10	2 Ø 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: 1,500 to 3,500 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 REI 90 available (REI 120 with an utilization of ≤ 85% in ULS)
- Elements delivered split into at least 3 sections - lower section with compression bars and shear bars, infill section and upper section with tie bars. Additional infill sections are added to create taller elements.

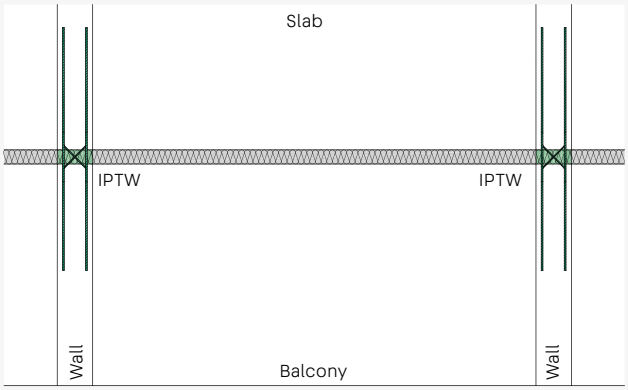
Type designation

IPTW 2 b/h = 220/2,000 REI 90

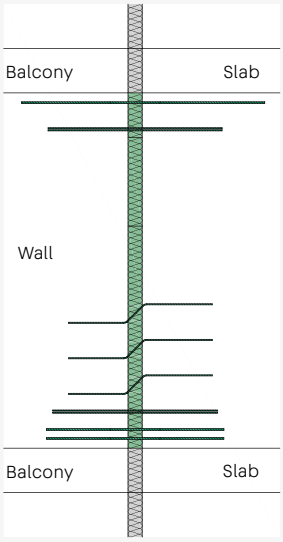
- REI 90 — Fire protection type
- b/h = 220/2,000 — Element dimensions
- IPTW 2 — Type and load-bearing capacity

Application – Element layout

This section contains planning aids and specific information on this product. In addition, the general notes on materials (from page 12), structural design (from page 15), fire protection (from page 20), installation on site (from page 22) etc. 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

Dimensioning table for concrete ≥ C25/30

Rated values of the moments that can be transferred M_{Rd} in kNm

Element height mm	IPTW 1	IPTW 2	IPTW 3	IPTW 4
≥ 1,500	64.7	115.3	178.7	178.7
≥ 1,750	76.6	136.8	212.7	212.7
≥ 2,000	88.4	158.4	246.8	246.8
≥ 2,250	100.3	179.9	280.8	280.8
≥ 2,500	112.1	201.4	314.8	314.8
≥ 2,750	124.0	222.9	348.8	348.8
≥ 3,000	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 transferred

	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	± 17.4	± 17.4	± 17.4	± 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	1,500 – 3,500	1,500 – 3,500	1,500 – 3,500	1,500 – 3,500
Tie bars	2 Ø 10	4 Ø 10	4 Ø 12	4 Ø 12
Shear bars	6 Ø 6	6 Ø 8	10 Ø 8	10 Ø 10
Horizontal bars	2 x 2 Ø 6	2 x 2 Ø 6	2 x 2 Ø 6	2 x 2 Ø 6
Compression bars	4 Ø 10	4 Ø 10	6 Ø 12	6 Ø 14

Notes on dimensioning
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 transferred 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 infill 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

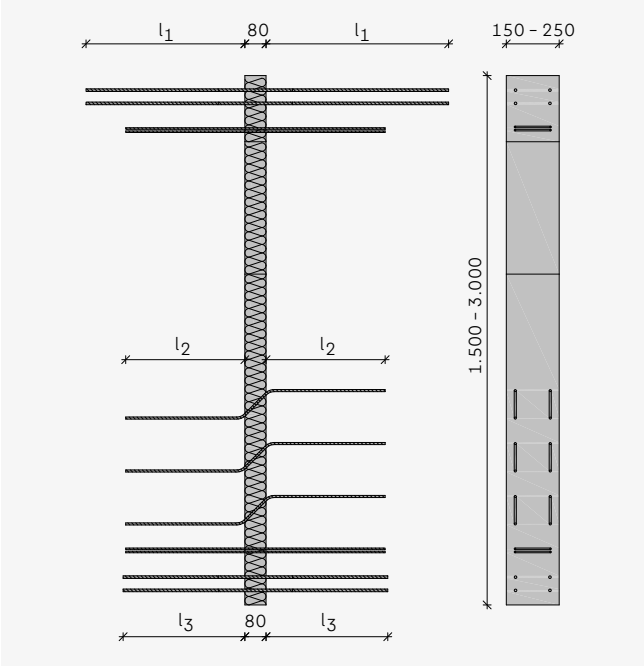
If the component dimensions exceed the maximum permissible expansion joint spacing, expansion joints must be aligned perpendicular to the insulation layer. The maximum permissible expansion joint spacing e depends on the maximum bar diameter across the expansion joint, and thus depends on the type. Fixed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

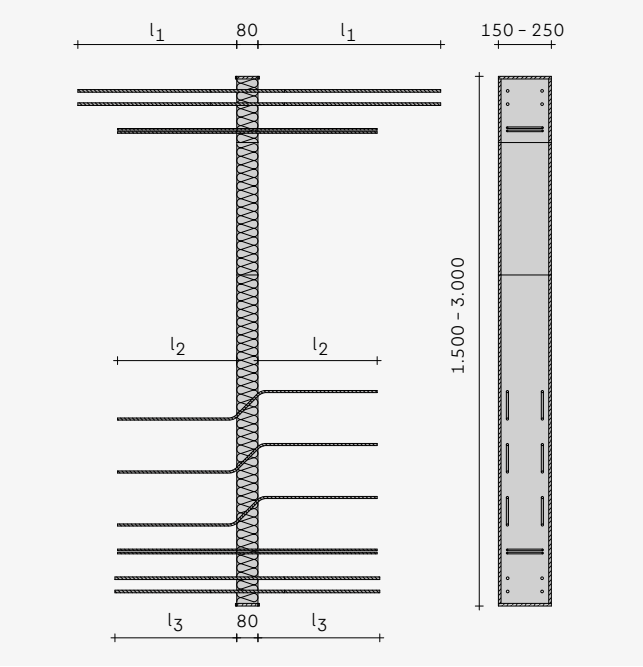
Maximum permissible expansion joint spacing

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

Element design ISOPRO® IPTW



ISOPRO® IPTW

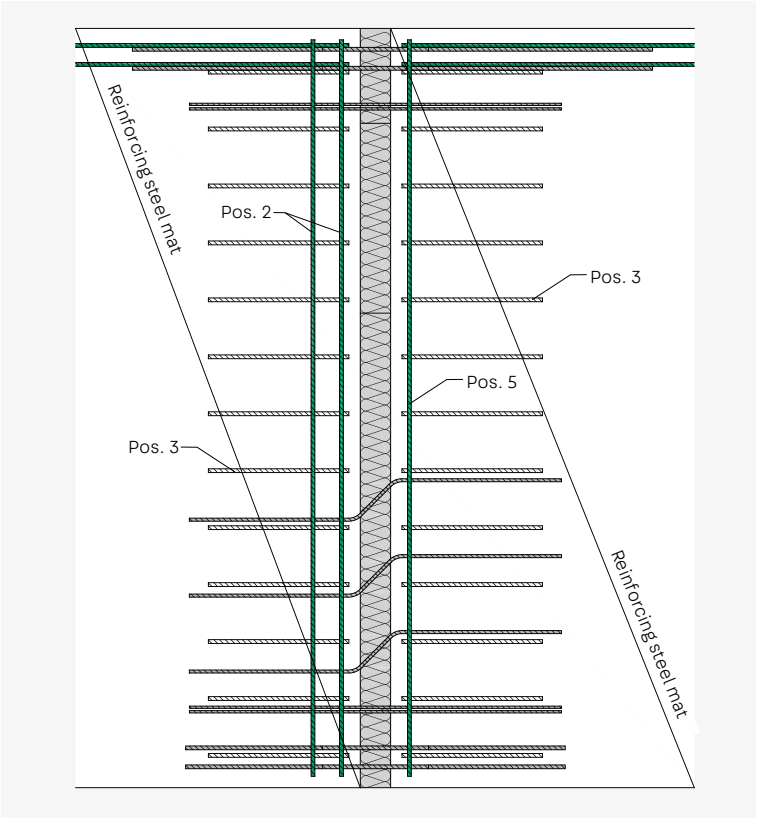


ISOPRO® IPTW – Version with fire protection panels – REI 90

	IPTW 1	IPTW 2	IPTW 3	IPTW 4
Length of tie bar l_1	650	650	750	750
Length of shear bar l_2	350/410	460	460	575
Length of shear bar, horizontal	450	450	450	450
Length of compression strut l_3	650	650	850	650

On-site reinforcement

ISOPRO® IPTW



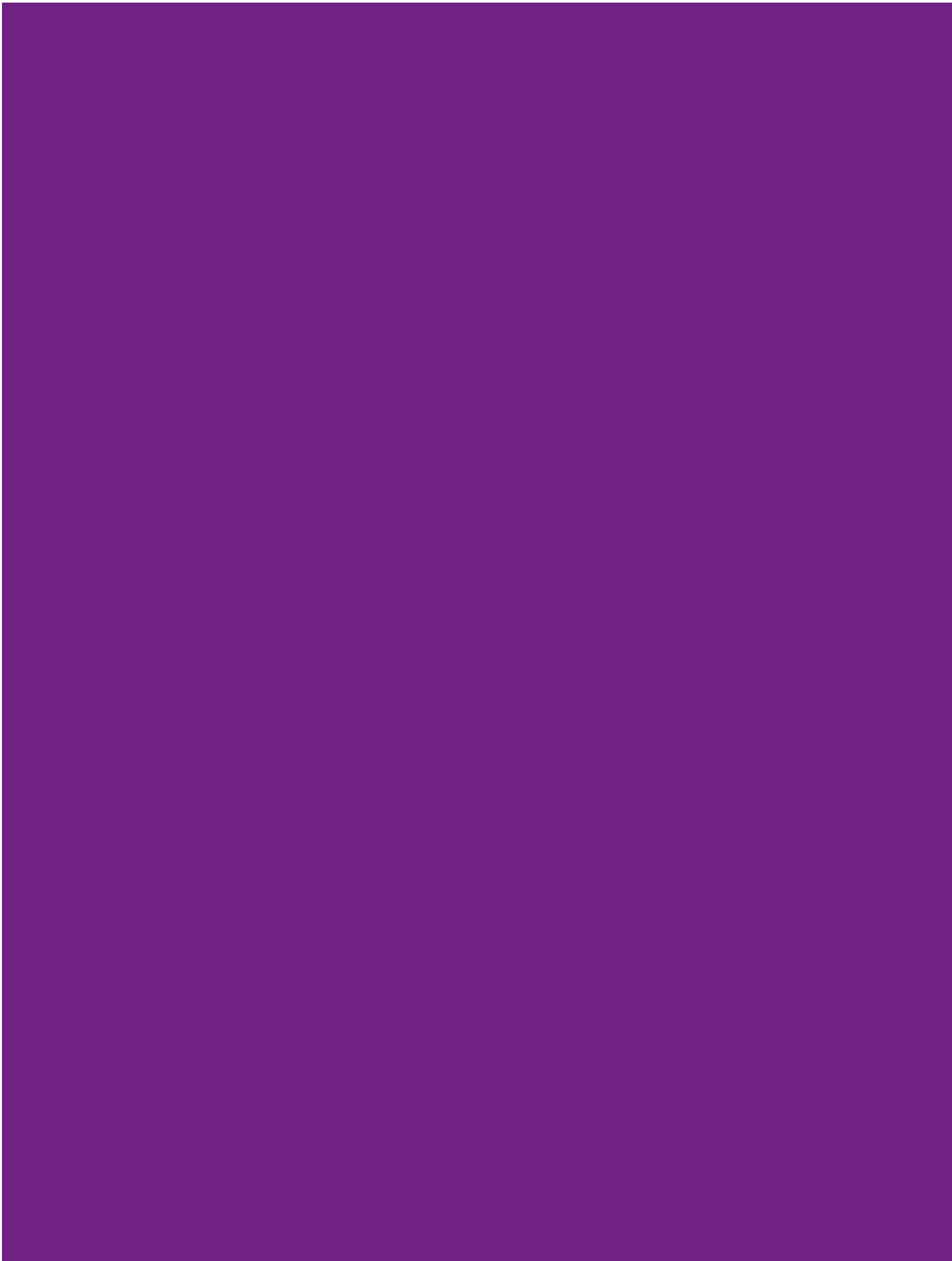
- Pos. 1 Connection reinforcement for the ISOPRO® element – see table
- Pos. 2 Longitudinal reinforcement 2 Ø 8
- Pos. 3: Horizontal U-bar according to the specifications of the structural engineer
- Pos. 5 Suspension reinforcement for the ISOPRO® element anchored with stirrups – see table
- When casting 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
$a_{s,erf}$ cm²/m	1.57	3.14	4.5	4.5
Recommendation	2 Ø 10	4 Ø 10	4 Ø 12	4 Ø 12

Suspension reinforcement Pos. 5

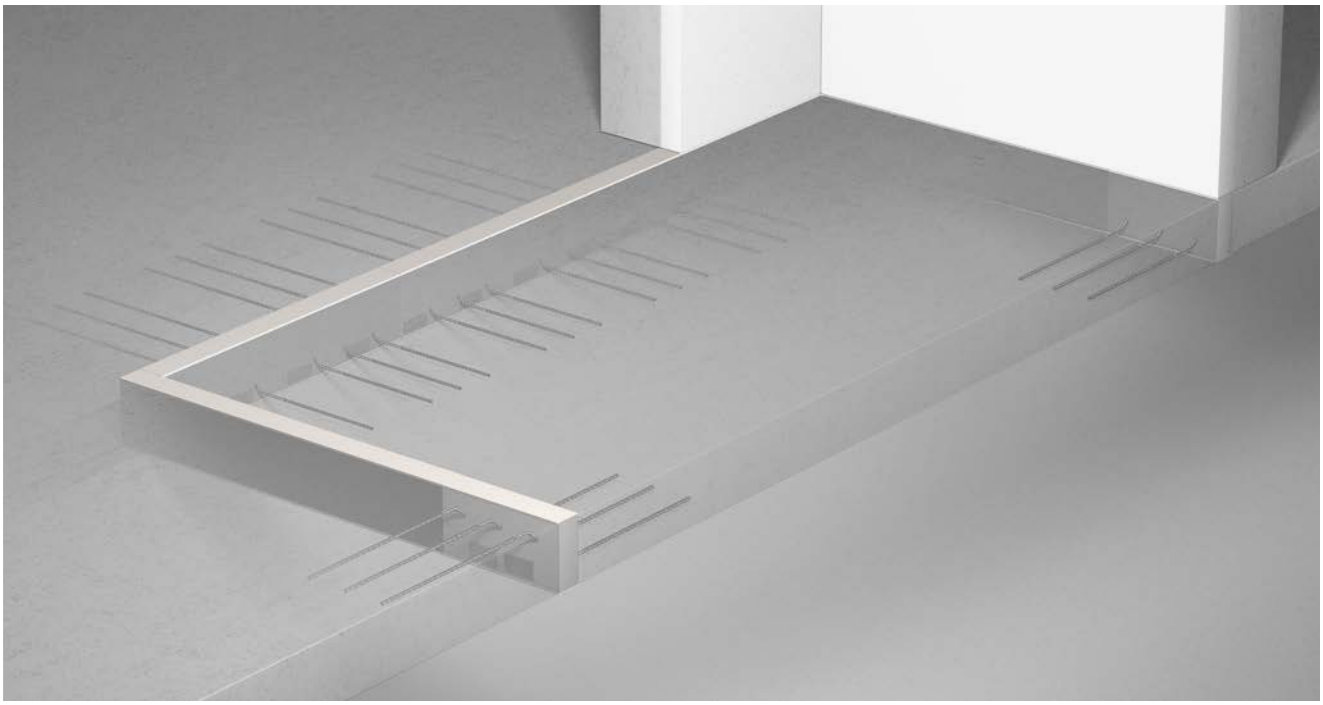
	IPTW 1	IPTW 2	IPTW 3	IPTW 4
$a_{s,erf}$ cm²/m	1.19	2.13	3.55	5.54
Recommendation	2 x 2 Ø 8	2 x 2 Ø 10	2 x 2 Ø 12	2 x 2 Ø 14



Insulating elements without load-bearing function

ISOPRO® Z-ISO

Elements used as infill insulation



ISOPRO® Z-ISO

- Infill 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

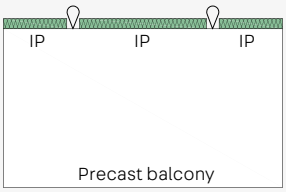
Type designation

IP Z-ISO h200 FP1

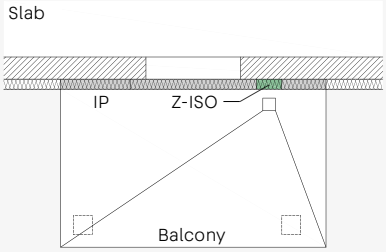
- FP1 — Fire protection type
- h200 — Element height
- IP Z-ISO — Type and load-bearing capacity

Application – Element layout

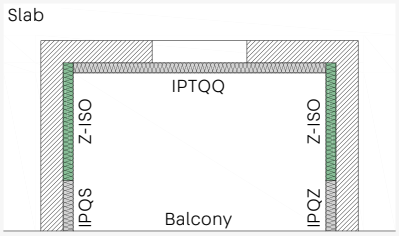
When using ISOPRO® Z-ISO elements, please note that the length and consequently the load-bearing capacity of the linear connection is reduced by the percentage of the length of the Z-ISO elements compared to the total connection length. The fire protection class of the Z-ISO FP1 element corresponds to 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-IS0 combined with ISOPRO® IPT – REI 90.



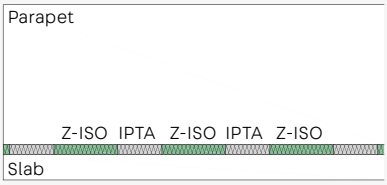
ISOPRO® Z-ISO – Precast balcony with transport anchors – the Z-ISO elements are added on the construction site



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

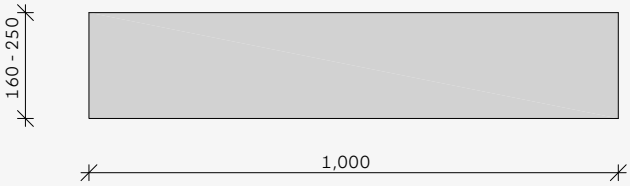


ISOPRO® Z-ISO – Loggia supported at specific points with IPQS/IPQZ

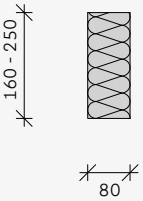


ISOPRO® Z-ISO – Parapet with use of ISOPRO® IPTA elements at specific points

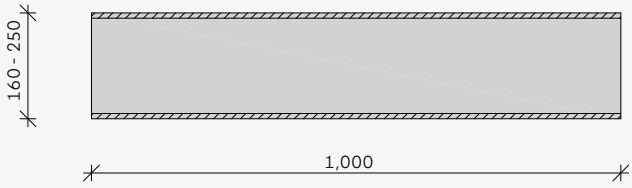
Element dimensions



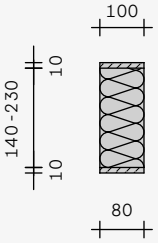
ISOPRO® Z-ISO – Product front view



ISOPRO® Z-ISO – Product cross-section



ISOPRO® Z-ISO FP1 – Product front view with fire protection panels top and bottom



ISOPRO® Z-ISO FP1 – 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

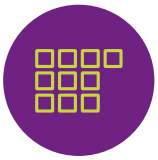
Our extensive network of consultants is available to answer all of your questions about our products on site. From planning to deployments, enjoy personal support from our qualified professionals.

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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