Deutsches Institut für Bautechnik

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

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European Technical Assessment ETA-17/0466 of 6 March 2025

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Slab connection ISOPRO
Product family to which the construction product belongs	Load bearing thermal insulating elements which form a thermal break between balconies and internal floors
Manufacturer	PohlCon GmbH Nobelstraße 51 12057 Berlin DEUTSCHLAND
Manufacturing plant	PohlCon GmbH Am Güterbahnhof 20 79771 Klettgau DEUTSCHLAND
This European Technical Assessment contains	50 pages including 4 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 050001-00-0301
This version replaces	ETA-17/0466 issued on 28 January 2022

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Specific part

1 Technical description of the product

The Slab connection ISOPRO is used as load-bearing thermal insulation element to connect reinforced concrete slabs under static or quasi-static load.

The product description is given in Annex A.

The characteristic material values, dimensions and tolerances of the Slab connection ISOPRO not indicated in Annexes A01 to A19 shall correspond to the respective values laid down in the technical documentation[1] of this European Technical Assessment.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the Slab connection ISOPRO is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the Slab connection ISOPRO of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Load bearing capacity	See Annex C01 – C02

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire of materials	See Annex A19
Resistance to fire	See Annex C03 – C06

3.3 Protection against noise (BWR 5)

Essential characteristic	Performance
Impact sound insulation	No performance assessed

3.4 Energy economy and heat retention (BWR 6)

Essential characteristic	Performance
Thermal resistance	No performance assessed

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 050001-00-0301, the applicable European legal act is: [1997/0597/EC].

The systems to be applied is: 1+

[1] The technical documentation of this European technical assessment is deposited at the Deutsches Institut für Bautechnik and, as far as relevant for th tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

The following standards and references are referred to in this European Technical Assessment:

EN 206:2013+A2:2021	Concrete - Specification, performance, production and conformity
EN 1992-1-1:2004 + AC:2010 + A1:2014	Eurocode 2 - Design of concrete structures - Part 1-1: General rules and rules for buildings, bridges and civil engineering structures
EN 1992-1-2:2004 + AC:2008 + A1:2019	Eurocode 2: Design of concrete structures – Part 1-2: General rules – Structural fire design
EN 1993-1-1:2005+ AC:2009 +A1:2014	Eurocode 3: Design of steel structures – Part 1-1: General design rules and rules for buildings
EN 1993-1-4:2006/A2:2020	Eurocode 3: Design of steel structures – Part 1-4: General rules – Supplementary rules for stainless
EN 10025-2:2019	Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels
EN 13163:2012+A2:2016	Thermal insulation products for buildings – Factory made expanded polystyrene (EPS) products – Specification
EN 13245-1:2010	Plastics – Unplasticized poly (vinyl chloride) (PVC-U) profiles for building applications – Part 1: Designation of PVC-U profiles
EN 13245-2:2008 + AC:2009	Plastics – Unplasticized poly (vinyl chloride) (PVC-U) profiles for building applications – Part 2: PVC-U profiles and PVC-UE profiles for internal and external wall and ceiling finishes
EN 13501-1:2018	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests
EN 13501-2:2016	Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services

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Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Kisan

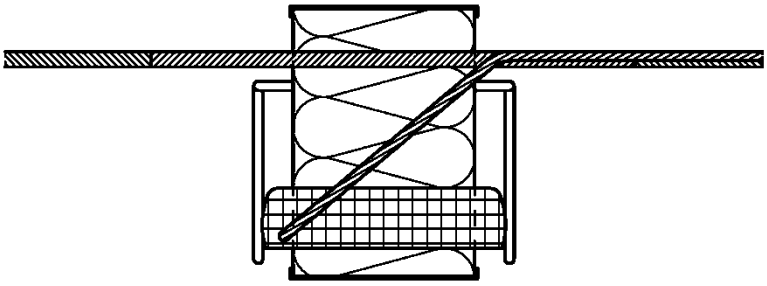
Deutsches Institut für Bautechnik DIBt

A.1 Type overwiew

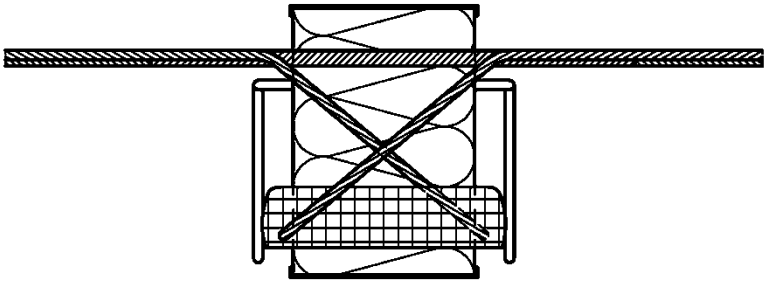
A.1.1 ISOPRO with high performance concrete compression bearings (HPCB) and high performance concrete compression shear bearings (HPCSB)

Types for the transmission of moments and shear forces

Type IP M DQ

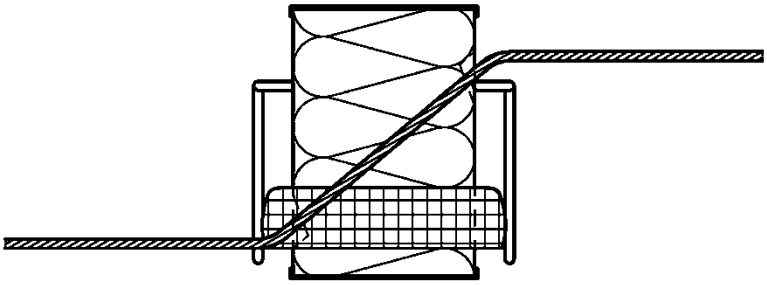


Type IP M DQQ

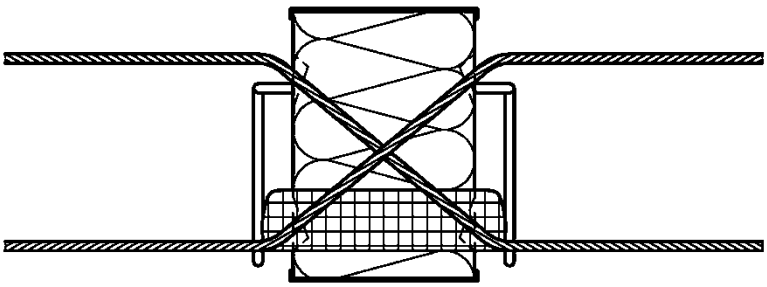


Types for the transmission of shear forces

Type IP Q
Type IP QS



Type IP QQ
Type IP QQS



Slab connection ISOPRO	**Annex A 01**
Product description: Overview ISOPRO with high performance concrete bearings	

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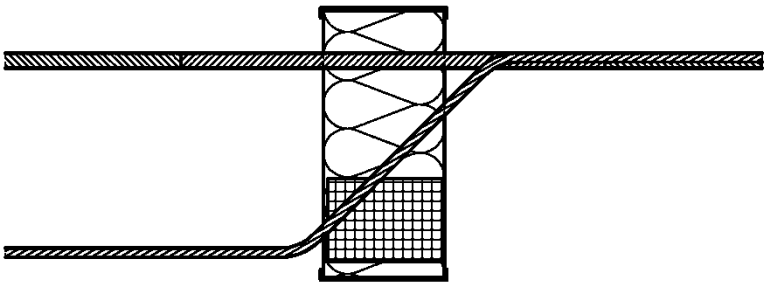
A.1.2 ISOPRO with concrete compression bearings (CCB)

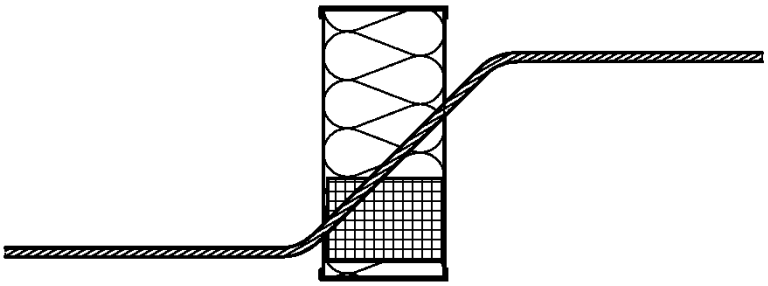
Type for the transmission of moments and shear forces

Type IP M Q

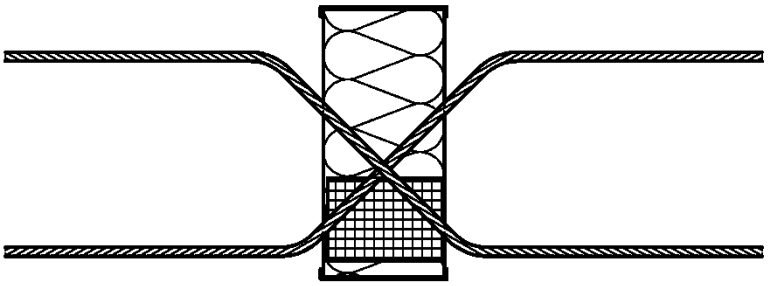


Types for the transmission of shear forces

Type IP Q
Type IP QS



Type IP QQ
Type IP QQS



Slab connection ISOPRO	Annex A 02
Product description: Overwiew ISOPRO with concrete compression bearings	

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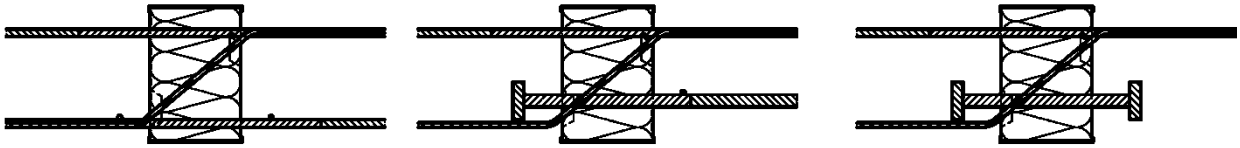
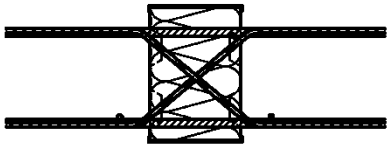
A.1.3 ISOPRO with steel compression bearings (SCB)

Types for the transmission of moments and shear forces

Type IP MT Q

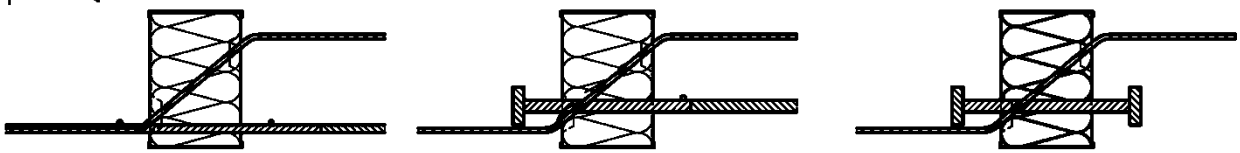


Type IP MT QQ und IP D

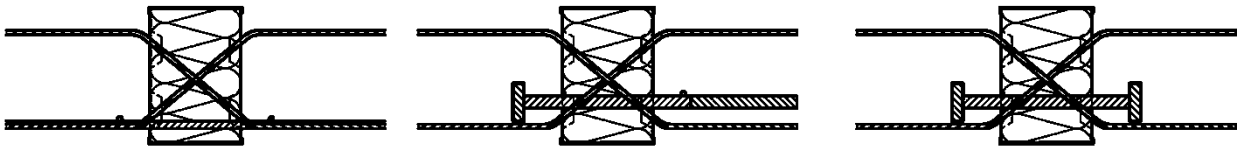


Types for the transmission of shear forces

Type IP QT
Type IP QTS



Type IP QQT
Type IP QQTS



Slab connection ISOPRO	**Annex A 03**
Product description: Overview ISOPRO with steel compression bearings	

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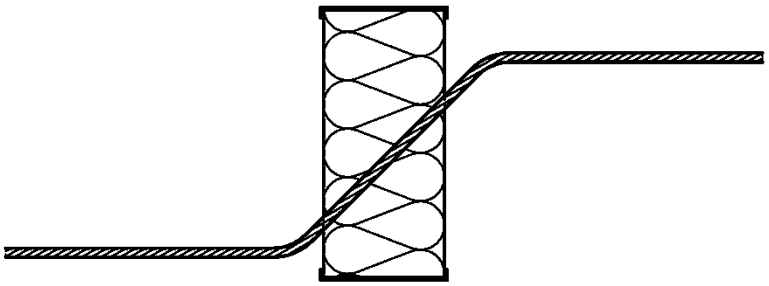
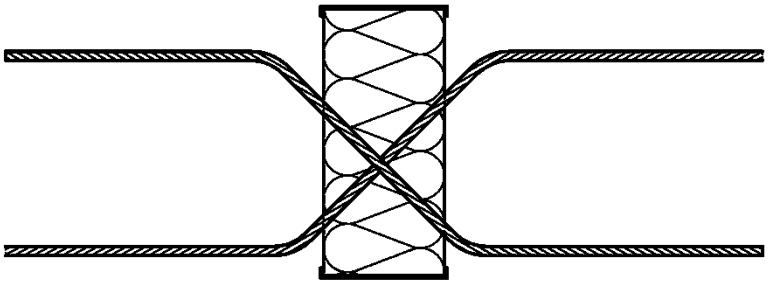
A.1.4 ISOPRO without compression bearings

Types for the transmission of shear forces for applications without constraints

Type IP QZ
Type IP QZS



Type IP QQZ
Type IP QQZS



Slab connection ISOPRO	**Annex A 04**
Product description: Overview ISOPRO without compression bearings	

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A.2 Dimensions and positions of the bars and compression bearings in the area of the insulation joint

The tension and shear force bars as well as the steel compression bearings consist of stainless reinforcing steel or stainless round steel in the insulation joint and over a length of at least 100 mm within the adjacent concrete components.

- Tension bars (TB) according to annex A12:
  - Diameter: ∅ ≤ 20 mm
    Graduated nominal diameter according to annex A 12
  - Quantity per meter: n ≥ 4
  - Axial distance: $c_{1,CD}$ ≤ 300 mm, average ≤ 250 mm
    $c_{1,CD}$ ≥ 50 mm
  - Axial edge distance: $c_1 \leq c_{1,CD,max}/2$ for CCB and SCB
    c_1 ≥ 50 mm
    c_1 ≥ 56 mm for HPCB

- Shear force bars (SB) according to A13:
  - Diameter: ∅ ≤ 14 mm
  - Inclination in the insulation joint: 30° ≤ β ≤ 60°
    35° ≤ β ≤ 60° for HPCB
  - Axial distance: $c_{1,CD}$ ≤ 300 mm, average ≤ 250 mm
    $c_{1,CD}$ ≥ min (10·∅; 100 mm) for HPCB
    $c_{1,CD}$ ≥ 100 mm for SCB
  - Axial edge distance: $c_1 \leq c_{1,CD,max}/2$ for CCB and SCB
    c_1 ≥ 50 mm for CCB
    c_1 ≥ 100 mm for HPCB
    c_1 ≥ 100 mm for SCB
  - In the concrete free area: Bars shall not have any bend
  - Mandrel diameter: According to Annex A 13 and subject to the rules of EN 1992-1-1
  - Starting point of bend: ≥ 2·∅ of free concrete surface, measured in bar direction

  Shear force bars in high performance compression shear bearings (HPCSB) according to Annex A14
  - Diameter: ∅ = 6 mm
  - Inclination in the insulation joint: 35° ≤ β ≤ 45°
  - Quantity per meter: n ≥ 8
  - Axial distance: $c_{1,CD}$ ≥ 36 mm
  - Axial edge distance: c_1 ≥ 82 mm
  - In the concrete free area: Bars shall not have any bend
  - Mandrel diameter: According to Annex A 14 and subject to the rules of EN 1992-1-1
  - Starting point of bend: ≥ 2·∅ of free concrete surface, measured in bar direction

Slab connection ISOPRO	**Annex A 05**
Product description: Dimensions	

- High performance compression bearings (HPCB) and high performance compression shear bearings (HPCSB) according to annex A14 and A15:
  - Quantity per meter: $n \geq 4$, HPCSB may be counted
  - Axial distance: : $c_{1,CD} \leq 330$ mm
    $c_{1,CD} \geq 50$ mm for M-types
    $c_{1,CD} \geq 100$ mm für Q-types without transfer of moments
  - Axial edge distance: $c_1 \geq 50$ mm

- Concrete compression bearings (CCB) according to annex A 16:
  - Quantity per meter: $n \geq 4$
  - Clear distance: ≤ 250 mm
  - Axial edge distance: $c_1 \leq c_{1,CD,max}/2$
    $c \geq 50$ mm

- Steel compression bearings (SCB) according to annex A 17:
  - Diameter: $\varnothing \leq 20$ mm
  - Quantity per meter: $n \geq 4$
  - Axial distance: : ≤ 300 mm, average ≤ 250 mm

Slab connection ISOPRO	**Annex A 06**
Product description: Dimensions	

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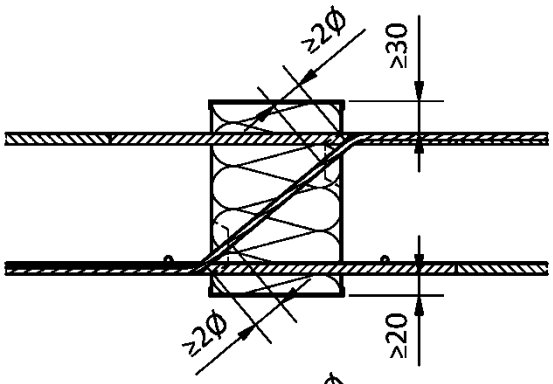
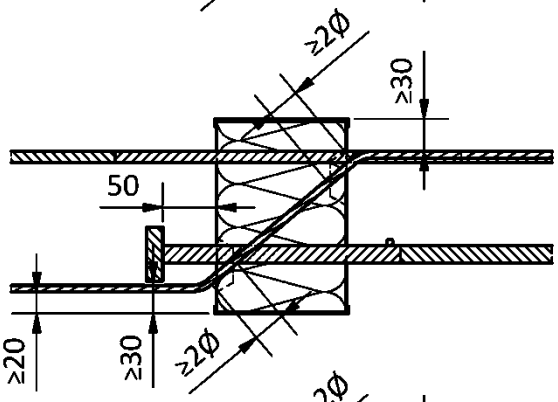
A.2.1 Position of the bars

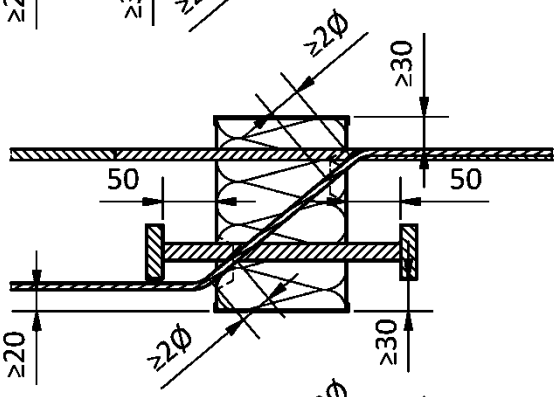
For SCB variant 1-3
according to annex A 17
exemplary type IP M Q



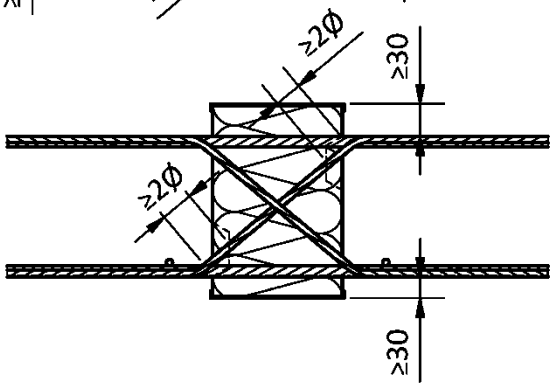
For SCB variant 4-5
according to annex A 17
exemplary type IP M Q



For SCB variant 6-7
according to annex A 17
exemplary type IP M Q



For SCB variant 1-3
according to annex A 17
exemplary type IP M QQ



Slab connection ISOPRO	**Annex A 07**
Product description: Position of the bars for ISOPRO with SCB	

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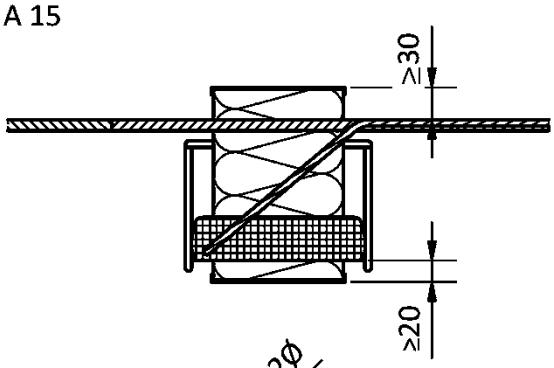
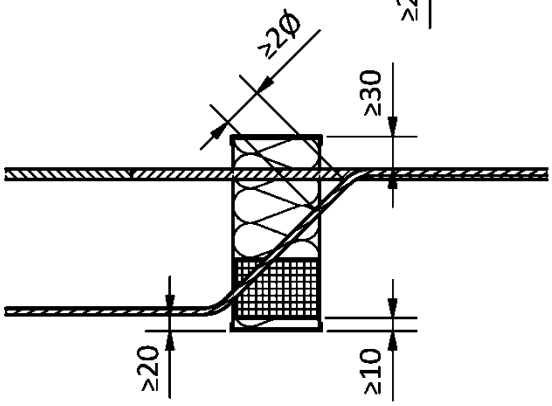
For HPCB und HPCSB
according to annex A 14 and A 15
Type IP M DQ
Type IP Q
Type IP QQ



For CCB
according to annex A 16
Type IP M Q
Type IP Q
Type IP QQ

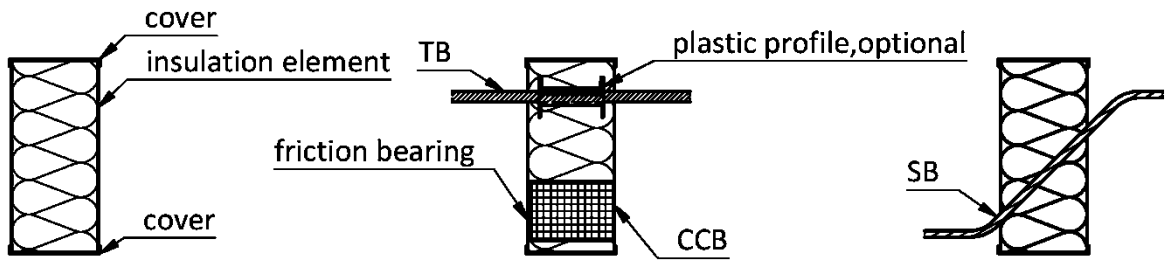


Slab connection ISOPRO	**Annex A 08**
Product description: Position of the bars for ISOPRO with HPCB, HPCSB or CCB	

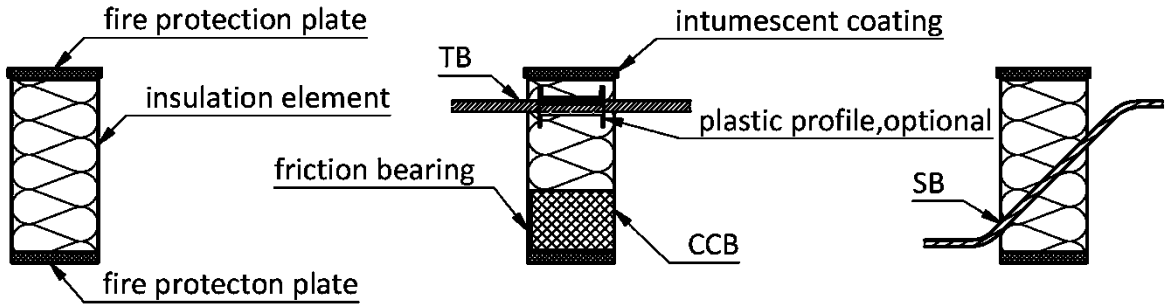
A.3 Design of the elements

A.3.1 ISOPRO with concrete compression bearings (CCB), exemplary type IP M Q

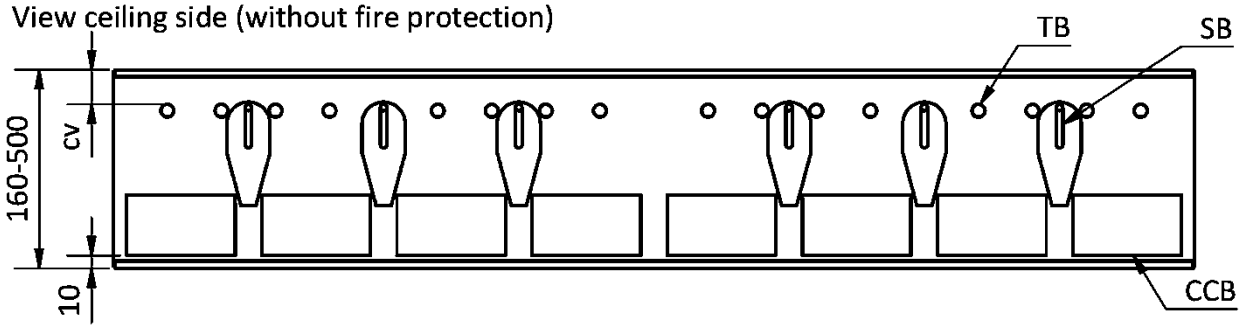
Without fire protection



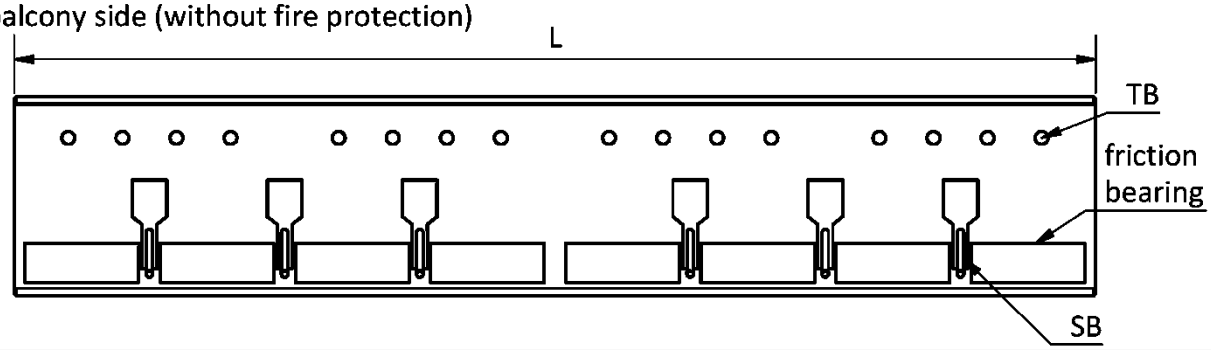
With fire protection



View ceiling side (without fire protection)



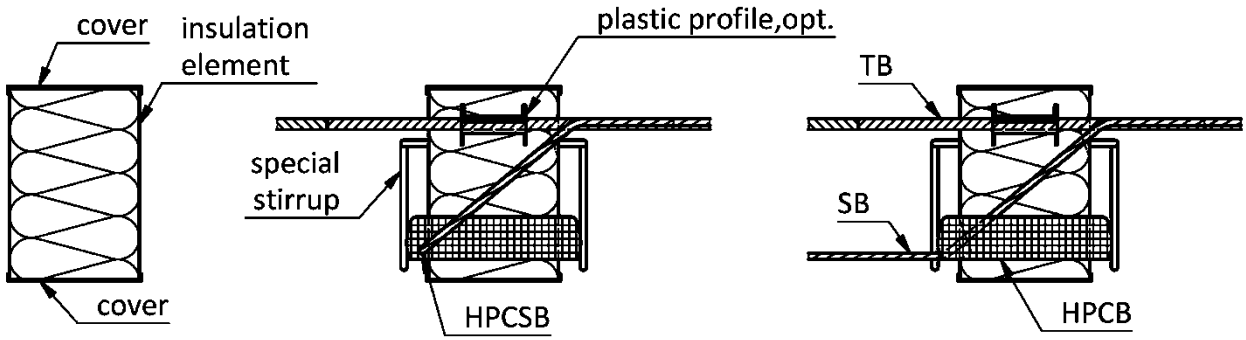
View balcony side (without fire protection)



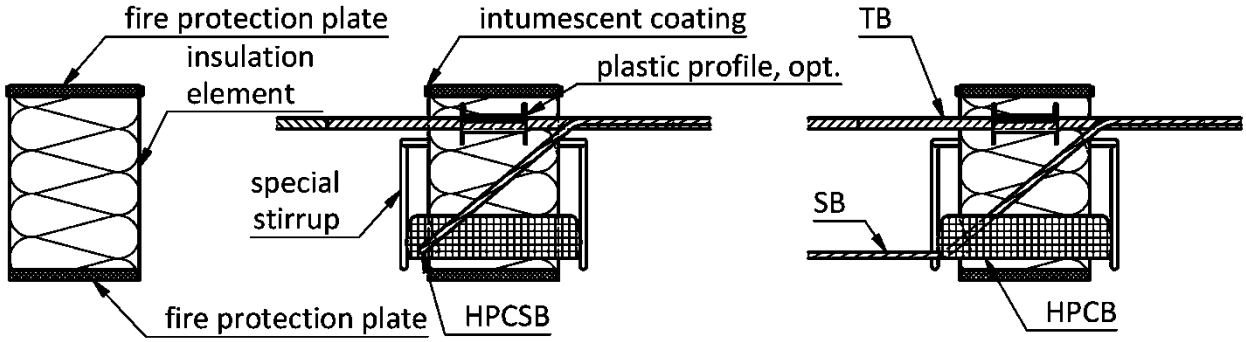
Slab connection ISOPRO	**Annex A 09**
Product description: Design of the elements ISOPRO with CCB	

A.3.2 ISOPRO with high performance concrete bearings (HPCB and HPCSB), exemplary types IP M

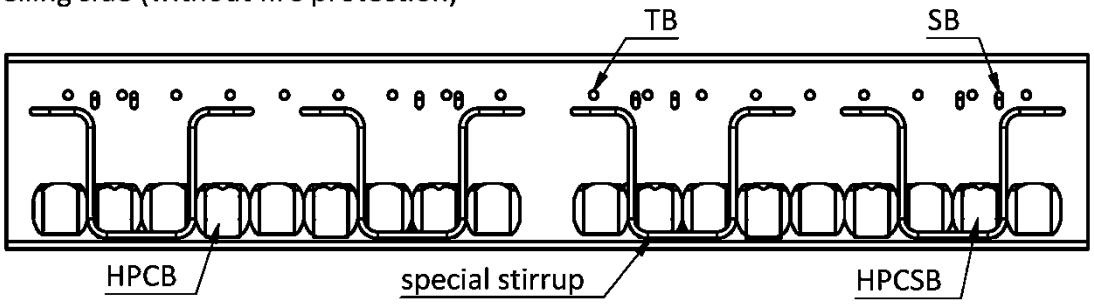
Without fire protection



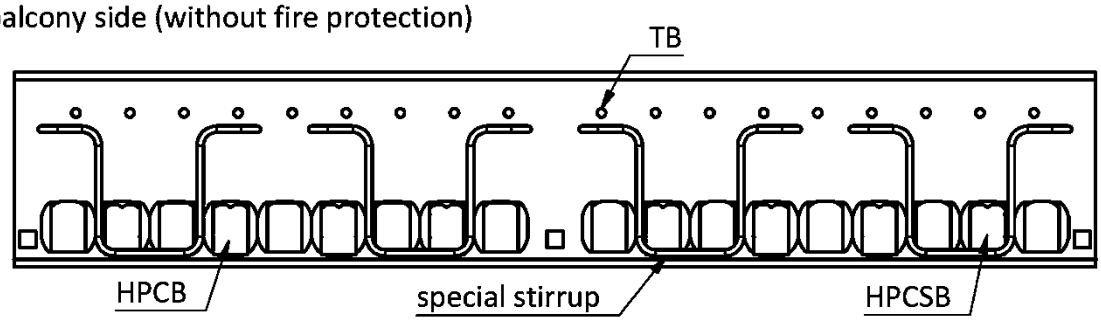
With fire protection



View ceiling side (without fire protection)



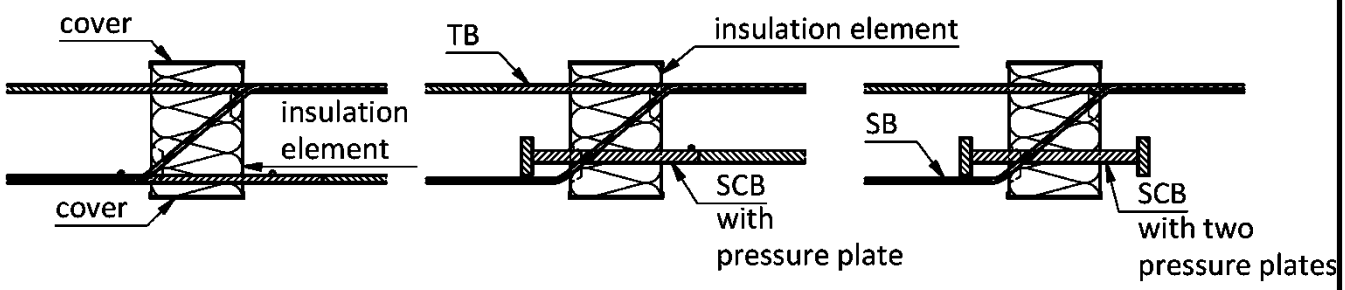
View balcony side (without fire protection)



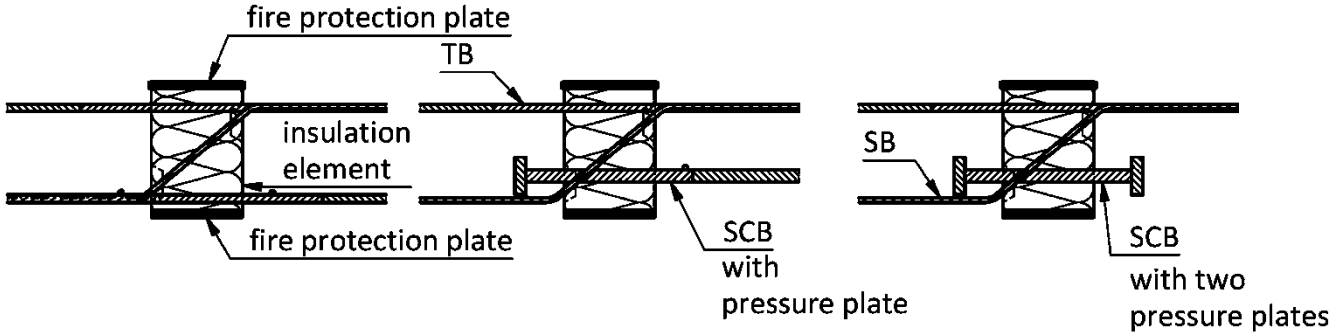
Slab connection ISOPRO	**Annex A 10**
Product description: Design of the elements ISOPRO with HPCB and HPCSB	

A.3.3 ISOPRO with steel compression bearings (SCB), exemplary types IP MT

Without fire protection



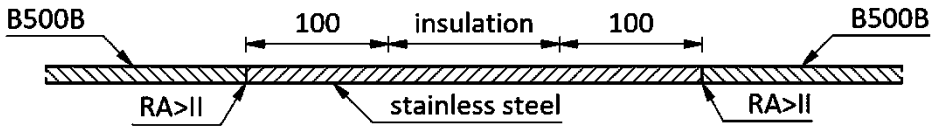
With fire protection



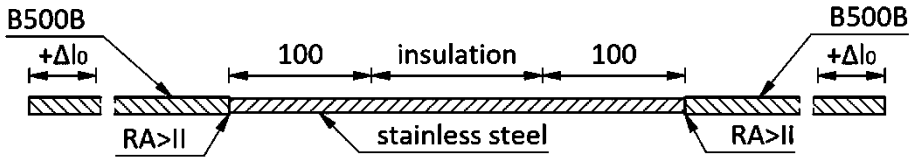
Slab connection ISOPRO	**Annex A 11**
Product description: Design of the elements ISOPRO with SCB	

A.3.4 Tension bar (TB)

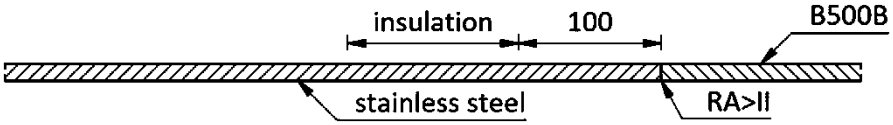
TB variant 1



TB variant 2



TB variant 3



TB variant 4

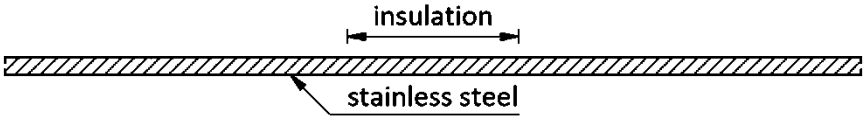


Table A.1: design for tension bar variants 1 and 2

Tension bar diameter [mm]			$R_{p\,0,2}$ [N/mm²]	$R_{p\,0,2}$ [N/mm²]	ΔL_0 [mm]
$\emptyset_1$	$\emptyset_2$	$\emptyset_3$	Steel bar $\emptyset_{1,3}$	Stainless steel bar $\emptyset_2$	
6	6	6	500	500	-
8	8	8	500	500	-
8	7	8	500	700	12
8	6,5	8	500	800	18
10	10	10	500	500	-
10	8	10	500	820	20
12	12	12	500	500	-
12	10	12	500	760	16
14	14	14	500	500	-
14	12	14	500	760	14

Slab connection ISOPRO	**Annex A 12**
Product description: Tension bars	

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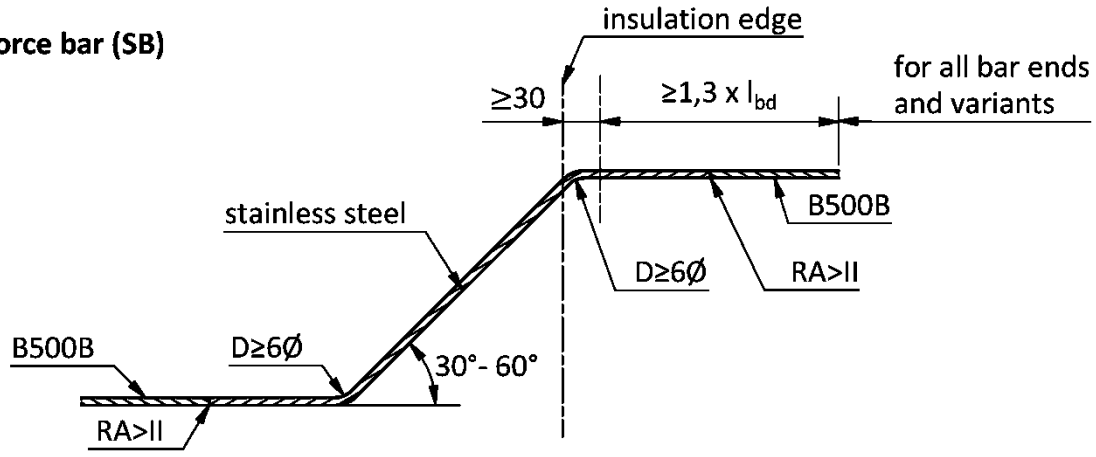
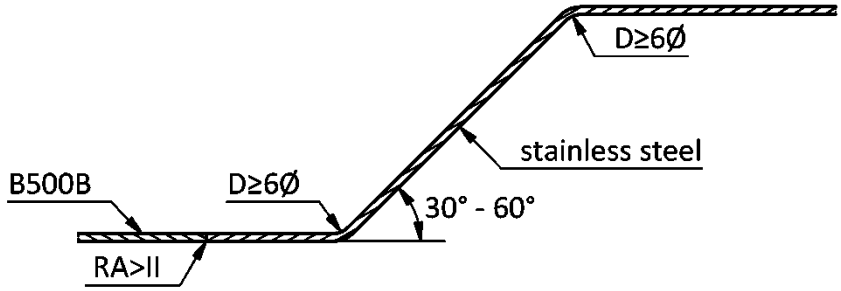
A.3.5 Shear force bar (SB)

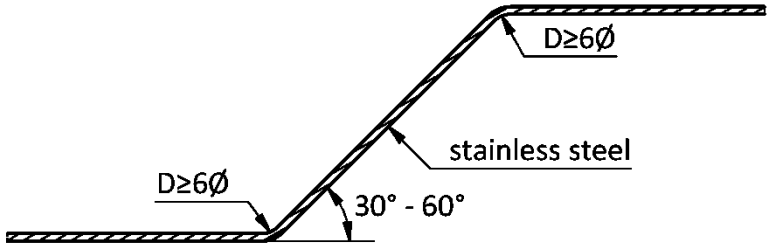
SB variant 1



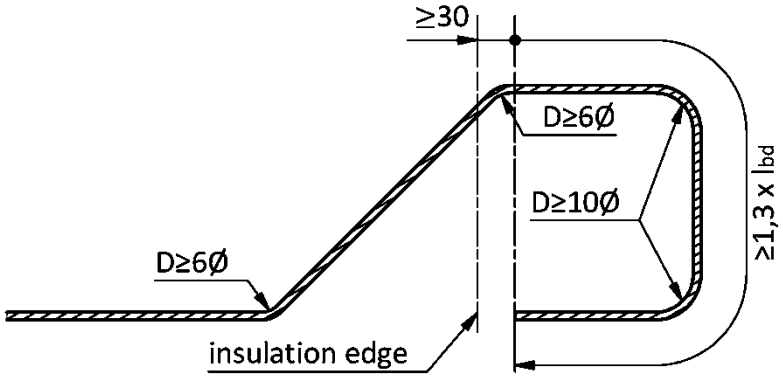
SB variant 2



SB variant 3



SB variant 1-3
for Ø6 and Ø8
ceiling side bended
Materials see above



Slab connection ISOPRO	**Annex A 13**
Product description: Shear force bar	

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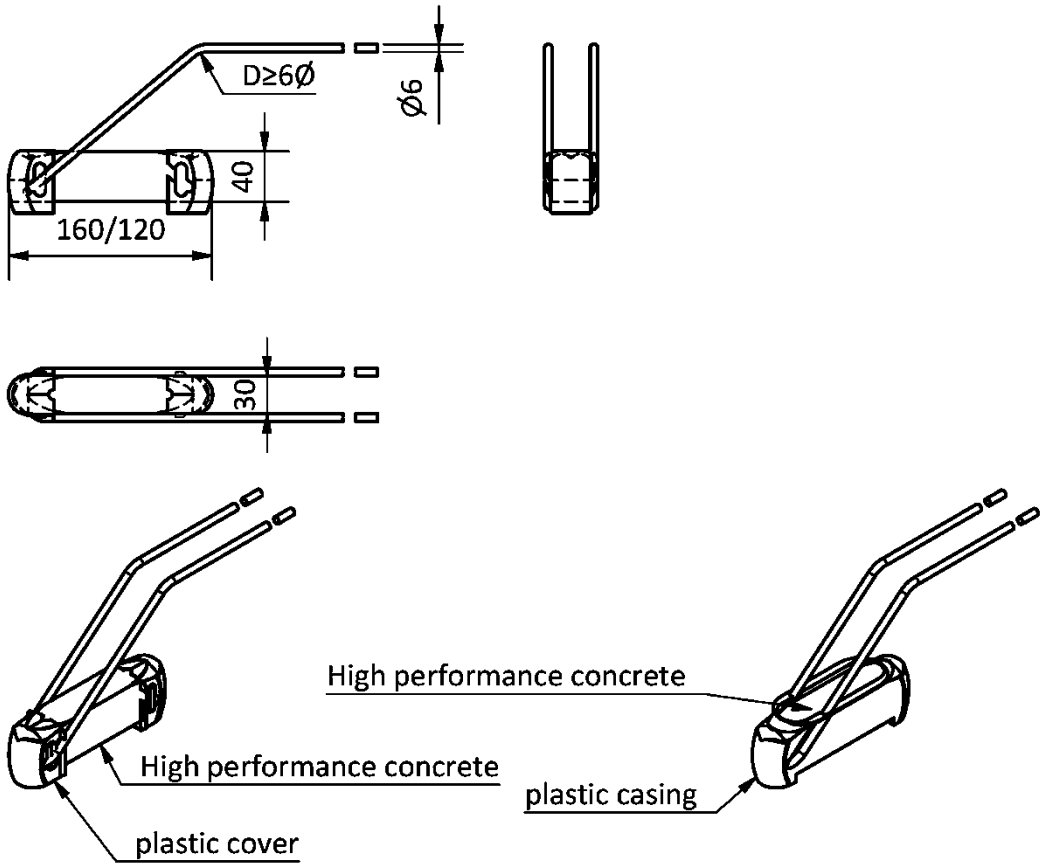
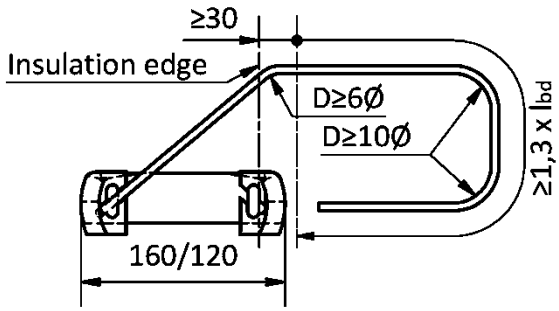
A.3.6 High performance compression shear bearing (HPCSB)

HPCSB for insulation thickness 120mm/80mm,
realisable with plastic cover or casing



Variant with bended shear force bars,
realisable with plastic cover or casing



Slab connection ISOPRO	**Annex A 14**
Product description: High performance compression shear bearing	

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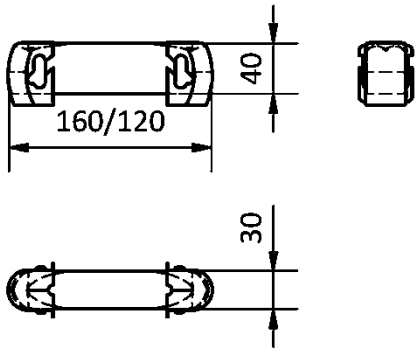
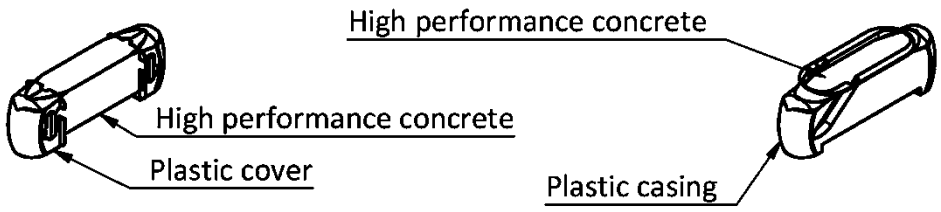
A.3.7 Compression bearings
A.3.7.1 High performance compression bearing (HPCB)

HPCB for insulation thickness 120mm/80mm,
realisable with plastic cover oder casing





Slab connection ISOPRO	**Annex A 15**
Product description: High performance compression bearing	

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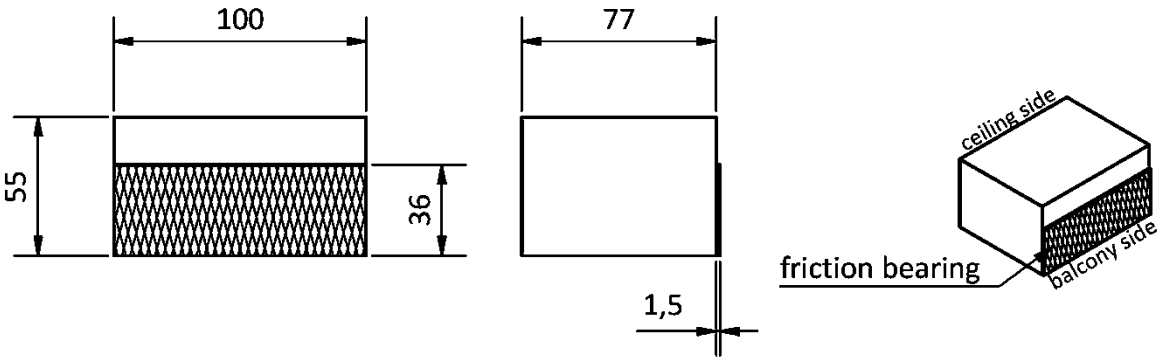
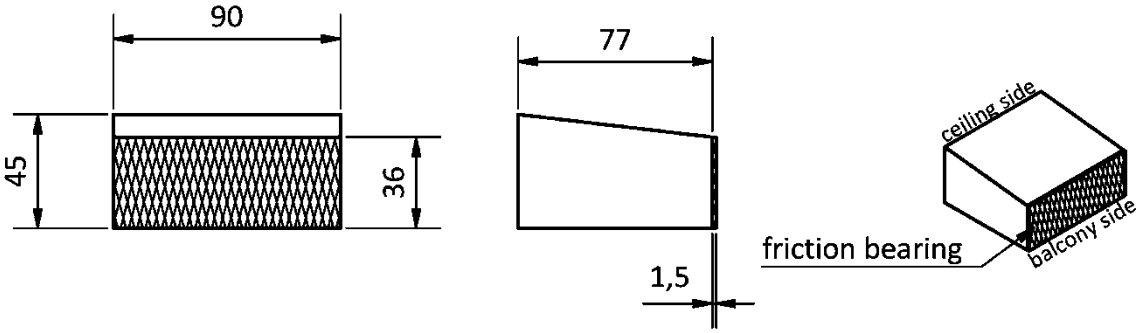
A.3.7.2 Concrete compression bearing (CCB)

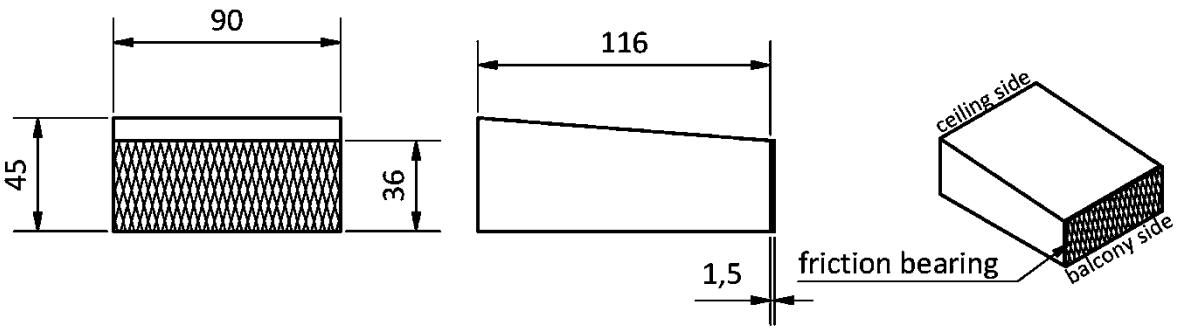
CCB variant 1 for insulation thickness 80mm



CCB variant 2 for insulation thickness 80mm



CCB for insulation thickness 120mm



Slab connection ISOPRO	**Annex A 16**
Product description: Concrete compression bearing	

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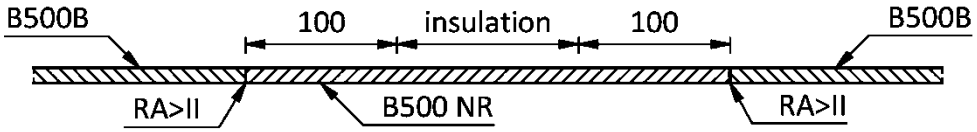
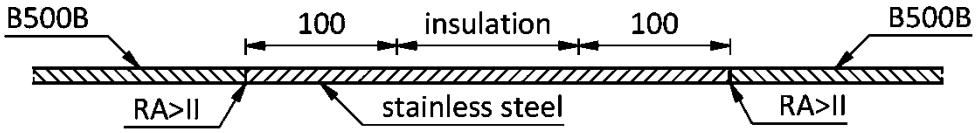
A.3.7.3 Steel compression bearing (SCB)

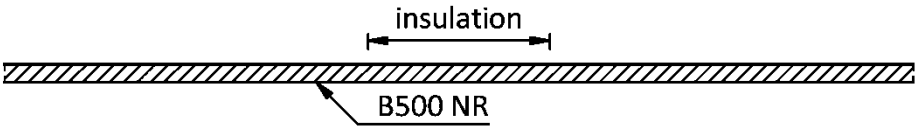
SCB variant 1



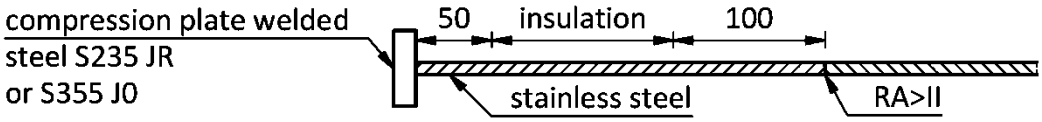
SCB variant 2



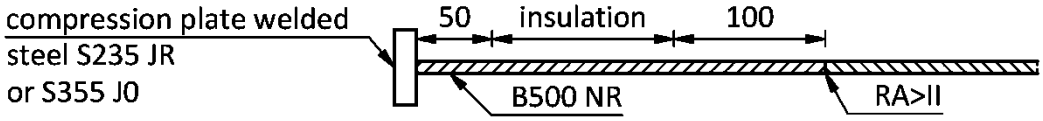
SCB variant 3



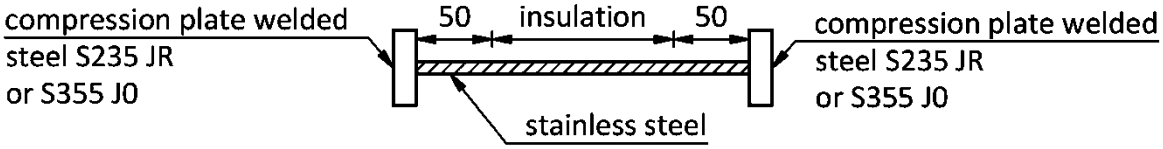
SCB variant 4



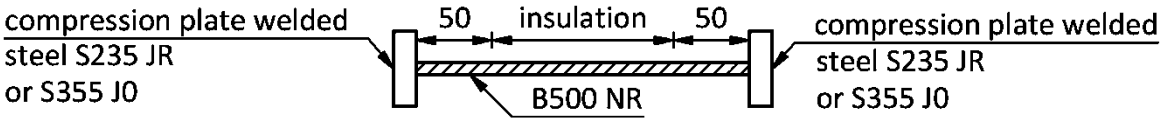
SCB variant 5



SCB variant 6



SCB variant 7



Slab connection ISOPRO	**Annex A 17**
Product description: Steel compression bearing	

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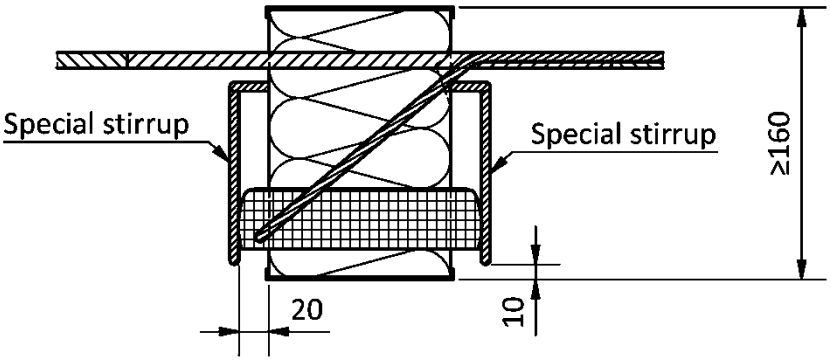
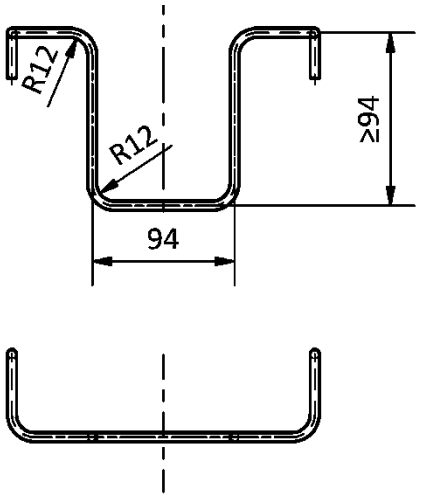
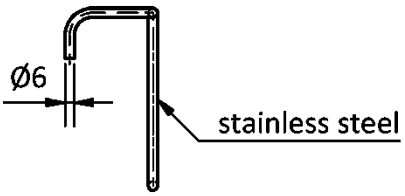
A.3.8 Special stirrup

only for ISOPRO with HPCB and HPCSB



Special stirrup





Slab connection ISOPRO	**Annex A 18**
Product description: Special stirrup	

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A.4 Materials:

▪ Reinforcing steel:	B500 B, class A1 according to EN 13501-1
▪ Stainless reinforcing steel:	B500 NR, corrosion resistance class III according to EN 1993-1-4, class A1 according to EN 13501-1
▪ Stainless steel round bars:	S355 or S460, corrosion resistance class III according to EN 1993-1-4, class A1 according to EN 13501-1
▪ Structural steel:	S235JR, S235J0, S355J2, S355JR or S355J0 according to EN 10025-2 for compression plates, class A1 according to EN 13501-1
▪ CCB:	High performance concrete, class A1 according to EN 13501-1
▪ Friction bearing:	Material according to datasheet, class E-d_2 according to EN 13501-1
▪ HPCB / HPCSB:	High performance concrete according to datasheet, class A1 according to EN 13501-1
▪ Plastic cover/casing:	PP plastic according to datasheet, class E according to EN 13501-1
▪ Plastic profiles:	PVC-, PP- or PS- plastic according to datasheet, class E according to EN 13501-1
▪ Insulation material:	Polystyrene-rigid foam (EPS) according to DIN EN 13163, class E according to EN 13501-1
▪ Fire protection plate:	Moisture repellent, weather-resistant, UV resistant, class A1 according to EN 13501-1
▪ Intumescent coating:	Halogen-free, three-dimensional foaming building material based on graphite, foaming factor min. 14, min. class B-s1-d0 according to EN 13501-1

Slab connection ISOPRO	**Annex A 19**
Product description: Materials	

B.1 Intended use

- Static or quasi-static actions
- In structures with fire resistance requirements
- Minimum concrete strength class of the reinforced components to be connected made of normal-strength concrete according to EN 206; C20/25, for exterior components C25/30
- For the connections of slabs with thicknesses of 160 mm to 500 mm
- Thickness of insulation joint 60 mm to 120 mm (depending on the compression bearing, see annex B02, table B.1)

B.1.1 Design

For design EN 1992-1-1 and EN 1993-1-1 along with the provisions of annex D apply.

- Expansion joints should be used to divide the connected slabs (arranged according to section B 02)
- The structural verification for the transmission of the forces from the tension and compression members to the connected structural components shall be carried out, see annex D
- Deviations from the state of expansion of an identical slab without insulation joint are limited to the joint area and the adjoining edges by compliance with this European Technical Assessment
- At a distance h from the edge of the joint, the undisturbed state of expansion may be assumed
- Variable moments and shear forces along the connected edge shall be taken into account
- Stresses of the slab connections due to local torsional moments shall be avoided
- Small normal forces from constraints in the girder bars (at the end of line supports, e.g. next to free edges or expansion joints), may be neglected in the structural calculation. Constrained normal forces in the direction of the bars of the slab connection shall be avoided (example see annex B 02)
- The ratio of height to width of connected components shall be ≤ 1/3, if no dedicated calculation for the bearing of the transverse tensile stresses is carried out
- Connecting elements may also be pre-fabricated in two parts, a top part and a bottom part, to facilitate the installation in precast slabs
- Connecting elements may also be used in short pieces, if the conditions according to A.2 are met
- Connecting elements of type IP QS may also be used in short pieces (l ≥ 300 mm, with at least two shear force bars and one concrete compression bearing per element). The shear force bars shall be arranged symmetrically in relation to the compression bearing. These elements can also be installed for the multi-sided support of slabs, provided that it is ensured that the individual short pieces are uniformly loaded and that the slab is supported without constraint in the plan view
- Connecting elements of type IP QZ may also be installed in short pieces (l ≥ 300 mm, with at least two shear force bars per element) and may be installed as freely movable perpendicular to the insulation joint. The tensile force resulting from these types shall be connected frictionally in the supporting structure on both sides of the insulation joint.

Slab connection ISOPRO	**Annex B 01**
Intended use: Conditions of use	

B.2 Installation requirements

B.2.1 Axial and joint distances

- Axial and edge distances according to A.2
- External structural components: expansion joints shall be arranged at right angles to the insulation joint
- Joint distances: Table B.1

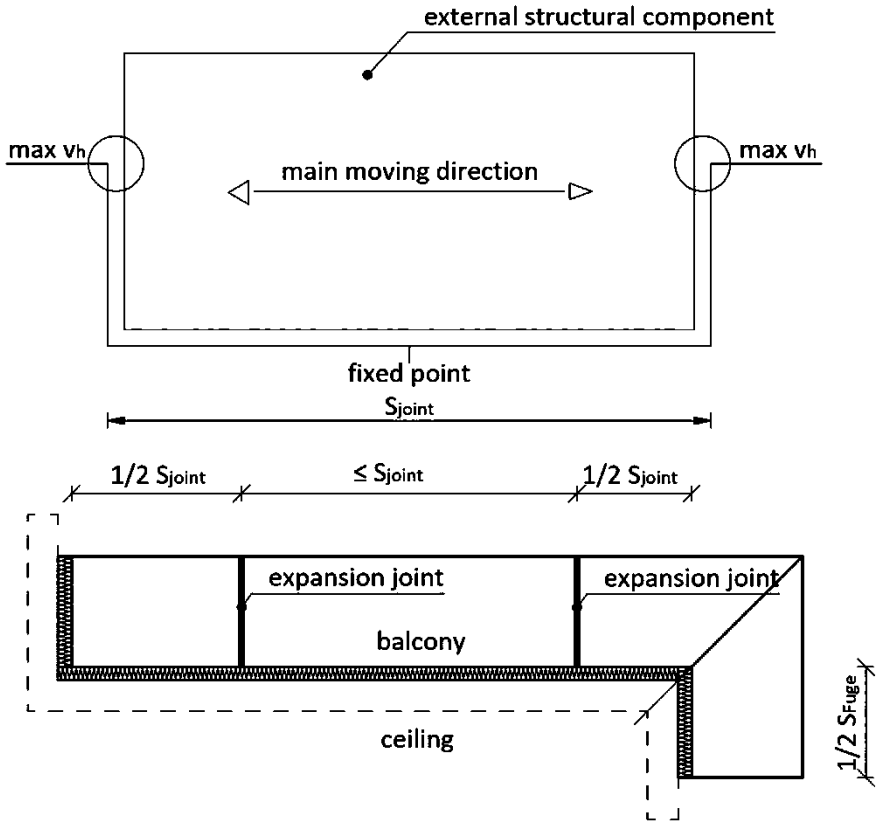

Table B.1: permissible joint distances s_{joint} in [m]

Compression bearing	Thickness of the insulation joint [mm]	Bar diameter in the joint [mm]						
		6,5	8	10	12	14	16	20
CCB	80	13,0	13,0	13,0	11,3	10,1	-	-
	120	21,7	21,7	21,7	19,8	17,0	-	-
SCB	60	7,8	7,8	7,8	6,9	6,3	5,6	5,1
	80	13,0	13,0	13,0	11,3	10,1	9,2	8,0
	120	21,7	21,7	21,7	19,8	17,0	15,5	13,5
HPCB / HPCSB	80	13,0	13,0	13,0	11,3	10,1	-	-
	120	24,0	21,7	21,7	19,8	17,0	-	-

Slab connection ISOPRO

Intended use: Axial and joint distances

Annex B 02

B.2.2 Structural design

Minimum concrete cover according to EN 1992-1-1 for tension bars, transverse reinforcement and supplementary reinforcement shall be observed.

Reinforcement of adjoining concrete components shall be brought up to the insulation layer considering the requirements for concrete covers according to EN 1992-1-1.

Transverse bars of the upper connection reinforcement shall normally lie on the outside of the longitudinal bars of the slab connections. Deviations are possible for diameters smaller than 16 mm, if the following conditions are met:

- Installation of the transverse bars directly under the longitudinal bar is possible
- Installation is checked, e.g. by a construction supervisor
- Installation steps shall be described in the installation instructions (see annex B 04 to B 09)

Front surface of the connected components shall be provided with structural edge reinforcement according to EN 1992-1-1, section 9.3.1.4, e.g. with stirrups of $\varnothing \geq 6$ mm, $s \leq 250$ mm and 2 longitudinal bars $\varnothing \geq 8$ mm.

Lattice girders with a maximum distance of 100 mm from the insulation joint according to Annex B 11 may be taken into account.

The supplementary reinforcement has to be executed as follows:

- Transmission of moments and shear forces:
  → tension bars have to be overlapped
- Transmission of shear forces only:
  → The tensile reinforcement in the area of the slab connection shall not be staggered
  → The tensile reinforcement at the front surface of the slab shall be anchored by hooks in the compression zone. Alternatively stirrups can be placed at each shear force bar
- Transmission of lifting moments and lifting shear forces:
  → tension bars and steel compression bearings have to be overlapped

Subsequent bending of the bars of the slab connection is not permitted.

Slab connection ISOPRO	**Annex B 03**
Intended use: Structural design	

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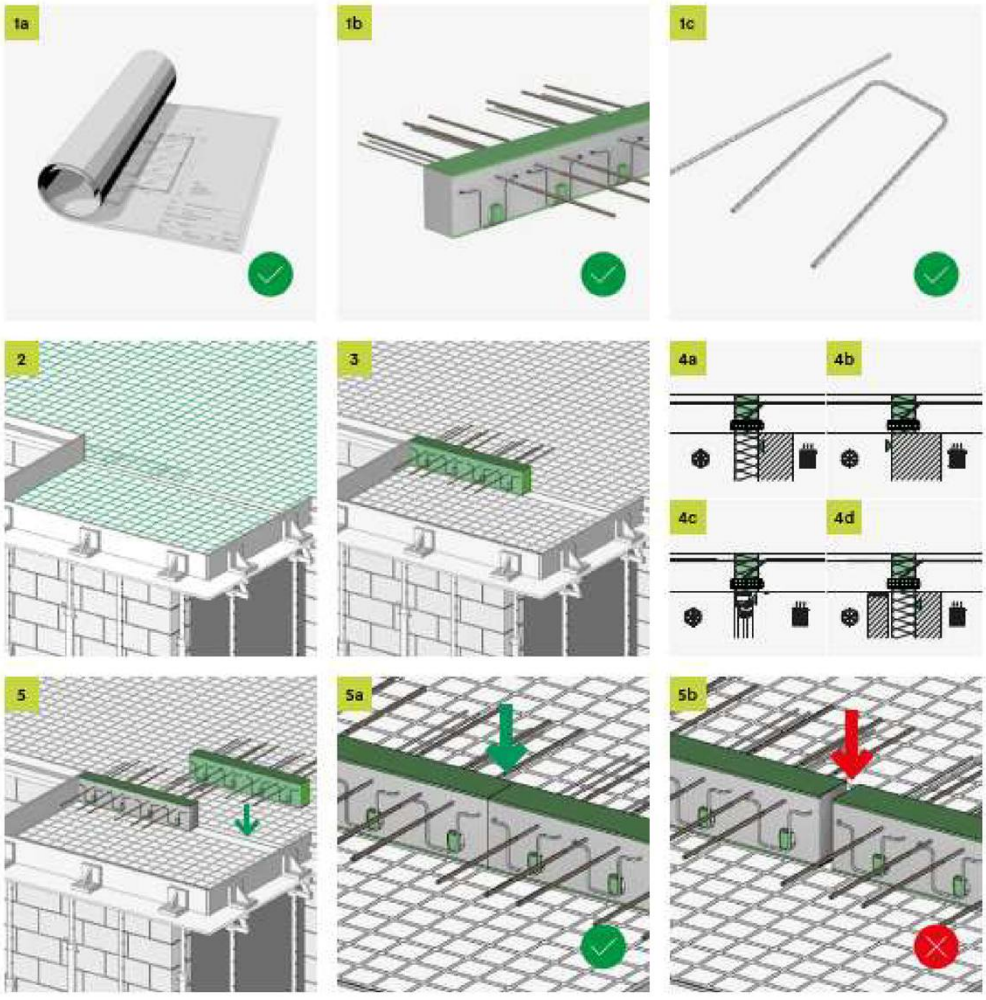
B.3 Installation instructions

PohlCon

ISOPRO® 120 M

Einbauanleitung/Installation Instructions



Slab connection ISOPRO	**Annex B 04**
Intended use: Installation instructions	

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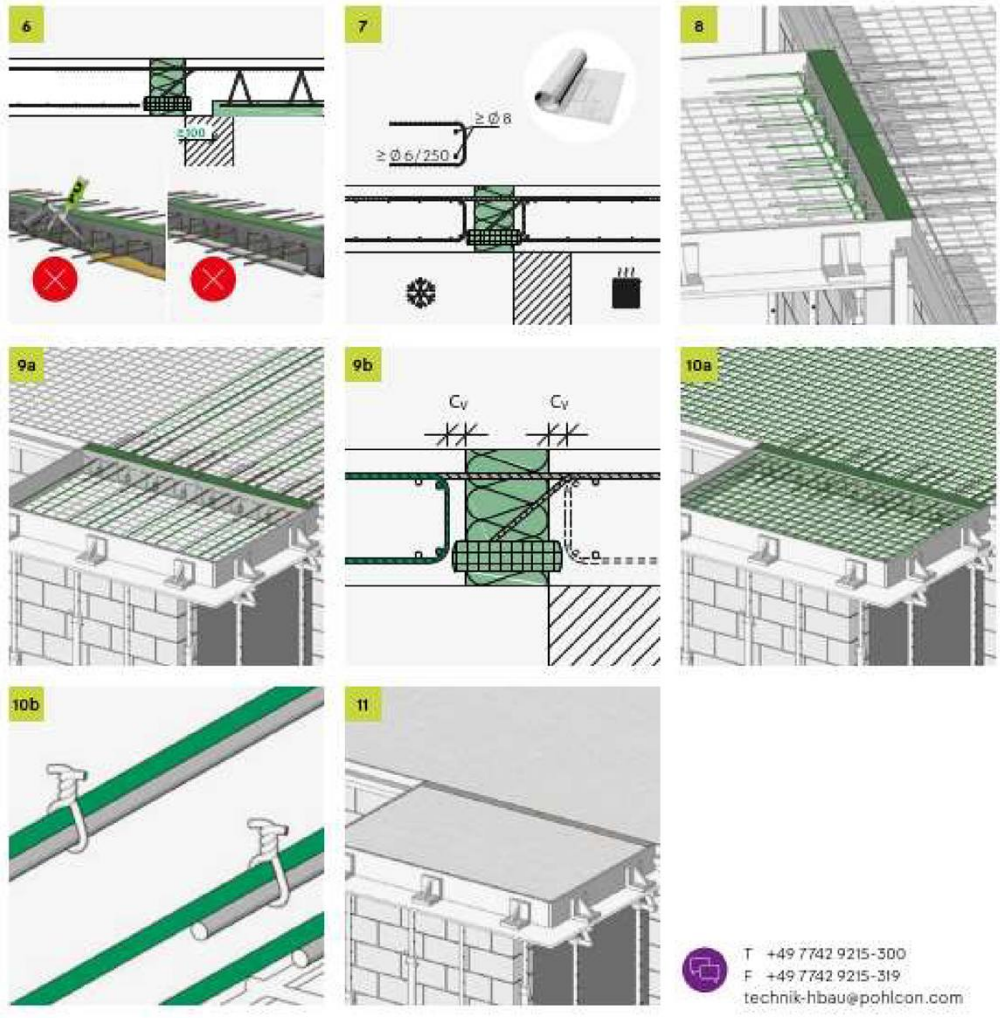

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Slab connection ISOPRO	**Annex B 05**
Intended use: Installation instructions	

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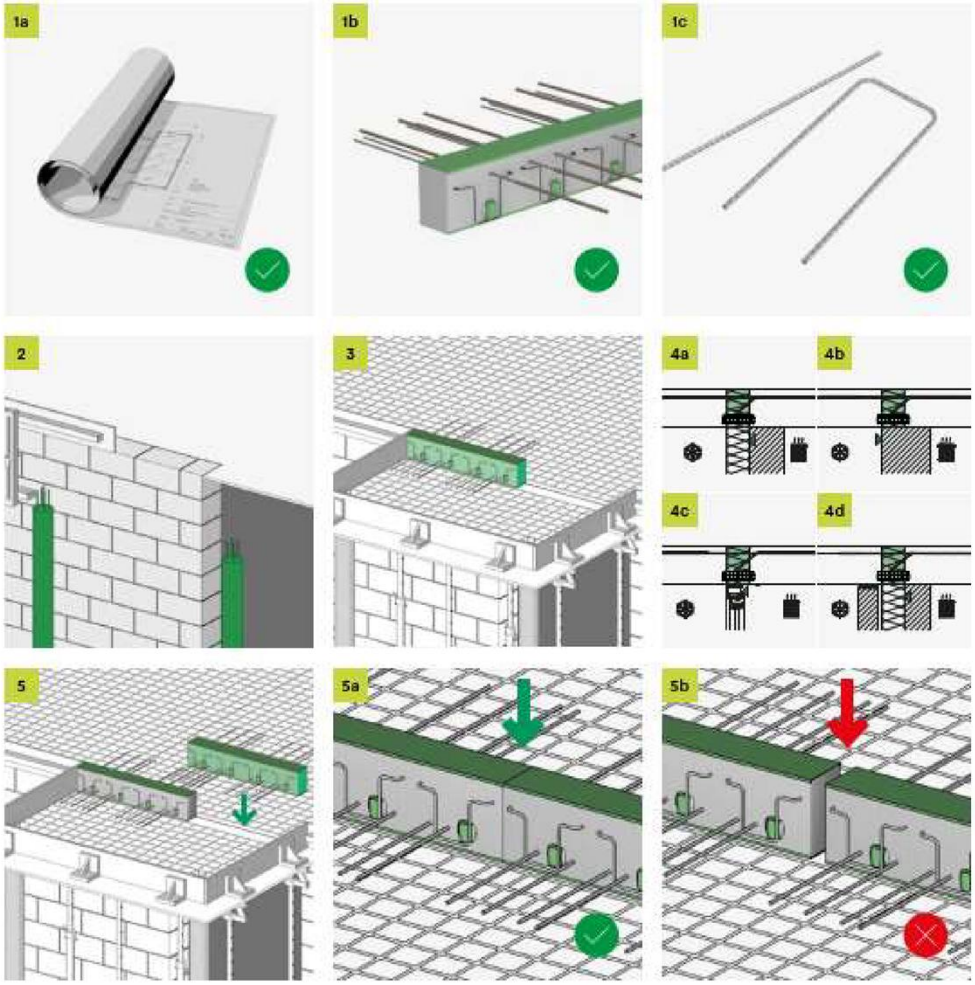
PohlCon

ISOPRO® 120 Q

Einbauanleitung/Installation Instructions



Slab connection ISOPRO	**Annex B 06**
Intended use: Installation instructions	

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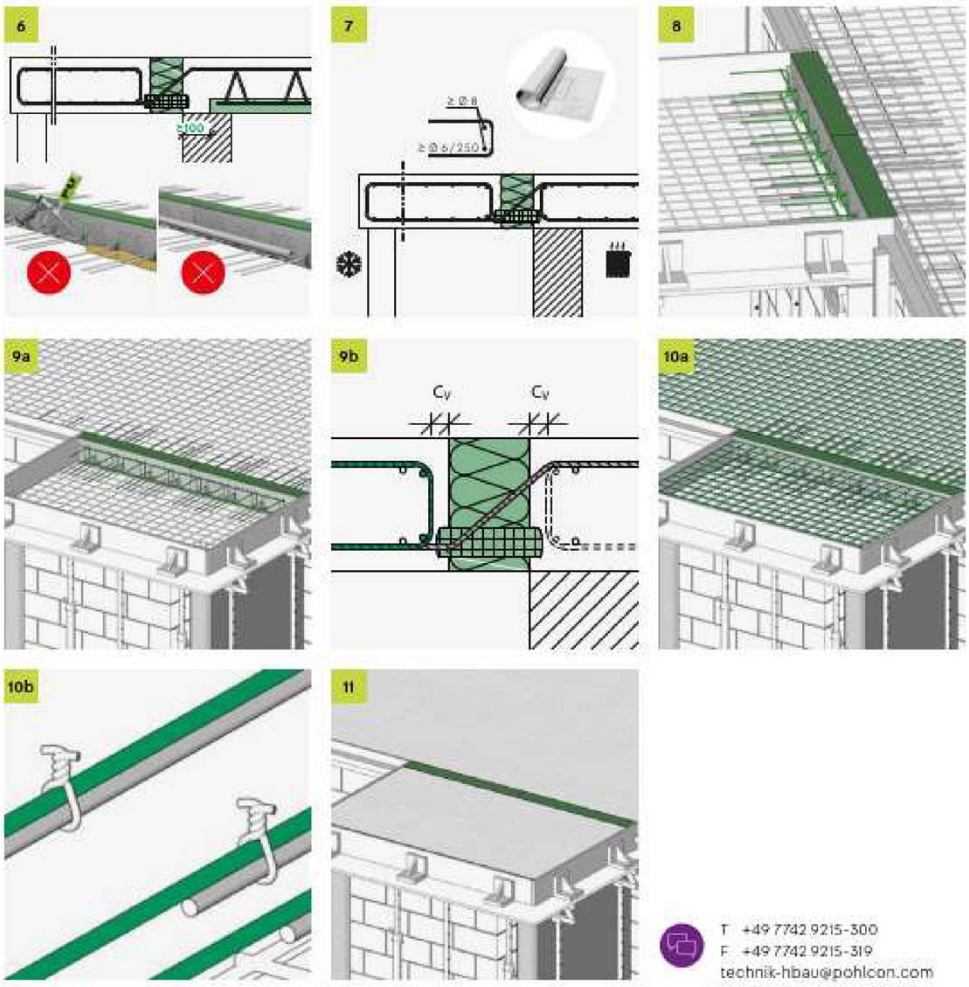

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Slab connection ISOPRO

Intended use: Installation instructions

Annex B 07

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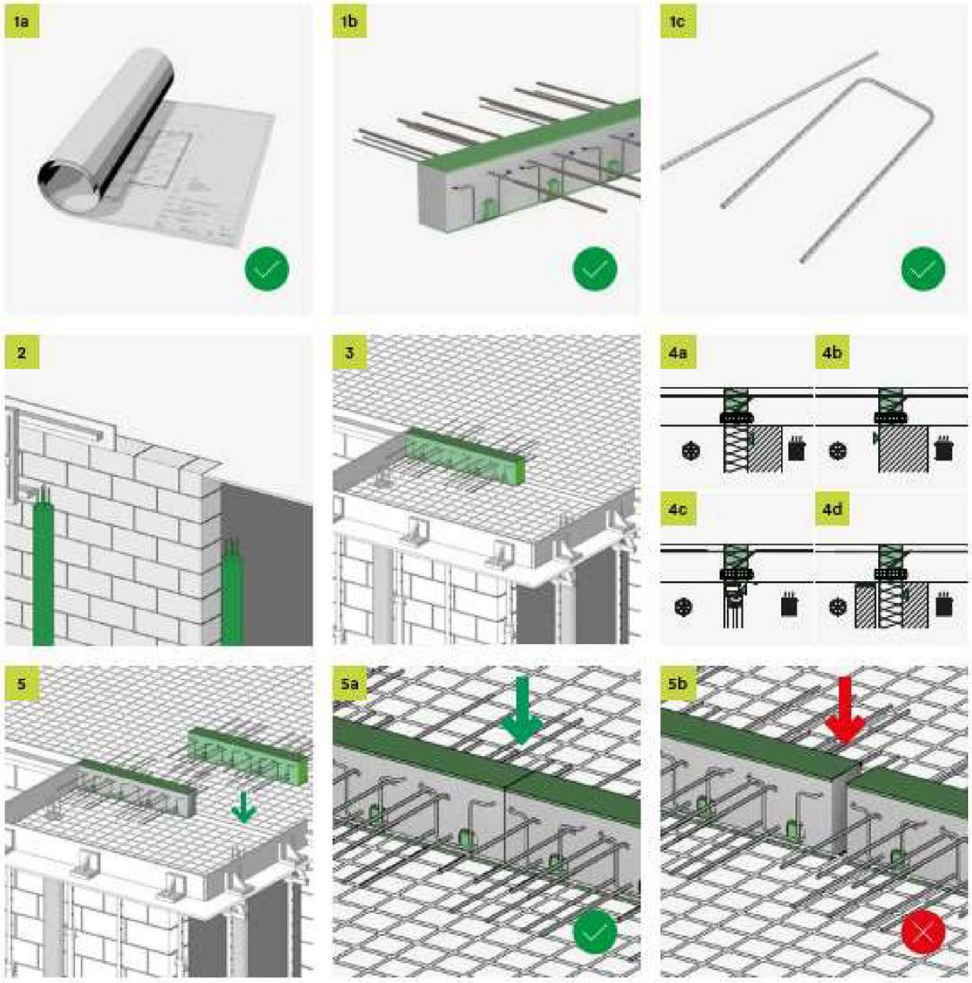
ISOPRO® 120 QQ

Einbauanleitung/Installation Instructions



Slab connection ISOPRO	**Annex B 08**
Intended use: Installation instructions	

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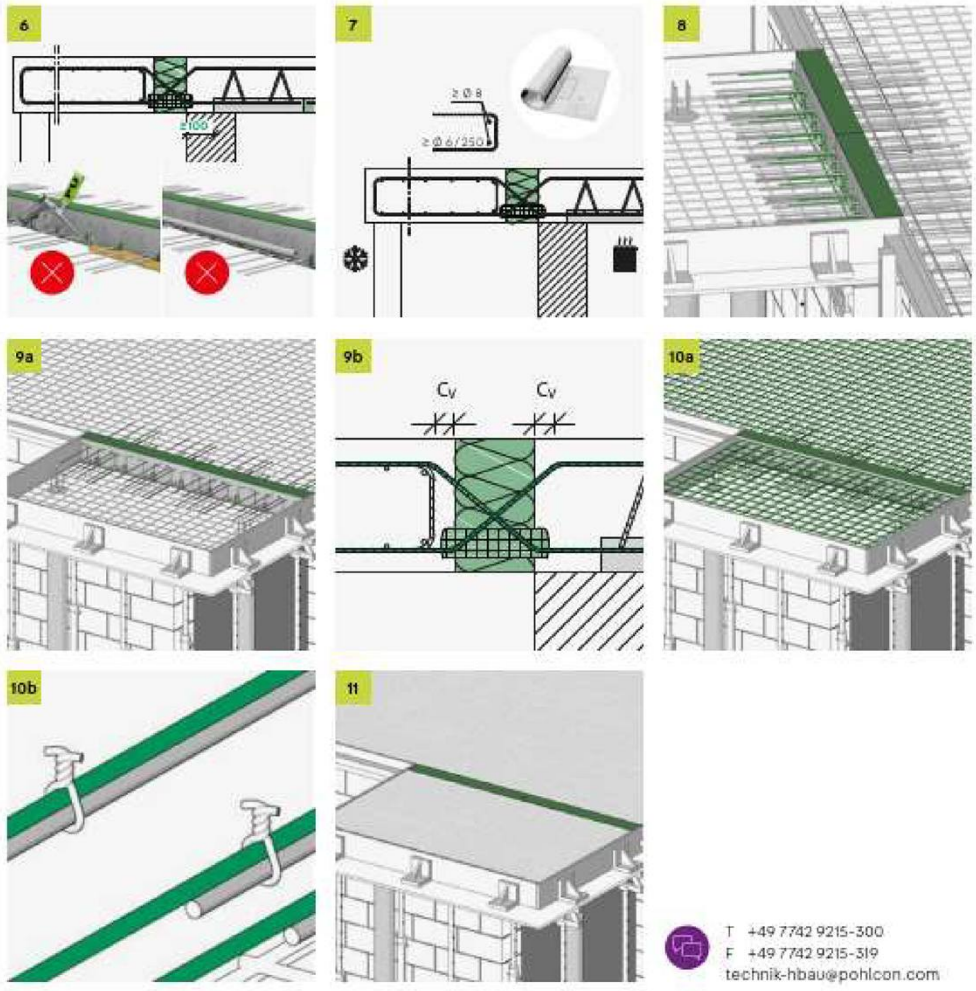

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Slab connection ISOPRO

Intended use: Installation instructions

Annex
B 09

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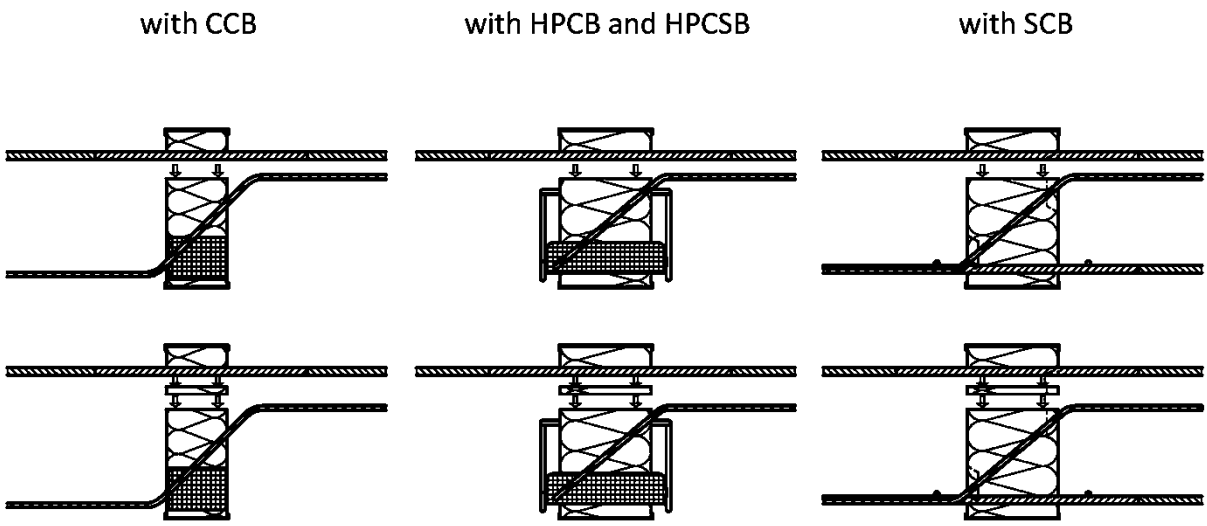
B.4 ISOPRO in two- or multi-part design
exemplary for type M Q



Slab connection ISOPRO	**Annex B 10**
Intended use: Multi-part design	

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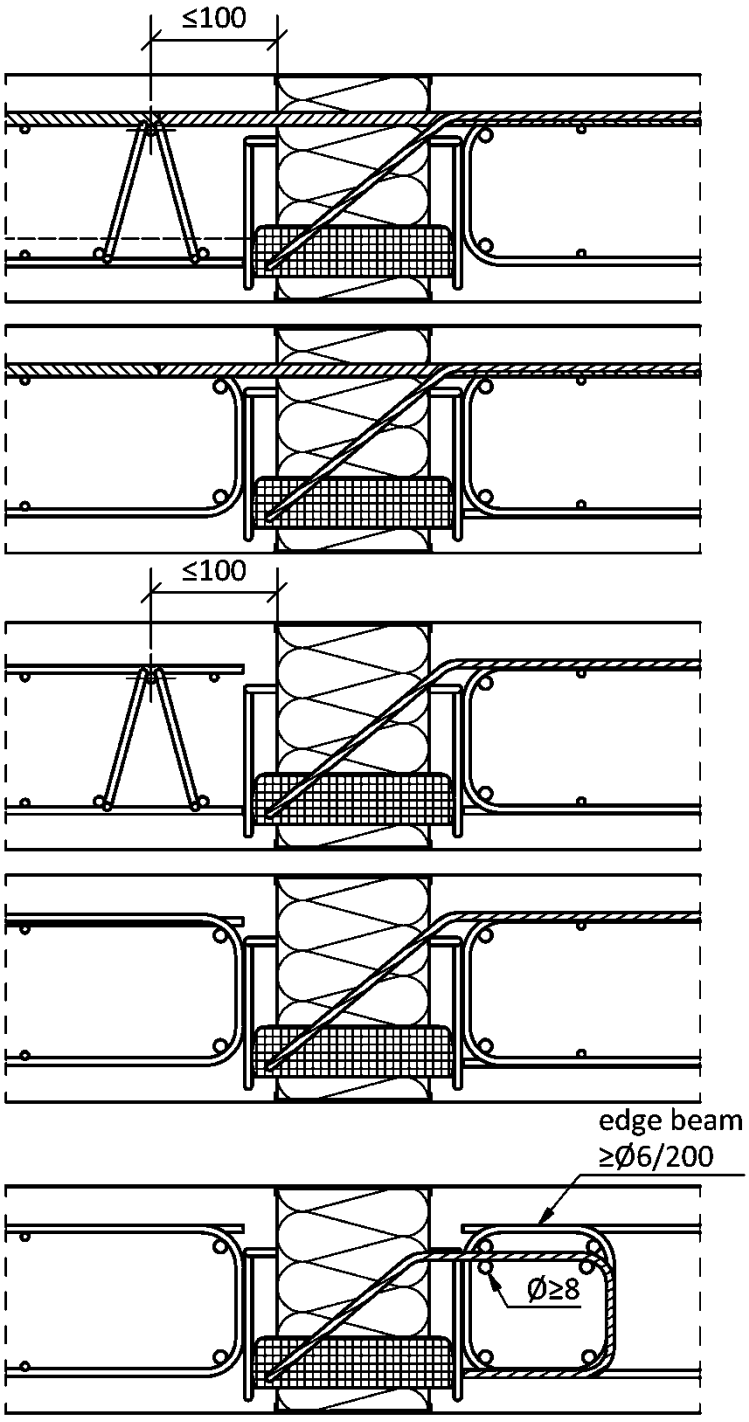
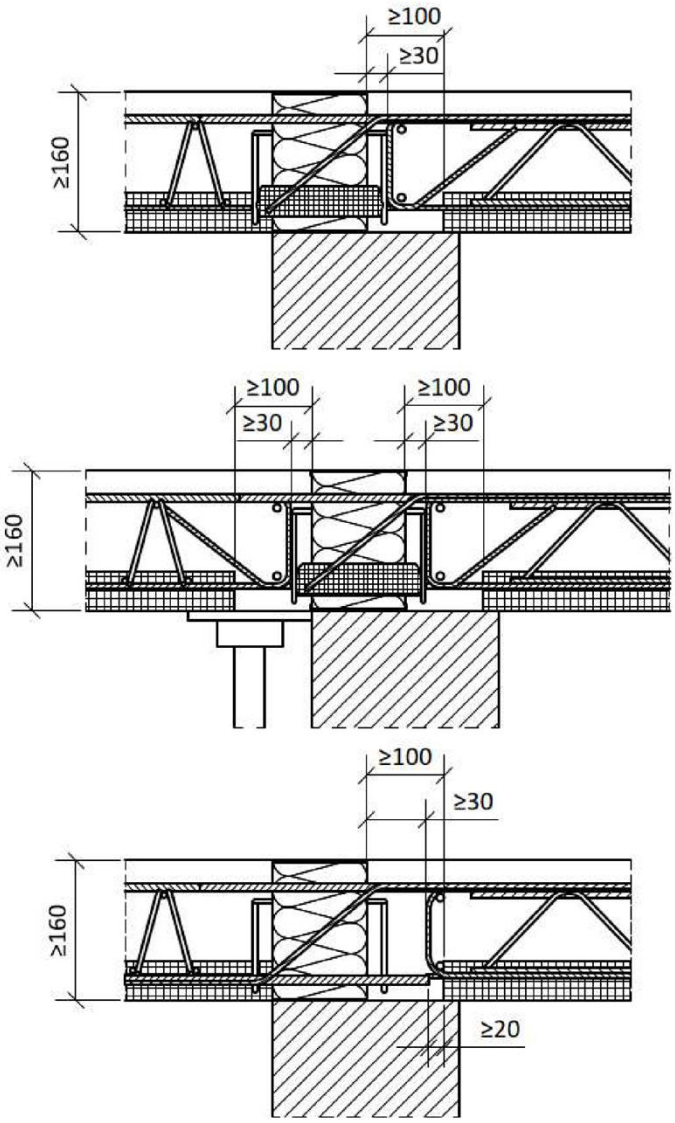
B.5 ISOPRO Edge reinforcement with and without lattice girder
exemplary with HPCB and HPCSB
with CCB and SCB identical



Slab connection ISOPRO	**Annex B 11**
Intended use: Edge reinforcement	

If the adjacent ceiling slabs connecting to slab connectors are designed as precast slabs, the following conditions apply:

- When using precast slabs and in-situ concrete a grouting strip at least 100 mm wide shall be installed as shown in the following figure
- The concrete mixture of the in-situ concrete joint (maximum aggregate size d_g) shall be adjusted to this distance



B.6 Instruction for use with fire protection requirements

When using the slab connectors to connect reinforced concrete slabs that are subject to fire protection requirements follow the provisions in section C.2.

Slab connection ISOPRO	**Annex B 12**
Intended use: Edge reinforcement	

C.1 Load-bearing capacity

C.1.1 Bearing capacity of single components

- Tension bars (TB)
  Design values of the tension bar load capacitiers Z_{Rd} [kN], $Ø_1$ according to annex A 12
  - $Ø_1$= 6 mm: 12,3 kN
  - $Ø_1$= 8 mm: 21,9 kN
  - $Ø_1$=10 mm: 34,1 kN
  - $Ø_1$=12 mm: 49,2 kN
  - $Ø_1$=14 mm: 66,9 kN
  - $Ø_1$=16 mm: 87,5 kN
  - $Ø_1$=20 mm: 136,7 kN

- Shear force bars (SB)
  Table C.1: Design values of the shear force bar load capacities $Z_{v,Rd}$ und shear force load capacities V_{Rd}

	$Z_{v,Rd}$ [kN]	$V_{Rd,30°}$ [kN]	$V_{Rd,40°}$ [kN]	$V_{Rd,45°}$ [kN]	$V_{Rd,60°}$ [kN]
Ø= 6mm	12,3	6,2	7,9	8,7	10,7
Ø= 8mm	21,9	11,0	14,0	15,5	19,0
Ø= 10mm	34,1	17,1	21,9	24,2	29,6
Ø= 12mm	49,2	24,6	31,6	34,8	42,6

- High performance compression shear bearings (HPCSB)
  Table C.2: Design values of the shear force bar load capacities Z_{Rd} and shear force load capacities V_{Rd}, for each HPCSB element depending, on different inclination angles:

	$Z_{v,Rd,HPCSB}$ [kN]	$V_{Rd,HPCSB,40°}$ [kN]	$V_{Rd,HPCSB,45°}$ [kN]
Ø= 6mm	28,3	18,2	20,0

- Concrete compression bearings (CCB)
  Design values of the concrete compression bearing load capacity D_{Rd} depending on the concrete strength class of adjoining concrete components:
  - ≥ C20/25: 54,4 kN
  - ≥ C25/30: 63,2 kN
  - ≥ C30/37: 71,3 kN

- High performance concrete compression bearings (HPCB)
  Design values of the concrete compression bearing load capacity D_{Rd} depending on the concrete strength class of adjoining concrete components:
  - ≥ C20/25: 38,5 kN
  - ≥ C25/30: 40,3 kN
  - ≥ C30/37: 42,5 kN

  (4 special stirrups per meter shall be arranged uniformly on the balcony and ceiling side, according to annex A 18)

Slab connection ISOPRO	**Annex C 01**
Performance parameters: Load-bearing capacity	

- Steel compression bearings

Table C.3: Design values of the steel compression bearing forces N_{Rd} depending on the insulation thickness

Diameter Ø [mm]	material	Compression force N_{Rd} [kN] Thickness of insulation 60 mm / 80 mm	Compression force N_{Rd} [kN] Thickness of insulation 120 mm
8	Stainless steel for round bars 1.4362	22,8	18,0
	Stainless steel for round bars 1.4571	16,0	13,7
10	Stainless steel for round bars 1.4362	38,0	33,0
	Stainless steel for round bars 1.4571	26,4	23,7
	S460 1.4571	27,8	25,2
12	Stainless steel for round bars 1.4362	56,6	50,6
	Stainless steel for round bars 1.4571	39,5	36,3
	S460 1.4571	41,1	37,7
14	Stainless steel for round bars 1.4571	55,1	50,9
	S460 1.4571	57,7	53,5
16	S460 1.4571	76,7	71,7
18	S460 1.4571	97,9	92,7
20	S460 1.4571	120,5	116,8

C.2 Fire resistance

C.2.1 Performance parameters regarding load-bearing capacity in case of fire

If the performance characteristics for the design under normal temperatures as specified in Annex C 01 und C 02 are complied with, the load-bearing capacity of the ISOPRO/ISOMAXX slab connection is also guaranteed in the event of fire in accordance with the intended use. The duration depends on the type of compression bearing used.
This applies to a reaction coefficient η_{fi} in accordance with EN 1992-1-2, section 2.4.2 to $\eta_f = 0.7$ for designs according to annex C 04 – C 06.

Table C.4: fire resistance time depending on the compression bearing variant

Compression bearing variant	Fire resistance period (load-bearing capacity) in minutes
High performance compression bearing (HPCB / HPCSB)	120
Concrete compression bearing (CCB)	120
Steel compression bearing (SCB)	90*

*when the reaction coefficient η_{fi} is reduced to 0,6, a load-bearing capacity of 120 minutes is guaranteed. This corresponds to a utilization of 85% in ULS.

The following boundary conditions shall be observed:

- The connection joint provided with the ISOPRO slab connection shall be completely covered on the top and bottom side with fire protection plates according to annex C 04 - C 06.
- In the area of planned tensile stresses, the fire protection plates shall be designed either with a lateral projection of 10 mm from the insulation body or with additional intumescent coating formers on both side surfaces

For required thickness t of the fire protection plates and minimum axial distance u of the reinforcement see annex C 04 - C 06.

Slab connection ISOPRO	**Annex C 03**
Performance parameters: load-bearing capacity in case of fire	

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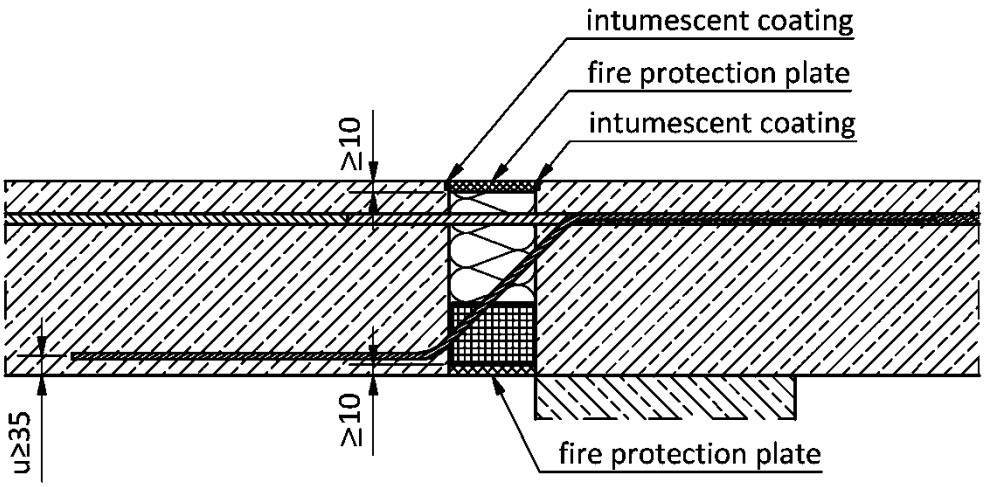
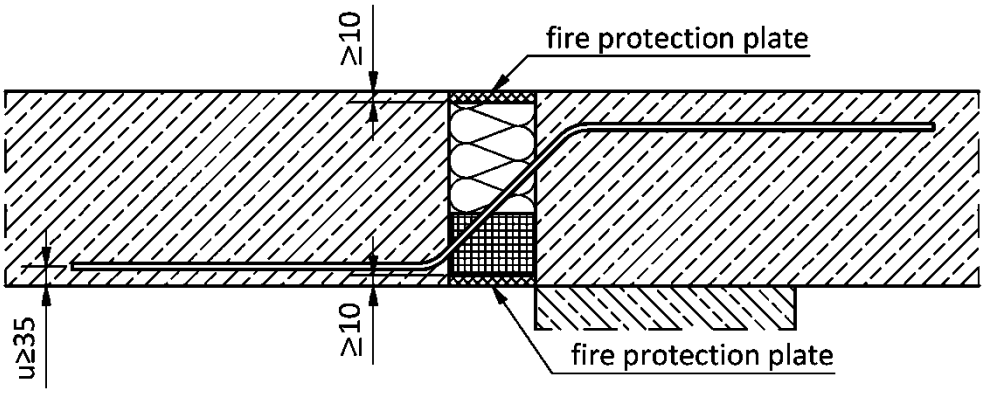
Type IP M Q



Type IP Q



Slab connection ISOPRO	**Annex C 04**
Performance parameters: Load bearing capacity in case of fire: ISOPRO with CCB	

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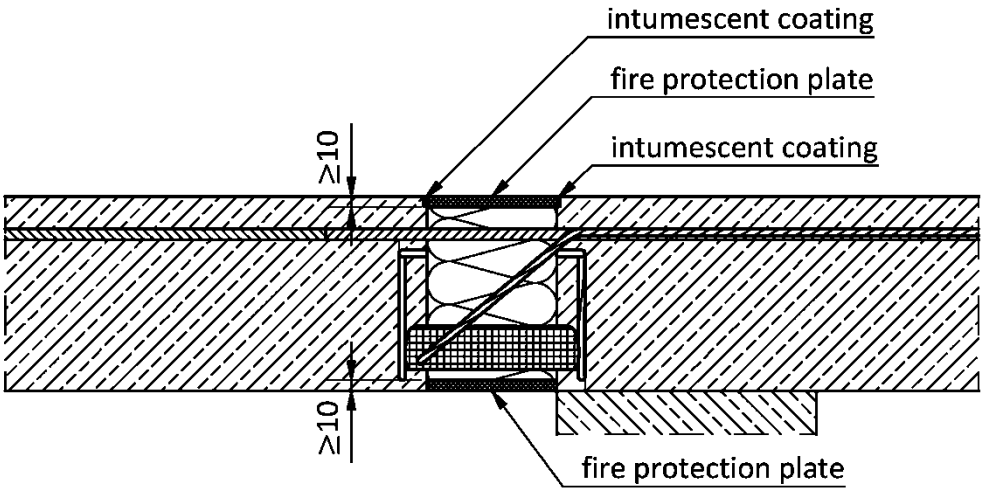
Type IP M DQ



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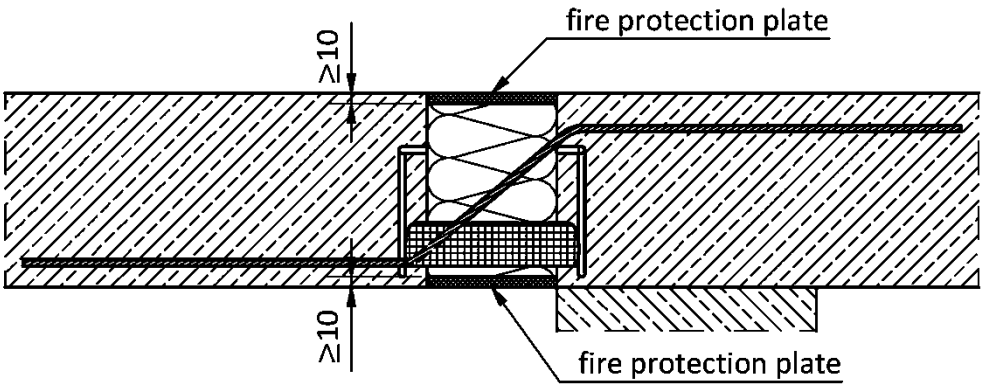

Slab connection ISOPRO	**Annex C 05**
Performance parameters: Load bearing capacity in case of fire: ISOPRO with HPCB/HPCSB	

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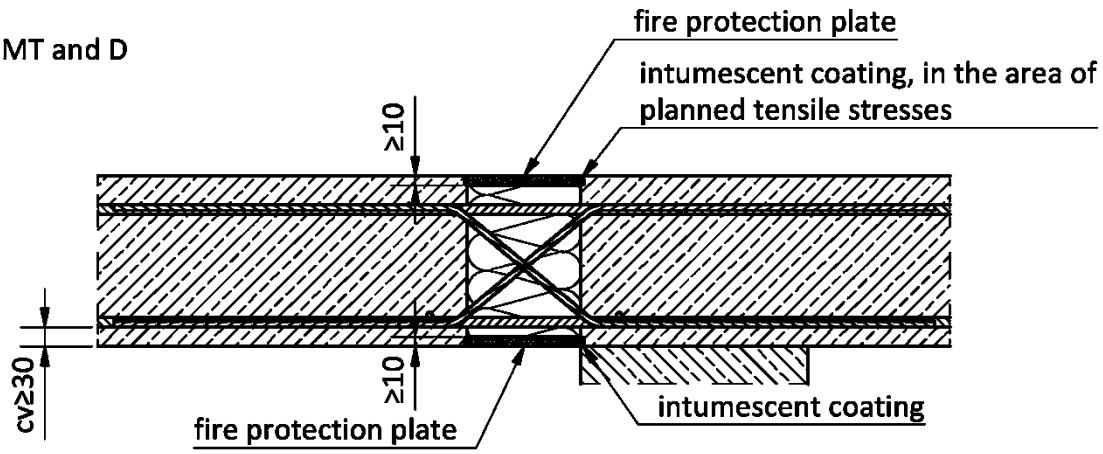
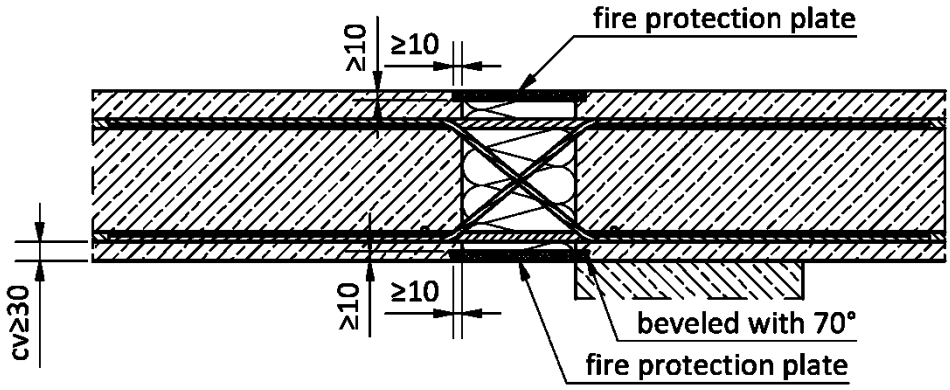
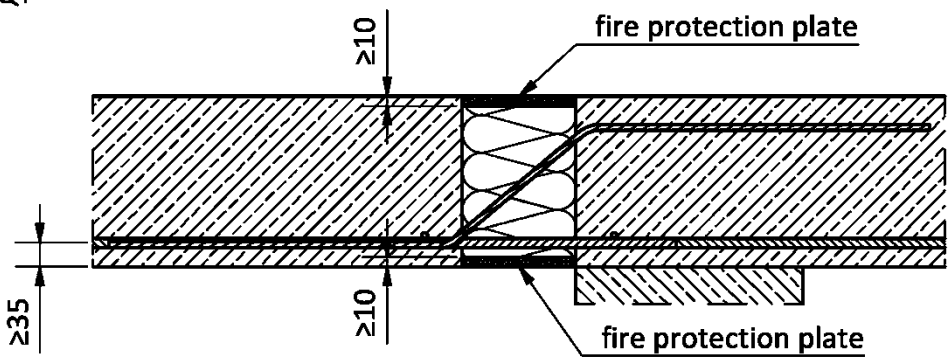
Type IP MT and D





Type IP QT



Slab connection ISOPRO	**Annex C 06**
Performance parameters: Load bearing capacity in case of fire: ISOPRO with SCB	

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C.2.2 Fire resistance of structural components (informative)

Floor and roof structures as well as balcony and walkways, which are connected to reinforced concrete components according to their intended use with the ISOPRO slab connector, can be classified with regard to fire resistance according to EN 13501-2, as shown in table C.5.
The following boundary conditions shall be observed:

- The performance in terms of load-bearing capacity in case of fire has been declared for the ISOPRO slab connector
- See annex C 03
- In case of floor and roof structures, the connections of the remaining edges of the floor or roof structures not connected with the ISOPRO slab connector to adjoining or supporting building components shall be verified in accordance with the regulations of the Member States for the corresponding fire resistance.

Table C.5: classification of component

Design version	Floor or roof construction with fire separating function	Balconies and walkways
according to annex C 04	REI 90	R 90
according to annex C 04	REI 120	R 120
according to annex C 05	REI 90	R 90
according to annex C 05	REI 120	R 120
according to annex C 06	REI 90	R 90
according to annex C 06	REI 120*	R 120*

*for reduction factor $\eta_{fi} = 0,6$

Slab connection ISOPRO	**Annex C 07**
Performance parameters: Fire resistance (informative)	

D.1 Structural analysis

D.1.1 General

- Design according to EN 1992-1-1 and EN 1993-1-1 (in the insulation joint)
- Structural verification shall be provided for each individual case
- Type-tested design tables may be used

Determination of internal forces:

- By linear-elastic analysis only
- Analysis with redistribution of internal forces, plastic analysis and non-linear analysis may not be used
- Principles for the design of frameworks according to EN 1992-1-1, section 5.6.4 shall be applied
- Strut-and-tie models according to annex D 02 to D 04 with $z = z_{strut\text{-}and\text{-}tie}$
- For the calculation of $z_{strut\text{-}and\text{-}tie}$ the resulting force in the compression unit has to be assumed in the middle of the friction bearing
- Internal forces M_{Ed} and V_{Ed} shall be applied on the referent axis
- Shear force bars obtain tension forces only
- Variable moments and shear forces along the edge of the slab shall be taken into account (see section B.1.1)
- The shear force reinforcement required in the insulation layer does not determine the minimum slab thickness according to EN 1992-1-1, section 9.3.2 (1)
- The front surface of the structural components to be connected, shall receive edge reinforcement in accordance with section B.2.2. A lattice girder which is arranged parallel to the insulation joint may be used if it encloses the shear force bars and is brought as close as possible to the insulation joint while maintaining the required concrete cover (see annex B 11). The lattice girder shall be raised up to underneath the tensile reinforcement. If the design section is outside the bearing area, a suspended reinforcement shall be arranged on the slab side, which shall be designed for the total shear force V_{Ed}. The edge reinforcement may be taken into account according to section B.2.2
- When steel compression bearings with welded on compression plates are used, the introduction of compressive stresses into the concrete shall be verified as partial area loading in accordance with EN 1992-1-1, Section 6.7. The superposition of neighbouring load propagation areas shall be taken into account. It shall be verified that the occurring splitting tensile forces can be absorbed.

Slab connection ISOPRO	**Annex D 01**
Structural analysis: General	

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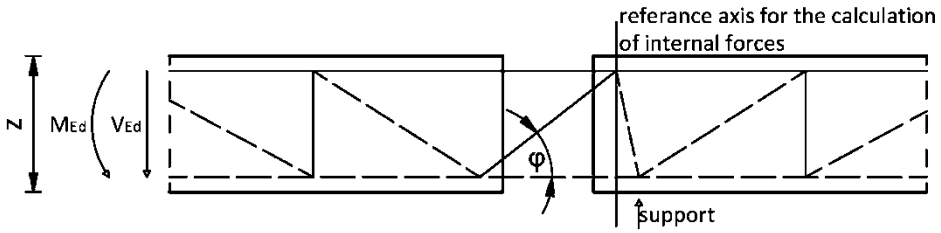
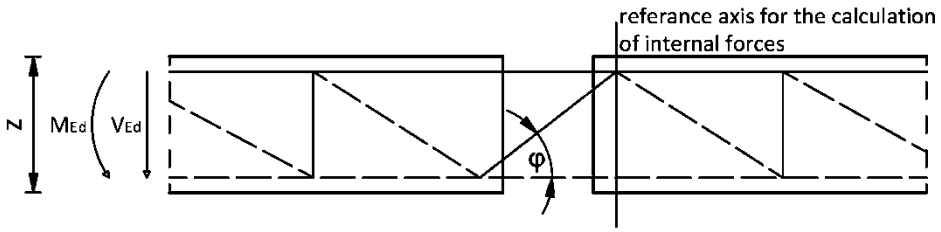
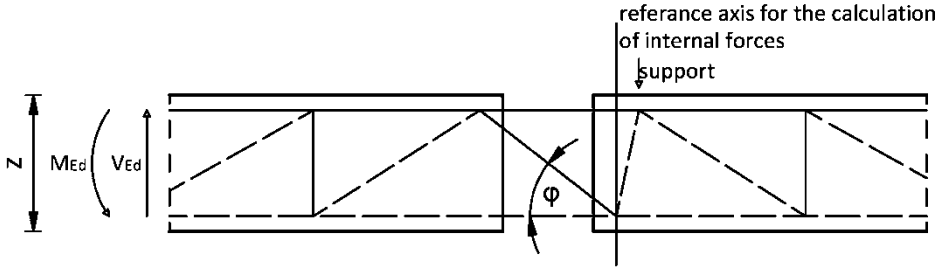
Type IP M Q and M DQ
direct support



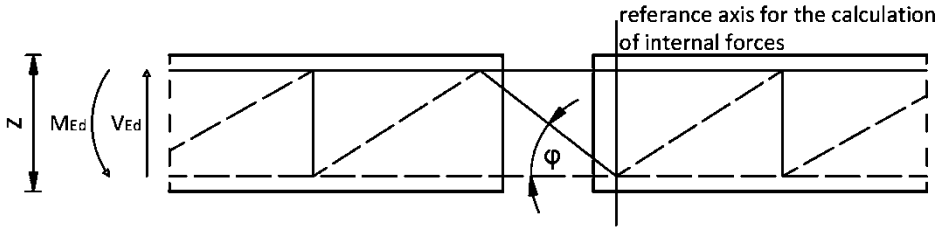
Type IP M Q and M DQ
indirect support



Type IP M QQ and M DQQ
direct support



Type IP M QQ and M DQQ
indirect support



slab connection ISOPRO	**Annex D 02**
Structural analysis: Strut-and-tie models	

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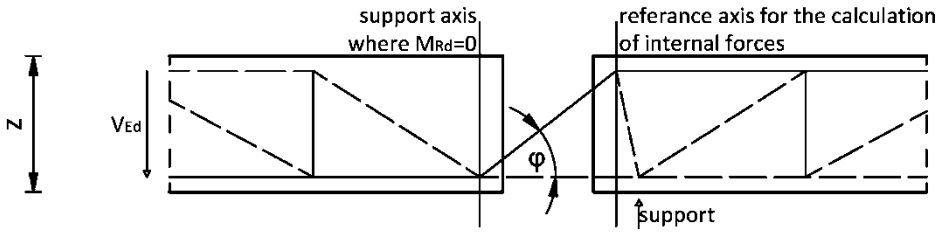
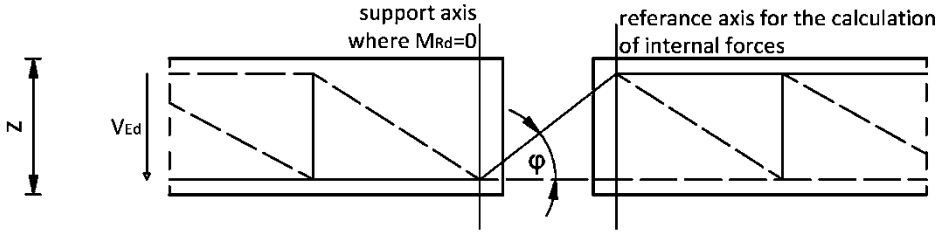
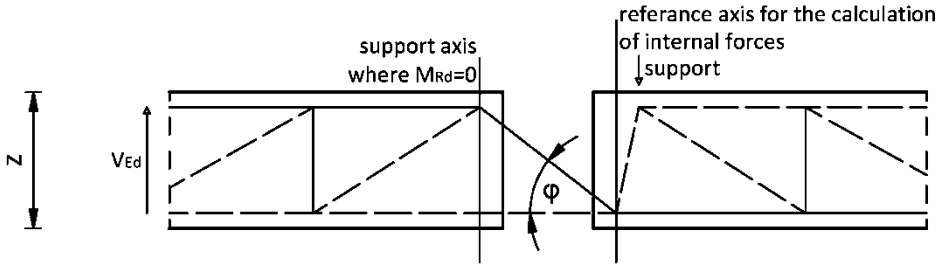
Type IP QQ and QQS (pos. shear force only)
Type IP Q and QS
direct support



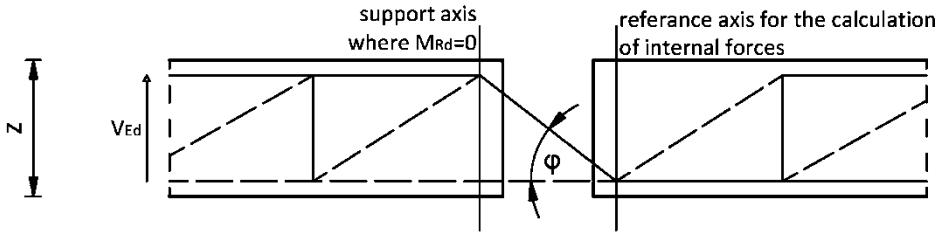
Type IP QQ and QQS (pos. shear force only)
Type IP Q and QS
indirect support



Type IP QQ and QQS (neg. shear force only)
direct support



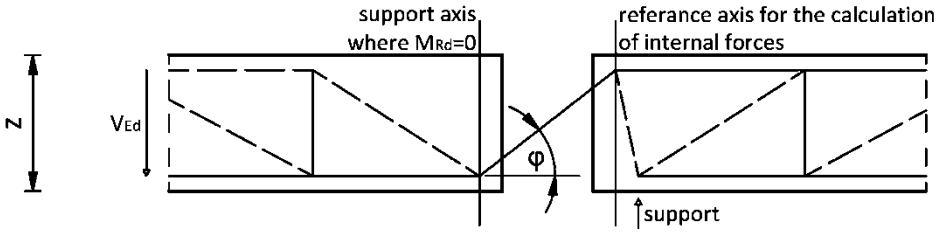
Type IP QQ and QQS (neg. shear force only)
indirect support



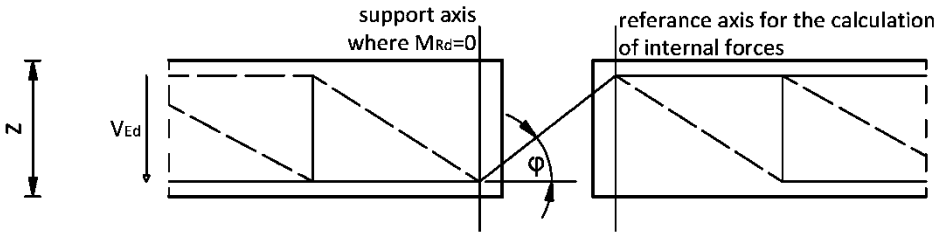
Slab connection ISOPRO	**Annex D 03**
Structural analysis: Strut-and-tie models	

Deutsches Institut für Bautechnik DIBt

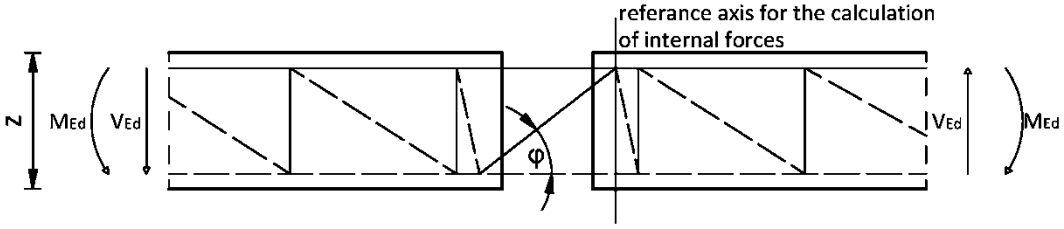
Type IP QZ and IP QZS
direct support

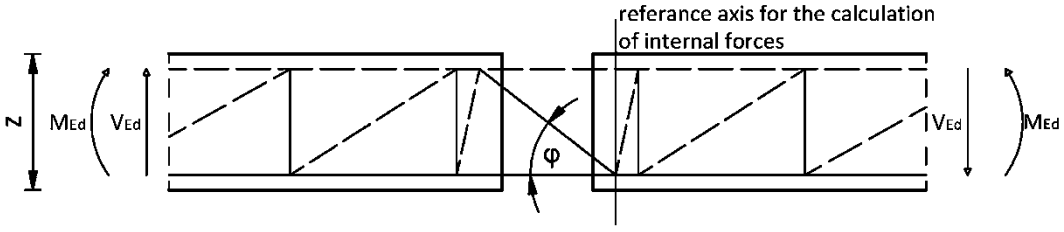


Type IP QZ and IP QZS
indirect support



Type IP MT QQ and D





Slab connection ISOPRO	**Annex D 04**
Structural analysis: Strut-and-tie models	

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D.1.2 Ultimate limit state

D.1.2.1 Verification of the compression bearings

D.1.2.1.1 Concrete compression bearing

- Design values D_{Rd} according to C.1.1

D1.2.2 Verification of the tension and shear force bars

- Verification according to EN 1993-1-4 with design values according to annex C 01 and C02
- Load-bearing capacity of welded joints between reinforcing steel and stainless steel or round steel does not need to performe seperately

D1.2.3 Shear force bearing capacity in the area of the insulation joint

- Shear force bearing capacity of the connection slabs according to EN 1992-1-1, section 6.2
- The required verification of the mandrel diameter can be omitted if the following two conditions are met:
  - Mandrel diameter according to annex A 13
  - Average axial distance of the shear force bars and to the free edge or the expansion joint (see A.2)

D1.2.4 Verification of fatigue due to temperature difference

- Verification by limiting the joint distances according to table B.1

D.1.2.5 Definition of the verification in the load introduction area of the concrete components

- Shear force bearing capacity of the undisturbed slabs according to EN 1992-1-1, section 6.2
- The design value of the shear force bearing capacity of the slabs without shear reinforcement is based on a shear force uniformly distributed over the concrete compression area. Therefore the elements shall be installed with uniform spacing.

Slab connection ISOPRO	**Annex D 05**
Structural analysis: Ultimate limit state	

D.1.2.6 Anchoring lengths and overlap joints of the bars crossing the thermal insulation layer

- Only use the ribbed bar sections for anchoring and overlapping
- Tension bars shall be overlapped with the tensile reinforcement of the slab to be connected
- When using graduated tension bars (tension bar variant TB2) the supplement of the lap length Δ_{l0} according to annex A 12 shall be taken into account
- Anchoring of shear force bars:
  - With straight legs in the slab or bended (see 3 points below)
  - in the tension zone overlap with 1,3 $l_{bd} \geq 1{,}3\ l_{b,min}$ according to EN 1992-1-1 and EN 1992-1-1 / NA, equation (8.4) with the tensile reinforcement of the slab to be connected
  - Anchoring in compression zone with l_{bd}; if shear force bars and compression bearings are not laid in one plane, determine anchorage length as in tension zone
- resist the arising transverse tensile forces, in addition to the shear reinforcement according to EN 1992-1-1, section 8.7.4 additional shear reinforcement shall be placed in the overlap area of the bars and anchored at the edge of the cross-section according EN 1992-1-1, section 8.7.4.1
- In the area of the slab connections grading of the tensile reinforcement is not permitted
- The design of a bent shear force bar according to annex A 13 or A 13 is possible, if an edge beam is designed with the construction details given in annex B 11
- For slab connections that only transfer shear forces, the tensile reinforcement of the slab to be connected shall be anchored in the compression zone by means of hooks on the frontal side. Alternatively, stirrups or lattice girders can be placed on each shear force bar. When using lattice girders, the tensile reinforcement shall lie over the lower chords of the lattice girders.

D.1.3 Serviceability limit state

D.1.3.1 Limitation of crack widths

- 1992-1-1, section 7.3 applies
- additional verification is not required at the front faces of the joints or in the area of load introduction if the provisions of this European Technical Assessment are observed

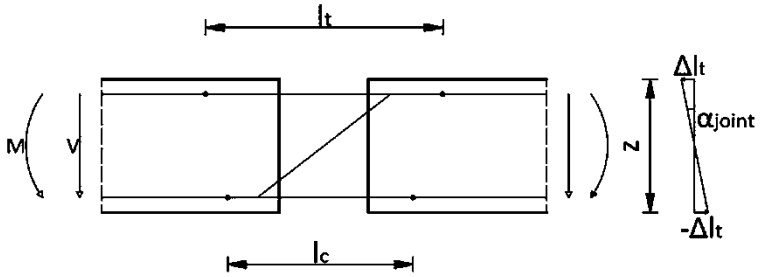
D1.3.2 Limitation of deformation

The following influencing factors shall be taken into account when calculating the deformation:
- elastic deformation of the load-bearing thermal insulating element and the adjoining slab concrete
- Temperature expansions

Verification of deformations:
- quasi-permanent load combination shall be applied, see annex D 07 and D 08
- Model for determination of bending deformation in the joint, see annex D 07 and D 08
- elastic deformation of tension bars as function of the applicable yield strengths, according to annex A 12, table A.1

Slab connection ISOPRO	**Annex D 06**
Structural analysis: Serviceability limit state	

- Torsion in the joint due to moment load



- Deformation due to moment load

$$\alpha = \tan^{-1}\left(\frac{\Delta_{lt} - \Delta_{lc}}{z}\right)$$

- Tension bar:

$$\Delta_{lt} = \frac{F_t}{A_{s,t}} \cdot \left(\frac{l_{t1}}{E_1} + \frac{l_{t2}}{E_1} + \frac{l_{t3}}{E_2}\right)$$

$F_t = \frac{M/z}{n_t}$: Force/tension bar

n_t : number of tension bars

E_1: 160.000 N/mm² for stainless steel
E_2: 200.000 N/mm² for B500B

$l_t = l_{T1} + l_{t2} + l_{t3}$
l_{t1} : joint width
l_{t2} : effective length of stainless steel
l_{t3} : effective length B500 B

for stainless reinforcement steel bars
$\varnothing \leq 10$ mm: $\rightarrow l_{t2} = 2 \cdot 10 \cdot \varnothing$ and $l_{t3} = 0$
$\varnothing > 10$ mm: $\rightarrow l_{t2} = 2 \cdot 100$ mm and $l_{t3} = 2 \cdot 10 \cdot \varnothing - 2 \cdot 100$ mm

for stainless round steel bars:
$l_{t2} = 2 \cdot 100$ mm und $l_{t3} = 2 \cdot 10 \cdot \varnothing$

Slab connection ISOPRO	**Annex D 07**
Structural analysis: Serviceability limit state	

- Compression bearing:

  n_c : number of compression bearings

  Concrete compression bearing:

  $$\Delta_{lc} = \frac{F_c}{A_{co}} \cdot \frac{l_{c,CB}}{E_{cm,CB}}$$

  $$F_c = \frac{M_z}{n_c}$$:Force / compression bearing

  $l_{c,CB}$: joint width

  High performance compression bearing (HPCB and HPCSB):

  $A_{c,0}$ = 30 mm · 40 mm = 1.200 mm²

  $E_{cm,cB}$ = 27.900 N/mm²

  Concrete compression bearing (CCB):

  $A_{c,0}$ = 100 mm · 36 mm = 3600mm² CCB variant 1 (see annex A 16)

  90 mm · 36 mm = 3240mm² CCB variant 2 (see annex A 16)

  $E_{cm,cB}$ = 41.000 N/mm²

  Steel compression bearing:
  (type D: for negative moments, tension and compression bar are changed)

  $$\Delta_{lc} = \sigma_c \cdot \frac{l_c}{E_1}$$

  $$\sigma_c = \frac{F_{Ed}}{A_{s,c}}$$

  l_c = joint width + 2 · 10 · ∅

  E_1 = 160.000 N/mm² for stainless steels

Deformations as a consequence of shear force V can be neglected.

Slab connection ISOPRO	**Annex D 08**
Structural analysis: Serviceability limit state	