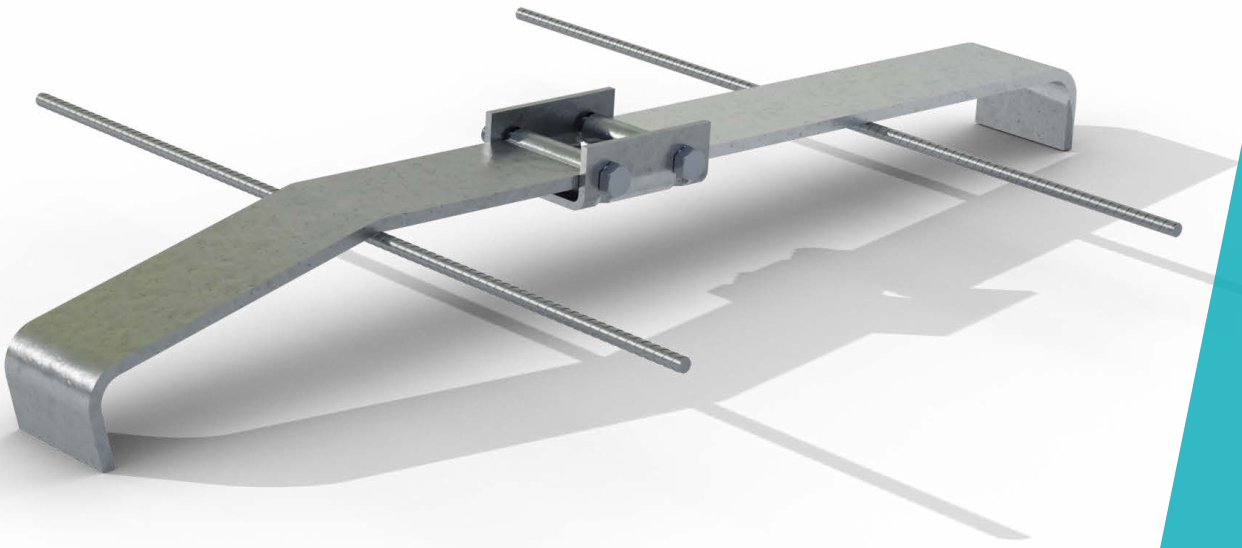
TECHNICAL MANUAL



PS Balcony Slab Connector

Hinged slab connection for supported balconies

Version PEIKKO GROUP 06/2023

peikko®

PS Balcony Slab Connector

Hinged slab connection for supported balconies

PS Balcony Slab Connector connects supported balcony slabs to the building, while enabling vertical movements of up to 20mm. The hinge part is installed to the balcony slab, and the anchor part is cast into the building's floor slab. After installation of balcony slab on site, the parts are connected.

PS Balcony Slab Connector transfers horizontal loads from supported balconies to the building.
The hinge part is installed to the balcony slab in the precast factory, and the load bearing part can be installed into the building's floor slabs either in the precast factory or at the construction site and the final connection is made by fixing the bolt connections.

Supported precast balconies can be assembled either simultaneously with the building frame or, if necessary, also afterwards by fixing the bolt connections if wall structure allows such assembly.

PS Balcony Slab Connector is made of stainless steel, and it is available in several sizes to enable the use with thick insulation layers.

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CONTENTS

About PS Balcony Slab Connector

1. Product properties

PS Balcony Slab Connectors are used to connect precast concrete slab elements. They are designed to transfer horizontal loads from a precast concrete slab to a load bearing structure.

The PS Balcony Slab Connectors are installed to one edge of the balcony slab and anchored to the load bearing structure on site. Other edges of the balcony slab need to be supported vertically by other elements, e.g., walls or columns.

PS Balcony Slab Connectors are installed to the formwork according to spacing specified by the designer.
If the length of the balcony slab is more than 4 meters, it is advisable to split it to shorter pieces by a movement joint. In slabs longer than 4 meters, deformations due to temperature variation are getting more significant and cause additional loads to the connectors at the edges of the slab. In such cases it is recommended to contact Peikko technical support.

Figure 1. Divided balcony slabs.

PS Balcony Slab Connector consists of a hinge element, bent plates with reinforcing bars and two bolts for a hinge assembling.

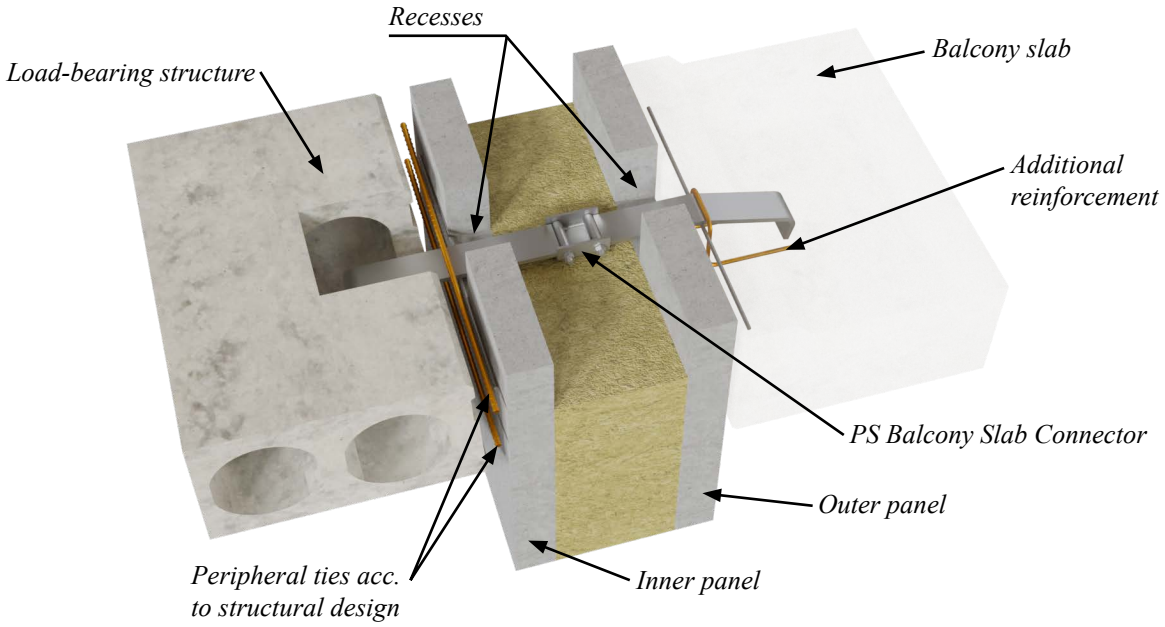


Figure 2. PS Balcony Slab Connector in the joint.

1.1 Structural behavior

PS Balcony Slab Connectors are designed to transfer horizontal forces from the balconies to the load-bearing structure, however, allowing vertical movements of 20 mm. Horizontal forces, in turn, are divided into two components: longitudinal axial tension N and transversal shear V shown in *Figure 3*.

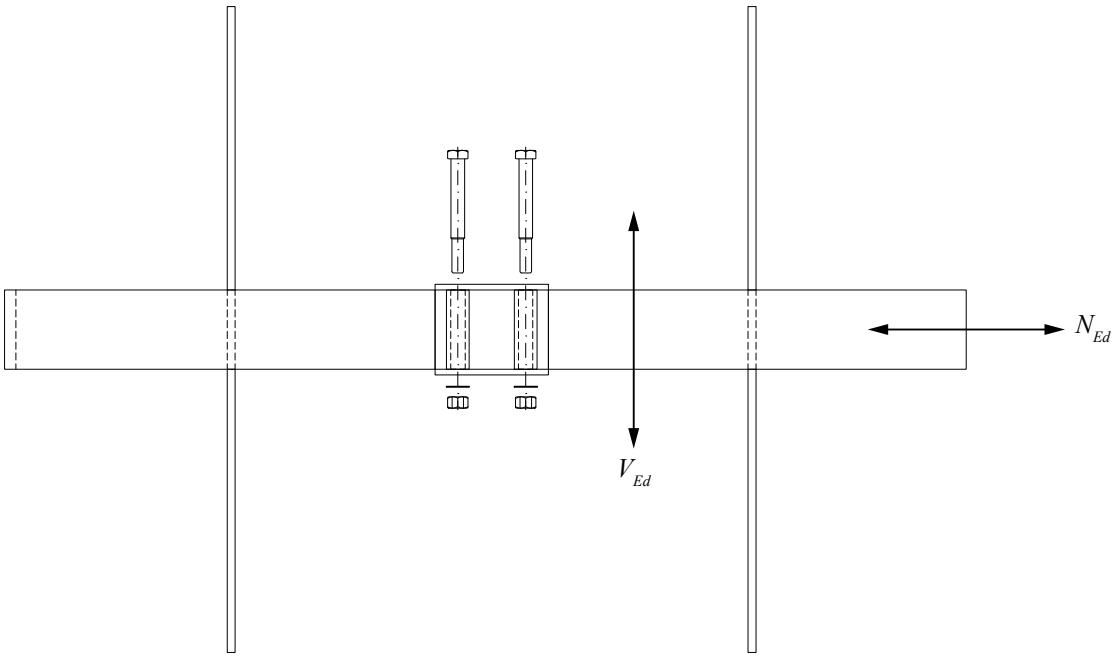


Figure 3. Components of horizontal forces.

Note: The joint connected by PS Balcony Slab Connectors works as a hinged joint. It is not possible to transfer bending moments with the connection.

1.1.1 Using conditions

The balcony slab must be supported vertically by other elements, e.g., walls or columns.

1.2 Limitations for application

The standard models of PS Balcony Slab Connectors are designed to be used in conditions specified in Section 1.1. If these conditions are not met or the slab length exceeds 4 meters, please contact Peikko Technical Support.

Contacting Technical Support is advised also in other special cases, such as concrete-wood structures.

1.2.1 Loading and environmental conditions

PS Balcony Slab Connectors are designed to transfer static loads. The design should be done in the ultimate limit state (ULS). For dynamic loads, please contact Peikko Technical Support. The static calculations are based on the standards in *Table 1*.

Table 1. Standards.

SFS-EN 1990, Eurocode + NA	Basis of structural design.
SFS-EN 1991, Eurocode 1 + NA	Actions on structures.
SFS-EN 1992-1-1, Eurocode 2 + NA	Design of concrete structures. Part 1-1: General rules and rules for buildings.
SFS-EN 1993-1-1, Eurocode 3 + NA	Design of steel structures. Part 1-1: General rules and rules for buildings.
SFS-EN 1993-1-8, Eurocode 3 + NA	Design of steel structures. Part 1-8: Design of joints.
SFS-EN 10088:2005	Stainless steels.
SFS-EN ISO 17660-1	Welding. Welding for reinforcing steel. Part 1: Load-bearing welded joints.
SFS-EN 1993-1-4, Eurocode 3 + NA	Design of steel structures - part 1-4: General rules – supplementary rules for stainless steel.
SFS 1259	Cold worked ribbed stainless steel bars for the reinforcement of concrete.

Note: The design of the PS Balcony Slab Connectors should take into account all structural changes and the resulting loads in the operational stage.

PS Balcony Slab Connector is designed to be used in conditions determined for the outside balcony constructions according to EN 1992-1-1. The concrete cover must be adequate according to the required environmental exposure class and designed service life. The slab must be sufficiently reinforced and produced with concrete grade C20/25 or higher.

1.2.2 Positioning of the PS Balcony Slab Connector

PS Balcony Slab Connector is designed for use in at least 240 mm thick balcony concrete slabs. PS Balcony Slab Connector is installed to the formwork with the bent hooks pointing to the bottom surface of the slab, as shown in *Figures 10* and *12*.

The bent part, Part B, of the balcony slab connector is installed into the balcony slab and the straight part, Part A, into the load bearing structure.

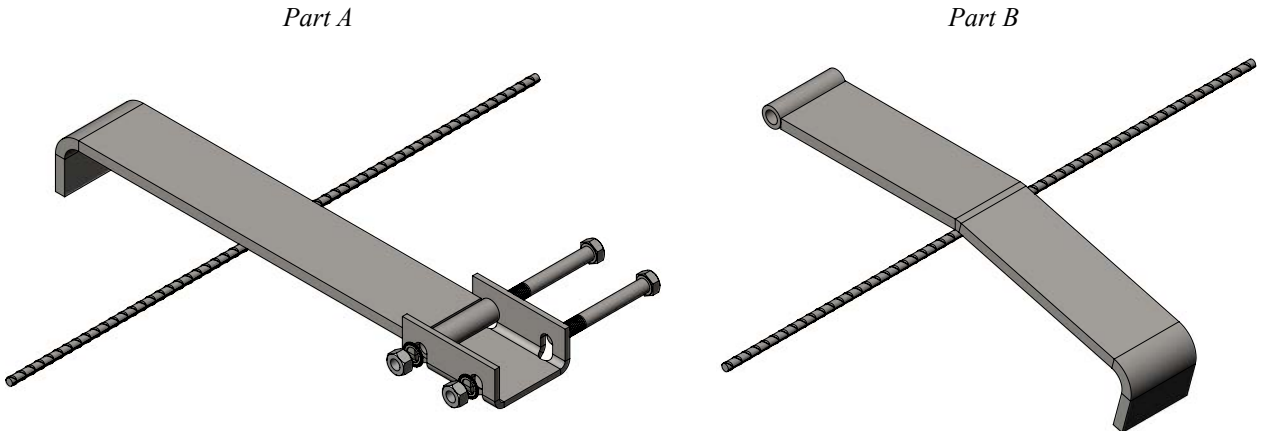


Figure 4. PS Balcony Slab Connector parts.

NOTE: Remember to create a proper clearance in the structure for the rebar in Part A.

Examples of the item positioning are shown in *Figures 5* and *6*.

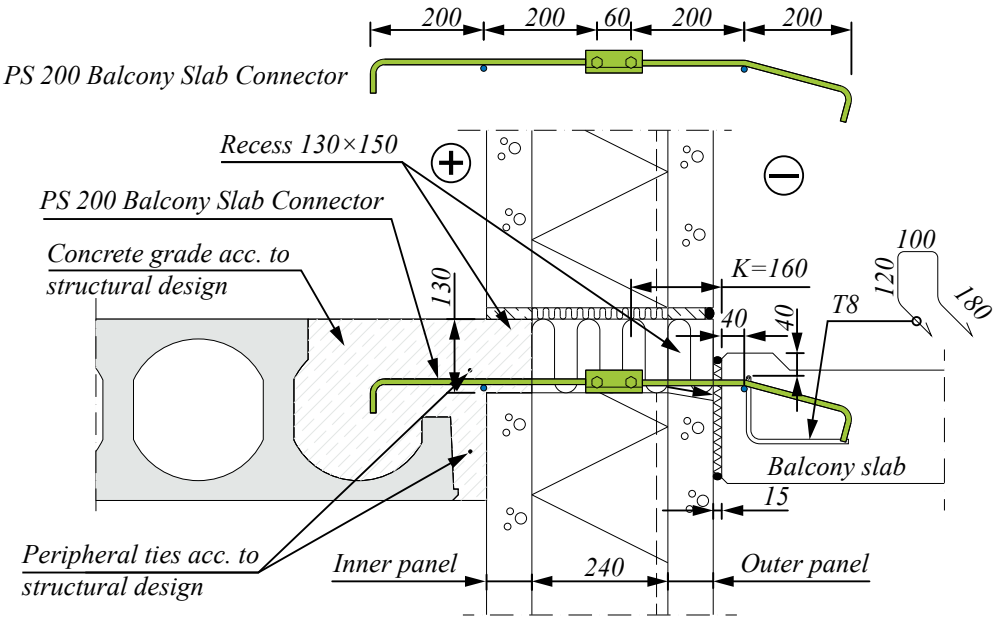


Figure 5. Balcony Slab Connector PS 200 in a non-load-bearing wall.

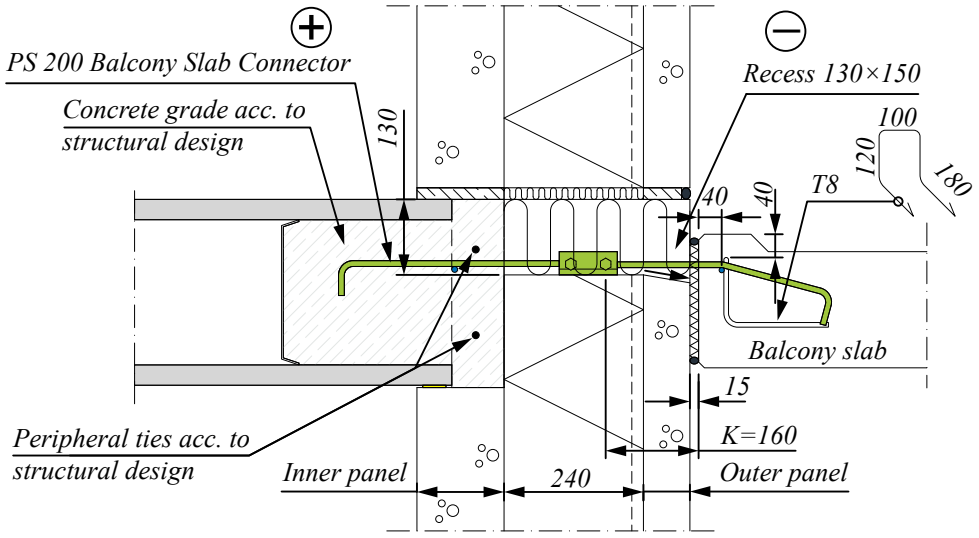


Figure 6. Balcony Slab Connector PS 200 on a load-bearing wall.

It is recommended to place the PS Balcony Slab Connector as presented in *Figure 7*.

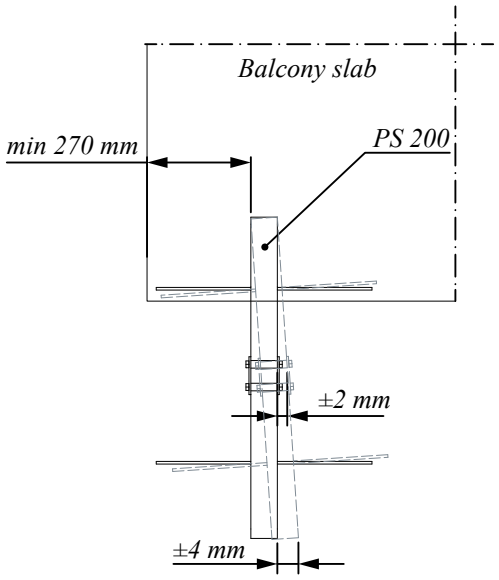


Figure 7. Positioning instructions.

1.3 Other properties

Materials used in the manufacture of components:

Plates	1.4301	EN 10088
Sleeve	1.4301	EN 10088
Bolts	A2	EN ISO 4014
Nuts	A2	DIN 934
Washers	A2	DIN 6798A
Ribbed bars	B600XB - 1.4301	SFS 1259

Peikko Group's production units are externally controlled and periodically audited based on production certifications and product approvals by various independent organizations. The PS Balcony Slab Connector has a Product Declaration issued by the Finnish Concrete Association (BY).

2. Resistances

Resistances are determined by a design concept that refers to the standards mentioned in *Table 1*.

The balcony slabs are subjected to horizontal loads (e.g. wind) which are transferred to the load-bearing structure through the PS Balcony Slab Connectors as axial force N_{Ed} and shear force V_{Ed}.

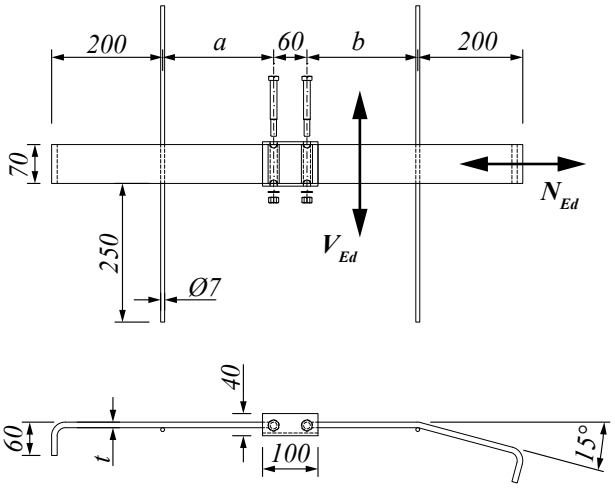


Figure 8. Dimensions of PS Balcony Slab Connector.

When the joint is loaded by both the shear force V_{Ed} and the axial force N_{Ed}, their interaction must be considered in design according to *Formula 1*:

Formula 1. Interaction of axial and shear force.

$$\left(\frac{V_{Ed}}{V_{Rd}}\right)^{\frac{4}{3}} + \left(\frac{N_{Ed}}{N_{Rd}}\right)^{\frac{4}{3}} \leq 1.00$$

where:
N_{Ed} – the design value of axial force
N_{Rd} – the design value of tensile resistance from *Table 2*
V_{Ed} – the design value of shear force
V_{Rd} – the design value of shear resistance from *Table 2*

Table 2. Dimensions[mm], resistances[kN] and weights[kg] of PS Balcony Slab Connector.

PS	t	a	b	N_{Rd}	V_{Rd}	Weight
Type	[mm]	[mm]	[mm]	[kN]	[kN]	[kg]
PS 110	8	110	170	33.2	8.1	4.6
PS 170	8	170	170	33.2	8.1	4.8
PS 200	10	200	200	33.2	8.1	6.2
PS 230	10	230	230	33.2	8.1	6.5

Note: The resistance of each individual hinge has to be checked for the interaction of axial and shear forces according to the interaction curve (*Figure 9*).

In addition: $N_{Ed} \leq N_{Rd}$ and $V_{Ed} \leq V_{Rd}$

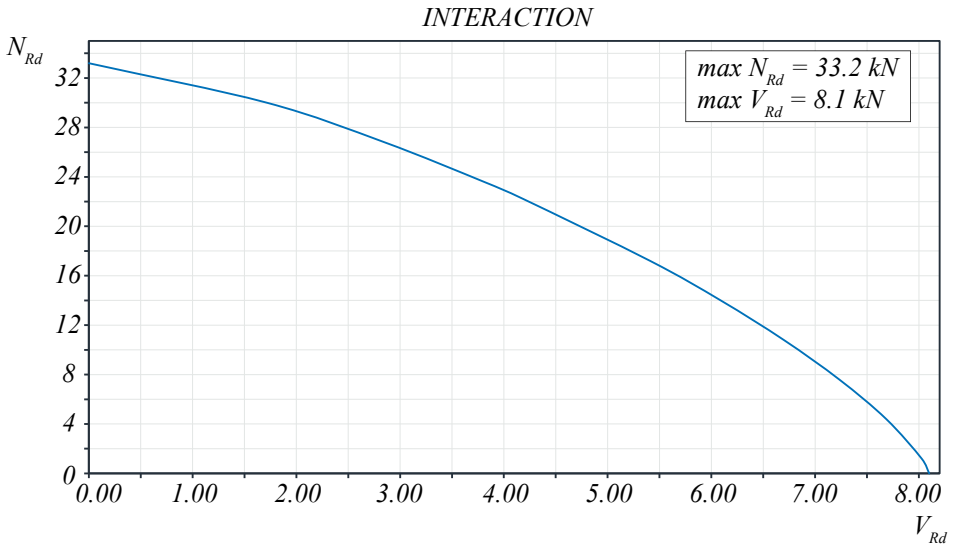


Figure 9. The resistance curve of a single PS Balcony Slab Connector for the combined shear and axial forces.

Selecting PS Balcony Slab Connector

Wall thickness must be considered when selecting the appropriate model of PS.

The connection can be verified according to the diagram in *Figure 9*.

Note: Normally each joint should have at least two PS Balcony Slab Connectors.

CALCULATION EXAMPLE:

Length of the balcony slab:	L = 3970 mm
Wall thickness:	400 mm
Concrete grade of the balcony:	C35/45
Grouting:	C35/45
The design value of axial load for the joint:	N_{Nd} = 20.2 kN
The design value of shear load for the joint:	V_{Nd} = 13 kN

NOTE: Since the length of the slab is less than 4 meters, only the wind loads are considered in the design.

Design:

PS 200 - 2 pcs of Balcony Hinges in the joint.

A single PS Balcony Slab Connector takes half of the total load: $N_{Ed} = N_{Nd}/2$ = 10.1 kN and $V_{Ed} = V_{Nd}/2$ = 6.5 kN, which is below its capacity according to *Figure 9* and *Table 2*.

Total axial force resistance of a single PS Balcony Slab Connector is 33.2 kN (see *Table 2*):
Total shear force resistance of a single PS Balcony Slab Connector is 8.1 kN (see *Table 2*):

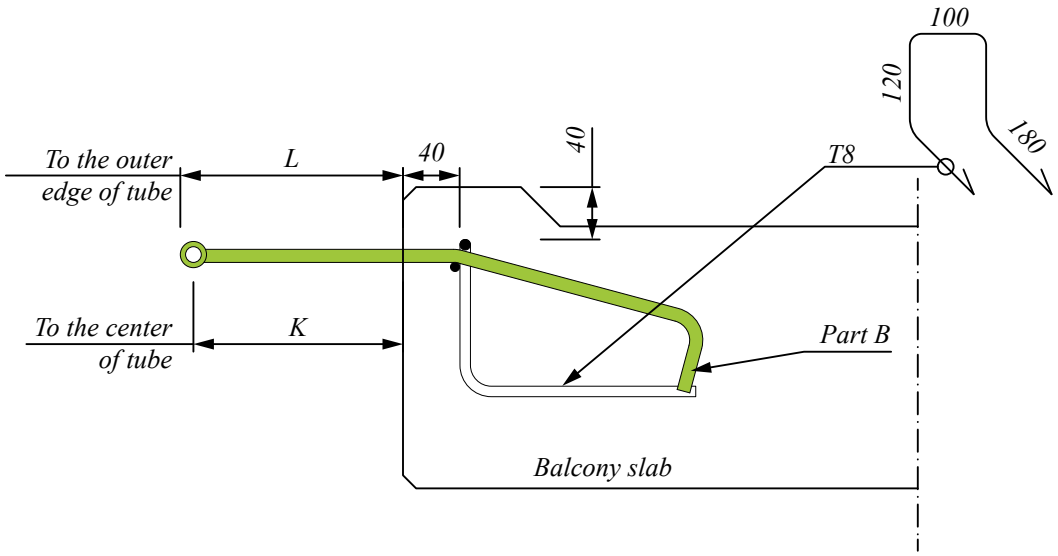
Verification:

$$\left(\frac{10.1}{33.2}\right)^{\frac{4}{3}} + \left(\frac{6.5}{8.1}\right)^{\frac{4}{3}} = 0.95 \leq 1.00$$

Installation of PS Balcony Slab Connector

INSTALLATION OF THE PRODUCT – PRECAST FACTORY

PS Balcony Slab Connector is installed on the formwork with the hooks pointing to the bottom surface of the slab. The bent part, Part B, of the Balcony Slab Connector is installed into the balcony slab before casting according to *Figures 10, 11 and 12*.



PS Type	K [mm]	L [mm]
PS 110	130	140
PS 170	130	140
PS 200	160	170
PS 230	190	200

Figure 10. Positioning of Part B.

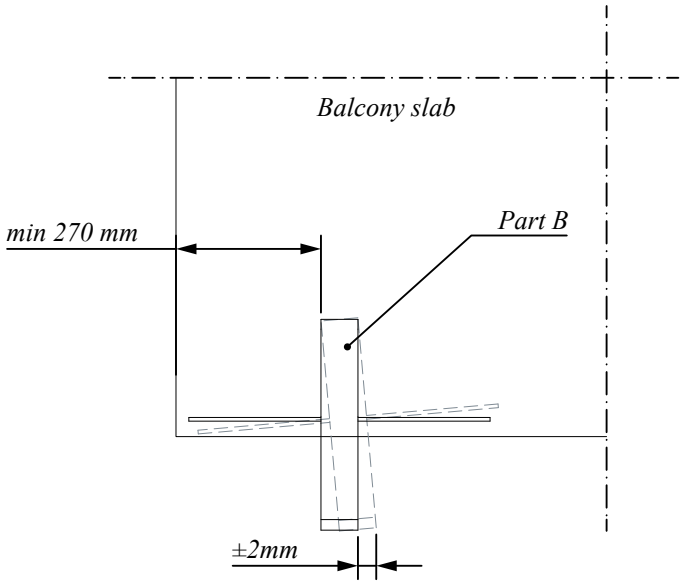


Figure 11. Positioning instructions.

Figure 12. Installation of the PS Balcony Slab Connector Part B to wooden formwork.

Note: In many cases, slabs are casted upside down and the top surface of the element is on the bottom of the mold.

Note: Gaps between the formwork and PS Part B should be filled with foam to prevent concrete leakage.

INSTALLATION OF THE PRODUCT – CONSTRUCTION SITE

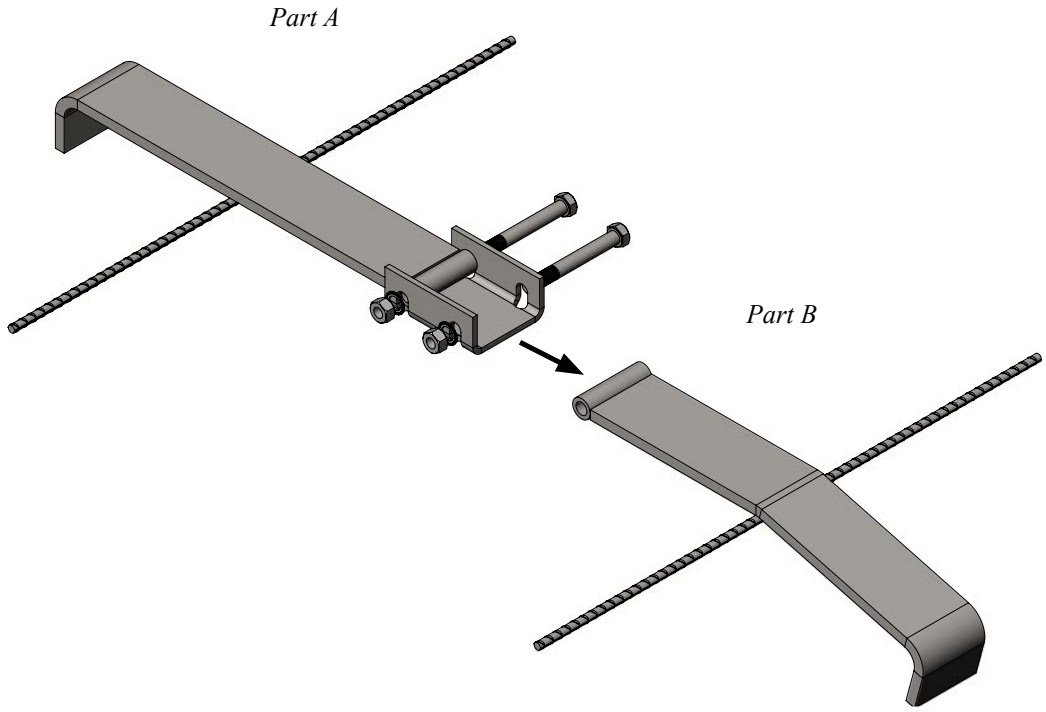


Figure 13. Assembly.

1. If not in place as delivered on site, attach Part A and the Hinge part with bolts to Part B on the balcony slab.
2. Create recesses in the floor slab if not in place as delivered.
3. Install the balcony slab with the free end (Part A) of the Balcony Slab Connector into the recess.
4. Check that the nuts are tightened before casting.
5. Secure the needed fixing to the frame structure and ensure that possible joint reinforcement is in place.
6. Check also that the formwork is done according to the assembly details and plans.
7. Pour the concrete into the formwork and fill the recess between floor slab and wall panel. After the concrete reaches the required strength, remove the formwork.
8. Fill the recesses in the outer panel and insulation layer according to the plan with thermal insulation (see *Figure 14*).
9. Gap between balcony slab and wall element should be secured after installation by non-flammable material (e.g. mineral wool), PE foam rod and elastic sealant (see *Figure 14*).
10. Check that the joint is covered with sheet metal to protect it from water.

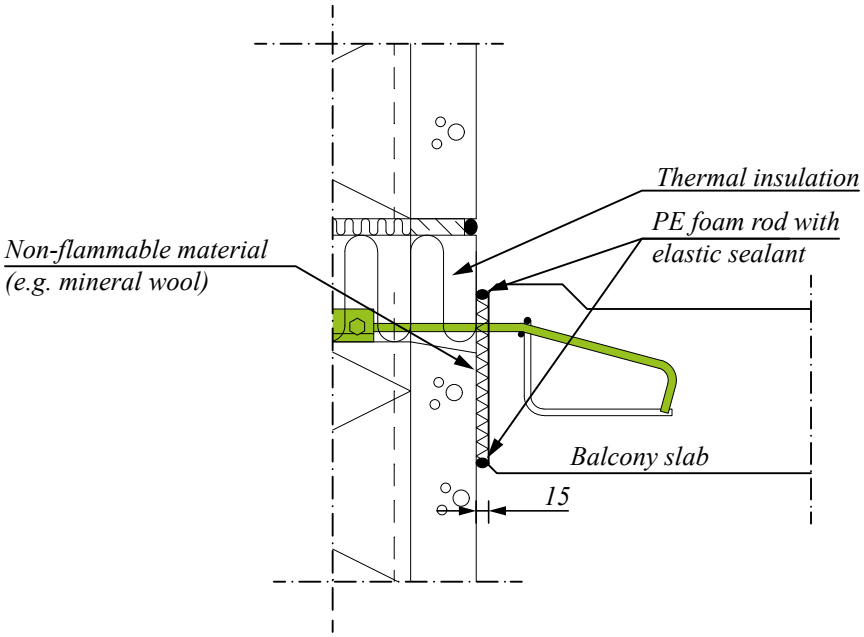


Figure 14. Joint filling.

PS carries horizontal loads from the precast slab into the base structure after the joint has reached the design strength.

Figure 15. Top view of joint before casting.

Figure 16. Balcony slab with PS Part B.

NOTES

NOTES

Revision History

Version: PEIKKO GROUP 06/2023. Revision: 002

- Layout updated to latest style.
- Improved user instructions.

Version: PEIKKO GROUP 07/2011. Revision: 001

- First publication.

Resources

DESIGN TOOLS

Use our powerful software every day to make your work faster, easier, and more reliable. Peikko design tools include design software, 3D components for modeling programs, installation instructions, technical manuals, and product approvals of Peikko's products.

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