TECHNICAL MANUAL

WILJA® Lifting Insert

Stainless steel lifting insert for sandwich elements

Version PEIKKO GROUP 04/2024

WILJA® Lifting Insert

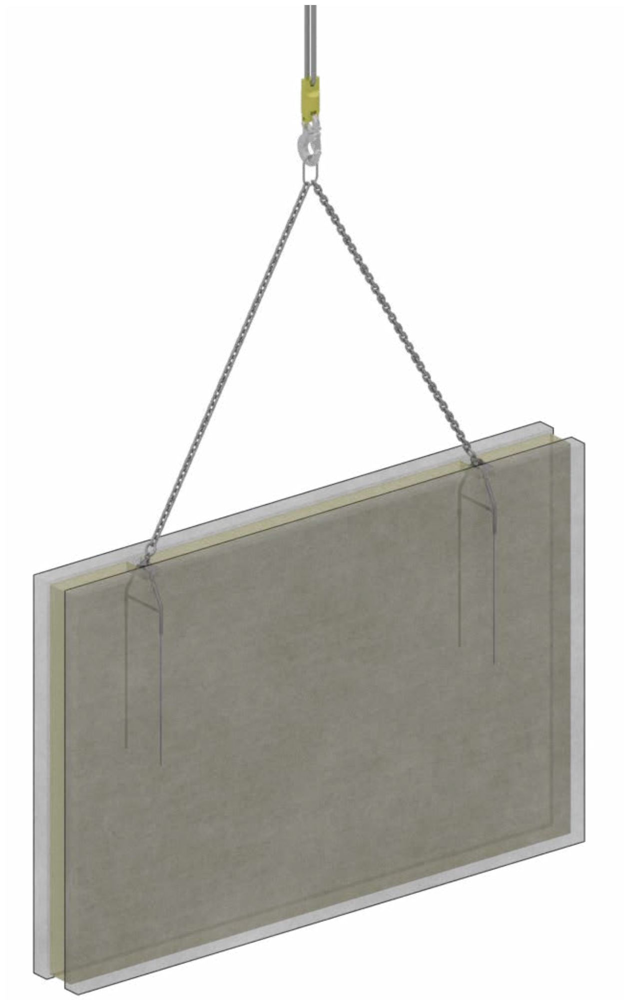
for transporting sandwich wall elements

The WILJA® Lifting Insert is designed for lifting and transporting precast sandwich wall elements. It is CE-marked, efficient and ready-to-use solution. WILJA® Lifting Insert have five different load classes and are available for several insulation thicknesses.

WILJA® Lifting Insert are permanently cast into the inner and outer panels of sandwich walls, and the anchoring is based on the inserts' own anchoring rebars. They are assembled perpendicularly to the wall panels and angular pull, with a maximum permitted load angle of 45°.

WILJA® Lifting Insert are made of stainless steel, which makes them the perfect choice for the outer panels of sandwich walls. They are an efficient solution where no system specific lifting keys are needed as the lifting slings can be attached straight to the WILJA® Lifting Inserts. The lifting event is a quick and easy process.

WILJA® Lifting Insert comply with MD 2006/42/EC and VDI BV-BS 6205. These guidelines are state of the art in this field.



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Handbook for the planning process

1. Product properties

1.1 Product description

WILJA® Lifting Insert are special lifting inserts designed for lifting and transporting sandwich wall elements. The length of the U-shaped anchorage bars requires enough anchoring depth and transfers the loads in equal parts into the concrete panels. The WILJA® Lifting Inserts is placed in the element's center of gravity and enables the element to be lifted in a more vertical position.

WILJA® Lifting Insert consist of one or up to three rebars covered by a tube and bent 180° to round or triangular shape. A crossbar secures the correct distance between both rebar legs depending on the thickness of the insulation layer (*Figure 1*). The tube ensures a more even load transfer into the reinforcement bars, it also gives the insert head additional stability and fastening point for the cross bar.

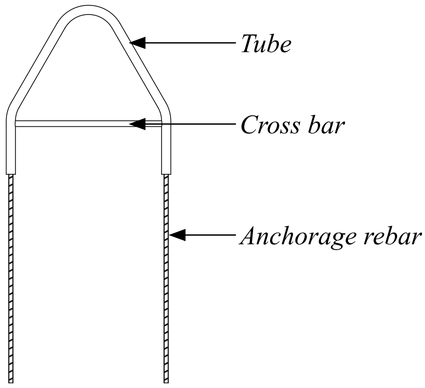


Figure 1. Components of WILJA® Lifting Insert.

The WILJA® Lifting Insert transfers the lifting load of the element into the concrete through the ribbed anchoring bars. The cross bar bears the compressive forces resulting from the insert geometry. Installation is performed in the façade panel and in the load-bearing panel with the insert width $E + 80\ mm$, depending on the insulation thickness E of the element (*Figure 2*).

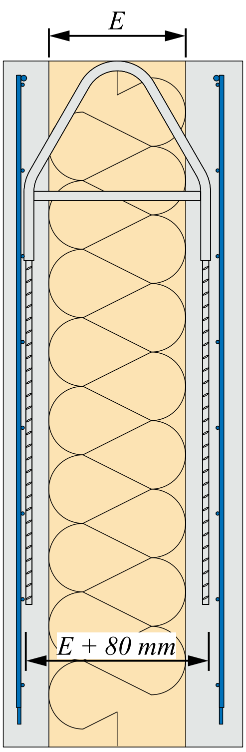


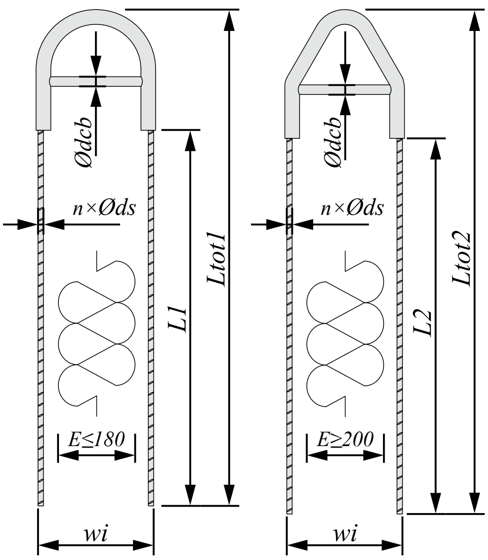
Figure 2. Installation position of WILJA® Lifting Insert.

1.1.1 Dimensions

WILJA® Lifting Insert are available in five load classes and for several insulation thicknesses E. The lifting inserts can be produced with insulation thicknesses of between 100 and 300 mm at 20 mm intervals, the same applies to the PD Diagonal Ties. WILJA® Lifting Insert are available in standard lengths as shown in *Table 1*. WILJA® Lifting Insert with customized lengths for special purposes are available upon request.

Table 1. Dimensions of WILJA® Lifting Insert.

Type		WILJA® 2	WILJA® 3	WILJA® 4	WILJA® 5	WILJA® 6
$n \times Ø ds$	[n×mm]	1 Ø 9	1 Ø 11	2 Ø 9	2 Ø 11	3 Ø 11
$Ø dcb$	[mm]	Ø 20	Ø 20	Ø 20 Ø25 (E>280)	Ø 20 Ø25 (E>260)	Ø 25 Ø30 (E>180)
wi	[mm]	E + 80	E + 80	E + 80	E + 80	E + 80
$L1min$	[mm]	515	715	645	1065	1065
$Ltot1$	[mm]	750 - 790	950 - 990	850 - 920	1270 - 1340	1270 - 1340
$L2min$	[mm]	500	700	600	1050	1050
$Ltot2$	[mm]	870 - 900	1070 - 1100	970 - 1000	1370 - 1450	1370 - 1450



Peikko standard products are always delivered in stainless steel (rebar, cross bar and sleeve). A sample order for Peikko WILJA® Lifting Insert and the product identification code is based on load class and thickness E of the insulation layer e.g. WILJA® 5 E200.

Item type from stainless steel with standard length

WILJA® 5 E200

- Item type WILJA® → WILJA®
- Type size 5 → 5
- Insulation thickness 200 mm → E200

PLEASE NOTE:
Selecting items such as WILJA® 5 E200 or WILJA® 5x1050 E200 defines the same product because a standard length will be selected when no other information is added. For customized lengths please use the following code: WILJA® 5 × L (L in mm). This method can be applied to all other WILJA® Lifting Insert.

1.1.2 Application conditions

The inserts can be used only by trained personnel who are familiar with the information presented in this technical manual and the local requirements for safe handling and lifting.

WILJA® Lifting Insert will be installed in the precast sandwich wall element with one leg in the inner and one leg in the outer concrete panel. The minimum thickness of one panel is 8 cm. Narrower panels require the support of the Peikko technical support team.

The inserts are used in reinforced normal concrete in combination with PD Diagonal Ties. The PD Diagonal Ties are single-lattice girders designed for connecting the inner and outer concrete layer of a sandwich wall element. For further details, please refer to our technical manual for PD Diagonal Ties.

The user instructions for installing the WILJA® Lifting Insert are given in the **Installation handbook for the precast plant**. Attaching the lifting key to the WILJA® Lifting Insert is specified in the **User's handbook for the lifting application**.

No system-specific equipment is necessary for lifting. Peikko WILJA® Lifting Insert can be used with standardized lifting keys (see the system compatibility section in the User's Handbook for the lifting application). These should be designed with at least the same load directions as for WILJA®.

1.1.3 Material properties

Materials used for WILJA® Lifting Insert are shown in *Table 2*. Customized material or special grades depends on material availability.

Table 2. WILJA® Lifting insert materials.

Part	Material	Standard
Rebar	B600XB	SFS1259
Tube, Cross bar	Stainless steel	EN10088

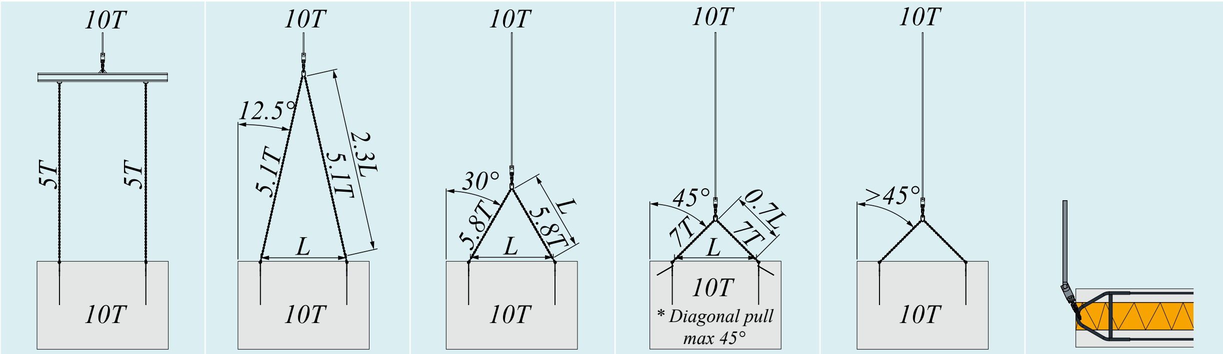
1.1.4 Allowable resistance for WILJA® Lifting Insert

The allowable resistance (R_{zul}) of the WILJA® Lifting Insert is determined by a design concept that refers to the following standards and regulations:

- EN13155
- Machinery directive 2006/42/EC
- VDI/BV-BS 6205.

The load capacities depend very much on how and in which combination the items will be used. The load direction determines in which way the WILJA® Lifting Insert can be used. *Table 3* shows the allowable load directions for WILJA® Lifting Insert.

Table 3. Allowable load direction for WILJA® Lifting Insert.



WILJA®	✓	✓	✓	✓	✗	✗

* Only with additional reinforcement.

The allowable resistances (R_{zul}) are based on specific dimensions and edge distances as given in the following sections. Before selecting the insert, please take note of the selection assumptions in this manual.
The minimum compressive cube strength of the concrete at the moment of load application is $f_{ck,cube}$ = 15MPa.

$$f_{ck,cube} = 15\ MPa$$

The allowable resistances (R_{zul}) of WILJA® Lifting Insert are shown in *Table 4*. Please pay special attention to select inserts that are suitable for the planned load directions. *Figure 3* illustrates the load directions related to this table.

Table 4. Allowable resistance (R_{zul}) for WILJA® Lifting Insert.

Type $E \leq 180$	Load class	R_{zul} for 0° [kN]	R_{zul} for β of 0° - 30° [kN] at 15 N/mm²	R_{zul} for β of 30° - 45° [kN] at 15 N/mm² only with U-rebar[*1]
WILJA® 2	24	24	24	24
WILJA® 3	36	36	36	36
WILJA® 4	48	48	48	48
WILJA® 5	72	72	72	68.8
WILJA® 6	109	109	92.8	68.8

Type $E \geq 200$	Load class	R_{zul} for 0° [kN]	R_{zul} for β of 0° - 30° [kN] and R_{zul} for β of 30° - 45° [kN] only with U-rebar[*1] at 15 N/mm²						
				E = 200	E = 220	E = 240	E = 260	E = 280	E = 300
WILJA® 2	24	24	30°	12.9	11.1	9.9	8.9	8.3	7.4
			-45°+ U-rebar	12.9	11.1	9.9	8.9	8.3	7.4
WILJA® 3	36	36	30°	19.3	16.6	14.9	13.3	12.4	11.1
			-45°+ U-rebar	19.3	16.6	14.9	13.3	12.4	11.1
WILJA® 4	48	48	30°	25.8	22.1	19.9	17.7	16.5	14.9
			-45°+ U-rebar	25.8	22.1	19.9	17.7	16.5	14.9
WILJA® 5	72	72	30°	38.7	33.2	29.8	26.6	24.8	22.3
			-45°+ U-rebar	37.0	31.7	28.5	25.4	23.7	21.3
WILJA® 6	109	109	30°	49.9	42.8	38.4	34.3	31.9	28.7
			-45°+ U-rebar	37.0	31.7	28.5	25.4	23.7	21.3

[*1] only valid when diagonal reinforcement (U-rebar) according to *Table 7* is installed.

PLEASE NOTE:
If higher resistance values in diagonal pull are needed, local thickening of panels around loop area is needed to utilize values given for narrower loop sizes.

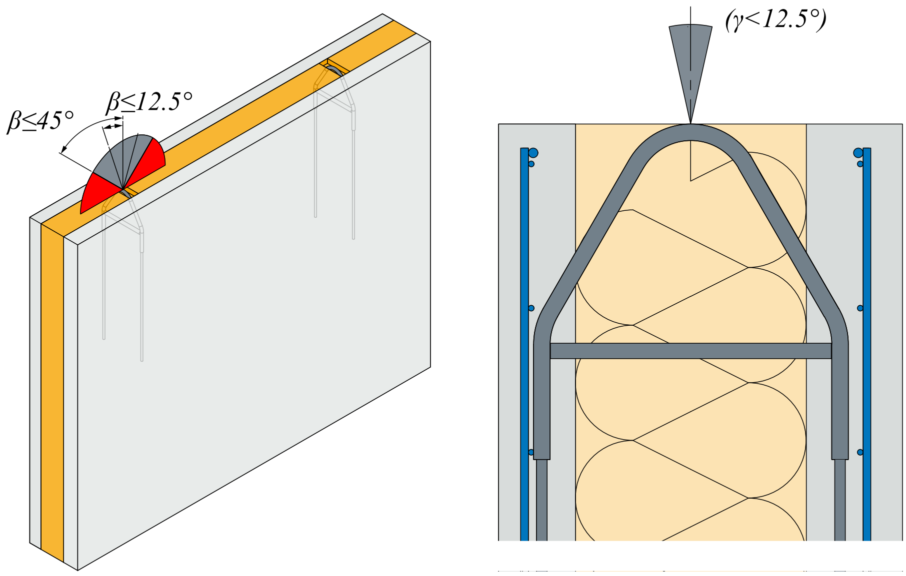


Figure 3. Load directions for WILJA® Lifting Insert.

PLEASE NOTE:
For diagonal pull up to β = 30° no additional diagonal reinforcement U-bar is needed. From β = 31° to 45°, diagonal pull only with additional reinforcement. Diagonal pull greater than β = 46° up to 90° (tilt-up) and tilt-up without tilt-up table is forbidden. Rotating of the element, please see Technical Manual for Element Turning available on Peikko website.

1.1.5 Unit geometry and spacing

The use of Peikko Lifting Systems requires a specific element geometry. The load capacities given in this section of the technical manual are based on specific dimensions, as well as on the edge and the axial distances. The safety factors can only be ensured as described, provided the geometric specifications are complied with. Peikko's engineering service offers customized solutions to facilitate special applications.

Before selecting and installing an insert, consider the general information in the other sections of this technical manual. The minimum element thicknesses (d_1 and d_2), the installation depth (c_{min}) as well as the minimum edge and axial distances (a and b) for the respective insert types are shown in *Table 5* and *Figure 4*.

Local panel thickening as visible in *Figure 4* is possible to increase the concrete section to fit the WILJA® Lifting Insert better into the panels. The panel thickening (40 mm one sided and alternative 20 mm two sided) makes it possible to utilize the capacities of the smaller WILJA® Lifting Insert type (E240 ⇨ E200) and offers increased capacities. The local panel thickening is valid only for a maximum of 40 mm of insulation change.

Table 5. Minimum unit geometry for WILJA® Lifting Insert.

Type	Geometrical dimensions				
	b [mm]	a [mm]	d_1 front panel/façade [mm]	d_2 inner panel/bearing [mm]	c_{min} [mm]
WILJA® 2/3/4	800	400	80	80	40
WILJA® 5/6	1000	500	80	80	40
For non-reinforced inner panel/bearing with thickness "d_2"					
WILJA® 2/3/4/5/6	800	400	80	150*	40

* only valid for non-reinforced inner panel.

NOTE: If dimensions above are not met, please see instructions for "additional reinforcement for narrow sections".

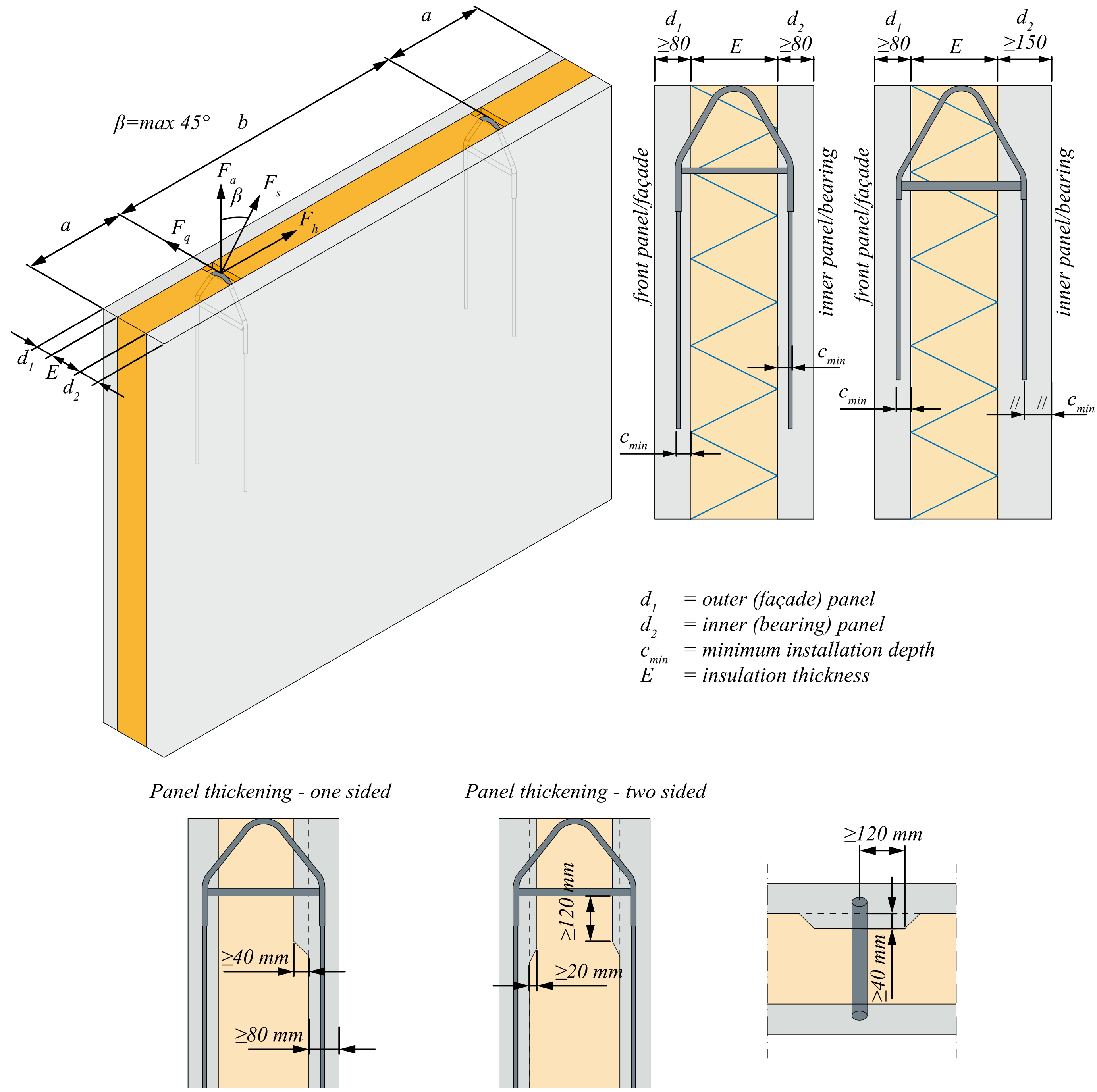


Figure 4. WILJA® Lifting Insert geometry requirements.

PLEASE NOTE:

The geometry specification requires that the installation be within the tolerances as defined in the section entitled "Installation handbook for the precast plant".

1.1.6 Reinforcement for WILJA® Lifting Insert

The WILJA® Lifting Insert requires a minimum level of reinforcement in the concrete elements. The reinforcement (usually B500A/B) that is defined by the structural design can be considered by taking into account the existing cross section. The required reinforcement can be attained by using single reinforcing bars or a wire mesh with an equivalent or greater cross section (mm^2/m or cm^2/m). If the designed reinforcement has to be removed or cut to install the WILJA® Lifting Insert, this area must be repaired by adding a similar cross section of reinforcement (single bars or wire mesh) with a sufficient overlapping length.

WARNING:
Never assume enough reinforcement – make precise calculations. Too little reinforcement can result in severe accidents and collapsing elements.

The reinforcement described in this section supports only the load impact of the WILJA® Lifting Insert on the concrete element. The structural designer must bear in mind that the element may bend as a result of the transportation process. Additional reinforcement may be needed to prevent the element from cracking. This must be defined separately. Surface reinforcement (mm^2/m) must be considered and installed crosswise for each element direction. For WILJA® Lifting Insert, the required surface reinforcement must be at least equal to that shown in *Table 6* and *Figure 5* (B500 is black steel, B600 is stainless steel).

Table 6. Reinforcement for WILJA® Lifting Insert.

Type	Surface reinforcement Pos 1 [mm^2/m]		Additional rebars Pos 2 [$n \times Ø$]		Longitudinal rebars for each panel Pos 3 [$n \times Ø$]		Inner panel/bearing panel d_2 [mm]
	B500	B600	B500	B600	B500	B600	
WILJA® 2/3/4	188	131	-	-	-	-	≥80
WILJA® 5	188	131	2 × Ø8	2 × Ø7	1Ø10	1Ø9	≥80
WILJA® 6	188	131	4 × Ø8	4 × Ø7	1Ø10	1Ø9	≥80
WILJA® 2/3/4	-	-	-	-	2Ø10	2Ø9	≥150*
WILJA® 5/6	-	-	-	-	2Ø12	2Ø11	≥150*

* only valid for non-reinforced inner panel, outer panel always reinforced and ≥ 80 mm.

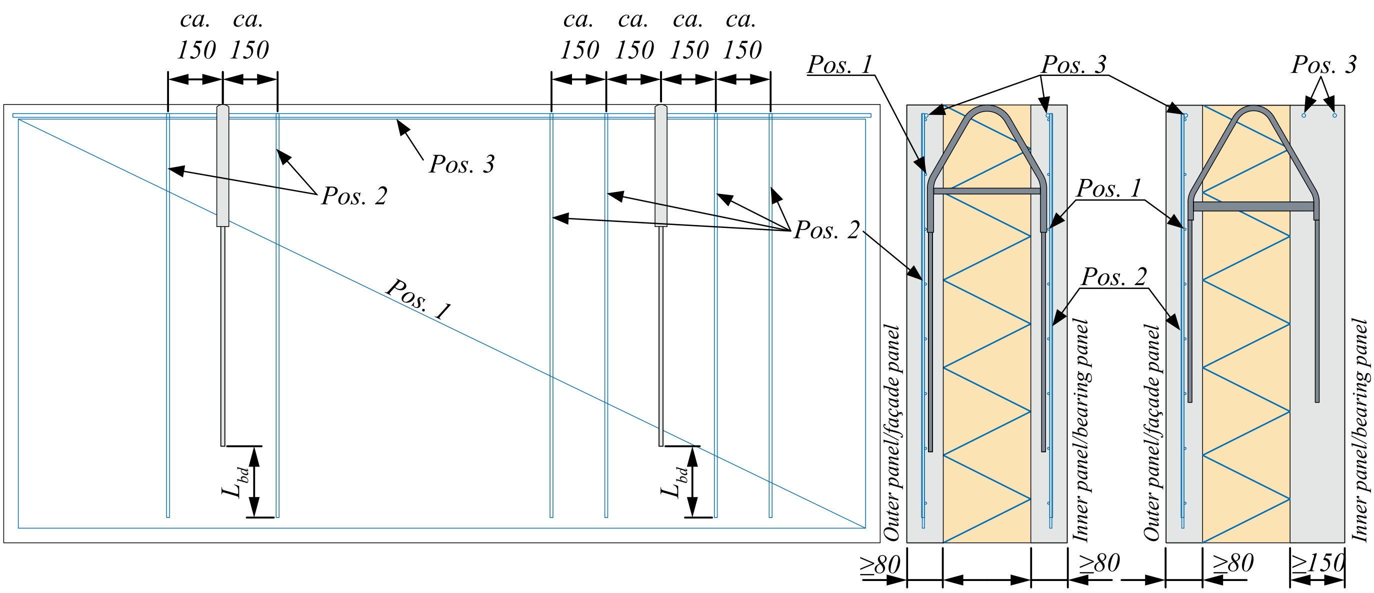


Figure 5. Reinforcement for WILJA® Lifting Insert.

1.1.7 Types and geometry of additional reinforcement

All additional reinforcement referred to in this section must be located to support the WILJA® Lifting Insert. The additional reinforcement must have pressure contact to the tube of WILJA® Lifting Insert. *Figure 6* shows from which diagonal pull angle β the reinforcement must be used.

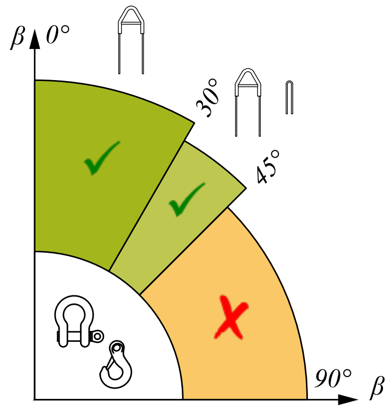


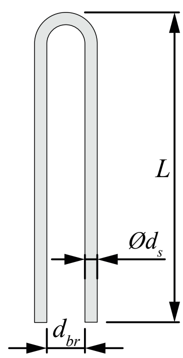
Figure 6. Diagonal pull angles.

1.1.8 Reinforcement for diagonal pull (from 31° to 45°)

Diagonal pull between 31° and 45° on the WILJA® Lifting Insert requires a special reinforcement as shown in *Table 7* (B500 is black steel, B600 is stainless steel). The installation is performed around the WILJA® Lifing Insert legs tube (see *Figure 7*) to support the load impact and load transfer. This reinforcement must always have direct pressure contact with the WILJA® Lifting Insert tube. This can be achieved easily by wire fixing the additional rebar to the WILJA® Lifting Insert.

Table 7. Diagonal reinforcement for WILJA® Lifting Insert.

Type	For all insert types				
		$31° \leq \beta \leq 45°$			
	$\beta \leq 30°$	$Ød_s$ [mm]		L [mm]	min. $Ød_{br}$ [mm]
		B500	B600		
WILJA® 2	No additional reinforcement required	2 × 1Ø8	2 × 1Ø7	350	32
WILJA® 3		2 × 1Ø10	2 × 1Ø9	450	40
WILJA® 4		2× 1Ø12	2× 1Ø11	750	48
WILJA® 5/6		2 × 2Ø12	2 × 2Ø11	750	48



The minimum bending diameter "$Ød_{br}$" of the diagonal reinforcement is a recommendation. If local regulations such as NA of EN1992-1-1:2011 require a different bending diameter, then local adaptions can be made.

A precise finish of diagonal reinforcement limits the possibility of installation errors. The installation is performed with an angle of approximately 20° to 30°.

If the minimum installation thickness c_{min} of 40 mm according to *Table 5* for the WILJA® Lifting Insert leg is retained, a local increase of concrete coverage to the diagonal reinforcement is needed when the inclination angle is between 31° and 45°. The local increase of concrete coverage can happen as local additional concrete or local thickening either one or two sided. The installation of diagonal reinforcement and the local increase of concrete coverage are shown in *Figure 7*.

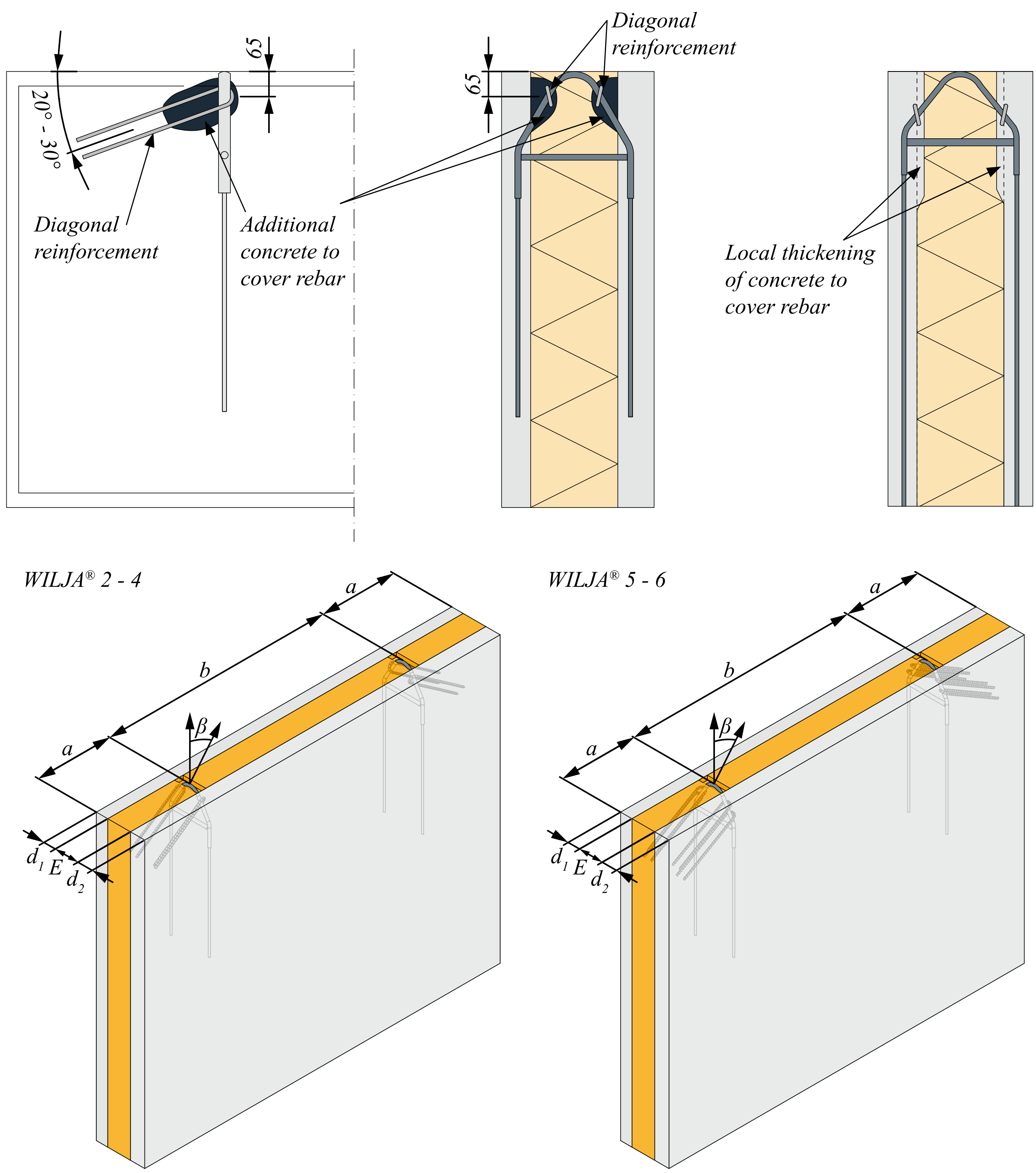


Figure 7. Additional concrete for WILJA® Lifting Insert.

1.1.9 Additional reinforcement for narrow sections

The following section is describing and explaining how to handle difficult application conditions. It is occasionally difficult to adhere to all the directions from the standard procedure on how to install WILJA® Lifting Insert, in case of limited space and narrow sections.

In the event that a narrow installation either between window openings, when geometrical limitations exists or close to the element's edge cannot be avoided, an increased amount of surface reinforcement must be installed. This serves to avoid cracking and to generate enough section capacity. The section capacity with the width "y" (*Figure 8*) must be as high as the nominal WILJA® Lifting Insert capacity. This can be achieved by adding to the basic surface reinforcement (see *Table 6*) the additional reinforcement mentioned here in *Table 8* (B500 is black steel, B600 is stainless steel). Only the increased reinforcement ratio (Pos 1 + Pos 2 + Pos 3 acc. *Table 6* plus A_s s according to *Table 8*) can generate sufficient section resistance. Other present reinforcement can be taken into account for A_s calculation.

Table 8. Additional reinforcement for narrow installations of WILJA® Lifting Insert.

Type	$y > 1.0$ m Min. A_s [cm²]	$y = 0.3$ m – 1.0 m Min. A_s [cm²]		$y < 0.30$ m Min. A_s [cm²]		Concrete cube strength [MPa]	Inner panel / bearing panel d_2 [mm]
		B500	B600	B500	B600		
WILJA® 2	Follow Table 6	1.53	1.06	1.53	1.06	15	≥ 80
WILJA® 3		1.53	1.06	1.53	1.06	15	≥ 80
WILJA® 4		1.53	1.06	1.53	1.06	15	≥ 80
WILJA® 5		2.28	1.57	Not recommended		15	≥ 80
WILJA® 6		3.88	2.68	Not recommended		15	≥ 80
WILJA® 2/3/4		-		-		25	≥ 150*
		$y = 0.5$ m – 1.0 m		$y < 0.50$ m			
WILJA® 5		-		Not recommended		30	≥ 150*
		$y = 0.75$m – 1.0m		$y < 0.75$ m			
WILJA® 6		-		Not recommended		30	≥ 150*

* only valid for non-reinforced inner panel, outer panel always reinforced and ≥ 80 mm.

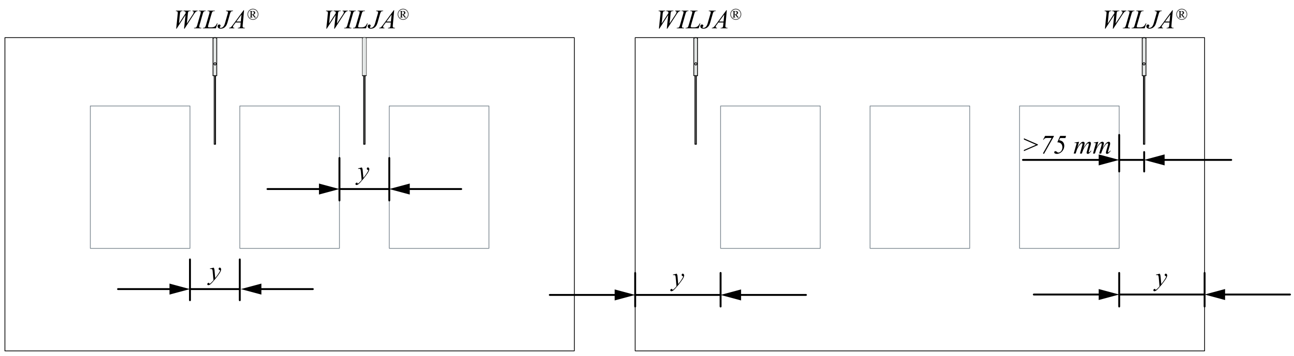


Figure 8. Narrow sections for WILJA® Lifting Inserts.

1.1.10 Installation close to and above windows

The installation of WILJA® Lifting Insert can be challenging if window or door openings are placed in such a way that a straight installation of inserts is impossible. In such cases, the WILJA® Lifting Insert can be bent into the correct position by the user, at the user's own risk under consideration of the following specifications:

- bending temperature of steel minimum 0°C, below zero not permissible.
- bending to happen just once, re-bending is not permissible, re-bent WILJA® Lifting Insert are scrap.
- bending diameter of mandrel is minimum $24 \times d_s$ at $f_{ck,cube}$ = 15 MPa concrete, $18 \times d_s$ at $f_{ck,cube}$ = 25 MPa (concrete cover < 100 mm) or min $15 \times d_s$ (concrete cover > 100 mm NA of EN1992).
- surface reinforcement to follow *Table 6* and *Table 8* for narrow installations.
- U-rebar according to *Table 7* to be placed in horizontal position in the bending area to take horizontal loads. resulting from angular deviation (*Figure 9*).
- consideration of *Table 8* and *Figure 8* to strengthen the section capacity of anchorage.
- WILJA® anchorage bars to be fixed with wire, so that they retain the spread position for better bonding.
- the dimension "v" from top to the bending follows *Table 9*.
- if the dimension "v" according to *Table 9* becomes smaller, then the user has to take care for sufficient concrete resistance.

Table 9. *Installation depth over openings.*

Type	$Ød_{br}$ at $f_{ck,cube}$ = 15 MPa [mm]	$Ød_{br}$ at $f_{ck,cube}$ = 25 MPa [mm]	Min. "v" $f_{ck,cube}$ = 15 MPa [mm]	Min. "w" * [mm]
WILJA® 2	216	162	450	50
WILJA® 3	264	198	450	50
WILJA® 4	216	162	450	50
WILJA® 5	264	198	650	50
WILJA® 6	264	198	650	50

* "w" is the distance from the end of the tube to the center of the bending diameter "$Ød_{br}$"

The aforementioned specifications and *Table 9* are to be applied when the installation is performed in a similar manner to or according to *Figure 9* and *Figure 10*.

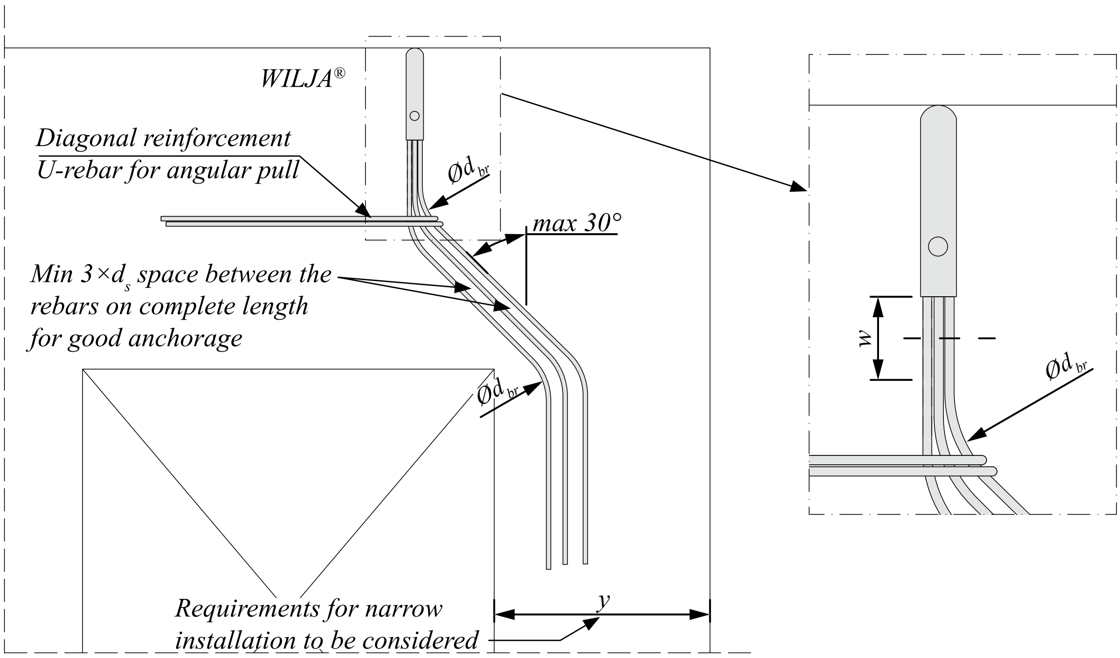


Figure 9. *Installation close to opening corners for WILJA® Lifting Inserts.*

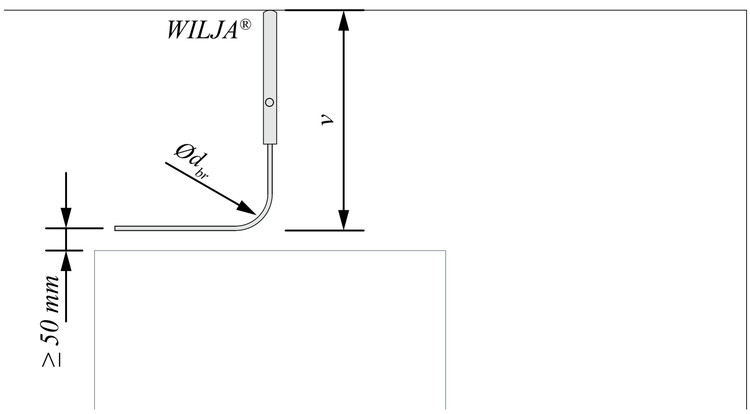


Figure 10. *Installation over openings for WILJA® Lifting Inserts.*

The minimum bending diameter "$Ød_{br}$" of the lateral reinforcement is a recommendation (see *Table 9*). If local regulations such as NA of EN1992-1-1:2011 require a different bending diameter, then local adaptions can be made.

1.1.11 Installation next to big openings

The installation of WILJA® Lifting Inserts can happen next to big openings, such as room high windows or door openings. In such cases it is recommended, to keep edge rebars uncut through the opening or to fix a steel profile into the opening during transport and lifting. Both might be beneficial to prevent cracking on the surface due to hoisting activities (see *Figure 11*).

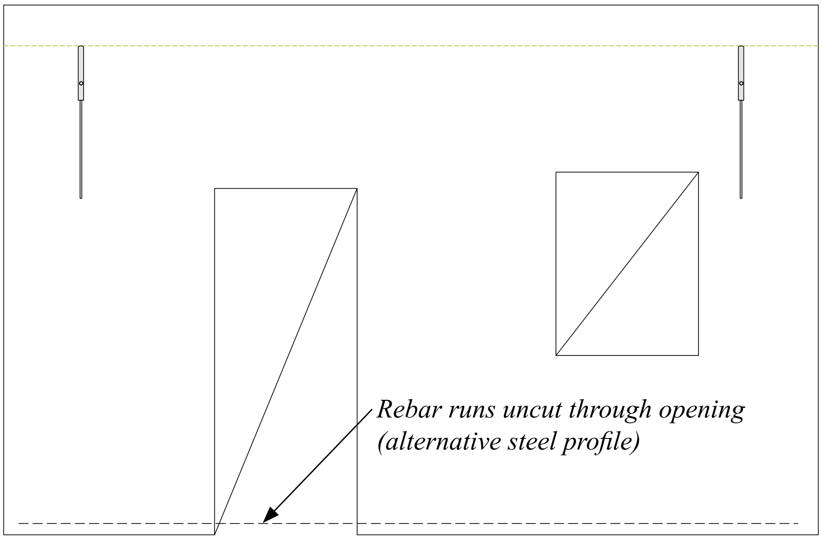


Figure 11. Installation of WILJA® Lifting Inserts next to big openings.

1.1.12 PD ties as installation item

The use of WILJA® Lifting Inserts in sandwich wall elements requires the use of PD Diagonal Tie lattice girders. PD Diagonal Ties connect the front panel with the internal panel and transfer the loads on to the bearing parts. The installation requires at least one PD Diagonal Tie with a spacing of approximately 300 mm next to each side of the WILJA® Lifting Inserts. The exemplary installation situation is shown in *Figure 12*. Placing requirement is typically met if PD Tie placing follows standard placing of *c/c* 600 mm.

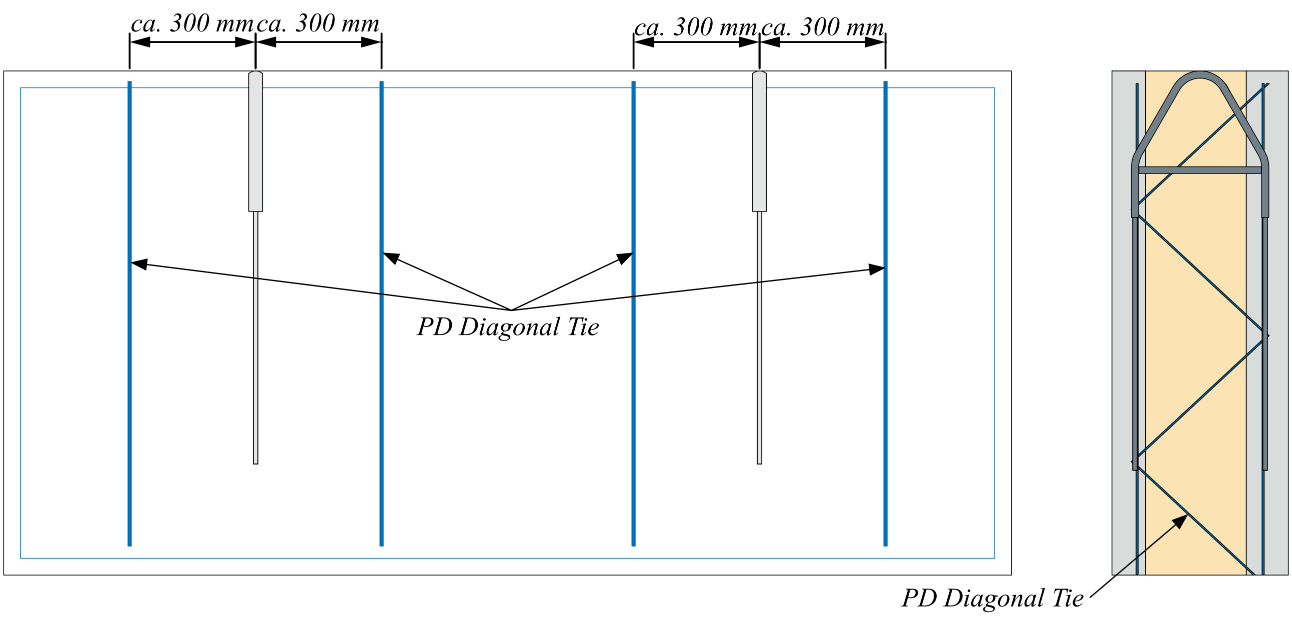


Figure 12. Installation detail for PD Diagonal Ties in combination with WILJA® Lifting Inserts.

2. Selecting a lifting system (Designer)

2.1 Definition of a lifting system

Regulations such as VDI/BV-BS 6205 (national German rule, “Lifting inserts and lifting insert systems for precast concrete elements”) govern lifting systems. According to the definition, WILJA® Lifting System consists of a WILJA® Lifting Insert, permanently anchored in the precast element and a lifting key. The lifting key, which hooks temporarily onto the embedded WILJA® Lifting Insert, can be a chain hook or a shackle. *Figure 12* shows this definition in an overview of the WILJA® Lifting System.

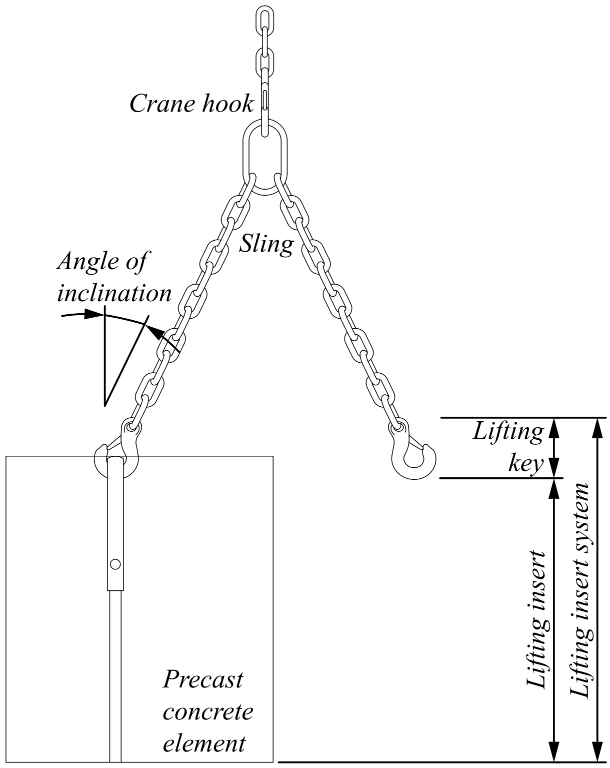


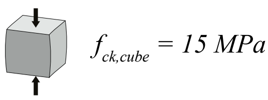
Figure 13. Definition of a lifting system according to VDI/BV-BS6205.

The structural behavior of a lifting systems depends on multiple factors. These design assumptions and impacts are given in the following sections.

2.1.1 Temporary conditions and concrete strength

When lifting systems are being used, temporary conditions at the precast plant or on site during the early hardening stage of the concrete must be considered.

The concrete must have a compressive cube strength of at least $f_{ck,cube}$ = 15 MPa prior to any lifting operation unless higher strength is defined in manufacturing and assembly drawings.



During temporary conditions the concrete often limits allowable resistance.

PLEASE NOTE:
Consider the environmental and temperature conditions. A series of concrete cubes can help to determine the development of the concrete’s strength.

2.1.2 Safety and factors

The insert's safety factors account for at least 3-fold protection against steel failure, as well as at least 2.5-fold protection against concrete failure depending on the concrete strength.

2.1.3 Number of inserts and lifting systems

During transportation, various defined and undefined balancing conditions may exist, depending on the chosen load lifting system.

For defined balance conditions (statically determined system), the insert loads can be calculated very precisely. This is the case when using two suspension gears, three suspension gears (with symmetrical insert distribution), or four suspension gears with a compensation seesaw. *Figure 14* shows examples of such transportation systems.

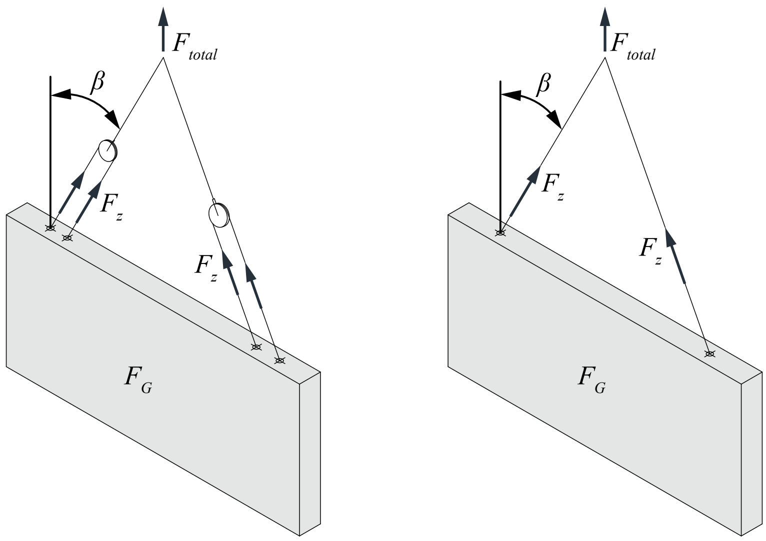


Figure 14. Balanced lifting conditions.

For undefined balance conditions, the lifting insert loads cannot be calculated exactly. This is the case when more than two lifting inserts are used, such as for wall elements with three lines installed or four suspension gears without compensation. In such a case, a maximum of two lifting inserts can be load bearing. *Figure 15* shows examples of such transportation systems.

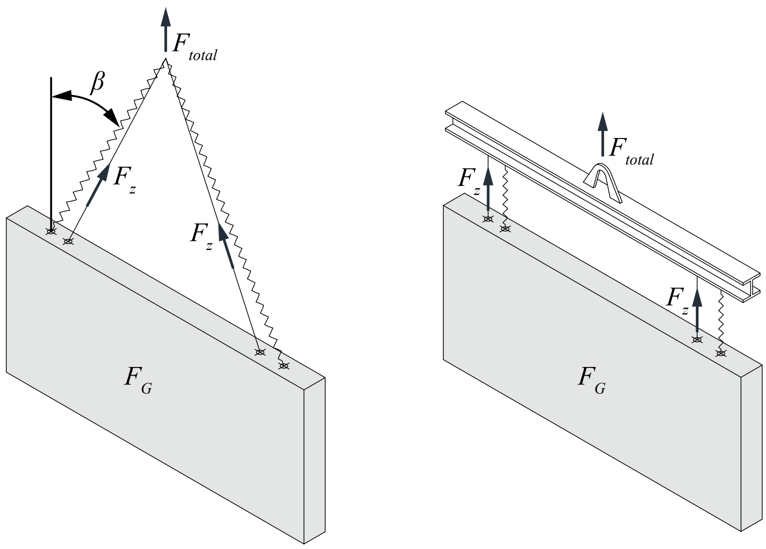


Figure 15. Imbalanced lifting condition.

For unclear lifting situations in which only the element's weight is known, it is recommended for safety reasons that **each insert is designed for the entire element weight**.

The use of tolerance-compensating equipment, such as (but not limited to) seesaws or lifting beams, allows a precise load distribution among the inserts. Before installation and lifting, ensure that all factors have been taken into consideration regarding the lifting actions.

PLEASE NOTE:
Always specify which load distribution and which conditions and equipment must be taken into account for safe lifting.

Asymmetrical element design requires consideration of asymmetrical insert installations. Before installing lifting systems into asymmetrical elements or asymmetrically, calculate the insert loads relative to the center of gravity. *Figure 16* shows such an application.

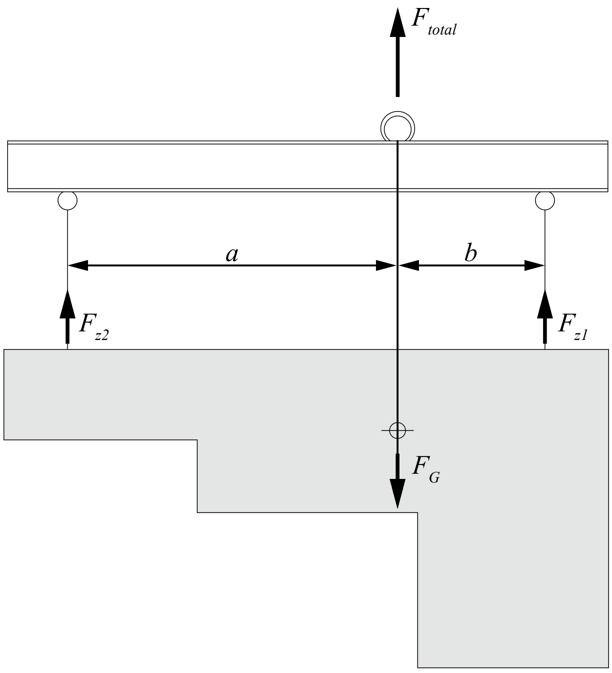


Figure 16. Asymmetrical insert layout.

2.1.4 Acceleration forces

The lifting insert system must withstand hoist and acceleration forces such as gravity, acceleration, drive loads, and up and down lifts, and must transmit those loads into the unit. The hoisting load coefficient is usually called the "dynamic factor" and is dependent on the individual hoisting class of the crane ($HC1$ to $HC4$ according to EN13001-2) or the transportation method. Notwithstanding the hoisting load, the coefficient can be defined based on evaluations or user experience for vehicles such as excavators or forklifts. Transportation with an excavator over uneven ground leads to a multiplication of the actual unit weight through acceleration forces. Reference values for hoisting equipment are introduced in section 2.1.9 in *Table 11*.

PLEASE NOTE:
The individual hoisting coefficient must be considered for the entire chain of transportation between the precast plant and final installation.

2.1.5 Mold adhesion

Lifting concrete units out of the mold creates an adhesion force between the element and the formwork. This adhesion force must be assumed when defining the lifting system. The adhesion force can increase the force required to several times the actual unit weight. This increase in force depends on the mold surface and the contact area between the concrete unit and the mold. Applying lubrication and separating agents reduces the required forces. Separately removable construction groups of formworks (side formwork or front-end formwork) must be removed before lifting. The adhesion forces can be determined by multiplying the contact area with the reference values for mold adhesion. Please bear in mind that mold adhesion may vary depending on the surface structure of the mold. Reference values for mold adhesion are given in *Table 10*.

The tilt-up procedure for wall elements can be simplified using wooden wedges to lower the adhesion forces. *Figure 17* shows how this can be executed.

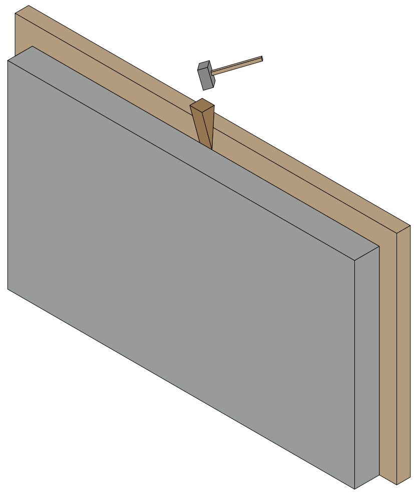


Figure 17. Lowering of the adhesion forces.

2.1.6 Element weight

According to EN 1991-1-1, the normal reinforced concrete element weight is defined as a specific weight of 25 kN/m^3. The use of reinforced heavy concrete requires specific weights of at least 27 kN/m^3. Lightweight aggregate concrete with an open structure and autoclaved aerated concrete can vary in weight from 9 kN/m^3 to 20 kN/m^3 depending on the aggregates used. The individual specific weight must be determined by the user.

For heavily reinforced structures, such as bridges or massive concrete foundations, the weight of the reinforcement must be considered separately. Openings should be considered for efficient calculation and optimal selection of the lifting system.

2.1.7 Load directions

During the chain of transportation, various processes such as tilt-up, loading, hoisting, rotation, and installation may take place. The selected lifting system must withstand all such conditions and be able to remain safe, even under multiple load directions.

A rotation process involves much different conditions than hoisting with a tower crane. For this reason, the user must consider the load directions that may occur when the selected lifting system is used. In principle, two different load directions can be defined (see *Figure 18*):

- **Axial tension:** occurs when lifting with a beam in the longitudinal direction of the insert axis. This is the most economical lifting direction, requiring the smallest insert size. There is no load increase caused by inclination.
- **Diagonal tension:** occurs when lifting with a chain under an angle of inclination longitudinal to the insert axis. This is the most commonly used lifting direction, requiring no special equipment except a lifting chain. It causes load increase due to the inclination angle.

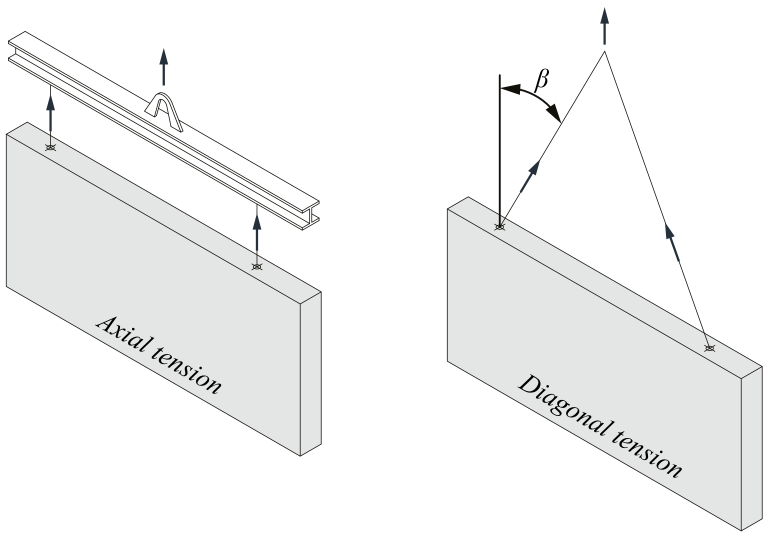


Figure 18. Load directions during hoisting.

The load increase depends on the chain inclination, which is defined by the angle "β" to the vertical. For Peikko's Lifting Systems, the maximum angle to the vertical is 45°. Greater angles are not permissible due to excess load increase. The relationship of the inclination angle "β" to the load increase and the spread angle of the chain "α" is shown in *Figure 19*. This shows the load distribution on double-strand lifting equipment when hoisting at different angles.

In practice, this means that the angle of inclination has a significant impact on the dimensioning of the transportation system. Transportation with diagonal tension with inclination angle "β" greater than 30° requires additional reinforcement for a WILJA® Lifting System.

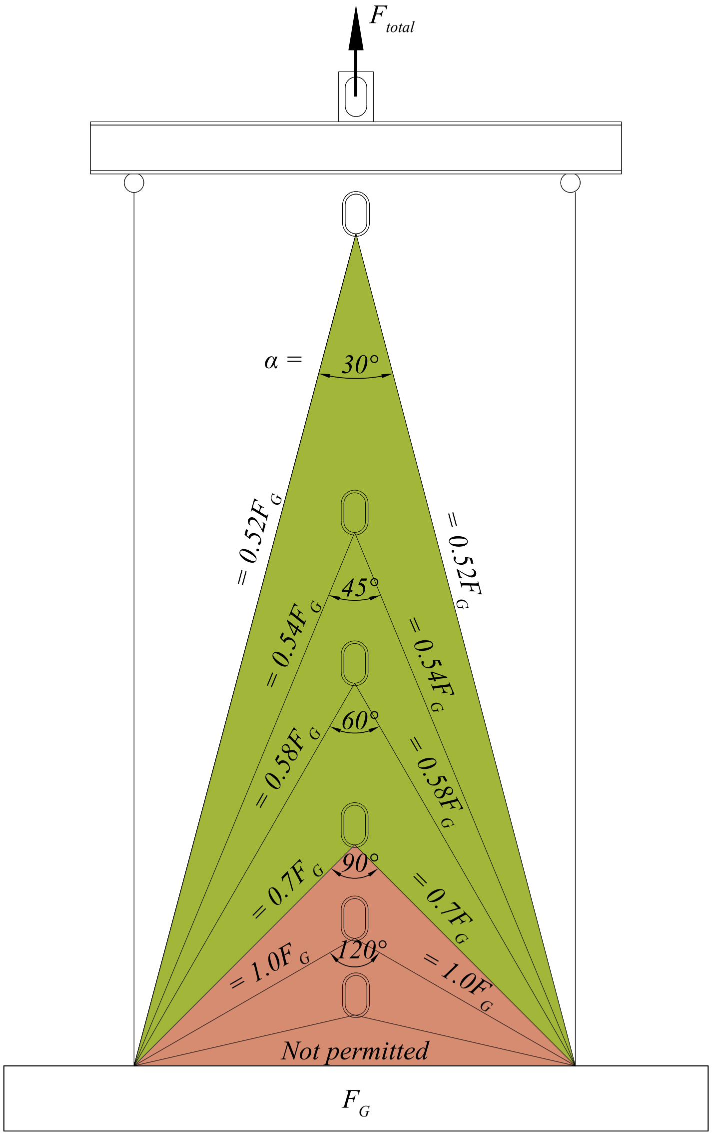


Figure 19. Load increase during hoisting.

Precast concrete elements are very often produced horizontally on casting tables. After concrete hardening, elements such as walls must be lifted from a horizontal position to a vertical position.

For WILJA® Lifting Insert a tilt-up table must be used to turn precast elements into vertical direction.

2.1.8 Load transfer to concrete

Lifting systems anchor the load into the concrete with different methods of load impact. This can be achieved through:

- Bond stress
- Geometry (wave, forged foot)
- Inclusion of concrete.

Before installing any lifting system, please ensure that it is suitable for your application and the unit geometry. Very often, the concrete strength limits the application and lifting takes place under undefined conditions.

Concrete elements must be designed with very precisely positioned lifting systems. The design must consider the deflection of the concrete element caused by lifting and load impact. Additional reinforcement may be needed to handle these impacts.

2.1.9 Selecting lifting systems

Before selecting a lifting system, the user must know which system parts fit together. *Figure 20* shows the combinations of WILJA® Lifting Insert with appropriate lifting keys.

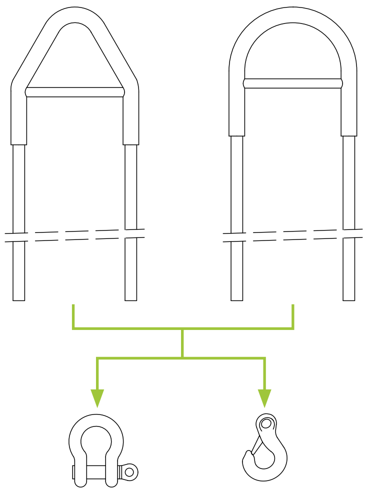


Figure 20. Combination of WILJA® Lifting Insert with lifting keys.

The lifting system is one of the most important factors in ensuring a safe transportation process.

The user must check the following:

- Is the element known (size, weight, geometry)?
- Is the center of gravity known or must it be defined?
- What is the transportation process after production and who is responsible for it?
- Which equipment is available for transportation to ensure that design assumptions are realized?

Loads are determined for the most challenging case of the transportation process. This guides the entire design of the lifting system. Designers' calculations must remain below the resistances of the lifting system given in this documentation. The rule "stress (E) < resistance (R_{zul})" must always be satisfied.

The lifting system must be decided upon depending on the application, taking account of the following factors:

- Unit weight (F_G)
- Mold adhesion (F_{adh})
- Acceleration forces (Ψ_{dyn})
- Force directions from insert loads (z)
- Manipulation within the entire transport chain
- Influence of multiple slings (n)
- Unit geometry

These factors must be considered when selecting a lifting system. The determination of the resulting force acting on the insert is calculated according to the following formula.

The unit weight is given by

$$F_G = V \times \rho_G \qquad \text{Formula 1}$$

F_G = weight of the precast element [kN]
V = volume of the precast element [m^3]
ρ_G = density of the concrete [kN/m^3]

The mold adhesion and form friction are assumed to work simultaneously when lifting elements out of formwork. Reference values for mold adhesion are given in *Table 10*. It shall be determined as given by

$$F_{adh} = q_{adh} * A_f \qquad \text{Formula 2}$$

F_{adh} = action due to adhesion and form friction [kN]
q_{adh} = basic value of combined adhesion and form friction [kN/m^2]
A_f = contact area between concrete and formwork [m^2]

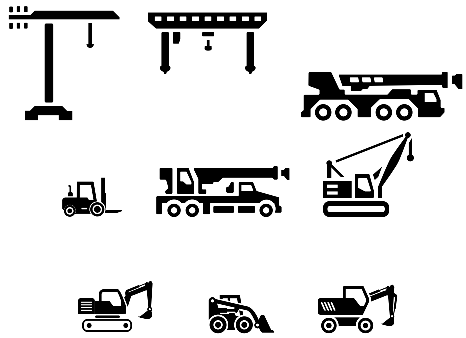
Table 10. Reference values for mold adhesion according to VDI/BV-BS6205.

Formwork and condition	q_{adh} [kN/m^2]
Oiled steel mold, oiled plastic-coated plywood	≥ 1.0
Varnished wooden mold with panel boards	≥ 2.0
Rough wooden mold	≥ 3.0

The acceleration forces will be considered by a dynamic factor called Ψ_{dyn}. This factor increases the static loads to consider dynamic influence. *Table 11* shows example hoisting coefficients for different hoisting equipment.

Table 11. Coefficient for different hoisting equipment according to VDI/BV-BS6205.

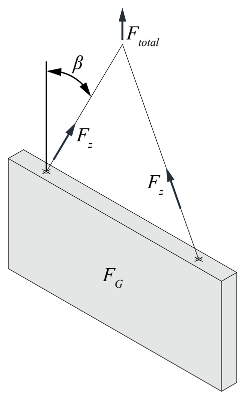
Hoist equipment (class)	Dynamic factor Ψ_{dyn}
Tower crane, portal crane, mobile crane	1.30
Lifting and moving on flat terrain	2.50
Lifting and moving on rough terrain	> 4.0



When lifting elements with a chain, a load increase results from the inclination angle of the lifting slings. This load increase factor is given for calculation purposes in *Table 12*.

Table 12. Z-factors for combined tension and shear (diagonal pull).

Inclination angle β	Cos β	Diagonal tension z-factor (1/cos β)
0.0°	1.00	1.00
15.0°	0.97	1.04
22.5°	0.92	1.08
30.0°	0.87	1.15
37.5°	0.79	1.26
45.0°	0.71	1.41

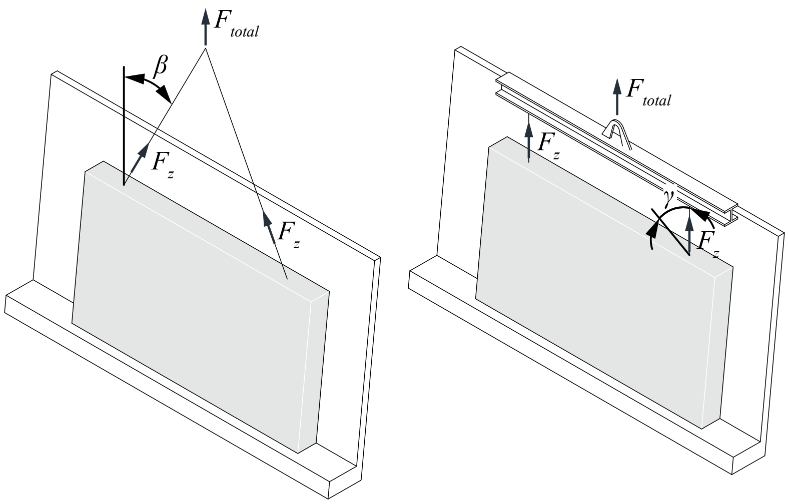


The manipulation within the entire transport chain must be considered and the most challenging case must guide the design. During manipulation, the following load conditions may occur:

- Erection in combination with adhesion and form friction
- Erection
- Lifting and handling under combined tension and shear

Load due to erection in combination with adhesion and form friction may occur when the element is lifted out of the formwork. For WILJA® Lifting Inserts erection with lateral pull is not recommended and a tilt-up table shall be used.

$F_Z = (F_G + F_{adh}) \times z / n$ Formula 3

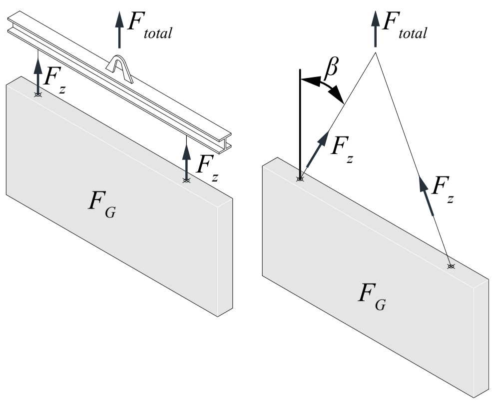


F_Z	= load acting on the lifting insert in direction of the sling axis [kN]
F_G	= weight of the precast element [kN]
F_{adh}	= action due to adhesion and from friction [kN]
z	= factor for combined tension and shear, $z = 1 / \cos \beta$
n	= number of load bearing lifting inserts

The erection process assumes that the element rests on the tilt-up table or formwork and adhesion forces are no longer present. Consider whether a beam or a chain will be used before the calculation procedure.

The most common lifting procedure is lifting with a chain. This is also known as lifting and handling under combined tension and shear. The calculation procedure for this lifting is as follows:

$F_Z = F_G \times \Psi_{dyn} \times z / n$ Formula 4



F_Z	= load acting on the lifting insert in direction of the sling axis [kN]
F_G	= weight of the precast element [kN]
Ψ_{dyn}	= dynamic factor
n	= number of load bearing lifting inserts
z	= factor for combined tension and shear, $z = 1 / \cos \beta$

After determining the actions, the permissible safe working load (R_{zul}) as given in section 1 must be compared with the actions. The following formula is always valid and requires that the actions ("E") never exceed the resistance (R_{zul}).

$$E \leq R_{zul}$$ Formula 5

E = action [kN]
R_{zul} = permissible load (resistance) [kN]

If the safe working load is at least as great as the action, the lifting system can be used in accordance with the geometrical requirements.

Installation handbook for the precast plant

3. Installation handbook

The installation of WILJA® Lifting Inserts in the precast plant or on site must be performed in a precise manner to ensure full load capacity of the WILJA® Lifting Inserts. The following information is important for a safe and adequate installation.

3.1 Personnel and safety requirements

Peikko products must be used by trained, qualified, experienced, and properly supervised personnel, adhering to the safety standards in this manual.

WARNING:
If untrained personnel use lifting systems, there is a risk of incorrect use, which may lead to items falling and may cause severe injury or death.

The user must evaluate the product application to determine the safe working load and control all field conditions to prevent applied loads from exceeding the product's safe working load. If it is not possible to define the loads acting on the insert through calculation (e.g. highly structured elements), inserts must then be installed in such a way that every insert is able to carry the unit's entire weight.

During the installation procedure, the operator is subject to different exposures (e.g. noise, dirt, dust, vibration, thermic influence, oil, and grease). The use of personal safety equipment is recommended.

3.2 Installing and positioning of the WILJA® Lifting System

The WILJA® Lifting System components are installed in a precast plant. During concreting proper compacting of the concrete is necessary to avoid air bubbles which affect the load impact.

Ensure that the surroundings and environmental conditions are dry and clean for installation. Any kind of environmental pollution must be avoided or minimized at any time.

The following must be considered prior to installing any type of lifting system:
- All personnel fulfill the requirements of the documentation and are familiar with it
- The limitations of applications and restrictions are known
- The design assumptions are defined and known.

During installation of any type of lifting system, the installation tolerances specified by the manufacturer must be complied with. The installation tolerances for vertical and horizontal positions are given in *Figure 21* and *Table 13*. The insert can incline a maximum of 2.5° in either direction and angle tolerance must remain within 5° of tolerance towards the insert axis.

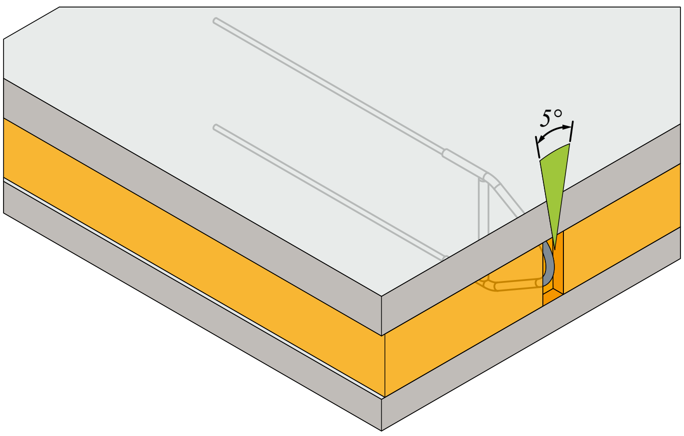
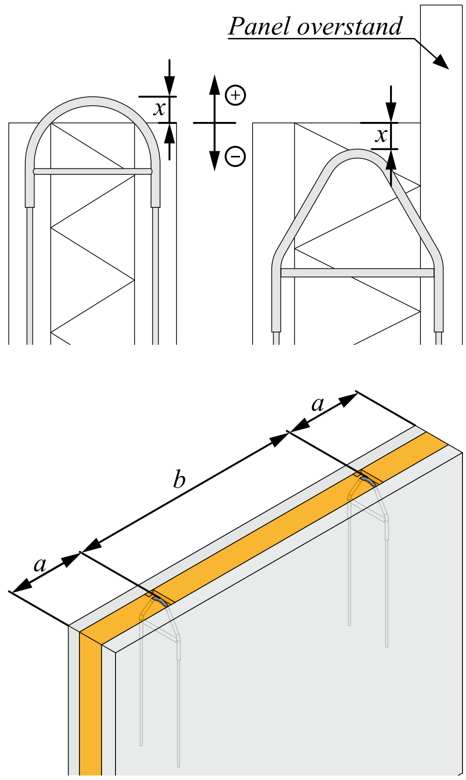


Figure 21. Angle tolerances for installation.

Table 13. Installation tolerances for WILJA® Lifting Insert.

Type	*x* [mm]	
WILJA® 2	+25	-50
WILJA® 3	+25	-50
WILJA® 4	+25	-50
WILJA® 5	+25	-50
WILJA® 6	+25	-50
Type	***a* [mm]**	***b* [mm]**
WILJA® 2	±25	±50
WILJA® 3	±25	±50
WILJA® 4	±25	±50
WILJA® 5	±25	±50
WILJA® 6	±25	±50



The items are installed by wire fixing the WILJA® Lifting Inserts to the element reinforcement which helps to comply with the tolerance requirement according to *Figure 21* and *Table 13*. The correct position after the concrete hardens ensures product usability and application according to design.

If an element has an insulation thickness that differs from standard WILJA® Lifting Inserts range (e.g. 19 cm, 21 cm, 23 cm), the next available size shall be used. The installation is performed in such a way that the minimum installation depth c_{min} (*Table 5* and *Figure 4*) has to be increased to 50 mm (*Figure 22*). This is also valid for insulation thicknesses where the correct WILJA® Lifting Inserts size is not in stock. A WILJA® Lifting Inserts for the next even size (insulation thickness +20 mm) can be used if the installation depth c_{min} is increased in both panels.

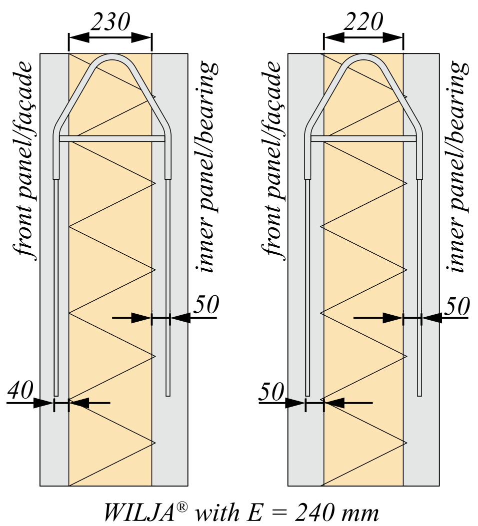


Figure 22. Uneven insulation thickness.

Lifting systems can be placed in almost any position in the concrete element. The user can choose whether the central, left, right, upper or lower position supports the application. Before installation and use, the position of the insert must be considered. It must always be higher than the center of gravity to prevent the element from tipping over as shown in *Figure 23*.

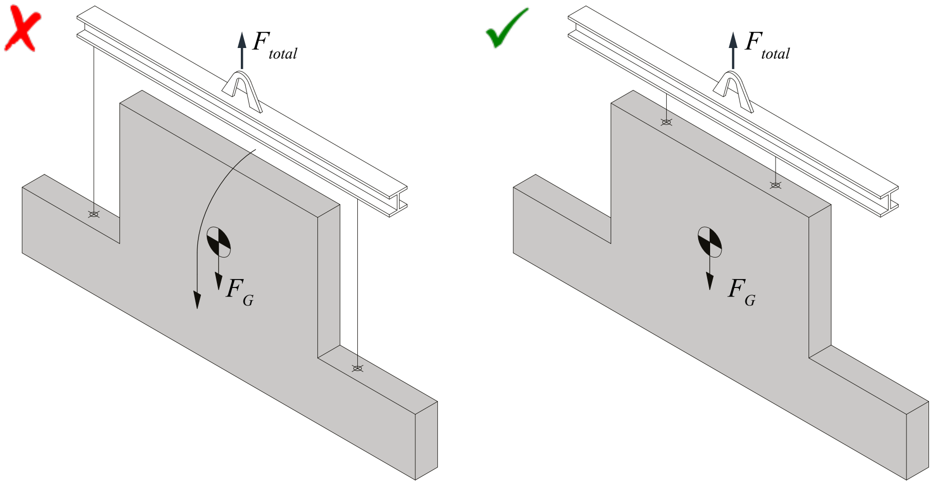


Figure 23. Lifting points lower than the center of gravity.

PLEASE NOTE:
Elements that tip over can cause severe injury to the user's limbs. Always ensure that the center of gravity is known, and the inserts are correctly positioned before attaching elements to hoisting equipment.

3.2.1 Welding and modification considerations

Peikko cannot control field conditions or field workmanship; it therefore cannot provide a guarantee for any Peikko product that has been modified in any way after it has left the manufacturing facility. This includes welding, bending (except information in chapter 1.1.10), heating it up, cutting and filing.

WARNING:
Never weld any of Peikko's products.

3.2.2 Corrosion, chemical effects, weather condition and concrete hardening

Corrosion may occur on exposed metal products when architectural precast elements are etched or acid washed. The amount of corrosion will depend on the acidity of the wash and/or the type of chemicals used. Similar effects may occur by using products in a chemical and industrial environment and in coastal zones that have a salty environment.

For lifting systems that are permanently exposed to weather, chemical conditions, and seawater atmospheres the usability of products might be affected by corrosion. Ensure that corrosion of lifting systems is prevented during storage, transport, and installation. In extreme conditions we recommend using inserts made of highly resistant stainless steel.

All Peikko lifting systems are delivered in useable condition. No further surface treatment (e.g. galvanizing, painting) is needed. Such treatments may result in unexpected embrittlement of the product.

WARNING:
Never galvanize or coat Peikko's products in any way.

All lifting system parts are subject to ultraviolet radiation. Prior to use, ensure that the products are not affected by material aging caused by ultraviolet radiation. Material aging effects occur on products that are kept in stock for extended periods or that have suffered the effects of bad weather.

All Peikko WILJA® Lifting Insert are from stainless steel. During the winter period, we recommend covering the WILJA® Lifting Insert and recess to avoid snow and ice from hampering use.

After final usage of Peikko lifting products further use is explicitly prohibited.

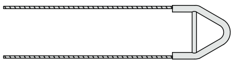
The concrete hardening process depends very much on environmental and temperature conditions. During the lifting application the concrete must be of the correct strength.

PLEASE NOTE:
A series of concrete cubes can help to determine the development of the concrete's strength before the lifting application starts.

Checklist Precast Plant

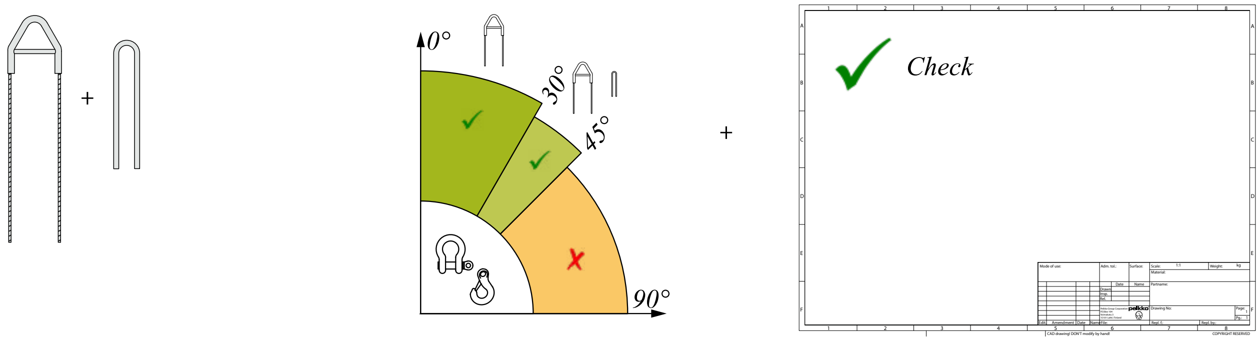
	NO then...	YES
Has the personnel the necessary qualification for the installation?	Check “Personnel and safety requirements” on page 28.	
Has the lifting insert been installed correctly? Are the geometrical requirements like edge distance and distance between inserts fulfilled?	Check *Figure 21*, *Figure 22*, *Table 5*.	
Have the tolerances been kept (minimum panel thickness, spacings, concrete cover)?	Check *Table 13* and *Figure 22*.	
WILJA® will be used in combination with PD Diagonal Ties.	Check on page 16.	
If rebars of the WILJA® Lifting Inserts have been bended, does bending follow the requirements?	Check on page 15.	
Cutting or welding the insert or heating it up is not allowed!	Check on page 30.	
Every layer of a sandwich element must be reinforced at least with 1.88 cm^2/m (B500) or 1.31 cm^2/m (B600) crosswise.	Check *Table 6*.	
Additional reinforcement is necessary for WILJA® 5 and 6 (see *Table 6*) in general and for all lifting procedures with diagonal pull 31° to 45°.	Check content of pages 12 to 13.	
Has the WILJA® Lifting Inserts and the reinforcement been fixed properly, so that it will not move during concreting process?	Check page 28.	
Has the concrete been properly compacted in the region of the insert placement?	Check page 28.	
Are the limitations of applications and restrictions known and have the design assumptions been defined and transferred?	Check “Handbook for the planning process” and internal documentation.	

WILJA® Lifting System

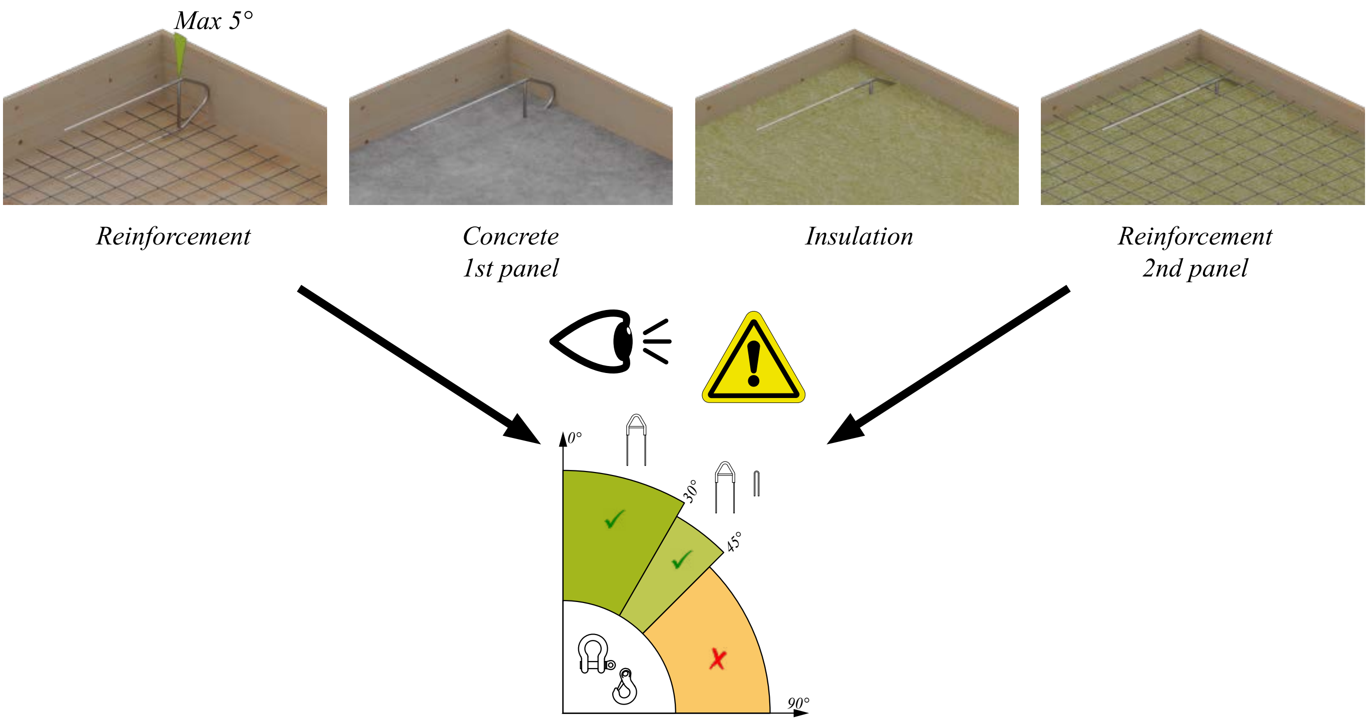


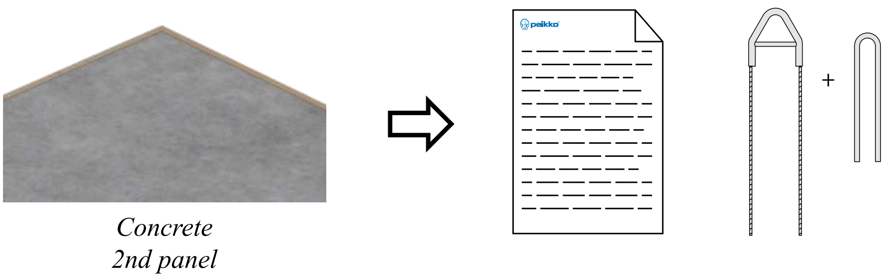
WILJA®

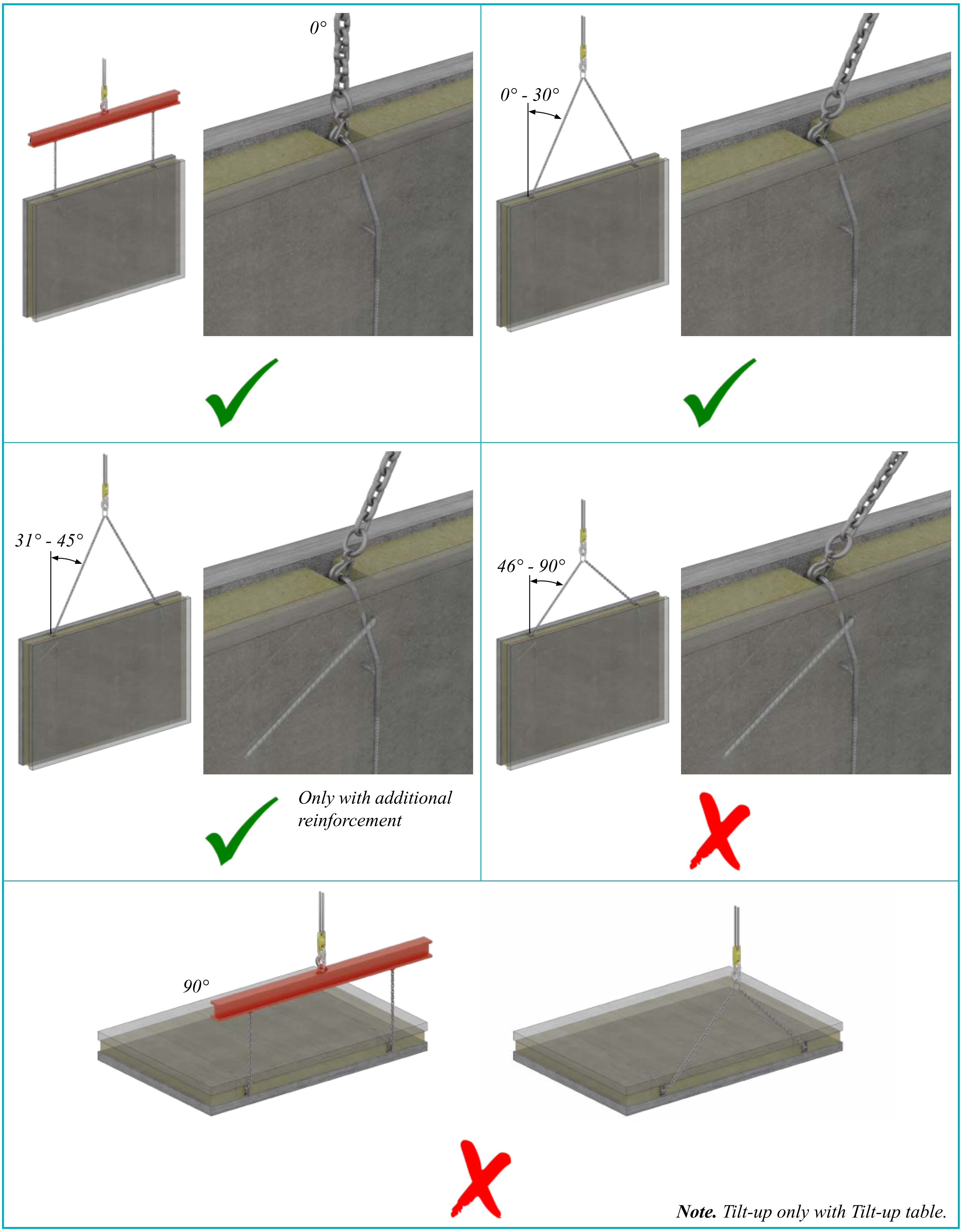
1. SELECTION



2. INSTALLATION






0°
0° - 30°
31° - 45°
Only with additional reinforcement
46° - 90°
90°
Note. Tilt-up only with Tilt-up table.

User's handbook for the lifting application

4. User's handbook

The attaching of lifting keys to WILJA® Lifting Insert, after the concrete is strong enough to carry the impacted loads, must be performed properly, so that accidents or failures of any kind are avoided. The following information is important for a safe load attachment of lifting keys to WILJA® Lifting Insert.

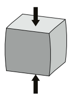
4.1 Loading, lifetime and environmental conditions

WILJA® Lifting Insert are designed for use in precast elements for transportation and with a temporary attachment to standardized lifting keys.

Multiple lifts can be completed before the final installation. The lifting system must not be installed or used in crane counterweights.

The lifetime of lifting systems begins with stocking and extends to the final installation of the precast element on the construction site. This might be hours, days, or sometimes weeks or months. During this time, it is essential to protect any recess against dirt, pollution, and water. This can be achieved by using a cover or by storing elements in dry conditions under a roof or other shelter.

All precast concrete elements in which WILJA® Lifting Insert can be used must be made from normal concrete according to EN 206. The minimum compressive cube strength must be $f_{ck,cube}$ = 15 MPa in normal cases. Exceptions for lower concrete strength require individual confirmation.

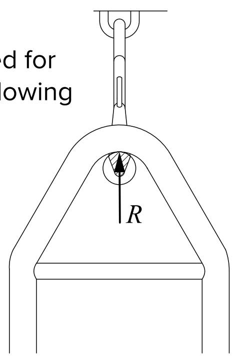


$$f_{ck,cube} = 15\ MPa$$

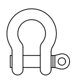
All Peikko lifting systems must be installed and used in clean, dry surroundings and environmental conditions. Environmental pollution needs to be minimized at all times. Normal humidity does not affect the durability. Dampness resulting from the concreting procedure is permissible and does not affect the usability.

To avoid cold bridge between façade - and load bearing panels it is possible to cut the visible area of WILJA® Lifting Insert after the sandwich element is installed and fixed to it's final position on the construction site. The insert slot can be filled with insulation e.g. with rockwool.

4.2 System compatibility



Peikko WILJA® Lifting Insert can be used with standardized lifting keys. These should be designed for at least the same load directions as WILJA®. The WILJA® Lifting Insert are compatible with the following lifting keys:

- Crane hooks, wire hooks and chain hooks of grade 8 or higher 
- Shackles (bolt diameter $>2R$ = 30mm) 

Lifting keys are subject to exchanging and forwarding actions during multiple lifting processes. Clarify compatibility prior to using any lifting keys in combination with WILJA® Lifting Insert.

WARNING:
Incompatible lifting keys may cause accidents and severe injuries.

4.3 Storage situation

Lifting components must be stored and protected in dry conditions, preferably under a roof. *Figure 24* shows a suitable storage location.

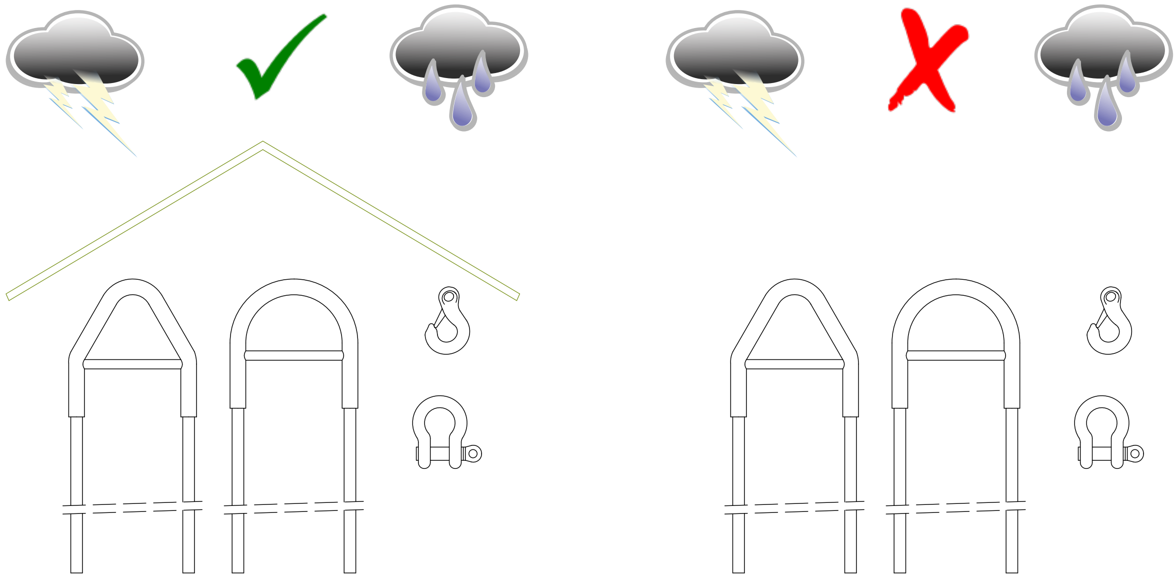


Figure 24. Storage location.

WARNING:
Lifting keys are subject to corrosion when they are unprotected and exposed to outdoor weather conditions such as large temperature variations, snow, ice, humidity, acidic atmospheres, or salt and sea water impact. These conditions may cause damage and shorten the standing time, which increases costs.

Lifting keys must be used by experienced and trained personnel. This reduces the risk of severe damage and injury. Always execute every lifting process according to the instructions.

The following are mandatory instructions for safe working. They must be complied with exactly whenever lifting systems are in use.

WARNING:

- Operate manually. Do not use any tools such as bars or claws.
- Visually inspect all lifting keys before use.
- Check and clean all Lifting Keys and inserts before use.
- Inspect all lifting keys regularly for safety purposes.
- Lifting keys to be stored under appropriate environmental conditions.
- Bear in mind local regulations for safe lifting and hoisting at any time and consider the design assumptions described in this manual.
- Don't break concrete around the WILJA® Lifting Insert and never rework mechanically (see *Figure 25*).

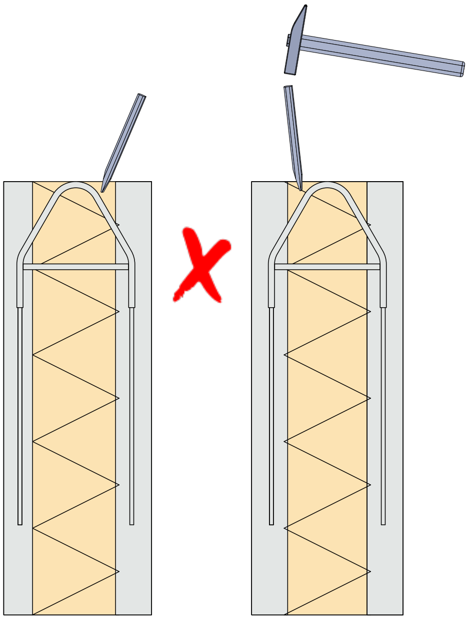
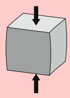


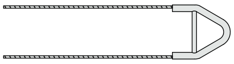
Figure 25. Rework at WILJA® Lifting Insert.

The correct lifting and handling guidelines must always be available when hoisting. This information must be supplied by the employer to all personnel concerned.

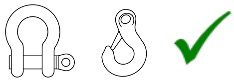
Checklist Lifting application

	NO check...	YES
Do the personnel have the necessary qualification for the lifting process?	Check page 28 and page 36.	
Visual check of installed inserts and concrete element. Inserts undamaged and at the right place? Do the shop drawings match the element?	Check page 23, "Handbook for the planning process", and internal documentation.	
Visual check of lifting equipment. Are chains, shackles etc. marked clearly with their working load limit, manufacturers name or symbol and a CE sign? No damage or significant wear out visible?	Check pages 35 and 36 and local regulations for lifting keys and safety regulations.	
Is the working load limit of lifting insert and lifting hardware enough for the designed loads?	Check page 17 and following.	
Lifting slings can be attached directly to the WILJA® Lifting Inserts. Minimum diameter d of the hook or shackle is 30 mm.	Check page 35.	
Load directions according to design of the wall element? Remember: Angular pull between 31° and 45° requires additional reinforcement.	Check content of pages 12 to 14.	
The minimum compressive cube strength of the concrete at first loading must be 15 N/mm².	 $f_{ck,cube} = 15\ MPa$	
WILJA® Lifting Insert are designed to withstand a temperature range of -20°C to +80°C.	Check existing temperature.	
Is there a need for temporary bracing to prevent the element from falling down after lifting procedure?	Check "Handbook for the planning process" and internal documentation.	
Have the necessary preparations been completed prior to the operation? Enough space, minimum number of people in the high-risk zone.	Check "Handbook for the planning process" and internal documentation.	

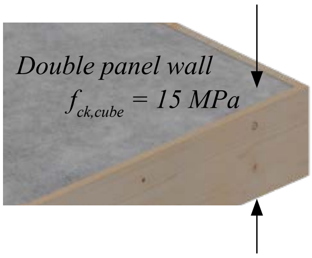
WILJA® Lifting System

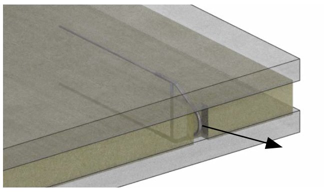


WILJA®

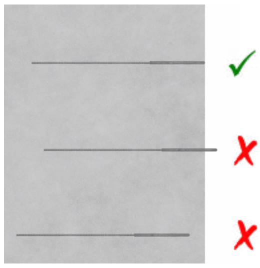


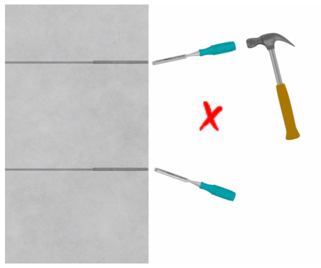
3. CASTING



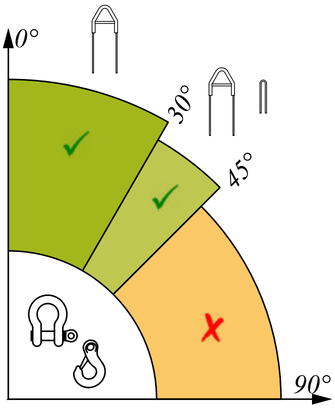


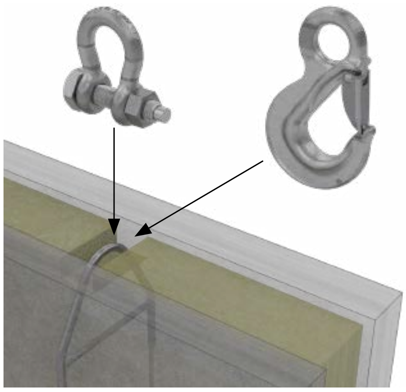
Remove local insulation at insert region





4. LIFTING

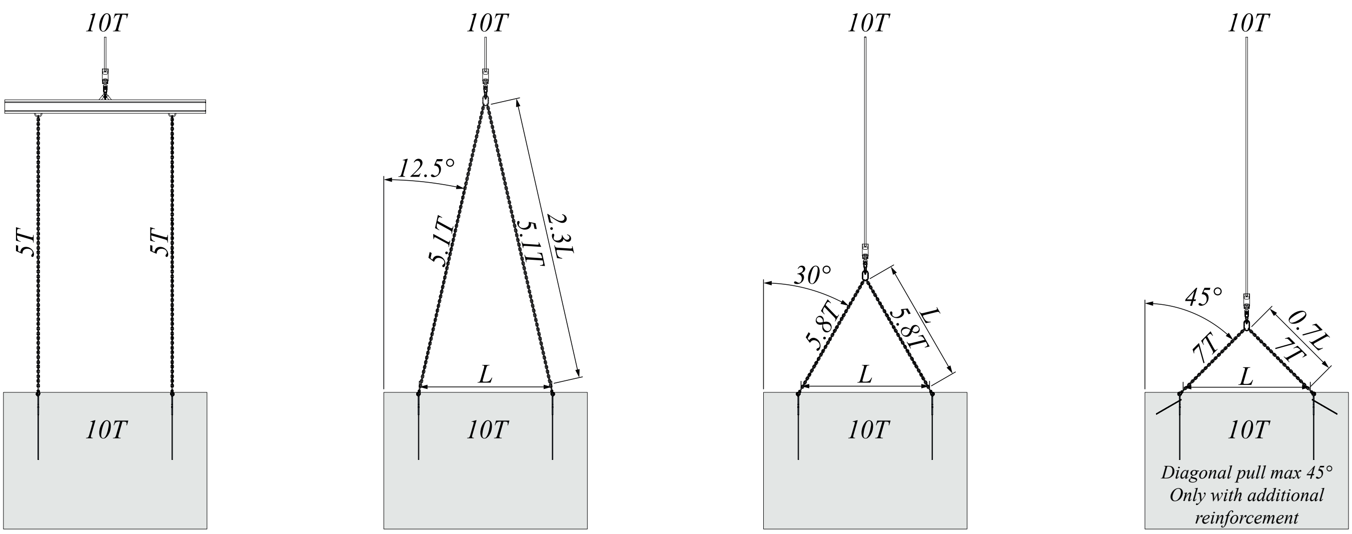




5. OPTIONAL CUTTING

After final use fill the insert region with insulation

6. LIFTING ANGLE INFLUENCE



Annex A – Calculation examples

Example 1: Transporting a sandwich wall element, tilt-up with tilt-up table

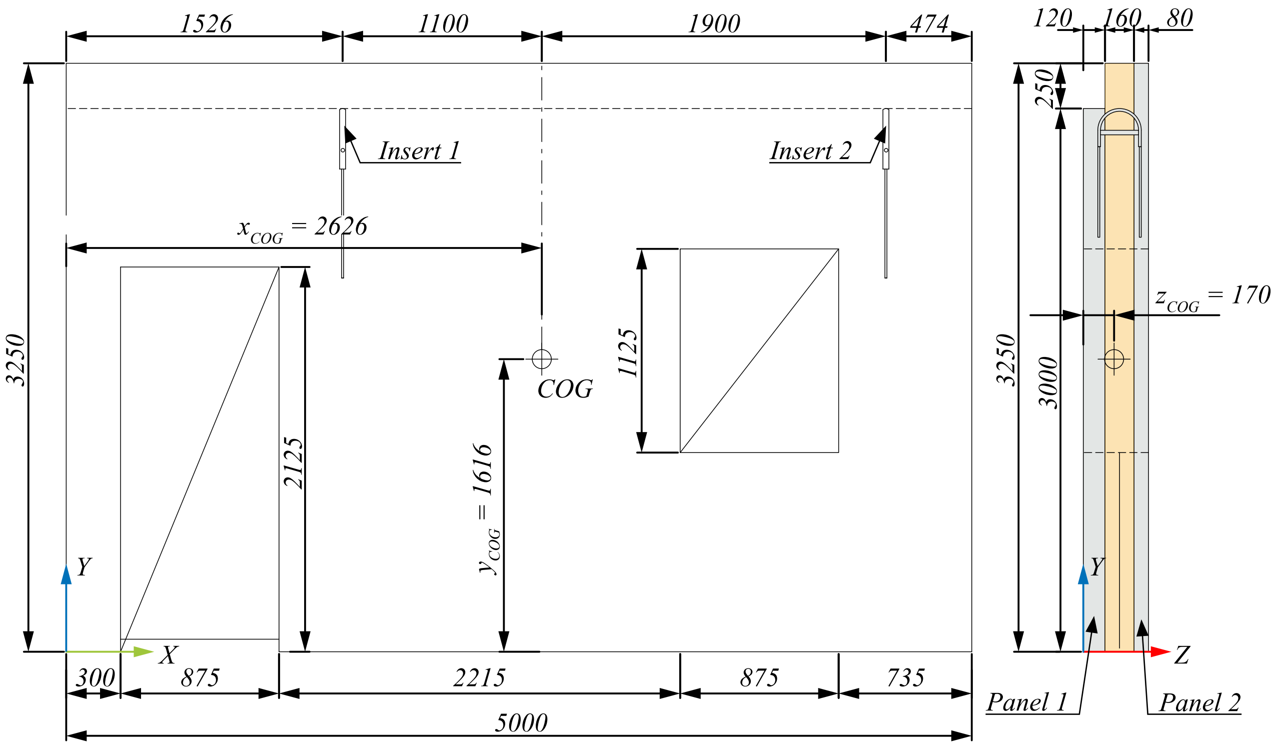
Conditions during the transport process

- Tilt-up process with a tilt-up table, no lateral pull on the entire chain of transport due to vertical storage
- Spreader beam available at the precast plant. Only chains available on the construction site with a spread angle of a maximum of 30°
- Hoisting factor of 1.3 (tower hoist crane, heavy duty mobile crane, truck crane)
- WILJA® Lifting Insert type should be used for sandwich element.

Unit geometry and material properties

Concrete compressive strength of 15 N/mm² at first loading, minimum cross-wise reinforcement: 1.88 cm²/m B500 or 1.31 cm²/m B600 (see *Table 6*),

l = 5.0 m h = 3.00/3.25 m d = 0.36 m (0.12 m + 0.16 m +0.08 m), Insulation PU with 160 mm and 0.40 kN/m³



Unit weight:

F_{G1} = 5.0 m × 3.25 m × 0.08 m × 25.0 kN/m³ = 32.5 kN
F_{G2} = 5.0 m × 3.0 m × 0.12 m × 25.0 kN/m³ = 45.0 kN
F_{G3} = 5.0 m × 3.25 m × 0.16 m × 0.40 kN/m³ = 1.04 kN
F_{O1} = (2.125 + 1.125) m × 0.875 m × (0.12 + 0.08) m × 25.0 kN/m³ = 14.22 kN
F_{O2} = (2.125 + 1.125) m × 0.875 m × 0.16 m × 0.40 kN/m³ = 0.18 kN
F_{Gtot} = 32.5 + 45.0 + 1.04 -14.22 - 0.18 = 64.14 kN

$F_G = V \times \rho_G$ (see Formula 1)
F_G = solid section
F_O = opening

Load case 1: Unit weight + dynamics + diagonal pull

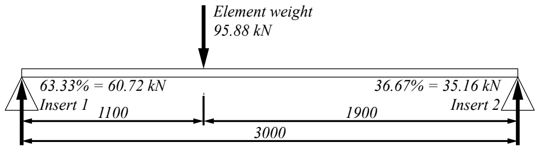
F_Z = 64.14 kN × 1.3 × 1.15 = 95.88 kN

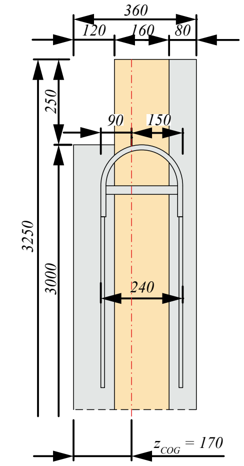
$F_Z = F_G * \Psi_{dyn} * z / n$ (see Formula 4)

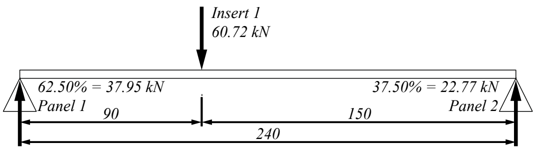
The position of the openings prevents an equal load share to the WILJA® Lifting Insert. The inserts are placed 1100 mm and 1900 mm from the center of gravity (*COG*) which results in an unequal load share to the inserts. The load share behaves as shown on the right with a simple beam. The left WILJA® Lifting Insert 1 gets 60.72 kN design load and the right insert 2 gets 35.16 kN design load.

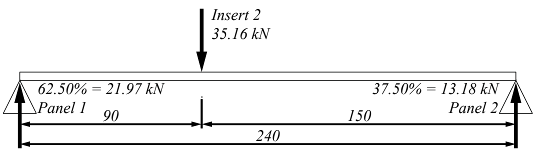
The installation of WILJA® Lifting Insert with different panels creates unequal load on the individual insert legs of the WILJA® Lifting Insert. This means that the design must consider different loads and can influence the insert selection. Load share occurs as before, as with a simple beam.

Considering sufficient safety for steel and concrete and equal loads on the insert legs, a lifting insert which can take 2 × 37.95 kN = 75.9kN at 30° must be selected in one case and an insert which can take 2 × 21.97 kN = 43.94 kN in the other.









Insert selection:
Following the calculations, we select a WILJA®6 with 92.8 kN of resistance for the left insert and a WILJA®4 with 48 kN of resistance for the right insert.

See *Table 4*.

Spacing, unit thickness and reinforcement
Minimum spacing ($b + a$) for WILJA® Lifting Insert is
WILJA® 4: a = min. 400 mm < 474 mm and
b = 800 mm < 3000 mm
WILJA® 6: a = min. 500 mm < 1526 mm and
b = 1000 mm < 3000 mm

Spacing required (see *Table 5*)

Minimum panel thickness (d) for WILJA® Lifting Insert is
Outer panel d_1 = min. 80 mm = 80 mm
Inner panel d_2 = min. 100 mm < 120 mm

Thickness required (see *Table 5*)

The surface reinforcement for WILJA® Lifting Insert must be 1.88 cm^2/m and by limiting the angular pull to maximum 30 degrees we don't need any additional diagonal pull reinforcement. The width of the section where the WILJA® 4 insert is installed is 735 mm. As per definition, a section is narrow when the width is below 1.0 m (y <1.0 m acc. *Table 8*) and the amount of reinforcement must be checked (min. A_s = 1.53 cm^2) to avoid cracking. In this case, a wire mesh reinforcement of #Ø6/150 is installed. We do not have enough reinforcement (735/150 = 4 bars ⇨ maximum 4 bars are installed) for the narrow section of 735 mm. This gives a total cross section area of 4 × 0.28 = 1.13 cm^2. The calculation shows that a minimum of 2 straight bars of Ø6 must be added (1.13 cm^2 + 2 × 0.28 = 1.69 cm^2).

Reinforcement required (see *Table 6*, *Table 7*, *Table 8*)

Example 2: Transporting a sandwich wall element, tilt-up with tilt-up table

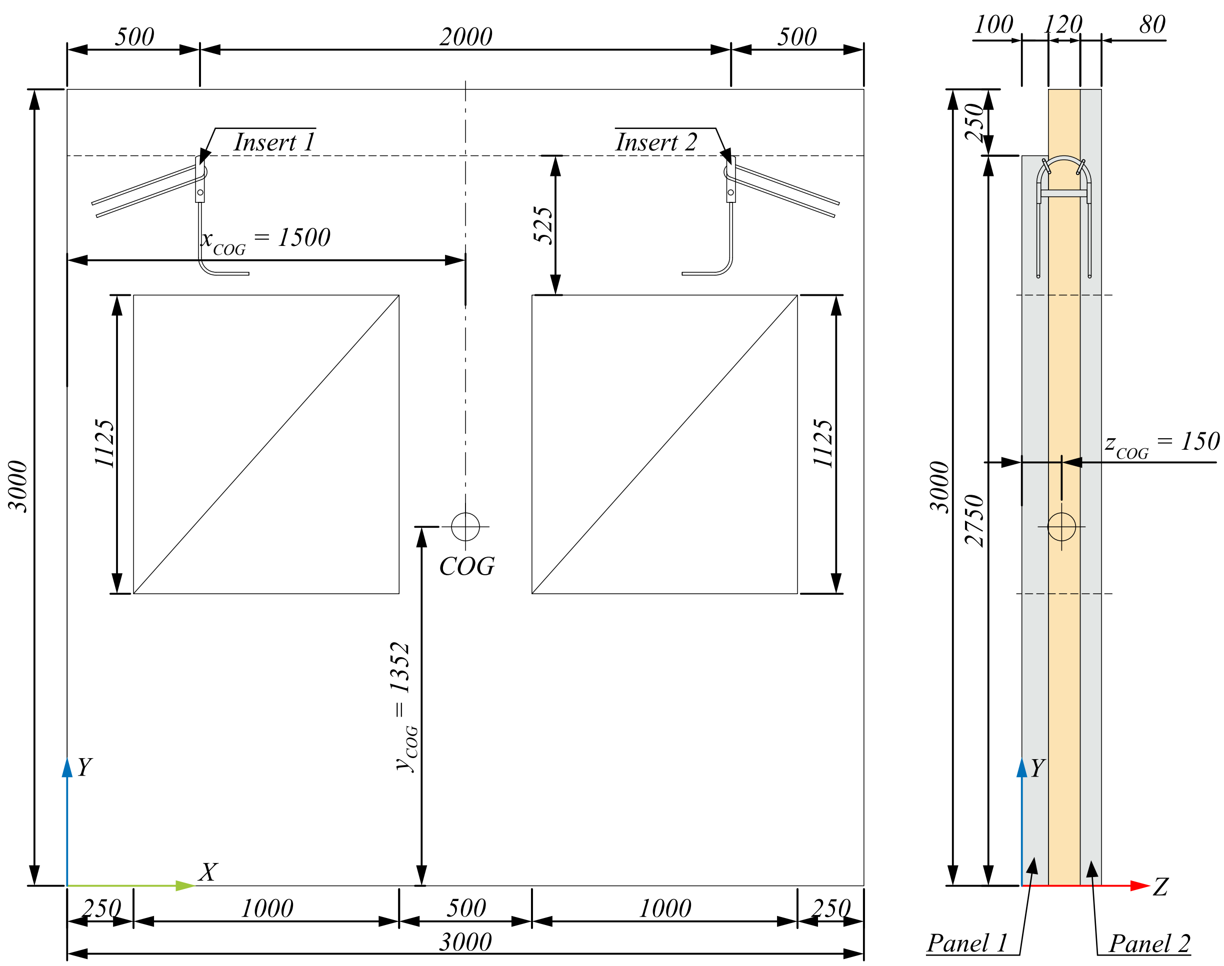
Conditions during the transport process

- Tilt-up process with a tilt-up table, no lateral pull on the entire chain of transport due to vertical storage
- Spreader beam available at the precast plant. Only chains available on the construction site with a spread angle of a maximum of 45°
- Hoisting factor of 1.3 (tower hoist crane, heavy duty mobile crane, truck crane)
- WILJA® Lifting Insert type should be used for sandwich element.

Unit geometry and material properties

Concrete compressive strength of 15 N/mm² at first loading, minimum cross-wise reinforcement: 1.88 cm²/m B500 or 1.31 cm²/m B600 (see *Table 6*),

l = 3.0 m h = 2.75/3.00 m d = 0.30 m (0.10 m + 0.12 m + 0.08 m), Insulation PU with 120 mm and 0.40 kN/m³



Unit weight:

F_{G1} $= 3.0\ m \times 3.0\ m \times 0.08\ m \times 25.0\ kN/m^3 = 18.0\ kN$

F_{G2} $= 2.75\ m \times 3.0\ m \times 0.10\ m \times 25.0\ kN/m^3 = 20.63\ kN$

F_{G3} $= 3.0\ m \times 3.0\ m \times 0.12\ m \times 0.40\ kN/m^3 = 0.43\ kN$

F_{O1} $= 2 \times 1.125 \times 1.0\ m \times (0.10+0.08)\ m \times 25.0\ kN/m^3 = 10.12\ kN$

F_{O2} $= 2 \times 1.125\ m \times 1.0\ m \times 0.12\ m \times 0.40\ kN/m^3 = 0.10\ kN$

F_{Gtot} $= 18.0 + 20.63 + 0.43 - 10.12 - 0.10 = 28.84\ kN$

$F_G = V \times \rho_G$ (see Formula 1)

F_G = solid section

F_O = opening

Load case 1: Unit weight + dynamics + diagonal pull

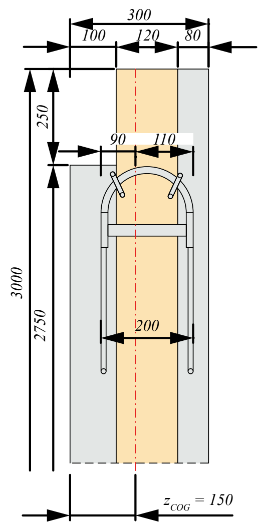
F_Z $= 28.84\ kN \times 1.3 \times 1.41 = 52.86\ kN$

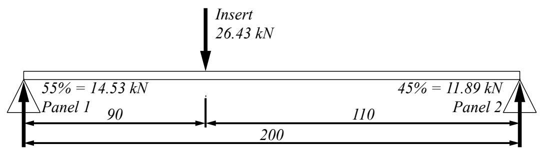
$F_Z = F_G * \Psi_{dyn} * z / n$ (see Formula 4)

The inserts are placed in such a way that equal load share is given 52.86 kN/2 = 26.43 kN/insert. The inserts are placed with 500 mm and 2000 mm spacing, symmetrical to the center of gravity (COG).

The installation of WILJA® Lifting Inserts with different panels creates unequal load on the individual insert legs of the WILJA® Lifting Insert. This means, that design must consider different loads and has influence to insert selection. Load share occurs as before, similar to on a simple beam.

Considering sufficient safety for steel and concrete and equal loads each insert must resist a load of 2 × 14.53 kN = 29.06 kN at 45°.





<u>Insert selection:</u>
Following the calculations, we select two WILJA® 3 inserts with resistance of 36 kN.

See *Table 4*.

<u>Spacing, unit thickness and reinforcement</u>
Minimum spacing ($b + a$) for WILJA® Lifting Inserts is
WILJA® 3: a = min. 400 mm < 500 mm and
b = 800 mm < 2000 mm

Spacing required (see *Table 5*)

Minimum panel thickness (d) for WILJA® Lifting Inserts is
Outer panel d_1 = min. 80mm = 80 mm
Inner panel d_2 = min. 80mm = 100 mm

Thickness required (see *Table 5*)

The reinforcement for WILJA® Lifting Inserts must be 1.88 cm^2/m and with the diagonal pull of maximum 45° additional diagonal pull reinforcement becomes necessary.

Reinforcement required (see *Table 6*, *Table 7* and *Figure 7*)

The narrow section over the windows requires the WILJA® Lifting Insert to be bended to fit in. The specifications as cited in the chapter "Installation close to and above windows" together with the installation depth over openings must be considered. In this case here we have enough installation depth (E = 120 mm for WILJA® 3 z = 450 mm) and criteria is fulfilled.

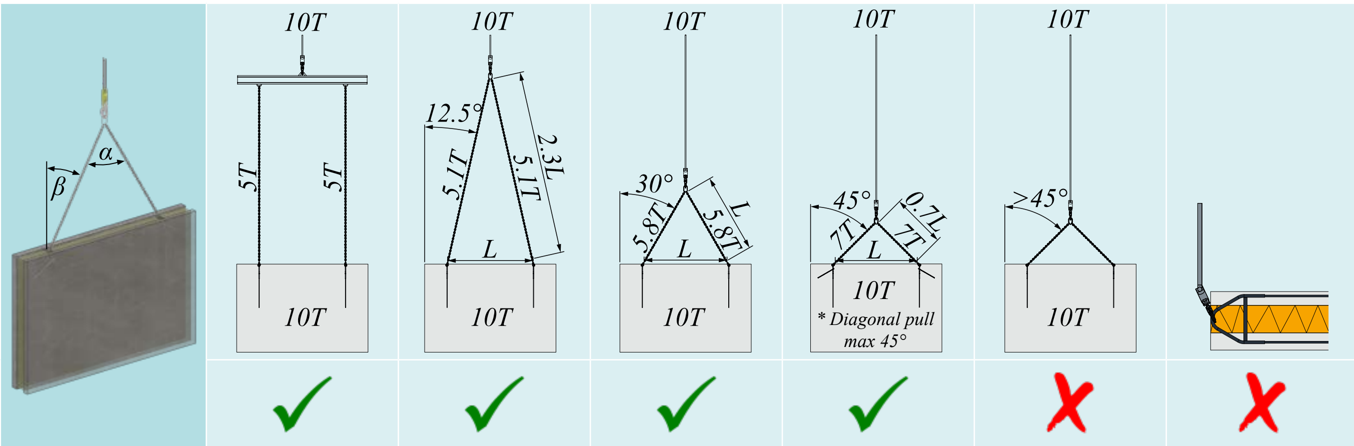
Table 9

Annex B – Quick selection

Quick selection tables for fast selection of correct WILJA® Lifting insert type

Conditions for use:

- 2 point lifting with slings/chains
- table values are dead weight in tons
- table valid for equal panel thickness
- ≥ 15 MPa concrete compressive strength
- hoisting coefficient considered with $\Psi_{dyn} = 1.3$
- diagonal pull already considered.



* Only with additional reinforcement.

Type	Load class	Spread angle	Inclination angle	$E < 180$	$E = 200$	$E = 220$	$E = 240$	$E = 260$	$E = 280$	$E = 300$
WILJA 2	24	$\alpha = 0$	$\beta = 0$	3.7	3.7	3.7	3.7	3.7	3.7	3.7
		$\alpha = 45$	$\beta = 22.5$	3.4	1.8	1.6	1.4	1.3	1.2	1.1
		$\alpha = 60$	$\beta = 30$	3.2	1.7	1.5	1.3	1.2	1.1	1.0
		$\alpha = 90$ [1]	$\beta = 45$ [1]	2.6	1.4	1.2	1.1	1.0	0.9	0.8
WILJA 3	36	$\alpha = 0$	$\beta = 0$	5.5	5.5	5.5	5.5	5.5	5.5	5.5
		$\alpha = 45$	$\beta = 22.5$	5.1	2.7	2.4	2.1	1.9	1.8	1.6
		$\alpha = 60$	$\beta = 30$	4.8	2.6	2.2	2.0	1.8	1.7	1.5
		$\alpha = 90$ [1]	$\beta = 45$ [1]	3.9	2.1	1.8	1.6	1.4	1.3	1.2
WILJA 4	48	$\alpha = 0$	$\beta = 0$	7.4	7.4	7.4	7.4	7.4	7.4	7.4
		$\alpha = 45$	$\beta = 22.5$	6.8	3.7	3.1	2.8	2.5	2.3	2.1
		$\alpha = 60$	$\beta = 30$	6.4	3.4	2.9	2.7	2.4	2.2	2.0
		$\alpha = 90$ [1]	$\beta = 45$ [1]	5.2	2.8	2.4	2.2	1.9	1.8	1.6
WILJA 5	72	$\alpha = 0$	$\beta = 0$	11.1	11.1	11.1	11.1	11.1	11.1	11.1
		$\alpha = 45$	$\beta = 22.5$	10.2	5.5	4.7	4.2	3.8	3.5	3.2
		$\alpha = 60$	$\beta = 30$	9.6	5.2	4.4	4.0	3.5	3.3	3.0
		$\alpha = 90$ [1]	$\beta = 45$ [1]	7.5	4.0	3.4	3.1	2.8	2.6	2.3
WILJA 6	109	$\alpha = 0$	$\beta = 0$	16.8	16.8	16.8	16.8	16.8	16.8	16.8
		$\alpha = 45$	$\beta = 22.5$	13.2	7.1	6.1	5.5	4.9	4.5	4.1
		$\alpha = 60$	$\beta = 30$	12.4	6.6	5.7	5.1	4.6	4.3	3.8
		$\alpha = 90$ [1]	$\beta = 45$ [1]	7.5	4.0	3.4	3.1	2.8	2.6	2.3

[1] only valid when additional reinforcement is installed (U-links)

Annex C – Declaration of conformity

peikko®

ENG / LT

CE	**EU Declaration of conformity according to Machine Directive 2006/42/EC, attachment II 1A** ES Atitikties deklaracija pagal mašinų direktyvos 2006/42/EC, priedą II 1A

The manufacturer / Gamintojas

Peikko Group Corporation
Voimakatu 3
15101 Lahti, FINLAND

declares that following products / pareiškia, kad šie gaminiai

Product name / Gaminio pavadinimas	WILJA® Lifting Insert / WILJA® kėlimo ankeris
Lifting Insert / Kėlimo ankeris	WILJA®
Material and surface / Medžiagos ir padengimas	stainless steel / nerūdijantis plienas; untreated / nevalytas
Lifting Key / Kėlimo kilpos	Standardized lifting keys / standartinės kėlimo kilpos
Thread size/ Sriegio dydis	WILJA® 2 / WILJA® 3 / WILJA® 4 / WILJA® 5 / WILJA® 6

comply due to conception and construction with the following cited regulations / atitinka dėl sampratos ir konstrukcinių nurodymų dėl šių nurodytų taisyklių reikalavimų

EU Machine Directive 2006/42/EC- ES Mašinų direktyva 2006/42/EC

Considered harmonized standards / Naudojami darnieji standartai

EN ISO 12100:2011-03 Safety of machinery-Generals principles for design – Risk assessment and risk reduction / EN ISO 12100:2011-03 Mašinų sauga. Bendrieji projektavimo principai. Rizikos vertinimas ir mažinimas
EN 13155:2020 Crane. Safety. Non-fixed load lifting attachments / EN 13155:2020 Kranai. Sauga. Netvirtinamoji krovinio kėlimo įranga

Other considered standards or specifications / Kiti naudojami standartai ar specifikacijos

VDI/BV-BS 6205:2012-04 Lifting inserts and lifting systems for precast concrete elements / VDI/BV-BS 6205:2012-04 Surenkamųjų betoninių elementų kėlimo įdėklai ir kėlimo įdėklų sistemos
DGUV Regel 100-101 Safety regulations for transport anchors and- systems of precast elements / DGUV Regel 100-101 Transporto inkarų ir surenkamųjų elementų sistemų saugos taisyklės
DGUV Regel 100-500 Use of work equipment chapter 2.8 / DGUV Regel 100-500 Darbo priemonių naudojimas, skyrius 2.8

Responsible commissioner for preparation and management of technical documentation is /
Už techinės dokumentacijos rengimą ir tvarkymą atsakingas gamintojo atstovas

Mr. Sebastian Gonschior,
R&D Engineer, Peikko Group Corporation

Lahti 18.03.2024

Žygimantas Kačinskas
Quality Manager
Peikko Group Corporation

PEIKKO GROUP OY

NOTES

Technical Manual Revisions

Version: PEIKKO GROUP 04/2024. Revision: 003

- Update of application information
- Quick dimension tables added
- Several content updates.

Version: PEIKKO GROUP 11/2020. Revision: 002

- PNLF name changed to WILJA®
- CE-marking according to EU Machinery Directive 2006/42/EC and a series of concrete tests.

Version: PEIKKO GROUP 03/2007. 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.

peikko.com/design-tools

TECHNICAL SUPPORT

Our technical support teams around the world are available to assist you with all of your questions regarding design, installation etc.

peikko.com/technical-support

APPROVALS

Approvals, certificates and documents related to CE-marking (DoP, DoC) can be found on our websites under each products' product page.

peikko.com/products

EPDS AND MANAGEMENT SYSTEM CERTIFICATES

Environmental Product Declarations and management system certificates can be found at the quality section of our websites.

peikko.com/qehs