TECHNICAL MANUAL

WRA Lifting System

For safe and efficient lifting of precast concrete elements

Version PEIKKO GROUP 05/2023

peikko®

WRA Lifting System

For safe and efficient lifting of precast concrete elements

The WRA Lifting System is used in applications such as beams, massive concrete slabs, or elements with sufficient concrete thickness. The system is designed for rapid coupling and release. Once the concrete has sufficient strength and the formwork is removed, the WRA Lifting Inserts in the precast element may be directly attached with the crane hooks.

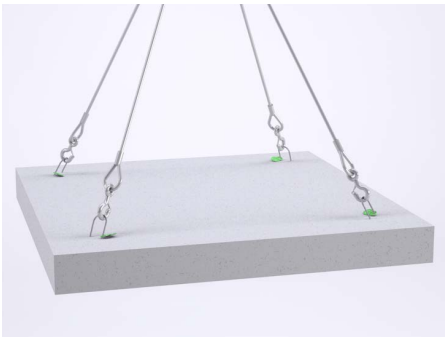
WRA Lifting Inserts are the best solution for very heavy elements of up to 99 tons per lifting point.

- Requires no lifting clutch
- Available in standard sizes up to 25 tons, special sizes up to 99 tons
- Ideal for precast concrete units with unexposed sides after lifting
- Color coding and individual serial numbering on the tag
- Protruding loops can be cut off or covered in concrete

WRA Lifting Inserts are only permitted for straight and angled pull up to a maximum of 45°.

All Peikko Lifting Systems are designed and manufactured in accordance with EU Machinery Directive 2006/42/EC and VDI/BV-BS 6205.

Product safety in use has been verified by a series of tests conducted in cooperation with the Technical University of Darmstadt.



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About WRA Lifting System

1. Product properties

The WRA Lifting System is a lifting insert system designed for lifting and handling precast concrete elements. It meets the requirements of the European machinery directive (2006/42/EC) in relation to the steel load capacity of the lifting systems mentioned in the directive. The VDI/BV-BS 6205:2012 requirements (national German rule: “Lifting inserts and lifting insert systems for precast concrete elements”) ensure that lifting systems that are cast into concrete can be used safely and have sufficient resistance against concrete failure.

WRA Lifting Insert systems are intended to enable concrete elements to be transported and installed with temporarily fastening lifting keys. Applications that require permanent load or that affect the stability of a building are not included in this range of applications.

WRA Lifting Insert systems consist of a WRA Lifting Insert that is permanently anchored in the precast element. A corresponding lifting key such as lifting hook or shackle hooks temporarily onto the protruding part. *Figure 1* is an overview of the WRA Lifting System.

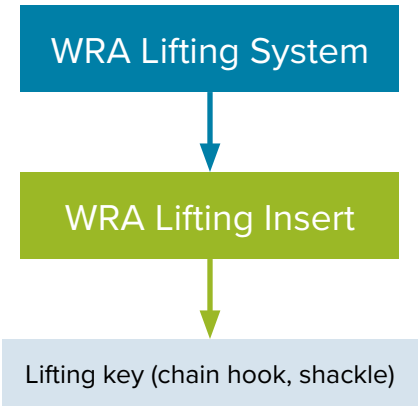


Figure 1. WRA Lifting System overview.

WRA Lifting System introduction

The WRA Lifting System consists of wire rope WRA Lifting Inserts that protrude out of the element and enable efficient handling of precast elements. To guarantee safe and reliable handling during all stages of transportation the system has been tested for use all year round.

The WRA Lifting System consists of just one part: the WRA Lifting Insert. It is used for applications such as beams or massive concrete elements where there is usually sufficient surrounding concrete. All WRA Lifting Inserts are cast into concrete elements to enable the elements to be lifted after the concrete hardens. The Lifting Key (chain hook or shackle) goes straight into the WRA Lifting Insert. This guarantees rapid and efficient handling.

Figure 2. WRA Lifting Insert.

WRA color-coding system

Peikko's WRA Lifting System has a color code for every load class, as shown in *Table 1* and *Figure 3*. This helps the user to allocate the right load class.

Table 1. The WRA Lifting System's color codes.

Item no.	Load class	Color
WRA-0.8Z	800	White
WRA-1.2Z	1,200	Red
WRA-1.6Z	1,600	Purple
WRA-2.0Z	2,000	Light green
WRA-2.5Z	2,500	Black
WRA-4.0Z	4,000	Green
WRA-5.2Z	5,200	Yellow
WRA-6.3Z	6,300	Light blue
WRA-8.0Z	8,000	Gray
WRA-10.0Z	10,000	Pink Metallic
WRA-12.5Z	12,500	Yellow
WRA-16.0Z	16,000	Lilac
WRA-20.0Z	20,000	Beige
WRA-25.0Z	25,000	Brown
WRA-28.0Z	28,000	White
WRA-32.0Z	32,000	Black
>WRA-37.0Z - WRA-99.0Z	>37,000 – 99,000	Orange

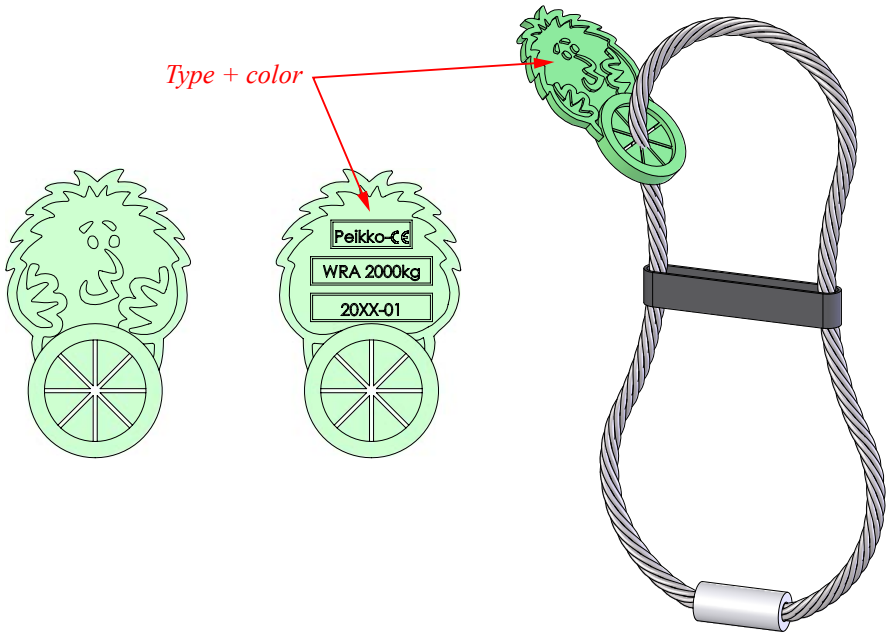


Figure 3. Color codes and marking information.

Peikko WRA Lifting Inserts have a colored tag that is connected to the wire and protrudes from the surface. The marking and the tag provide the user with information about the manufacturer, the load class, the load direction, the type and size, CE marking, and production date (tags only). *Figure 4* shows this marking system.

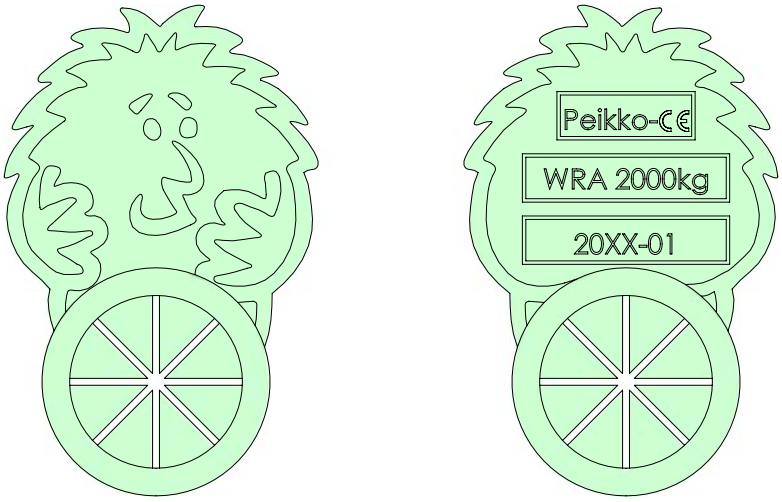


Figure 4. Marking information on the tag.

To enable the product to be identified after casting, the WRA Lifting Inserts must be installed in such a way that the colored tag is always visible in the protruding loop. *Figure 5* shows the installation detail.

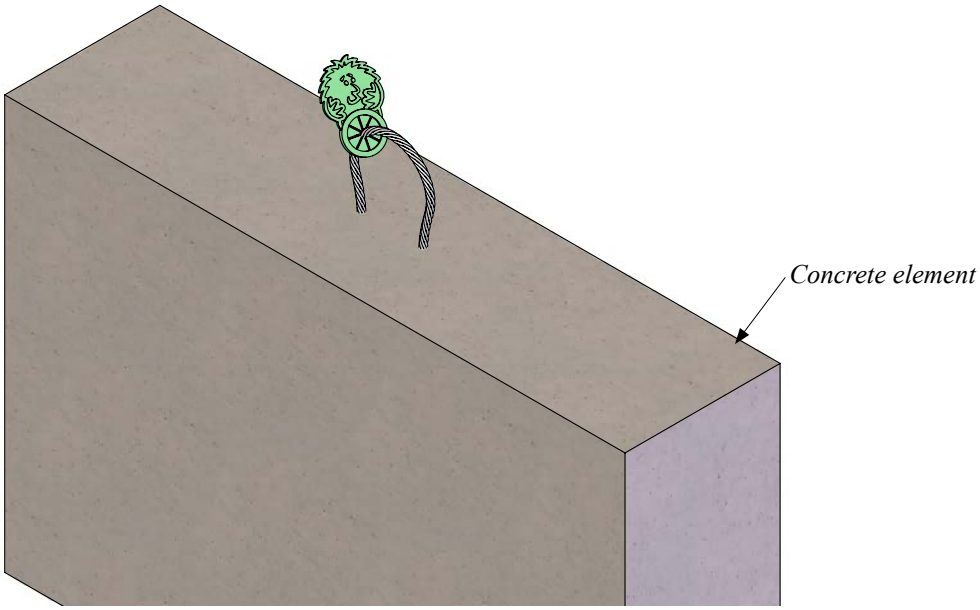


Figure 5. Tag always visible after installation.

1.1 Standard WRA Lifting Inserts

WRA Lifting Inserts are used in applications such as beams or massive concrete slabs or elements where sufficient surrounding concrete is present. This section describes the product properties of standard WRA products. Peikko's standard products are delivered with a galvanized wire rope finish. All dimensions given in this section are valid for all finishes equally.

WRA Lifting Inserts are ideal for all types of lifting operation. Only the WRA Lifting Insert is needed and no special accessories are required. A standard chain hook or shackle can be used to connect the parts together.

WRA-2.0Z: WRA Lifting Insert galvanized with load class 2000 (standard item)
WRA-2.0: WRA Lifting Insert black with load class 2000 (available upon request)

1.1.1 Dimensions and weights of system components

WRA Lifting Inserts are available in standard dimensions and weights, which are shown in *Table 2* and *Figure 6*. Inserts with customized lengths for special purposes are available upon request.

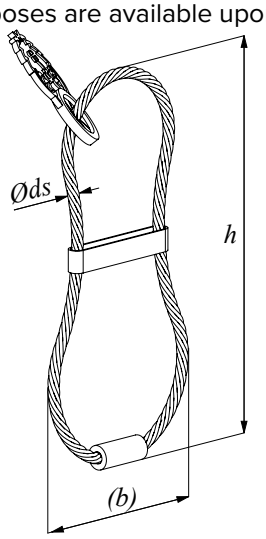


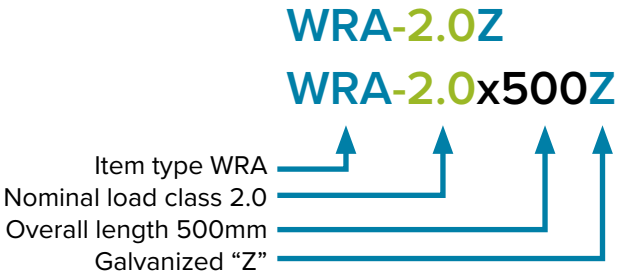
Figure 6. Standard WRA Lifting Inserts.

Table 2. Dimensions and weights of standard WRA Lifting Inserts.

Item No.	Load class	*h*	*b*	*Øds*	Color code	Weight
		[mm]	[mm]	[mm]	[-]	[kg/pcs]
WRA-0.8Z	800	210	100	6	White	0.13
WRA-1.2Z	1200	225	110	7	Red	0.18
WRA-1.6Z	1600	235	120	8	Purple	0.24
WRA-2.0Z	2000	280	130	9	Light green	0.34
WRA-2.5Z	2500	315	140	10	Black	0.45
WRA-4.0Z	4000	340	150	12	Green	0.67
WRA-5.2Z	5200	360	160	14	Yellow	0.97
WRA-6.3Z	6300	390	195	16	Light blue	1.42
WRA-8.0Z	8000	440	250	18	Gray	2.08
WRA-10.0Z	10000	525	270	20	Pink Metallic	2.93
WRA-12.5Z	12500	570	300	22	Yellow	3.88
WRA-16.0Z	16000	615	330	24	Lilac	4.94
WRA-20.0Z	20000	730	360	28	Beige	7.74
WRA-25.0Z	25000	800	390	32	Brown	11.09

Order example for Peikko WRA Lifting Inserts. All standard WRA Lifting Inserts have a galvanized wire rope.

Item type with galvanized wire rope with standard length.



PLEASE NOTE:
Selecting items such as WRA-2.0Z or WRA-2.0 galvanized 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: WRA-2,0×L (L in mm). This method can be applied to all other WRA Lifting Inserts.

1.1.2 Safe working loads for standard WRA Lifting Inserts

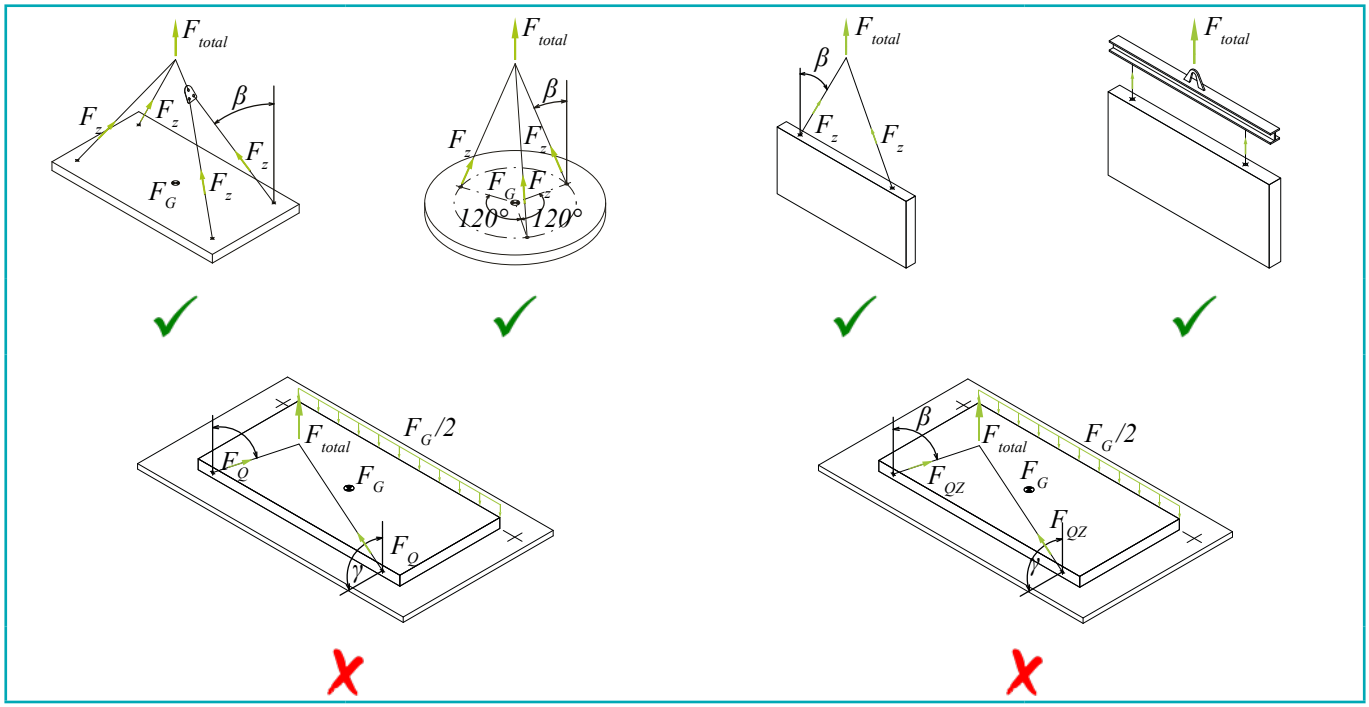
The resistance of the WRA Lifting System is determined by a design concept that refers to the following standards and regulations:

- EN1992-1-1:2011
- Machinery directive 2006/42/EC
- VDI/BV-BS6205:2012

The load capacities depend very much on how and in which load direction the WRA Lifting Insert will be used. They are shown in *Table 4* and are based on specific dimensions and edge distances as given in the following sections. Before selecting the WRA Lifting Insert, ensure that the selected WRA Lifting Insert is suitable for the planned load direction and consider the selection assumptions in this manual. **The minimum compressive strength of the concrete at the moment of load application is 15MPa.**

Table 3 and *Figure 7* show the permissible load directions for WRA Lifting Inserts.

Table 3. Permissible lifting actions for standard WRA Lifting Inserts.



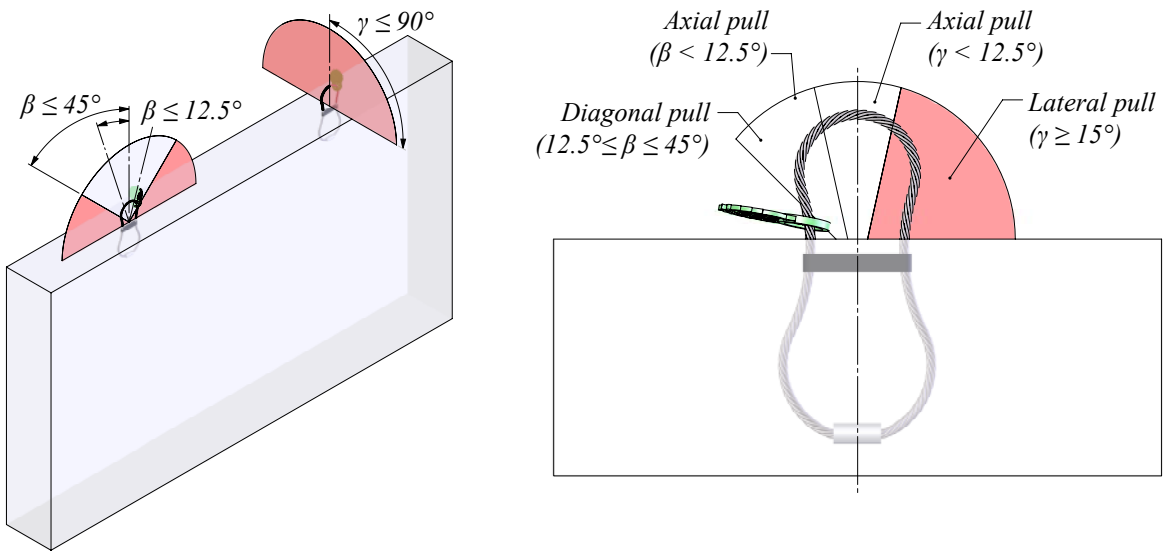


Figure 7. Load directions for standard WRA Lifting Inserts.

Table 4. Safe working load (R_{zul}) for standard WRA Lifting Inserts.

Item No.	Load class	R_{zul} [kN] for standard WRA Lifting Inserts at concrete strength of											
		15MPa			20MPa			25MPa			30MPa		
		0°-12.5°	12.5°-30°	30°-45°	0°-12.5°	12.5°-30°	30°-45°	0°-12.5°	12.5°-30°	30°-45°	0°-12.5°	12.5°-30°	30°-45°
WRA-0.8Z	800	7.4	5.2	3.9	8.0	6.0	4.6	8.0	6.7	5.1	8.0	7.3	5.6
WRA-1.2Z	1200	11.1	7.8	5.9	12.0	9.0	6.8	12.0	10.0	7.6	12.0	11.0	8.4
WRA-1.6Z	1600	16.0	11.9	9.3	16.0	13.7	10.7	16.0	15.3	12.0	16.0	16.0	13.2
WRA-2.0Z	200	20.0	15.6	12.4	20.0	18.0	14.3	20.0	20.0	16.0	20.0	20.0	17.5
WRA-2.5Z	250	25.0	19.8	16.0	25.0	22.8	18.4	25.0	25.0	20.6	25.0	25.0	22.6
WRA-4.0Z	4000	40.0	29.6	24.3	40.0	34.2	28.1	40.0	38.3	31.4	40.0	40.0	34.4
WRA-5.2Z	5200	52.0	41.3	33.8	52.0	47.7	39.1	52.0	52.0	43.7	52.0	52.0	47.9
WRA-6.3Z	6300	62.5	47.5	39.0	63.0	54.9	45.0	63.0	61.3	50.3	63.0	63.0	55.1
WRA-8.0Z	8000	78.6	62.1	50.9	80.0	71.7	58.8	80.0	80.0	65.7	80.0	80.0	72.0
WRA-10.0Z	10000	100.0	83.6	68.5	100.0	96.5	79.1	100.0	100.0	88.4	100.0	100.0	96.9
WRA-12.5Z	12500	117.0	97.1	79.6	125.0	112.1	91.9	125.0	125.0	102.8	125.0	125.0	112.6
WRA-16.0Z	16000	135.9	119.5	98.0	156.9	138.0	113.2	160.0	154.3	126.6	160.0	160.0	138.6
WRA-20.0Z	20000	177.7	163.5	134.0	200.0	188.7	154.8	200.0	200.0	173.0	200.0	200.0	189.6
WRA-25.0Z	25000	198.3	186.4	152.8	228.9	215.2	176.5	250.0	240.6	197.3	250.0	250.0	216.1

PLEASE NOTE:
Diagonal pull up to 45° is admissible. **No lateral pull** resulting from the tilt-up process is permissible.

1.1.3 Unit geometry and spacing

The use of Peikko Lifting Systems requires a specific element geometry. The load capacities given in this manual are based on specific dimensions and edge and axial distances. The safety factors can only be ensured as described if the geometric specifications are complied with. Before selecting and installing an insert consider the general information in the following sections of this manual.

WRA Lifting Inserts are commonly used in concrete elements with sufficient surrounding concrete. There is no special assembly direction requirement parallel or perpendicular to the element. Capacities are limited by the element thickness or the concrete strength. The minimum element thickness, edge distance, and axial distance for WRA Lifting Inserts is shown in *Figure 8* and in *Table 5*.

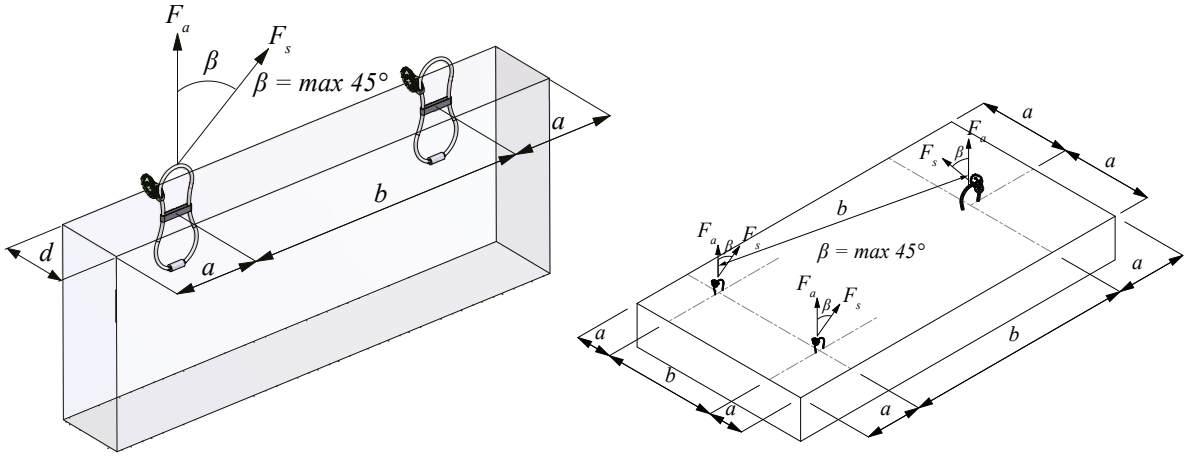
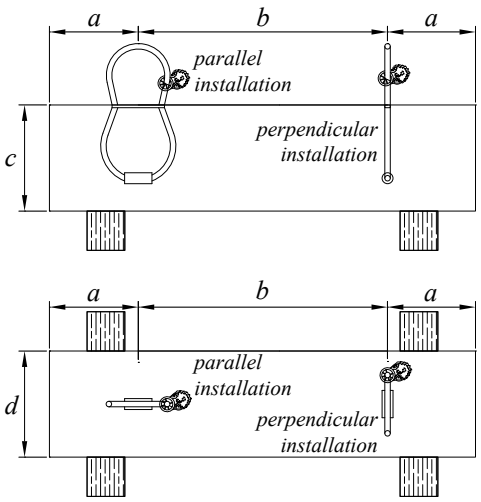


Figure 8. Geometry requirements for WRA Lifting Inserts.

Table 5. Minimum unit geometry for standard WRA Lifting Inserts.

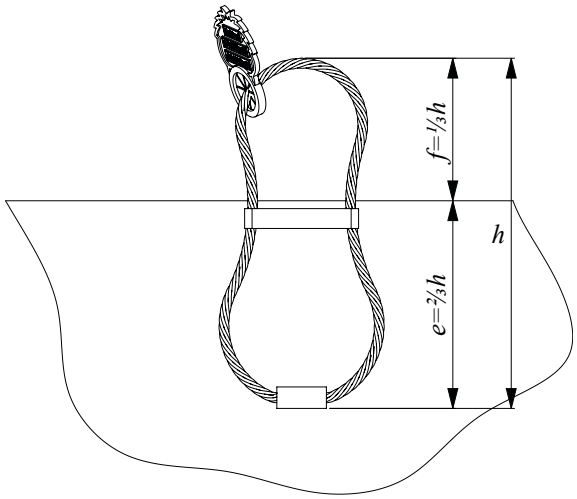
Item No.	*d*	*c*	*a*	*b*
	[mm]	[mm]	[mm]	[mm]
WRA-0.8Z	70	180	215	430
WRA-1.2Z	90	190	230	460
WRA-1.6Z	120	195	235	470
WRA-2.0Z	140	230	285	570
WRA-2.5Z	160	260	330	660
WRA-4.0Z	200	270	345	690
WRA-5.2Z	290	290	370	740
WRA-6.3Z	320	310	400	800
WRA-8.0Z	400	350	450	900
WRA-10.0Z	440	420	560	1120
WRA-12.5Z	500	450	600	1200
WRA-16.0Z	620	480	640	1280
WRA-20.0Z	680	580	785	1570
WRA-25.0Z	750	630	850	1700



WRA Lifting Inserts must be installed into concrete elements at the depths shown in *Table 6*.

Table 6. Installation details for standard WRA Lifting Inserts.

Item No.	*h*	*e*	*f*
	[mm]	[mm]	[mm]
WRA-0.8Z	210	150	60
WRA-1.2Z	225	160	65
WRA-1.6Z	235	165	70
WRA-2.0Z	280	200	80
WRA-2.5Z	315	230	85
WRA-4.0Z	340	240	100
WRA-5.2Z	360	260	100
WRA-6.3Z	390	280	110
WRA-8.0Z	440	320	120
WRA-10.0Z	525	390	135
WRA-12.5Z	570	420	150
WRA-16.0Z	615	450	165
WRA-20.0Z	730	550	180
WRA-25.0Z	800	600	200



WRA Lifting Inserts geometry and installation requirements

PLEASE NOTE:
The geometry specification requires that the installation be within the tolerances as defined in the section entitled “Installation of the WRA Lifting System”.

1.1.4 Reinforcement for standard WRA Lifting Inserts

The WRA Lifting System requires a minimum level of reinforcement in the concrete elements. The reinforcement that is defined by the structural design can be considered by taking into account the existing cross-section. The required reinforcement level 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 reinforcement must be removed or cut to install the WRA 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.

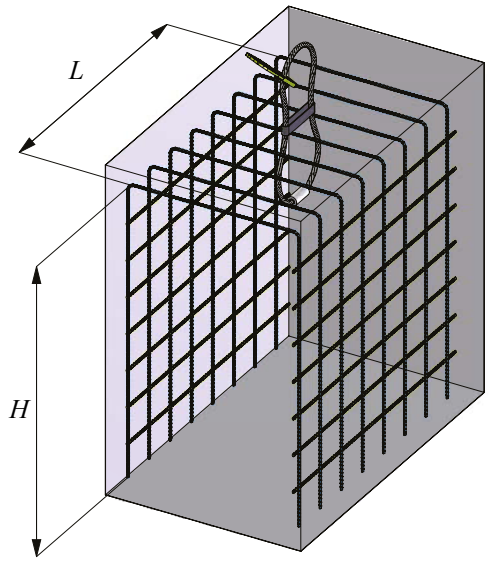
WARNING:
Always ensure that reinforcement is sufficient – make precise calculations. Too little reinforcement can result in severe accidents and collapsing elements.

The reinforcement described in this section supports only the load impact of the WRA Lifting System 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 required to prevent the element from cracking. This must be defined separately. Surface reinforcement (mm^2/m) must be considered and installed cross wise for each element direction.

For WRA Lifting Inserts, the required surface reinforcement must be at least equal to that shown in *Table 7*.

Table 7. Reinforcement for standard WRA Lifting Inserts.

Item No.	Surface reinforcement	Min. *L*	Min. *H*
	[mm²/m]	[mm]	[mm]
WRA-0.8Z	188	400	250
WRA-1.2Z	188	450	300
WRA-1.6Z	188	500	350
WRA-2.0Z	188	550	350
WRA-2.5Z	188	650	450
WRA-4.0Z	188	700	500
WRA-5.2Z	257	800	550
WRA-6.3Z	257	950	600
WRA-8.0Z	257	1050	700
WRA-10.0Z	257	1200	800
WRA-12.5Z	257	1300	900
WRA-16.0Z	424	1500	1000
WRA-20.0Z	424	1700	1150
WRA-25.0Z	524	1950	1300



WRA Lifting Inserts reinforcement requirements

1.2 Heavy duty WRA Lifting Inserts

Heavy duty WRA Lifting Inserts are used in applications such as bridge beams, massive retaining wall elements, or other massive precast elements. This section gives an overview of the dimensions and standard sizes of heavy duty WRA Lifting Inserts. All dimensions given in this section are valid for all finishes equally.

Heavy duty WRA Lifting Inserts are ideal for all types of lifting operation. Only the WRA Lifting Insert is needed and no special accessories are required. A standard chain hook or shackle can be used to connect the parts together.

WRA-57.0Z: heavy duty WRA Lifting Insert galvanized with load class 57000 (standard version)
WRA-57.0: heavy duty WRA Lifting Insert black with load class 57000 (available upon request)

1.2.1 Dimensions and weights of system components

Heavy duty WRA Lifting Inserts are available in standard dimensions and weights, which are shown in *Table 8* and *Figure 9*. This information is valid for all finishes. Inserts with customized lengths for special purposes are available upon request.

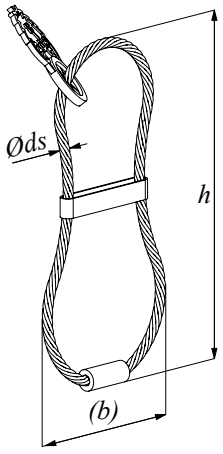


Figure 9. Heavy duty WRA Lifting Inserts.

Table 8. Dimensions of heavy duty WRA Lifting Inserts.

Item No.	*h*	*b*	*Ød s* *	Color code	Weight
	[mm]	[mm]	[mm]	[-]	[kg]
WRA-28.0Z	800	390	32	White	11.2
WRA-32.0Z	890	390	32	Black	15.3
WRA-37.0Z	950	400	40	Orange	20.2
WRA-42.0Z	1000	420	40	Orange	21.2
WRA-47.0Z	1100	440	44	Orange	28.1
WRA-52.0Z	1200	460	48	Orange	36.4
WRA-57.0Z	1350	500	48	Orange	40.4
WRA-65.0Z	1430	600	50	Orange	51.4
WRA-75.0Z	1530	700	56	Orange	65.0
WRA-85.0Z	1680	750	56	Orange	70.6
WRA-99.0Z	1800	800	56	Orange	86.8

* Rope diameter may vary according to rope construction and availability.

1.2.2 Safe working loads for heavy duty WRA Lifting Inserts

The resistance of the heavy duty WRA Lifting System is determined by a design concept that must be designed and evaluated for every individual application.

The load capacities depend very much on how and in which combination the different items will be used. Heavy duty WRA Lifting Inserts are customized by Peikko's Customer Engineering for the specific application. Due to the variety of influences and changing geometry, no fixed installation geometry is published.

PLEASE NOTE:
Diagonal pull of up to 30° is permissible for heavy duty WRA Lifting Inserts. No lateral pull resulting from the tilt-up process is permissible.

1.2.3 Reinforcement for heavy duty WRA Lifting Inserts

The use of WRA Lifting Systems requires a minimum level of reinforcement in the concrete elements. The reinforcement that is defined by the structural design can be considered by taking into account the existing cross-section. The required reinforcement can be attached using single reinforcing bars or a wire mesh with an equivalent or greater cross-section (mm^2/m or cm^2/m). If the reinforcement must be removed or cut to install the 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:
Always check that sufficient reinforcement is designed and installed. Too little reinforcement can result in severe accidents and collapsing elements.

The reinforcement for your individual application must be designed by a structural engineer or by Peikko's Customer Engineering.

1.3 Safety information for standard and heavy duty WRA Lifting Inserts

1.3.1 Storage situation

Lifting components must be stored and protected in dry conditions, preferably under a roof. *Figure 10* shows a suitable storage location.

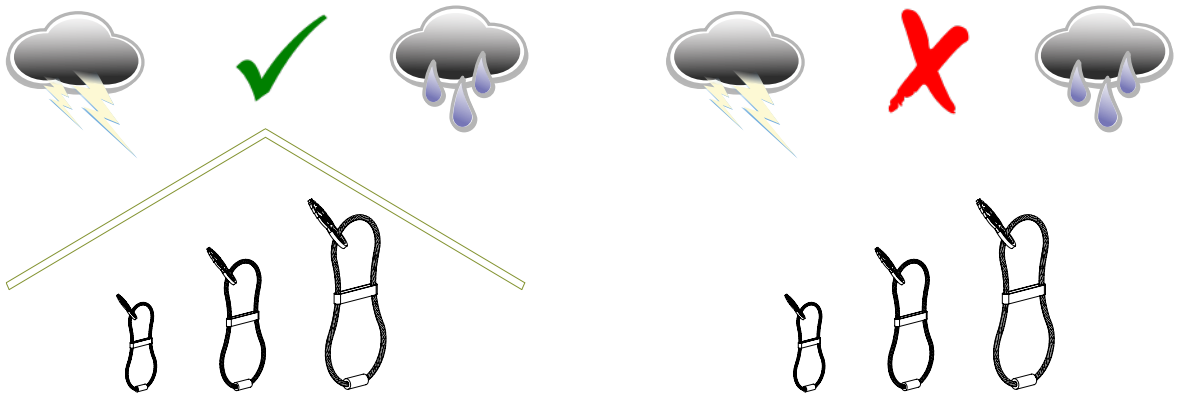


Figure 10. Storage location.

WARNING:
WRA Lifting Inserts 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.

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

All WRA Lifting Inserts provided by Peikko are intended for lifting processes. Never use WRA Lifting Inserts for lashing or for fixing loads onto trucks as this may cause damage to the inserts, leading to a reduced service life.

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

WARNING:

- Operate all WRA Lifting Inserts manually. Do not use any tools such as bars or claws.
- Hook in all lifting keys freely without requiring force. If this is not possible, check for damage to the hook safety lash or the presence of obstructions.
- Inspect the WRA Lifting Insert visually before use.
- Check and clean all WRA Lifting Inserts before use.
- Use WRA Lifting Inserts only in appropriate environmental conditions.
- Keep in mind local regulations for safe lifting and hoisting at all times and consider the design assumptions described in this manual.

1.3.2 Lifting radius

When using WRA Lifting Inserts made from wire, ensure that the hook or bolt going through the rope loop always has a radius of at least 2.5*ds*, where ds is the existing rope diameter as illustrated in *Figure 11*. This prevents loss of rope capacity due to the combined tension and pressure forces.

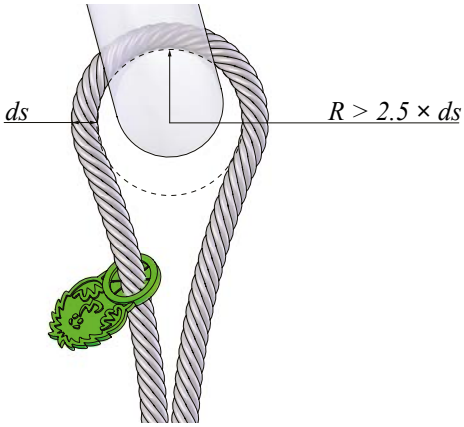


Figure 11. Minimum radius of wire.

2. Selecting lifting systems

Regulations such as VDI/BV-BS 6205:2012 (national German rule: “Lifting inserts and lifting insert systems for precast concrete elements”) govern lifting systems. According to the definition, lifting systems consist of a WRA Lifting Insert, permanently anchored in the precast element, and the corresponding lifting key, which hooks temporarily onto the embedded lifting insert. *Figure 12* shows this definition in an overview of the WRA system.

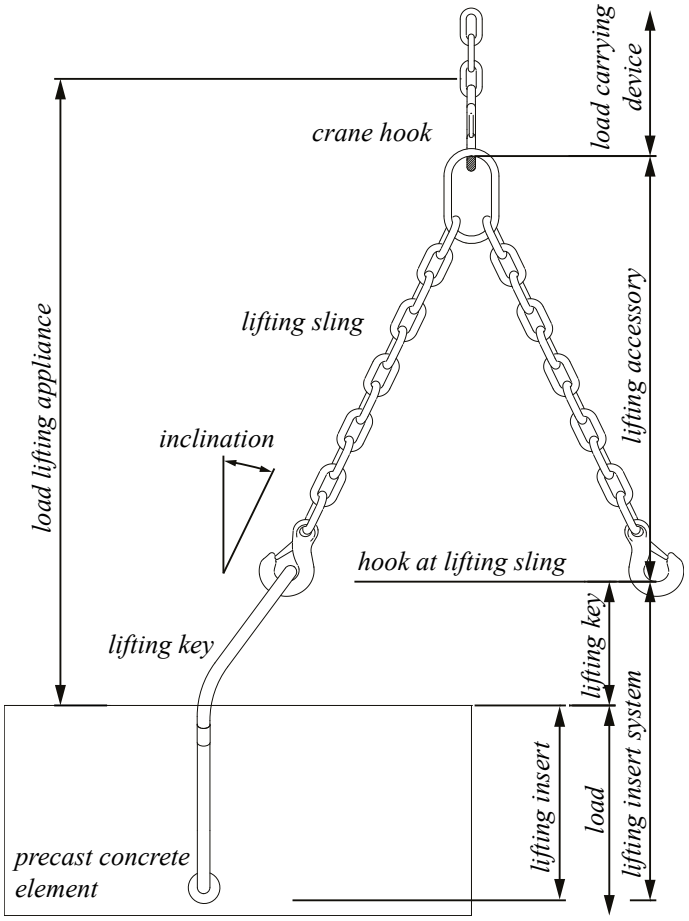


Figure 12. Definition of a lifting system according to VDI/BV-BS6205:2012.

Elements that are parts of lifting accessory or load carrying device shown in *Figure 12* are not documented here. The structural behavior of lifting systems depends on multiple factors. These design assumptions and impacts are given in the following sections.

2.1 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 taken into account. **The concrete must have a compressive strength of at least 15MPa prior to any lifting operations. During temporary conditions the concrete often limits safe working loads.**

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

2.2 Safety 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.

2.3 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 13* shows examples of such transportation systems.

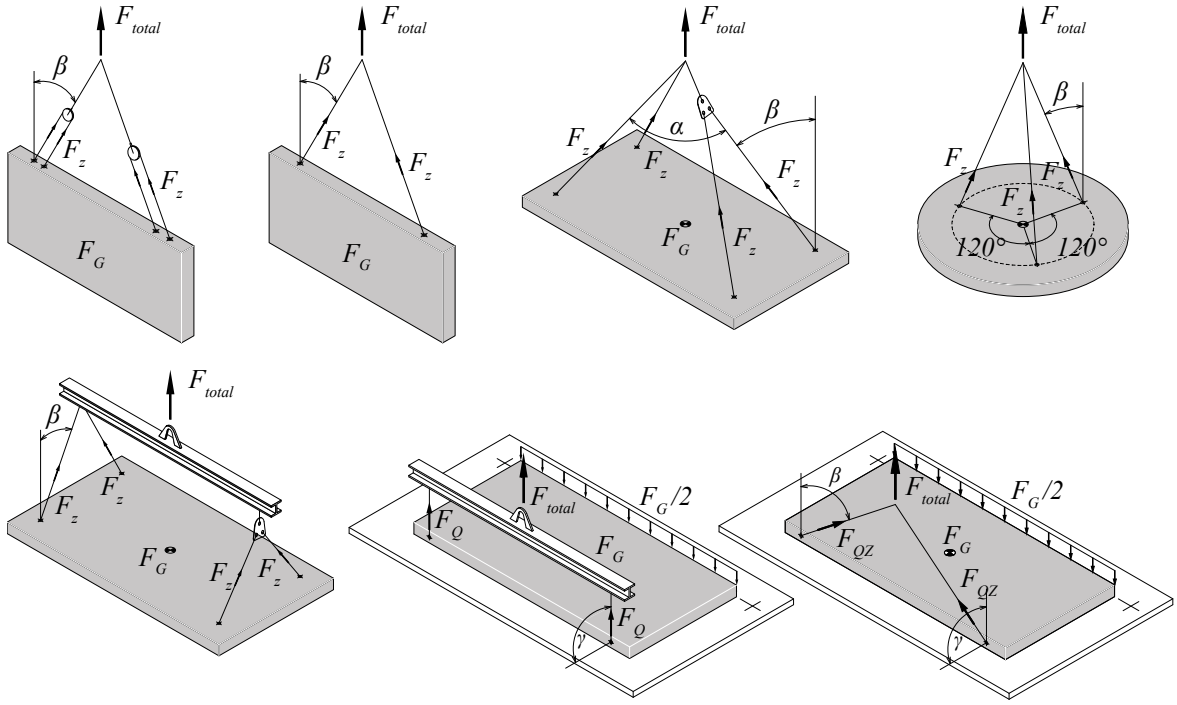


Figure 13. Balanced lifting conditions.

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 14* shows examples of such transportation systems.

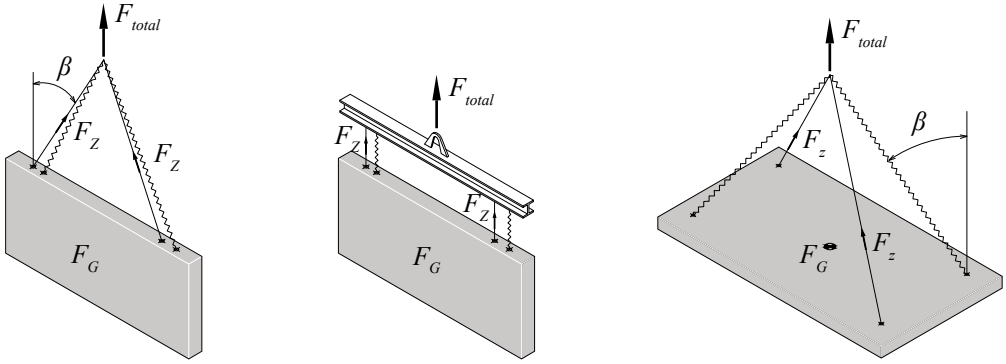


Figure 14. Imbalanced lifting conditions.

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.**

Using tolerance-compensating equipment such as (but not limited to) seesaws or lifting beams allows 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 15* shows such an application.

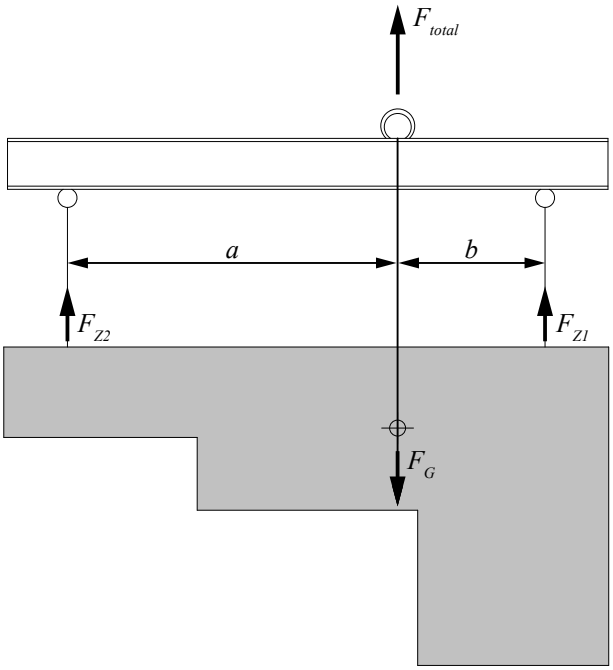


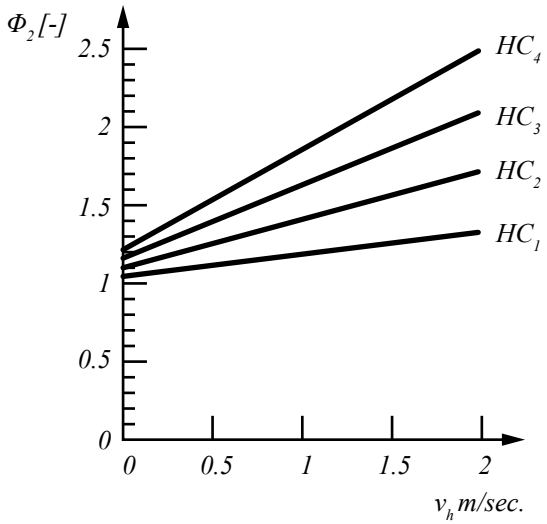
Figure 15. Asymmetrical insert layout.

2.4 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 it is chosen depending on the hoist class of the crane (according to EN 13001-2) 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 the dynamic factor are given in section 2.9 (Selecting a lifting system).

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

Depending on the individual hoisting class (HC_1 to HC_4) for cranes, the minimum hoisting coefficient (ϕ_2) for cranes can be taken from *Figure 16*, which shows the development of the hoisting coefficient related to hoisting speed (according EN 13001-2) where ϕ_2 = dynamic coefficient and v_h = hoisting speed. Reference values for hoisting equipment are introduced in *Table 10*.



ϕ_2 = dynamic coefficient [-] for hoisting operations of cranes acc. EN13001-2. When ϕ_2 is unknown or not to determine, reference values of Ψ_{dyn} acc. Table 10 must be taken.

Figure 16. Hoisting coefficient development.

2.5 Mold adhesion

When lifting concrete units out of the mold there is an adhesion force between the element and mold. 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 the 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 formwork (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 section 2.9 (Selecting a lifting system).

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

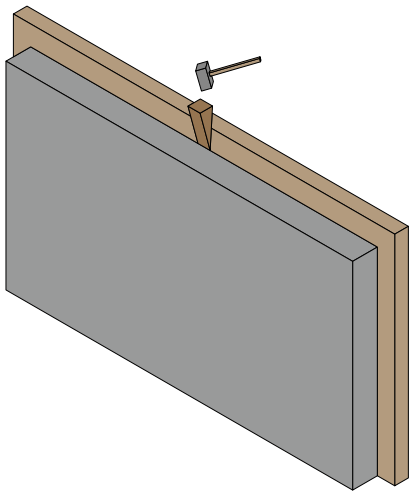


Figure 17. Lowering the adhesion forces.

For slabs with a regular distribution of lifting inserts it may be helpful to first lift up with two of the four installed inserts. This lowers adhesion forces all over the contact area with the formwork. Thereafter, there will be no adhesion forces and the lifting can take place on all four inserts.

2.6 Element weight

According to EN 1991-1-1:2010, 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.

2.7 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.

It is clear that 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, four 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.
- **Lateral tension:** occurs when lifting with a beam perpendicular to the longitudinal direction of the insert axis. This is the preferred method of demolding elements and lifting them from the horizontal to the vertical direction. This is only possible with certain unit thicknesses due to the perpendicular load impact on the unit thickness.
- **Diagonal lateral tension:** occurs when lifting with a chain perpendicular to and under an angle of inclination longitudinal to the insert axis. This is very similar to lateral tension but carried out with a chain instead of a beam. This is only possible with certain unit thicknesses due to the almost perpendicular load impact on the unit thickness.

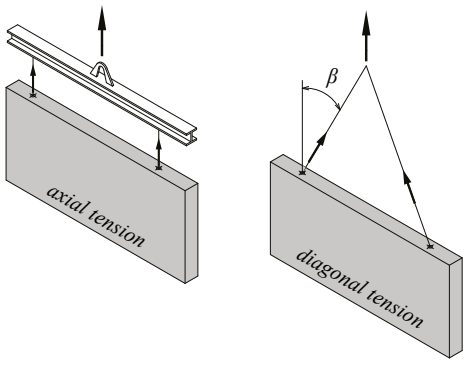


Figure 18. Load directions during hoisting.

The load increase depends on the chain inclination, which is defined by the angle "β" to the vertical. For standard WRA Lifting Inserts, the maximum angle to the vertical is 45° and for heavy duty WRA inserts 30°. Greater angles are not permissible due to excess load increase.

The relationship of the inclination angle to the load increase 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 requires additional reinforcement when the inclination angle "β" is >12.5°.

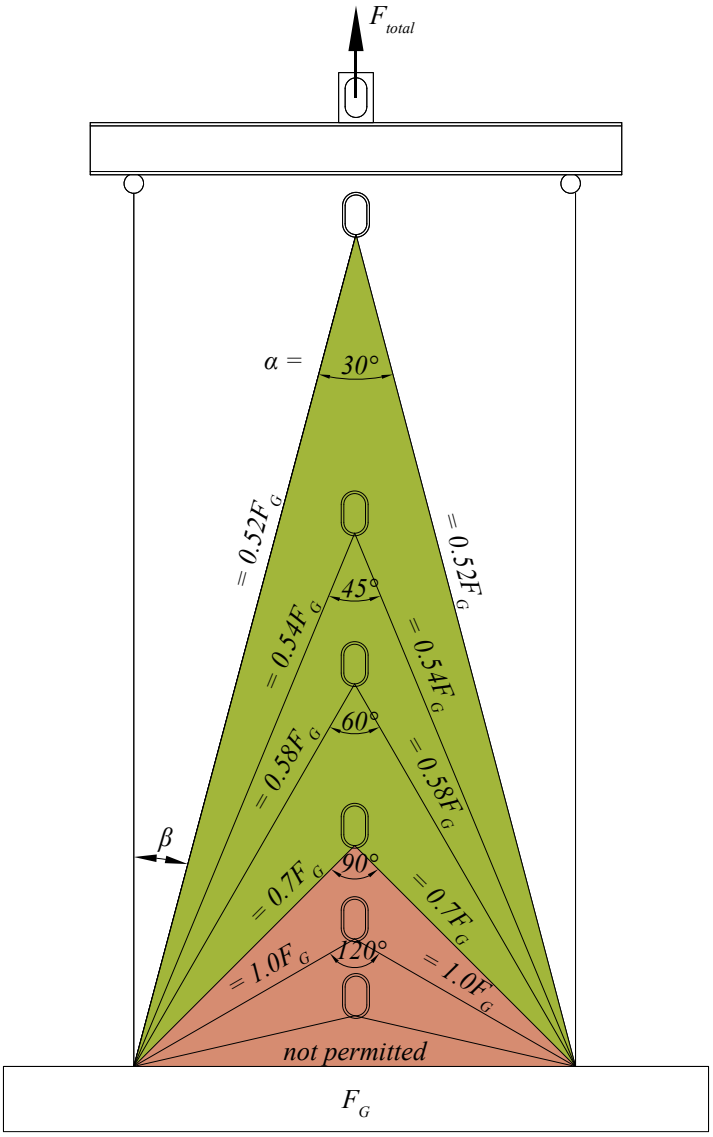


Figure 19. Load increase during hoisting.

Precast concrete elements are very often produced horizontally on casting tables. After concrete hardening, elements such as walls must be lifted from a horizontal to a vertical position. In many cases, no special tilt-up equipment, such as tilt-up tables or special tilt-up machinery, is available. In such cases, the insert installed in the front end assumes only half of the loads during the tilt-up process. This results from the fact that half of the element's weight remains on the casting table and half is taken by the installed lifting system. For this type of lifting procedure (lateral tension or diagonal lateral tension), the lifting system must be provided with additional reinforcement.

Additional reinforcement can be left out when the inclination angle "γ" is < 15° and a tilt-up table is used (see *Figure 20*).

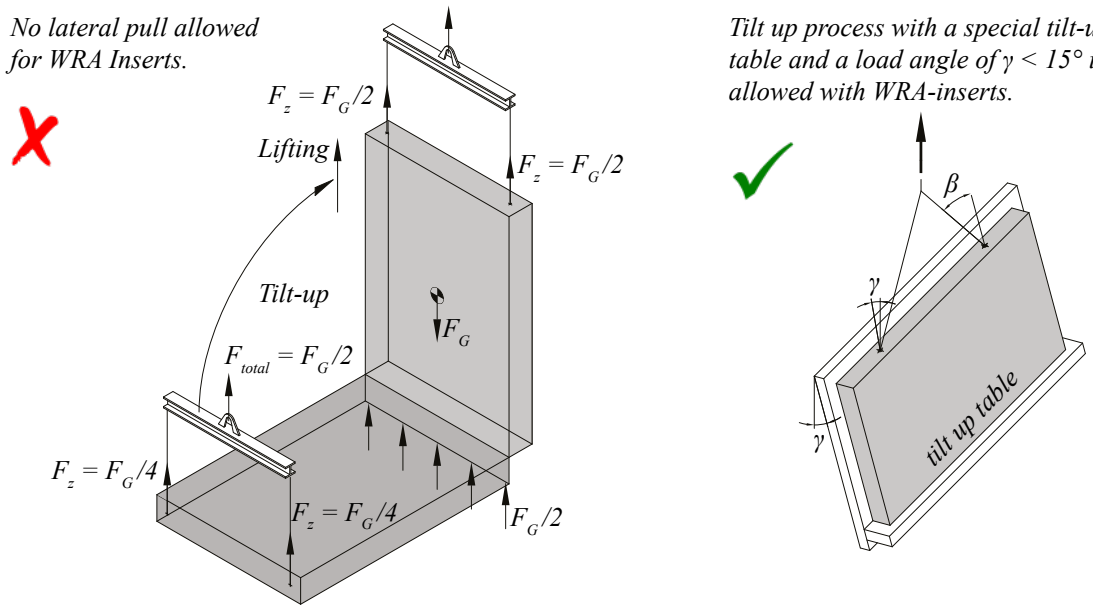


Figure 20. Hoisting procedure from horizontal to vertical.

2.8 Load transfer to concrete

Lifting systems anchor the load into the concrete with different methods of load impact. This can happen by

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

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

The engineer must design concrete elements 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.

2.9 Selecting a lifting system

Before selecting a lifting system, the user must know which system parts should be used.
The lifting system is one of the most important factors in ensuring a safe transportation process.

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

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. Engineer 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 into account 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

All of 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 formulae.

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 23*. It shall be determined as given by

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

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]

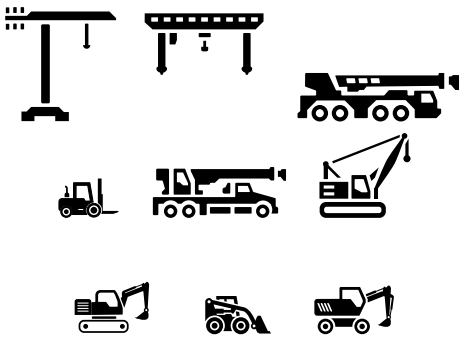
Table 9. Reference values for mold adhesion according to VDI/BV-BS6205:2012.

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 10* shows example hoisting coefficients for different hoisting equipment.

Table 10. Coefficient for different hoisting equipment according to VDI/BV-BS6205:2012.

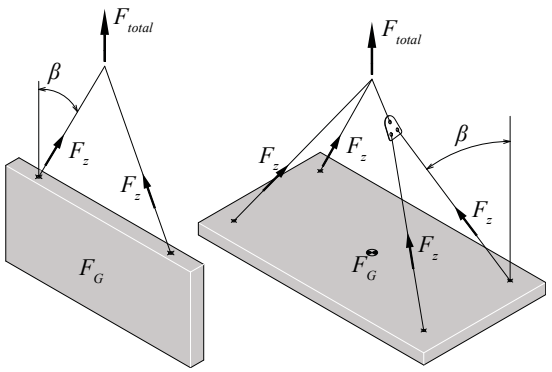
Hoist equipment (class)	Dynamic factor Ψ_{dyn}
Tower crane, portal crane, mobile crane	1.30
Lifting and moving on flat terrain	2.50
Lifting and moving on rough terrain	> 4.0



By lifting elements with a chain, there is a load increase resulting from the angle of inclination. This load increase factor is given for calculation purposes in *Table 11*.

Table 11. 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



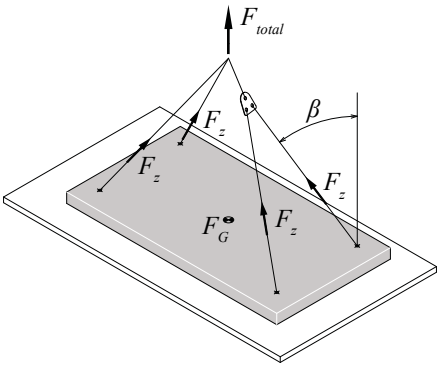
The manipulation within the entire transport chain must be considered and the most challenging case must guide the design. During manipulation, the following load conditions may occur:

- 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. It is assumed that the element does not rest one-sided on the formwork. The load is calculated as follows:

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

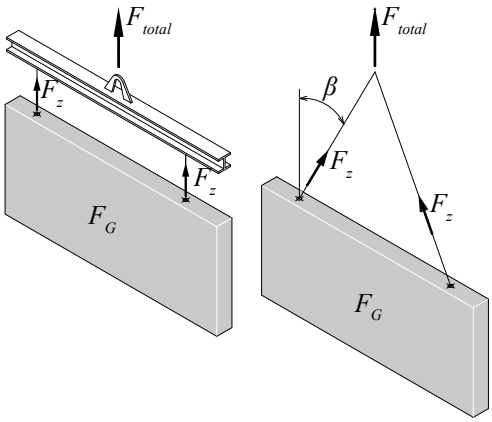
F_Q = load acting on the lifting insert [kN]
F_G = weight of the precast element [kN]
F_{adh} = action due to adhesion and from friction [kN]
z = factor for combined tension and shear, $z = 1 / \cos \beta$
n = number of load bearing lifting inserts



The 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:

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

F_Z = load action 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 carrying lifting inserts
z = factor for combined tension and shear, $z = 1 / \cos \beta$.



After determining the actions, the permissible safe working load (SWL) 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}").

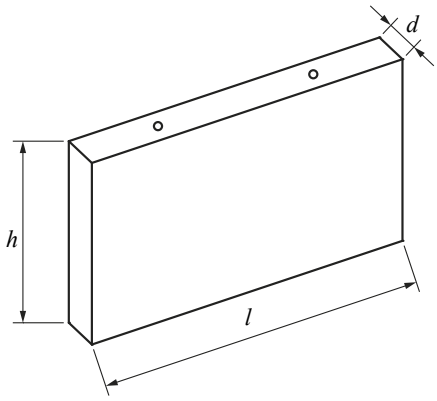
$$E \leq R_{zul} \qquad \text{Formula 5}$$

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

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

Annex A – Calculation Examples

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



Conditions during the transport process

- Tilt-up process with a tilt-up table, no lateral pull of 90 degrees on the entire chain of transport due to vertical storage
- Spreader beam available at the precast plant. Only chains available on the construction site (concrete >25 MPa) with a spread angle of a maximum of 30°
- Hoisting factor of 1.3 (tower hoist crane, heavy duty mobile crane, truck crane)
- WRA Lifting Inserts can be utilized
- Mold adhesion comes from the steel formwork

Unit geometry and conditions during production
Concrete with a minimum compressive strength of 15 MPa at first loading (see section 2.1)
Minimum cross-wise reinforcement: 1.88 cm²/m (see *Table 7*)

l = 5.0 m h = 1.0 m d = 0.25 m

Unit weight:

$$F_G = 5.0\ m \times 1.0\ m \times 0.25\ m \times 25.0\ kN/m^3 = 31.2\ kN \qquad F_G = V \times \rho_G$$ (see formula 1)

Mold adhesion:

$$F_{adh} = 5.0\ m \times 1.0\ m \times 1\ kN/m^2 = 5.0\ kN \qquad F_{adh} = q_{adh} \times A_f$$ (see formula 2)

Load case 1: Unit weight + dynamics + diagonal pull

$$F_Z = 31.25\ kN \times 1.3 \times 1.15 / 2 = 46.72\ kN / 2 = 23.36\ kN/insert \qquad F_Z = F_G \times \Psi_{dyn} \times z / n$$ (see formula 4)

Load case 2: Unit weight + adhesion + tilt-up with diagonal pull

$$F_Q = F_Z = (31.25\ kN + 5.0\ kN) \times 1.15 / 2 = 20.8\ kN/insert \qquad F_Q = (F_G + F_{adh}) \times z / n$$ (see formula 3)

⇨ Load case 1 causes the highest load and determines the design for diagonal lifting.

Insert selection:
WRA-2.5Z with safe working load of 25 kN for load case 1. See *Table 6*

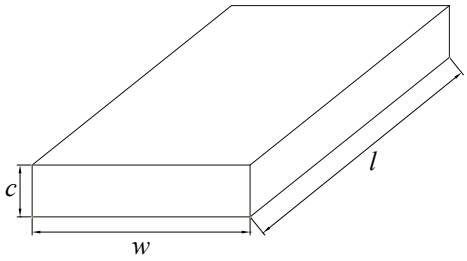
Spacing, unit thickness and reinforcement

Minimum spacing ($b + a$) for WRA-2.5Z 660 mm + 2 × 330 mm = 1320 mm < 5000 mm	Spacing required (see *Table 5*) ($b + 2 \times a$)
Minimum thickness (d) for WRA-2.5Z 250 mm > 160 mm	Thickness required (see *Table 5*) (d)
Minimum reinforcement for WRA-2.5Z #188 mm²/m	Reinforcement required (see *Table 7*)

Example 2: Transport of a slab

Conditions during the transport process

- Tilt-up process directly from the production table, no lateral pull during the entire chain of transport due to vertical storage
- Only chains available at the precast plant and on the construction site (concrete > 25MPa) with a maximum 30° spread angle
- Hoisting factor of 1.3 (tower hoist crane, heavy duty mobile crane, truck crane)
- WRA Lifting Inserts can be utilized
- Mold adhesion due to a steel formwork



Unit geometry and conditions during production
Concrete with a minimum compressive strength of 15MPa at first loading (see section 2.1)
Minimum cross-wise reinforcement of 1.88 cm²/m (see *Table 7*)

w = 1.80 m l = 2.20 m c = 0.25 m

Unit weight:

$F_G = 1.80\ m \times 2.20\ m \times 0.25\ m \times 25.0\ kN/m^3 = 24.8\ kN$ $F_G = V \times \rho_G$ (see formula 1)

Mold adhesion:

$F_{adh} = 3.0\ m \times 1.8\ m \times 1\ kN/m^2 = 5.4\ kN$ $F_{adh} = q_{adh} \times A_f$ (see formula 2)

Load case 1: Unit weight + dynamics + diagonal pull

$F_Z = 24.8\ kN \times 1.3 \times 1.15 / 2 = 37.1\ kN / 2 = 18.55\ kN/insert$ $F_Z = F_G \times \Psi_{dyn} \times z / n$ (see formula 4)

Load case 2: Unit weight + adhesion + diagonal pull

$F_Z = F_Q = (24.8\ kN + 5.4\ kN) \times 1.15 / 2 = 17.4\ kN/insert$ $F_Q = (F_G + F_{adh}) \times z / n$ (see formula 3)

- ⇨ Load case 1 causes the highest load and determines the design.
- ⇨ Only chains available ⇨ just 2 inserts share the load

Insert selection:
WRA-2.0Z with safe working load of 20 kN.
The user can reduce the insert load by half by using special lifting equipment such as balanced suspensions.

See *Table 4*

Spacing, unit thickness and reinforcement

Minimum spacing ($b + a$) for size WRA-2.0Z
570 mm + 2 × 285 mm = 1140 mm < 1800 mm and 2200 mm

Spacing required (see *Table 5*)
($b + 2 \times a$)

Minimum thickness (c) for size WRA-2.0Z
250 mm > 230 mm

Thickness required (see *Table 5*)
(c)

Minimum reinforcement for size WRA-2.0Z
#188 mm²/m

Reinforcement required (see *Table 7*)

Annex B – Application conditions

B1. Loading: Lifetime and environmental conditions

Peikko Lifting Systems are designed for use in precast elements for transportation and temporary fastening.

Multiple lifts can be completed before the final installation. The lifting system must not be installed or used in crane counter weights. Lifting systems for such applications must be made from stainless steel.

The lifetime of lifting systems begins with stocking and stretches 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 the elements in dry conditions under a roof or other shelter.

All precast concrete elements in which Peikko's Lifting Systems can be used must be made from normal concrete according to EN206. The minimum compressive strength at first lifting must be 15MPa in normal cases. Exceptions for lower concrete strength require individual confirmation.

The products described in this technical manual are not intended for use in lightweight concrete, lightweight aggregate concrete with an open structure, or autoclaved aerated concrete. Light concrete requires separate verification of proper conditions and must not be used without detailed specifications.

All Peikko lifting systems must be installed and used in clean, dry surroundings and environmental conditions. Environmental pollution should be minimized at all times. The item must be stored under dry conditions, preferably under a roof. Normal humidity does not affect durability during stocking. Dampness resulting from the concreting procedure is permissible and does not affect usability.

B2. Interaction with lifting keys

Please read, understand, and use the instructions for interaction with lifting keys. This is the only way to ensure that loads are transferred properly.

Peikko offers different WRA Lifting Inserts that protruding out of the concrete element. WRA Lifting Inserts are not designed for all load directions. They can be used for axial and diagonal loads up to a maximum of 45° (heavy duty WRA maximum 30°). *Figure 21* shows the permissible load directions for WRA Lifting Inserts.

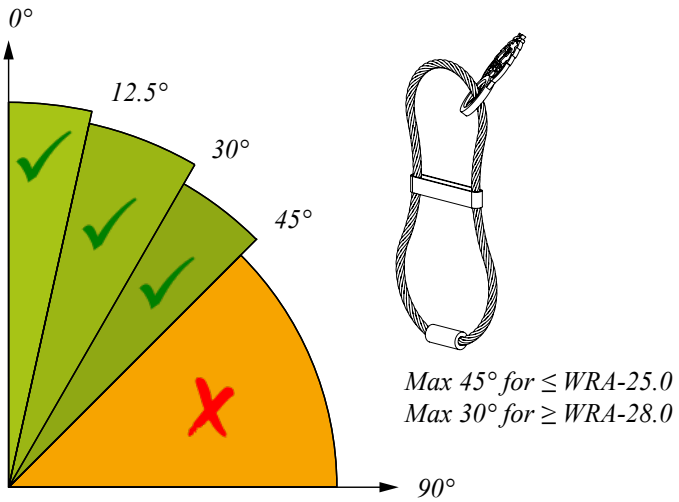


Figure 21. Permissible load directions.

B3. Positioning of lifting inserts

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 22*.

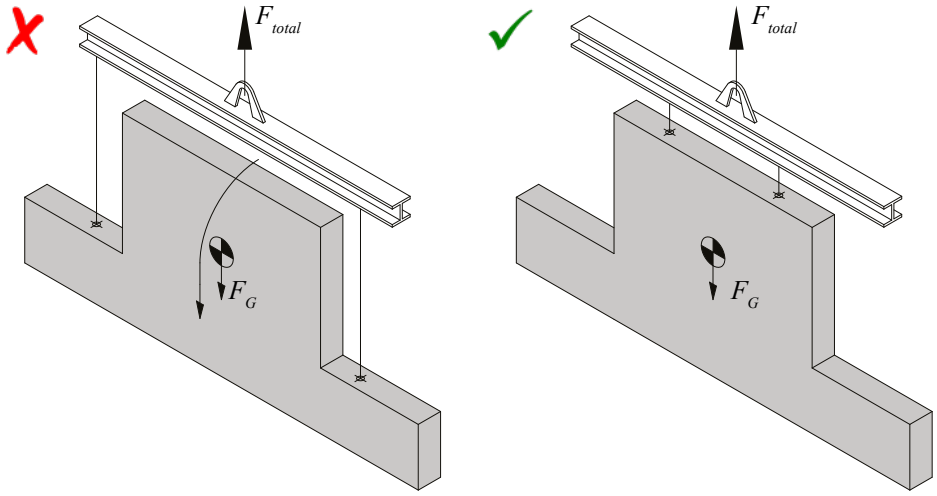


Figure 22. Lifting points lower than the center of gravity.

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

During installation, the tolerances as defined in the section “Installation of WRA Lifting Systems” must be complied with. Utilization of installation accessories in combination with wire fixing on the element reinforcement can help to comply with this requirement. The correct position after concrete hardening ensures product usability and application according to design. The details in the installation section are valid for vertical and horizontal installation equally.

B4. System compatibility

Peikko’s lifting systems offer various product series for transporting precast concrete elements. As described under the product properties, the WRA lifting system consists solely of lifting inserts. Cross-wise combination with different product series such as JENKA, RR, KK is not possible.

Peikko WRA Lifting Inserts can be used with ordinary lifting accessories. Peikko WRA Lifting System inserts are compatible with the following lifting keys:

- Standard hoisting hooks for the use with chain or wire ropes
- Standard hoisting shackles (bolt diameter ≥ 2.5 × ds)

Lifting hooks and other lifting accessories are subject to exchanging and forwarding actions during multiple lifting processes. Clarify compatibility prior to using any lifting accessory in combination with Peikko’s lifting inserts.

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

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

B5. Welding considerations

Peikko cannot control field conditions or field workmanship; therefore it cannot provide a guarantee for any Peikko product that has been altered in any way after it has left the manufacturing facility. This includes welding, bending, and filing.

WARNING:
Never weld any of Peikko's products.

B6. Corrosion, chemical effects, weather condition

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 when using products in a chemical and industrial environment and in coastal zones that have a salty atmosphere.

For lifting systems that are permanently exposed to weather, chemical conditions, and seawater atmosphere the usability of products might be affected by corrosion. Ensure that black or electro galvanized lifting systems are prevented from corrosion during storage, transport, and installation. In extreme conditions we recommend inserts made of stainless steel.

Permanent corrosion protection is technically not given. Casted products must be protected from environmental influence. Peikko accessories can be used for protection purposes.

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 parts of lifting systems 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 products are either black or galvanized. Choose the correct surface finish prior to installation depending on your application (seawater conditions, changing weather conditions, etc.).

After final usage of Peikko lifting products that remain installed, further use is explicitly prohibited. Sealing of the cut wire parts with mortar is recommended to avoid corrosion and ensure durability of the element.

B7. Personnel and safety requirements

Peikko products must be used by trained, qualified, experienced, and properly supervised workmen 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 by calculation (e.g. highly structured elements), then inserts must be installed in such a way that every insert is able to carry the unit's entire weight.

The items are installed either by wire fixing, nailing, drilling, or any other type of tooling. During these procedures, 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.

Documentation is subject to regular updates. Prior to use, always check Peikko's website for latest revision. When updated documentation is published, this version expires with immediate effect.

B8. Material properties and quality

All Peikko lifting system products are designed to withstand a temperature range of -20°C to +80°C. Material impact resistance is essential due to rough handling and lifting procedures. *Table 12* gives an overview of the materials used for WRA Lifting Systems.

Table 12. WRA Lifting Insert materials.

	Material	Standard
Ferrule	Carbon steel / Aluminium	EN13411-3
Rope	Steel wire min 1770MPa	EN12835-4

Peikko has its own plants worldwide, enabling it to offer special and customized steel grades for lifting items in addition to standard grades. Products can be customized on demand to individual configurations such as higher impact strengths for low temperatures. A proper consultation is required to identify special considerations during application.

Peikko Group's production units are externally controlled and periodically audited on the basis of production certifications and product approvals by various independent organizations.

Annex C - Declaration of conformity

Peikko Group Oy
Voimakatu 3
FI-15101 Lahti
www.peikko.com

EU Declaration of conformity according to Machine Directive 2006/42/EC, attachment II 1A
EG Konformitätserklärung gemäß EG Maschinenrichtlinie 2006/42/EG, Anhang II 1A

The manufacturer / der Hersteller **Peikko Group Oy, Voimakatu 3, FI-15101 Lahti, FINLAND**

with production plants / mit Produktionsstätten

Peikko Deutschland GmbH Brinker Weg 15 D-34513 Waldeck GERMANY	Peikko Construction Accessories (Zhangjiagang) Co., Ltd, No. 9 Fuxin Rd., Zhangjiagang Economic Development Zone, JiangSu Province, CHINA	Peikko Finland Oy Voimakatu 3 FI-15101 Lahti FINLAND	Peikko Russia ООО "Пейкко" 197348 Санкт-Петербург Коломяжский пр. 10, лит. Ф RUSSIA

Declares that following lifting devices acc. to article 2 d)	Erklärt folgende Lastaufnahmemittel nach Artikel 2 d) mit der
Product name / Produktbezeichnung:	Peikko WRA System
Lifting Insert / Transportanker	WRA / WRA-Z
With surface treatment / mit Oberflächenbehandlung	galvanized (verzinkt)
In the version/ in den Ausführungen:	WRA0,8 – WRA25,0 WRA0,8Z – WRA25,0Z
Complies due to conception and construction the regulations of the following cited regulations	Aufgrund Konzipierung und Bauart den Bestimmungen der nachfolgend aufgeführten Richtlinien entspricht
EU Machine Directive 2006/42/EC - EG Maschinenrichtlinie 2006/42/EG	

Considered harmonized standards / Angewandte harmonisierte Normen

EN ISO 12100:2011-03 Safety of machinery-Generals principles for design – Risk assessment and risk reduction / Sicherheit von Maschinen – Allgemeine Gestaltungsleitsätze Risikobeurteilung –Risikominderung
EN 13155:2009-09 Cranes-Safety-Non fixed load lifting attachments / Krane-Sicherheit-Lose Lastaufnahmemittel

Other considered standards or specifications / Sonstige angewandte Normen oder Spezifikationen

DGUV Regel 100-101 safety regulations for transport anchors and- systems of precast elements / Sicherheitsregeln für Transportanker und –Systeme von Betonfertigteilen
DGUV Regel 100-500 use of work equipment chapter 2.8 / Betreiben von Arbeitsmitteln Kapitel 2.8
VDI/BV-BS 6205:2012-04 Lifting inserts and lifting insert systems for precast concrete elements, principles, design, application / Transportanker und Transportankersysteme für Betonfertigteile, Grundlagen, Bemessung, Anwendung

Responsible commissioner for preparation and management of technical documentation is /
Verantwortlicher Bevollmächtigter zur Erstellung und Führung der technischen Dokumentation ist
Mr. Sebastian Gonschior
R&D Engineer, Peikko Group Oy

Lahti 26.05.2020

Mr. Žygimantas Kačinskas
Quality Manager
Peikko Group Oy

PEIKKO GROUP OY

Installing WRA Lifting System

The WRA Lifting System's components are installed either on the construction site or in a precast plant. Ensure that the surroundings and environmental conditions are dry and clean for installation. Environmental pollution of all kinds should be avoided or minimized at all times.

The following must be taken into account prior to installing any type of lifting system:

- All workers 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 23*, which shows that the insert can incline a maximum of 2.5° in either direction and angle tolerance must stay within 5° of tolerance towards the insert axis.

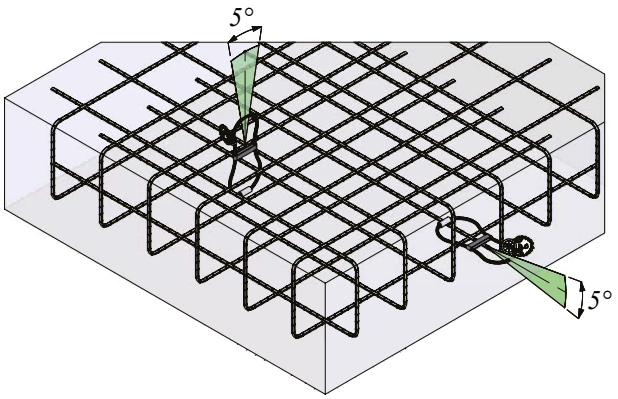
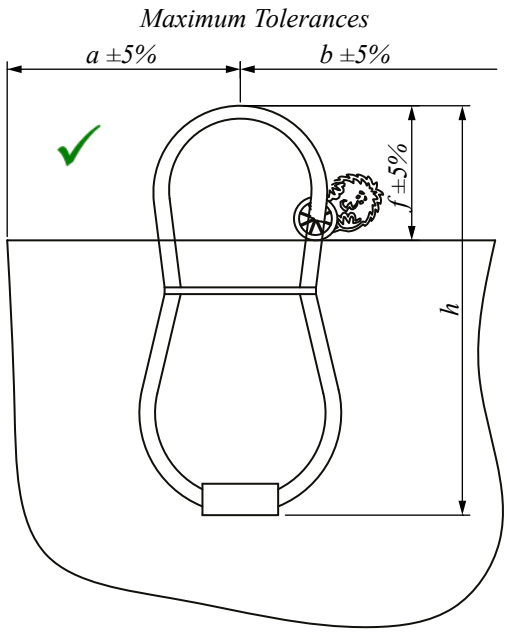


Figure 23. Angle tolerances for installation.

Installation into concrete elements requires the insert to stay in its initial position. *Table 13* defines the permitted installation tolerances for all inserts.

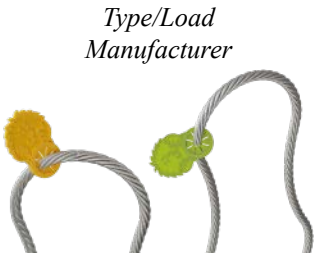
Table 13. Installation tolerances for WRA Lifting Inserts.

Item No.	5% of *f*	5% of *a*	5% of *b*
	[mm]	[mm]	[mm]
WRA-0.8Z	3	10	21
WRA-1.2Z	3	11	23
WRA-1.6Z	3	11	23
WRA-2.0Z	4	14	28
WRA-2.5Z	4	16	33
WRA-4.0Z	5	17	34
WRA-5.2Z	5	18	37
WRA-6.3Z	5	20	40
WRA-8.0Z	6	22	45
WRA-10.0Z	6	28	56
WRA-12.5Z	7	30	60
WRA-16.0Z	8	32	64
WRA-20.0Z	9	39	78
WRA-25.0Z	10	42	85



WRA Lifting System

1. Selection

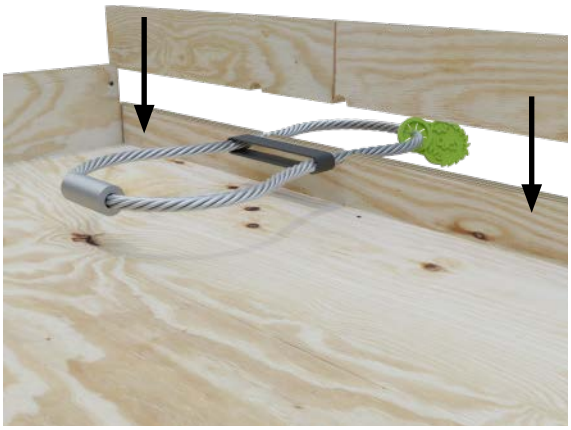


Load Class	Color
800	White
1500	Red
1600	Purple
2000	Light Green
2500	Black
4000	Green

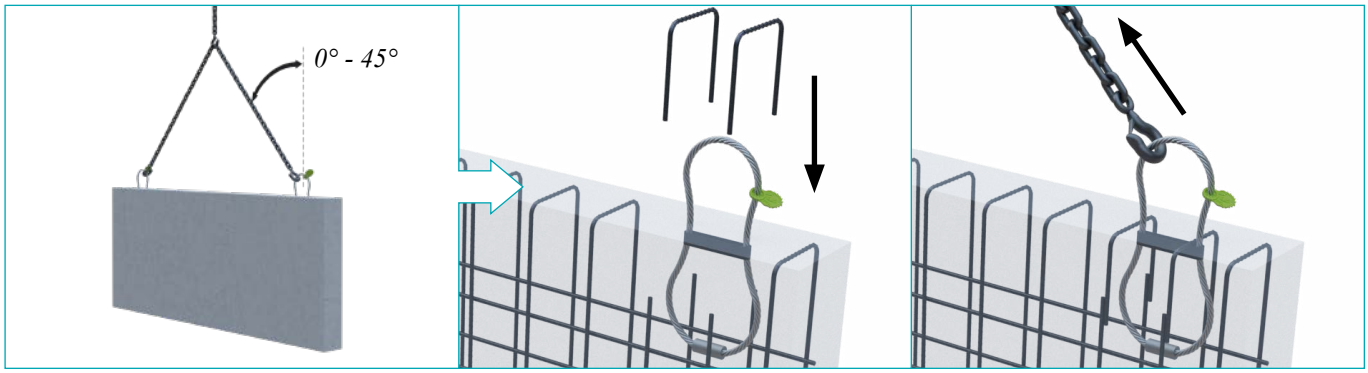
Load Class	Color
5200	Yellow
6300	Light Blue
8000	Gray
10000	Metallic Pink
12500	Yellow
16000	Lilac

Load Class	Color
20000	Beige
25000	Brown
28000	White
32000	Black
>37000 - 99000	Orange

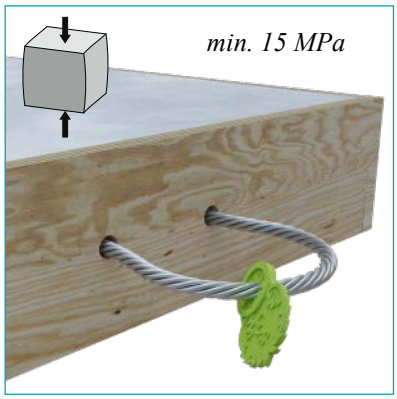
2. Installation

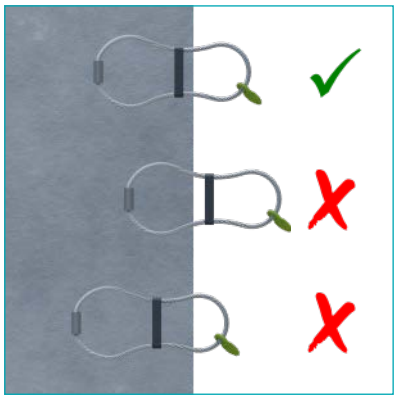


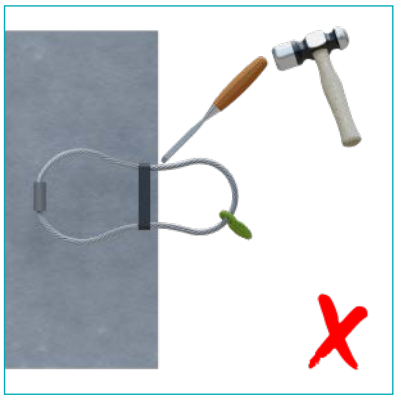
3. Reinforcement



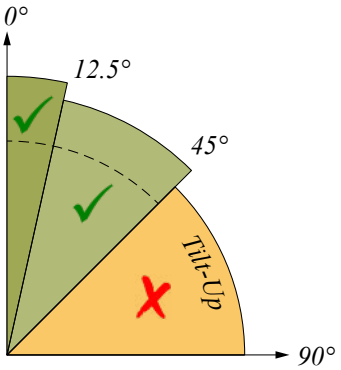
4. Casting

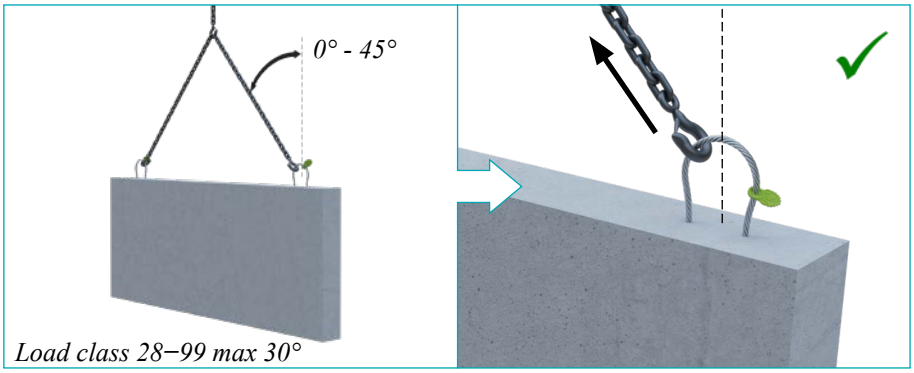


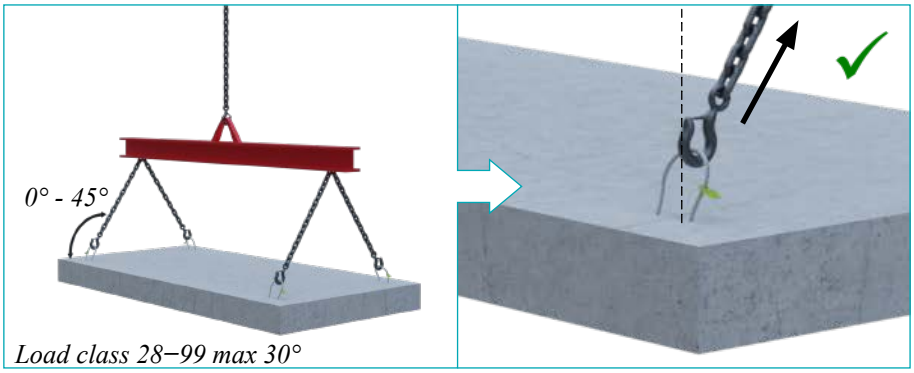


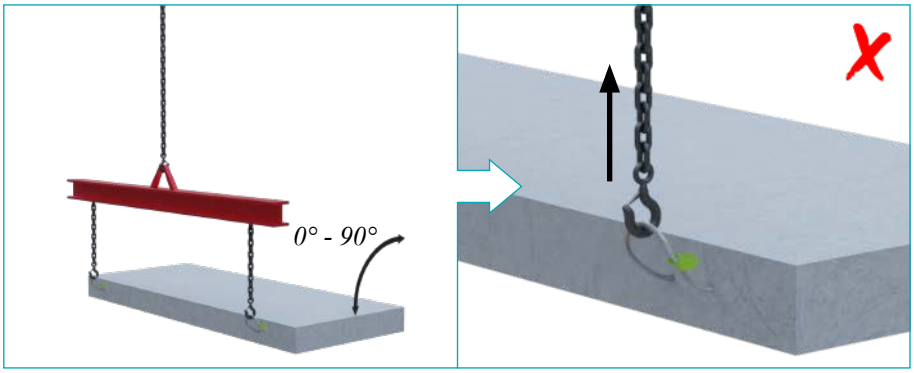


5. Lifting

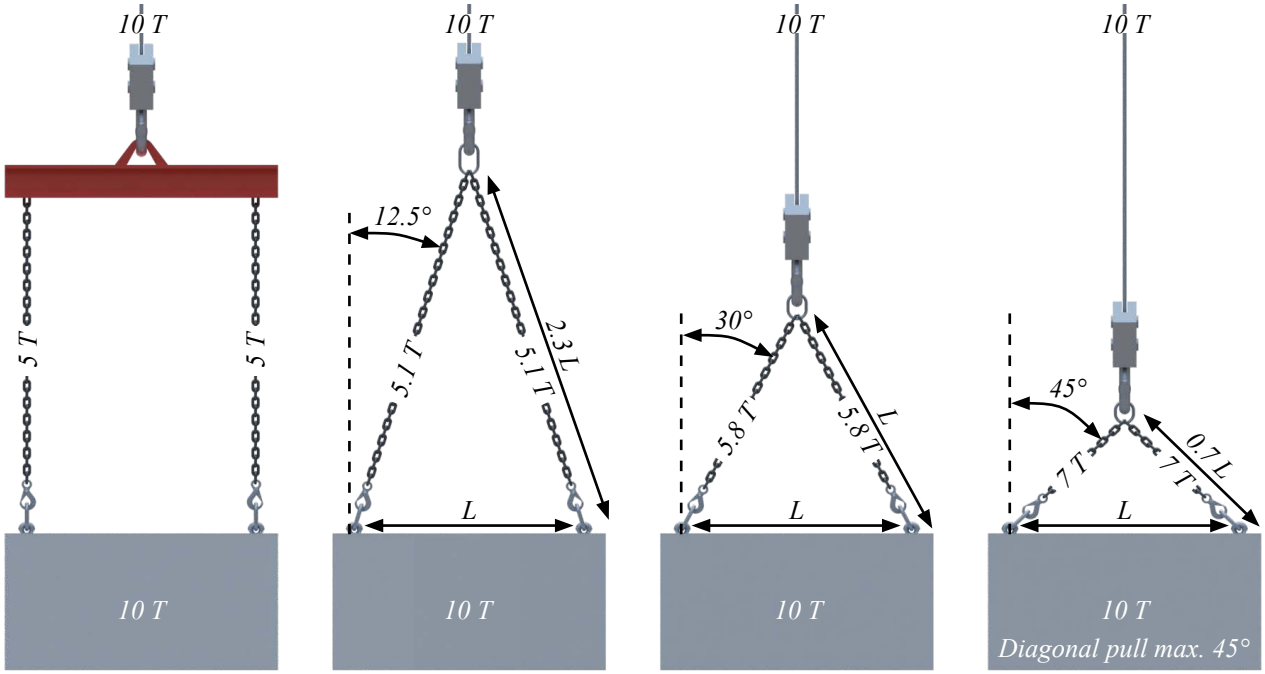

0°
12.5°
45°
Tilt-Up
90°


0° - 45°
Load class 28–99 max 30°


0° - 45°
Load class 28–99 max 30°


0° - 90°

6. Lifting Angle Influence



NOTES

Revisions

Version: PEIKKO GROUP 05/2023. Revision: 003

- Update of data in Tables 2 and 8.

Version: PEIKKO GROUP 04/2016. Revision: 002*

- New cover design for 2018 added.

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

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ISO 45001