TECHNICAL MANUAL

RR Lifting System

Rapid Release Flat Steel Lifting System

Version: PEIKKO GROUP 04/2016

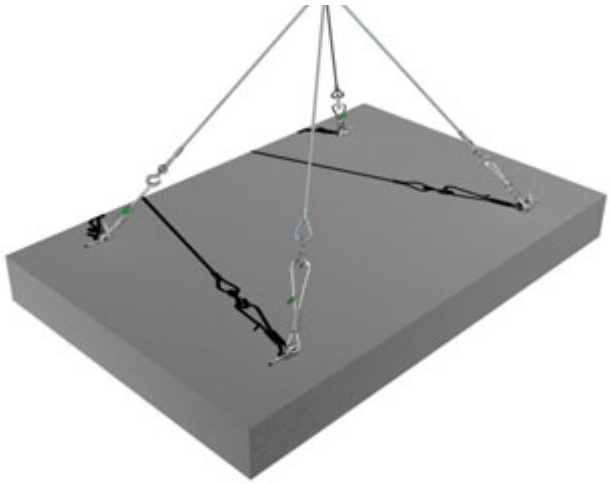
peikko®

RR LIFTING SYSTEM

For safe and efficient lifting and handling of all types of precast concrete elements.

The RR Lifting System is a rapid coupling and release lifting system with flat steel inserts. Used with special Lifting Keys, RR Inserts offer a wide range of application, from slabs to columns, walls, and beams with no limit on lifting load direction. A wide selection of Lifting Inserts suit different kinds of lifting and transportation needs.

- Rapid coupling and release
- All lifting directions possible
- Available in load classes from 2.5 to 26 tons
- Easy installation with recess formers, no protruding of inserts
- Two optional Lifting Keys with individual serial numbering



The RR Lifting System enables angles up to 90 degrees.

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 TU Darmstadt.

Contents

Contents continued...

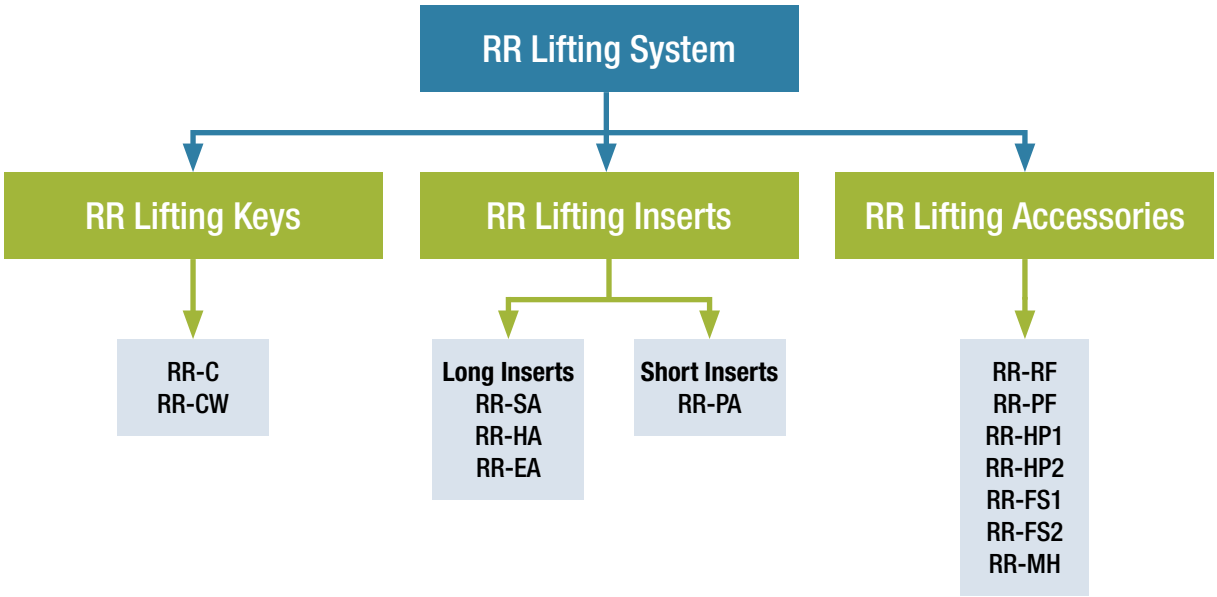
1. Product properties

The RR 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), related 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.

The RR Lifting Insert System is intended for temporarily fastening RR Lifting Keys, to enable concrete elements to be transported and installed. Applications that require permanent load or that affect the stability of a building, are not included in this range of applications.

The RR Lifting System consists of a RR Lifting Insert that is permanently anchored in the precast element and a corresponding RR Lifting Key, which hooks temporarily on to the embedded RR Lifting Insert. *Figure 1* is an overview of the parts of the RR Lifting System.

Figure 1. RR Lifting System overview.

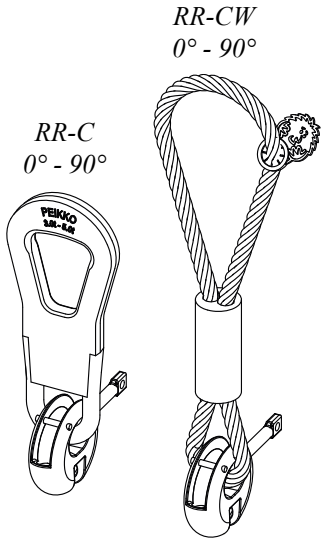


RR Lifting System introduction

The RR Lifting System consists of RR Lifting Keys, RR Lifting Inserts, and RR Lifting Accessories. All of the parts of the RR Lifting System enable the efficient handling of precast elements. The system has been tested for use all year round, guaranteeing safe and reliable handling during all stages of transportation.

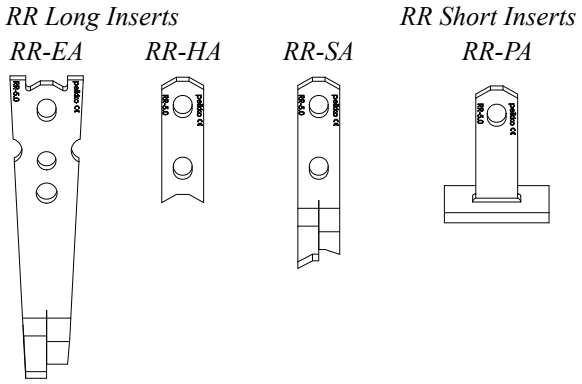
RR Lifting Keys such as RR-C or RR-CW models, as well as other compatible lifting keys, can be used several times for different lifting actions throughout their service life. *Figure 2* shows RR Lifting Keys for the RR Lifting System. To handle the concrete elements, RR Lifting Keys hook on to the recessed RR Lifting Inserts.

Figure 2. RR Lifting Keys RR-C and RR-CW.



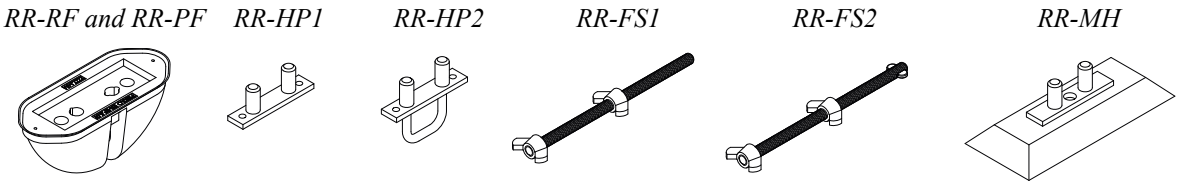
RR Lifting Inserts consists of two groups. The first group RR Long Inserts, is for applications with sufficient anchoring depth, such as walls and beams. This group includes RR Lifting Inserts such as RR-SA, RR-HA, and RR-EA. The second group, RR Short Inserts, is for applications with only limited anchoring depth, such as slabs. This group includes RR-PA Lifting Inserts. All RR Lifting Inserts are cast into concrete elements to enable the elements to be lifted after the concrete has hardened. For this reason, RR Lifting Inserts can only be used once. RR Lifting Inserts are available in black as standard, but are available galvanized or in hot dipped galvanized steel upon request. *Figure 3* shows the long and short RR Lifting Inserts.

Figure 3. RR Lifting Inserts.



RR Lifting Accessories facilitate the application of RR Lifting System components. The installation items ease the installation procedure and help to fix the inserts into the mold with minimal effort. *Figure 4* shows the range of accessories available for the RR Lifting System.

Figure 4. RR Lifting accessories.



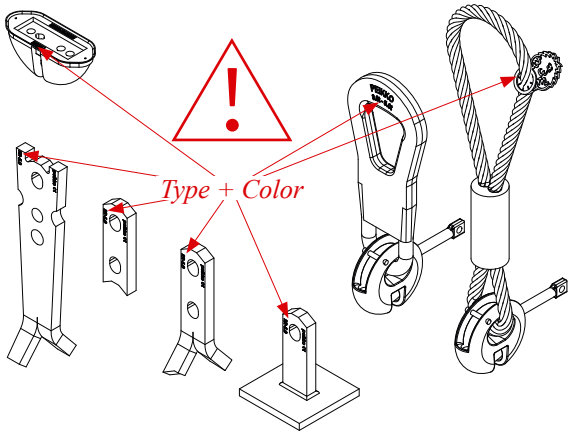
RR color-coding system

Peikko RR Lifting System has a color code for RR-RF and RR-PF recess items which enables easy recognition of every load class. System parts such as RR-RF and RR-PF recess items are colored in accordance with *Table 1* and *Figure 5*. This helps the user, to allocate the right combination of RR Lifting Insert, RR Lifting Accessories, and RR Lifting Key.

Table 1. RR Lifting System color codes.

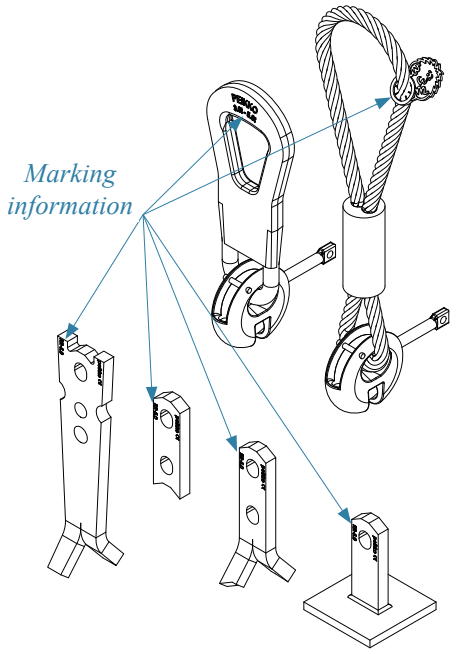
Load class	Load categories covered		RR-RF and RR-PF colors
2.5	0.7	1.4	Orange
	2.0	2.5	
5.0	3.0	4.0	Black
	5.0		
10.0	7.5	10.0	Green
26.0	12.5	14.0	Blue
	17.0	22.0	
	26.0		

Figure 5. Color codes and marking information.



The inserts and RR-C Lifting Keys in the RR Lifting System can be identified by the markings on their surface. The RR-CW Lifting Keys have a colored tag which contains identification information. The marking and the tag information provide the user with information about the manufacturer, the load class, the type, the CE marking, and the production date (tags only). *Figure 6* shows this marking system.

Figure 6. Marking information.



The RR Lifting Keys, RR-C and RR-CW are marked with a unique serial number, which is engraved on the RR Lifting Key surface or on the tag. This serial number enables full traceability of a RR Lifting Key from the finished product back to the raw material. This unique feature is provided for safety purposes. A further safety feature of all RR Lifting Keys is a preloading with at least 2.5 times the safe working load prior to sales. This ensures a quality level that is among the highest on the market with certifications available upon request (serial number needed).

1.1 RR Long Inserts

RR Long inserts, (RR-SA, RR-EA, and RR-HA) are used in applications like walls and beams where sufficient anchoring depth is available. This section describes the product properties of RR Long Inserts.
RR Inserts – both long and short – are ideal for all types of lifting operation. The RR-SA is a universal lifting insert designed to lift and transport walls and beams. The RR-EA Lifting Insert is especially designed for tilt-up processes where elements must be lifted from a horizontal to a vertical position. The RR-SA and RR-EA Lifting Inserts can be used for all load directions.

The RR-HA Lifting Insert is used for lifting processes with an axial or diagonal load of up to 45°. Thanks to their short length, they can be utilized in a wide range of elements. Additional rebar is needed and can easy to be installed.

Peikko's standard products are always delivered in black (uncoated). All dimensions given in this section are valid for all finishes.

RR-SA-5.0-240: RR Lifting Insert (standard item)
RR-SAG-5.0-240: RR Lifting Insert electro galvanized (available upon request)

1.1.1 Dimensions and weights of system components

RR Long Inserts are available in standard lengths as shown in *Figure 7* and *Table 2* as well as in *Figure 8* and *Table 3*. Inserts with customized length for special purposes are available upon request.

Figure 7. RR-SA and RR-HA Lifting Insert types.

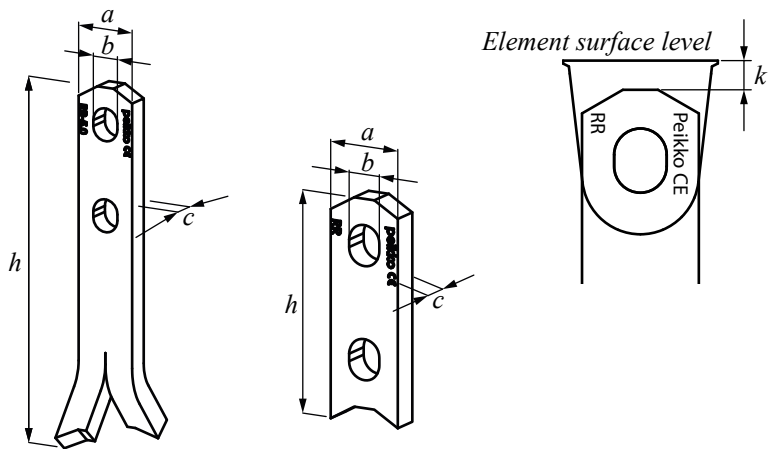


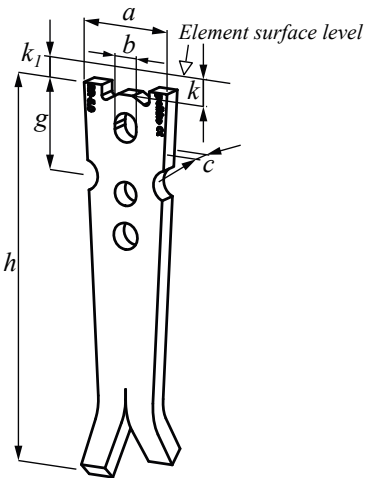
Table 2. Dimensions of RR-SA and RR-HA Lifting Inserts.

Load Class	Dimensions b [mm]	c [mm]	k [mm]	a [mm]	RR-SA dimensions Type	h [mm]	Weight [kg/pcs]	RR-HA dimensions Type	h [mm]	Weight [kg/pcs]
2.5	14	6	10	30	RR-SA-1.4-110	110	0.1	RR-HA-1.4-90	90	0.1
		10			RR-SA-2.5-150	150	0.3	RR-HA-2.5-90	90	0.2
5.0	18	10	10	40	RR-SA-3.0-200	200	0.6	RR-HA-3.0-120	120	0.3
		12						RR-HA-4.0-120	120	0.4
		15			RR-SA-5.0-180	180	0.8	RR-HA-5.0-120	120	0.5
					RR-SA-5.0-240	240	1.1			
10.0	26	16	15	60	RR-SA-7.5-300	300	2.1	RR-HA-7.5-160	160	1.0
		20			RR-SA-10.0-300	300	2.7	RR-HA-10.0-170	170	1.2
					RR-SA-10.0-370	370	3.3			
26.0	35	20	15	80	RR-SA-14.0-370	370	3.9	RR-HA-14.0-240	240	2.6
		30		90	RR-SA-22.0-500	500	7.6	RR-HA-22.0-300	300	4.1
		30		120				RR-HA-26.0-300	300	7.2

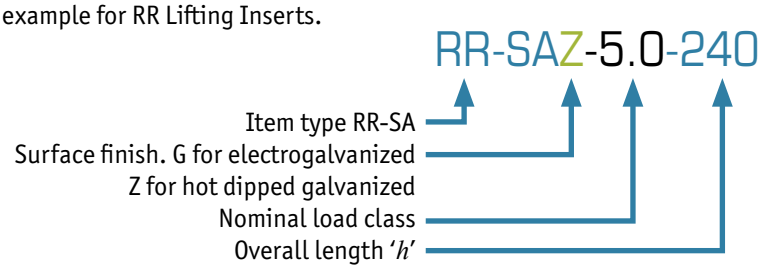
Table 3. Dimensions of RR-EA Lifting Inserts.

Load class	Type	RR-EA dimensions b [mm]	c [mm]	k [mm]	h [mm]	a [mm]	k_1 [mm]	g [mm]	Weight [kg/pcs]
2.5	RR-EA-1.4-200	14	6	10	200	55	5	45	0.37
	RR-EA-2.5-230	14	10		230	55	5	45	0.69
5.0	RR-EA-4.0-270	18	12	10	270	70	5	70	1.30
	RR-EA-5.0-290	18	15		290	70	5	70	1.66
10.0	RR-EA-7.5-320	26	16	15	320	95	6	90	2.42
	RR-EA-10.0-390	26	20		390	95	6	90	3.95
26.0	RR-EA-12.5-500	35	20	15	500	148	9	90	6.64
	RR-EA-17.0-500	35	25		500	148	9	90	8.18
	RR-EA-22.0-500	65	30		500	148	9	90	9.84

Figure 8. RR-EA Lifting Insert types.



Ordering example for RR Lifting Inserts.



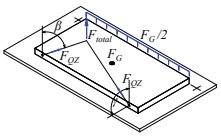
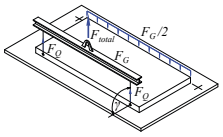
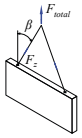
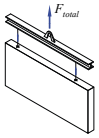
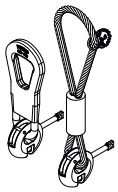
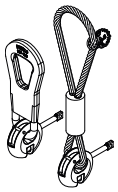
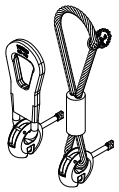
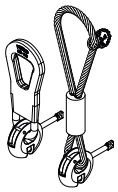
1.1.2 Safe working loads for RR Long Inserts

The resistances of the RR Lifting System are determined by a design concept that refers to the following standards and regulations:

EN 1992-1-1:2011
Machinery directive 2006/42/EC
VDI/BV-BS6205:2012

The load capacities depend very much on how and in which combination the different items will be used. The load direction determines which RR Lifting Key and which RR Lifting Insert must be used. *Table 4* shows the possible RR Lifting Inserts/RR Lifting Keys (RR-C and RR-CW) combination for different load directions.

Table 4. Combination of RR Lifting Inserts with RR Lifting Keys.

				
				
RR-SA	✓	✓	✓	✓
RR-HA	✗	✗	✓	✓
RR-EA	✓	✓	✓	✓

The safe working load capacities are based on specific dimensions and edge distances as given in following sections. Before selecting the insert, take note of the selection assumptions in this manual. **The minimum compressive strength of the concrete at the moment of load application is 15MPa.**


Min
15MPa

The concrete element thickness requirement is illustrated in *Figure 9* and *Figure 10* shows the load directions for the application.

Figure 9. Element thickness for RR Long Inserts.

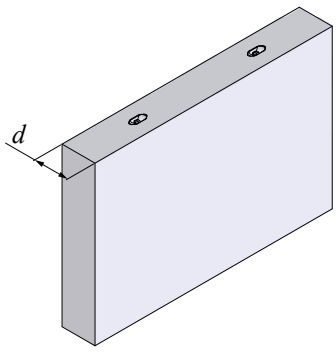
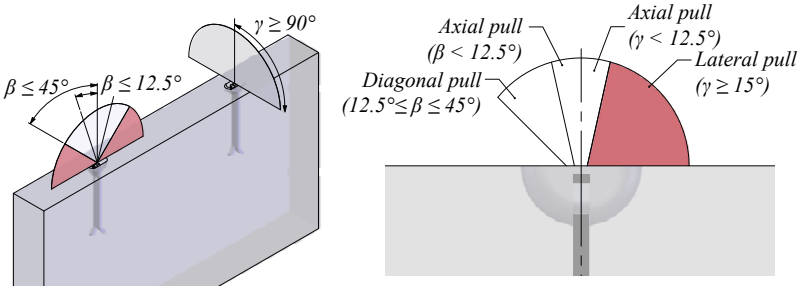


Figure 10. Load directions for RR Long Inserts.



The safe working loads (SWL) of RR-SA Inserts are shown in *Table 5* and *Table 6*. For RR-HA Inserts, the safe working loads (SWL) are shown in *Table 7*, and for RR-EA Inserts, they are given in *Table 8*. Take care to select inserts which are suitable for the planned load directions.

Table 5. Safe working load (SWL) for RR-SA Inserts.

			Safe working loads [kN]						
			for β = 0°-12.5°			for β = 12,5°-45°			
Load class	Type	d [mm]	15 MPa	20 MPa	25 MPa	15 MPa	20 MPa	25 MPa	30 MPa
2.5	RR-SA-1.4-110	80	5.2	6.0	6.7	5.2	6.0	6.7	7.4
		100	6.7	7.8	8.7	6.4	7.5	8.3	9.1
		120	8.3	9.6	10.8	7.8	9.1	10.1	11.1
		150	10.9	12.7	14.0	10.1	11.6	12.9	14.0
	RR-SA-2.5-150	120	11.4	13.2	14.8	10.7	12.4	13.9	15.2
		150	14.9	17.2	19.3	13.6	15.7	17.5	19.2
		190	20.1	23.1	25.0	17.8	20.6	22.9	25.0
		220	24.3	25.0	25.0	21.3	24.6	25.0	25.0
5.0	RR-SA-3.0-200	120	17.1	19.7	22.1	16.0	18.5	20.7	22.6
		150	21.9	25.4	28.4	20.1	23.1	25.9	28.3
		200	30.0	30.0	30.0	27.4	30.0	30.0	30.0
	RR-SA-5.0-180	200	26.3	30.4	33.9	23.3	26.9	30.1	32.9
		250	35.1	40.5	45.3	30.5	35.2	39.3	43.1
		320	37.5	43.4	48.5	37.5	43.4	48.5	50.0
	RR-SA-5.0-240	180	34.1	39.4	44.1	30.5	35.2	39.4	43.1
		200	38.6	44.6	49.9	34.2	39.5	44.1	48.3
		230	45.7	50.0	50.0	39.9	46.1	50.0	50.0
10.0	RR-SA-7.5-300	200	52.1	60.1	67.3	46.1	53.2	59.5	65.2
		230	61.3	70.7	75.0	53.5	61.8	69.1	75.0
		250	67.6	75.0	75.0	58.7	67.8	75.0	75.0
	RR-SA-10.0-300	250	67.6	78.1	87.3	58.7	67.8	75.8	83.1
		300	68.2	78.7	88.1	68.2	78.7	88.1	96.4
		350	71.2	82.2	91.9	71.2	82.2	91.9	100.0
	RR-SA-10.0-370	200	69.5	80.2	89.7	61.5	70.9	79.4	86.9
		230	81.4	93.9	100.0	71.1	82.1	91.8	100.0
		260	87.5	100.0	100.0	87.5	100.0	100.0	100.0
26.0	RR-SA-14.0-370	250	84.3	97.4	108.9	73.2	84.6	94.5	103.6
		350	97.1	112.2	125.4	88.3	101.9	114.1	124.9
		450	104.5	120.6	134.9	94.9	109.6	122.6	134.3
	RR-SA-22.0-500	300	141.0	162.8	182.1	128.2	148.1	165.5	181.3
		400	149.1	172.2	192.5	135.5	156.5	174.9	191.7
		500	157.4	181.8	203.2	143.1	165.3	184.8	202.4

Table 6. Safe working load (SWL) for RR-SA Inserts and tilt-up actions.

Load class	Type	d [mm]	Safe working loads [kN] for γ = 90° 15 MPa
2.5	RR-SA-1.4-110	200	7.0
	RR-SA-2.5-150	200	12.5
5.0	RR-SA-3.0-200	250	15.0
	RR-SA-5.0-240	300	25.0
10.0	RR-SA-7.5-300	350	37.5
	RR-SA-10.0-370	400	50.0
26.0	RR-SA-14.0-370	550	70.0
	RR-SA-22.0-500	700	110.0

Table 7. Safe working load (SWL) for RR-HA Inserts.

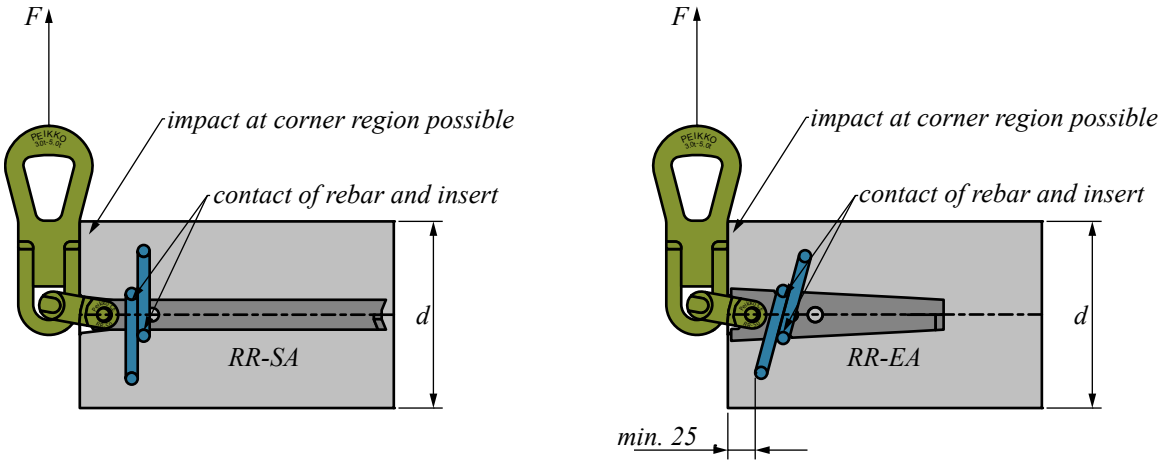
Load class	Type	Safe working loads [kN] for β = 0°-12.5°		for β = 12.5°-30°	for β = 30°-45°			for γ = 90°
		15 MPa	20 MPa	15 MPa	15 MPa	20 MPa	25 MPa	
2.5	RR-HA-1.4-90	14	14	14	14	14	14	Not Permissible
	RR-HA-2.5-90	25	25	25	23	25	25	
5.0	RR-HA-3.0-120	30	30	30	30	30	30	
	RR-HA-4.0-120	40	40	40	37	40	40	
	RR-HA-5.0-120	50	50	50	37	43	48	
10.0	RR-HA-7.5-160	75	75	75	71	75	75	
	RR-HA-10.0-170	100	100	100	80	92	100	
26.0	RR-HA-14.0-240	125	140	140	110	125	140	
	RR-HA-22.0-300	220	220	220	175	200	220	
	RR-HA-26.0-300	242	260	260	180	208	220	

Table 8. Safe working load (SWL) for RR-EA Inserts.

Load class	Type	d [mm]	Safe working loads [kN] for β = 0°-12.5° 15 MPa	20 MPa	25 MPa	for β = 12.5°-45° 15 MPa	20 MPa	25 MPa	for γ = 90°* 15 MPa	20 MPa	25 MPa
2.5	RR-EA-1.4-200	100	14.0	14.0	14.0	14.0	14.0	14.0	5.6	6.5	7.0
	RR-EA-2.5-230	120	20.8	24.1	25.0	19.5	22.5	25.0	9.9	11.0	12.5
5.0	RR-EA-4.0-270	150	33.2	38.3	40.0	30.2	34.9	40.0	13.4	15.5	17.5
	RR-EA-5.0-290	160	38.9	44.9	50.0	35.2	40.6	45.5	14.4	16.7	18.6
10.0	RR-EA-7.5-320	175	49.1	56.7	63.4	43.9	50.8	56.8	15.4	17.9	20.1
	RR-EA-10.0-390	240	91.9	100.0	100.0	80.1	92.4	100.0	34.3	39.6	44.3
26.0	RR-EA-12.5-500	240	124.6	125.0	125.0	108.5	125.0	125.0	38.7	44.6	50.0
	RR-EA-17.0-500	300	130.2	150.4	170.0	130.2	150.4	170.0	49.9	56.5	63.1
	RR-EA-22.0-500	380	135.0	155.0	173.1	135.0	155.0	173.1	64.3	74.2	82.9

Note: *The safe working load for γ = 90° is valid only when meeting the geometry requirements and using additional reinforcement for lateral pull as shown on *Figure 11* and *Table 16*. If the thickness of the element is too small, it may cause impact in the corner region.

Figure 11. Tilting up with RR-SA and RR-EA Inserts.



PLEASE NOTE:
Diagonal pull between 12.5° and 45° and lateral pull resulting from tilting up is only permitted with additional reinforcement according to the following section.

1.1.3 Unit geometry and spacing

The use of Peikko Lifting Systems requires a specific element geometry. The load capacities given in this section of the 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. Peikko engineering service offers customized solutions to make special applications possible.

Before selecting and installing an insert, consider the general information in the previous sections of this manual. The required element geometry specifications for RR Long Inserts differs from those for short inserts. The two types cannot replace each other or be applied in the same way unless all of the geometric requirements are complied with.

RR Long Inserts are commonly used in thin or very thin elements with sufficient anchorage depth. For this reason, most insert types go into the depth of the element. In many cases, capacities are limited by the element thickness "d". The minimum element thickness as well as minimum edge and axial distances for the respective RR Lifting Insert types are shown in *Table 9*, *Table 10*, *Table 11*, and *Figure 12*.

Table 9. Minimum unit geometry for RR-SA Inserts.

Load Class	Type	*d* [mm]	*a* [mm]	*b* [mm]
2.5	RR-SA-1.4-110	See *Table 5*	190	380
	RR-SA-2.5-150		260	520
5.0	RR-SA-3.0-200		355	710
	RR-SA-5.0-180		300	600
	RR-SA-5.0-240		420	840
10.0	RR-SA-7.5-300		530	1060
	RR-SA-10.0-300		515	1030
	RR-SA-10.0-370		655	1310
26.0	RR-SA-14.0-370		615	1230
	RR-SA-22.0-500		850	1700

Table 10. Minimum unit geometry for RR-HA Inserts.

Load Class	Type	*d** [mm]	*a* [mm]	*b* [mm]
2.5	RR-HA-1.4-90	80	250	500
	RR-HA-2.5-90	100	300	600
5.0	RR-HA-3.0-120	100	325	650
	RR-HA-4.0-120	110	350	700
	RR-HA-5.0-120	120	375	750
10.0	RR-HA-7.5-160	130	600	1200
	RR-HA-10.0-170	140	600	1200
26.0	RR-HA-14.0-240	160	750	1500
	RR-HA-22.0-300	180	750	1500
	RR-HA-26.0-300	200	750	1500

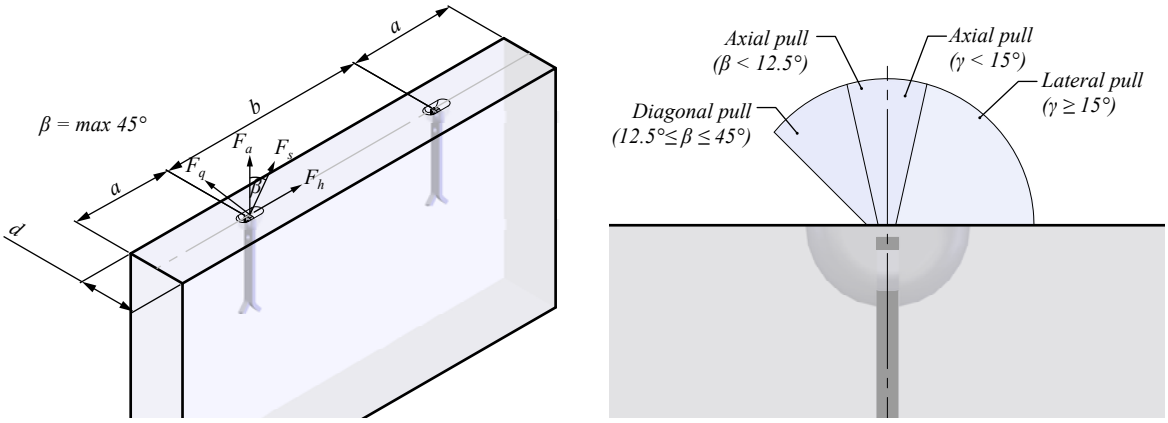
Note: *When using RR Lifting Inserts in concrete elements having these minimum thicknesses a check for the need of additional rebars for diagonal tension is needed. Consider also a sufficient concrete coverage over the additional rebar.

Table 11. Minimum unit geometry for RR-EA Inserts.

Load Class	Type	*d** [mm]	*a* [mm]	*b* [mm]
2.5	RR-EA-1.4-200	See *Table 8*	350	700
	RR-EA-2.5-230		400	800
5.0	RR-EA-4.0-270		475	950
	RR-EA-5.0-290		500	1000
10.0	RR-EA-7.5-320		600	1200
	RR-EA-10.0-390		750	1500
26.0	RR-EA-12.5-500		750	1500
	RR-EA-17.0-500		750	1500
	RR-EA-22.0-500		750	1500

Note: *For lateral pull table values "*d*" are only valid with additional reinforcement.

Figure 12. Long inserts geometry requirements.



PLEASE NOTE:
The geometry specification requires that the installation is within the tolerances as defined in the section "Installation of RR Lifting System".

1.1.4 Reinforcement for RR Long Inserts

The RR 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 (mm²/m or cm²/m). If the designed reinforcement must be removed or cut to install a RR 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 sufficient 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 RR Lifting System on the concrete elements. 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 cross-wise for each element direction.
The load impact on the concrete element from RR Lifting System is highly concentrated through the spread steel tail (RR-SA and RR-EA) or through the anchoring rebar (RR-HA). The load impact to the element always requires the use of additional stirrups to overcome the full load.

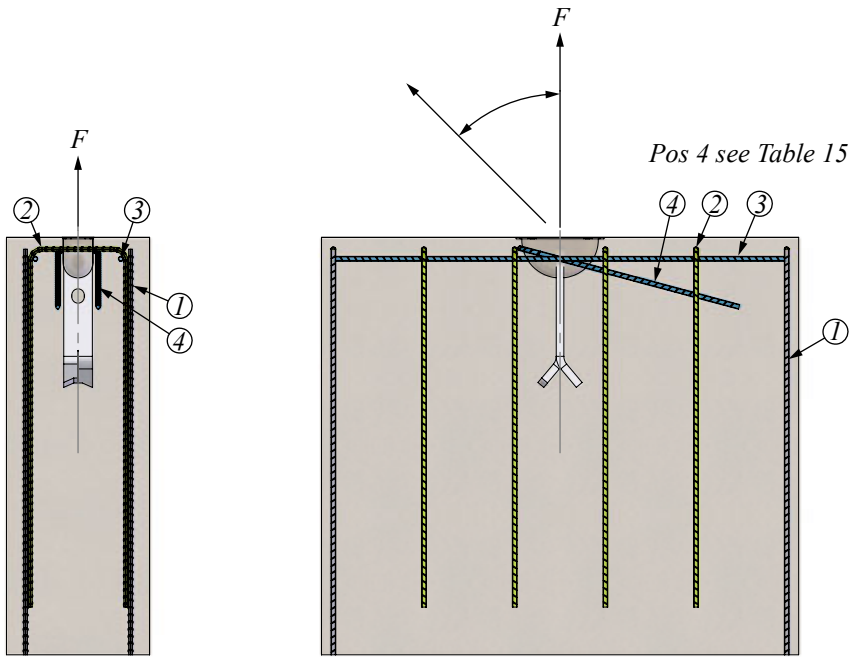
For RR-SA Inserts, the required surface reinforcement must be at least equal to that shown in *Table 12* and *Figure 13*.

Table 12. Reinforcement for RR-SA Inserts.

Load Class	Type	Surface Reinforcement [#mm^2/m] Pos 1	U-stirrup $Ø ds \times L$ Pos 2	Edge Rebar $Ø ds$ [mm] Pos 3
2.5	RR-SA-1.4-110	188*	2Ø6×400	
	RR-SA-2.5-150	188	2Ø8×600	
5.0	RR-SA-3.0-200	188	2Ø8×600	
	RR-SA-5.0-180	188	2Ø10×700	
	RR-SA-5.0-240	188	2Ø10×700	
10.0	RR-SA-7.5-300	188	4Ø10×800	2Ø10
	RR-SA-10.0-300	188	4Ø10×800	2Ø12
	RR-SA-10.0-370	188	4Ø10×800	2Ø14
26.0	RR-SA-14.0-370	257	6Ø10×1000	2Ø14
	RR-SA-22.0-500	257	8Ø10×1000	2Ø16

Note: *For load class 1.4 only one center reinforcement layer needed.

Figure 13. RR-SA Insert reinforcement details.



For RR-HA Inserts the reinforcement and the additional anchoring bar is given in *Table 13*. The bending diameter of the anchoring bar must correspond to applicable standards. The installation of the reinforcement is shown in *Figure 14*.

Table 13. Reinforcement for RR-HA Inserts.

Load Class	Type	Stirrups $n \times Ø ds \times L1$ Pos 2	Surface Reinforcement [#mm2/m] Pos 1	Anchoring Bar $Ø ds \times L$
2.5	RR-HA-1.4-90		188	Ø10×325
	RR-HA-2.5-90		188	Ø12×500
5.0	RR-HA-3.0-120		188	Ø14×500
	RR-HA-4.0-120		188	Ø16×600
	RR-HA-5.0-120		188	Ø16×750
10.0	RR-HA-7.5-160		188	Ø20×875
	RR-HA-10.0-170		188	Ø25×925
26.0	RR-HA-14.0-240		188	Ø28×1175
	RR-HA-22.0-300	4Ø12×1200	188	Ø28×1500
	RR-HA-26.0-300	6Ø12×1200	188	2Ø28×1500

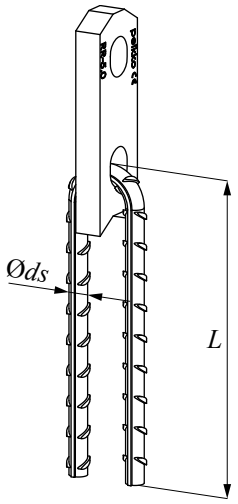
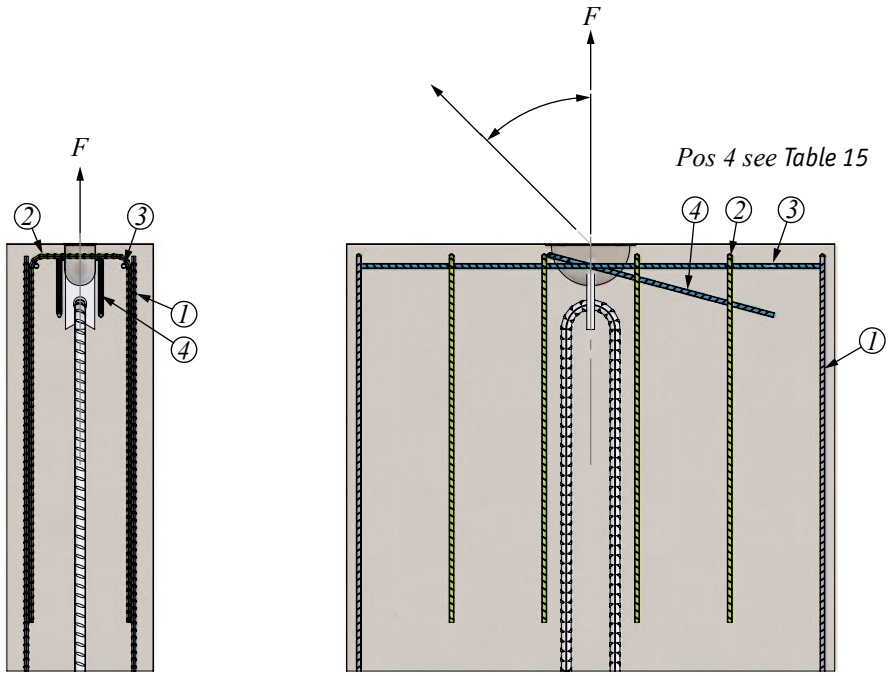


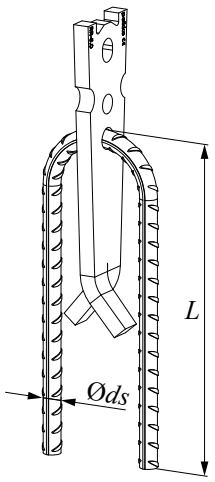
Figure 14. RR-HA Long Insert reinforcement details.



RR-EA, designed specifically for the tilt-up process, needs to be used with u-stirrups and edge reinforcement according to *Table 14* and additional reinforcement according to the load. For lateral tension, the needed additional reinforcement is according to *Table 16*, for axial and diagonal tension according to *Table 14*, *Table 15* and *Figure 15*.

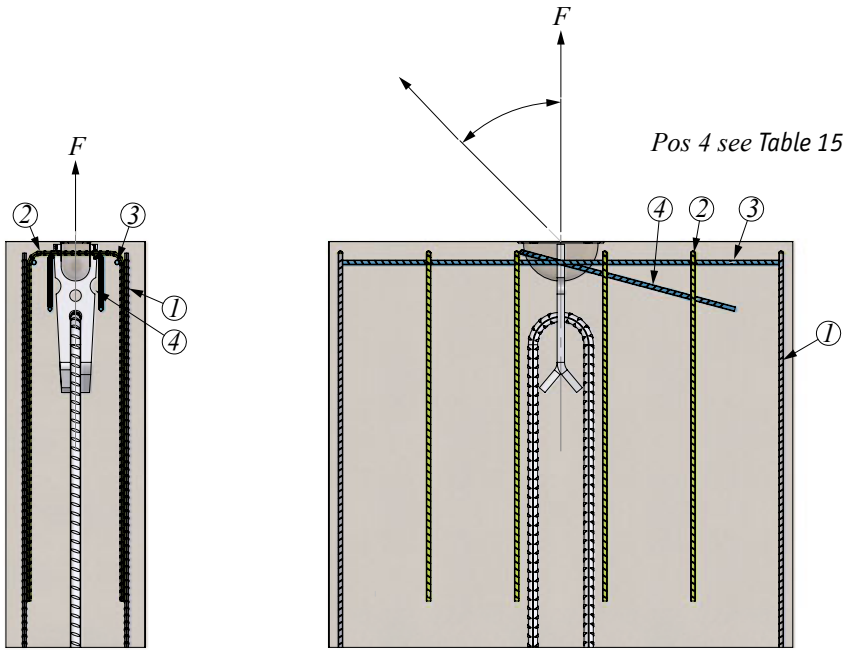
Table 14. Reinforcement for RR-EA Inserts.

Load Class	Type	Surface reinforcement [#mm²/m] Pos 1	U-stirrup Ø*ds* × *L* Pos 2	Edge rebar Ø*ds* [mm] Pos 3	Anchoring Bar * Ø*ds* x *L*
2.5	RR-EA-1.4-200	188	2Ø6×400		Ø10×325
	RR-EA-2.5-230	188	2Ø8×600		Ø12×500
5.0	RR-EA-4.0-270	188	2Ø8×600		Ø16×600
	RR-EA-5.0-290	188	2Ø10×700		Ø16×750
10.0	RR-EA-7.5-320	188	4Ø10×800	2Ø10	Ø20×875
	RR-EA-10.0-390	188	6Ø10×800	2Ø14	Ø20×925
26.0	RR-EA-12.5-500	188	6Ø10×1000	2Ø14	Ø25×1100
	RR-EA-17.0-500	257	8Ø10×1200	2Ø16	Ø28×1250
	RR-EA-22.0-500	257	8Ø10×1200	2Ø16	Ø28×1500



Note: *The anchoring bar is only needed when element thickness complies with *Table 10* (RR-HA) and usage of RR-EA Lifting Insert types. In such a case, the lateral load direction (90°) is not permissible.

Figure 15. RR-EA Insert reinforcement details.



1.1.5 Types and geometry of additional reinforcement

All additional reinforcement referred to in this section must be located as to support RR Lifting Insert.

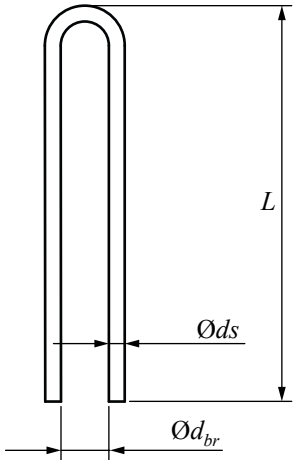
Reinforcement for diagonal pull (from 12.5° to 45°)

Diagonal pull on the inserts requires special reinforcement around the RR Lifting Recess to support the RR Lifting Insert. This reinforcement must always have direct pressure contact with the recess made with the RR-RF or RR-PF item. This can be achieved by fixing with wire.

For load angles up to 45°, the reinforcement is shown in *Table 15*. If the load is limited to a maximum of 30°, rebar with a smaller diameter can be used.

Table 15. Diagonal rebar for RR Long Inserts.

RR Long Inserts Pos 4				
Load Class	**Load Category**	**12.5° ≤ β ≤ 45° $\varnothing ds \times L$ [mm]**	**12.5° ≤ β ≤ 30° $\varnothing ds \times L$ [mm]**	**$\varnothing d_{br}$ [mm]**
2.5	0.7	Ø6×240	Ø6×170	35
	1.4	Ø8×220	Ø6×200	
	2.0	Ø8×310	Ø8×220	
	2.5	Ø10×300	Ø8×300	
5.0	3.0	Ø10×370	Ø8×330	47
	4.0	Ø12×410	Ø10×350	
	5.0	Ø12×420	Ø10×420	
10.0	7.5	Ø16×580	Ø14×470	67
	10.0	Ø16×770	Ø14×620	
26.0	12.5	Ø20×750	Ø16×700	100
	14.0	Ø20×860	Ø20×610	
	17.0	Ø25×840	Ø20×740	
	22.0	Ø25×1080	Ø25×770	
	26.0	Ø28×1140	Ø25×900	

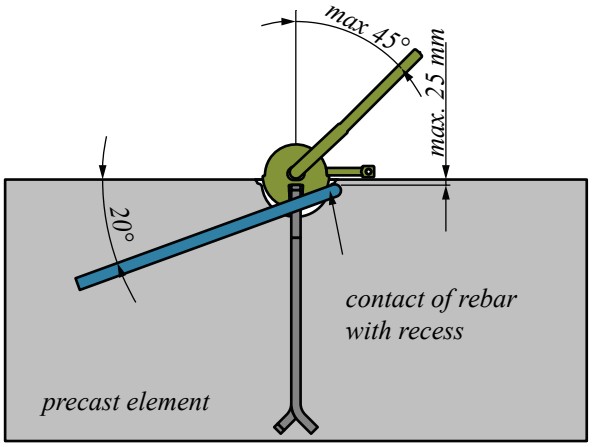


The recommended bending diameter of the diagonal rebar 'dbr' is the outer diameter of the RR-RF or RR-PF recess. This ensures a precise finish and limits the possibility of installation errors. As an alternative, a sufficiently large bending diameter according to EN 1992-1-1:2011 can be implemented so that the rebar encloses the RR-RF or RR-PF recess.

The diagonal pull rebar must be installed at an angle of approximately 20°. *Figure 16* demonstrates this.

If very slim wall elements do not offer sufficient space or concrete coverage, the diagonal pull must be limited to 30° and a smaller rebar diameter in accordance with *Table 15* can be used.

Figure 16. Reinforcement installation for diagonal pull of long inserts.



Reinforcement for lateral pull (90° for RR-EA and RR-SA Inserts only)

Lateral pull that results in upward tilting actions applies only to RR Long Inserts RR-SA and RR-EA. No other type of RR Long Insert may be used in the lateral direction.

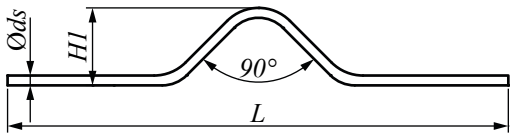
Lateral pull on the inserts requires reinforcement around RR Lifting Insert during the early hardening stage of the concrete. This reinforcement must always have direct pressure contact with RR Lifting Insert. For RR-SA Lifting Inserts this can be achieved by using wire fixing and a precise installation routine. For RR-EA Lifting Inserts the existing semicircular notches take the additional reinforcement and transfer the load directly to the Insert. When lowering and raising the component, the user must take into account the direction of the reinforcement in accordance with *Table 16*.

It is recommended that additional reinforcement be used on both sides of the RR-EA or RR-SA Long Inserts. In such a case, no additional diagonal pull reinforcement is needed.

Table 16. Lateral rebar (if $\gamma \geq 15°$) for RR-SA and RR-EA Lifting Inserts.

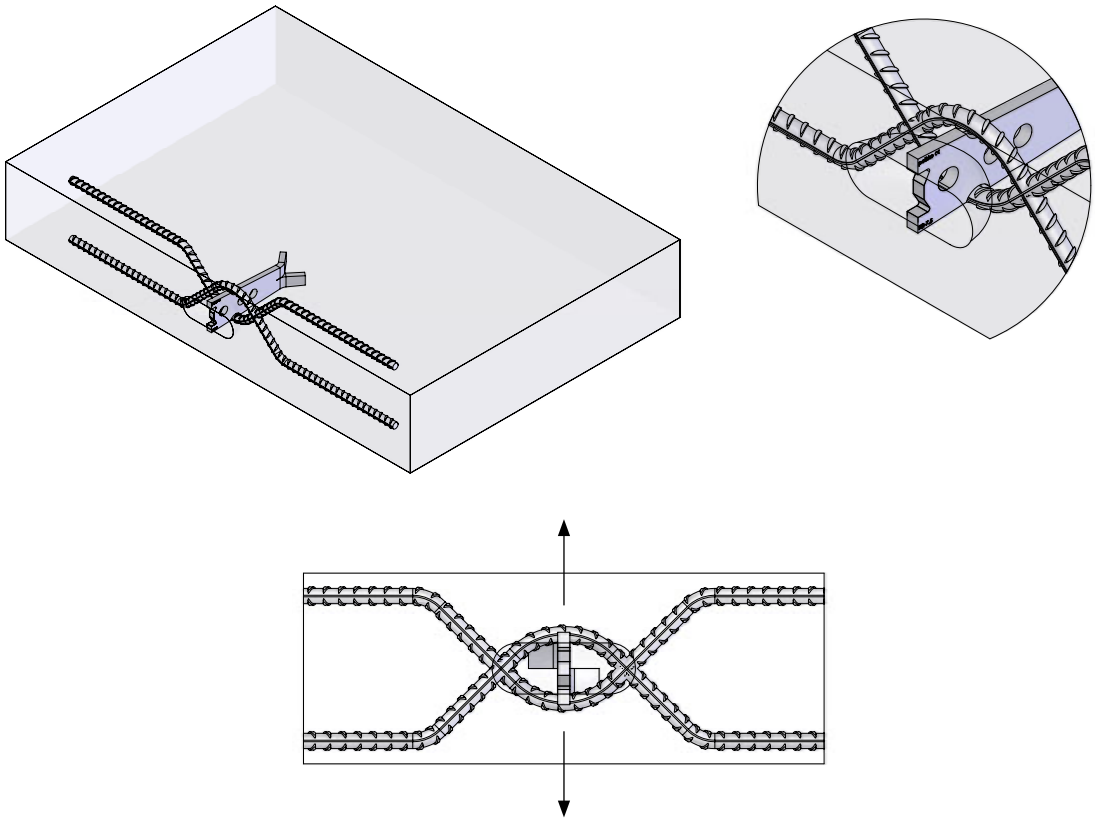
Load Class	Type	Type	$Ød_s \times L1$ [mm]
2.5	RR-EA-1.4-200	RR-SA-1.4-110	Ø10×700
	RR-EA-2.5-230	RR-SA-2.5-150	Ø12×800
5.0		RR-SA-3.0-200	Ø14×900
	RR-EA-4.0-270		Ø14×900
	RR-EA-5.0-290	RR-SA-5.0-180	Ø16×1000
		RR-SA-5.0-240	Ø16×1000
10.0	RR-EA-7.5-320	RR-SA-7.5-300	Ø20×1200
	RR-EA-10.0-390	RR-SA-10.0-300	Ø20×1200
		RR-SA-10.0-370	Ø20×1200
26.0	RR-EA-12.5-500		Ø25×1500
		RR-SA-14.0-370	Ø25×1500
	RR-EA-17.0-500		Ø25×1500
	RR-EA-22.0-500	RR-SA-22.0-500	Ø25×1800

Lateral pull reinforcement



H1 to be selected according unit geometry and requirements

Figure 17. Lateral reinforcement for RR-EA and RR-SA Inserts.



1.2 RR Short Inserts

RR Short Inserts are used in applications where only limited anchoring depth is present, such as in slabs. They are not intended for tilting up process and the load angle is limited to 45°. This section describes the product properties of RR Short Inserts. Peikko standard products are always delivered in black (uncoated). All dimensions given in this section are valid for all finishes.

RR-PA-2.5-80: RR Lifting Insert (standard item)
RR-PAG-2.5-80: RR Lifting Insert electro galvanized (available upon request)

1.2.1 Dimensions and weights of system components

RR Short Inserts are available in standard length shown in *Figure 18* and *Table 17*. Inserts with customized length for special purposes are available upon request.

Figure 18. RR-PA Short Insert types.

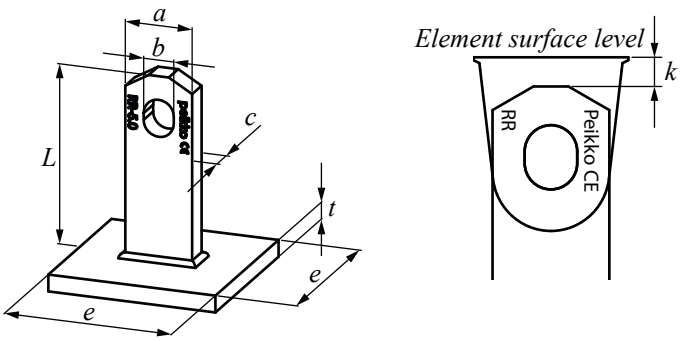
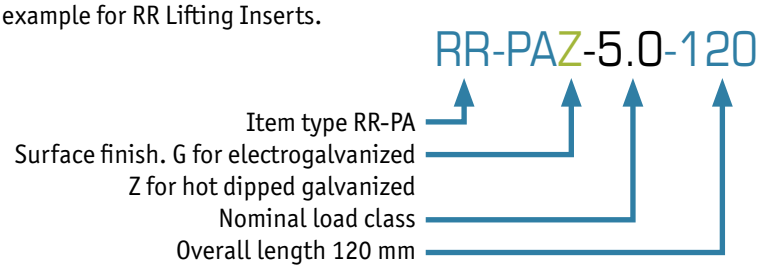


Table 17. Dimensions of RR-PA Short Inserts.

Load Class	Type	RR-PA Dimensions L [mm]	a [mm]	b [mm]	c [mm]	t [mm]	k [mm]	Weight [kg/pcs]
2.5	RR-PA-1.4-55	55	30	14	6	8	10	0.49
	RR-PA-2.5-80	80	30	14	10	8	10	0.55
5.0	RR-PA-5.0-120	120	40	18	15	10	10	1.26
10.0	RR-PA-10.0-160	160	60	26	20	12	15	3.15

Ordering example for RR Lifting Inserts.



PLEASE NOTE:
Selecting items such as RR-PA-2.5-80 defines a standard product when no other information is added. For customized lengths and finish please use the following code: RR-PA-2.5-L (L in mm and finish information). The method can be applied to all other products.

1.2.2 Safe working loads for RR Short Inserts

RR Lifting System's resistances are determined by a design concept that refers to the following standards and regulations:

EN 1992-1-1:2011
Machinery directive 2006/42/EC
VDI/BV-BS6205:2012

The load capacities depend very much on how, and in which combination, the different items will be used. For RR Short Inserts all RR Lifting Keys (RR-C and RR-CW) can be used at an angle β of 0-45°.

The safe working load capacities (SWL) are based upon specific dimensions and edge distances as given in following sections. Before selecting the insert, take note of the design assumptions in this manual. **The minimum compressive strength of the concrete at the moment of load application is 15MPa.**

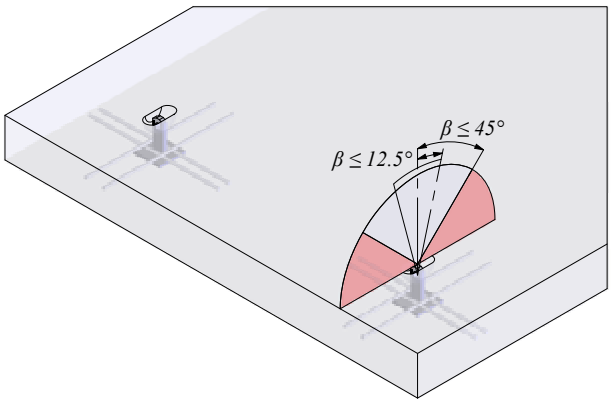
Min
15MPa

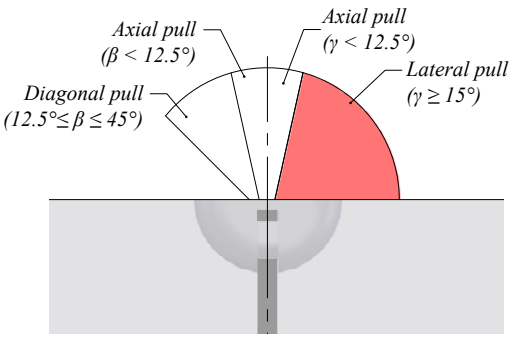
Table 18 shows the safe working load (SWL) levels of short inserts. Select inserts that are suitable for the planned load directions. *Figure 19* illustrates the load directions related to this table.

Table 18. Safe working load (SWL) for RR-PA Short Inserts.

		Safe working loads [kN]					
		SWL for β = 0°-12.5° [kN]			SWL for β = 12,5°-45° [kN]		
Load class	Type	fck ≥ 15 MPa	fck ≥ 20 MPa	fck ≥ 25 MPa	fck ≥ 15 MPa	fck ≥ 20 MPa	fck ≥ 25 MPa
2.5	RR-PA-1.4-50	14.0	14.0	14.0	14.0	14.0	14.0
	RR-PA-2.5-80	22.7	25.0	25.0	25.0	25.0	25.0
5.0	RR-PA-5.0-120	44.0	50.0	50.0	38.0	43.9	49.1
10.0	RR-PA-10.0-160	63.0	73.0	82.0	80.0	92.4	100

Figure 19. Load directions for short inserts.





PLEASE NOTE:
Diagonal pull between 12.5° and 45° is only permitted with additional reinforcement according to the following section.

1.2.3 Unit geometry and spacing

The use of Peikko Lifting Systems requires a specific geometry of the element. The load capacities given in this section of 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. Peikko's engineering service offers customized solutions to make special applications possible.

Before selecting and installing an insert, consider the general information in the previous sections of this manual. The required element geometry specification for RR Short Inserts differs from that of RR Long Inserts. The two types cannot replace each other or be applied in the same way unless all the geometric requirements are complied with.

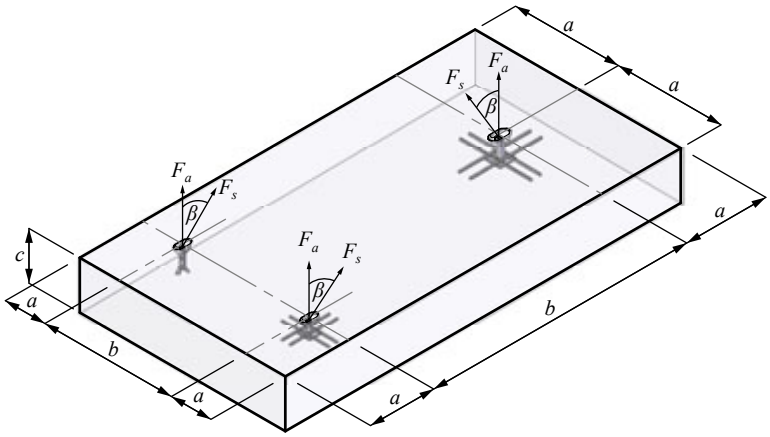
RR Short Inserts are commonly used in thin flat elements with limited anchorage depth. For this reason the loads are transferred over the width of the element. In many cases, capacities are limited by the element thickness "*c*" due to slab bending during lifting.
The minimum element thickness, as well as minimum edge and axial distances for respective insert types are shown in *Table 19*.

Figure 20 visualizes the requirement.

Table 19. Minimum unit geometry for short inserts.

		Spacing		
Load class	**Type**	***c*** **[mm]**	***a*** **[mm]**	***b*** **[mm]**
2.5	RR-PA-1.4-50	85	110	220
	RR-PA-2.5-80	110	160	320
5.0	RR-PA-5.0-120	150	240	480
10.0	RR-PA-10.0-160	195	320	640

Figure 20. Short inserts geometry requirements.



PLEASE NOTE:
The geometry specification requires that installation be within the tolerances defined in section 2. Reinforcement for RR Short Inserts

1.2.4 Reinforcement for RR Short Inserts

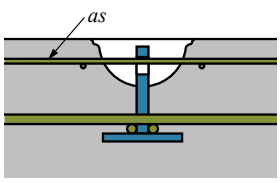
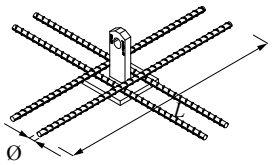
The use of lifting systems requires a minimum level of reinforcement in the concrete elements. The reinforcement that is defined by structural design can be considered, by taking into account the existing cross section. The needed reinforcement level can be attained by using single reinforcing bars or wire mesh with an equivalent or greater cross section (mm^2/m or cm^2/m). If the designed reinforcement must be removed or cut to install RR Lifting Insert, this area must be repaired by adding similar cross section of reinforcement (single bars or wire mesh) with 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 described in this section supports only the load impact of the RR Lifting System on the concrete element. The structural designer must bear in mind, that as a result from transportation process the element may bend. Additional reinforcement might be needed 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 RR Short Inserts types there is a top surface reinforcement layer needed and additional cross wise installed plate rebars. These plate rebars run in direct contact with the base steel plate. The *Table 20* shows the required reinforcement level.

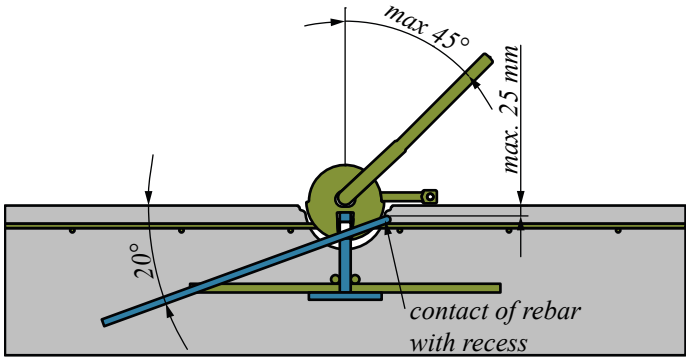
Table 20. Reinforcement for RR Short Inserts.

Load Class	Type	*as* [mm^2/m]		Bars $n \times Ø \times L$	
2.5	RR-PA-1.4-50	188		2+2 Ø8×200	
	RR-PA-2.5-80	188		2+2 Ø10×300	
5.0	RR-PA-5.0-120	188		2+2 Ø12×450	
10.0	RR-PA-10.0-160	257		2+2 Ø16×600	

Types and geometry of additional reinforcement

All additional reinforcement referred to in this section must be located so as to support the RR Lifting Insert. *Figure 21* shows the optimum position for the additional reinforcement where the rebar has contact with the recess.

Figure 21. Position of additional rebar after installation.



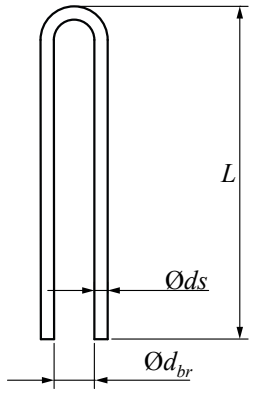
Reinforcement for diagonal pull (from 12.5° to 45°)

Diagonal pull on the inserts requires special reinforcement around the RR Lifting Recess to support RR Lifting Insert. This reinforcement must always have direct pressure contact with the RR-RF or RR-PF recess. This can be achieved by fixing with wire.

For the load angles up to 45°, the reinforcement is shown in *Table 21*. If the load is limited to a maximum of 30° a smaller diameter of rebar can be used.

Table 21. Diagonal rebar for RR Short Inserts.

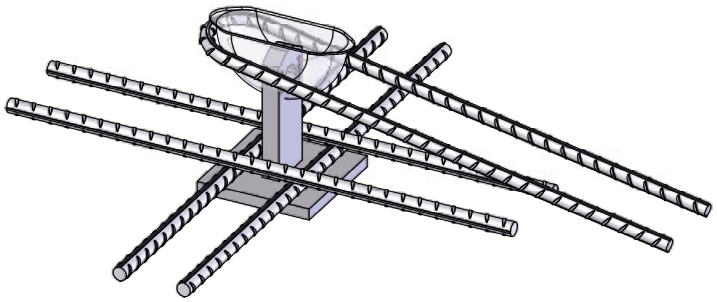
RR Short Inserts Pos 4				
Load Class	**Load Category**	**12.5° ≤ β ≤ 45° Øds × L [mm]**	**12.5° ≤ β ≤ 30° Øds × L [mm]**	**Ød_{br} [mm]**
2.5	1.4	Ø8×220	Ø6×200	35
	2.5	Ø10×300	Ø8×300	
5.0	5.0	Ø12×420	Ø10×420	47
10.0	10.0	Ø16×770	Ø14×620	67



The recommended bending diameter of the diagonal rebar 'dbr' is the outer diameter of the recess RR-RF or RR-PF. This ensures a precise finish and limits the possibility of installation errors. As an alternative, a sufficiently large bending diameter according to EN 1992-1-1:2011 can be implemented so that the rebar encloses the RR-RF or RR-PF recess.

The diagonal pull rebar must be installed at an angle of approximately 20° as demonstrated in *Figure 21*.

Figure 22. Installation for RR-PA Short Inserts.



1.3 RR Lifting Keys

1.3.1 Dimensions and weights of system components

RR Lifting Keys are used to attach the crane hook, lifting slings or chains to the RR Lifting Insert which is cast into the concrete element. RR Lifting Keys are designed for all load directions.
RR Lifting Keys can be used with all of the RR Lifting System's insert types. Information on the dimension and weights of standard items is shown in *Figure 23* and *Table 22* for RR-C and *Table 23* for RR-CW Lifting Keys. Peikko's standard products are always delivered electro galvanized.

Figure 23. RR-C and RR-CW Lifting Keys.

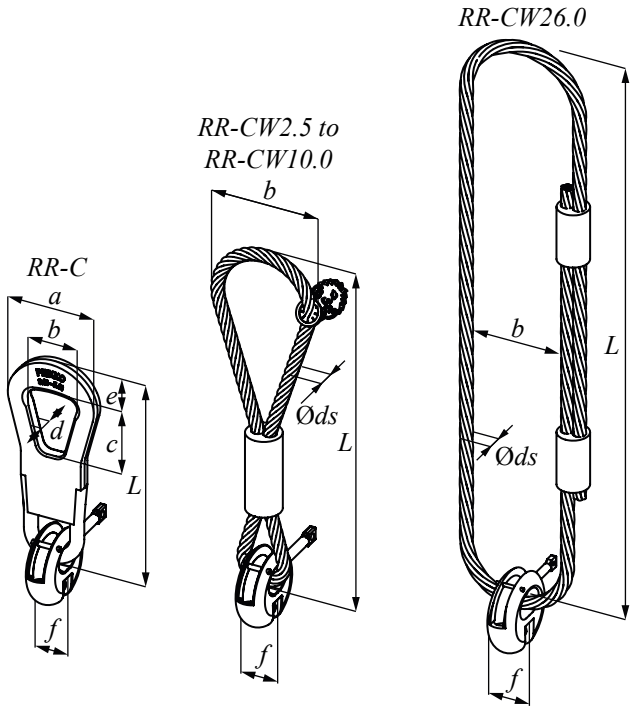


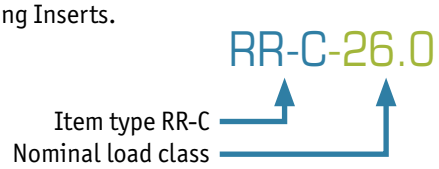
Table 22. Dimensions and weights of RR-C Lifting Keys.

Load class	Item	Dimensions of RR-C							SWL [kN] for 0°-45°	SWL [kN] for 90°	Weight [kg/pcs]
		a [mm]	*b* [mm]	*c* [mm]	*d* [mm]	*e* [mm]	*L* [mm]	*f* [mm]			
2.5	RR-C-2.5	59	95	70	12	12.5	265	59	25	12.5	1.8
5.0	RR-C-5.0	66	117	85	17	25.0	330	66	50	25.0	3.5
10.0	RR-C-10.0	85	148	110	25	50.0	425	85	100	50.0	8.1
26.0	RR-C-26.0	120	210	160	30	130.0	605	120	260	130.0	30.6

Table 23. Dimensions and weights of RR-CW Lifting Keys.

Load class	Item	Dimensions of RR-CW				SWL [kN] for 0°-45°	SWL [kN] for 90°	Weight [kg/pcs]
		d_s [mm]	*L* [mm]	*b* [mm]	*f* [mm]			
2.5	RR-CW-2.5	14	560	110	59	25	12.5	1.8
5.0	RR-CW-5.0	18	595	140	66	50	25.0	3.5
10.0	RR-CW-10.0	22	700	170	85	100	50.0	8.1
26.0	RR-CW-26.0	32	1570	250	120	260	130.0	30.6

Ordering example for RR Lifting Inserts.

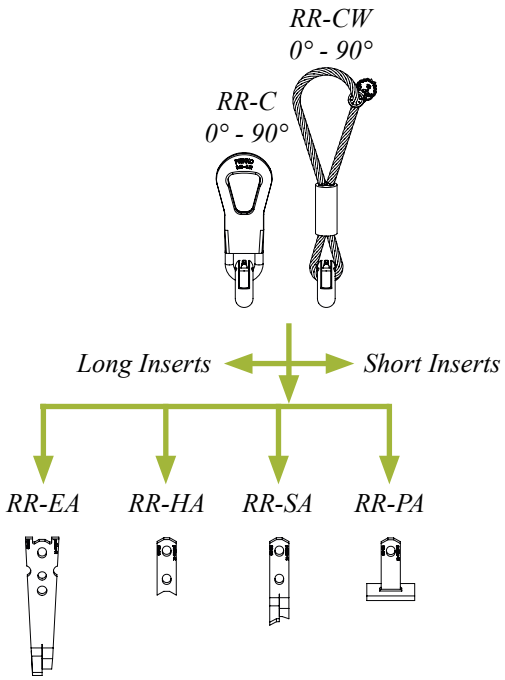


1.3.2 Instructions for using RR Lifting Keys

When RR Lifting Systems are used, this manual, including the instructions for safe use, must be available at all times. Before using any of these Peikko products on building sites, the contractor must ensure that the instructions are available and have been read, understood, and followed. Misuse, misapplication, or lack of proper supervision and/or inspection can result in serious accidents.

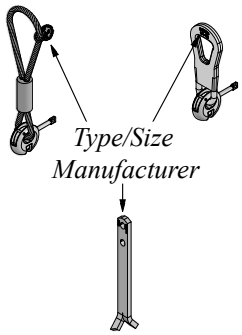
The safe use of any lifting systems requires the RR Lifting Key and the insert to fit properly together. RR Lifting System has a color code at the RR-RF and RR-PF recess items and a load class marking on the anchor that defines which RR Lifting Keys fit which insert. All original RR Lifting Keys can be used with all inserts without limitation as illustrated in *Figure 24*. The permitted load directions must be followed.

Figure 24. Combination of inserts with RR Lifting Keys.



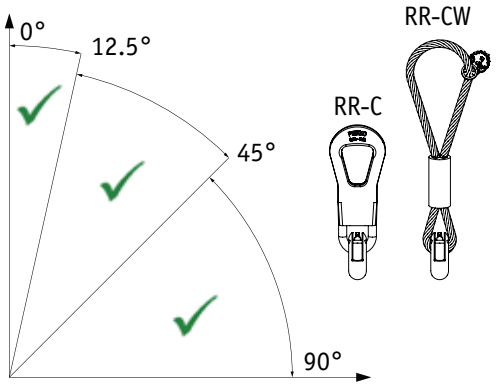
Prior to use, check whether RR Lifting Key fits the installed insert. Always ensure that the correct RR Lifting Key is used with the correct RR Lifting Insert and load class as shown in *Figure 25*.

Figure 25. Right combination of RR Lifting Insert and RR Lifting Key.



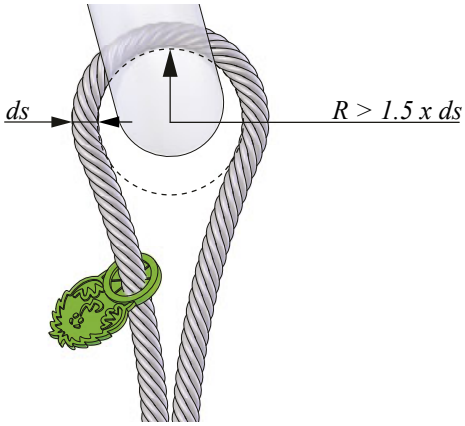
Different lifting keys have different permissible load direction. For RR-C and RR-CW Lifting Key load directions between 0° and 45° and for 90° tilt-up processes are permitted. *Figure 26* illustrates the permissible load directions of RR Lifting Keys.

Figure 26. Permissible load directions.



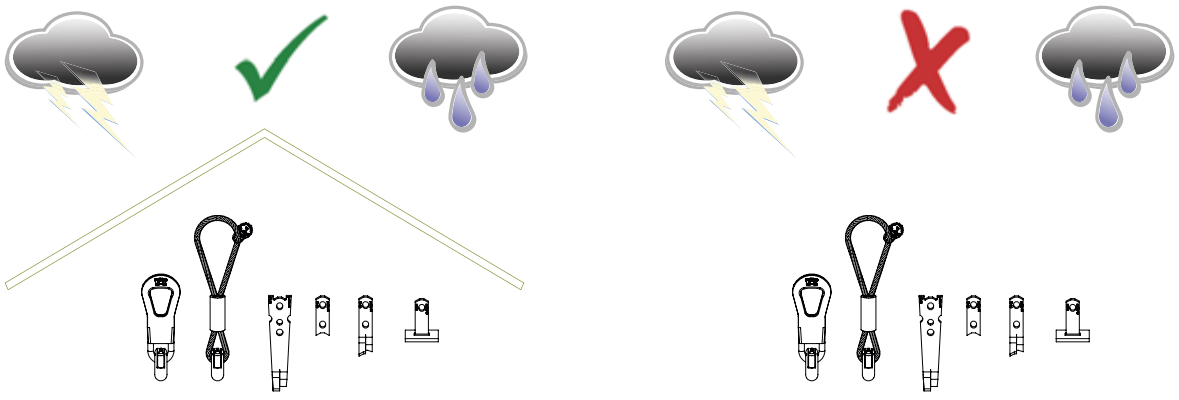
When using RR-CW Lifting Keys made from wire or containing wire parts, ensure that the hook or the bolt going through the rope loop always has a radius of at least *1.5ds*, where ds is the existing rope diameter. This prevents loss of rope capacity due to the combined tension and pressure forces illustrated in *Figure 27*.

Figure 27. Minimum radius for the wire.



Lifting components must be stored and protected in dry conditions, preferably under a roof. *Figure 28* shows a suitable storage location.

Figure 28. Storage location.



WARNING:

RR 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 damages and shorten the standing time, which increases costs.

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

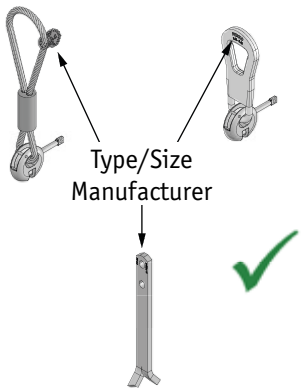
The following are mandatory instructions for safe working. They must be complied with exactly whenever lifting systems are in use.

WARNING:

- Lock RR Lifting Keys completely into the RR Lifting Insert with handle position to lifting direction.
- Operate manually. Do not use any tools such as bars or claws.
- During the attachment process the RR Lifting Key should move freely without requiring force. If RR Lifting Key is blocked, check for damage and the presence of obstructions.
- Visually inspect all items before use.
- Check and clean all surfaces of the RR Lifting Keys and the recess of RR Lifting Inserts before use. It is highly recommended that the RR-RF and RR-PF interior be lubricated to avoid concrete pollution. Pollution can prevent the RR Lifting Key from fitting of the RR Lifting Insert, which has an immediate impact on the safety level, and may result in danger of death.
- Inspect all RR Lifting Keys regularly for safety purposes.
- Use RR Lifting Keys 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.

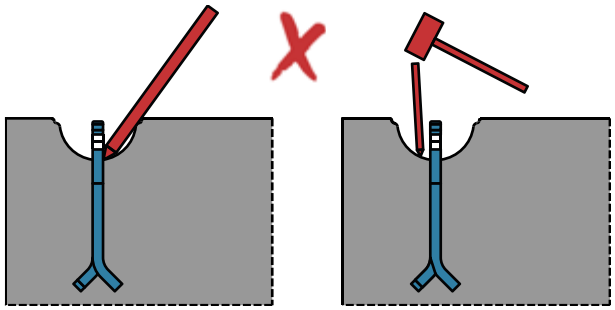
The hoisting process requires the right combination of RR-C or RR-CW Lifting Keys and RR Lifting Inserts as shown in *Figure 29*.

Figure 29. Right combination of RR Lifting System parts.



The recess items such as RR-RF and RR-PF creates a recess which corresponds very precisely to the geometry of RR Lifting Keys. Do not break the concrete around RR Lifting Insert and never mechanically rework the items (see *Figure 30*).

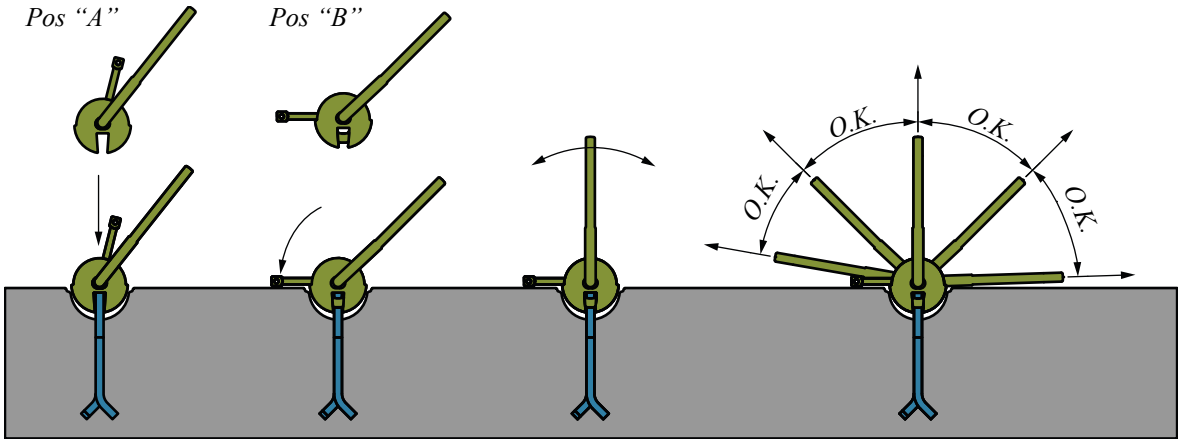
Figure 30. Rework at recess and RR Lifting Insert.



RR-C and RR-CW Lifting Keys are used in the RR Lifting System. Connection and disconnection is fast, easy, and safe. RR-RF or RR-PF recess items must be used to ensure the correct position of RR Lifting Insert and RR Lifting Key. The installation guide for RR Lifting System and the load class of the RR Lifting Key and the RR Lifting Insert must always be considered before use.

When connecting RR Lifting Key to RR Lifting Insert, ensure that the casted part of RR Lifting Key is placed correctly over RR Lifting Insert with the locking bolt in position "*A*" (see marking on casted part) as shown in *Figure 31*. Push the RR Lifting Key to the recess and secure the Lifting System by pushing the locking bolt to the element surface into position "*B*". The locking bolt runs in position "*B*" through the hole and a safe connection is given between the RR Lifting Insert and the RR Lifting Key.

Figure 31. Connection detail of RR Lifting Keys and RR Lifting Inserts.



Disconnection of RR Lifting Key from RR Lifting Insert happens always in unloaded condition. To disconnect the RR Lifting Key move the locking bolt to position '*A*' (see *Figure 31*). Once in position '*A*', the RR Lifting key can be removed from RR Lifting Insert.

All load directions are permissible for RR Lifting Keys after locking (straight, angle, and lateral pull). Angular pull caused by angle of inclination is limited to a maximum of 45° (see *Figure 32*).

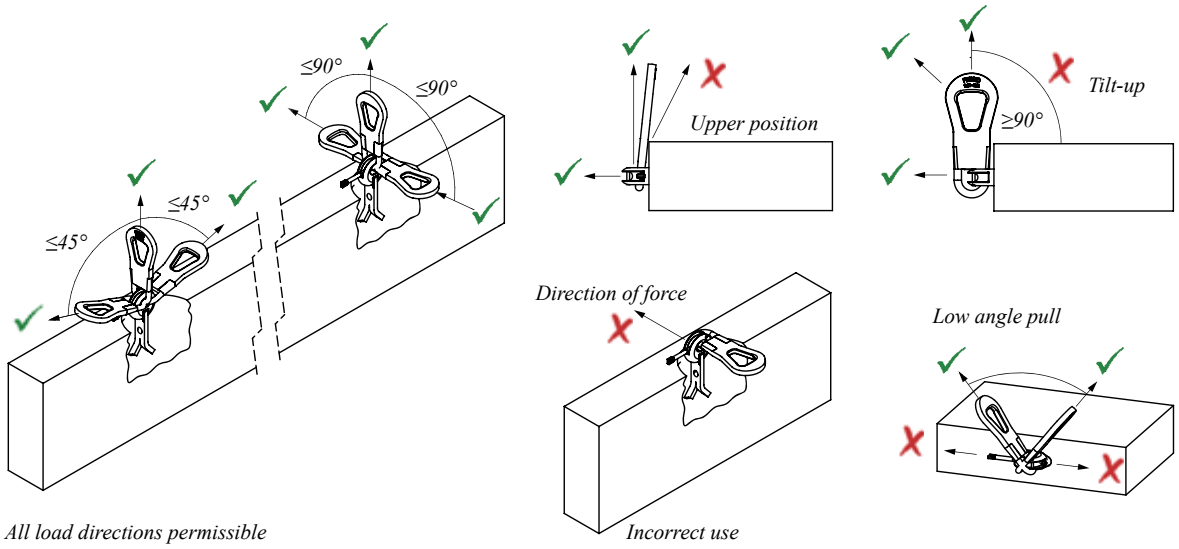
For tilt-up procedures, the RR Lifting Key must be used in the position as shown in *Figure 32*. This ensures load impact and avoids causing damage to the RR Lifting Key. Additional reinforcement of the RR Lifting Insert must be used to prevent damage to the concrete.

In the upper position the handle can be blocked in the casted part. Only the permissible load directions are to be applied in that position (see *Figure 32*). Never pull the handle against the concrete edge. This can bend the handle and can cause damages on the handle and spallings on the concrete.

Low angle pull as shown in *Figure 32* can cause deformations on the handle. Turning the handle by 45° avoids this.

Wrong use can happen during hoisting actions when the handle of the RR Lifting Key is blocked (see *Figure 32*). Never use RR Lifting Keys in this position. When RR Lifting Key handle remains in the position during lifting, bending can happen which results in irreparable damage.

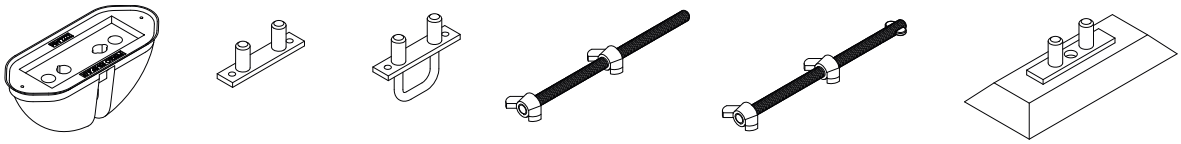
Figure 32. Permissible load directions and use for RR-C and RR-CW Lifting Keys.



1.4 RR Lifting Accessories

The RR Lifting System has a range of RR Lifting Accessories for installation. Installation is easy and must be done in the direction of the pull. For bigger RR Lifting Inserts it might be necessary to fix the insert with wire to prevent it from sliding in the mold.

1.4.1 Installation accessories



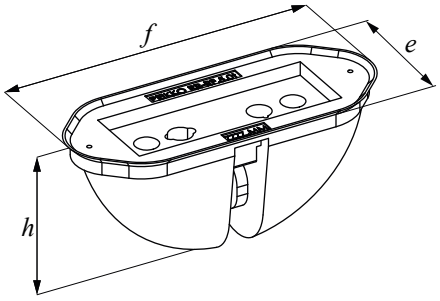
Installation accessories are efficient aids for users who are placing lifting systems in the formwork. Installation accessories can be screwed, nailed, or fixed with thread bars depending on the individual application.
Peikko recommends greasing the accessories to prevent concrete pollution which can limit system's usability.

RR-RF (rubber) and RR-PF (plastic) Recess Items are used to correctly install and position the lifting insert and create an opening for the RR Lifting Key on the surface of the concrete element. The Recess Item is pulled open and the RR Lifting insert is placed between the two halves with the insert hole placed on the rubber barriers anchoring the insert from the top hole.
The closed recess Item is fixed into the mold by using either RR-FS or RR-HP fixing items. The upper edge of the recess item must flush with the concrete surface.
Recess items are available in four sizes matching the load classes of RR Lifting Keys and can be used with all RR Lifting Inserts.

Figure 33. RR-RF and RR-PF dimensions.

Recess former rubber and hard plastic

Load Class	Item	Item	Color	*h* [mm]	*e* [mm]	*f* [mm]
2.5	RR-RF-2.5	RR-PF-2.5	Orange	45	43	106
5.0	RR-RF-5.0	RR-PF-5.0	Black	59	55	126
10.0	RR-RF-10.0	RR-PF-10.0	Green	85	78	188
26.0		RR-PF-26.0	Blue	118	120	234

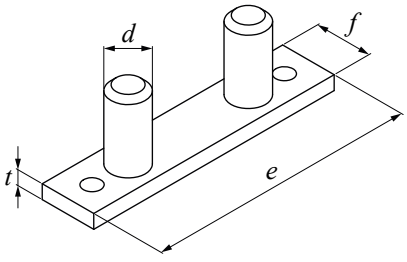


RR-HP1 Fixing Items are mostly used on elements such as walls, where a horizontal RR Lifting Insert installation is needed. Fixing is done by nailing or screwing the RR-HP1 to a wooden formwork and then pressing the pre-installed Recess Item with Lifting Insert to it. RR-HP1 Fixing Items are compatible with all RR-RF and RR-PF Recess Items. No tools are needed for removing the nails and screws.

Figure 34. RR-HP1 dimensions.

RR plate with nailing holes

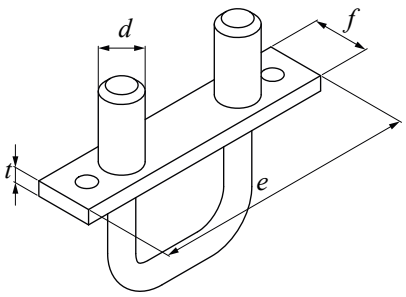
Load Class	Item	*e* [mm]	*f* [mm]	*t* [mm]	*d* [mm]
2.5	RR-HP1-2.5	70	15	3	8
5.0	RR-HP1-5.0	85	30	4	10
10.0	RR-HP1-10.0	125	45	4	12
26.0	RR-HP1-26.0	175	65	4	16



RR-HP2 Fixing Items are mostly used on elements such as slabs, where a vertical RR Lifting Insert installation is needed. RR-HP2 Fixing Item is pressed to the back of the Recess Item with pre–installed Lifting Insert. The ready installed combination will be pushed into the fresh concrete, flush with the surface. RR-HP2 Fixing items are compatible with all RR-RF and RR-PF Recess Items. No nails or screws are needed for the installation.

Figure 35. RR-HP2 dimensions.

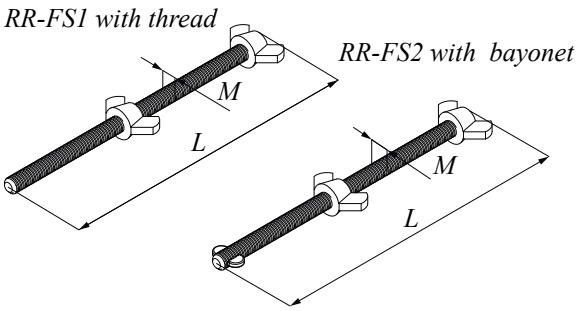
RR holding plate with handle					
Load Class	Item	*e* [mm]	*f* [mm]	*t* [mm]	*d* [mm]
2.5	RR-HP2-2.5	70	15	4	10
5.0	RR-HP2-5.0	85	30	4	10
10.0	RR-HP2-10.0	125	45	4	12
26.0	RR-HP2-26.0	175	65	4	16



The Fixing Screws RR-FS1 and RR-FS2 are used to fix the RR Lifting Insert to the formwork in vertical or horizontal directions.
The fixing is done by inserting the Fixing Screw to the back of the Recess Item with pre-installed Lifting Insert, pushing the screw through a hole on the formwork and fixing by a wing nut.
RR-FS1 and RR-FS2 Fixing Items are compatible with all RR-RF and RR-PF Recess Items. No nails or screws are needed for the installation. The RR-FS1 and RR-FS2 Items can be removed manually.

Figure 36. RR-FS1 and RR-FS2 dimensions.

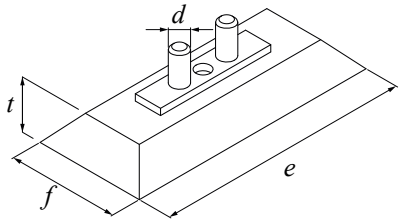
RR Fixation Screw with Thread and Bayonet Connection				
Load Class	Item	Item	*L* [mm]	*M* [mm]
2.5	RR-FS1-2.5	RR-FS2-2.5	160	M8
5.0	RR- FS1-5.0	RR- FS2-5.0	160	M8
10.0	RR- FS1-10.0	RR- FS2-10.0	160	M12
26.0	RR- FS1-26.0	RR- FS2-26.0	180	M12



RR-MH Magnetic Holding Items are used for all applications where RR Lifting Inserts are used with steel formwork. No drilling or other treatments to the formwork are needed. The fixing is done by pressing the Magnetic Holding Item to the back of pre-installed Recess Item with Lifting Insert and placing this to the formwork. RR-MH Magnetic Holding Items are compatible with all RR-RF and RR-PF Recess Items and can be removed manually.

Figure 37. RR-MH dimensions.

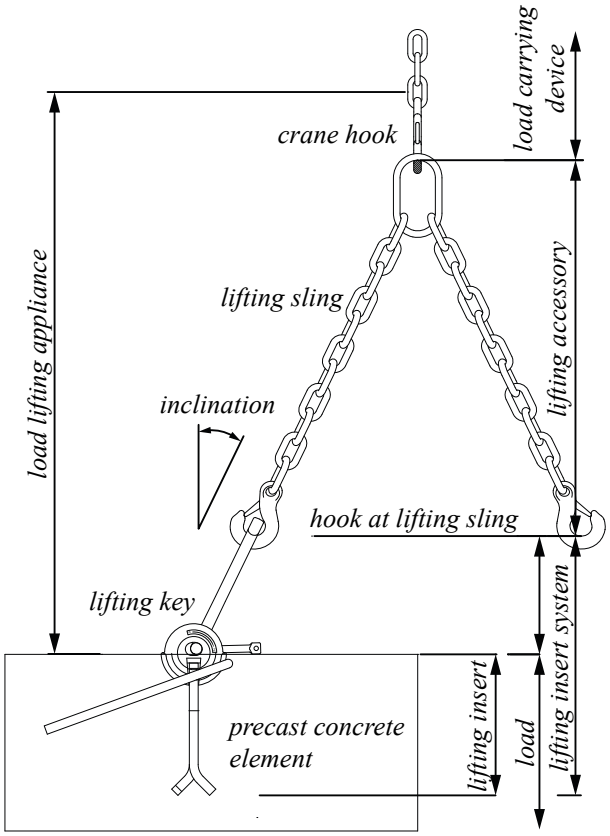
RR magnetic holder					
Load Class	Item	*e* [mm]	*f* [mm]	*t* [mm]	*d* [mm]
2.5	RR-MH-2.5	144	63	16	10
5.0	RR-MH-5.0	144	63	16	10
10.0	RR-MH-10.0	220	126	16	12



2. Selecting a lifting system

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, RR Lifting Systems consist of RR Lifting Insert, permanently anchored in the precast element, and the corresponding RR Lifting Keys, which hooks temporarily on to the embedded RR Lifting Insert. *Figure 38* shows this definition in an overview of RR Lifting System parts.

Figure 38. Definition of a lifting system according to VDI/BV-BS6205:2012.



Elements that are parts of lifting accessories or load carrying device shown in *Figure 38* 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 operation.**

Min
15MPa

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

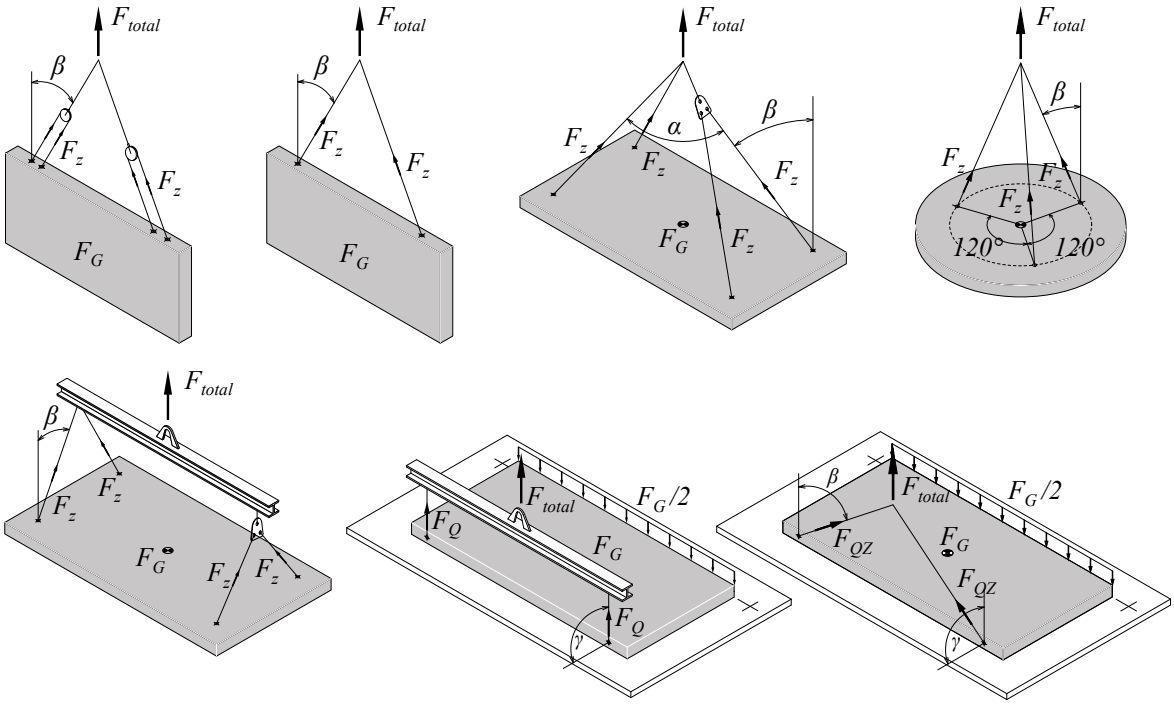
RR Lifting insert's safety factors account for at least 3-fold protection against steel failure, as well as at least 2.5-fold protection against concrete failure depending on the concrete strength. All RR Lifting Keys account for at least 4-fold protection against steel failure.

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.

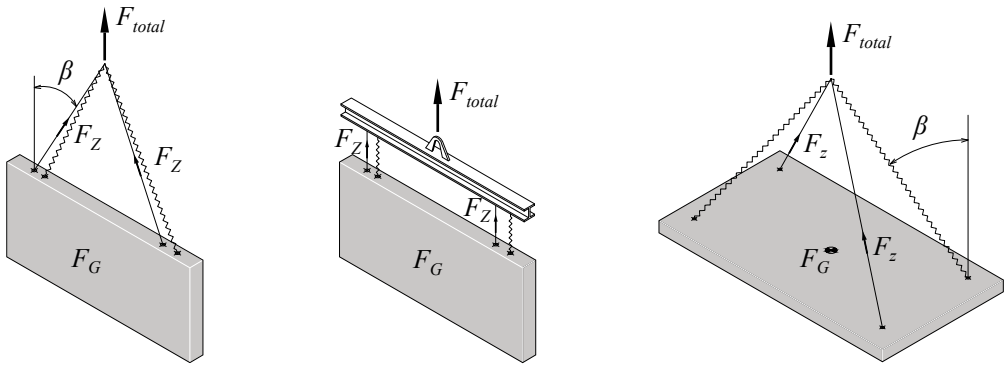
For defined balance conditions (statically determined system), the insert loads can be calculated very precisely. This is the case when using two suspension gears, three suspension gears (with symmetrical insert distribution), or four suspension gears with a compensation seesaw. *Figure 39* shows examples of such transportation systems.

Figure 39. Balanced lifting condition.



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 40* shows examples of such transportation systems.

Figure 40. Imbalanced lifting condition.



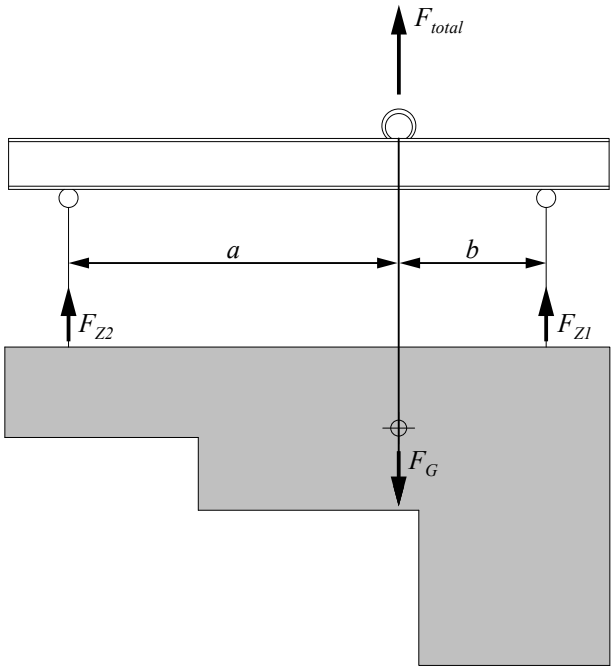
For unclear lifting situations in which only the element's weight is known, it is recommended for safety reasons that **each insert is designed for the entire element weight.**

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 41* shows such an application.

Figure 41. Asymmetrical insert layout.



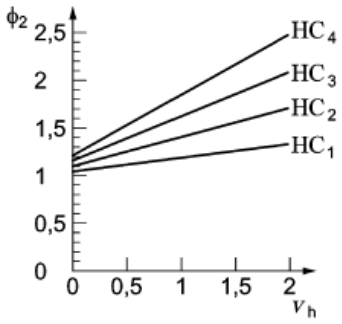
2.4 Acceleration forces

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 (H1 to H4) for cranes, the minimum hoisting coefficient (HC) for cranes can be taken from *Figure 42*, which shows the development of the hoisting coefficient related to hoisting speed (according EN 13001-2)) where $\emptyset_2$= dynamic coefficient and v_h = hoisting speed. Reference values for hoisting equipment are introduced in *Table 26*.

Figure 42. Hoisting coefficient development.

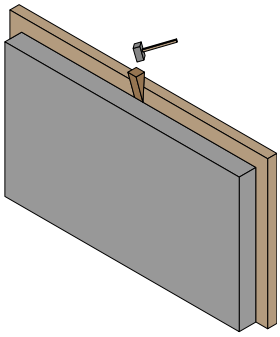


2.5 Mold adhesion

When lifting concrete units out of the mold there is an adhesion force between the element and the formwork. This adhesion forces 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 43* shows how this can be executed.

Figure 43. 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 25kN/m³. The use of reinforced heavy concrete requires specific weights of at least 27kN/m³. Lightweight aggregate concrete with an open structure and autoclaved aerated concrete can vary in weight from 9kN/m³ to 20kN/m³ depending on the aggregates used. The individual specific weight must be determined by the user.

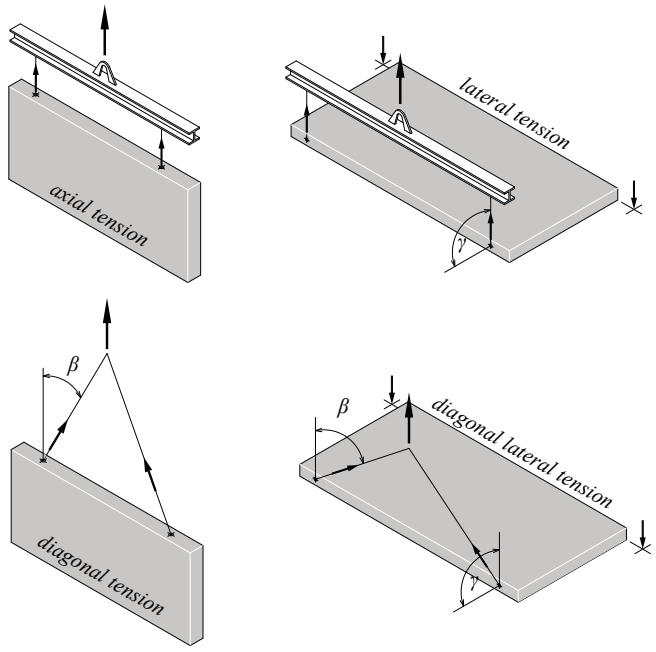
For heavily reinforced structures such as bridges or massive concrete foundations, the weight of the reinforcement must be considered separately. Openings should be considered for efficient calculation and optimal selection of the lifting system.

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 44*).

- **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.

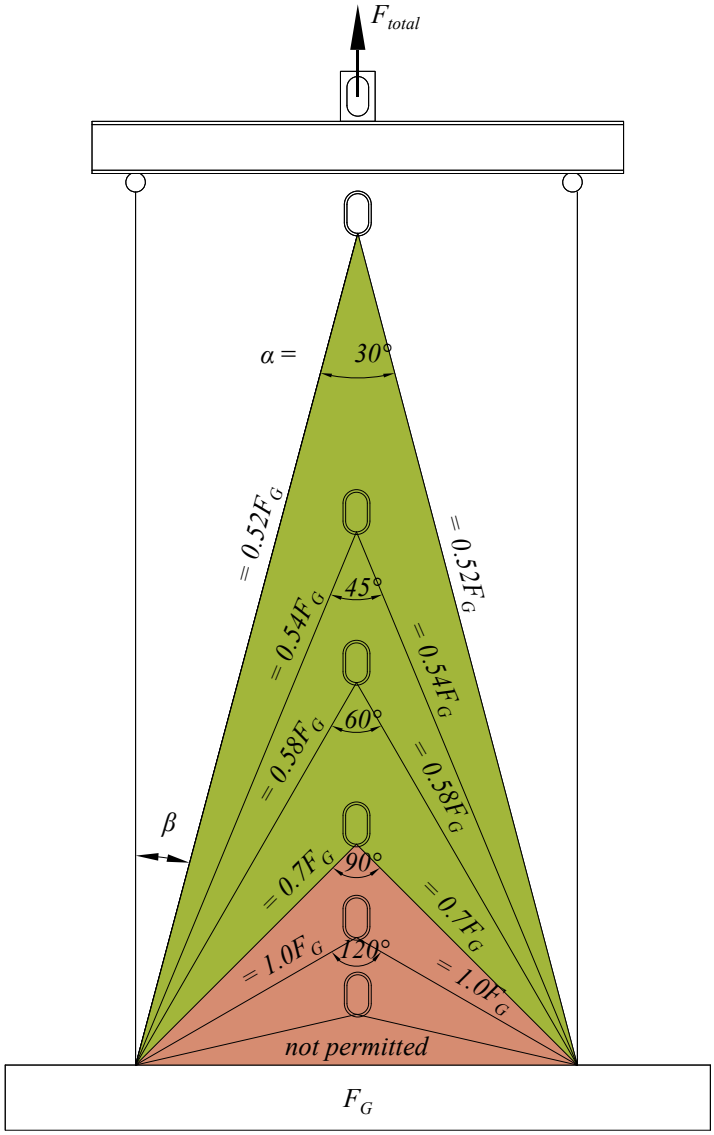
Figure 44. Load directions during hoisting.



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.

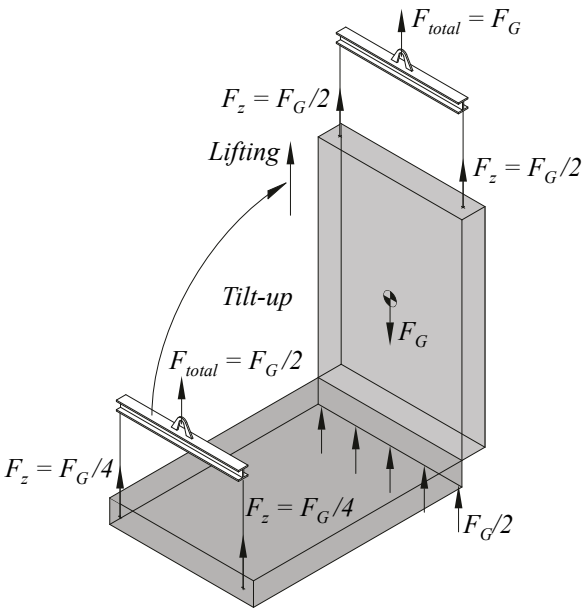
The relationship of the inclination angle "β" to the load increase and the spread angle of the chain "α" is shown in *Figure 45*. This shows the load distribution on double-strand lifting equipment when hoisting at different angles. In practice, this means that the angle of inclination has a significant impact on the dimensioning of the transportation system. Transportation with diagonal tension requires additional reinforcement when the inclination angle β is >12.5°.

Figure 45. Load increase during hoisting.

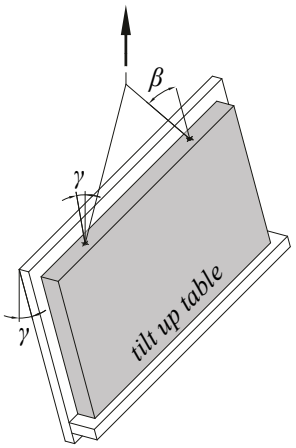


Precast concrete elements are very often produced horizontally on casting tables. After concrete hardening, elements such as walls must be lifted from a horizontal position to a vertical position. In many cases, no special tilt up equipment, such as tilt up tables or special tilt up machinery, is available. In such cases, the insert installed in the front end assumes only half of the loads during the tilt up process. This is due to 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 46*).

Figure 46. Hoisting procedure from horizontal to vertical.



The lateral pull reinforcement can be omitted when using a tilt up table and a load angle of γ <15°.



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 fit together. *Figure 47* shows the combinations of RR Lifting Inserts, RR Lifting Keys and RR Lifting Accessories.

Figure 47. Combination of inserts with RR Lifting Keys.

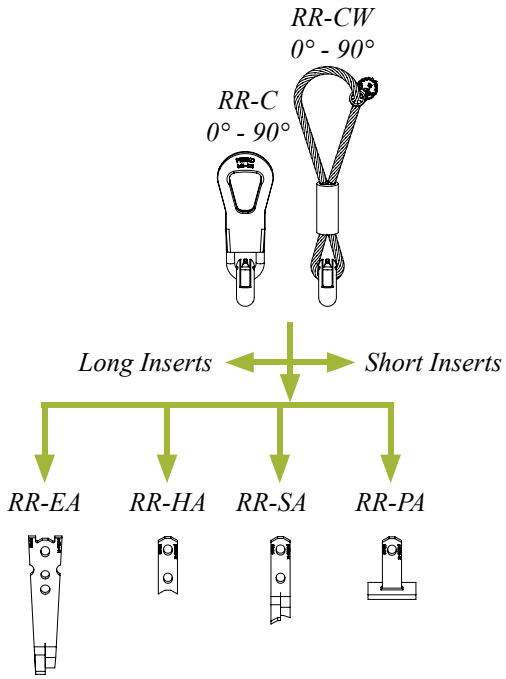
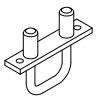
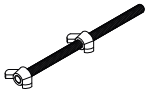
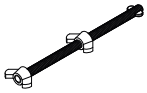
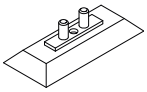


Table 24. Combination of RR Lifting Keys and RR Lifting Accessories.

	 RR-C	 RR-CW	 RR-HP1	 RR-HP2	 RR-FS1	 RR-FS2	 RR-MH
 RR-RF	✓	✓	✓	✓	✓	✓	✓
 RR-PF	✓	✓	✓	✓	✓	✓	✓

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

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

F_G = weight of the precast element [kN]
V = volume of the precast element [m³]
ρ_G = density of the concrete [kN/m³]

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

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

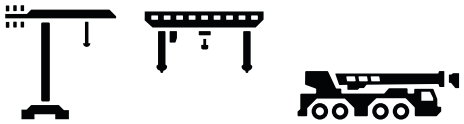
F_{adh} = action due to adhesion and form friction [kN]
q_{adh} = basic value of combined adhesion and form friction [kN/m²]
A_f = contact area between concrete and formwork [m²]

Table 25. Reference values for mold adhesion according to VDI/BV-BS6205:2012.

Formwork and condition	q_{adh} [kN/m²]
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 27* shows example hoisting coefficients for different hoisting equipment.

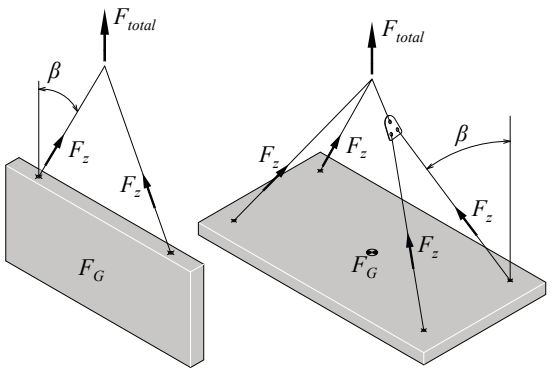
Table 26. Coefficient for different hoisting equipment according to VDI/BV-BS6205:2012.

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 27*.

Table 27. 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

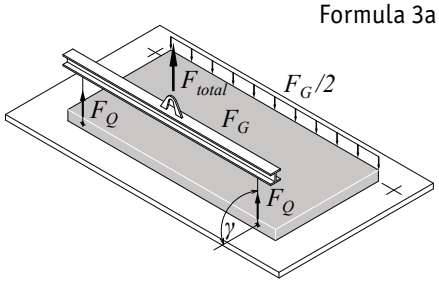


The manipulation within the entire transport chain must be considered and the most challenging case must guide the design. During manipulation, the following load conditions may occur:

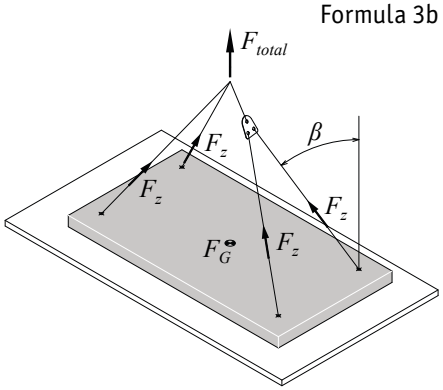
- Erection in combination with adhesion and form friction
- Erection
- Lifting and handling under combined tension and shear

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 (Formula 3a) rest one-sided on the formwork. The load is calculated as follows:

Formula 3a



Formula 3b



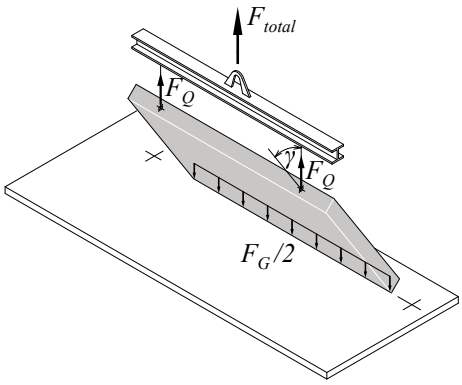
$$F_Q = (F_G/2 + F_{adh}) * z / n \qquad \text{Formula 3a}$$

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

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 erection process assumes that the element rests one-sided on the formwork or has been tilted up and adhesion forces are no longer present. Consider whether a beam or a chain will be used before calculation. The load is calculated as follows:

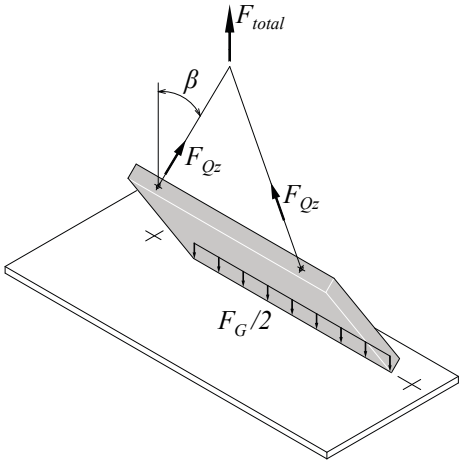
$$F_Q = (F_G/2) \cdot \Psi_{dyn}/n \qquad \text{Formula 4}$$



where

F_Q	shear load acting on the lifting insert (shear) directed perpendicular to the longitudinal axis of the concrete component, e.g. during lifting from the horizontal position with a beam [kN]
F_G	weight of the precast element [kN]
Ψ_{dyn}	dynamic factor
n	number of load carrying lifting inserts

$$F_{QZ} = (F_G/2) \cdot \Psi_{dyn} \cdot z/n \qquad \text{Formula 5}$$

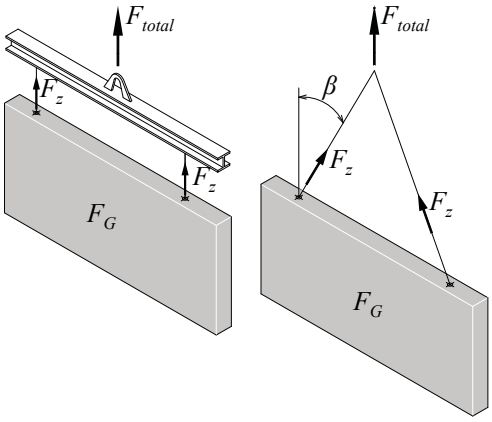


where

F_{QZ}	shear load acting on the lifting insert (shear) directed perpendicular to the longitudinal axis of the concrete component, e.g. during lifting from the horizontal position [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 $z = 1/\cos\beta$.

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:

$$F_Z = F_G \cdot \Psi_{dyn} \cdot z/n \qquad \text{Formula 6}$$



where

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}").

$$E \leq R_{zul} \qquad \text{Formula 7}$$

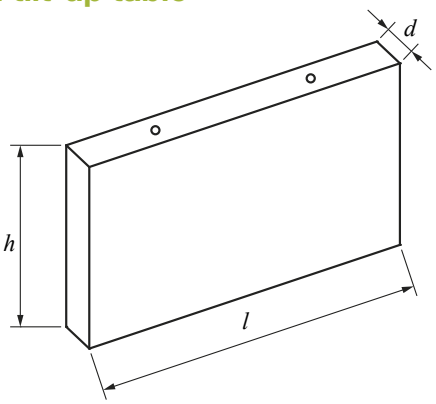
where

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 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 an angle of inclination of a maximum of 30°
- Hoisting factor of 1.3 (tower hoist crane, heavy duty mobile crane, truck crane)
- RR insert types that can be utilized: RR-SA, RR-HA and RR-EA
- 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 9*)

l = 4.8 m h = 2.20 m d = 0.25 m

Unit weight:

$$F_G = 4.8\ m * 2.20\ m * 0.25\ m * 25.0\ kN/m^3 = 66.0\ kN$$

$F_G = V * \rho_G$ (see formula 1)

Mold adhesion:

$$F_{adh} = 4.8\ m * 2.2\ m * 1\ kN/m^2 = 10.56\ kN$$

$F_{adh} = q_{adh} * A_f$ (see formula 2)

Load case 1: Unit weight + dynamics + diagonal pull
$F_Z = 66.0\ kN * 1.3 * 1.15 / 2 = 98.7\ kN / 2 = 49.3\ kN/insert$

$F_Z = F_G * \Psi_{dyn} * z / n$ (see formula 6)

Load case 2: Unit weight + adhesion + tilt-up with diagonal pull
$F_Q = F_{QZ} = (66.0\ kN /2 + 10.56\ kN) * 1.15 / 2 = 25.1\ kN/insert$
Here only half load applies due to one sided support by mold

$F_Q = (F_G /2 + F_{adh}) * z / n$ (see formula 3a)

Load case 3: Unit weight + dynamics + tilt-up with diagonal pull
$F_Q = F_{QZ} = 66.0\ kN / 2 * 1.3 * 1.15 / 2 = 24.7\ kN/insert$

$F_{QZ} = (F_G /2) * \Psi_{dyn} * z / n$ (see formula 5)

- ⇨ Load case 1 causes the highest load and determines the design for diagonal lifting.
- ⇨ Load case 2 determines the design for tilt-up actions.

Insert selection:
RR-SA-5.0-240 / RR-HA-5.0-120 / RR-EA-5.0-290 Lifting Inserts with safe working load of 50 kN for load case 1.
For load case 2 due to tilt-up actions, just RR-SA-5.0-240 or RR-EA-5.0-290 can be selected but the safe working load is too less, therefore a tilt-up table is recommended.

See *Table 5* to *Table 8*

Spacing, unit thickness and reinforcement
Minimum spacing ($b + a$) for
RR-SA-5.0-240: 840 mm + 2 x 420 mm = 1680 mm < 4800 mm
RR-EA-5.0-290: 1000 mm + 2 x 500 mm = 2000 mm < 4800 mm
RR-HA-5.0-120: 750 mm + 2 x 375 mm = 1500 mm < 4800 mm

Spacing required (see *Table 9* to *Table 11*)
($b + 2 * a$)

Minimum thickness (d) for
RR-SA-5.0-240: 250mm > 230mm, RR-EA-5.0-290: 250mm > 160mm
RR-HA-5.0-120: 250mm > 120mm

Thickness required (see *Table 9* to *Table 11*)
(d)

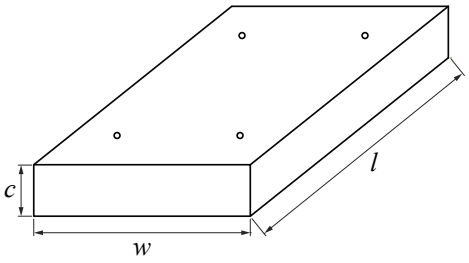
Minimum reinforcement for
RR-SA-5.0-240: #188mm²/m + 2Ø10x700 (stirrup) + Ø10x420 (diagonal rebar for 30°)
RR-EA-5.0-290: #188mm²/m + 2Ø10x700 (stirrup) + Ø10x420 (diagonal rebar for 30°)
RR-HA-5.0-120: #188mm²/m + 1Ø16x750 (anchoring bar) + Ø10x420 (diagonal rebar for 30°)

Reinforcement required (see *Table 10*, *Table 13* and *Table 14*).

Example 2: transport of a slab

Conditions during the transport process

- Tilt up process directly from the production table. No lateral pull on the inserts.
- Only chains available at the precast plant and on the construction site with a maximum 30° spread angle
- Hoisting factor of 1.3 (tower hoist crane, heavy duty mobile crane, truck crane)
- RR Lifting Insert that can be utilized: RR-PA
- Mold adhesion comes from the 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 19*)

w = 3.0 m l = 1.80 m c = 0.18 m

Unit weight:

$$F_G = 3.0\ m * 1.80\ m * 0.18\ m * 25.0\ kN/m^3 = 24.3\ kN$$

$F_G = V * \rho_G$ (see formula 1)

Mold adhesion:

$$F_{adh} = 3.0\ m * 1.8\ m * 1\ kN/m^2 = 5.4\ kN$$

$F_{adh} = q_{adh} * A_f$ (see formula 2)

Load case 1: Unit weight + dynamics + diagonal pull
$F_Z = 24.3\ kN * 1.3 * 1.15 / 2 = 36.3\ kN / 2 = 18.2\ kN/insert$

$F_Z = F_G * \Psi_{dyn} * z / n$ (see formula 6)

Load case 2: Unit weight + adhesion + diagonal pull
$F_Z = F_Q = (24.3\ kN + 5.4\ kN) * 1.15 / 2 = 17.1\ kN/insert$

$F_Q = (F_G + F_{adh}) * z / n$ (see formula 3b)

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

Insert selection:
RR-PA-2.5-80 with safe working load of 22.7 kN.
The user can reduce the insert load by half by using special lifting equipment such as balanced suspensions.

See *Table 18*

Spacing, unit thickness and reinforcement
Minimum spacing *(b + a)* for size KK2.5x85.
320 mm + 2 x 160 mm = 640 mm < 1800 mm and 3000 mm.

Spacing required (see *Table 19*)
*(b + 2 * a)*

Minimum thickness (*c*) for size RR-PA-2.5-80.
180 mm > 110 mm.

Thickness required (see *Table 18*)
(*c*)

Minimum reinforcement for size RR-PA-2.5-80
#188 mm²/m + 2x2Ø10x300 (bars) + Ø8x300 (diagonal rebar)

Reinforcement required (see *Table 20* and *Table 21*)

Annex B - Application conditions

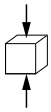
B1. Loading, lifetime and environmental conditions

RR Lifting Systems are designed for use in precast elements for transportation and temporarily fastening with RR Lifting Keys.

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 any opening against dirt, pollution, and water. This can be achieved by covering openings or by storing 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 must be 15 MPa 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 RR Lifting Keys

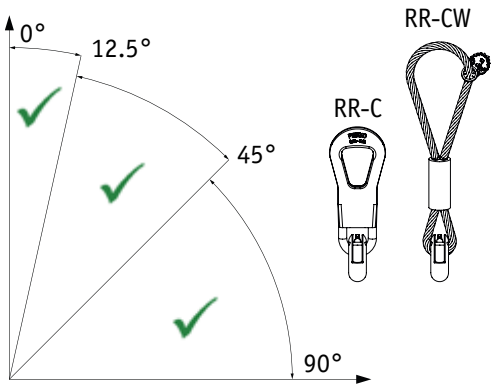
Ensure that all RR Lifting Keys are used correctly during each interaction. Please read, understand, and use the instructions for the RR Lifting Keys. This is the only way to ensure that loads are transferred properly.

All RR Lifting Keys are designed for use with both hands (RR-C and RR-CW). When using RR Lifting Keys please bear in mind the designed functioning method and load transfer. RR Lifting Keys transfer loads to the concrete via contact pressure with the element to concrete.

WARNING:
Cutting, filing, and reworking Peikko Lifting Keys is strictly prohibited.

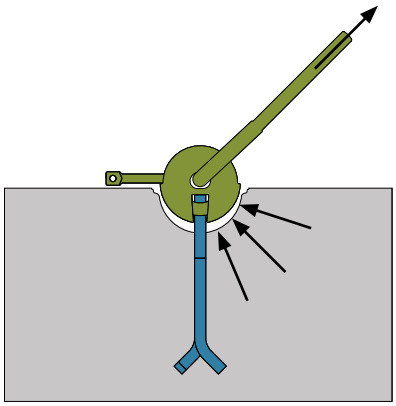
Peikko offers RR Lifting Keys which are designed for all load directions. *Figure 48* shows the permissible load directions for RR Lifting Keys.

Figure 48. Permissible load directions.



Technically, RR Lifting Key works together with the opening created by RR-RF and RR-PF Recess Items in the concrete for RR Lifting Key part. This supports the load impact to RR Lifting Key, gives better performance and reduces the risk of damaging the Lifting System parts during use. The impact of horizontal loads from RR Lifting Keys to concrete is shown in principle in *Figure 49*.

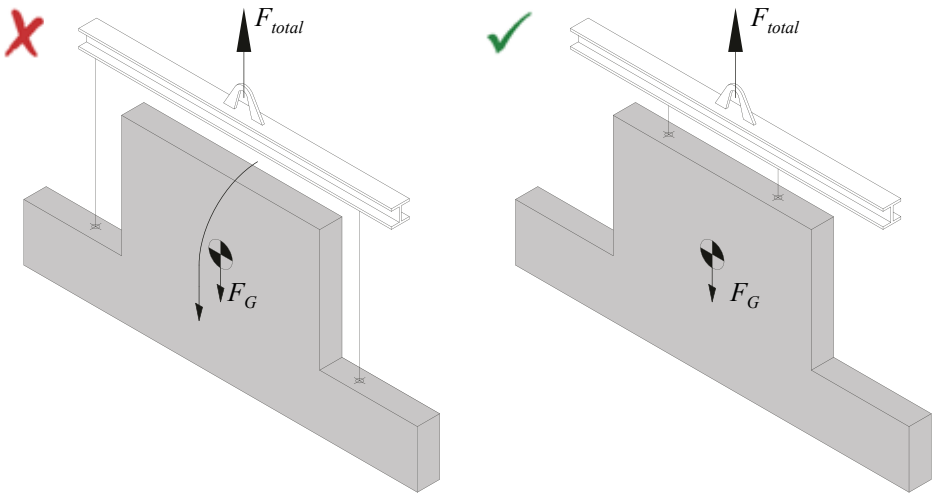
Figure 49. Impact of horizontal loads.



B3. Positioning of RR 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 50*.

Figure 50. 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.

During installation, the tolerances as defined in the section "Installation of RR Lifting System" 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 include various product series for transporting precast concrete elements. As described under the product properties, RR Lifting System consists of RR Lifting Inserts and RR Lifting Keys. Cross-wise combination of different product series such as JENKA, RR, KK is not possible.

RR Lifting Inserts can be used with other RR-Lifting Keys. Prior to use, compatibility must be certified and approved by Peikko. RR Lifting System Inserts are compatible with the following Lifting Keys:

- RR Lifting Keys such as RR-C and RR-CW and modifications placed on the market by Peikko
- Other Lifting Keys that are certified and approved by Peikko prior to use

Lifting Keys are subject to exchanging and forwarding actions during multiple lifting processes. Clarify compatibility prior to using any Lifting Keys in combination with Peikko's Lifting Inserts.

WARNING:
Incompatible lifting keys 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 by 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.

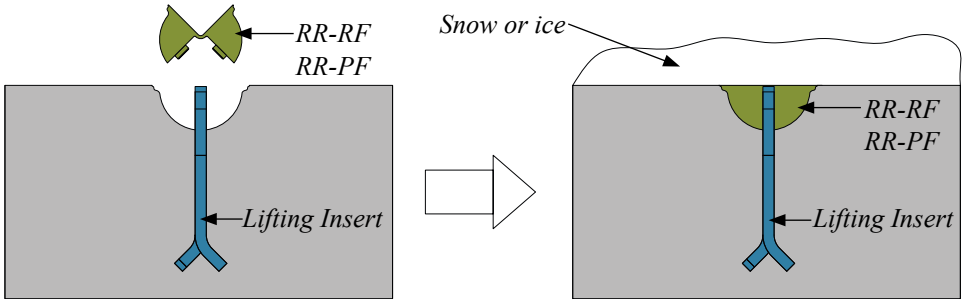
WARNING:
Never galvanize or coat Peikko's products in any way.

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 RR Lifting Inserts are either black, electro galvanized, or hot dipped galvanized. Choose the correct surface finish prior to installation depending on your application (seawater conditions, changing weather conditions etc.).

During winter the RR-RF recess item shown in *Figure 51* can be used, to protect the casted inserts from bad weather conditions. It is a very efficient and simple technique to protect lifting systems from winter conditions. Inserts can be easily removed using simple tools to break the ice. The opening is protected almost perfectly when keeping dust, dirt, and water away.

Figure 51. Winter protection of lifting systems.



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

B7. Regular inspections

For safety reasons, all RR Lifting Keys must be properly used and maintained. Never use damaged or corroded lifting system parts. All reusable lifting keys must be inspected regularly by the user to determine if they may be used at the rated safe working load or must be taken out of use. The frequency of inspections depends upon factors such as (but not limited to) the amount of use, period of service and environment. Inspections must take place at least annually. It is the responsibility of the user to schedule hardware inspections for wear and to take products out of use when wear is identified. Peikko recommends recording the inspections of all items with serial numbers on record cards as shown in *Figure 52*.

Specific and more detailed product information, which supports the user during regular inspections, is available in Annex D.

Figure 52. Record card for lifting systems.

<table>
<tr><td colspan="2">Chain record card
DGUV 209-063
(previous BGI 879-2)
Release: September 2015</td><td colspan="3">☐ Hoist chain
☐ Chain sling with welded in master and end links
For assembled chain sling made from parts a chain record card according DGUV 209-062 must be used</td><td>peikko group
CONCRETE CONNECTIONS
Peikko Group Corp.
Voimakatu 3
FI-15101 Lahti
www.peikko.com</td></tr>
<tr><td colspan="5">Name of the chain</td></tr>
<tr><td>Order No.</td><td>Chain No.</td><td colspan="3">Capacity SWL</td></tr>
<tr><td rowspan="2">Grade</td><td rowspan="2">Nominal thickness
mm</td><td rowspan="2">Hoist chain
t</td><td rowspan="2">1-strand
t</td><td>Chain sling
-strands/legs</td></tr>
<tr><td>β ≤ 45°
t</td><td>β ≤ 60°
t</td></tr>
<tr><td>Length
m</td><td>Weight
kg</td><td>Manufacturer symbol*)</td><td>Inspection certificate
No.</td><td>Date</td><td>Delivery from:</td></tr>
<tr><td colspan="4">Next inspection date</td><td rowspan="2">Taken into use on:</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td rowspan="2">Taken out of use on:</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

B8. Personnel and safety requirements

Peikko products must be used by trained, qualified, experienced, and properly supervised workers 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, check Peikko's website for updated documentation. When updated documentation is published, this version expires with immediate effect.

B9. Material properties and quality

All Peikko Lifting System products are designed to withstand temperatures between -20°C and +80°C. Material impact resistance is essential due to rough handling and lifting procedures. *Table 26* gives an overview of the materials used for KK Lifting Systems.

Table 28. Lifting system materials.

Plate material	S355	EN10025
Ropes	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's production units are regularly externally controlled and periodically audited by various organizations on the basis of production certifications and product approvals. The quality of production is confirmed by organizations including VTT Expert Services, Nordcert, SLV, MPA NRW, TSUS, SPSC, and others as shown in *Table 29*.

Table 29. Production quality certifications.

OHSAS18001:2007 ISO9001:2008 ISO3834-2:2005	EN 1090:2009 EXC3	Various approvals and 3rd party inspection

Annex C - Declaration of conformity

Peikko Group Oy
Voimakatu 3
FI-15101 Lahti
www.peikko.com
E-Mail: lifting.systems@peikko.com

CE	**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 RR System
Lifting Insert / Transportanker	SA / HA / EA / PA / FA /
With surface treatment / mit Oberflächenbehandlung	galvanized (verzinkt) / untreated (unbehandelt) / hot dipped galvanized (feuerverzinkt)
Lifting Key / Lastaufnahmemittel	RR-C / RR-CW
In the version/ in den Ausführungen:	RR-0,7 – RR-26,0

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 23.03.2016

Mr. Teppo Lassila
Quality Manager
Peikko Group Oy

Mr. Sebastian Gonschior
R&D Engineer
Peikko Group Oy

Annex D - Inspection criteria for lifting keys

The use of RR-C and RR-CW Lifting Keys requires the consideration of safety and accident prevention regulations. The additional information given in regulation DGUV 52 (German national rule: "cranes/Krane") and in rule DGUV 100-500 (German national rule: "load lifting equipment in hoisting operation") must be considered.
The use of RR Lifting Keys is only permitted when a competent person has inspected them. The inspection is to be executed according to the aforementioned criteria and rule (DGUV 100-500) and the intervals must be between one and three years. Before inspection, clean RR Lifting Keys thoroughly.

Chains and chain-like non-fixed RR Lifting Keys (RR-C):

- Inspection by a competent person
- Visual check at least once per year for external damage such as
  - Bent chain links
  - Twisted chain links
  - Indents
  - Plastic elongation due to overloading
  - Readability of the marking
  - Ratio elongation due to wear out
  - Wear out of diameter (due to permanent use)
- Crack absence inspection at least every third year
- Additional inspection after unexpected incidents
- No visible cracks or deformations
- No necking or material tapering
- No welding in any location
- The tolerances provided by manufacturer must be complied with

RR Lifting Keys head (RR-C+RR-CW):

- Movability of casted head vs wire rope or handle
- Movability of the latch and size of bolt and opening
- No visible cracks or bents
- Marking information visible and readable
- Presence of safety pin for latch

RR Lifting Keys containing wire rope (RR-CW):

- No bending or kinks permissible
- No breaking of strands
- No loosening of the external layer on the free length of the wire
- No squeezing in the free length of the rope
- No damage or heavy wear to the rope end connection
- Not more than four wires in the support area of the loop
- More significant wire breakages make further use impossible

Figure 53. Rope measurement at RR-CW.

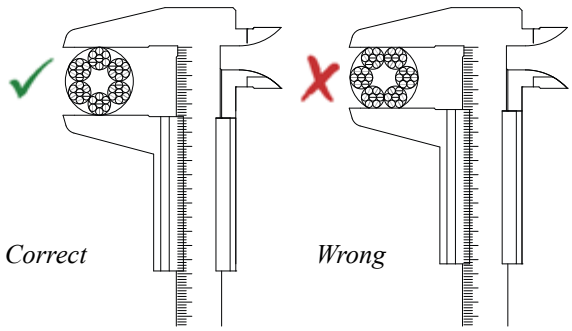
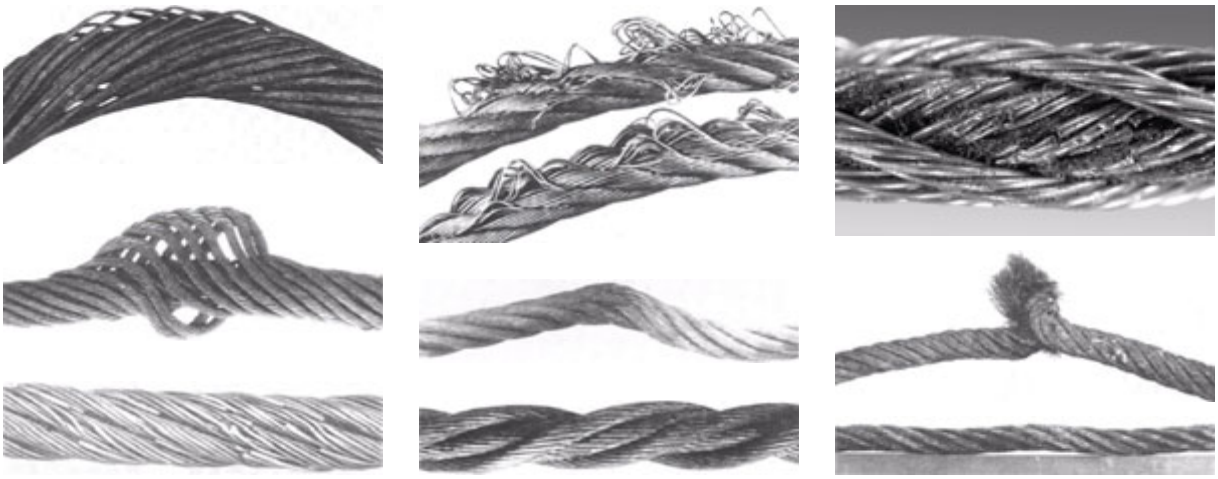


Table 30. Number of broken wires maximum allowed according to DGUV 100-500.

Rope construction	Amount of visible rope damages on a length of		
	3 x ds	6 x ds	30 x ds
Stranded rope	4	6	16

Figure 54. Possible rope damage. †



Documentation (RR-C and RR-CW):

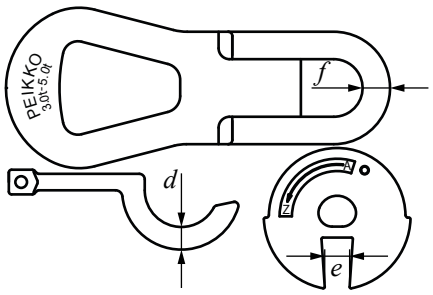
- Business order (internal company procedure)
- Chain record card for RR Lifting Keys
- Overall inspection protocol tested items
- Single inspection protocol tested item
- Testing label or marking visible on the item

RR-C and RR-CW Lifting Keys

RR Lifting Key dimensions at delivery stage are shown in *Table 31*.

Table 31. Wear out tolerances of RR-C and RR-CW Lifting Key.

RR-C/RR-CW	Head		Bar		Ring	
Load class	*e* [mm]	*Max. e* [mm]	*f* [mm]	*Min. f* [mm]	*d* [mm]	*Min. d* [mm]
2.5	12.0	13.0	14.0	13.0	13.0	12.0
5.0	18.0	19.5	20.0	19.0	16.5	15.5
10.0	22.0	23.5	25.0	24.0	23.5	22.5
26.0	34.0	37.0	40.0	38.5	32.0	30.5



No further use is permitted if the measures in *Table 31* are reached. Changes to the construction and repairs (especially welding) of RR-C and RR-CW Lifting Keys are prohibited.

† "Reproduced with the permission of the Verein Deutscher Ingenieure e.V."
From guideline VDI2358:2012-12 Wire ropes for materials-handling equipment, picture number 58, 61c, 64 to 67, 69, 72 and 73.

Inspection of the following regions of RR-C and RR-CW Lifting Keys is recommended

Figure 55. Regions to check at RR Lifting Keys.

Movability of latch

Bolt diameter

Size of opening

Chain link diameter

Welding damages

Installing RR Lifting System

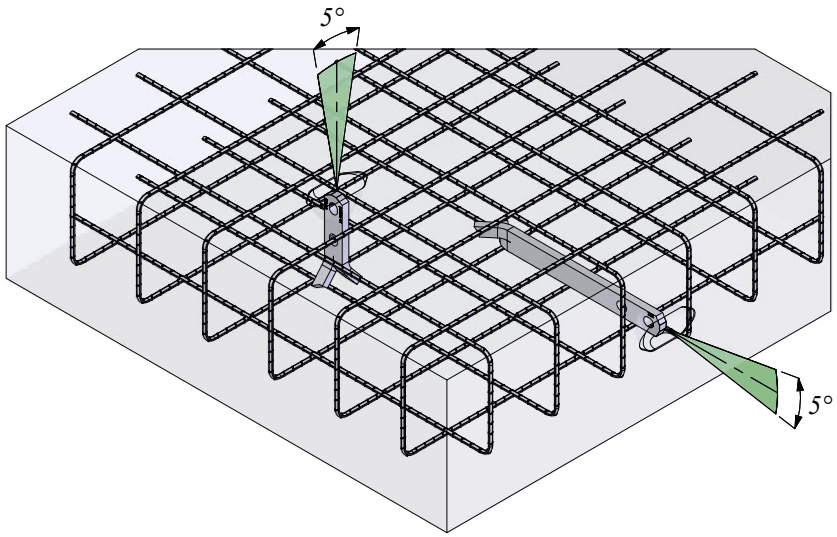
RR Lifting System components are installed either on the construction site or in a precast plant. RR Lifting Accessories should be used to facilitate the installation process. Lubricating the outside and inside of recess items prevents concrete or dust pollution from affecting the usability.
Ensure that the surroundings and environmental conditions are dry and clean for installation. Environmental pollution of all kinds should be avoided or minimized at all times. For easier removal, all installation items such as RR-RF and RR-PF should be lubricated.

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 56*, which shows that 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.

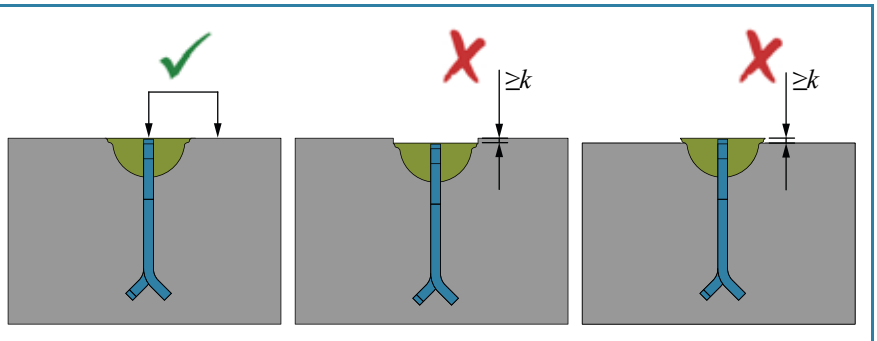
Figure 56. Angle tolerances for installation.



Installation into concrete elements requires the insert to stay in its initial position. If the insert moves out of place, *Table 32* defines the permitted installation tolerances for all inserts.

Table 32. Installation tolerances for RR Lifting Inserts.

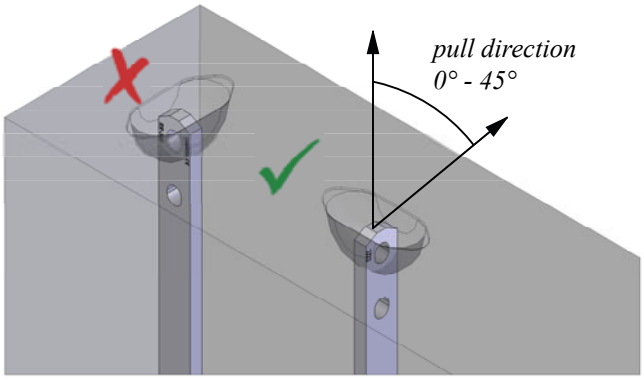
Load class	Tolerance "k" [mm]
0.7 + 1.4	±1.0
2.0 + 2.5	±1.5
3.0+4.0+5.0	±2.0
7.5 + 10.0	±2.5
12.5 + 14.0	±3.0
17.0 + 22.0 + 26.0	±4.0



PLEASE NOTE:
The tolerances given in *Figure 56* are to be considered for recessed installation with RR-RF and RR-PF.

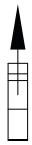
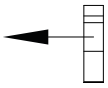
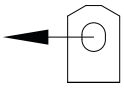
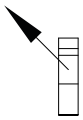
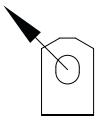
For installation purposes, no special marking accessories must be used. The insert is to be fixed into the formwork with installation accessories (RR-RF, RR-PF and RR-FS and RR-HP). The fixation items RR-HP and RR-FS facilitates installation. The oval shape of the recess item RR-RF and RR-PF requires a special assembly direction towards the pull as shown in *Figure 57*.

Figure 57. Correct assembly direction toward the pull.

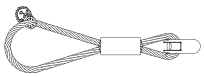


The oval recess geometry results in multiple hoisting directions, which are possible for the system. Be sure to have right installation direction when installation procedure happens. Consider the safe working loads and load directions according *Table 5* for RR-SA, *Table 7* for RR-HA, *Table 8* for RR-EA, and *Table 18* for RR-PA Lifting Inserts. The overview of possible load directions which results from installation procedure are given in *Table 33*.

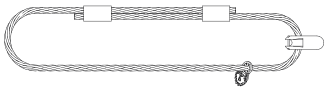
Table 33. Possible load directions on RR Lifting Inserts resulting from installation.

				
Axial pull in direction of Lifting Insert axis	Lateral pull perpendicualr to the Lifting Insert surface	Lateral pull parallel to the Lifting Insert surface	Diagonal pull, lateral component perpendicular to the Lifting Insert surface	Diagonal pull, lateral component parellel to the Lifting Insert surface

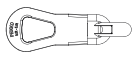
RR Lifting System



RR-CW
2.5 - 10.0



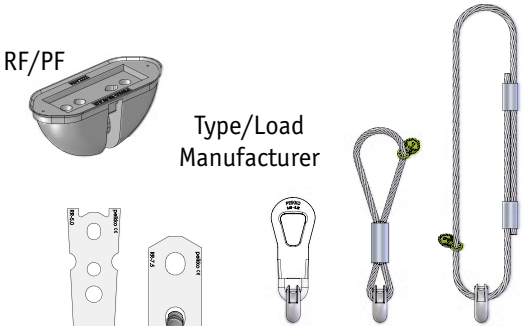
RR-CW
26.0



RR-C
2.5 - 26.0

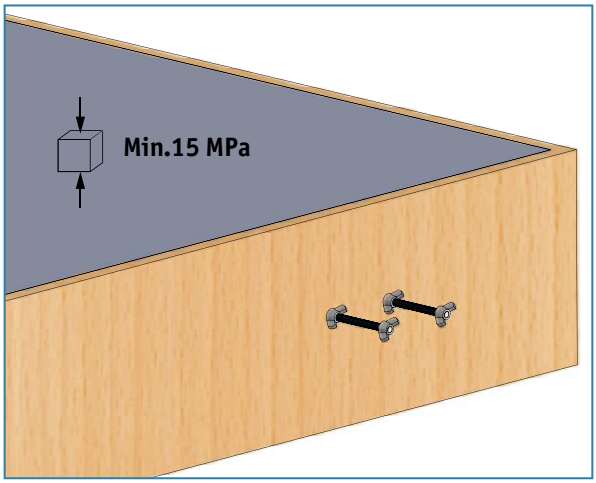
CE

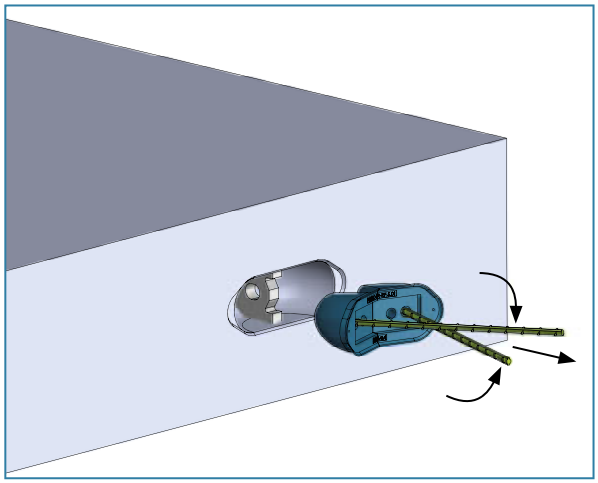
1. SELECTING

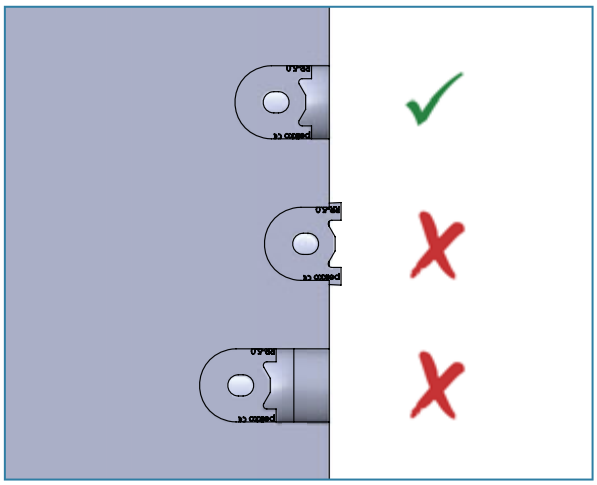


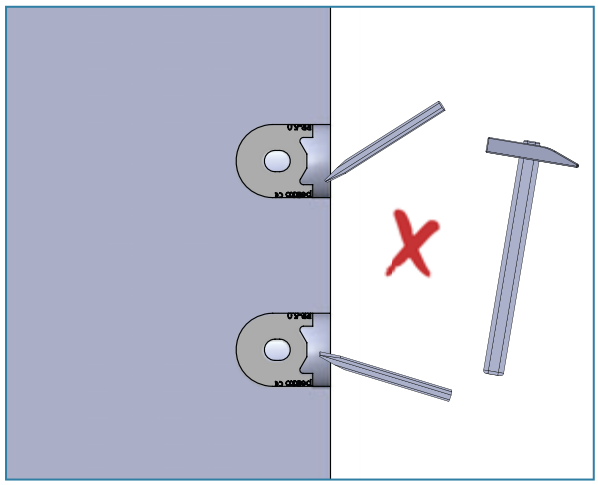
Load Class [t]	RR-RF and RR-PF Colour
2.5	Orange
5.0	Black
10.0	Green
26.0	Blue

2. INSTALLATION

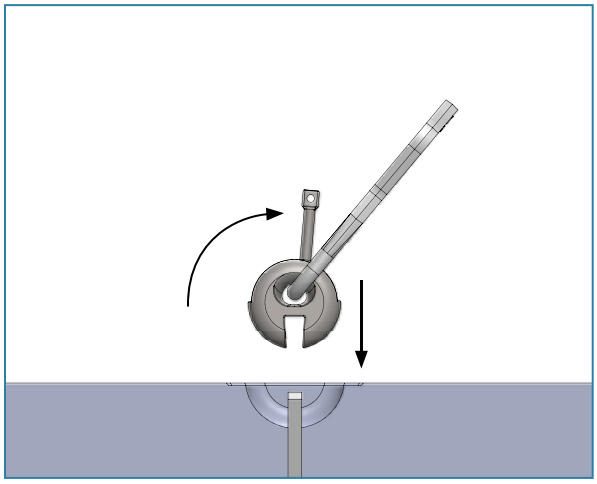


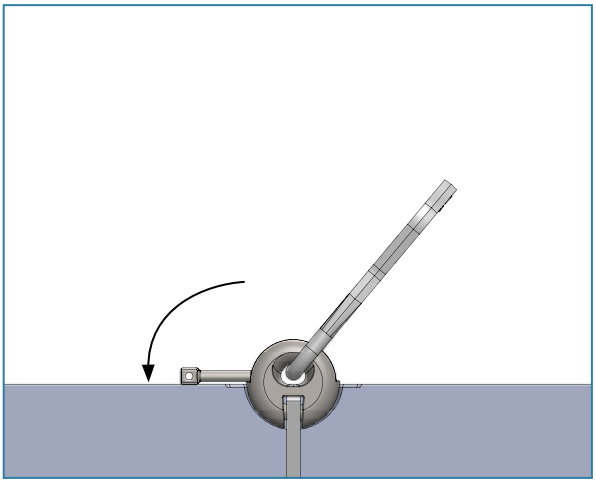


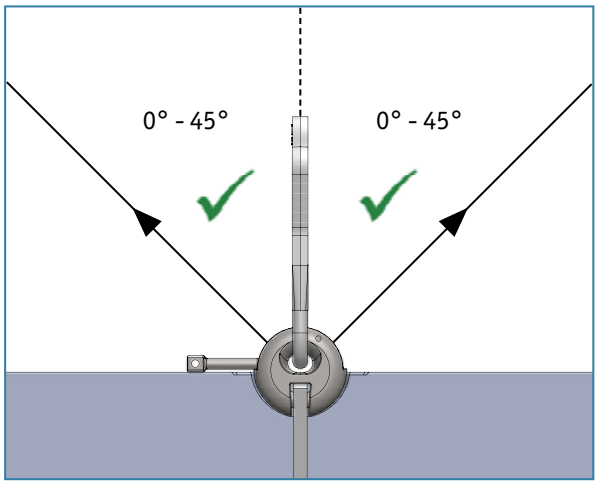




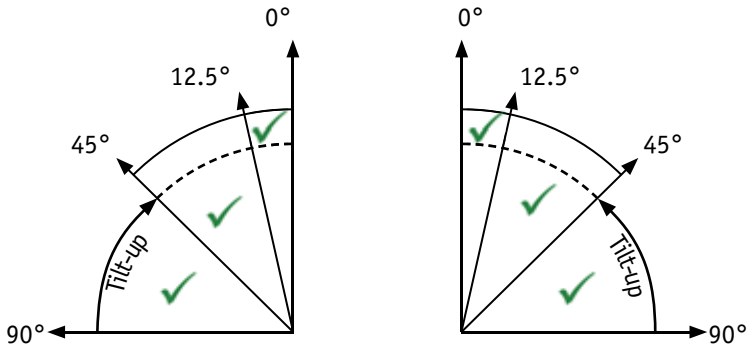
RR-CW, RR-C





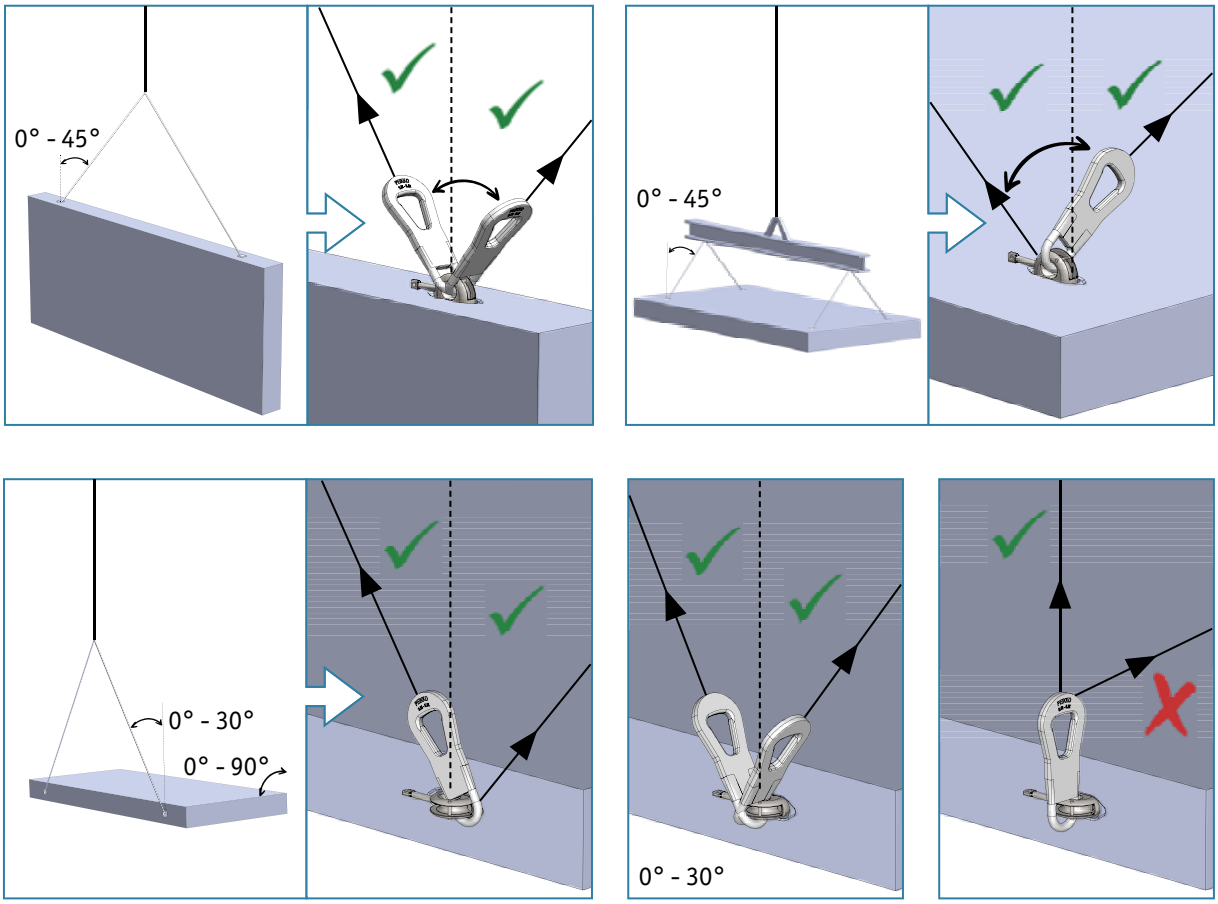


3. LIFTING

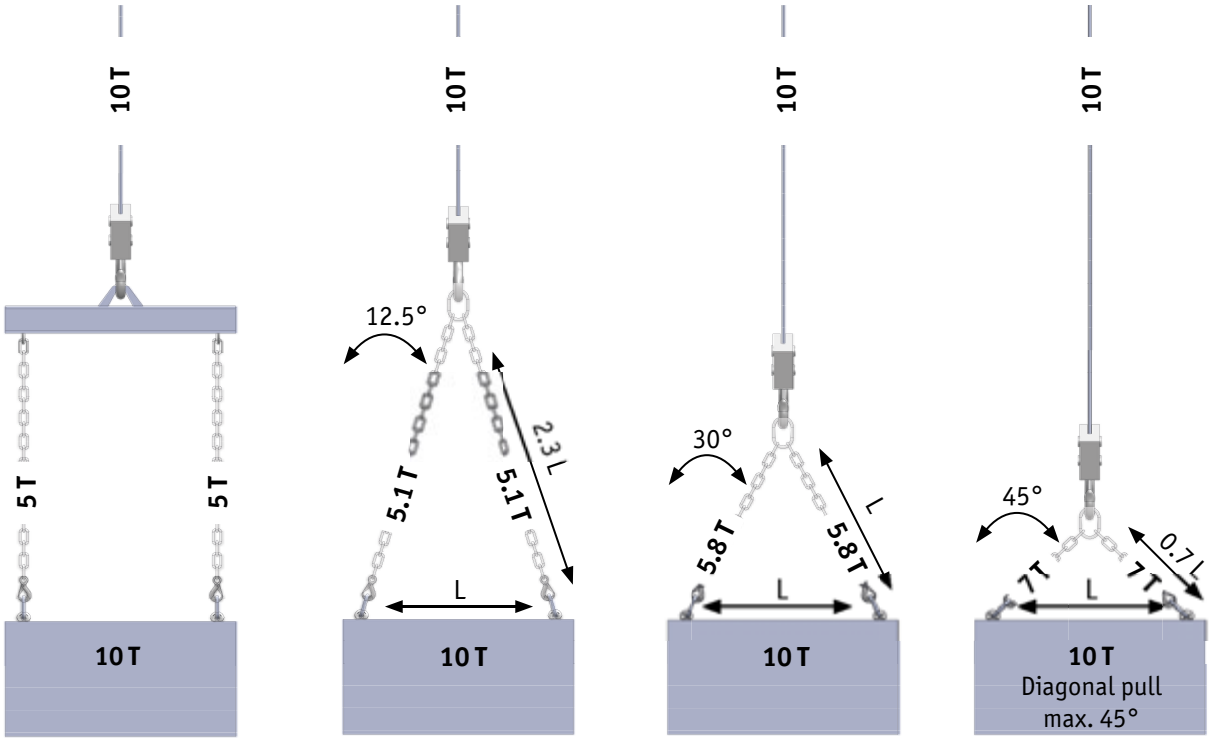


4. CASTING

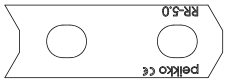
RR-CW, RR-C



5. LIFTING ANGLE INFLUENCE



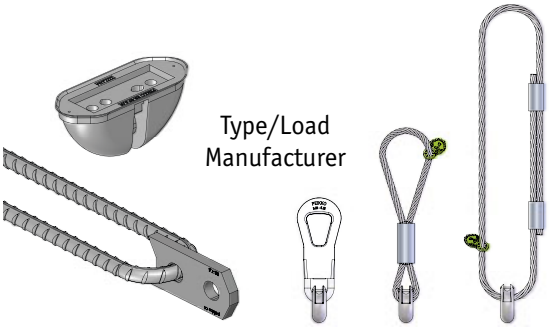
RR Lifting System



HA

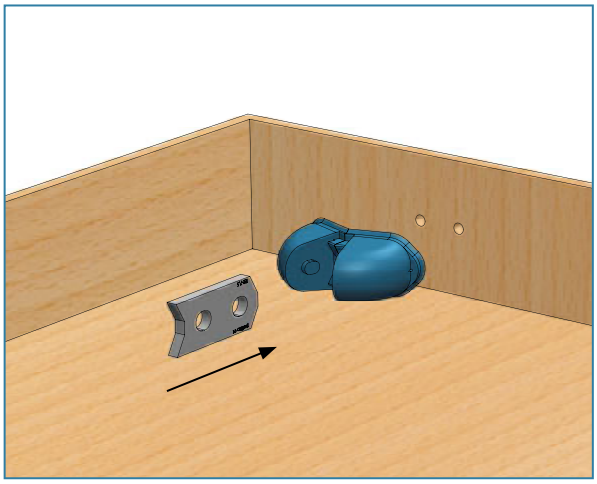
CE

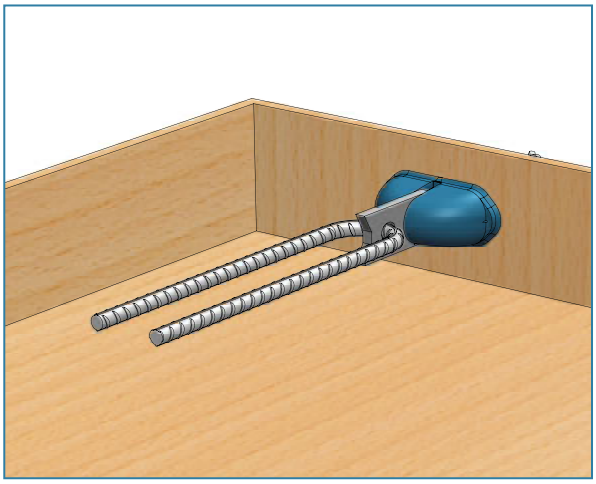
1. SELECTING

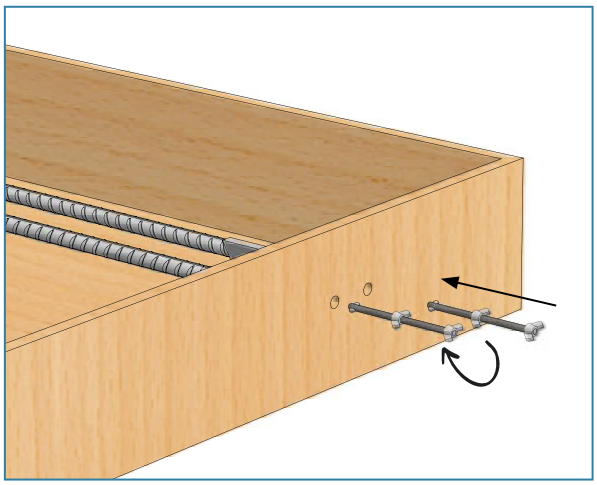


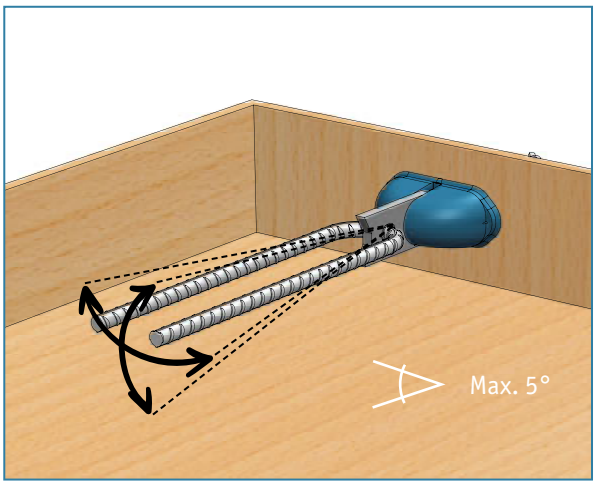
Load Class [t]	RR-RF and RR-PF Colour
2.5	Orange
5.0	Black
10.0	Green
26.0	Blue

2. INSTALLATION

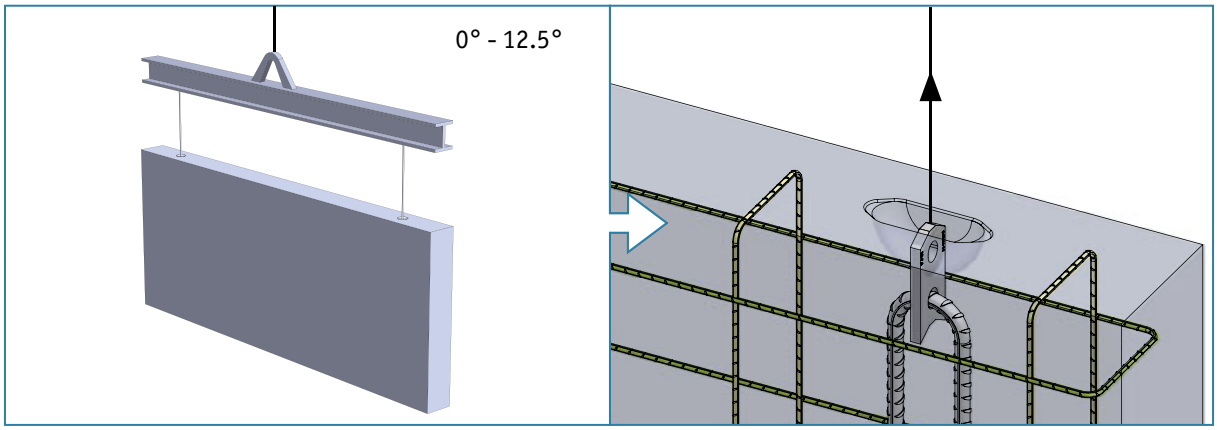


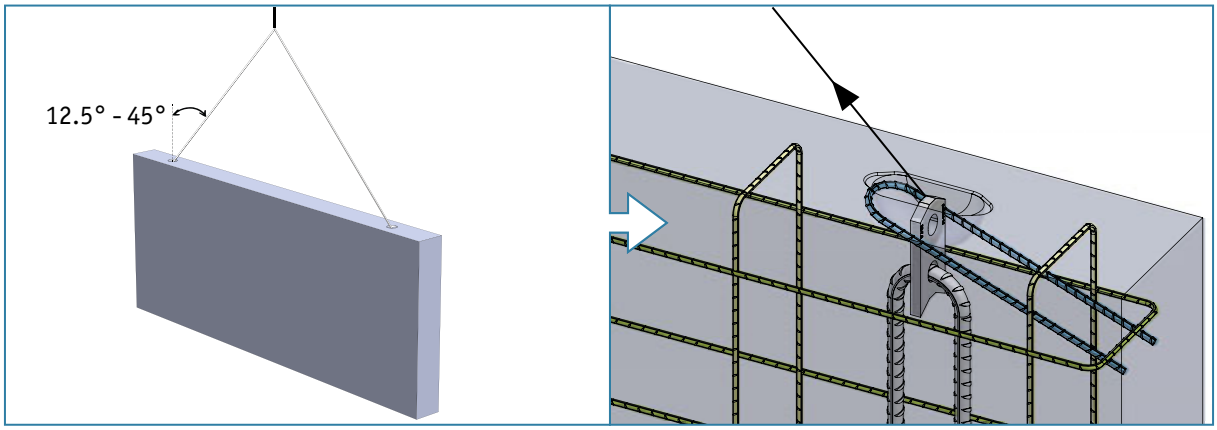


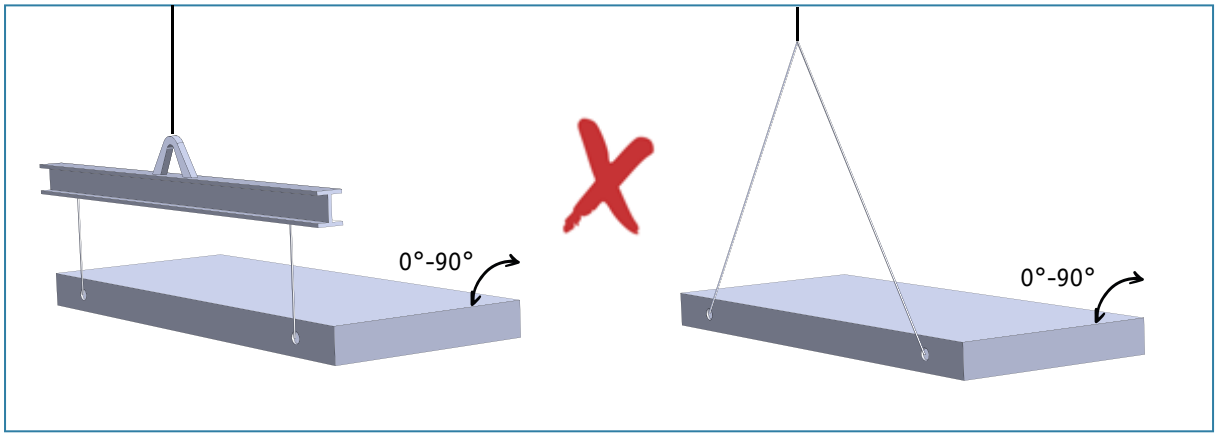




3. REINFORCEMENT HA

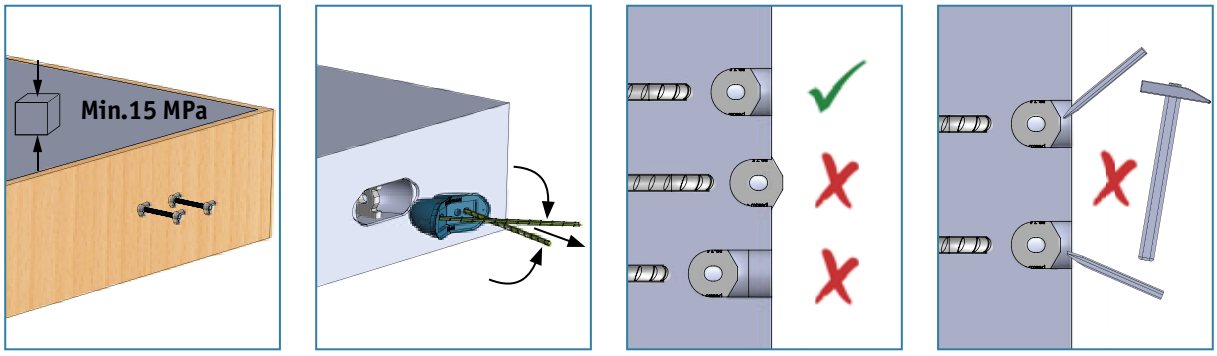




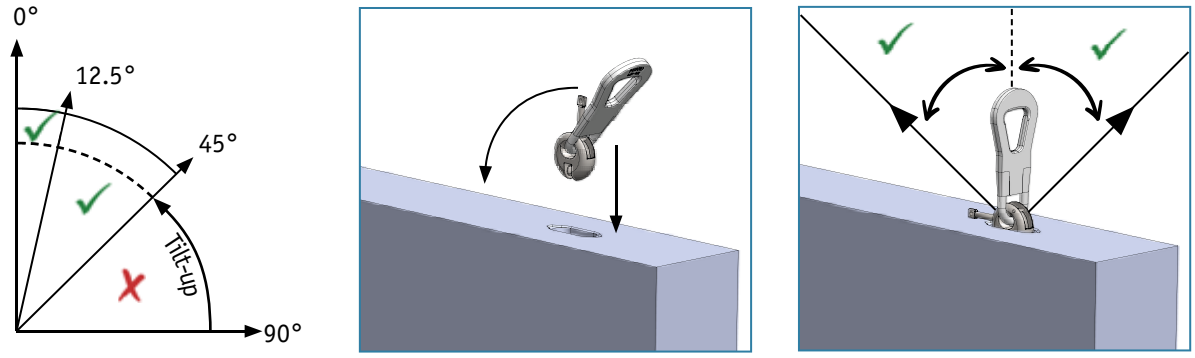


4. CASTING

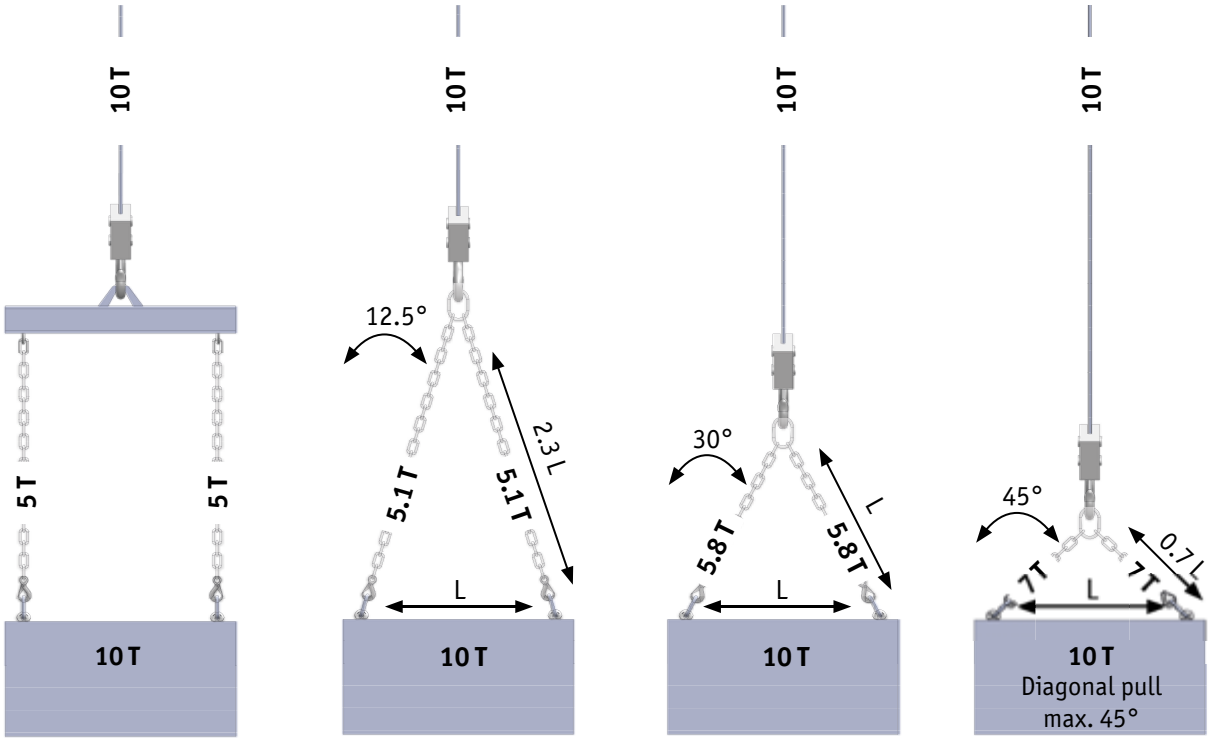
HA



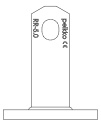
5. LIFTING



5. LIFTING ANGLE INFLUENCE



RR Lifting System



PA

CE

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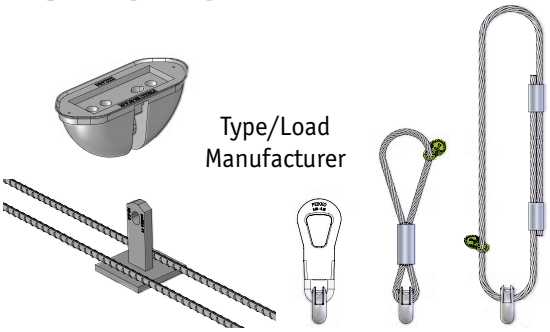
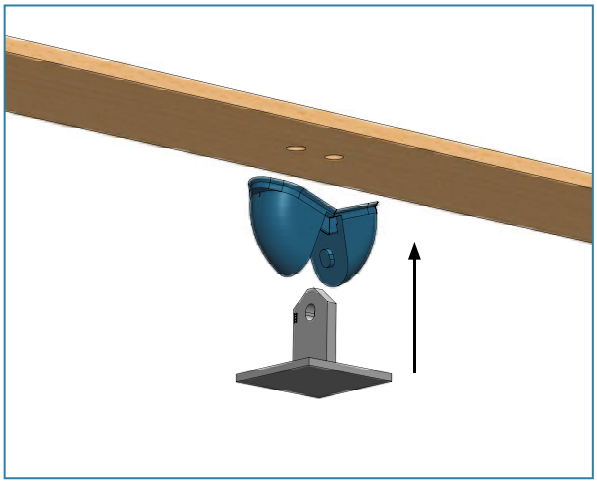
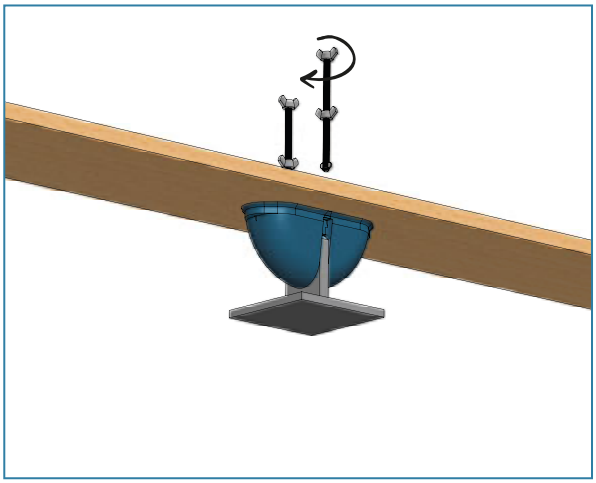
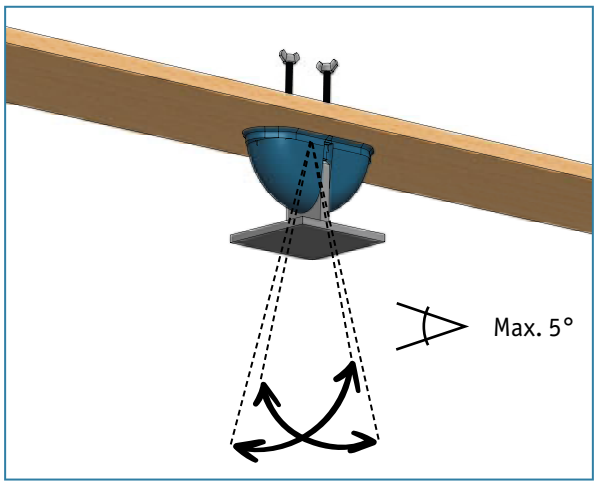


Load Class [t]	RR-RF and RR-PF Colour
2.5	Orange
5.0	Black
10.0	Green
26.0	Blue

2. INSTALLATION

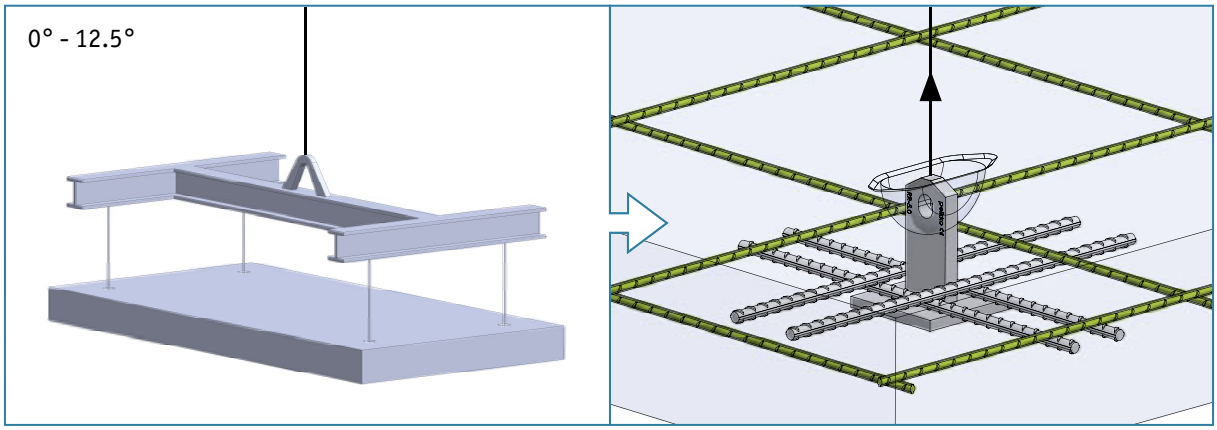


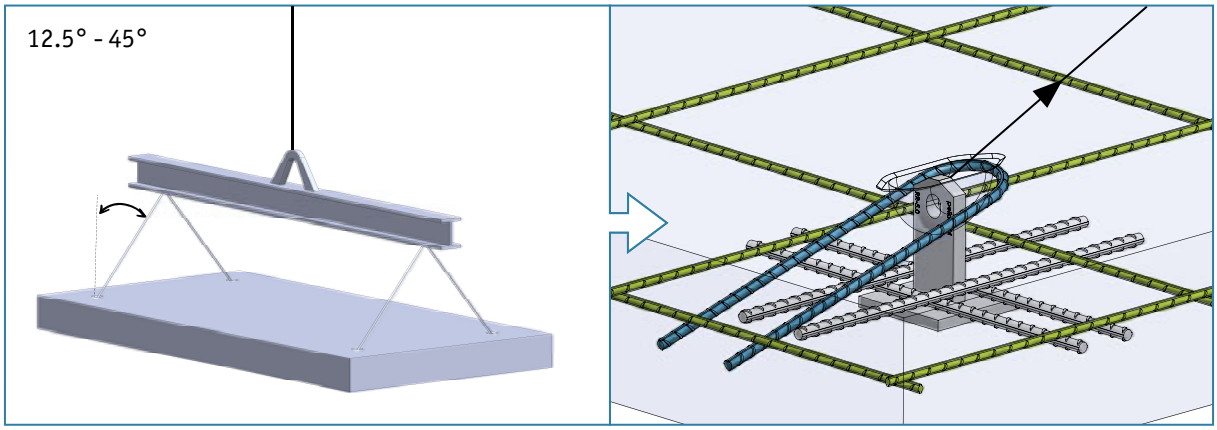


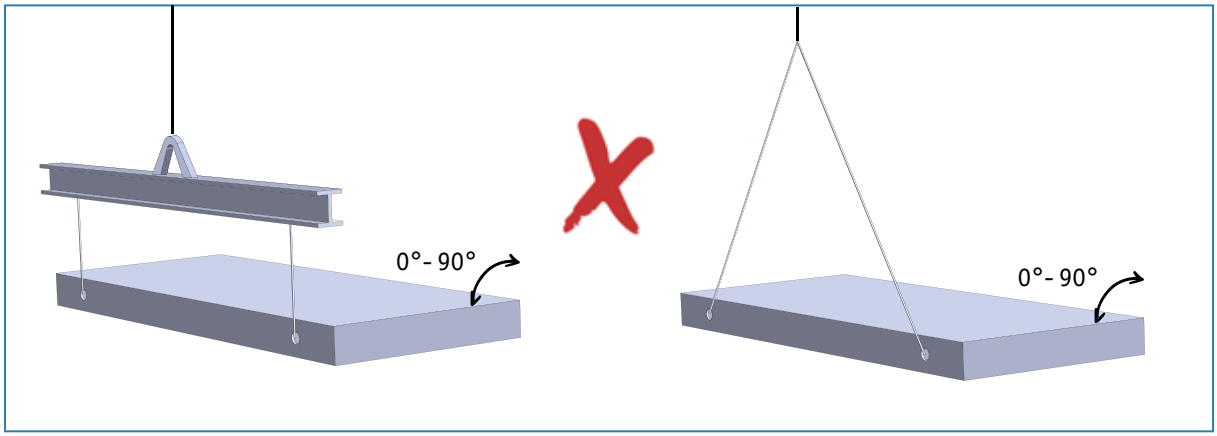


3. REINFORCEMENT

PA

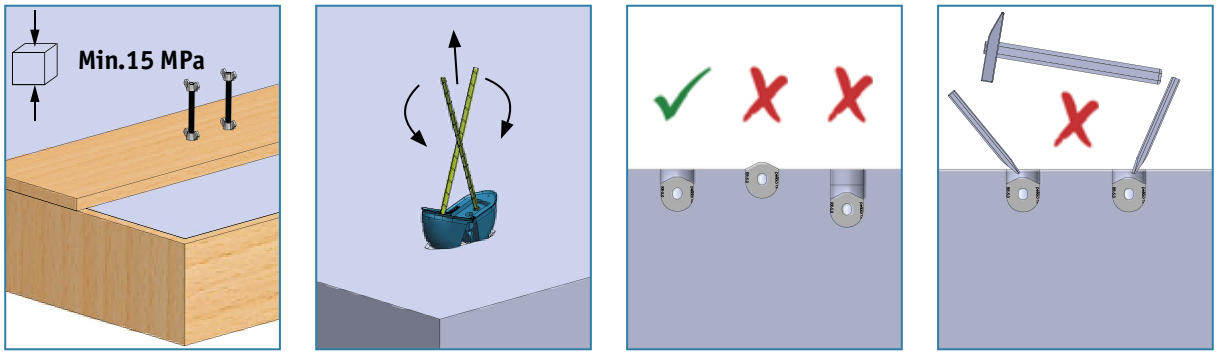




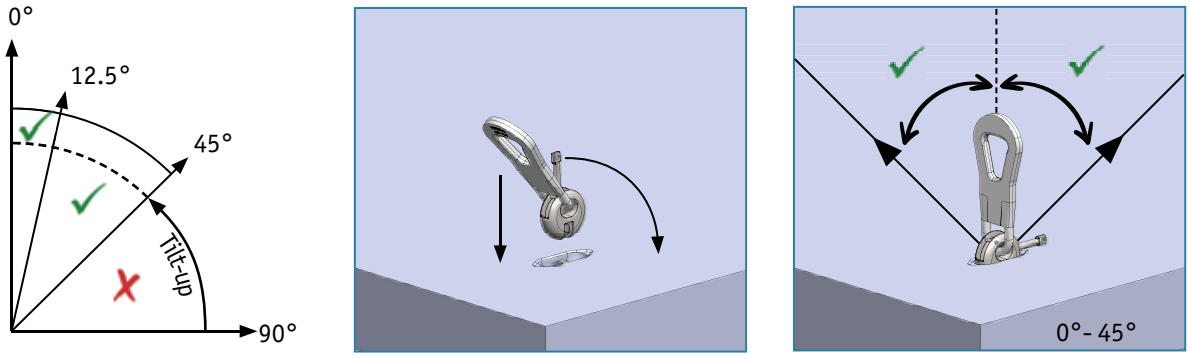


4. CASTING

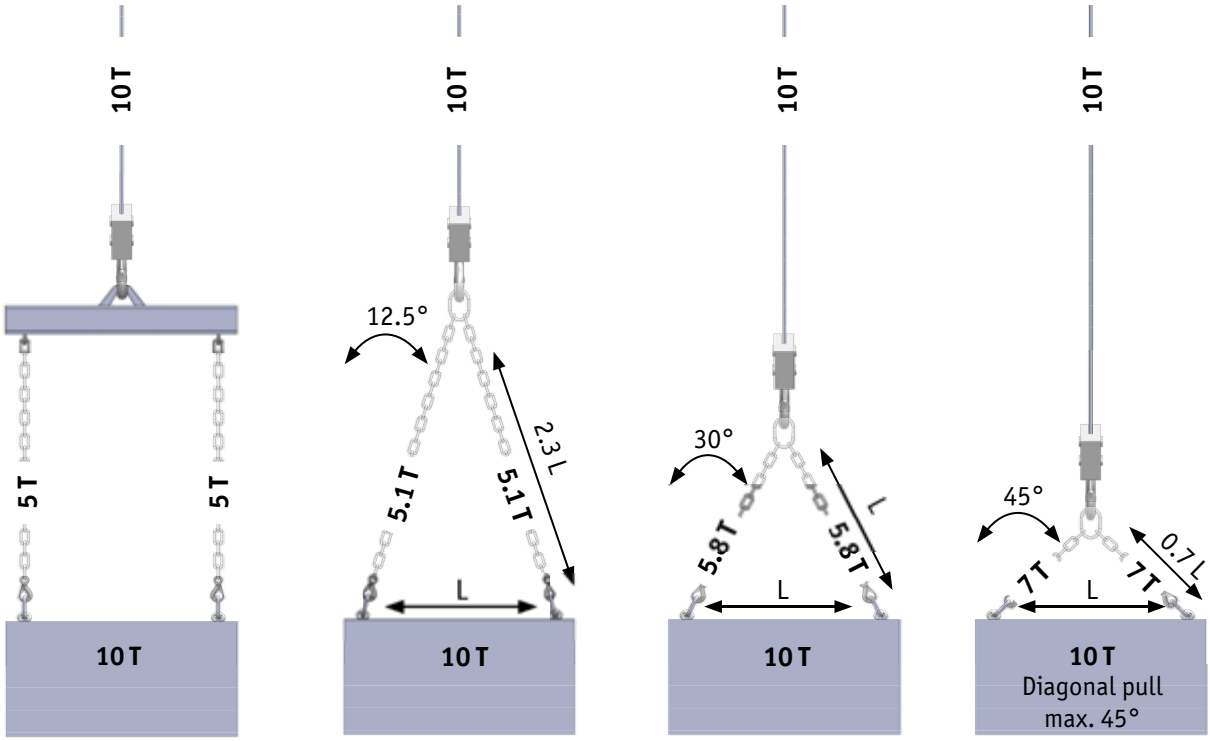
PA



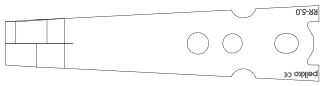
5. LIFTING



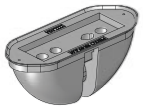
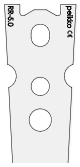
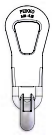
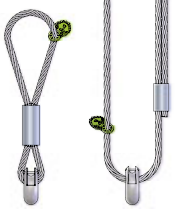
5. LIFTING ANGLE INFLUENCE



RR Lifting System

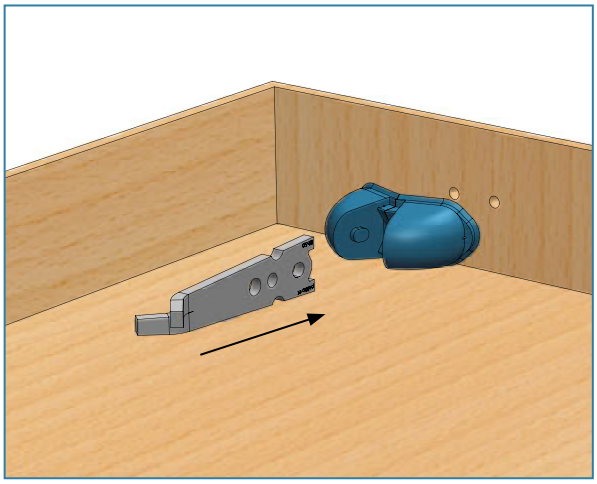
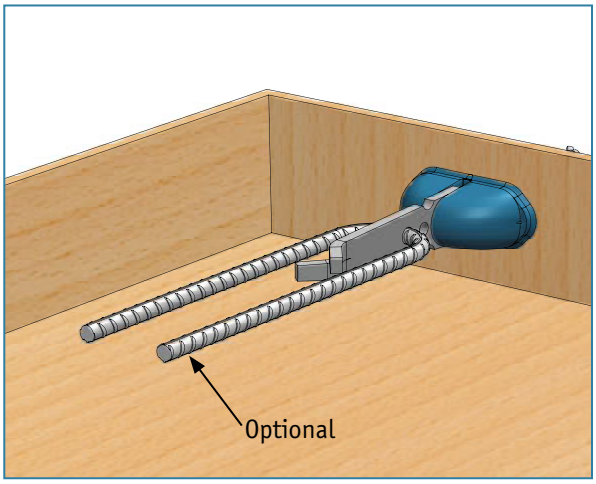

SA

EA

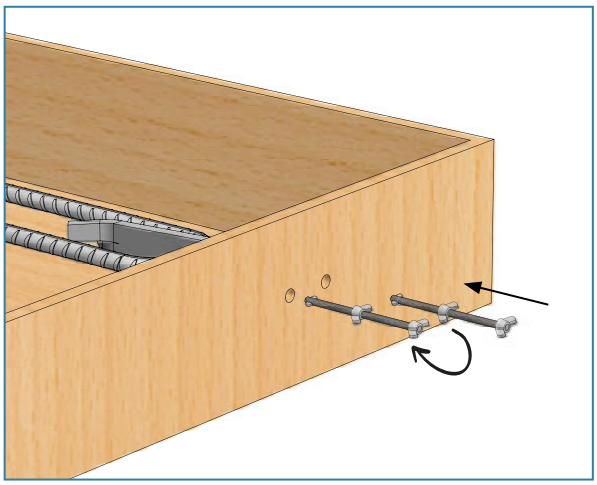
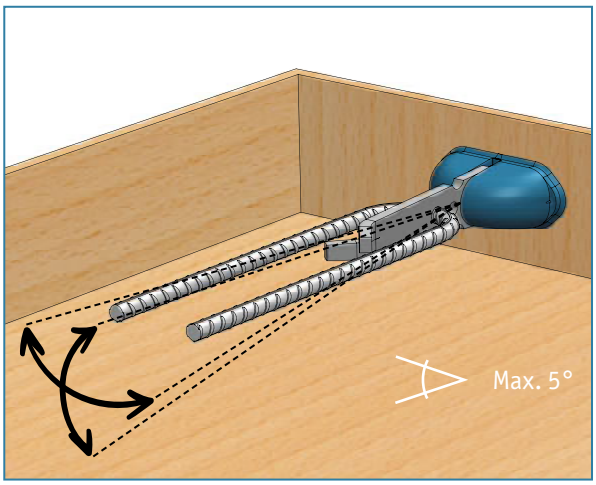
1. SELECTING



Type/Load
Manufacturer



Load Class [t]	RR-RF and RR-PF Colour
2.5	Orange
5.0	Black
10.0	Green
26.0	Blue

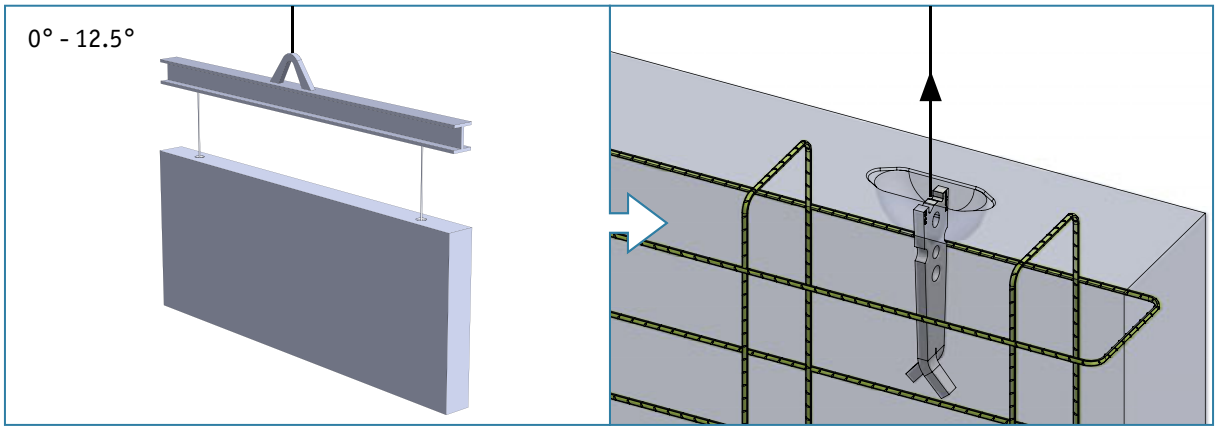
2. INSTALLATION

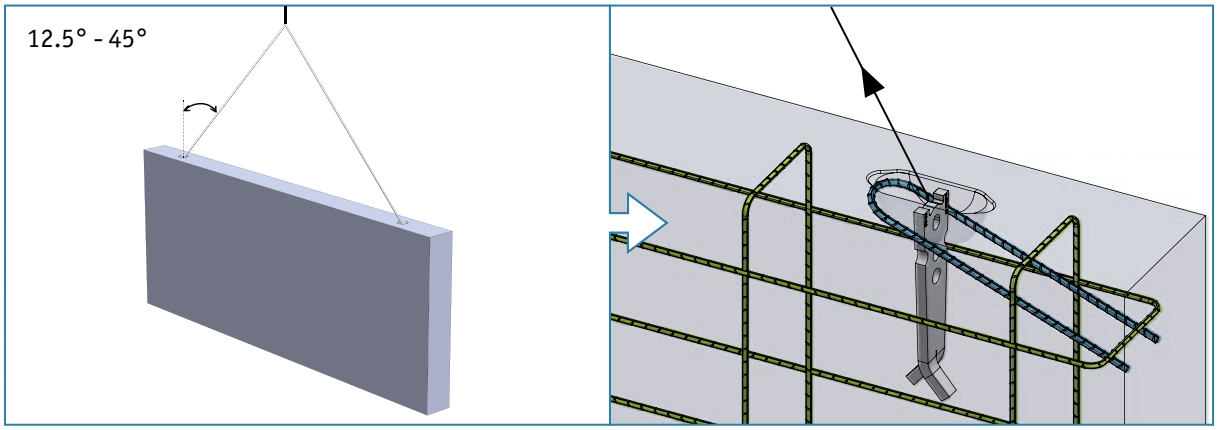



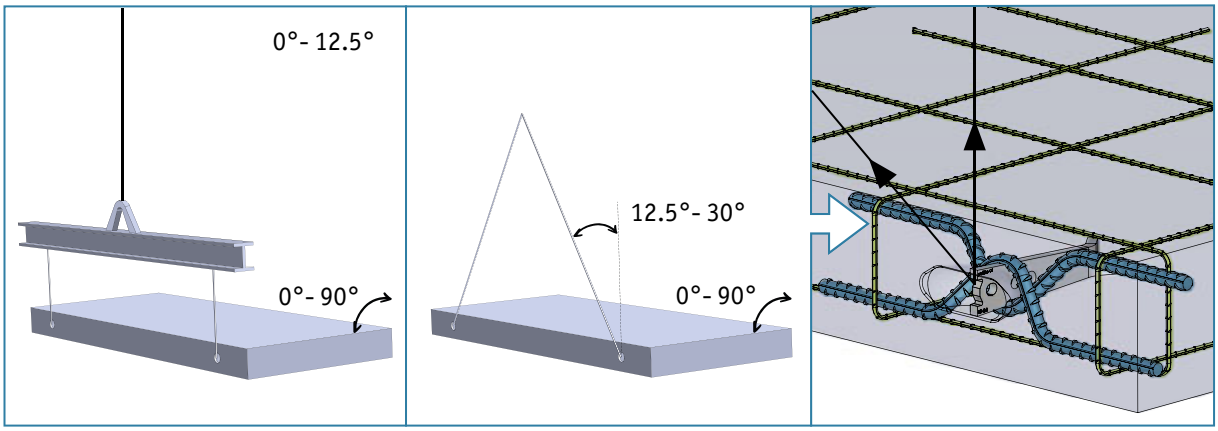



3. REINFORCEMENT

SA, EA

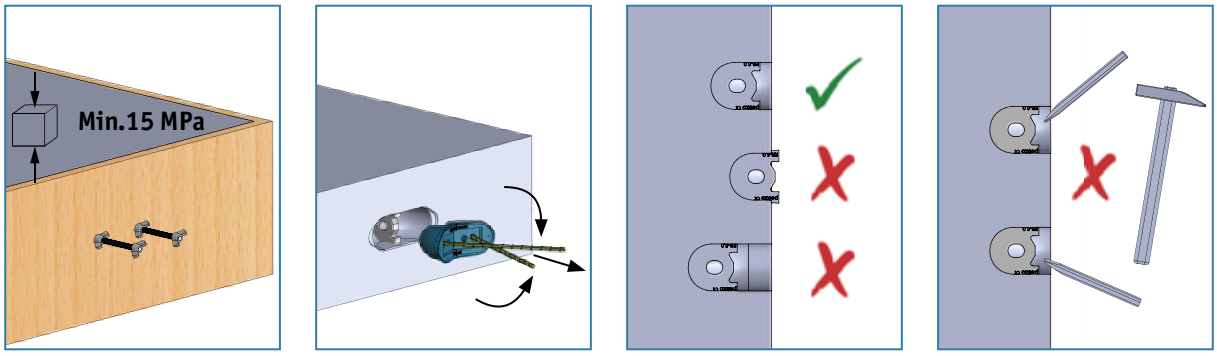




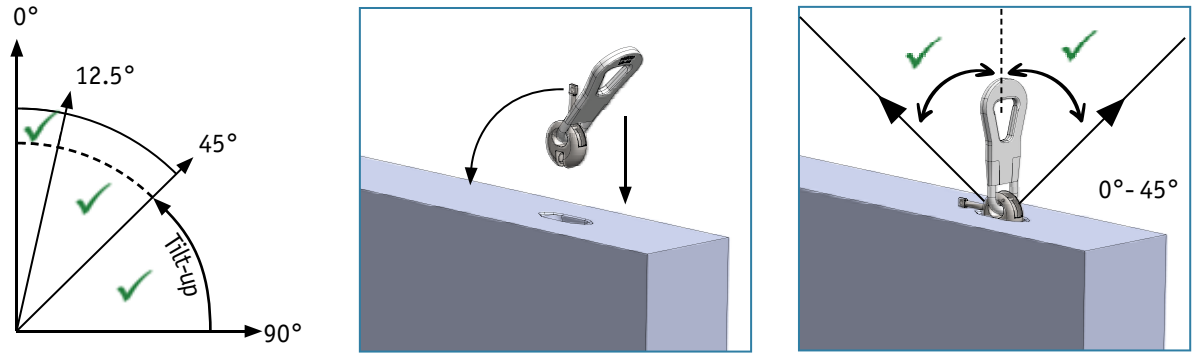


4. CASTING

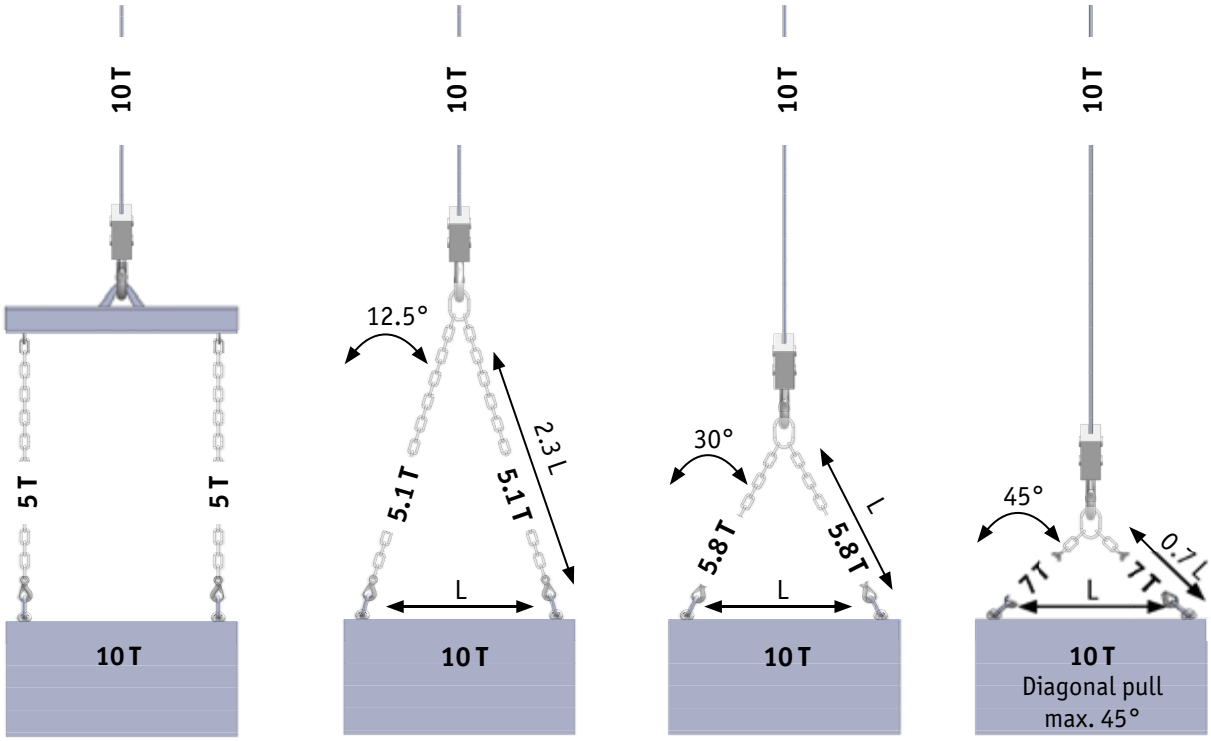
SA, EA



5. LIFTING



5. LIFTING ANGLE INFLUENCE



Technical Manual Revisions

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.

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