R lifting anchor

Technical manual

Version: **10.02.2026**

Machinery Directive 2006/42/EC & VDI/BV-BS 6205

Index

1. DESCRIPTION OF THE SYSTEM

R lifting anchors systems manufactured by R-Group Baltic OÜ are lifting anchors consisting of studded end round steel bars with Rd thread and compatible lifting keys. R lifting anchors enable lifting of slabs, columns, beams, walls and other precast concrete elements. R lifting anchors can be used in all lifting directions and for lifting angles up to 90 degrees.

R lifting anchors are designed and manufactured in accordance with EU Machinery Directive 2006/42/EC and VDI/BV-BS 6205. Lifting anchors meet the requirements for safe lifting and handling of concrete elements.

Figure 1. R lifting anchor

2. DIMENSIONS AND MATERIALS

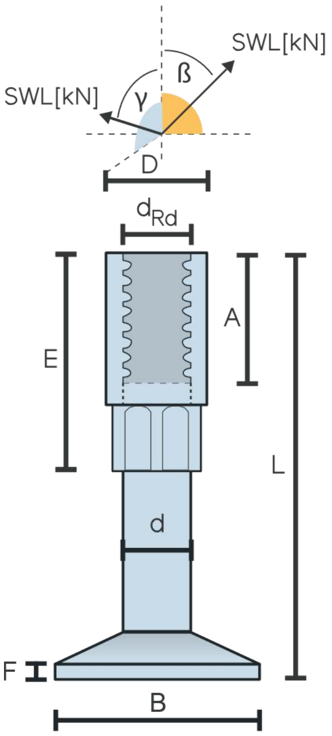


Figure 2. R lifting anchor dimensions

Table 1. R lifting anchor dimensions and tolerances

Lifting anchor	L [mm] ±2	A [mm] ±1	d_{Rd} [mm] *	E [mm] ±2	D [mm] **	B [mm] +2/-0	d [mm] **	F [mm] +2/-0
R16	100	29	16	45	22	42	16	3
R20	115	40	20	60	28	54	20	5
R24	130	46	24	70	32	63	24	5
R30	175	60	30	90	40	78	30	6
R36	225	69	36	105	48	99	36	8

* Tolerances of Rd thread 6h and 6H (DIN405).

** Measurement tolerance (DIN1030/EN10060).

2.1. Materials and standards

Table 2. Materials and standards

Part	Insert type	Material	Standard
Anchor part	R, Rr, Rh	S235JR+AR	EN 10025
Inner thread socket	R	S235JR+AR	EN 10025
Inner thread socket	Rr	1.4301	EN 10088
Inner thread socket	Rh	1.4401	EN 10088

2.2. Ordering codes

Ordering code of R lifting anchors consists of type, thread diameter and length of the anchor.

Anchor code	Anchor type
R	Electro zinced
Rr	Stainless
Rh	Acid resistant

E.g. for stainless R lifting anchor with Rd 16 thread ordering code is Rr 16x100.

3. MANUFACTURING

3.1. Markings

R lifting anchors are marked with RSTEEL® logo, Rd (size) and CE-marking. Products are delivered in boxes on a truck palette. Product package is equipped with an RSTEEL® pallet label, which contains the following information: product type, product name, quantity, ISO 9001 and ISO 14001 quality and environment system markings and CE-marking.

3.2. Quality control

R-Group Baltic OÜ internal manufacturing and quality control in accordance with EN 1090-2. External quality control provided to R-Group Baltic OÜ by Kiwa Inspecta OÜ.

4. RESISTANCES

4.1. Calculation principles

Capacities of the R lifting anchors are calculated for static loads according to the limit state dimensioning method presented in Eurocodes.

The calculations are made according to the following regulations and instructions:

EN 1992-1-1: Design of concrete structures

EN 1992-4:2018: Design of fastenings for use in concrete

Machinery directive 2006/42/EC

VDI/BV-BS 6205

Global safety factors used in calculation of safe working loads are:

Steel failure $\gamma = 3.0$

Concrete failure $\gamma = 2.5$

Safe working loads are based on concrete dimensions, anchor steel bars and lifting anchor edge distances given in the following sections. Minimum concrete compressive strength at the moment of load application $f_{ck.cube.min}$ = 15 MPa.

Safety concept:

$$E \leq SWL$$

where:

E – action placed on lifting anchor

SWL – safe working load of lifting anchor

Actions placed on lifting anchors must take into account all loads and load distribution to lifting anchors according to following sections.

4.2. Safe working loads

4.2.1. Safe working loads for wall elements

Safe working loads of R lifting anchors in wall elements are given in Table 3. Safe working loads are applicable with concrete thickness and anchor spacing according to Table 5 and lifting anchor reinforcement according to Section 5.2.

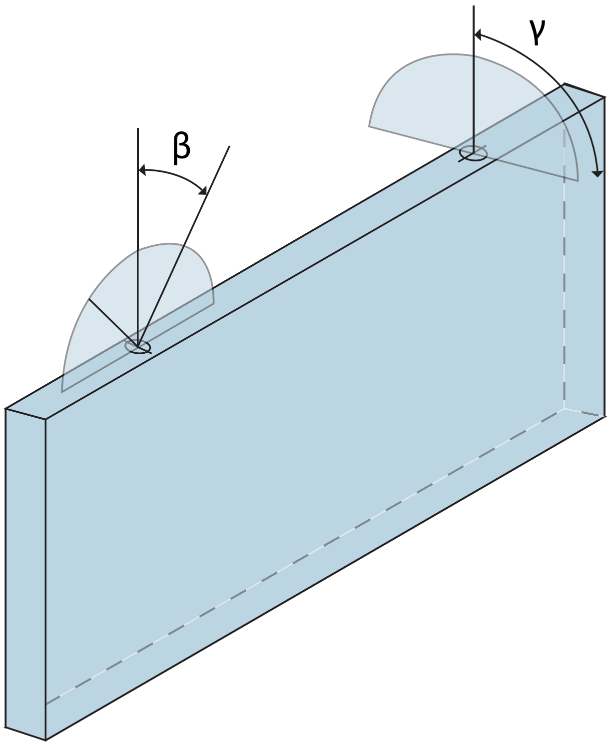


Figure 3. R lifting anchor load directions in wall elements

Table 3. R lifting anchors safe working loads in wall elements

Load group	Lifting anchor	Safe working loads (SWL) [kN]		
		β = 0° - 45°	γ = 0° - 10°	γ = 10° - 90°
		C12/15	C12/15	C12/15
1.2	**R16**	12	12	6
2.0	**R20**	20	20	10
2.5	**R24**	25	25	12.5
4.0	**R30**	40	40	20
6.3	**R36**	63	63	31.5

For lifting angle β > 15°, diagonal pull reinforcement as per Section 5.2 is always required.

For lifting angle γ > 10°, tilting reinforcement as per Section 5.2 is always required.

4.2.2. Safe working loads for slab elements

Safe working loads of R lifting anchors in slab elements are given in Table 4. Safe working loads are applicable with concrete thickness and anchor spacing according to Table 6 and lifting anchor reinforcement according to Section 5.2.

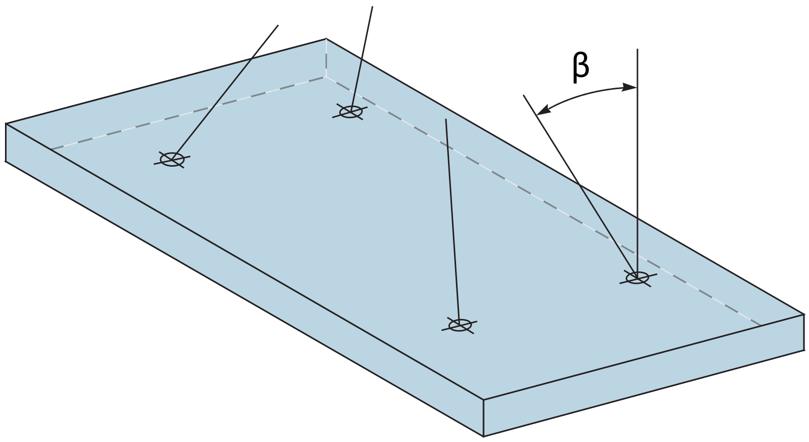


Figure 4. R lifting anchor load directions in slab elements

Table 4. R lifting anchors safe working loads in slabs

Load group	Lifting anchor	Safe working loads (SWL) [kN]	
		β = 0° - 45°	
		C12/15	C16/20
1.2	**R16**	12	12
2.0	**R20**	20	20
2.5	**R24**	25	25
4.0	**R30**	40	40
6.3	**R36**	63	63

5. APPLICATION

5.1. Minimum edge and center distances

5.1.1. Concrete thickness and anchor spacing in wall elements

Safe working loads are valid only with minimum concrete thickness and minimum lifting anchor spacing given in Figure 5 and Table 5.

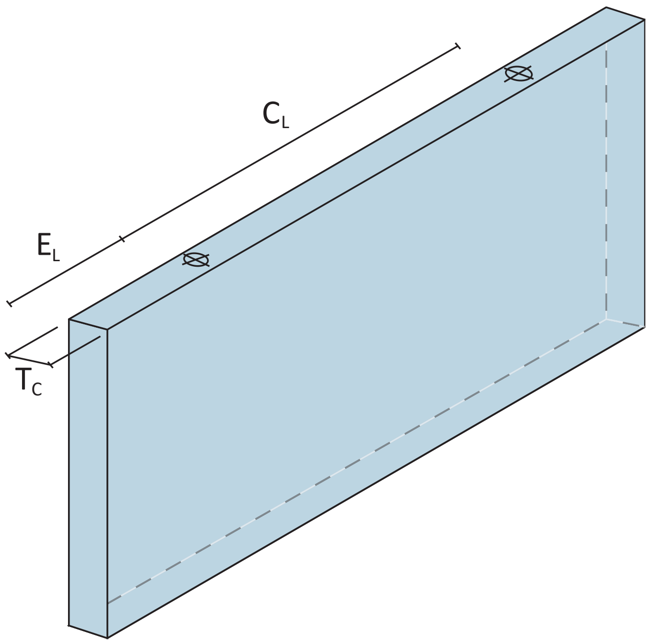


Figure 5. Minimum element thickness and lifting anchor spacing

Table 5. Minimum element thickness and minimum lifting anchor spacing in wall elements

Lifting anchor	Minimum concrete thickness T_C [mm]	Minimum lifting anchor edge spacing E_L [mm]	Minimum lifting anchor center spacing C_L [mm]
R16	100	150	300
R20	120	170	340
R24	130	200	400
R30	140	260	520
R36	160	330	660

5.1.2. Concrete thickness and anchor spacing in slab elements

Safe working loads are valid only with minimum concrete thickness and minimum lifting anchor spacing given in Figure 6 and Table 6.

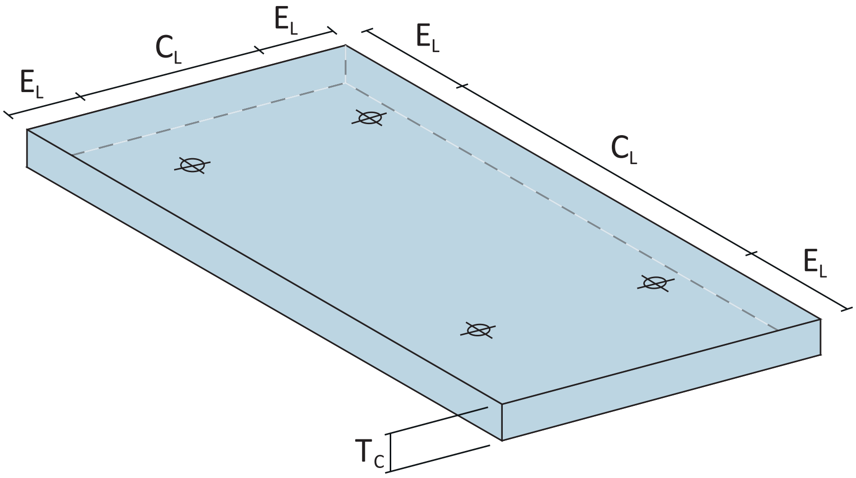


Figure 6. Minimum slab thickness and lifting anchor spacing

Table 6. Minimum slab thickness and minimum lifting anchor spacing in slab elements

Lifting anchor	Minimum slab thickness T_C [mm]	Minimum lifting anchor edge spacing E_L [mm]	Minimum lifting anchor center spacing C_L [mm]
R16	120	150	300
R20	135	170	340
R24	150	200	400
R30	195	260	520
R36	235	330	660

5.2. Additional reinforcement

Additional reinforcement for lifting anchors, ribbed steel bar according to EN 10080, $f_{yk} \geq 500$ MPa.

5.2.1. Axial pull reinforcement in wall elements

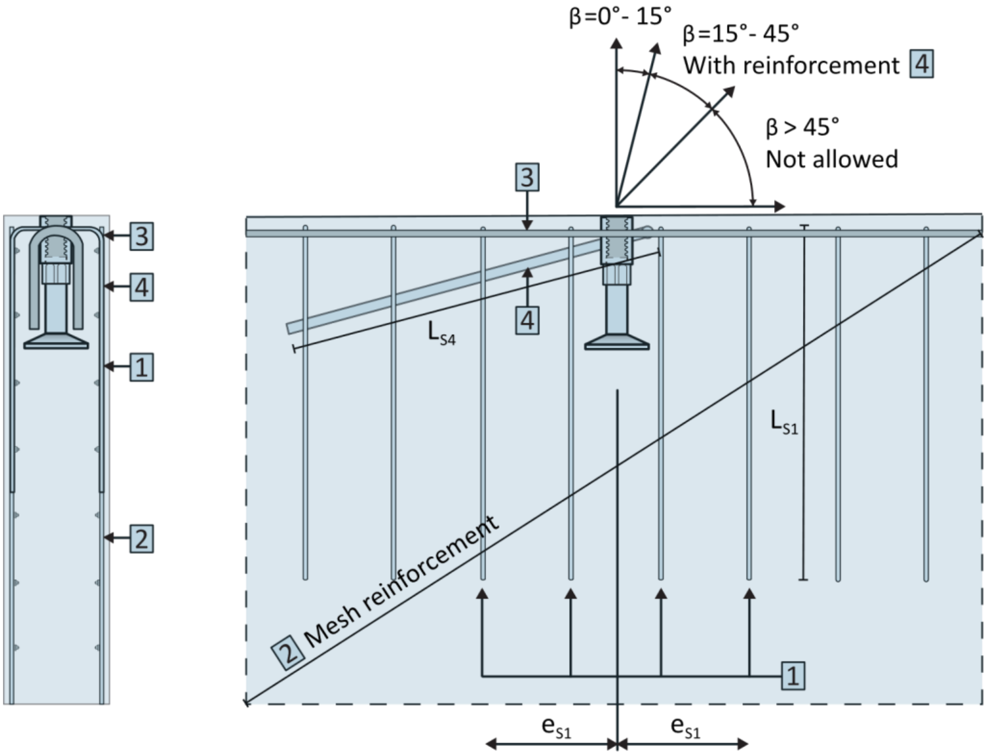


Figure 7. R lifting anchor reinforcement for axial pull in wall elements

R lifting anchors must always have reinforcement according to Figure 7 and Table 7. This reinforcement transfers the load from the lifting anchor to the concrete.

Stirrup reinforcement [1], additional surface reinforcement [2] and edge reinforcement [3] must be placed at the lifting anchor area. Maximum distance for stirrup reinforcement [1] from the center of R lifting anchor e_{S1} is lifting anchor height ($e_{S1.max}$ = L). These reinforcements may be replaced by structural reinforcement in concrete element, providing the structural reinforcement has sufficient cross-section area and overlap lengths.

Table 7. R lifting anchors reinforcement for axial pull in wall elements

Lifting anchor	Stirrup reinforcement [1]			Mesh reinforcement [2]	Edge Reinforcement [3]
	n [pcs]	Diameter $Ø_{S1}$ [mm]	Length L_{S1} [mm]	Both surfaces [mm^2/m]	Diameter $Ø_{S5}$ [mm]
R16	2	6	350	200	8
R20	2	8	450	250	10
R24	2	8	450	250	10
R30	2	10	600	333	12
R36	4	10	650	333	12

Reinforcement given in this section covers only the load impact the lifting anchor has on the concrete. Due to eccentricities and lifting angles the concrete element may be subject to bending. Due to loads placed on the concrete elements by the lifting actions the concrete element may be subject to cracking. Concrete element must be separately reinforced for bending and cracking.

5.2.2. Axial pull reinforcement in slab elements

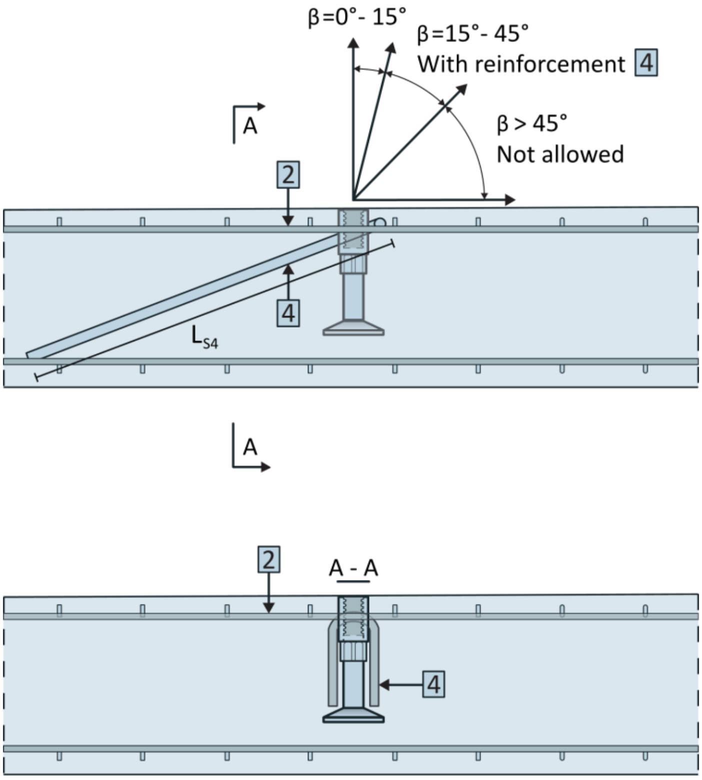


Figure 8. Axial pull reinforcement in slab element

R lifting anchors in slab elements must always have mesh reinforcement [2] according to Figure 8 and Table 8. This reinforcement may be replaced by structural reinforcement in concrete element, providing the structural reinforcement has sufficient cross-section area and overlap lengths.

Table 8. R lifting anchor reinforcement for axial pull in slab elements

Lifting anchor	**Mesh reinforcement [2]**
	Top surface [mm^2 / m]
R16	200
R20	250
R24	250
R30	333
R36	333

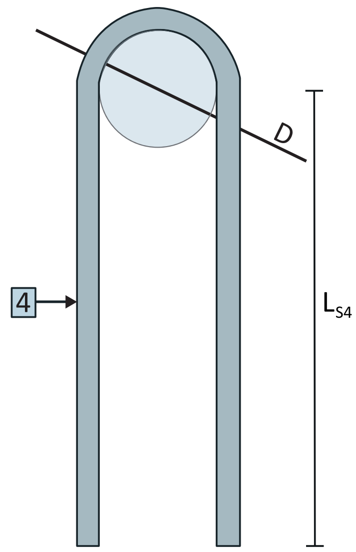
5.2.3. Diagonal pull reinforcement

In addition to axial pull reinforcement, the lifting anchors must be reinforced for diagonal pull if the lifting angle β is greater than 15°. Diagonal pull reinforcement [4] is given in Figure 7, Figure 8 and Table 9. Reinforcement given in Table 7 and Table 8 must always be present for diagonal pull.

Diagonal pull reinforcement must be placed in direct contact with the lifting anchor according to Figure 7 and Figure 8. Bending diameter "D" should be same as the outer diameter of the lifting anchor for a tight fit.

Table 9. R lifting anchor reinforcement for diagonal pull

Lifting anchor	Diagonal pull reinforcement [4]	
	Diameter $Ø_{S4}$ [mm]	Length L_{S4} [mm]
R16	8	300
R20	8	400
R24	10	450
R30	12	550
R36	14	700

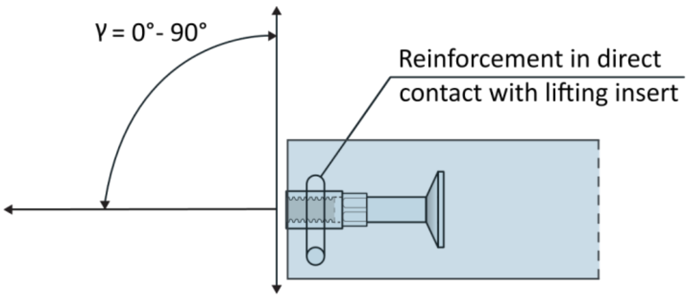


5.2.4. Tilting reinforcement

R lifting anchors can be used for tilting of concrete elements (load angle γ = 0°- 90°). For tilting and lateral pull R lifting anchors must be reinforced with lateral pull reinforcement [5] according to Figure 9 and Table 10. Reinforcement given in Table 7 and Table 8 must always be present for lateral pull.

Lateral pull reinforcement must be placed in direct contact with the recess former of the lifting anchor.

Direction of lifting force and tilting reinforcement must be according to Figure 9. If the direction of lifting force can be changed or there is a possibility of lifting force direction being according to Figure 10 it is recommended to install tilting reinforcement to both sides of R lifting anchor, see Figure 10.



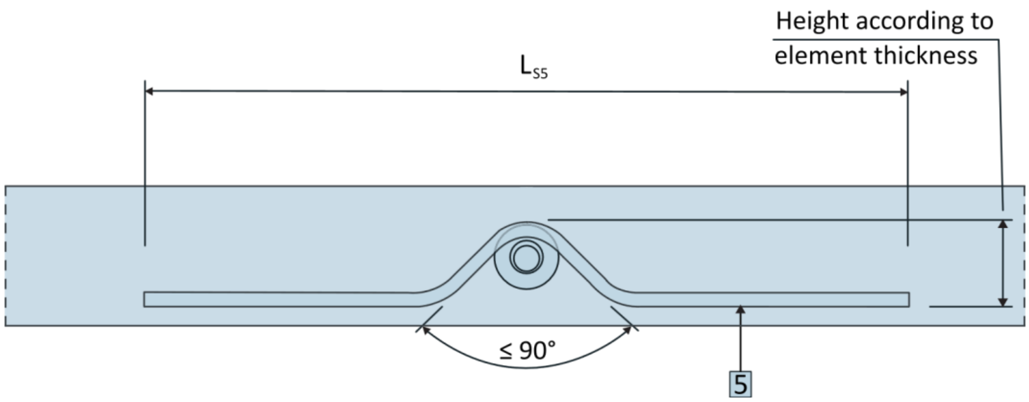


Figure 9. R lifting anchor tilting reinforcement

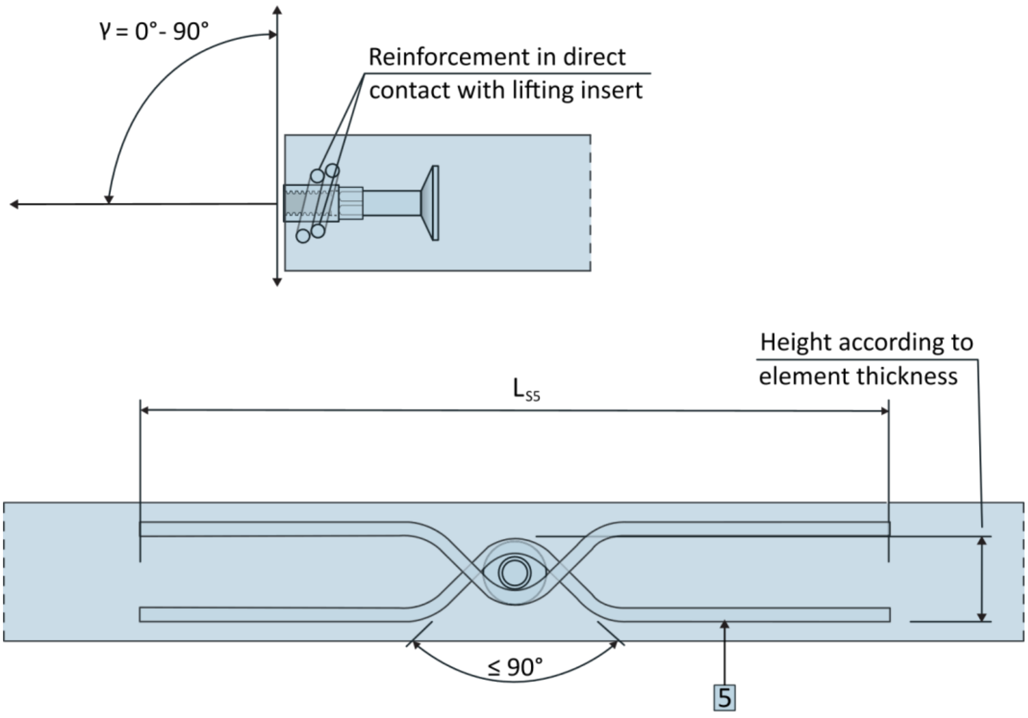


Figure 10. R lifting anchor tilting reinforcement, lifting force both directions

Table 10. R lifting anchor reinforcement for lateral pull

Lifting anchor	Lateral pull reinforcement [5]	
	Diameter $Ø_{s5}$ [mm]	Length L_{s5} [mm]
R16	10	650
R20	12	800
R24	12	800
R30	16	1050
R36	16	1050

5.3. Actions on lifting inserts

The loads acting on a lifting insert shall be determined considering the following factors:

- statical system
- element self-weight
- adhesion and form friction
- dynamic effects
- position and number of lifting inserts
- type of lifting equipment and different load scenarios (tension, combined tension and shear, shear loading).

5.3.1. Number and actions of lifting inserts

The number of load bearing lifting inserts and the load acting on the lifting inserts shall be determined corresponding with the individual lifting situations. The statistical system of lifting inserts must be accounted for in these calculations. Actions from all individual lifting situations must be calculated according to Sections 5.3.2 to 5.3.10.

After actions placed on lifting inserts are determined, the safe working load (SWL) in Section 4 shall then be compared with the actions. The safety concept requires that the action E does not exceed the safe working load SWL. The following formula must be satisfied for all actions on lifting inserts

$$E \leq SWL$$

where:

E – action on lifting insert, see Sections 5.3.2 to 5.3.10, in kN

SWL – safe working load of lifting insert, see Section 4, in kN

The most unfavourable relation from action to resistance resulting governs the design.

5.3.2. Statical system

Lifting equipment used in lifting of pre-cast elements shall allow determinate load distribution to all present lifting inserts. Figure gives examples of statically indeterminate systems where only two lifting inserts carry the load. The load distribution is not clearly defined in these applications. Therefore, these statically indeterminate systems shall be avoided.

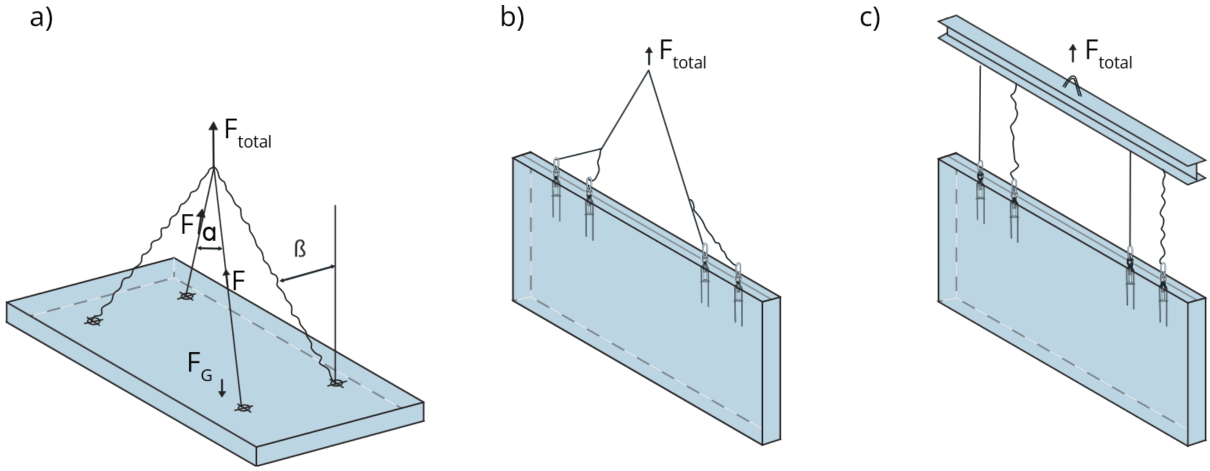


Figure 11. Examples of statically indeterminate lifting systems which should not be used

- **a) statically indeterminate system. Load bearing inserts n = 2.**
- **b) statical system without clearly defined load-bearing mechanism. Load bearing inserts n = 2.**
- **c) statically indeterminate load distribution to the lifting inserts of a wall element. Load bearing inserts n = 2.**

To ensure a statically determinate system and that all lifting inserts carry their required part of the load in case of applications with more than two lifting inserts transport aids such as sliding or rolling couplings or balancing beams shall be used.

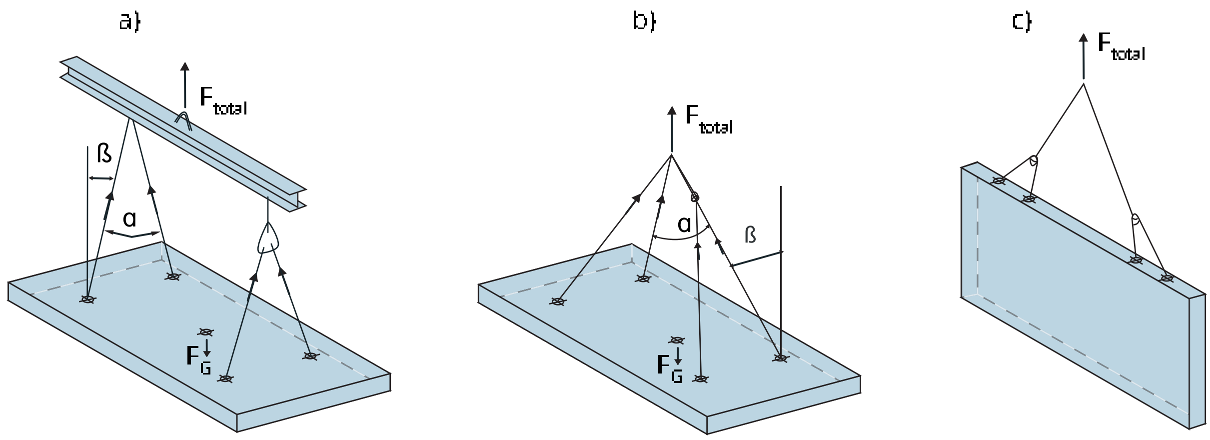


Figure 12. Transportation aids for the statically determinate lifting of slabs and wall elements

- **a) balancing beam and rolling coupling. Load bearing inserts n = 4.**
- **b) sliding coupling. Load bearing inserts n = 4.**
- **c) rolling coupling. Load bearing inserts n = 4.**

In case of inclined lifting slings, the lifting inserts are loaded by combined tension and shear loads. The inclination β according to Figure 12 governs the level of combined tension and shear loads to be taken into account in the design.

If three lifting inserts are located in slab and situated in star pattern with same distance to the centre of gravity with equal inclinations of 120° (Figure 13) it is ensured that all three lifting inserts experience the same load.

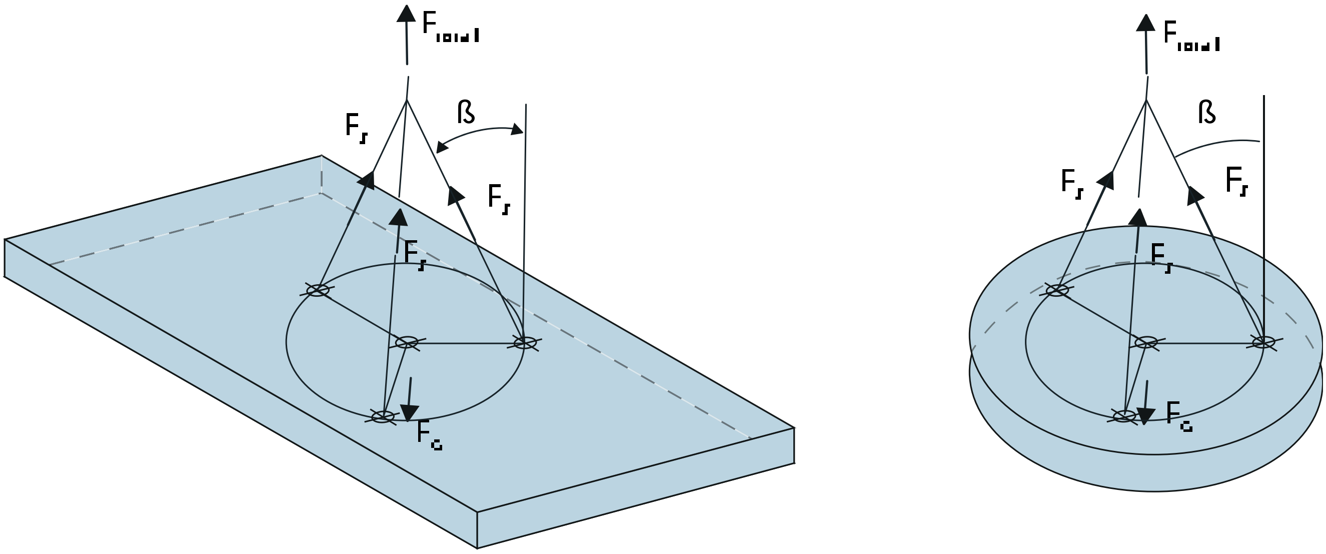


Figure 13. Statically determinate load distribution by means of lifting inserts in star pattern

5.3.3. Load distribution for non-symmetrical insert layout

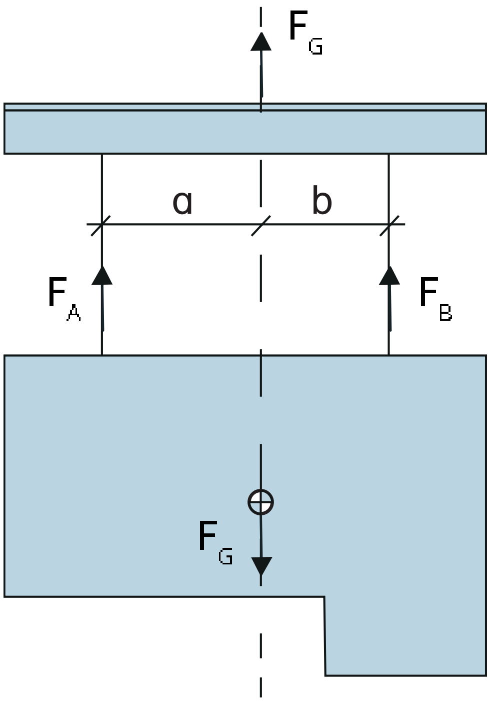


Figure 14. Load distribution for non-symmetrical insert layout using spreader beam

If the inserts are not installed symmetrically to the load's centre of gravity, the load distribution to different inserts is:

$$F_A = F_G \cdot b/(a+b)$$

$$F_B = F_G \cdot a/(a+b)$$

where:

F_G – weight of the pre-cast element, in kN

a – distance from insert to centre of gravity, in m

b – distance from insert to centre of gravity, in m

If elements are lifted without spreader beam, the lifting inserts must be installed symmetrically with respect to the elements centre of gravity.

5.3.4. Spread angle

The influence of spread angle on the actions for lifting inserts must be considered.

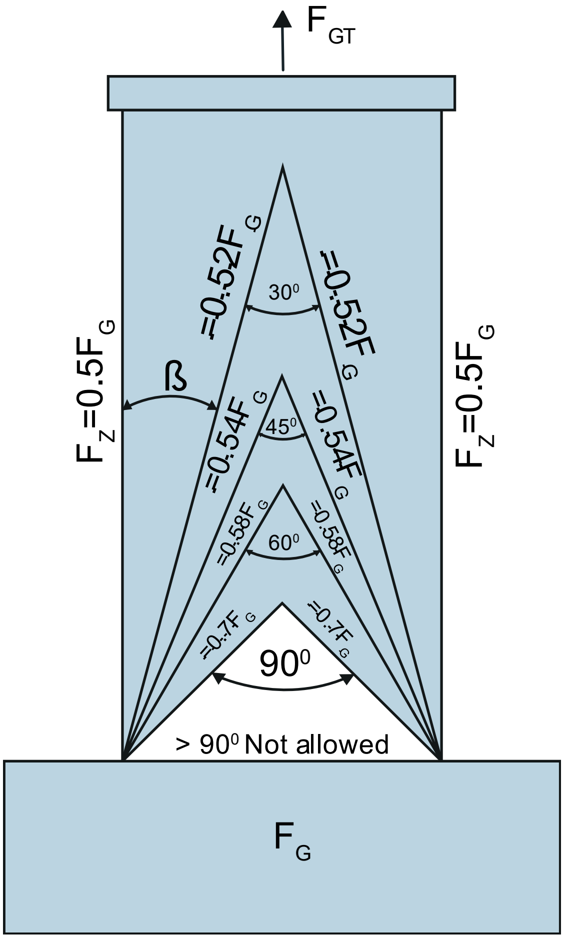


Figure 15. Spread angle factors

Table 11. Spread angle factors

Cable angle β	Spread angle α	Load factor z
0°	-	1.00
7.5°	15°	1.01
15°	30°	1.04
22.5°	45°	1.08
30°	60°	1.15
37.5°	75°	1.26
45°	90°	1.41

5.3.5. Self-weight

The self-weight F_G of pre-cast elements shall be determined as

$$F_G = V \cdot \rho_G$$

where:

V – volume of the pre-cast element, in m^3

ρ_G – density of the concrete, in kN/m^3

5.3.6. Adhesion and form friction

Adhesion and form friction are assumed to act simultaneously during the lifting of the precast element from the formwork. The action for demolding situations is:

$$F_{adh} = q_{adh} \cdot A_f$$

where:

F_{adh} – action due to adhesion and form friction, in kN

q_{adh} – basic value of combined adhesion and form friction as per Table 12, in kN/m^2

A_f – contact area between concrete and formwork, in m^2

Table 12. Minimum values of adhesion and form friction q_{adh}

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

a) Structured surfaces should be considered separately.

b) The area to be used in the calculations is the total contact area between the concrete and the form.

Note: The minimum values of Table 12 are valid only if suitable measures to reduce adhesion and form friction are taken e.g. casting on tilting or vibrating the formwork during the demolding process.

5.3.7. Dynamic actions

During lifting and handling of the precast elements the lifting devices are subjected to dynamic actions. The magnitude of the dynamic actions depends on the type of lifting machinery. Dynamic effects shall be considered by the dynamic factor Ψ_{dyn}. For further guidance values of Ψ_{dyn} depending on the lifting machinery and characteristics of the terrain are given in Table 13.

Table 13. Dynamic factor Ψdyn according to VDI/BV-BS6205:2012

Condition	Dynamic factor Ψ_{dyn}
Tower crane, portal crane, mobile crane	1.3
Lifting and moving on flat terrain	2.5
Lifting and moving on rough terrain	≥ 4

Note: Other values of Ψ_{dyn} than given in Table 13 based on reproducible tests or verified experience can be used in the design. In case of other lifting and handling conditions than reported in Table 13 the factor Ψ_{dyn} shall be determined on the base of tests or engineering judgement.

5.3.8. Load condition "erection in combination with adhesion and form friction"

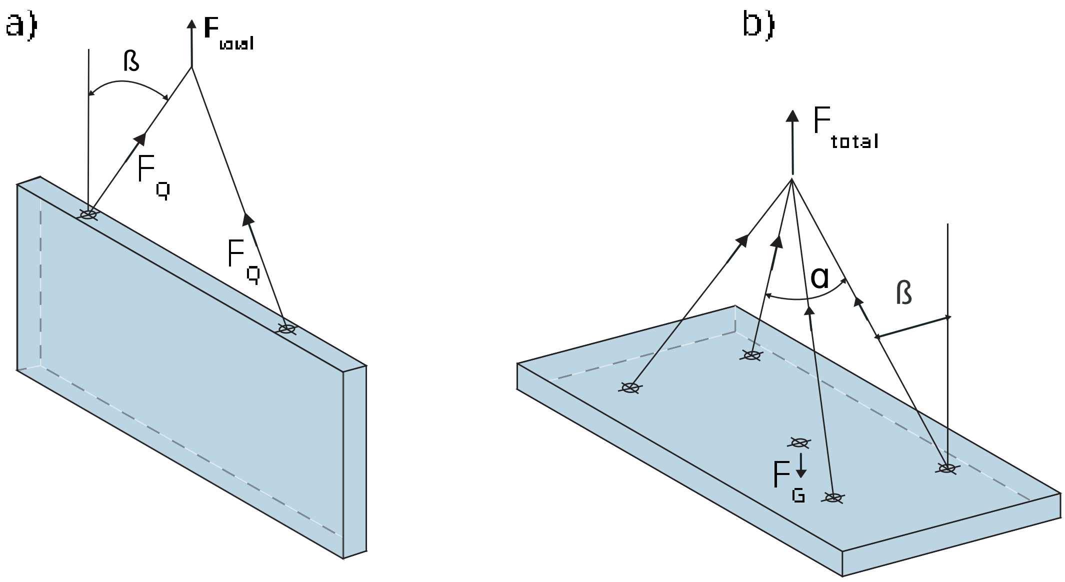


Figure 16. Erection in combination with adhesion and form friction

When pre-cast elements are lift from form according to the action F_Q on lifting inserts is

$$F_Q = (F_G + F_{adh}) \cdot z/n$$

where:

F_Q – load acting on individual lifting insert, in kN

F_G – self-weight of the pre-cast element, Section 5.3.5, in kN

F_{adh} – action due to adhesion and form friction, Section 5.3.6, in kN

z – factor for combined tension and shear,

z = 1 / cos β, angle β in accordance with Figure 16.

Note: in case of only tension z = 1.

n – number of lifting anchors carrying the load.

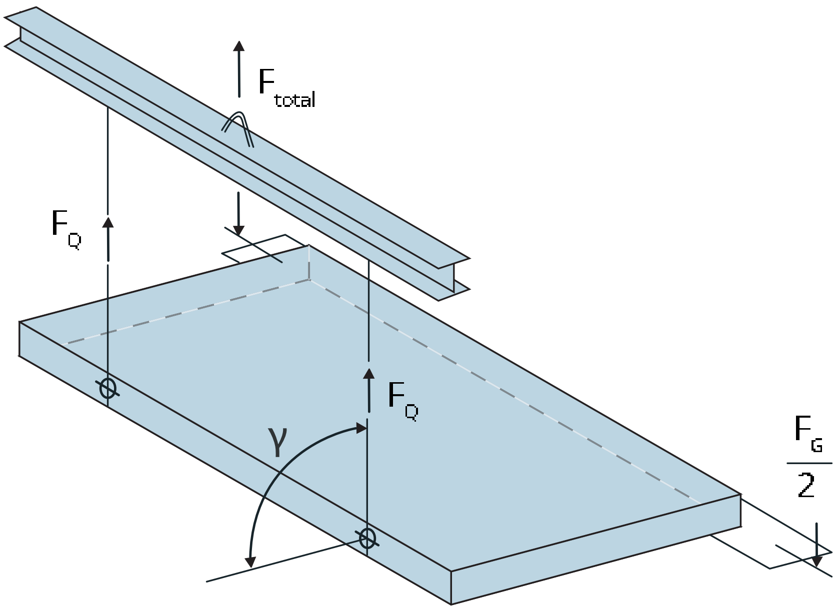


Figure 17. Erection in combination with adhesion and form friction, lifting with balancing beam

When pre-cast elements are lift from form according to the action F_Q on lifting inserts is:

$$F_Q = \left(\frac{F_G}{2} + F_{adh}\right)/n$$

where:

F_Q – load acting on individual lifting insert, in kN

F_G – self-weight of the pre-cast element, Section 5.3.5, in kN

F_{adh} – action due to adhesion and form friction, Section 5.3.6, in kN

n – number of lifting anchors carrying the load.

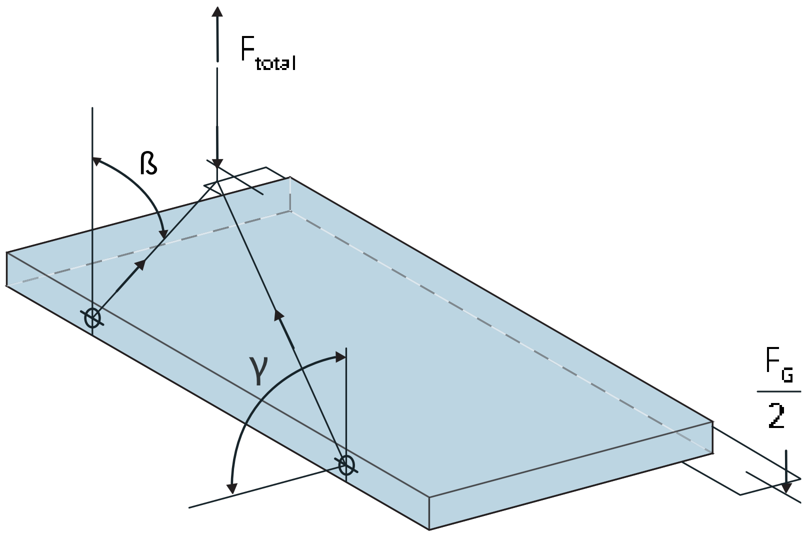


Figure 18. Erection in combination with adhesion and form friction, lifting with chains

When pre-cast elements are lift from form according to the action F_Q on lifting inserts is:

$$F_Q = \left(\frac{F_G}{2} + F_{adh}\right) \cdot z/n$$

where:

F_Q – load acting on individual lifting insert, in kN

F_G – self-weight of the pre-cast element, Section 5.3.5, in kN

F_{adh} – action due to adhesion and form friction, Section 5.3.6, in kN

z – factor for combined tension and shear

z = 1 / cos β, angle β in accordance with Figure 18.

n – number of lifting anchors carrying the load.

5.3.9. Load condition “erection”

It is assumed that the pre-cast element rests one-sided in the form or has been tilted up and forces from adhesion and form friction are no longer present.

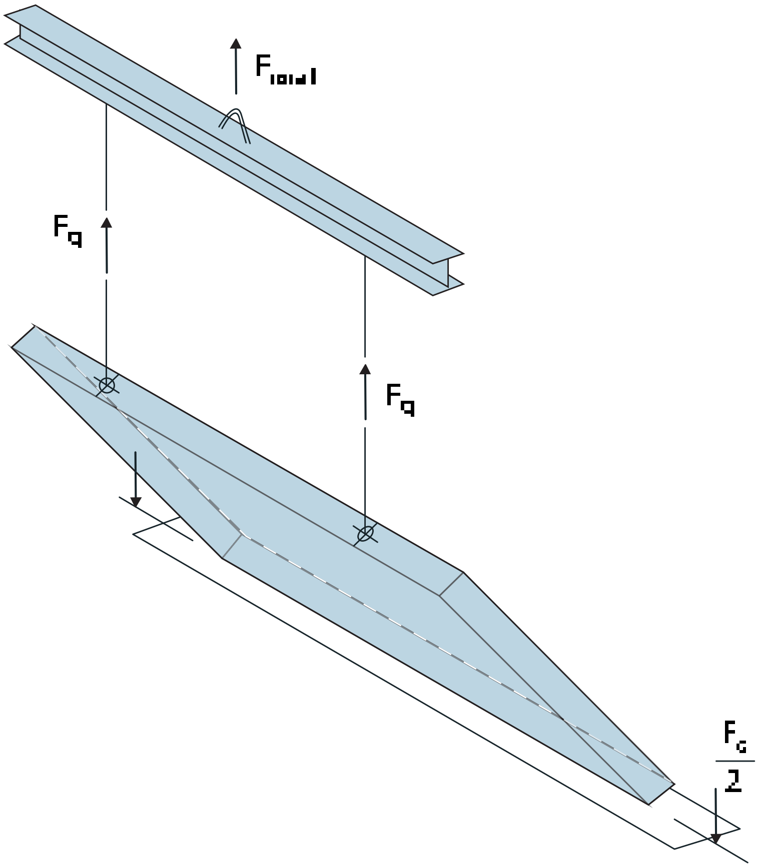


Figure 19. Element erection with balancing beam

Erection with balancing beam, action on lifting insert is:

$$F_Q = \left(\frac{F_G}{2}\right) \cdot \psi_{dyn}/n$$

where:

F_Q – shear load acting on individual lifting insert, in kN

Note: shear directed perpendicular to the longitudinal axis of the concrete component e.g. during lifting from the horizontal position with a beam

F_G – self-weight of the pre-cast element, Section 5.3.5, in kN

Ψ_{dyn} – dynamic factor, Section 5.3.7

n – number of lifting anchors carrying the load.

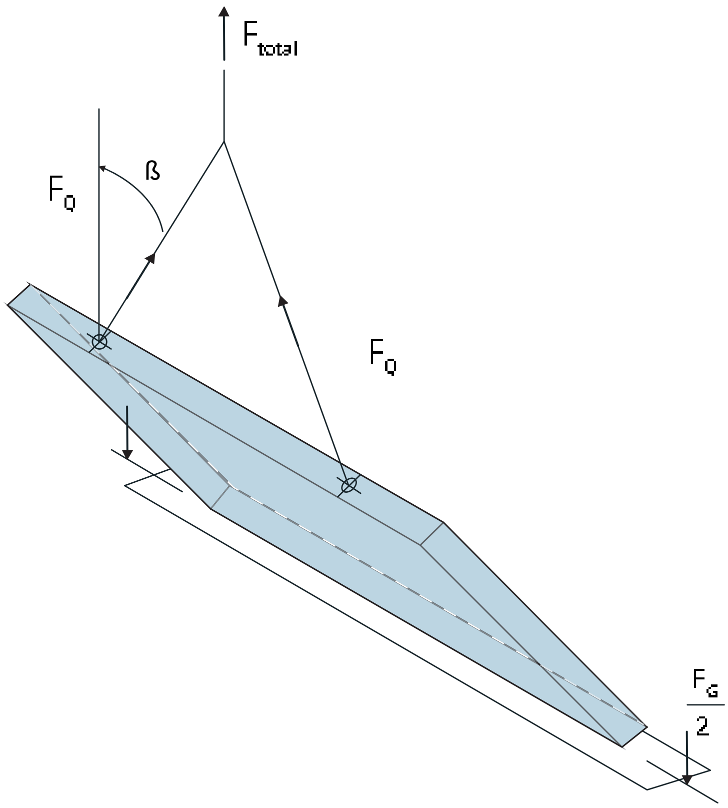


Figure 20. Element erection with chains

For transverse shear (lifting according to Figure 20) action on lifting insert is:

$$F_{QZ} = F_G \cdot \psi_{dyn} \cdot z/n$$

where:

F_{QZ} – inclined shear load acting on individual lifting insert, in kN

Note: inclined and perpendicular to the longitudinal axis of the precast element e.g. during lifting from the horizontal position

F_G – self-weight of the pre-cast element, Section 5.3.5, in kN

Ψ_{dyn} – dynamic factor, Section 5.3.7

z – factor for combined tension and shear

z = 1 / cos β, angle β in accordance with Figure 20

n – number of lifting anchors carrying the load.

5.3.10. Load condition “lifting and handling under combined tension and shear”

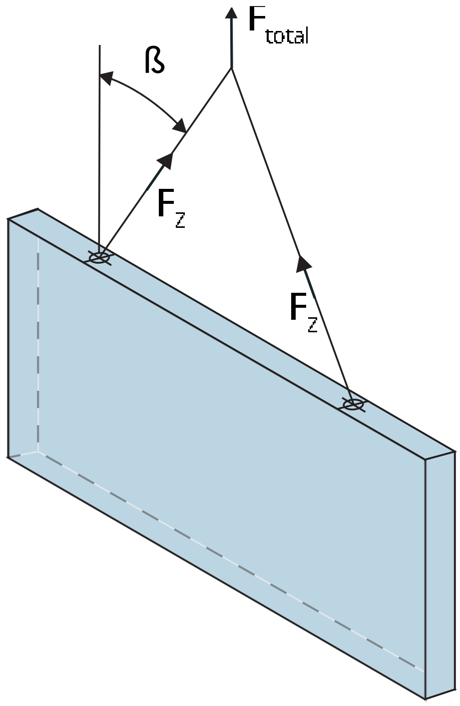


Figure 21. Lifting and handling under combined tension and shear

The load condition “lifting and handling under combined tension and shear” is presented in **Figure 21Figure 1**. This is the most common lifting procedure. Action on lifting insert is:

$$F_Z = F_G \cdot \psi_{dyn} \cdot z/n$$

where:

F_Z – load acting on the lifting insert in direction of the sling axis, in kN

F_G – self-weight of the pre-cast element, Section 5.3.5, in kN

Ψ_{dyn} – dynamic factor, Section 5.3.7

z – factor for combined tension and shear

z = 1 / cos β, angle β in accordance with Figure 21.

n – number of lifting anchors carrying the load.

6. INSTALLATION

6.1. Attachment to formwork

R lifting anchor must be attached securely so it cannot move during casting of the concrete. Concrete must be compressed carefully. The lifting anchor itself cannot be vibrated.

When attaching to the side of the formwork, a hole may be drilled through the plywood formwork, through which is then set up a bolt with the same thread as the lifting anchor.

6.2. Supervision of installation

6.2.1. Installation of R lifting anchors

Following controls should be done by the user.

Check list before casting:

- lifting anchor is in good condition
- lifting anchor is according to designs and in the right place
- lifting anchor is attached firmly
- required additional reinforcement is assembled

During the casting:

- lifting anchor stays in the right place
- concrete is thoroughly vibrated around the R lifting anchor

After the casting:

- the position of the lifting anchor is according to designs
- the thread is intact and free of concrete

NOTES

TECHNICAL MANUAL REVISIONS

06.05.2022 (AV/FA/JK)

- Dimensions and types updated
- New format

01.08.2022 (AV)

- New dimension (F) is added

16.05.2024 (AV)

- New layout
- Action on lifting inserts added

10.02.2026 (AV)

- New naming

SUPPORT MATERIAL

DESIGN TOOLS

RSTEEL® Design Tool was created to facilitate the work of designers and offer the best and most transparent design process on the market. The free and fully cloud-based software guarantees seamless workflow within the design organization, as well as continuous support and updates.

rsteel-design.com

DESIGN COMPONENTS

We have created design components for Tekla as well as Revit and AutoCAD. More products will be created, and existing products will receive steady updates and fixes when needed.

warehouse.tekla.com/#/organization/u7be79e90-ace8-46ca-a26c-849a5dc4c283

prodlib.com/rsteel

SALES AND TECHNICAL SUPPORT

Our excellent sales and support team will assist you with all your challenges and questions.

rsteel.eu/contact-us/

DOCUMENTATION

All our products have been tested and have all necessary approvals and markings. You can find all related information on each products page.

rsteel.eu/products/