RSTEEL®

RLAB Lifting Inserts

According to Eurocodes, EU Machinery directive 2006/42/EC and VDI/BV-BS 6205
CE Approved

Technical Manual

Technical changes and errors reserved

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THE STRONGEST IN FINLAND 2017 R-Group Finland OY asiakastieto.fi

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1. Description of the system

RLAB lifting inserts systems manufactured by R-Group Finland Oy are lifting anchors consisting of studded end round steel bars and rapid release lifting keys. RLAB lifting anchors are intended for lifting of pre-cast sandwich wall elements.

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

1.1 Manufacturing markings

RLAB lifting inserts are marked with R-Steel logo, type and load class of lifting insert and CE-marking.

Products are delivered [in cardboard boxes] on a truck palette. Product package is equipped with an R-Steel Pallet Label, which contains the following information: product type, product name, quantity, ISO9001 and ISO14001 quality and environment system markings, and CE, FI and BY (Concrete Association of Finland) logo.

1.2 Quality control

Quality control of the inserts is done according to the requirements of EN 1090-2 and the instructions according to quality and environment system of the R-Group Finland Oy (ISO9001 and ISO14001). R-Group Finland Oy has a quality control contract with Inspecta Sertifiointi Oy.

2. Lifting Systems Parts

2.1 RLAB lifting insert

2.1.1 RLAB lifting insert dimensions

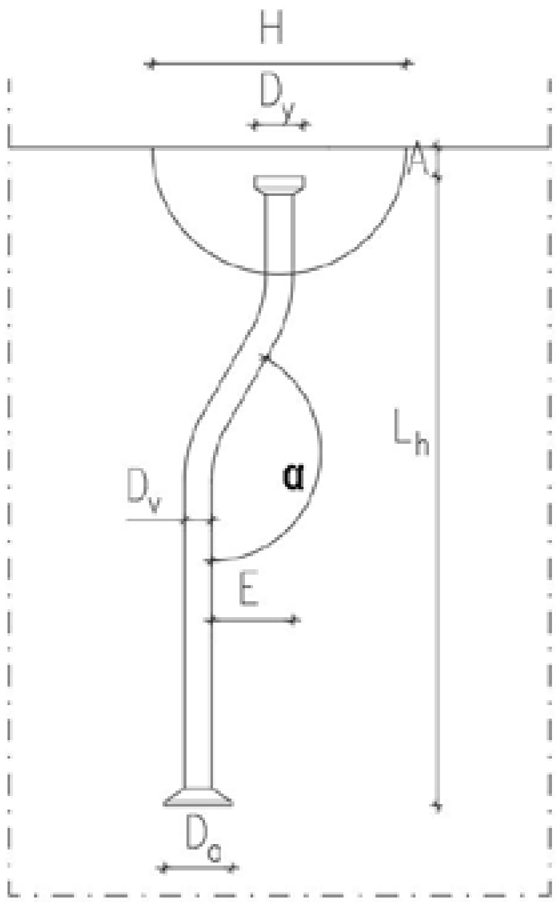


Figure 1. RLAB lifting inserts dimensions

Table 1. RLAB lifting inserts dimensions and tolerances [all dimensions in mm]

Load group	Lifting anchor RLAB	D_y		D_v		D_a		L_h		E	α	A	H
			±		±				±		[°]		
2.5	2.5 - 265 - 60	26	0,5	14	0,2	35	+ 2 / - 4	265	2		60	11	74
	5.0 - 406 - 60							406			60		
5.0	5.0 - 466 - 45	36	0,5	20	0,2	50	+2 / - 5	466	2	60	45	15	94
	5.0 - 466 - 60										60		
7.5	7.5 - 664 - 60	47	0,5	24	0,2	60	+ 3 / - 6	664	2		60	15	118

Lifting devices and recess formers are designed to be compatible with load class and type of RLAB lifting inserts.

2.1.2 Lifting insert materials and ordering code

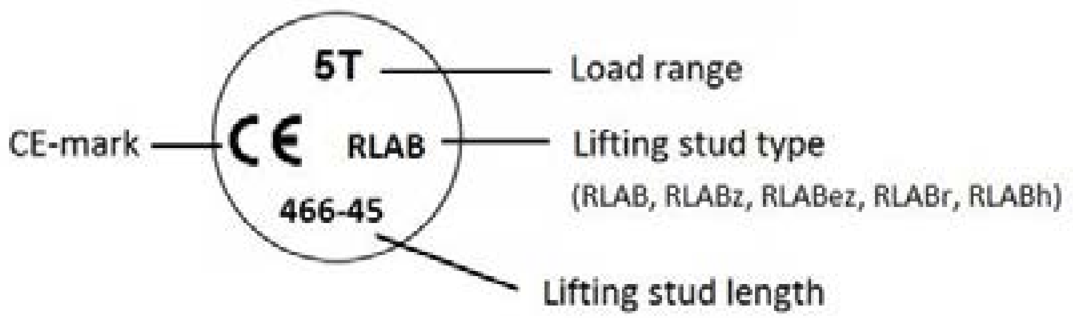
Part	Ordering code	Material	Standard
Lifting anchor	RLAB	S355J2+N	EN 10025
	RLABz	S355J2+N	EN 10025
	RLABez	S355J2+N	EN 10025
	RLABr	1.4301	EN 10088
	RLABh	1.4401	EN 10088

RLAB lifting inserts are available in two surface finishes. Standard delivery surface finish is black (uncoated). Lifting inserts are also available as electro zinced.

Ordering code	Type
RLAB	Plain
RLABz	Hot zinced
RLABez	Electro zinced
RLABr	Stainless
RLABh	Acid resistant

Ordering code consists of type, size and length of RLAB lifting anchor.

Marking on top of RLAB lifting stud:



3. Safe Working Loads

3.1 Design concept

Safe working loads of RLAB lifting inserts are calculated according to following standards and instructions:

EN 1992: Eurocode 2
EN 1993: Eurocode 3
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	$\gamma = 2{,}1$

Global safety factor 2,1 for concrete failure assumes that the lifted pre-cast elements are produced under plant specific continuous supervision. In other lifting situations, global safety factor of 2,5 for concrete failure must be used and the given safe working loads must be multiplied reduction factor of 2,5 / 2,1 = 0,84.

Safe working loads are based on concrete dimensions, anchor steel bars and lifting insert 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 insert
SWL = safe working load of lifting insert

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

3.2 Safe working loads

3.2.1 RLAB lifting inserts safe working loads for wall elements

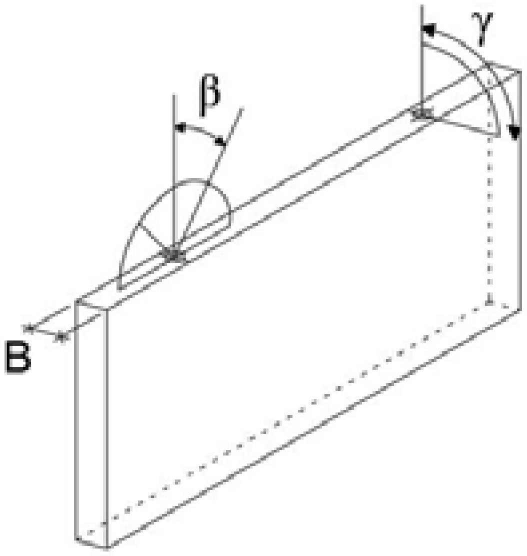


Figure 2. Lifting insert load directions in wall elements

Safe working loads of RLAB lifting inserts in wall elements are given in table 2. Safe working loads are applicable with concrete strength and concrete thickness according to table 2, insert spacing according to table 3 and reinforcement according to sections 3.4 and 3.5.

Table 2. RLA lifting inserts safe working loads in wall elements

Load group	Lifting insert RLAB	B [mm]	Safe working loads (SWL) [kN]						
			β = 0° - 15°				γ = 0° - 90°		
			C12/15	C16/20	C20/25	C28/35	C12/15	C16/20	C20/25
2.5	2.5 -265 -60	80	14,4	16,6	18,5	21,9	7,2	8,3	9,3
		100	17,9	20,7	23,2	23,3	9,0	10,4	11,6
		120	21,5	23,3	23,3	23,3	10,8	11,6	11,6
5.0	5.0 -406 -60	160	42,2	48,7	50,0	50,0	21,1	24,3	25,0
		180	47,4	50,0	50,0	50,0	23,7	25,0	25,0
		200	50,0	50,0	50,0	50,0	25,0	25,0	25,0
	5.0 -466 -45	160	41,1	41,1	41,1	41,1	20,5	20,5	20,5
		180	41,1	41,1	41,1	41,1	20,5	20,5	20,5
		200	41,1	41,1	41,1	41,1	20,5	20,5	20,5
	5.0 -466 -60	160	42,2	48,7	50,0	50,0	21,1	24,3	25,0
		180	47,4	50,0	50,0	50,0	23,7	25,0	25,0
		200	50,0	50,0	50,0	50,0	25,0	25,0	25,0
7.5	7.5 -664 -60	160	50,3	58,1	65,0	69,5	25,2	29,1	32,5
		180	56,6	65,4	69,5	69,5	28,3	32,7	34,7
		200	62,9	69,5	69,5	69,5	31,5	34,7	34,7

Lifting angle β must not exceed 15°. Concrete spalling and serious damage may occur if angle β = 15° is exceeded.

3.2.2 Allowed lifting practices

Lifting with RLAB lifting inserts is only allowed by lifting practices which don’t induce any bending on lifting inserts. Lifting angle must not exceed 15°. Concrete spalling and serious damage may occur if angle β = 15° is exceeded.

Lifting angle γ is only allowed in one direction (see figure 4). Lifting allowed only with lifting device with a pressure plate.

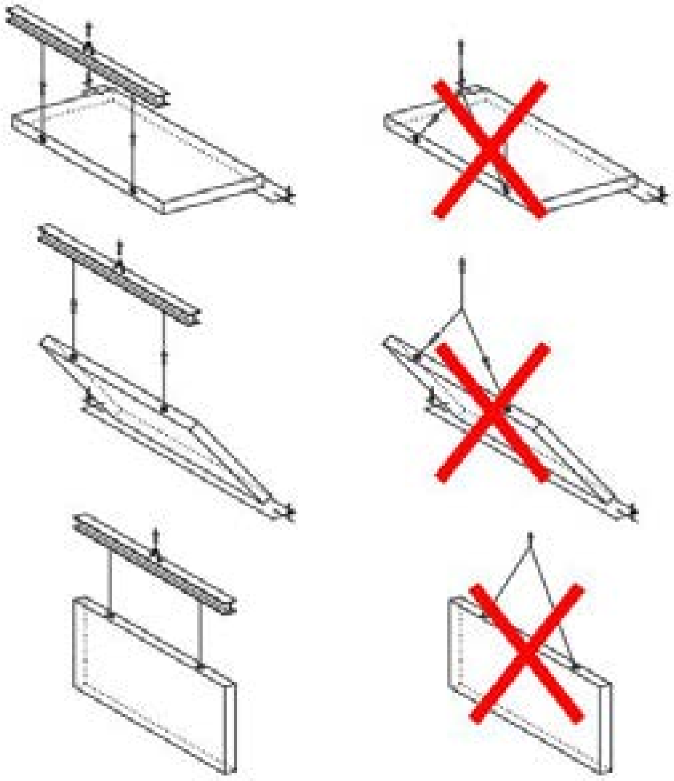


Figure 3. RLAB lifting practices

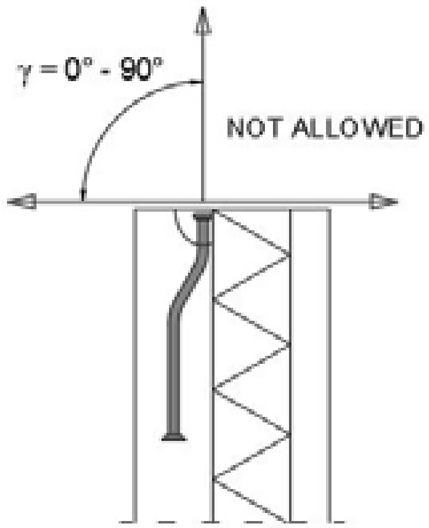


Figure 4. Lifting angle γ

3.3 Concrete thickness and insert spacing in wall elements

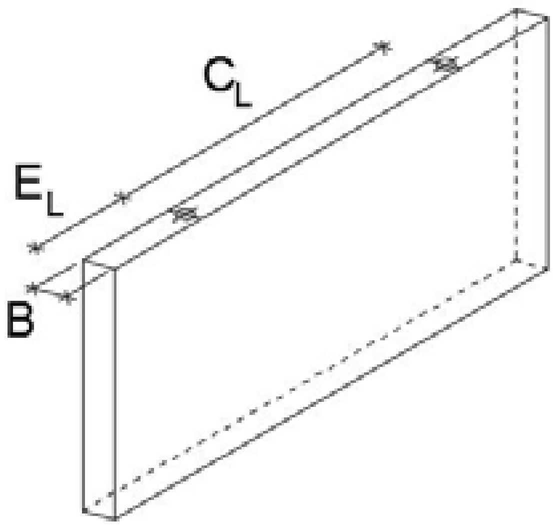


Figure 5. Minimum element thickness and lifting insert spacing in wall elements

Safe working loads are valid only with minimum concrete thickness and minimum lifting insert spacing given in figure 5 and table 3.

Table 3. Minimum element thickness and minimum lifting insert spacing in wall elements

Lifting insert RLAB	Minimum concrete thickness B [mm]	Minimum lifting insert edge spacing E_L [mm]	Minimum lifting insert centre spacing C_L [mm]
2.5 -265 -60	80	270	540
5.0 -406 -60 5.0 -466 -45 5.0 -466 -60	160	470	940
7.5 -664 -60	160	670	1340

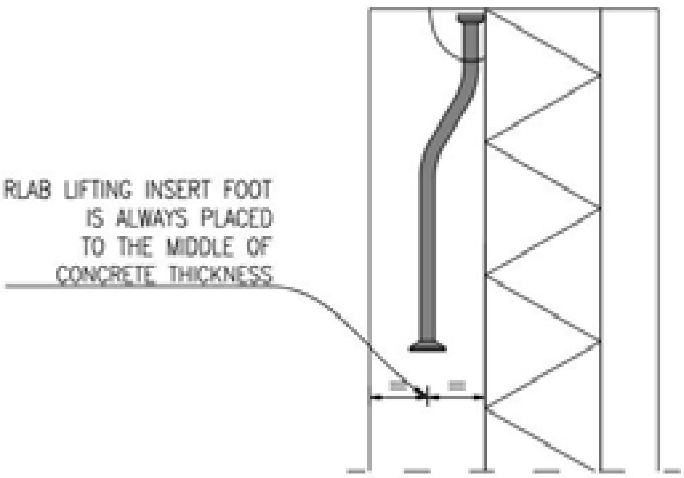


Figure 6. RLAB lifting insert placement in thickness direction

3.4 Reinforcement of the pre-cast element

The concrete element must have at least minimum reinforcement according to EN 1992-1-1. Concrete element must be reinforced to withstand all actions from lifting, tilting and transport including dynamic actions. This reinforcement must be designed by the structural designer.

3.5 RLAB lifting insert reinforcement

Additional reinforcement for lifting inserts B500B (K500C-T).

3.5.1 Axial pull reinforcement in wall elements

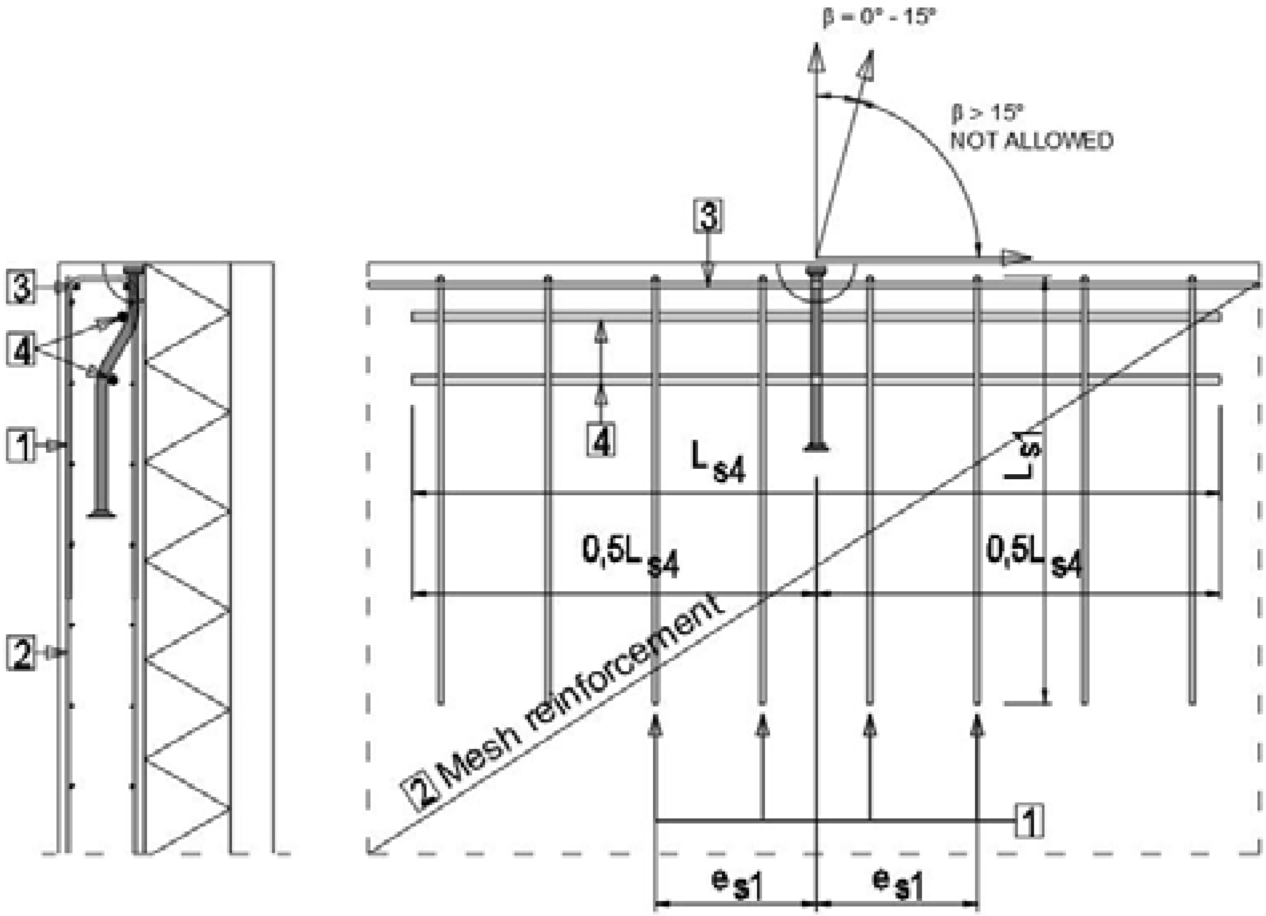


Figure 7. RLAB lifting insert reinforcement for axial pull in wall elements

RLAB lifting inserts must always have reinforcement according to figure 7 and table 4. This reinforcement transfers the load from the lifting insert to the concrete.

Stirrup reinforcement 1, additional surface reinforcement 2 and edge reinforcement 3 must be placed at the lifting insert area. Maximum distance for stirrup reinforcement 1 from the center of RLAB lifting insert e_{s1} is lifting insert height ($e_{s1.max} = L_h$). These reinforcements may be replaced by structural reinforcement in concrete element, providing the structural reinforcement has sufficient cross-section area and overlap lengths.
Reinforcement 4 is placed to the inner edge of the bending of RLAB lifting insert, see figure 5.

Table 4. RLAB lifting reinforcement for axial pull in wall elements

Load group	Stirrup reinforcement 1			Mesh reinforcement 2	Edge reinforcement 3	Reinforcement 4	
	n [pcs]	Diameter $ø_{s1}$ [mm]	Length L_{s1} [mm]	Both surfaces [mm^2 / m]	Diameter $ø_{s3}$ [mm]	Diameter $ø_{s4}$ [mm]	Length L_{s4} [mm]
2.5	2	8	500	100	10	12	600
5.0	2	10	700	140	12	16	800
7.5	4	10	700	180	12	20	1000

Reinforcement given in this section covers only the load impact the lifting insert 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.

3.6 Actions on lifting inserts

3.6.1 General

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).

3.6.2 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. Statical system of lifting inserts must be accounted for in these calculations. Actions from all individual lifting situations must be calculated according to sections 3.6.3 to 3.6.10.

After actions placed on lifting inserts are determined, the safe working load (SWL) in section 3.2 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 3.6.3 to 3.6.10, in kN
SWL safe working load of lifting insert, see section 3.2, in kN

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

3.6.3 Statical system

Lifting equipment used in lifting of pre-cast elements shall allow determinate load distribution to all present lifting inserts. Figure 8 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.

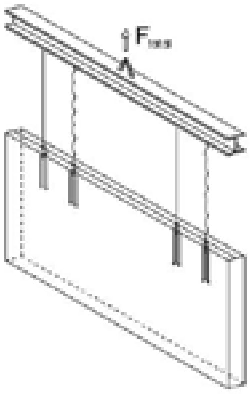


Figure 8. Example of statically indeterminate lifting systems which should not be used. Load bearing inserts n = 2.

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.

3.6.4 Load distribution for non-symmetrical insert layout

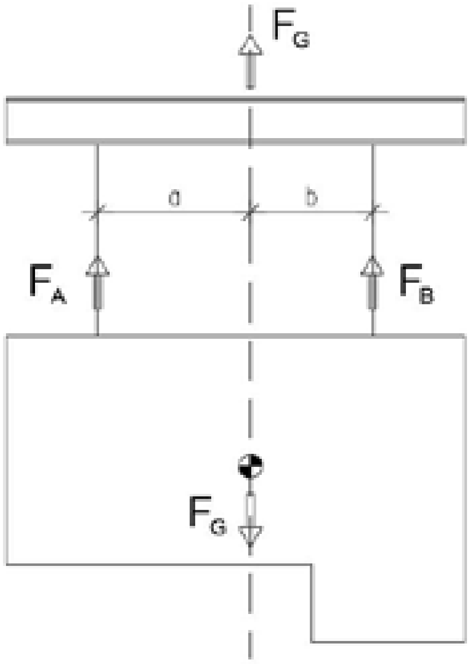


Figure 9. Load distribution for non-symmetrical insert layout using spreader beam

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.

3.6.5 Spread angle

Influence of spread angle on the actions for lifting inserts must be taken into account.

Table 5. Spread angle factors

Cable angle β	Spread angle α	Load factor z
0°	-	1,00
7,5°	15°	1,01
15°	30°	1,04

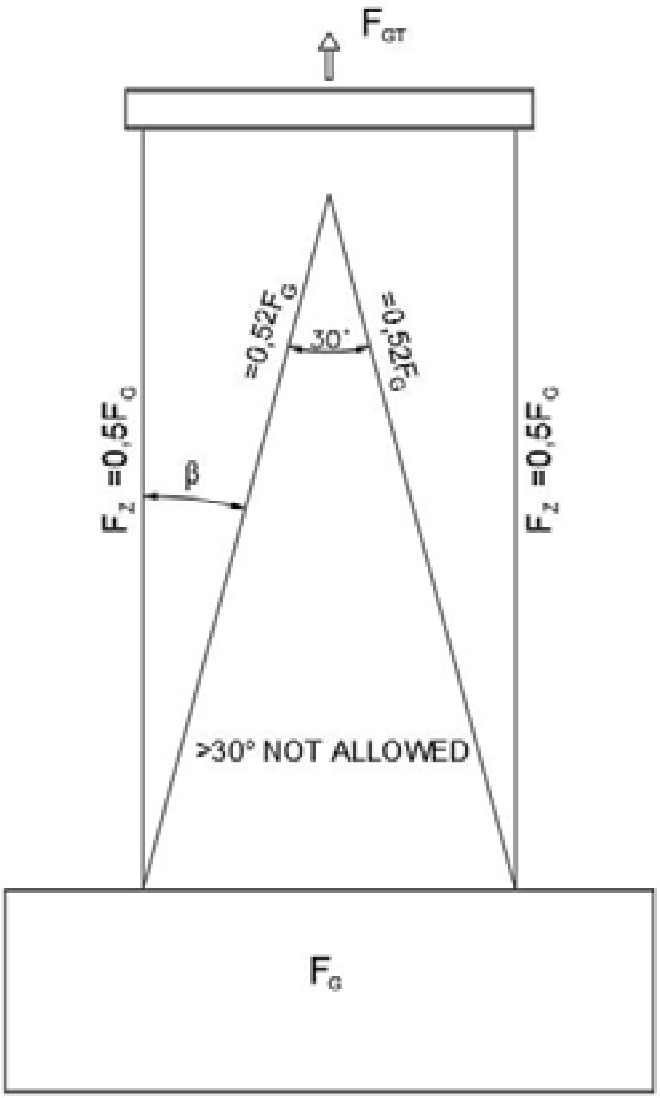


Figure 10. Spread angle factors

3.6.6 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

3.6.7 Adhesion and form friction

Adhesion and form friction are assumed to act simultaneously during the lifting of the precast element from the formwork. The actions 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 7, in kN/m^2

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

Table 6. 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 7 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.

3.6.8 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 taken into account 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 7.

Table 7. Dynamic factor ψ_{dyn}

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 8 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 8 the factor ψ_{dyn} shall be determined on the base of tests or engineering judgement.

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3.6.9 Load condition "erection in combination with adhesion and form friction"

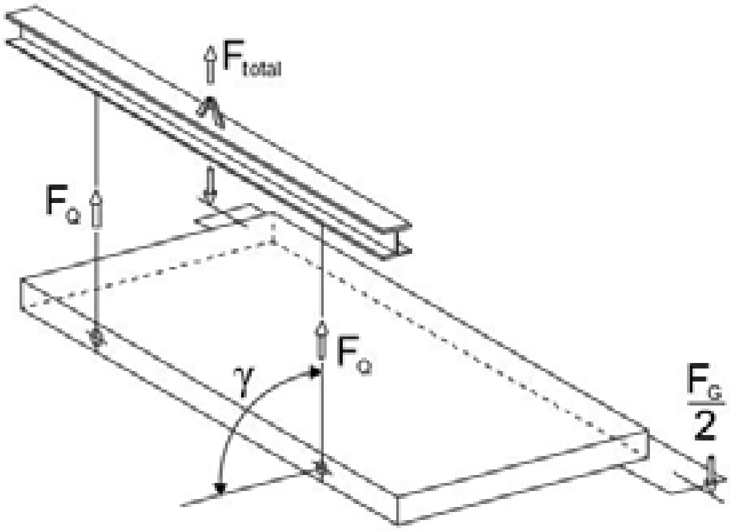

Figure 11. Erection in combination with adhesion and form friction, lifting with balancing beam

When pre-cast elements are lift from form according to figure 13 the action F_Q on lifting inserts is

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

where
F_Q load acting on individual lifting insert, in kN
F_G self-weight of the pre-cast element, section 3.6.6, in kN
F_{adh} action due to adhesion and form friction, section 3.6.7, in kN
n number of lifting anchors carrying the load.

3.6.10 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.

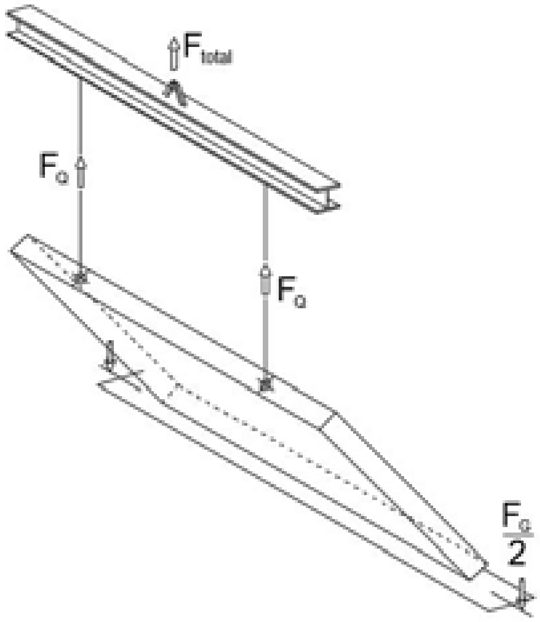

Figure 12. element erection with balancing beam

Erection with balancing beam (Figure 12 14), 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
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 3.6.6, in kN

ψ_{dyn} dynamic factor, section 3.6.8

n number of lifting anchors carrying the load.

Notes

CREATE A NOTE

Notes

CREATE A NOTE

About
R-Group

R-Group is a leading provider of steel connections for precast and cast-in- situ construction around the globe.

With over three decades of our participation in huge projects, we don't compromise on quality or customer satisfaction and we create connections for a lifetime.

Our customer-oriented service, excellent and reliable network of suppliers plus our extensive product portfolio ensure that we are able to offer professional and flexible solutions for any kind of projects.

In our operations we comply with the ISO 9001 and 14001 standards

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