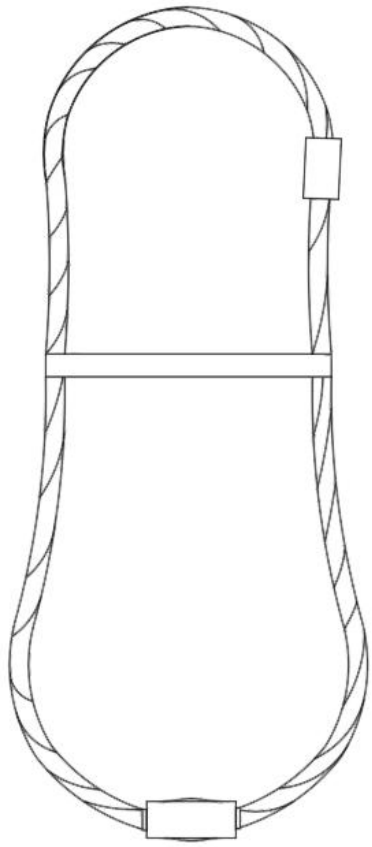
EXMET
PRECAST ACCESSORIES



Lifting Loop

TECHNICAL MANUAL

EXM-LL-DC-1001 R0 - 20.11.2021

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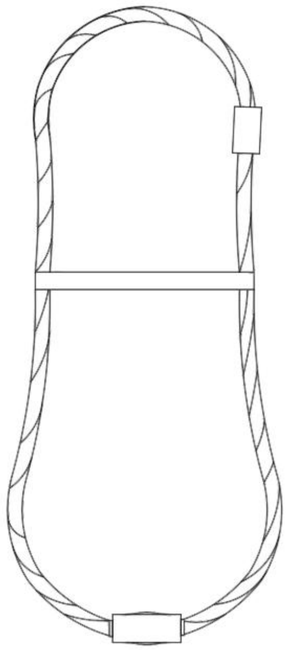
Lifting Loop

The lifting loop are economic and with high quality galvanized wire rope. The key benefits and features of lifting loops as below:

- Reduce rusting of the anchor.
- Easy installation in element and no recess former.
- Safe Working Loads from 8 kN to 250 kN

1. Introduction

Lifting loops used in the pre-cast concrete structure manufacturing and building industries to aid transportation and placement of structural components conveniently and safely.Lifting loops are manufactured from steel rope with a swaged connecting ferrule and a colour coded tag that identifies the SWL and batch number of the loop. Cast in loops are suitable for use from production to final installation but are not suitable for multi use applications. Lifting loops are set in concrete can transfer high loads and is the ideal solution for heavy elements. Both ends of the rope are bonded together. No special device is required for lifting loop. Lifting loop wire is made from high quality galvanized wire ropes.



EWRL

Figure 1. EWRL LIFTING LOOP

Safety Features

Lifting loops has been tested for a higher safety level. General safety factor given to concrete failure mechanism is 2.5 against the characteristic strength of concrete.Global safety factors used in calculation of safe working loads are

Steel failure $\gamma = 4.0$

Concrete failure $\gamma = 2.1$

Safety factor 2.1 for concrete failure assumes that the lifted precast elements are produced under plant specific continuous supervision.

Color coding System

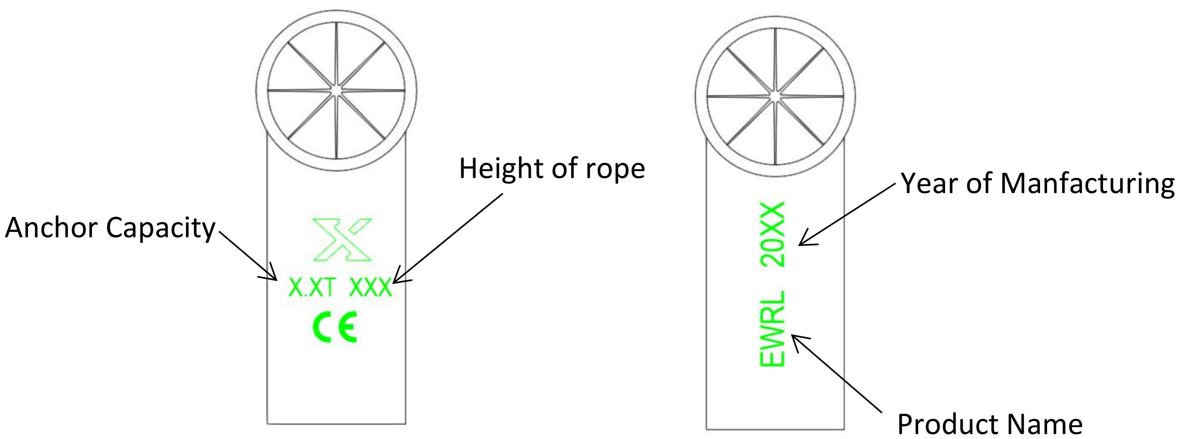
Each loop has a color-coded tag for easy identification of tension capacities.Color coding system is used for easy to find the every rope.

Table 1. Color codes for threaded lifting system

Lifting Insert Type	Colour
EWRL - 8	Pure White
EWRL - 12	Flame Red
EWRL - 16	Light Pink
EWRL - 20	Pastel Green
EWRL - 20	Pastel Orange
EWRL - 25	Jet Black
EWRL - 40	Emerald Green
EWRL - 52	Curry
EWRL - 63	Light Blue
EWRL - 80	Silver Grey
EWRL - 100	Claret Violet
EWRL - 125	Sulfur Yellow
EWRL - 160	Blue Lilac
EWRL - 200	Beige
EWRL - 250	Clay Brown

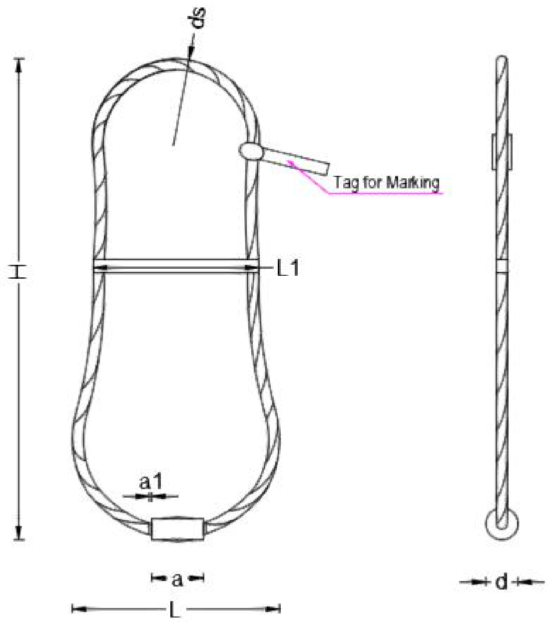
Markings

Generally we are providing marking on the product in which we provide the information of Anchor capacity,Height of rope,Year of manfacturing and product name as shown in Figure2



2. Product Dimensions

2.1 EWRL Lifting Loop Dimensions



Lifting Loop	Load Class	H	L	ds	L1	a	a1	d	tolerance	Wire Rope	Cutting Length
	[kN]	[mm]	[mm]	[mm]					d		
EWRL - 8	8	200	85	6	65	27	5	12	+0.15 -0.00	6x19 IWRC 6 mm	505
EWRL - 12	12	225	90	7	70	32	5	14	+0.15 -0.00	6x19 IWRC 7 mm	565
EWRL - 16	16	245	100	8	70	36	5	16	+0.15 -0.00	6x19 IWRC 8 mm	605
EWRL - 20	20	265	125	9	95	40	5	18	+0.15 -0.00	6x19 IWRC 9 mm	665
EWRL - 20	20	900	270	9	180	44	10	20	+0.15 -0.00	6x19 IWRC 9 mm	2130
EWRL - 25	25	285	140	10	115	45	5	20	+0.2 -0.0	6x19 IWRC 10 mm	760
EWRL - 40	40	345	160	12	130	54	5	24	+0.2 -0.0	6x19 IWRC 12 mm	900
EWRL - 52	52	390	180	14	160	63	5	28	+0.3 -0.0	6x19 IWRC 14 mm	990
EWRL - 63	63	415	210	16	180	72	5	32	+0.3	6x19 IWRC	1100

									-0.0	16 mm	
EWRL - 80	80	460	220	18	170	100	15	36	+0.4 -0.0	6x19 IWRC 18 mm	1250
EWRL - 100	100	510	250	20	180	90	10	40	+0.4 -0.0	6x19 IWRC 20 mm	1280
EWRL - 125	125	570	280	22	225	99	10	44	+0.4 -0.0	6x19 IWRC 22 mm	1430
EWRL - 160	160	640	295	24	240	108	10	48	+0.5 -0.0	6x19 IWRC 24 mm	1550
EWRL - 200	200	715	320	28	260	117	10	56	+0.5 -0.0	6x19 IWRC 28 mm	1800
EWRL - 250	250	800	380	30	300	126	10	60	+0.5 -0.0	6x19 IWRC 30 mm	1800

EWRL Lifting Loop are available in following materials.

Part	Material	Standard
Wire rope	High Strength Steel Wire min. 1770 Mpa	EN 12385-4
Ferrule	Alloy	EN 13411-3
Plastic belt	Polypropylene	
Dataring	Metal	

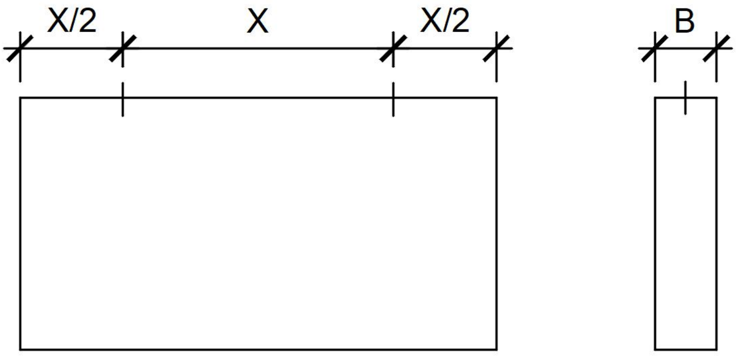
3. Design Load Capacity (Safe Working Loads)

The resistance of the heavy duty EWRL Lifting System is determined by a design concept that must be designed and evaluated for every individual application. Safe working loads of EWRL lifting loops are given in Table 1. The load capacities depend very much on how and in which combination the different items will be used.

Table 1.

Insert Size	Design Load Capacity(Safe Working Load) (β = 0° – 45°, γ = 0° – 12.5°)		
	C12/15	C16/20	C20/25
EWRL-8	4.9	5.9	6.9
EWRL-12	12.0	12.0	12.0
EWRL-16	15.9	16.0	16.0
EWRL-20	19.4	20.0	20.0
EWRL-20	20.0	20.0	20.0
EWRL-25	23.2	25.0	25.0
EWRL-40	33.7	40.0	40.0
EWRL-52	44.4	52.0	52.0
EWRL-63	54.4	63.0	63.0
EWRL-80	67.3	80.0	80.0
EWRL-100	82.9	100.0	100.0
EWRL-125	101.9	123.5	125.0
EWRL-160	124.9	151.3	160.0
EWRL-200	162.8	197.2	200.0
EWRL-250	195.1	236.4	250.0

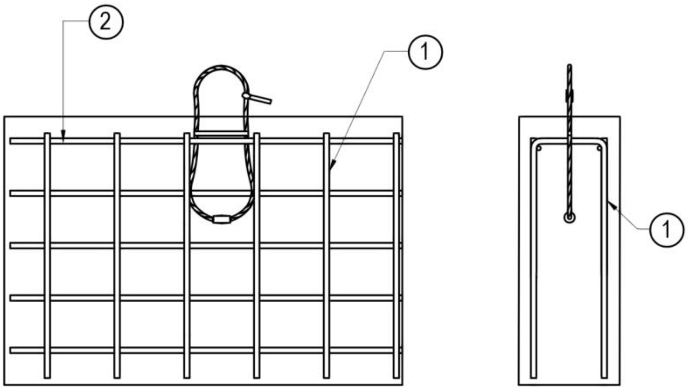
4. Minimum Element Thickness and Spacing of Inserts



EWRL	Wall Thickness, B [mm]	Minimum Edge Distance, X/2 [mm]	Minimum Centre to Centre Distance, X [mm]
EWRL-8	70	205	410
EWRL-12	90	225	450
EWRL-16	120	250	500
EWRL-20	140	270	540
EWRL-20	140	900	1800
EWRL-25	160	285	570
EWRL-40	200	345	690
EWRL-52	290	390	780
EWRL-63	320	420	840
EWRL-80	400	465	930
EWRL-100	440	510	1020
EWRL-125	500	570	1140
EWRL-160	620	645	1290
EWRL-200	680	720	1440
EWRL-250	750	805	1610

5. Reinforcement

Reinforcement for Lifting Anchors is based on the assumption that the angle of lifting (β) lies between 0° – 45°. Angles greater than 45° are not allowed.



EWRL	Reinforcement area (1)	Minimum reinforced width (2)
	[mm² / m]	[mm]
EWRL-8	170	410
EWRL-12	170	450
EWRL-16	170	500
EWRL-20	170	540
EWRL-20	170	1800
EWRL-25	170	570
EWRL-40	170	690
EWRL-52	245	780
EWRL-63	245	840
EWRL-80	245	930
EWRL-100	245	1020
EWRL-125	245	1140
EWRL-160	414	1290
EWRL-200	414	1440
EWRL-250	514	1610

6. Actions on lifting loops

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 loops
- type of lifting equipment and different load scenarios (tension, combined tension andshear, shear loading).

6.2 Number and actions of lifting loops

The number of load bearing lifting loops and the load acting on the lifting loops shall be determined corresponding with the individual lifting situations.

Statical system of lifting loops 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 loops 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 loops

$E \leq SWL$

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.

6.3 Statical system

Lifting equipment used in lifting of precast elements shall allow determinate load distribution to all present lifting loops. Figure 5 gives examples of statically indeterminate systems where only two lifting loops carry the load. The load distribution is not clearly defined in these applications. Therefore, these statically indeterminate systems shall be avoided.

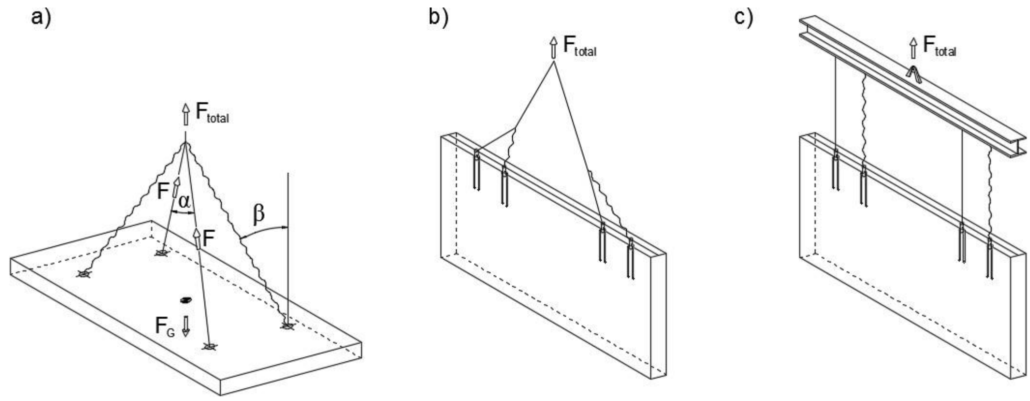


Figure 5. Examples of statically indeterminate lifting systems which should not beused

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

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

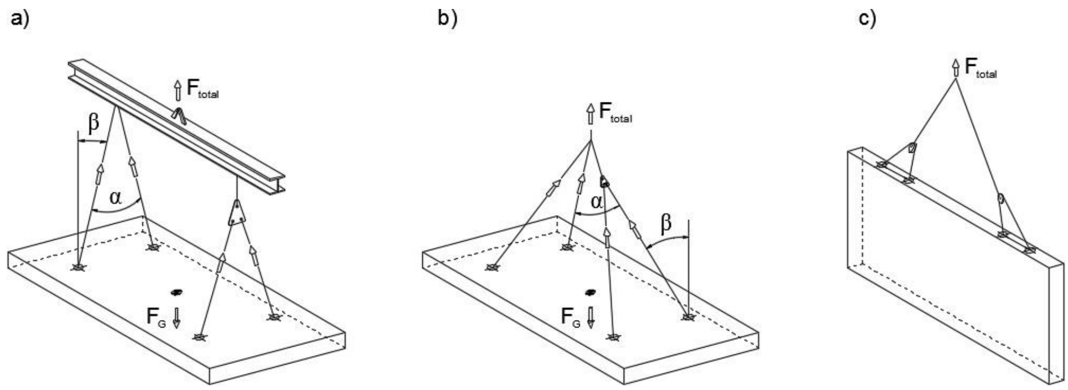


Figure 6. Transportation aids for the statically determinate lifting of slabs and wallelements

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

In case of inclined lifting slings the lifting loops are loaded by combined tension and shear loads. The inclination β according to Figure 6 governs the level of combined tension and shear loads to be taken into account in the design.

If three lifting loops are located in slab and situated in star pattern with same distance to the centre of gravity with equal inclinations of 120° (Figure 7) it is ensured that all three lifting loops experience the same load.

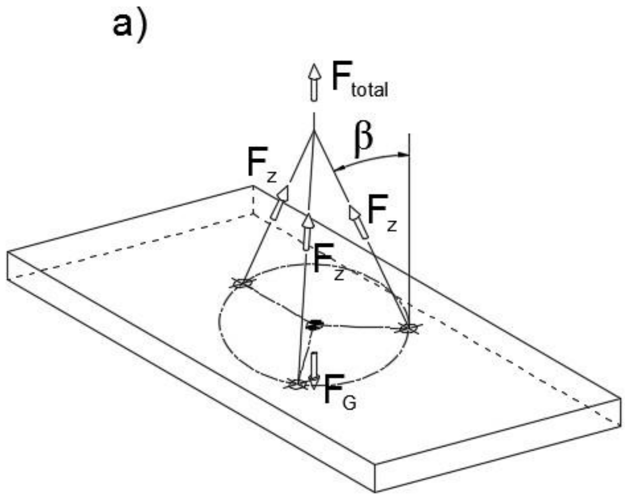


Figure 7. Statically determinate load distribution by means of lifting loops in starpattern

a) **slab. Load bearing loops n = 3.**
b) **cover plate. Load bearing loops n = 3.**

6.4 Load distribution for non-symmetrical insert layout

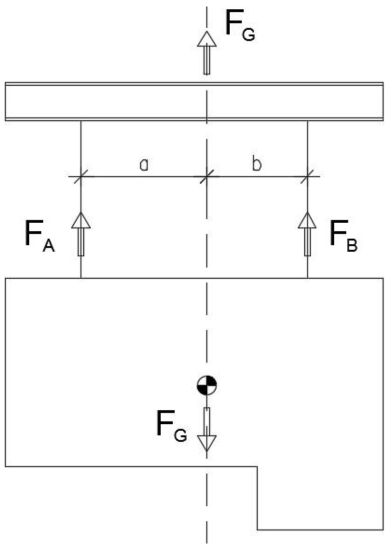


Figure 8. Load distribution for non-symmetrical insert layout using spreader beam

If the loops are not installed symmetrically to the load's centre of gravity, the load distributionto different loops is

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

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

where

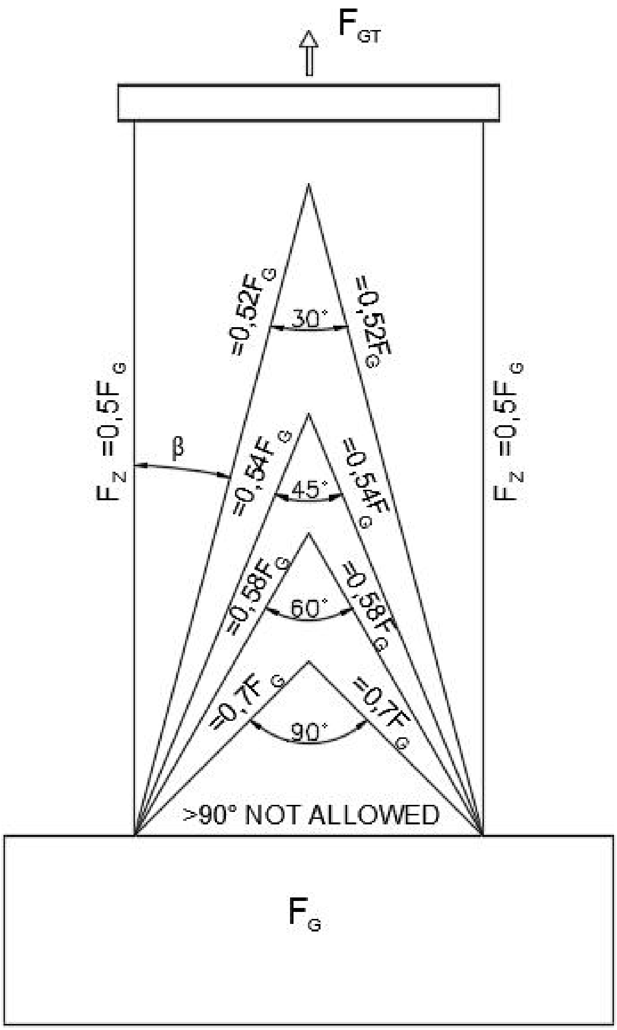
FG	weight of the pre-cast element, in kN
a	distance from insert to centre of gravity, in m
b	distance from insert to centre of gravity, in m

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

6.5 Spread angle

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

Table 6. Spread anglefactors



Cable angleβ	Spread angleα	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

Figure 9. Spread angle factors

6.6 Self-weight

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

$F_G = V \cdot \rho_G$

where

V volume of the pre-cast element, in $m^3 \rho$

G density of the concrete, in kN/m^3

6.7 Adhesion and form friction

Adhesion and form friction are assumed to act simultaneously during the lifting of the precastelement 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 7. Minimum values of adhesion and form friction q_{adh}

Formwork and condition [a)]	q_{adh} [b)] [kN/m²]
Oiled steel mold, oiled plastic coatedplywood	≥ 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 concreteand 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.

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 ψdyn. For furtherguidance values of ψdyn depending on the lifting machinery and characteristics of the terrain are given in Table 8.

Table 8. Dynamic factor ψ_{dyn}

Condition	**Dynamic factor ψdyn**
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 ψdyn 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 ψdyn shall be determined on the base of tests or engineering judgement.

6.9 Load condition "erection in combination with adhesion andform friction"

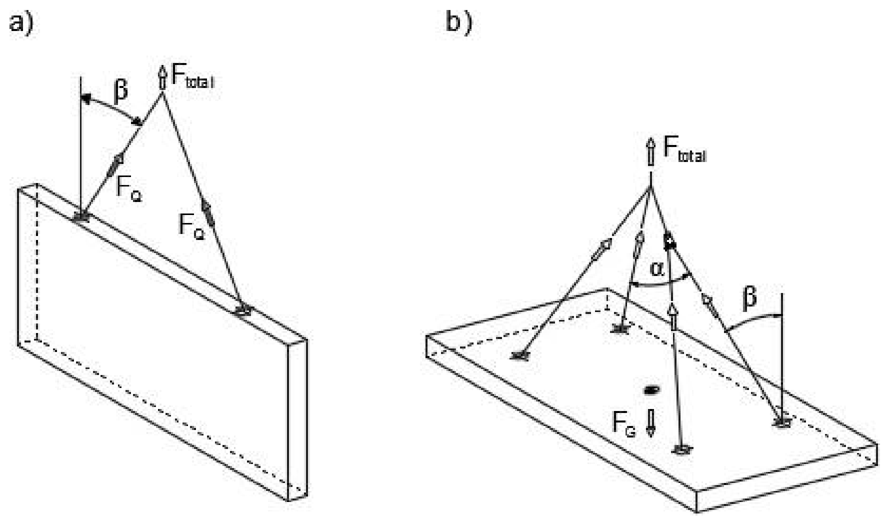


Figure 10. Erection in combination with adhesion and form friction

When pre-cast elements are lift from form according to Figure 10 the action F_Q on lifting loopsis

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

where

FQ load acting on individual lifting insert, in kN

FG self-weight of the pre-cast element, section 3.6.6, in kN

Fadh action due to adhesion and form friction, section 3.6.7, in kN

z factor for combined tension and shear,

z = 1 / cos β , angle β in accordance with Figure 10.

In case of only tension z = 1.

n number of lifting anchors carrying the load.

6.10 Load condition “lifting and handling under combinedtension and shear”

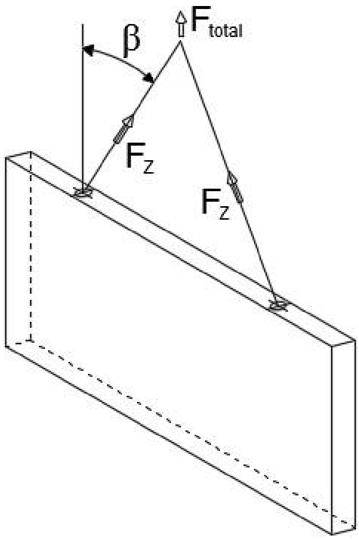


Figure 11. Lifting and handling under combined tension and shear

The load condition “lifting and handling under combined tension and shear” is presented in Figure 11. This is the most common lifting procedure. Action on lifting insert is

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

where

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

FG self-weight of the pre-cast element, section 3.6.6, in kN

ψdyn dynamic factor, section 3.6.8

z factor for combined tension and shear

z = 1 / cos β , angle β in accordance with Figure 11.

n number of lifting anchors carrying the load.