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PLATE ANCHOR LIFTING SYSTEM

TECHNICAL MANUAL

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PLATE ANCHOR LIFTING SYSTEM

The plate Anchor Lifting System is cost effective . Hole lock lifting system consist of flat steel, recess former and ring clutches. The anchor head is designed with the hole at top where the ring clutch is installed.

The following advantages of hole lock lifting system are shown as below :

- Safe, easy to handle and cost-effective system.
- Efficient anchoring and clutch release.
- Available in various load ranges from 1.4 kN to 25 kN
- Simple installation of anchors in a component using a recess former.
- Rapid and simple for installation.
- Huge range of anchors for precast elements.
- Availability of erection anchors for tilting of thin elements with no edge breaking.

ENDURA

Table of Content

1. INTRODUCTION

Plate Anchor Lifting System are unique lifting inset for lifting and handling of thin-precast elements. It consists of flat steel and fixed with recess former and ring clutches. These lifting system are high quality steel, cost-effective. These anchors are designed for various precast elements such as columns, walls, slabs, beams and staircase. Lifting Inserts are embedded in concrete elements which allow the lifting once the concrete has cured.

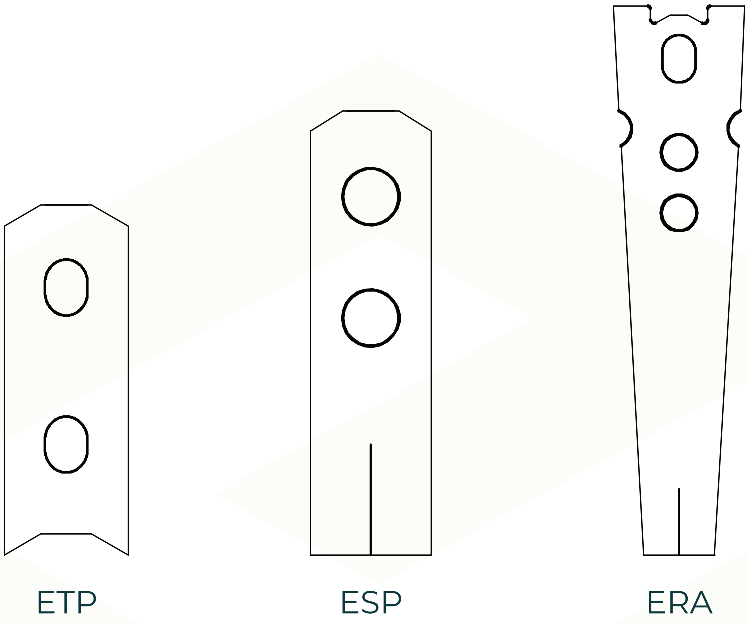


Figure 1. Plate Anchor Lifting System

ETP - The top part (head) of ETP anchor is similar as spread anchor (ESP). In this anchor the additional reinforcement is pass through the lower hole. This anchor is generally used lifting for slabs, beams, columns, walls and other precast elements. The anchor is cast into the concrete and transfers lifting forces safely from the lifting equipment into the concrete member.

ESP - This anchor are spread anchors are used for lifting most types of beams, wall panels and slabs. The second hole provides the option to use extra reinforcement where required. The anchorage in the concrete is produced by the foot of the spread anchor creating a wrenching cone.

ERA - ERA is special shaped anchor head. The anchorage in the concrete is produced by the foot of the spread anchor creating a wrenching cone. This anchor is generally used lifting for beams, columns, walls and other precast elements. The anchor is cast into the concrete and transfers lifting forces safely from the lifting equipment into the concrete member.

1.1 Accessories

Ring clutch is placed into the indentation of the embedded anchor and the locking bolt is operated by manually. It is rapid, safe and simple connection. Endura Lifting Clutch is a reusable mechanical lifting device designed for the safe handling of precast concrete elements equipped with compatible lifting anchors. The clutch features a forged steel body with a self-engaging locking mechanism that enables rapid attachment and release during lifting operations. Its compact geometry allows efficient load transfer while maintaining ease of installation.

Figure 2. Plate Anchor Lifting Device (Ring Clutch)

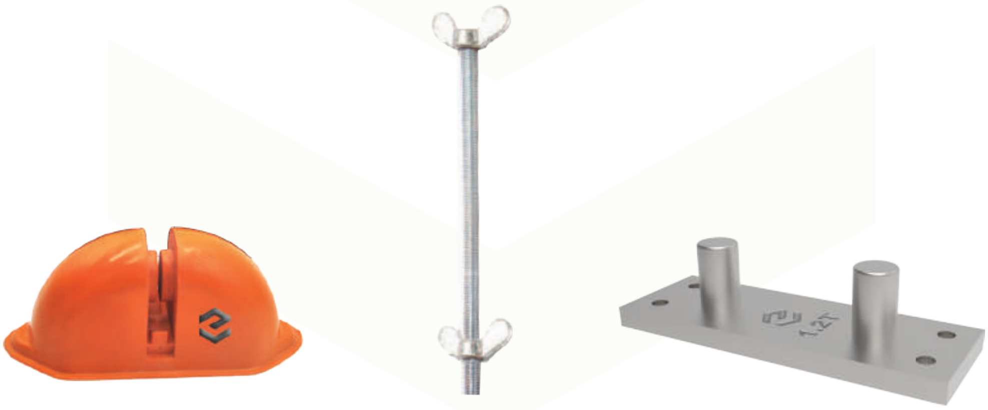


Figure 3. Plate anchor Lifting Accessories

Recess former is made of rubber and is used to hold the hole anchor in place during casting. The recess former protects the anchor, so that lifting can be hooked into the anchor. The recess provides sufficient clearance for the attachment and removal of a compatible lifting clutch during handling, transportation, and installation operations.
This is a threaded bolt with a flanged base plate and a wing nut at the top for tool-free tightening.

Safety Features

The safety of the spherical head lifting system has been verified through testings. Factor of safety for concrete is 2.1, against the strength of concrete, (5% fractile)

1.2 Color classification scheme

The colour classification scheme simplifies the process of identifying each load category.

Table 1. Color classification for Hole lock lifting system

Load Category	2.5		5.0			10.0		26.0				
Load Categories Covered (T)	1.4	2.5	3.0	4.0	5.0	7.5	10.0	12.5	14.0	17.0	22.0	25.0
Colour	Canary Yellow	Ocean Blue	Red	Lemon Chiffon	Light Salmon	Violet	Lawn Green	Hot Pink	Orange	Lavender	Tan	Cyan

2. PRODUCT SPECIFICATIONS

2.1 ETP Lifting Insert Dimensions

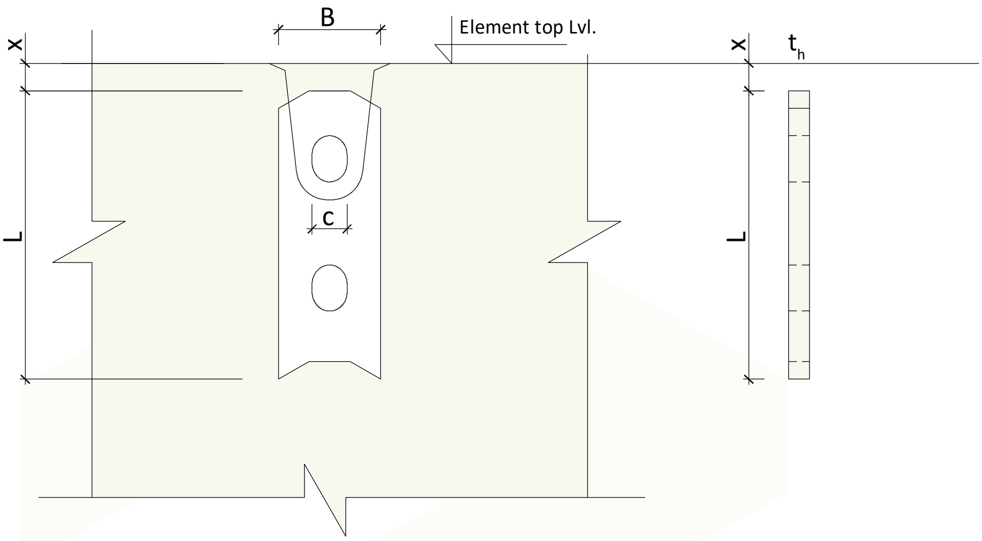


Figure 4. ETP Lifting Anchor

Table 2. ETP Lifting Anchor dimensions

Load Category	L [mm]	B [mm]	t_h [mm]	C [mm]	x [mm]
ETP 1.4	90	30	6	14	10
ETP 2.5	90	30	10	14	10
ETP 3.0	120	40	10	18	10
ETP 4.0	120	40	12	18	10
ETP 5.0	120	40	15	18	15
ETP 7.5	160	60	15	26	15
ETP 10.0	165	60	20	26	15
ETP 14.0	240	80	20	35	15
ETP 22.0	300	90	25	35	15
ETP 26.0	300	120	30	35	15

2.2 ESP Lifting Insert Dimensions

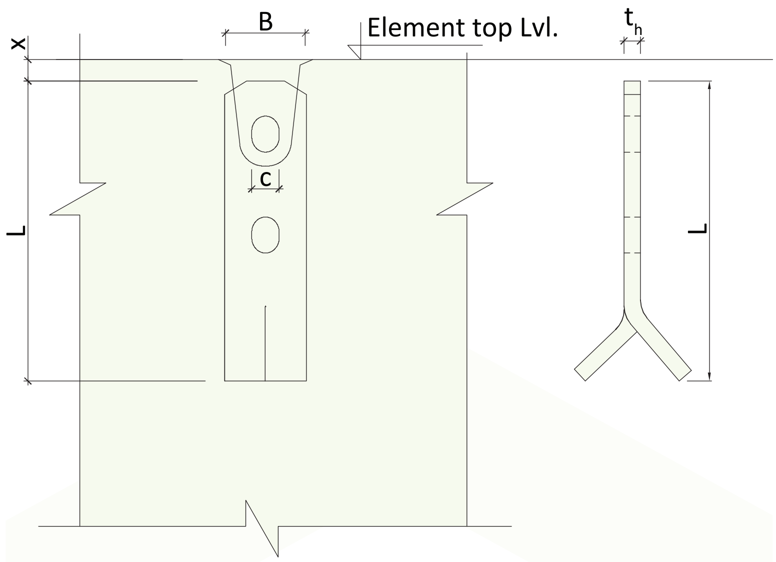


Figure 5. ESP Erection Anchor

Table 3. ESP Lifting Anchor dimensions

Load Category	L [mm]	B [mm]	C [mm]	t_h [mm]
ESP 1.4	110-210	30	14	6
ESP 2.5	150-250	30	14	10
ESP 3.0	160-280	40	18	10
ESP 4.0	180-400	40	18	12
ESP 5.0	180-400	40	18	15
ESP 7.5	260-420	60	26	16
ESP 10.0	300-520	60	26	20
ESP 14.0	370-460	80	35	20
ESP 22.0	500-620	80	35	26

2.3 ERA Lifting Insert Dimensions

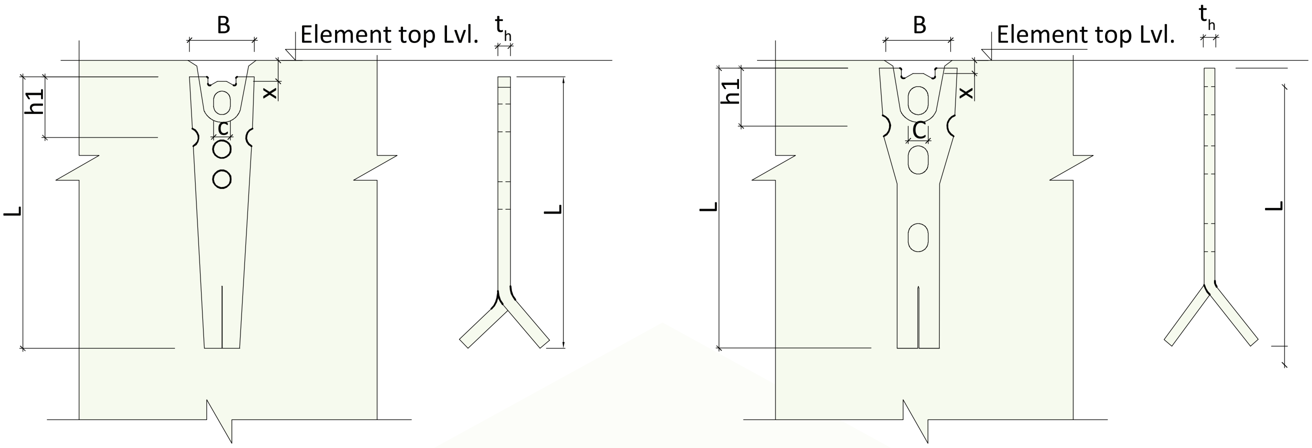


Figure 6. ERA Erection Anchor

Table 4. EP Lifting Insert dimensions

Load Category	L [mm]	B [mm]	t_h [mm]	C [mm]	h1 [mm]	x [mm]
ERA 1.4	200	55	6	14	45	10
ERA 2.5	230	55	10	14	45	10
ERA 4.0	270	70	12	18	70	10
ERA 5.0	290	70	15	18	70	10
ERA 7.5	320	95	15	26	90	15
ERA 10.0	390	95	20	26	90	15
ERA 12.5	500	148	20	35	90	15
ERA 17.0	500	148	25	35	90	15
ERA 22.0	500	148	30	35	90	15

2.4 Material

Table 4. EP Lifting Insert dimensions

Lifting	Material	Material Type	Standard
ETP, ERA, ESP	S355J2	Electro Zinced	EN 10025
ESPs	1.4301	Stainless Steel	EN 10088
ESPa	1.4401	Acid resistant	EN 10088

Lifting inserts are corrosion protection may be provided through galvanization. These protective treatments help minimize the effects of moisture, weathering, and temporary site exposure prior to the completion of construction.

2.5 Storage Environment condition

The lifting system does not offer permanent corrosion protection by design. Cast-in components must be shielded from environmental influences (moisture, temperature cycling, atmospheric exposure) to maintain long-term performance.

WARNING

Requirement	Specification
Storage environment	Dry, covered conditions at all times
Material protection	Galvanised steel components must be stored undercover to prevent unnecessary exposure to moisture in any form
Outdoor storage	Not permitted — items shall not be left in open outdoor conditions without overhead weather protection.
Minimum acceptable provision	Covered shelter providing complete protection from rainfall (where fully enclosed indoor storage is unavailable)

2.6 Product Markings

Usually, we mark the product to show information such as Load category, height of anchor, Product type and product manufacturing shown below figure:

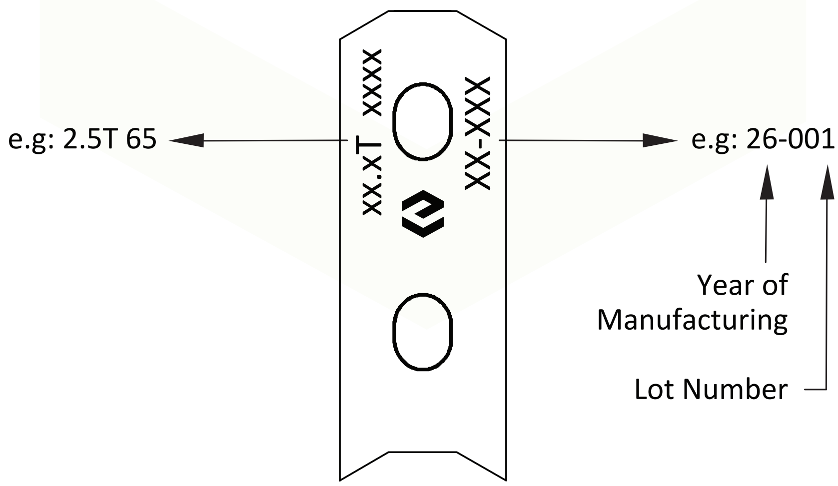


Figure 7: Markings of Hole Lock Lifting

3. DESIGN LOAD CAPACITY (SAFE WORKING LOADS)

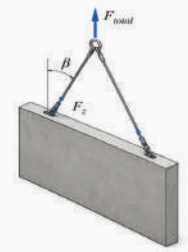
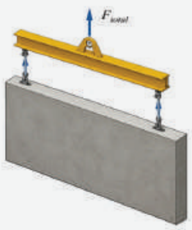
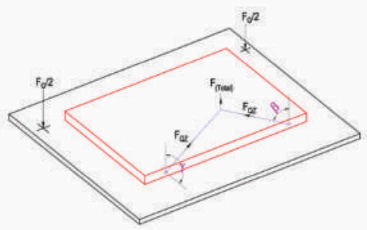
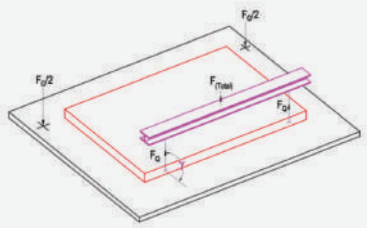
The design of Lifting Anchors is according with European standards. Following European standards are - EN 1992, EN 1993, Machinery Directive 2006/42/EC, VDI/BV-BS 6205

Following Safety factors for failure are as below:

Steel Breakage of anchor	Concrete breakout (cone failure)
$\gamma_s = 3.0$	$\gamma_c = 2.1$

Safety factor 2.1 applies where the precast element is produced under plant-specific conditions. If a safety factor of 2.5 is to be used, then the design load capacity (safe working load) should be divided with factor of 2.1/2.5

Combination of Lifting anchor with Ring clutches:

		This combination is most suitable for ETP, ESP, and ERA plate anchor lifting system.
		This combination is most suitable for ETP, ESP, and ERA plate anchor lifting system.
		This combination is suitable for ESP, and ERA plate anchor lifting system.
		This combination is suitable for ESP, and ERA plate anchor lifting system.

The concrete is required to achieve a minimum compressive cube strength of 15 MPa prior to load application, and is treated as uncracked for the purposes of analysis.

3.1. Walls

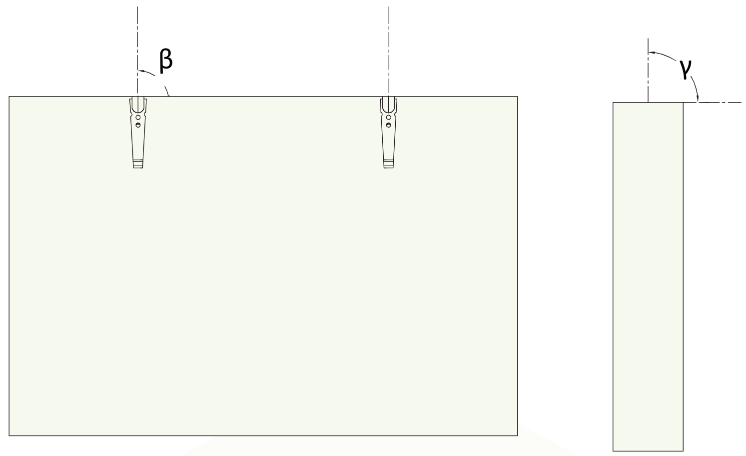


Figure. 8

Table 6: Safe Working Load (SWL) for ETP Lifting Insert

Load Category	Design Load Capacity (Safe Working Load), kN	
	β = 0° – 45°	γ = 0° – 10°
ETP 1.4	ETP 1.4	ETP 1.4
ETP 2.5	ETP 2.5	ETP 2.5
ETP 3.0	ETP 3.0	ETP 3.0
ETP 4.0	ETP 4.0	ETP 4.0
ETP 5.0	ETP 5.0	ETP 5.0
ETP 7.5	75.0	75.0
ETP 10.0	100.0	100.0
ETP 14.0	140.0	140.0
ETP 22.0	220.0	220.0
ETP 26.0	260.0	260.0

Table 7: Safe Working Load (SWL) for ESP Lifting Insert

Load Category	Design Load Capacity (Safe Working Load), kN	
	$\beta = 0° – 45°$	$\gamma = 0° – 10°$
ESP 1.4	14.0	7.0
ESP 2.5	25.0	12.5
ESP 3.0	30.0	15.0
ESP 4.0	40.0	20.0
ESP 5.0	50.0	25.0
ESP 7.5	75.0	37.5
ESP 10.0	100.0	50.0
ESP 14.0	140.0	70.0
ESP 22.0	220.0	110.0

Table 8: Safe Working Load (SWL) for ERA Lifting Insert

Lifting Anchor	Design Load Capacity (Safe Working Load), kN	
	$\beta = 0° – 45°, \gamma = 0° – 10°$	$\gamma = 10° – 00°$
ERA 1.4	14.0	7.0
ERA 2.5	25.0	12.5
ERA 4.0	40.0	20.0
ERA 5.0	50.0	25.0
ERA 7.5	75.0	37.5
ERA 10.0	100.0	50.0
ERA 12.5	125.0	62.5
ERA 17.0	170.0	85.0
ERA 22.0	220.0	110.0

4. MINIMUM ELEMENT THICKNESS AND SPACING OF ANCHORS

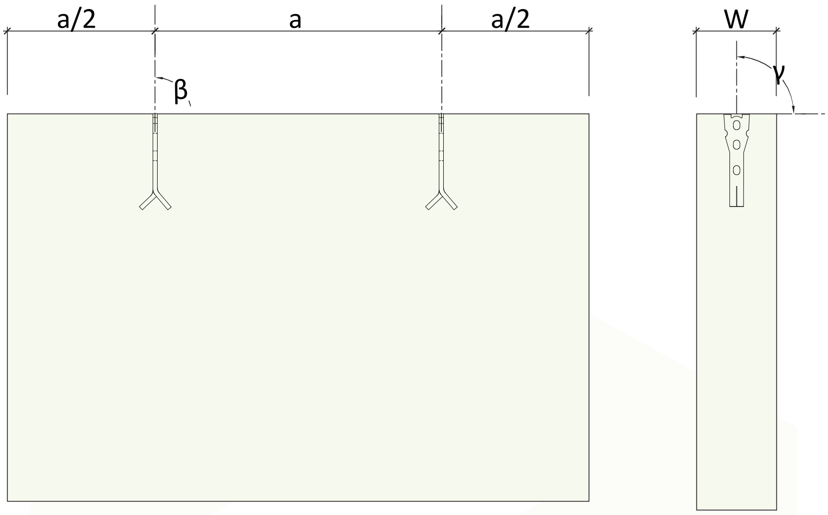


Figure. 9 Minimum element thickness and minimum lifting insert spacing in wall elements

Table 9. Minimum element thickness and minimum lifting Anchor spacing in wall elements for ETP Lifting Insert

Lifting Anchor	Wall Thickness, W [mm]	Minimum Edge Distance, a/2 [mm]	Minimum Centre to Centre Distance, a [mm]
ETP 1.4	80	250	500
ETP 2.5	100	300	600
ETP 3.0	100	325	650
ETP 4.0	110	350	700
ETP 5.0	120	375	750
ETP 7.5	130	600	1200
ETP 10.0	140	600	1200
ETP 14.0	160	750	1500
ETP 22.0	180	750	1500
ETP 26.0	200	750	1500

Table 10. Minimum element thickness and minimum lifting Anchor spacing in wall elements for ESP Lifting Insert

Lifting Anchor	Wall Thickness, W [mm]	Minimum Edge Distance, a/2 [mm]	Minimum Centre to Centre Distance, a [mm]
ESP 1.4	80	165	330
	80	190	382
	80	240	480
	80	250	500
ESP 2.5	120	225	450
	120	300	600
	120	375	750
ESP 3.0	160	240	480
	120	300	600
	120	420	840
ESP 4.0	210	270	540
	150	360	720
	150	480	960
ESP 5.0	350	270	540
	180	360	720
	180	600	1200
ESP 7.5	340	390	780
	240	450	900
	200	630	1260
ESP 10.0	450	450	900
	270	555	1110
	250	780	1560
ESP 14.0	610	555	1110
	350	690	1380
ESP 22.0	760	750	1500
	450	930	1860

Table 11. Minimum element thickness and minimum Anchor insert spacing in wall elements for ERA Lifting Insert

Lifting Anchor	Wall Thickness, W [mm]	Minimum Edge Distance, a/2 [mm]	Minimum Centre to Centre Distance, a [mm]
ERA 1.4	100	250	500
ERA 2.5	120	300	600
ERA 4.0	150	350	700
ERA 5.0	160	375	750
ERA 7.5	175	600	1200
ERA 10.0	240	600	1200
ERA 12.5	260	750	1500
ERA 17.0	300	750	1500
ERA 22.0	360	750	1500

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.

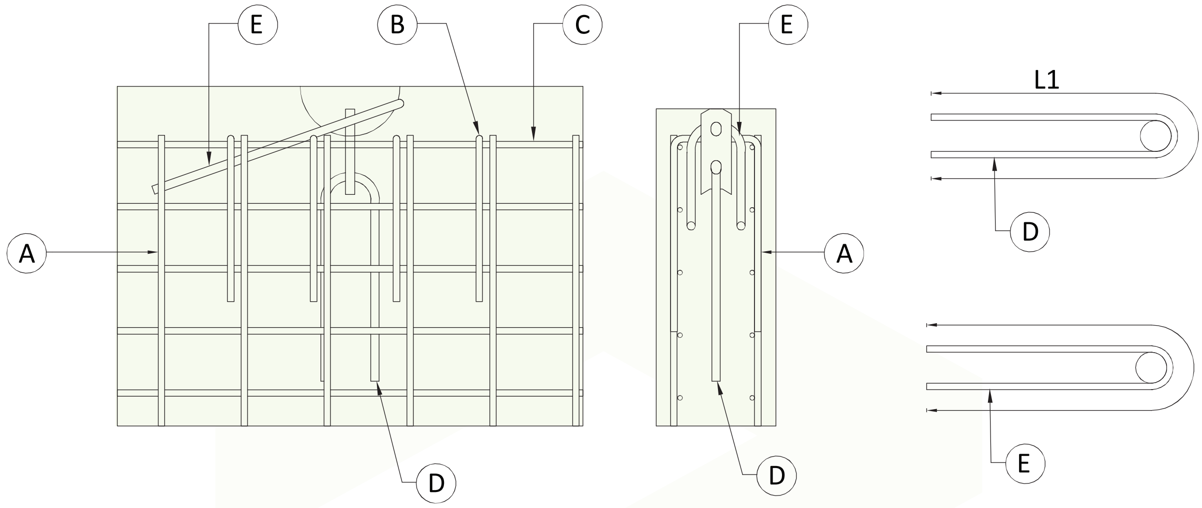


Figure. 10 ETP Lifting Anchor reinforcement details

Table 12. ETP Lifting Anchor Reinforcement details

Lifting Anchor	Mesh Reinforcement, A [mm2/m]	Stirrup Reinforcement, B			Edge Reinforcement (both sides), C	Anchor Reinforcement, D (Ø – L1)	Angle Pull Reinforcement, E (Ø – L2)
		Pcs.	Diameter[mm]	Length [mm]			
ETP 1.4	2x131	4	6	400	Ø8	10 – 650	6 – 900
ETP 2.5	2x131	4	8	600	Ø10	12 – 1000	8 – 1200
ETP 3.0	2x131	4	8	700	Ø10	12 – 1000	10 – 1150
ETP 4.0	2x131	4	8	800	Ø12	16 – 1200	10 – 1500
ETP 5.0	2x188	4	10	800	Ø12	16 – 1500	12 – 1550
ETP 7.5	2x188	4	10	800	Ø12	20 – 1750	14 – 2000
ETP 10.0	2x188	6	10	1000	Ø14	25 – 1850	16– 2300
ETP 14.0	2x257	8	10	1000	Ø14	28 – 2350	20 – 2600
ETP 22.0	2x257	8	10	1200	Ø16	28 – 3000	25 – 3000
ETP 26.0	2x257	8	12	1200	Ø16	28 – 3050	25 – 3450

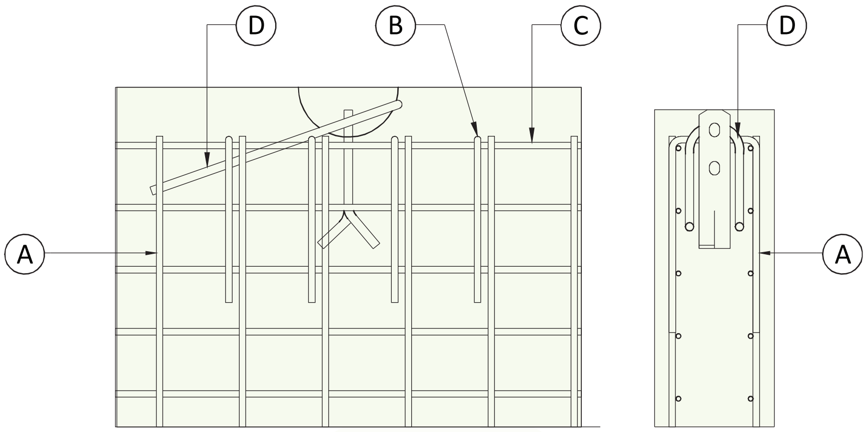


Figure. 11 ESP Lifting Anchor reinforcement details

Table 13. ESP Lifting Anchor Reinforcement details

Lifting Anchor	Mesh Reinforcement, A [mm2/m]	Stirrup Reinforcement, B			Edge Reinforcement (both sides), C	Angle Pull Reinforcement, E (Ø – L2)
		Pcs.	Diameter[mm]	Length [mm]		
ETP 1.4	2x188	2	6	400	Ø8	8 – 220
ETP 2.5	2x188	2	8	600	Ø10	10 – 300
ETP 3.0	2x188	2	8	600	Ø10	10 – 370
ETP 4.0	2x188	2	8	700	Ø12	12 – 410
ETP 5.0	2x188	2	10	700	Ø12	12 – 420
ETP 7.5	2x188	4	10	800	Ø12	16 – 580
ETP 10.0	2x188	4	10	800	Ø14	16 – 770
ETP 14.0	2x257	6	10	1000	Ø14	20 – 860
ETP 22.0	2x257	8	10	1000	Ø16	25 – 1080

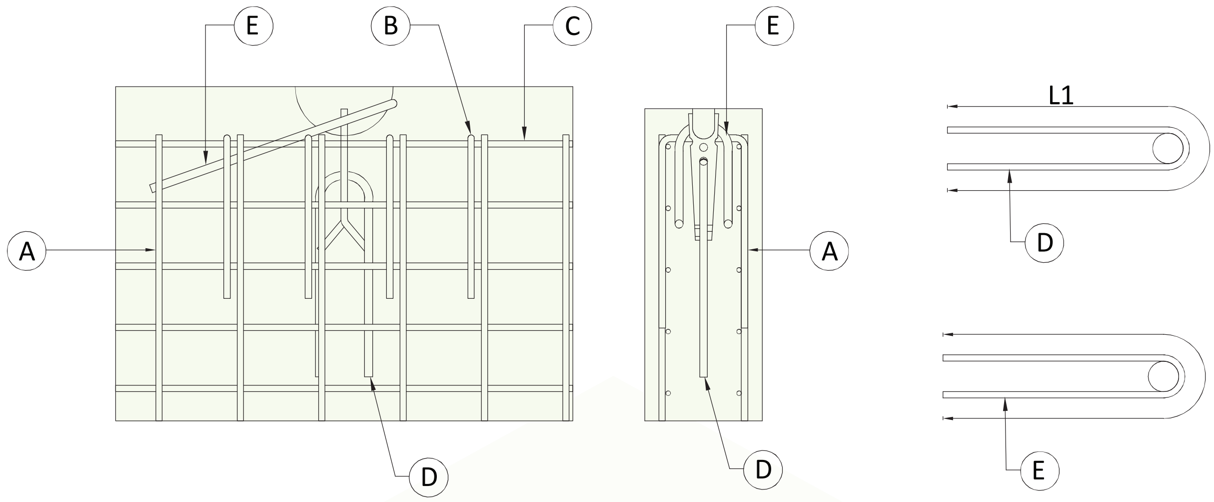


Figure 12. ERA Lifting Anchor reinforcement details

Table 14. ERA Lifting Anchor Reinforcement details

Lifting Anchor	Mesh Reinforcement, A [mm2/m]	Stirrup Reinforcement, B			Edge Reinforcement (both sides), C	Anchor Reinforcement, D (Ø – L1)	Angle Pull Reinforcement, E (Ø – L2)
		Pcs.	Diameter[mm]	Length [mm]			
ERA 1.4	2x131	4	6	400	Ø8	10 – 650	6 – 900
ERA 2.5	2x131	4	8	600	Ø10	12 – 1000	8 – 1200
ERA 4.0	2x131	4	8	800	Ø12	16 – 1200	10 – 1150
ERA 5.0	2x131	4	10	800	Ø12	16 – 1500	10 – 1500
ERA 7.5	2x188	4	10	800	Ø12	20 – 1750	12 – 1550
ERA 10.0	2x188	6	10	1000	Ø14	20 – 1900	14 – 2000
ERA 12.5	2x257	8	10	1000	Ø14	25 – 2200	16– 2300
ERA 17.0	2x257	8	10	1200	Ø16	28 – 2500	20 – 2700
ERA 22.0	2x257	8	10	1200	Ø16	28 – 3000	25 – 3200

Lateral rebar for ERA Lifting Insert

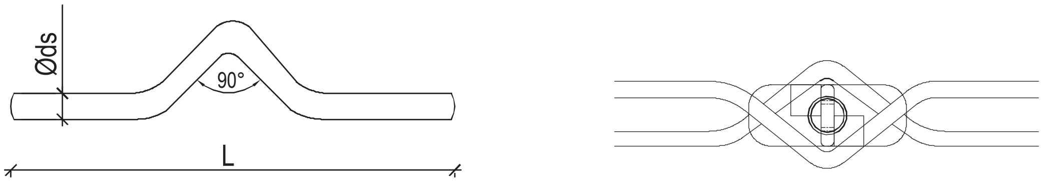


Figure. 13

Lifting Anchor	Lateral Reinforcement, (Øds x L2)
ERA 1.4	10 – 700
ERA 2.5	12 – 800
ERA 4.0	14 – 950
ERA 5.0	16 – 1000
ERA 7.5	20 – 1200
ERA 10.0	20 – 1500
ERA 12.5	25 – 1800
ERA 17.0	28 – 1800
ERA 22.0	28 – 1800

6. INSTALLATION PROCESS

- **Check plate type** – confirm ETP , ESP and ERA) matches the design drawing for that lift point.
- **Inspect plate** – no cracks, bends, or corrosion
- **Position plate** at the marked lift-point location on the formwork/rebar layout.
- **Orient plate** – holes aligned vertically along the intended lifting/pull direction; foot (notched/forked) facing into the concrete body.
- **Fix plate in place** – tie wire through the upper hole to the rebar cage, or use a threaded fixing rod through the formwork.
- **Fit recess former/helmet** over the top hole(s) to keep them clear of concrete.
- **Verify embedment depth** – top hole sits flush/accessible at the finished concrete surface.
- **Check cover and edge distance** per the plate's rated WLL.
- **Pour and compact concrete** carefully, avoiding displacement of the plate.
- **After stripping** – remove recess former, clear debris from holes, inspect for cracking/spalling.
- **Confirm concrete strength** has reached the minimum lifting strength (cube test) before loading.
- **Engage matching clutch** fully into the hole(s); confirm full lock.
- **Proof lift** (50–100 mm raise, pause, inspect) before full hoist.

7. ACTIONS ON LIFTING ANCHOR

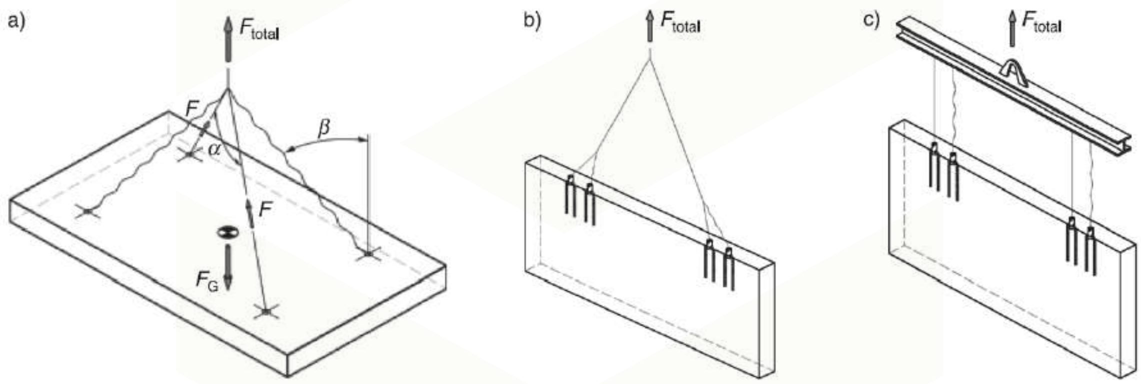
7.1 General

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

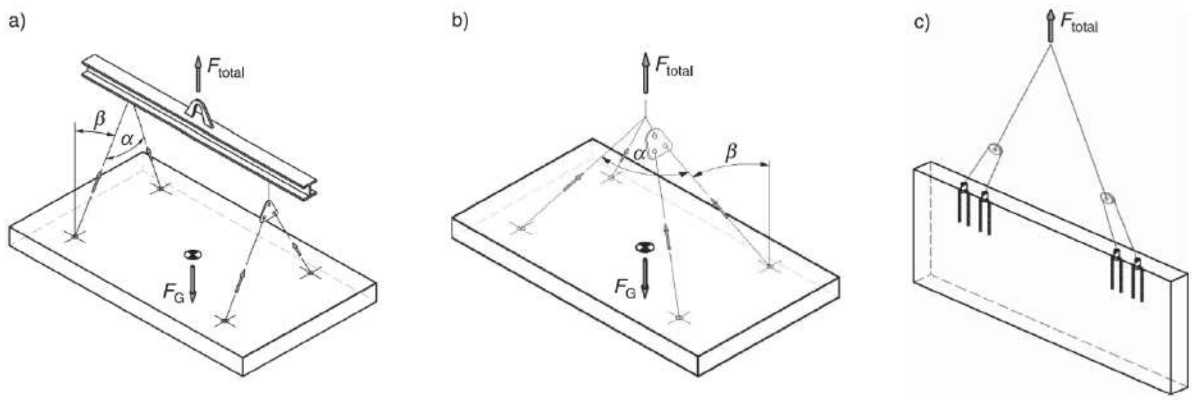
- Statical system
- Element self-weight
- Adhesion and form friction
- Dynamic effects
- Position and number of lifting inserts and type of lifting equipment

7.2 Statical System

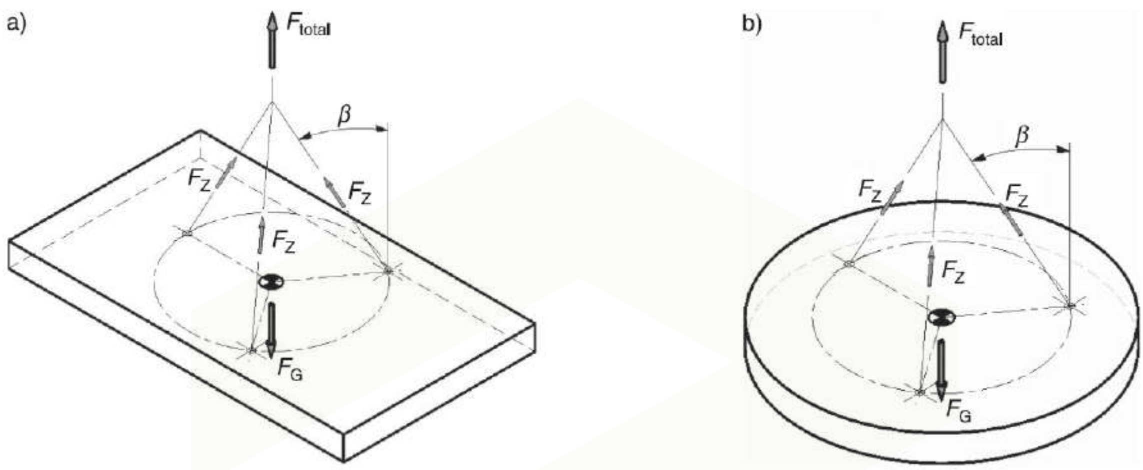
The lifting equipment shall allow a statically determinate load distribution to all present lifting inserts and lifting insert systems. Figures below give examples of statically indeterminate systems where only two lifting inserts carry the load. The load distribution is not clearly defined in these applications. Therefore, statically indeterminate systems shall be avoided.



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. In below figure, more transportation aids for slabs and wall elements are illustrated.



In case of inclined lifting slings the lifting inserts are loaded by combined tension and shear loads. The inclination β according to figure above (on previous page) governs the level of combined tension and shear loads to be taken into account in the design.
In the special case of three lifting inserts located in a slab located and situated in a star pattern with the same distance to the centre of gravity with equal inclinations of 120° it is ensured that all three lifting inserts experience the same load.



7.3 Self-Weight

The weight FG of precast elements shall be determined as given by equation below

$F_G = V \cdot \rho_G$

where,

F_G Weight of the precast element, in kN

V Volume of the precast element, in m^3

ρ_G Density of the concrete, in kN/m^3

7.4 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 demoulding situations shall be determined from equation below

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

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 below, in kN/m2

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

Formwork and Condition [a]	q_{adh} [b] kN/m^2
Oiled steel mould, oiled plastic-coated plywood	≥ 1.0
Varnished wooden mould with panel boards	≥ 2.0
Rough wooden mould	≥ 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 above 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 demoulding process.

7.5 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 below.

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

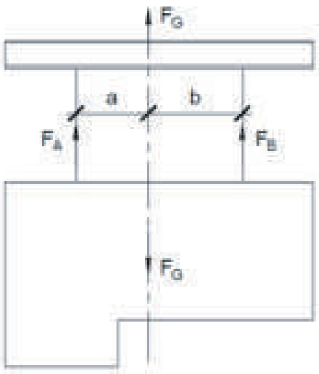
Note: Other values of ψ_{dyn} than given in Table above based on reproducible tests or verified experience can be used in the design. In case of other lifting and handling conditions than reported in Table above the factor ψ_{dyn} shall be determined on the base of tests or engineering judgement.

7.6 Distribution of Load for Asymmetrical Elements

For non-symmetrical installation of lifting anchors (using spreader beam only), the load distribution is as in the equations below.

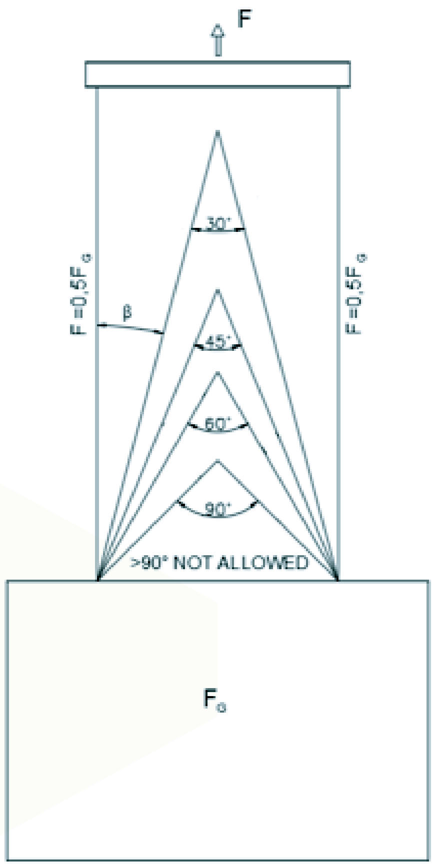
FA = FG . b / (a + b)
FB = FG . a / (a + b)
where,

F_G Weight of the pre-cast element, in kN
a Distance from insert A to centre of gravity, in m
b Distance from insert B to centre of gravity, in m



7.7 Spread Angle

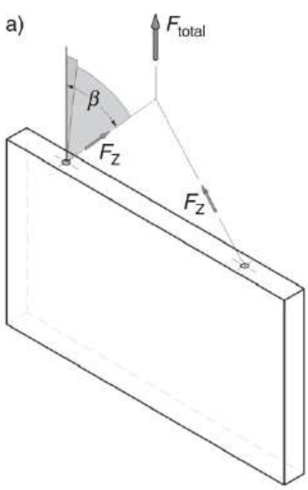
Cable Angle β	Spread Angle α	Load Factor z
0°	-	1.00
7.5°	15°	1.01
15°	30°	1.04
22.5°	45°	1.08
30°	60°	1.15
37.5°	75°	1.26
45°	90°	1.41

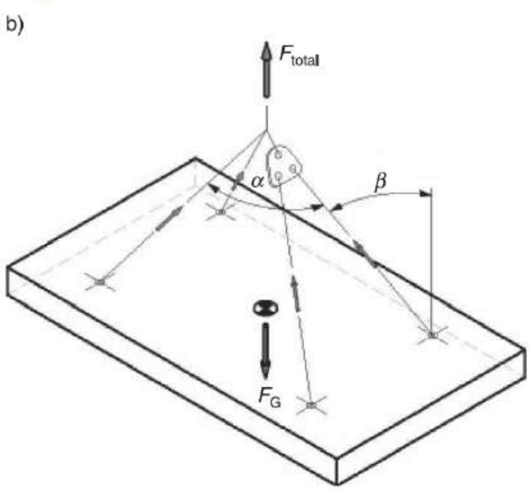


7.8 Number and Actions of Lifting Anchors

The number of and the load acting on the lifting insert shall be determined corresponding with the individual lifting situations in accordance with Equations given in the different situations below. The most unfavorable relation from action to resistance resulting from these equations governs the design.

7.8.1 Load condition “erection in combination with adhesion & form friction”





It is assumed that the precast element does not rest one-sided on the form. Then the action FQ is:

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

where,

F_Q Load acting on the lifting insert, in kN

F_G Weight of the precast element

F_{adh} Action due to adhesion and form friction

z Factor for combined tension and shear, $z = 1/\cos \beta$

In case of tension: z = 1.

n Number of load carrying lifting inserts

7.8.2 Load condition "erection"

It is assumed that the precast element rests one-sided on the form. Then the action FQ is:

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

where,

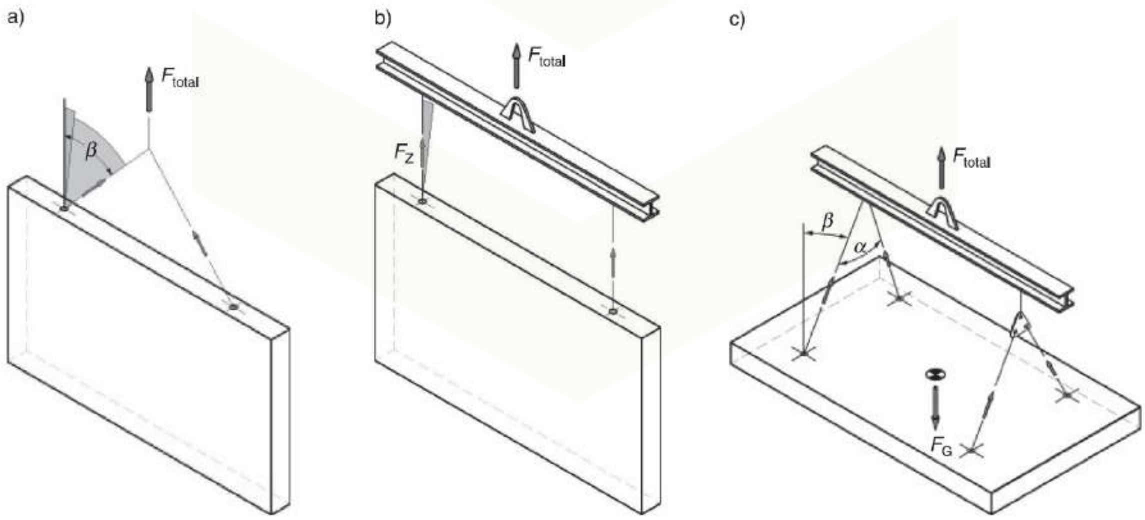
F_Q Shear load acting on the lifting insert (shear) directed perpendicular to the longitudinal axis of the concrete component

F_G Weight of the precast element

ψ_{dyn} Dynamic factor

n Number of load carrying lifting inserts

7.8.3 Load condition "lifting and handling under combined tension & shear"



The load condition is shown in the figure below. The action FZ 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 Weight of the precast element

ψ_{dyn} Dynamic factor as per Dynamic Actions table (Section 7.5)

z Factor for combined tension and shear, $z = 1/\cos \beta$

In case of tension: z = 1.

n Number of load carrying lifting inserts

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