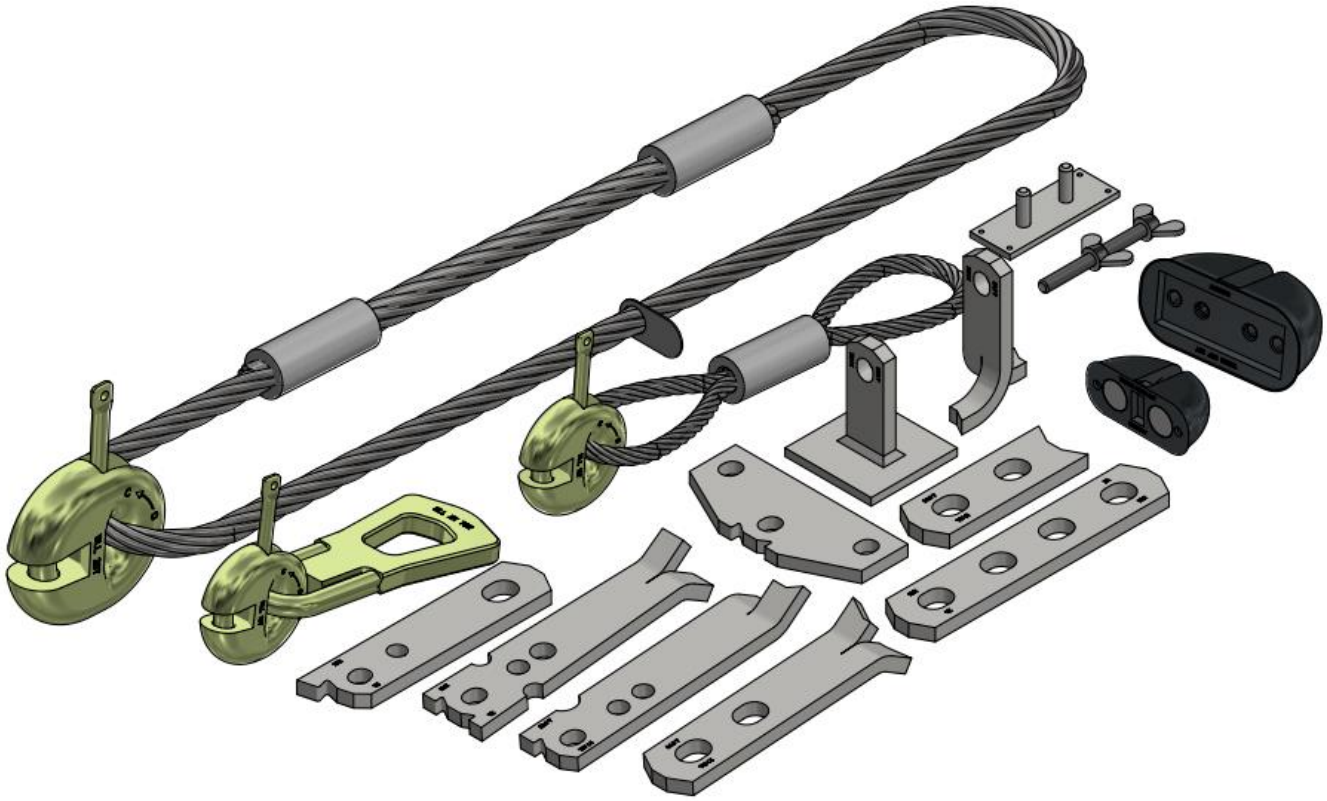
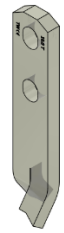
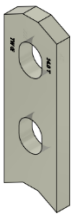
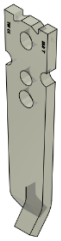
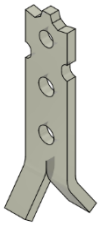
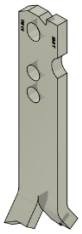
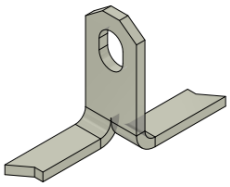
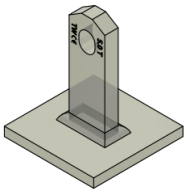
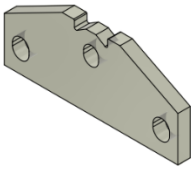
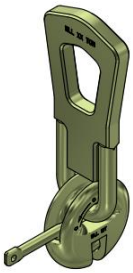
TECHNICAL DOCUMENTATION

LIFTING SYSTEMS | 2D STRIP ANCHOR LIFTING SYSTEM



EN – Original Instructions

OVERVIEW

LIFTING CLUTCHES AND TRANSPORT ANCHOR				
SA-B  Page 23	**SA-ST**  Page 30	**SA-TTU**  Page 33	**UNIVERSAL ANCHOR 1.25 t**  Page 36	**SA-TU-HP**  Page 37
SA-FA  Page 40	**SA-FAW**  Page 42	**SA-SP**  Page 44	**SA-LSP**  Page 47	
TF1  Page 49	**TF1-260**  Page 49	**TF2**  Page 49		
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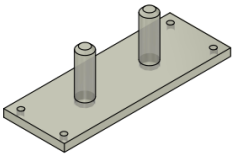
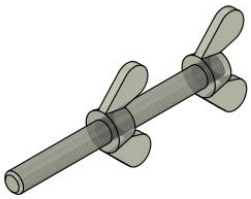
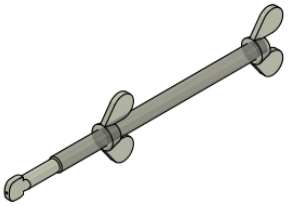
RBF  Page 57	**RBFM**  Page 58	**TMP**  Page 59		
TDV  Page 60	**TBV**  Page 60			

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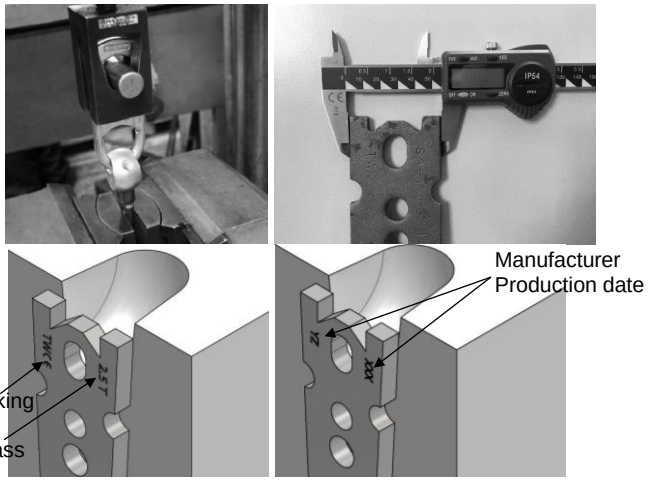
INTRODUCTION

The strip anchor lifting system manufactured by TERWA is a high quality, safe, easy to handle, cost-effective system. It used for transporting all types of concrete elements.
Some of the important advantages of these systems include:

- Safe, simple, and fast connection and disconnection between lifting links and correspondent anchors.
- Anchors and lifting keys are designed for load capacities between **0.7 – 26.0 t**.
- High-quality alloy material for lifting keys and anchors can be used in any environment.
- Available in a hot-dip galvanised version for corrosion protection.
- Perfect lifting and transport solution for most applications and precast elements.
- CE-certified system. All Terwa lifting systems have the CE marking which guarantees conformance with the European regulations.

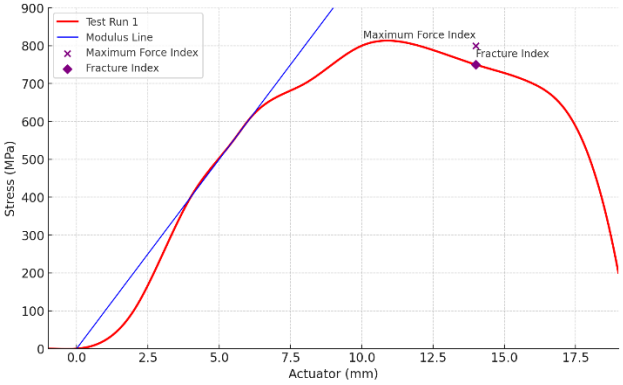
The design for Terwa strip anchors and technical instructions comply with the national German guideline VDI/BV-BS 6205:2021-09 “Lifting inserts and lifting insert for precast concrete elements”. Based on this guideline, the manufacturer must also ensure that the lifting systems have sufficient strength to prevent concrete failure.
A failure of lifting anchors and lifting anchor devices can endanger human lives as well as can lead to significant damage. Therefore, lifting anchors and lifting devices are high-quality products, carefully selected and designed for the intended applications and for use by qualified personnel in accordance with the lifting and handling instructions.
The anchors are designed to resist at a minimum safety factor = 3.
Welding on the anchor is not permitted.

Quality
Terwa continuously controls the anchor production process in terms of strength, dimensional and material quality, and performs all of the required inspections for a superior quality system. All of the products are tracked from material acquisition to the final, ready to use product.



Marking and traceability
All anchors and lifting clutches have the CE marking and all data necessary for traceability and load class.

Anchor testing
Terwa lifting anchors are designed to resist at a minimum safety factor of **3x load group**



Application of lifting anchor system

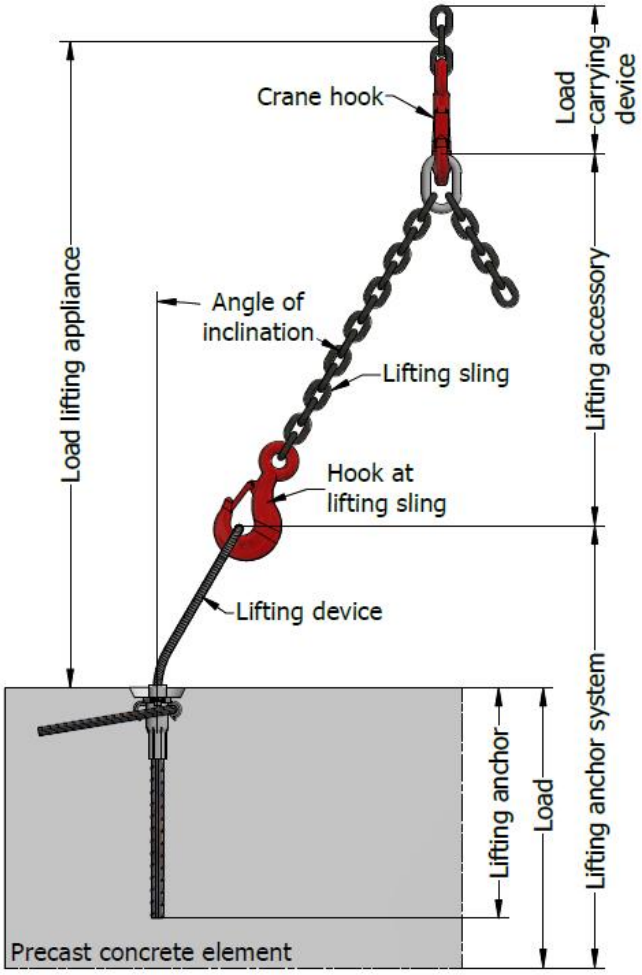
Load carrying devices - are equipment that is permanently connected to the hoist for attaching lifting devices, lifting accessory or loads.

Lifting accessory – equipment that creates a link between the load carrying device and the lifting device.

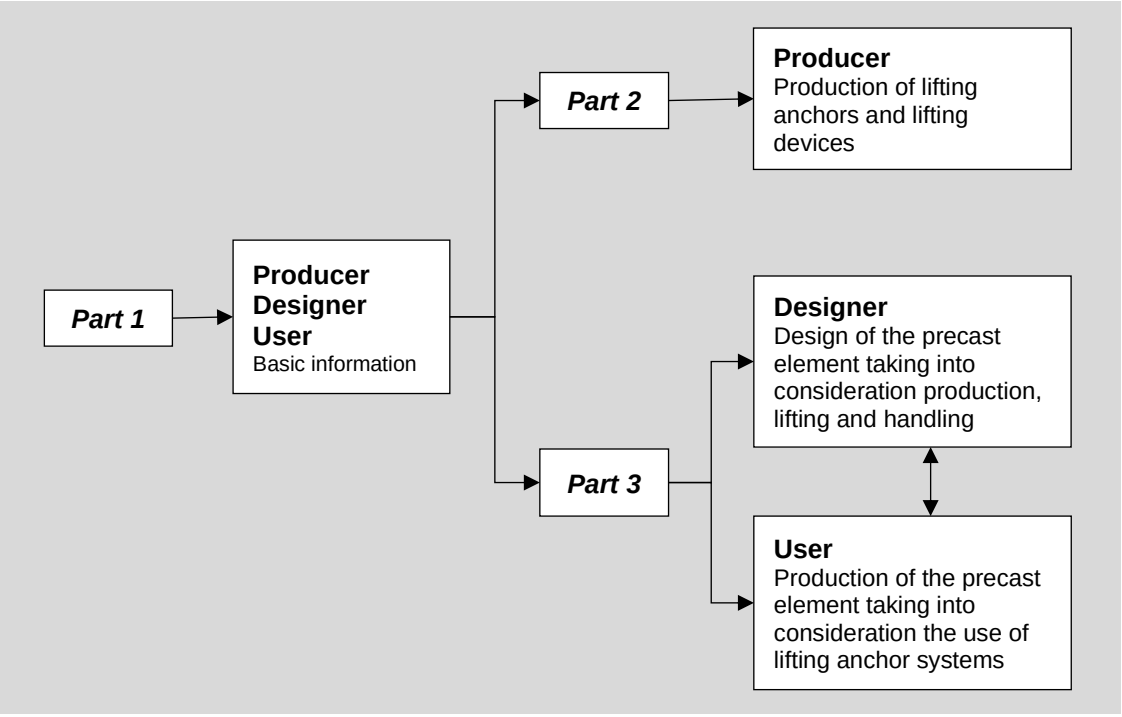
Lifting device (lifting key) – equipment that connects the loads to the load carrying device by means of lifting accessories.

Lifting anchor – steel part embedded in the concrete element, which is intended as an attachment point for the lifting device.

Lifting anchor system - consists of a lifting anchor (insert), which is permanently anchored in the precast concrete element and the corresponding lifting device, which is temporarily fixed to the embedded lifting anchor.



Interaction between the parts of the series of guidelines VDI/BV-BS 6205



CE MARKING

CE marking means that a product is manufactured and inspected in accordance with a harmonised European standard (hEN) or a European Technical Approval (ETA). ETA can be used as the basis for CE marking for cases in which there is no hEN. However, ETA is voluntary and not required by EU directives or legislation.
Manufacturers may use the CE marking to declare that their construction products meet harmonised European standards or have been granted ETA Approvals. These documents define properties the products must have to be granted the right to use the CE marking and describe how the manufacture of these products is supervised and tested.
EU Construction Products Regulation takes full effect on 1 July 2013. There are no harmonised EN standards for detailed building parts, such as connections used in concrete constructions, excluding lifting items and devices, which are covered by the EU Machinery Directive. For steel constructions, CE marking will become mandatory as of 1 July 2014 as covered by the EU Construction Products Directive.

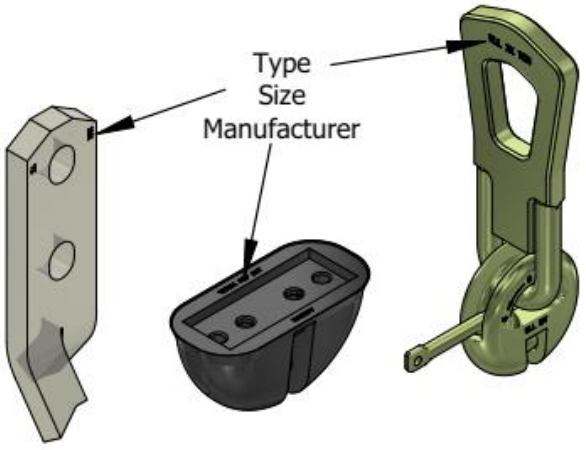
PRODUCT RANGE

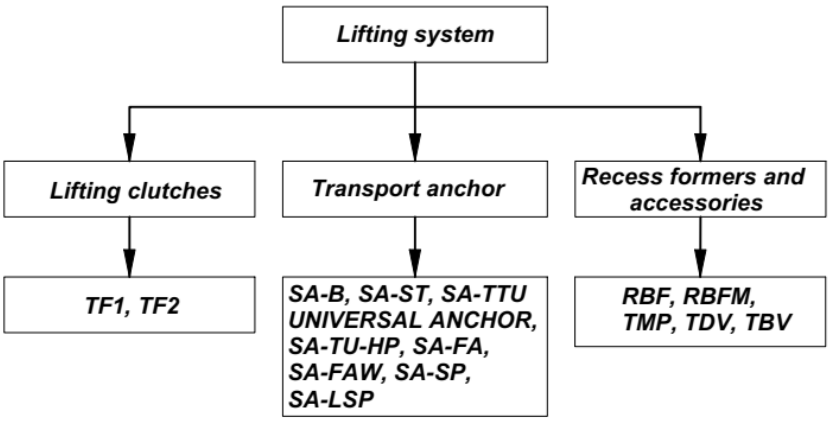
LIFTING SYSTEMS

- **RE-USABLE LIFTING SYSTEM**
  Terwa offers various types of ring clutches suitable for lifting, transport and installation of precast concrete elements.

- **TRANSPORT ANCHORS**
  Strip anchors made from high-quality steel.

- **RECESS FORMERS AND MOUNTING ACCESSORIES**
  Wide range of mounting accessories for fixing the anchors to the formwork during the production of the precast element.





TECHNICAL INFORMATION – CHOOSING THE TYPE OF ANCHOR

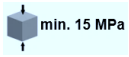
Terwa has 3 types of lifting systems:

- 1D threaded lifting system.
- 2D strip anchor lifting system.
- 3D T-slot anchor lifting system.

The method for choosing the anchor is identical for all these types and depends on the lifting method and/or experience.
The 1D threaded lifting system is mainly used when the hoisting angles are limited, while the 2D strip anchor lifting system and the 3D T-slot anchor lifting system can be used for all hoisting angles, with minor limitations for the 2D strip anchor lifting system. The difference between the 2D strip anchor lifting system and the 3D T-slot anchor lifting system lies principally in the experience one has in using one or the other system.
Terwa also has software for making the anchor calculations.

SAFETY RULES

The lifting system consists of a threaded anchor embedded in concrete and a threaded lifting device. The threaded lifting loop is connected to the anchor only when required for lifting. **Ensure that the concrete has reached MPa strength of at least 15 before beginning lifting.**



These lifting systems are not suitable for intensive re-use.
In designing the lifting system, the safety factors for the failure mode steel rupture derived from the Machinery Directive 2006/42/EC are:

- **for steel component (solid sections)** $\gamma = 3$
- **for steel wires** $\gamma = 4$

For this, the load-side dynamic working coefficient $\psi_{dyn} = 1.3$
For the determination of the characteristic resistances based on method A in accordance with DIN EN 1990 - Annex D for the concrete break-out, splitting, blow-out and pull-out failure modes, the safety factor is $\gamma = 2.5$
The safety concept requires that the action E does not exceed the admissible value for the resistance R_d:

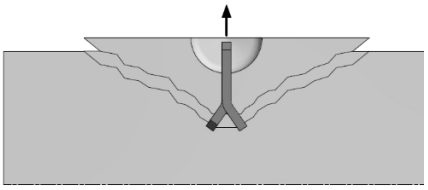
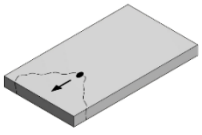
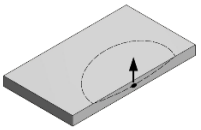
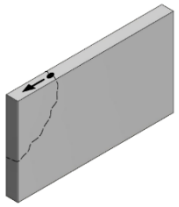
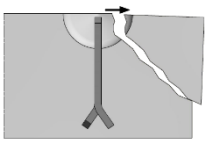
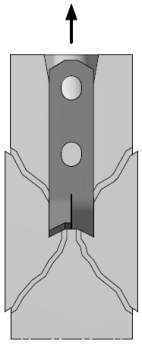
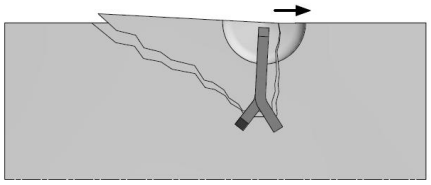
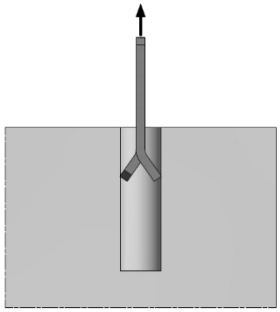
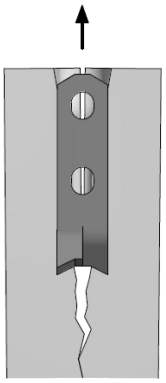
$E_d \leq R_d$ Where: E_d - Design value of the effects of actions, R_d – Design value of the corresponding resistance

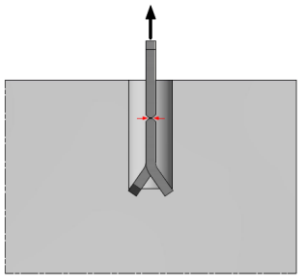
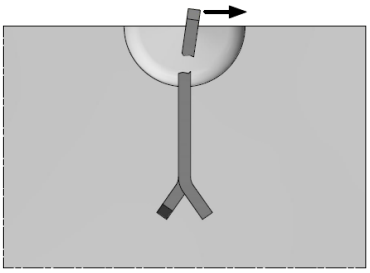
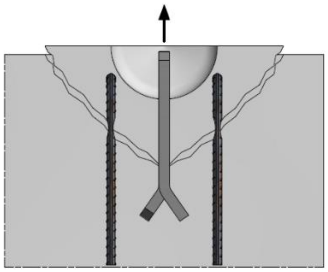
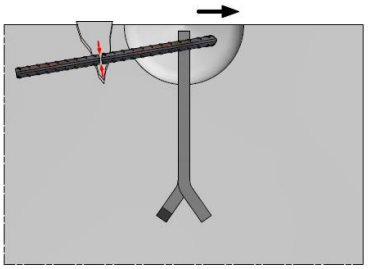
The admissible load (resistance) of lifting anchor and lifting device is obtained as follows:

$R_d = \frac{R_k}{\gamma}$ Where: R_k – characteristic value of the resistance of the anchoring of a lifting anchor or lifting device, γ - partial safety factor

Notice: The lifting anchors must always be installed above the centre of gravity. Otherwise, the element can tip over during transport.
The maximum permitted load on the components quoted in the tables has been obtained by applying a safety factor on test data.

POSSIBLE TYPES OF FAILURE OF A LIFTING ANCHOR

Failure type	Fracture pattern: tensile force	Fracture pattern: transverse shear force
Concrete break-out Failure mode, characterised by a wedge or cone shaped concrete break-out body, which was separated from the anchor ground and is initiated by the lifting anchor		   
Local concrete break-out (blow-out) Concrete spalling at the side of the component that contains the anchor, at the level of the form-fitting load application by the lifting anchor into the concrete break-out at the concrete surface.		
Pry-out (rear breakout of concrete) Failure mode characterised by the concrete breaking out opposite the direction of load, on lifting anchors with shear load.		
Pull-out Failure mode, where the lifting anchor under tension load is pulled out of the concrete with large displacements and a small concrete break-out.		
Splitting of the component A concrete failure in which the concrete fractures along a plane passing through the axis of the lifting anchor.		

Failure type	Fracture pattern: tensile force	Fracture pattern: transverse shear force
Steel failure Failure mode characterised by fracture of the steel lifting anchor parts.		
Steel failure of additional reinforcement Steel failure of the supplementary reinforcement loaded directly or indirectly by the lifting anchor		

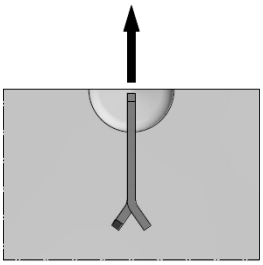
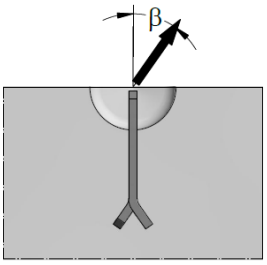
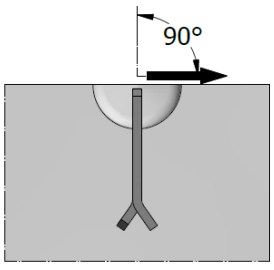
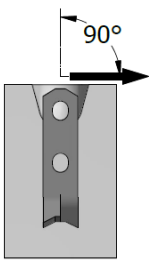
DIMENSIONING OF LIFTING ANCHOR SYSTEM

For the safe dimensioning of lifting anchor systems for precast concrete elements, the following points must be made clear at the start:

- The type of the structural element and the geometry
- Weight and location of centre of gravity of the structural element
- Directions of the loads on the anchor during the entire transport process, with all loading cases that occur.
- The static system of taking on the loads.

To determine the correct size of lifting anchor, the stresses in the direction of the wire rope sling must be determined for all load classes. These stresses must then be compared with the applicable resistance values for the type of loading case.

Stress ≤ Resistance always applies

Direction of stress			
Axial tension		***Parallel shear pull***	
Load or load component action in the direction of the longitudinal axis of the lifting anchor.		Load or load component action at an angle β to the longitudinal axis of the lifting anchor in the plane of the precast component.	
Transverse shear pull parallel to the structural element plane		***Transverse shear pull perpendicular to the structural element plane***	
Load or load component parallel to the surface of structural element and to the plane of the element, acting at an angle β perpendicular to the longitudinal axis of the lifting anchor.		Load or load component parallel to the building component surface and perpendicular to the surface of the component.	

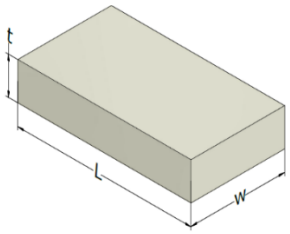
LOAD CAPACITY

The load capacity of the anchor depends on multiple factors such as:

- The deadweight of the precast concrete element "F_G"
- Adhesion to the formwork
- The load direction, angle of pull
- Number of load bearing anchors
- The edge distance and spacing of the anchors
- The strength of the concrete when operating, lifting, or transporting
- The embedded depth of the anchor
- Dynamic forces
- The reinforcement arrangement

WEIGHT OF PRECAST UNIT

The total self-weight "F_G" of the precast reinforced concrete element is determined using a specific weight of: **ρ = 25kN/m³.** For prefabricated elements composed of reinforcing elements with a higher concentration, this will be taken into consideration when calculating the weight.



$$F_G = \rho \times V$$

$$V = L \times w \times t$$

Where:

V - volume of precast unit in [m³]
L – length in [m]
w – width in [m]
t – thickness in [m]

ADHESION TO FORMWORK COEFFICIENT

When a precast element is lifted from the formwork, adhesion force between element and formwork develops. This force must be taken into consideration for the calculation of the anchor load and depends on the total area in contact with the formwork, the shape of the precast element and the material of the formwork. The value "F_{adh}" of adhesion to the formwork is calculated using the following equation:

$$F_{adh} = q_{adh} \times A_f \; [kN]$$

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

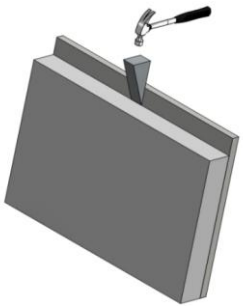
q_{adh} - the adhesion to formwork and form friction factor corresponding to the material of the formwork

A_f - the area of contact between the formwork and the concrete element when starting the lift

Adhesion to the formwork	q_{adh} in kN/m²
Oiled steel formwork, oiled plastic-coated plywood	≥ 1
Varnished timber formwork with panel boards	≥ 2
Rough timber formwork	≥ 3

In some cases, such as **π** - panel or other specially shaped elements, an increased adhesion coefficient must be taken into consideration.

Increased adhesion to the formwork	
π - panels	$F_{adh} = 2 \times F_G \; [kN]$
Ribbed elements	$F_{adh} = 3 \times F_G \; [kN]$
Waffled panel	$F_{adh} = 4 \times F_G \; [kN]$



Adhesion to the formwork should be minimised before lifting the concrete element out of the formwork by removing as many parts of the formwork as possible.

Before lifting from the table, the adhesion to the formwork must be reduced as much as possible by removing the formwork from the concrete element (tilting the formwork table, brief vibration for detachment, using wedges).

DYNAMIC LOADS COEFFICIENT

During lifting and handling of the precast elements, the lifting devices are subject to dynamic actions. The value of the dynamic actions depends on the type of lifting machinery. Dynamic effect shall be considered by the dynamic factor ψ_{dyn}.

Lifting equipment	Dynamic factor ψ_{dyn}
Tower crane, portal crane and mobile crane	1.3 *)
Lifting and moving on flat terrain	2.5
Lifting and moving on rough terrain	≥ 4.0
*) lower values may be appropriate in precast plants if special arrangements are made.	

For special transport and lifting cases, the dynamic factor is established based on the tests or on proven experience.

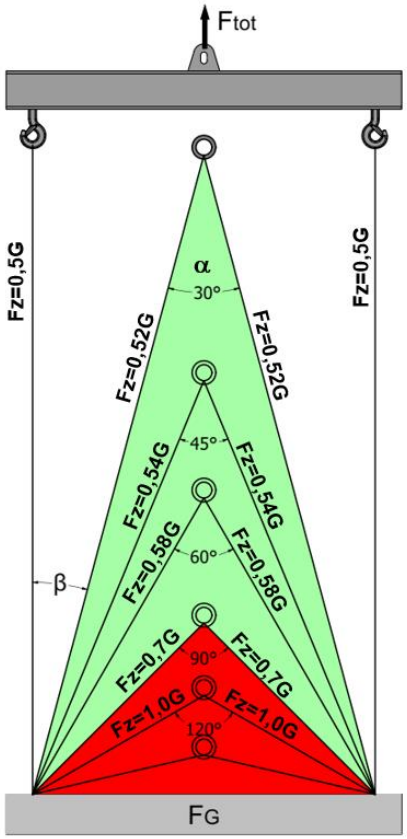
LIFTING OF PRECAST CONCRETE ELEMENT UNDER COMBINED TENSION AND SHEAR LOADING

The load value applied on each anchor depends on the chain inclination, which is defined by the angle β between the normal direction and the lifting chain.
The cable angle β is determined by the length of the suspension chain. We recommend that, if possible, β should be kept to $\beta \leq 30^o$. The tensile force on the anchor will be increased by a cable angle coefficient "**z**".

z = 1/cosβ

$$F = \frac{F_{tot} \times z}{n}$$

Where:
z - cable angle coefficient
n - number of load bearing anchors



Cable angle β	Spread angle a	Cable angle coefficient z
0 °	-	1.00
7.5 °	15 °	1.01
15.0 °	30 °	1.04
22.5 °	45 °	1.08
30.0 °	60 °	1.16
*37.5°	75 °	1.26
*45.0°	90 °	1.41

*** Preferred options ß ≤ 30°**

Note: If no lifting beam is used during transport, the anchor must be installed symmetrical to the load's centre of gravity.
To prevent the prefabricated elements from hanging at an angle when they are moved, the hook in the lifting beam must be directly above the centre of gravity.

ASYMMETRIC DISTRIBUTION OF THE LOAD

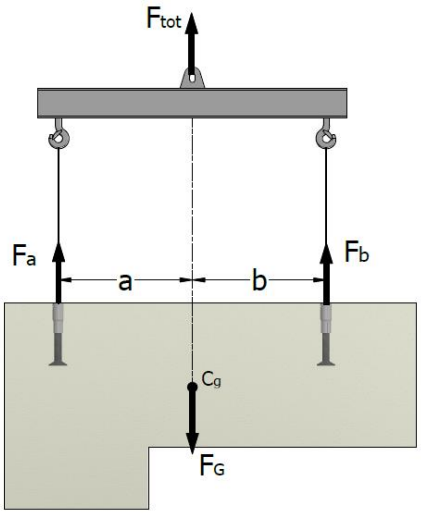
For asymmetrical elements, calculate the loads based on the centre of gravity before installing the anchors.
The load of each anchor depends on the embedded position of the anchor in the precast unit and on the transport mode:

a) If the arrangement of the anchors is asymmetrical in relation to the centre of gravity, the individual anchors support different loads. For the load distribution in asymmetrically installed anchors when a spreader beam is used, the forces on each anchor are calculated using the following equation:

$$F_a = F_{tot} \times \mathbf{b}/(\mathbf{a}+\mathbf{b})$$

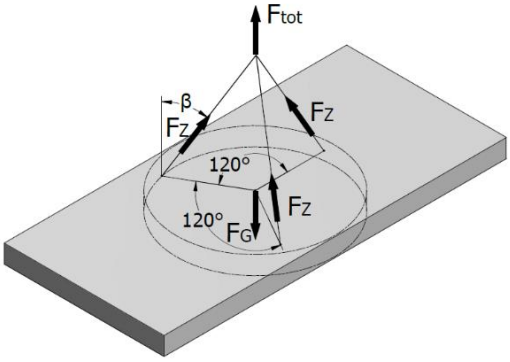
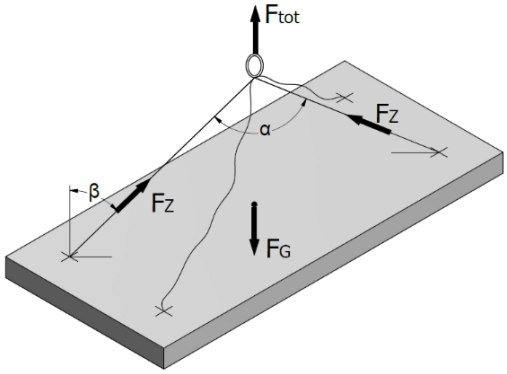
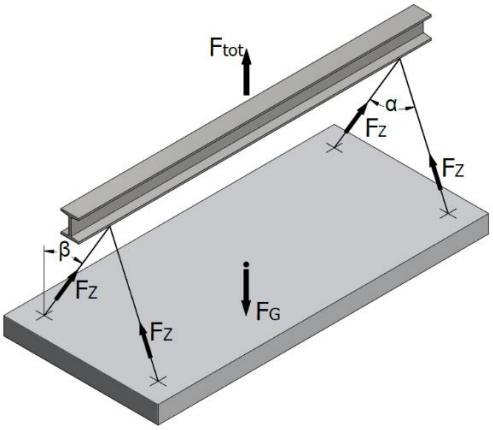
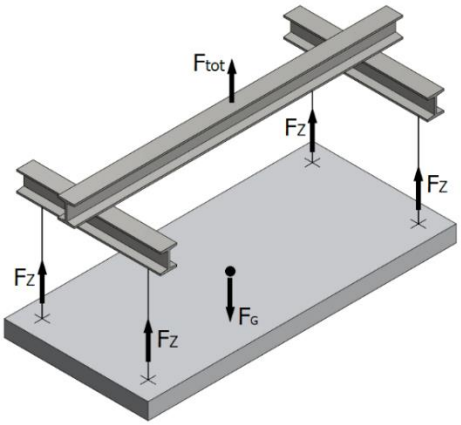
$$F_b = F_{tot} \times \mathbf{a}/(\mathbf{a}+\mathbf{b})$$

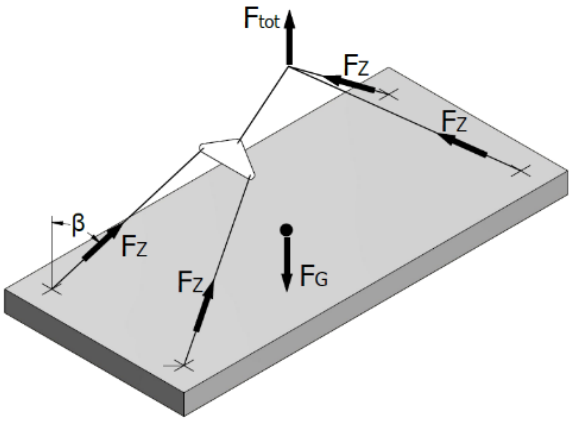
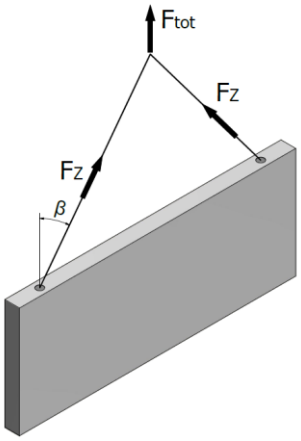
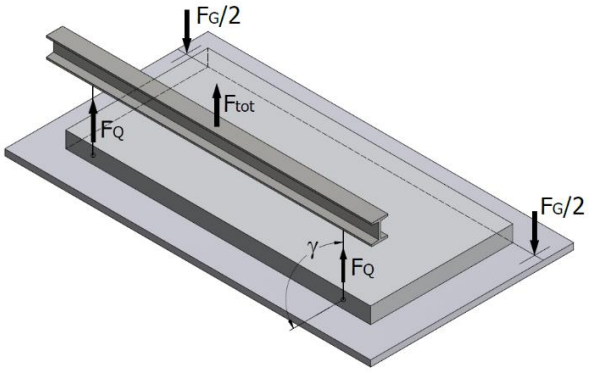
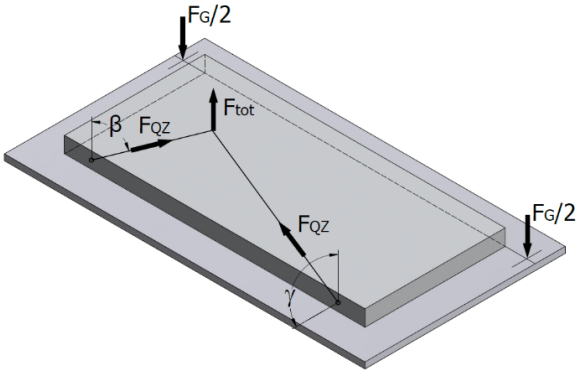
Note: To avoid tilting the element during transport, the load should be suspended from the lifting beam in such a way that its centre of gravity (Cg) is directly under the crane hook.



b) For transporting without a lifting beam, the load on the anchor depends on the cable angle (ß).

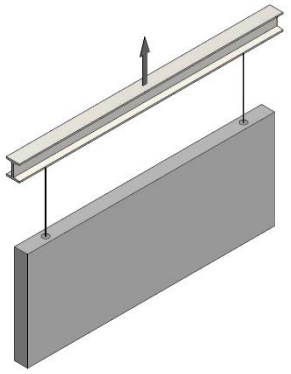
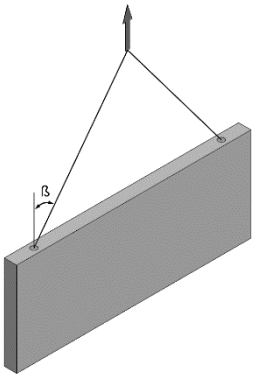
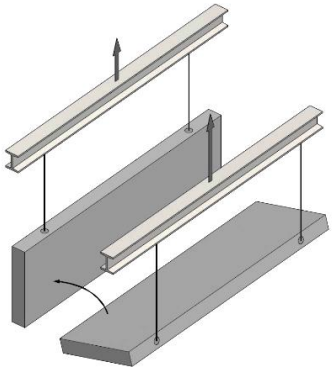
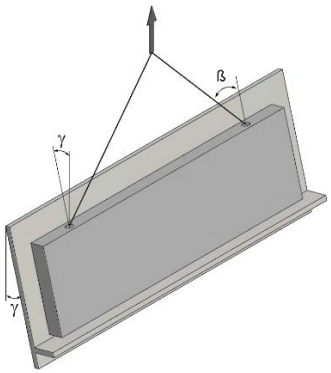
ANCHORS LIFTING CONDITIONS

Using three anchors spaced the same distance apart from each other as in the figure, three load bearing anchors can be assumed. Load bearing anchors: **n=3** **Load type – lifting of formwork.** -shear pull factor $z \geq 1$ -formwork adhesion -no dynamic factor **Load type – transport** -shear pull factor $z \geq 1$ -no formwork adhesion -dynamic factor	
Using four anchors lifted without a spreader beam, only two load bearing anchors can be assumed. The load distribution is randomly based. Load bearing anchors: **n=2** **Load type – lifting of formwork.** -shear pull factor $z \geq 1$ -formwork adhesion -no dynamic factor **Load type – transport** -shear pull factor $z \geq 1$ -no formwork adhesion -dynamic factor	
Perfect force distribution is assumed using a spreader beam. Load bearing anchors: **n=4** **Load type – lifting of formwork.** -shear pull factor $z \geq 1$ -formwork adhesion -no dynamic factor **Load type – transport** -shear pull factor $z \geq 1$ -no formwork adhesion -dynamic factor	
Perfect static weight distribution can be obtained using a lifting beam and two pairs of anchors symmetrically placed. Load bearing anchors: **n=4** **Load type – lifting of formwork.** -shear pull factor $z \geq 1$ -formwork adhesion -no dynamic factor **Load type – transport** -shear pull factor $z \geq 1$ -no formwork adhesion -dynamic factor	

The compensating lifting slings ensure equal force distribution. Load bearing anchors: **n=4** **Load type – lifting of formwork.** -shear pull factor $z \geq 1$ -formwork adhesion -no dynamic factor **Load type – transport** -shear pull factor $z \geq 1$ -no formwork adhesion -dynamic factor	
Lifting of wall elements parallel to the axis of concrete element Load bearing anchors: **n=2** **Load type – transport** -shear pull factor $z \geq 1$ -no formwork adhesion -dynamic factor	
When the element is lifted without a lifting table at a straight angle and contact with the ground is maintained. Additional shear reinforcement is required. Load bearing anchors: **n=2** **Load type – lifting of formwork.** -shear pull factor $z = 1$ -formwork adhesion -no dynamic factor **Load type – transport** -shear pull factor $z = 1$ -no formwork adhesion -dynamic factor	
When the element is lifted without a lifting table at a straight angle and contact with the ground is maintained. Additional shear reinforcement is required. ***ß ≤ 30°*** Load bearing anchors: **n=2** **Load type – lifting of formwork.** -shear pull factor $z \geq 1$ -formwork adhesion -no dynamic factor **Load type – transport** -shear pull factor $z \geq 1$ -no formwork adhesion -dynamic factor	

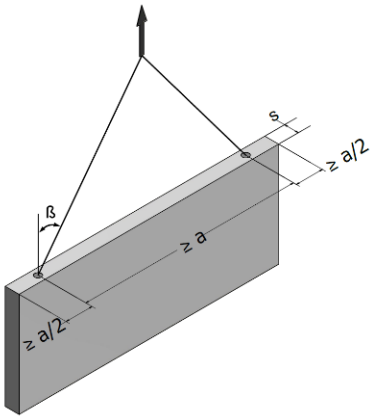
LOAD DIRECTIONS

Various scenarios may occur during transport and lifting, such as tilt-up, rotation, hoisting and, of course, installation. The lifting anchors and clutches must have the capacity for all these cases and combinations of them. Therefore, the load direction is a very important factor for proper anchor selection.

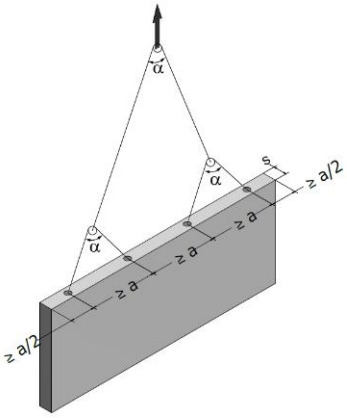
Axial load **ß = 0º to 10º** 	Diagonal load **ß = 10º to 45º** *Note:* ***ß ≤ 30º*** *is recommended* 
Tilting **g = 90 º** ***Additional shear reinforcement steel must be used.*** 	When a tilting table is used, the anchors can be used without additional shear reinforcement steel, not to angle **g < 15 º** 

POSITIONING THE ANCHORS IN WALLS

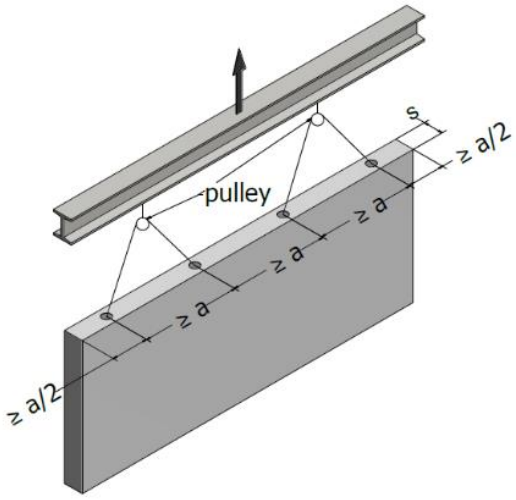
Load bearing anchors:
n=2

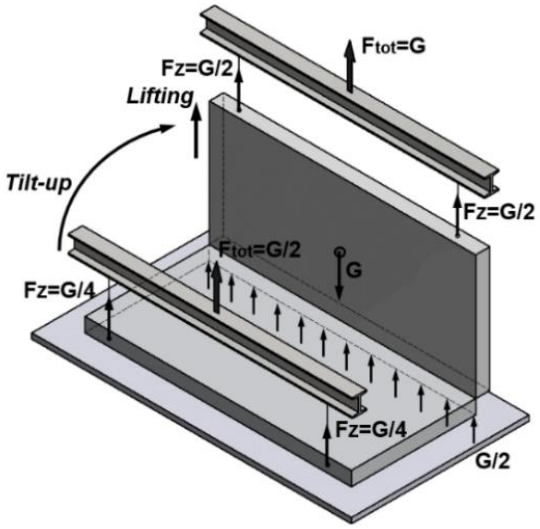


Load bearing anchors:
n=4



Load bearing anchors:
n=4

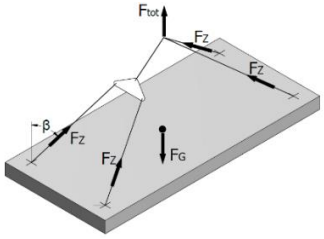
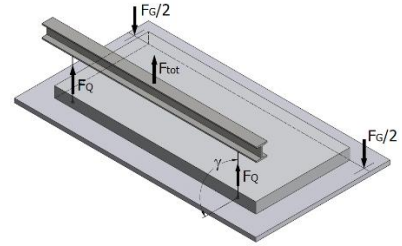
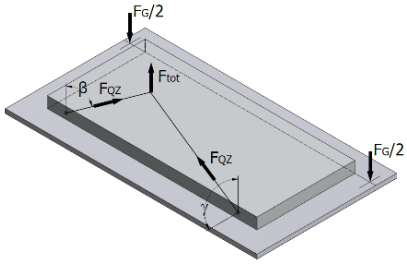
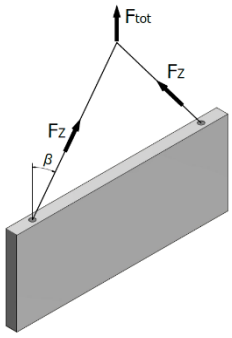




Lifting the walls from horizontal to vertical position without tilt-up table.

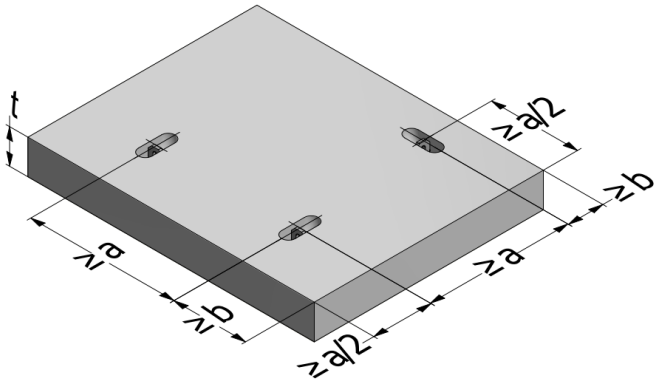
In this case, the anchors are loaded with half of the element weight since half of the element remains in contact with the casting table.

DETERMINATION OF ANCHOR LOAD

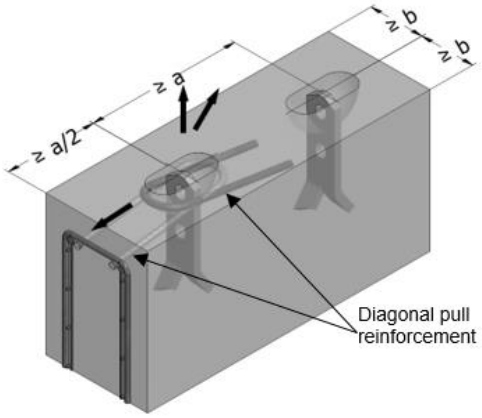
Load type		*Calculation*	*Verification*
Lifting with formwork adhesion		$F_Z = \frac{(F_G + F_{adh}) \times z}{n}$ F_Z – Load acting on the lifting anchor in kN	$F_Z \leq N_{R,adm}$ $N_{R,adm}$ – admissible normal load
Erecting		$F_Q = \frac{(F_G/2) \times \psi_{dyn}}{n}$ F_Q – Shear load acting on the lifting anchor directed perpendicular to the longitudinal axis of the concrete element when lifting from horizontal position with a beam in kN	$F_Q \leq V_{R,adm}$ $V_{R,adm}$– admissible shear load
		$F_{QZ} = \frac{(F_G/2) \times \psi_{dyn} \times z}{n}$ F_{QZ} – Shear load acting on the lifting anchor inclined and perpendicular to the longitudinal axis of the concrete element when lifting from horizontal position with a beam in kN	$F_{QZ} \leq V_{R,adm}$ $V_{R,adm}$– admissible shear load
Transport		$F_Z = \frac{F_G \times \psi_{dyn} \times z}{n}$ F_Z – Load acting on the lifting anchor in kN	$F_Z \leq N_{R,adm}$ $N_{R,adm}$ – admissible normal load

BASIC PRINCIPLES FOR THE ANCHOR SELECTION

Anchors for large surface precast unit

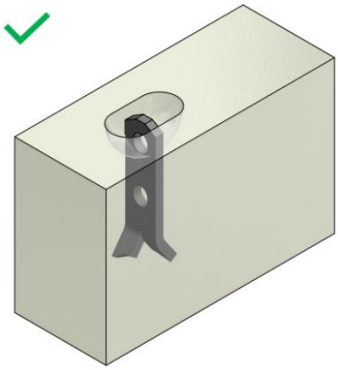


Anchors for thin-walled precast units

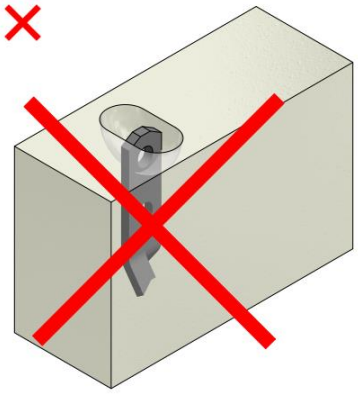


When the load is near the narrow edge, reinforcement for angled pull is necessary.
Design and use of the diagonal reinforcement must comply with EN 1992.

Anchors are for placement in thin-walled elements.
In thin-walled units, such as panels, the anchors may only be installed with the flat steel at right angles to the slab.

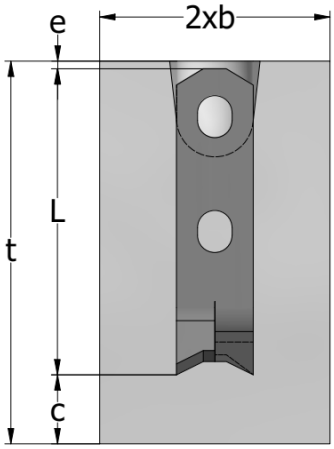


CORRECT INSTALLATION



INCORRECT INSTALLATION

Minimum thickness of the elements



$$t = c + \mathrm{L} + e$$

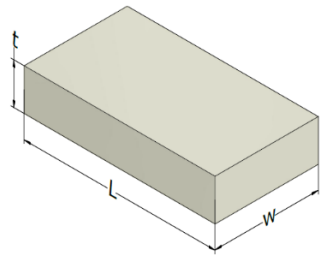
Where:

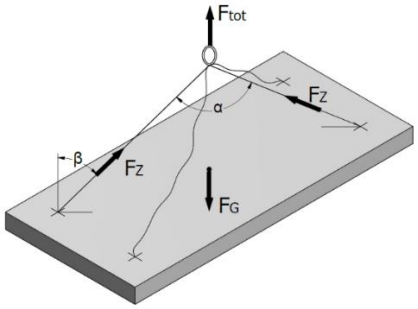
t = minimum thickness of precast unit
L = anchor length
e = cover to anchor head
c = concrete cover according to EN 1992

The length of the anchor depends on the minimum thickness of precast units and must be chosen correctly with respect to the standards.

CALCULATION EXAMPLES

EXAMPLE 1: SLAB UNIT





The slab unit has the following dimensions:
$\boldsymbol{L = 5\ m}$
$\boldsymbol{w = 2\ m}$
$\boldsymbol{t = 0.2\ m}$

Weight $\boldsymbol{F_G = \rho \times V = 25 \times (5 \times 2 \times 0.2) = 50kN}$
Formwork area $\boldsymbol{A_f = L \times w = 5 \times 2 = 10\ m^2}$
Load-bearing anchor $\boldsymbol{n = 2}$

General data:	Symbol	De-mould	Transport	Mount
Concrete strength at de-mould [MPa]		15	15	
Concrete strength on site [MPa]				35
Weight for element [kN]	F_G	50		
Element area in contact with formwork [m²]	A_f	10		
Cable angle factor at de-mould (β = 15.0°)	z	1.04	1.04	
Cable angle factor on site (β = 30.0°)	z			1.16
Dynamic coefficient at transport	ψ_{dyn}		1.3	
Dynamic coefficient on site	ψ_{dyn}			1.3
Adhesion to formwork factor for varnished timber formwork [kN/m²]	q_{adh}	2		
Anchor number for de-mould	n	2		
Anchor number for transport at the plant	n		2	
Anchor number for transport on site	n			2

De-mould at the plant:

Adhesion to formwork factor: q_{adh} = 2 kN/m²
Cable angle factor: z = 1.04 (β = 15.0°)
Concrete strength: 15 MPa

$$\boldsymbol{F_Z = \frac{[(F_G + q_{adh} \times A_f) \times z]}{n} = \frac{[(50 + 2 \times 10) \times 1.04]}{2} = 36.4\ kN = 3.64t}$$

Transport at the plant:

Dynamic coefficient: Ψ_{dyn} = 1.3
Cable angle factor: z = 1.04 (β = 15.0°)
Concrete strength: 15 MPa

$$\boldsymbol{F_Z = \frac{F_G \times \psi_{dyn} \times z}{n} = \frac{50 \times 1.3 \times 1.04}{2} = 33.80\ kN = 3.38t}$$

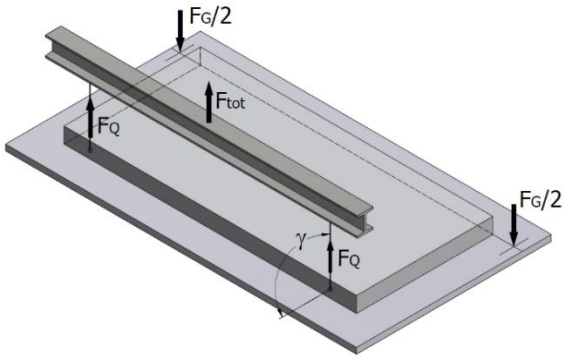
Transport on site:

Dynamic coefficient: Ψ_{dyn} = 1.3
Cable angle factor: z = 1.16 (β = 30.0°)
Concrete strength: 35 MPa

$$\boldsymbol{F_Z = \frac{F_G \times \psi_{dyn} \times z}{n} = \frac{50 \times 1.3 \times 1.16}{2} = 37.70\ kN = 3.77t}$$

An anchor SA-FA in the **4t** range is required.

EXAMPLE 2: WALL PANEL



The slab unit has the following dimensions:
$\boldsymbol{L = 7.5\ m}$
$\boldsymbol{w = 2\ m}$
$\boldsymbol{t = 0.2\ m}$

Weight $\boldsymbol{F_G = \rho \times V = 25 \times (7.5 \times 2 \times 0.2) = 75kN}$
Formwork area $\boldsymbol{A_f = L \times w = 7.5 \times 2 = 15\ m^2}$
Anchor number $\boldsymbol{n = 2}$

General data:	Symbol	De-mould	Tilting	Mount
Concrete strength at de-mould [MPa]		15	15	
Concrete strength on site [MPa]				35
Weight for element [kN]	F_G	75		
Element area in contact with formwork [m²]	A_f	15		
Cable angle factor at de-mould (β = 0,0°)	z	1.0		
Cable angle factor at tilting (β = 0.0°)	z		1.0	
Cable angle factor on site (β = 30°)	z			1.16
Dynamic coefficient at tilting	ψ_{dyn}		1.3	
Dynamic coefficient on site	ψ_{dyn}			1.3
Adhesion factor for oiled steel formwork [kN/m²]	q_{adh}	1.0		
Anchor number for de-mould	n	2		
Anchor number at tilting	n		2	
Anchor number for transport on site	n			2

De-mould / Tilt-up at the plant:

Adhesion to formwork factor: q_{adh} = 1 kN/m²
Cable angle factor: z = 1 (β = 0°)
Concrete strength: 15 MPa

$$\boldsymbol{F_Q = \frac{[(F_G/2 + q_{adh} \times A_f) \times z]}{n} = \frac{[(75/2 + 1 \times 15) \times 1]}{2} = 26.25\ kN = 2.63t}$$

Transport at the plant:

Dynamic coefficient: ψ_{dyn} = 1.3
Cable angle factor: z = 1 (β = 0°)
Concrete strength: 15 MPa

$$\boldsymbol{F_Q = \frac{F_G \times \psi_{dyn} \times z}{n} = \frac{75 \times 1.3 \times 1}{2} = 48.75\ kN = 4.88t}$$

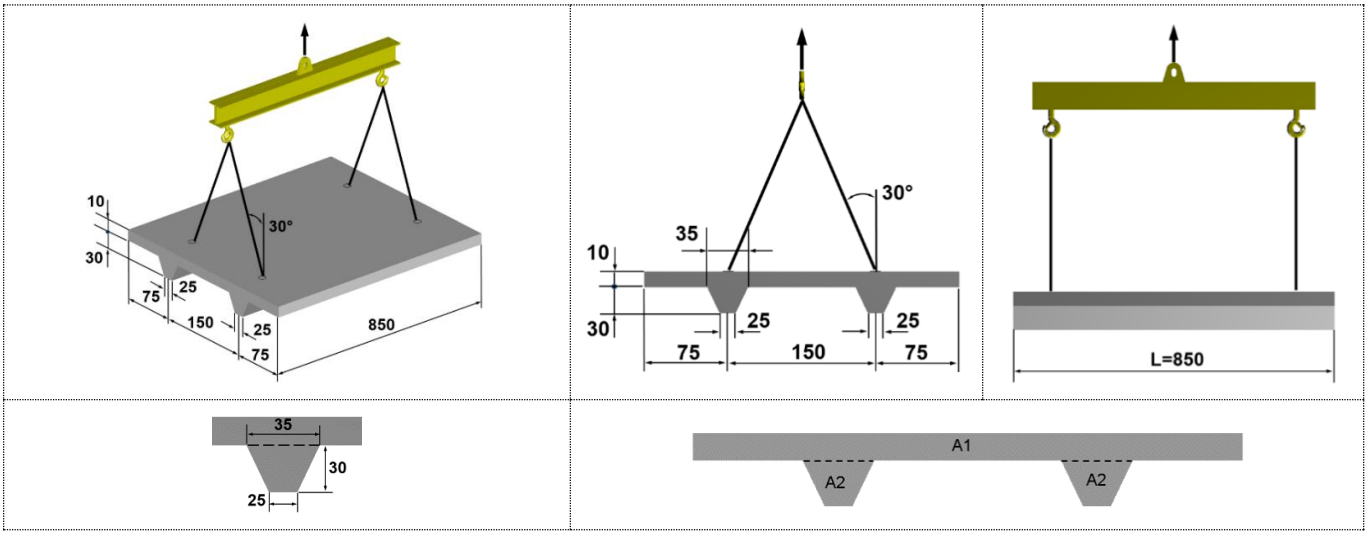
Transport on site:

Dynamic coefficient: ψ_{dyn} = 1.3
Cable angle factor: z = 1.16 (β = 30.0°)
Concrete strength: 35 MPa

$$\boldsymbol{F_Q = \frac{F_G \times \psi_{dyn} \times z}{n} = \frac{75 \times 1.3 \times 1.16}{2} = 56.55\ kN = 5.66\ t}$$

Two anchors embedded on the lateral side, **SA-TTU type in the 7.5 t range** are required. For tilting, additional reinforcement will be added (see page 33).

EXAMPLE 3: DOUBLE-T BEAM



NOTE: Dimensions are in cm

General data:	Symbol	De-mould	Transport
Concrete strength at de-mould and transport [MPa]		25	25
Element weight [kN]	F_G	102	
Formwork area [m²]	A_f	35.8	
Cable angle factor at de-mould (ß = 30.0°)	z	1.16	
Cable angle factor on site (ß = 30.0°)	z		1.16
Dynamic coefficient at transport	ψ_{dyn}		1.3
Anchor number for de-mould and transport	n	4	4

Load capacity when lifting and transporting at the manufacturing plant.

Concrete strength when de-mould	≥ 25 MPa
Cable angle factor	z = 1.16 (ß = 30.0°)
Dynamic coefficient	ψ_{dyn} = 1.3
Anchor number	n = 4

$F_G = V \times \rho = (A \times L) \times \rho = (A1 + A2 \times 2) \times L \times \rho = (0.1 \times 3 + 0.09 \times 2) \times 8.5 \times 25 = 102\ kN$
$L = 8.5\ m$
$A1 = 0.1 \times 3\ (m^2)$
$A2 = \frac{[(0.35 + 0.25) \times 0.3]}{2} = \frac{(0.6 \times 0.3)}{2} = 0.09\ (m^2)$

Weight:	$F_G = 102\ kN$
Adhesion to mould	$F_{adh} = 2 \times F_G = 204\ kN$
Total load	$F_{tot} = F_G + F_{adh} = 102 + 204 = 306\ kN$

Load per anchor when de-mould:

$$\boldsymbol{F = \frac{F_{tot} \times z}{n} = \frac{[(F_G + F_{adh}) \times z]}{n} = \frac{306 \times 1.16}{4} = 88.74\ kN = 8.87t}$$

Load per anchor when transporting:

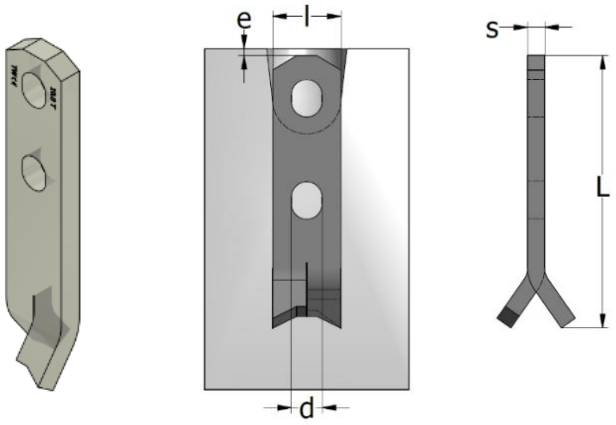
$$\boldsymbol{F = \frac{F_{tot} \times \psi_{dyn} \times z}{n} = \frac{F_G \times \psi_{dyn} \times z}{n} = \frac{102 \times 1.3 \times 1.16}{4} = 38.46\ kN = 3.85t}$$

Four anchors in the 10t range are required (> 8.87 t)

STRIP ANCHORS

SPREAD ANCHOR SA-B

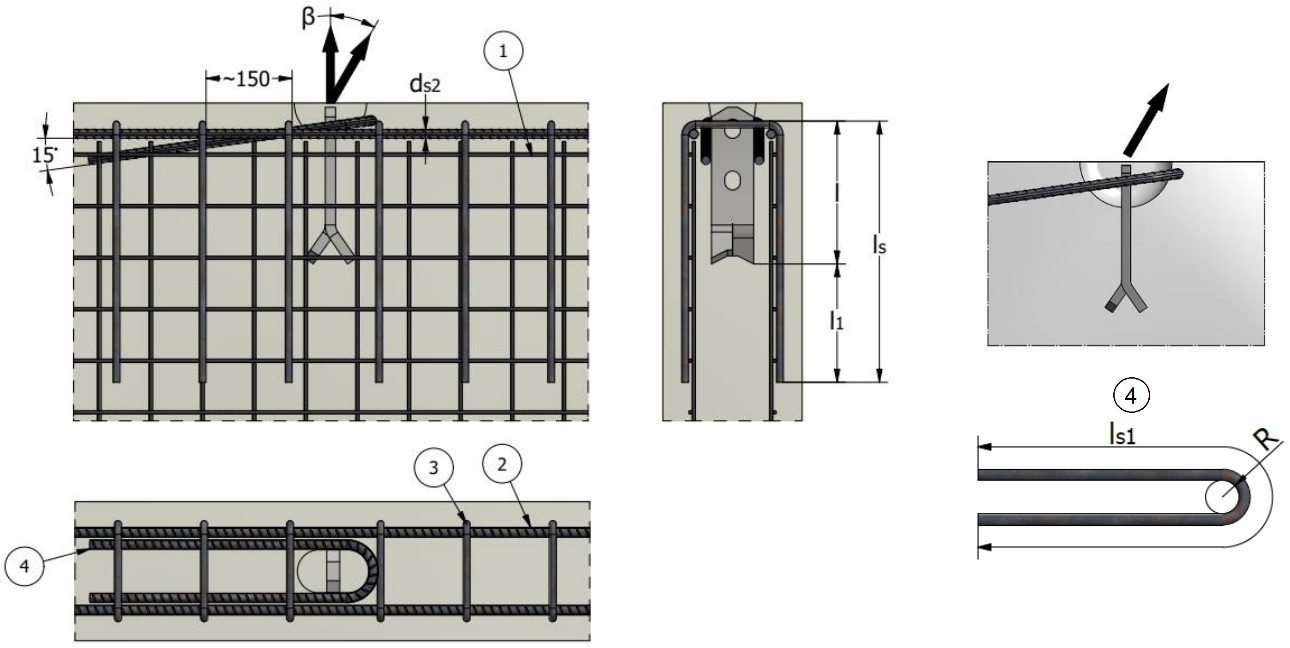
The **"spread anchors" SA-B** are designed for load range 0.7 t to 22 t. They are easily adaptable and provide an efficient anchorage for thin panels as well as for large slabs or other precast elements. The anchor is designed with a hole for extra reinforcement steel.



Spread anchor SA-B - Dimensions

Anchor Type	Product number		L	l	s	d	Load range	e
	Black	Hot dip galvanized	[mm]	[mm]	[mm]	[mm]	[t]	[mm]
Lifting clutch load group 2.5 t								
SA -B 0.7 t – 110	44991	45022	110	30	5	14	0.7	10
SA -B 1.4 t – 110	44992	45023	110	30	6	14	1.4	
SA -B 1.4 t – 160	44993	45024	160	30	6	14	1.4	
SA -B 2.0 t – 130	44994	45025	130	30	8	14	2.0	
SA -B 2.0 t – 160	44995	45026	160	30	8	14	2.0	
SA -B 2.0 t – 210	44996	45027	210	30	8	14	2.0	
SA -B 2.0 t – 250	61482	61483	250	30	8	14	2.0	
SA -B 2.5 t – 150	44997	45028	150	30	10	14	2.5	
SA -B 2.5 t – 200	44998	45029	200	30	10	14	2.5	
SA -B 2.5 t – 250	44999	45030	250	30	10	14	2.5	
Lifting clutch load group 5 t								
SA -B 3.0 t – 160	45000	45031	160	40	10	18	3.0	10
SA -B 3.0 t – 220	45001	45032	220	40	10	18	3.0	
SA -B 3.0 t – 280	45002	45033	280	40	10	18	3.0	
SA -B 4.0 t – 180	45003	45034	180	40	12	18	4.0	
SA -B 4.0 t – 215	64541	64542	215	40	12	18	4.0	
SA -B 4.0 t – 240	45004	45035	240	40	12	18	4.0	
SA -B 4.0 t – 320	45005	45036	320	40	12	18	4.0	
SA -B 5.0 t – 180	45006	45037	180	40	15	18	5.0	
SA -B 5.0 t – 240	45007	45038	240	40	15	18	5.0	
SA -B 5.0 t – 265	64543	64544	265	40	15	18	5.0	
SA -B 5.0 t – 400	45008	45039	400	40	15	18	5.0	
Lifting clutch load group 10 t								
SA -B 5.3 t – 220	45009	45040	220	60	12	26	5.3	15
SA -B 5.3 t – 260	45010	45041	260	60	12	26	5.3	
SA -B 5.3 t – 340	45011	45042	340	60	12	26	5.3	
SA -B 7.5 t – 260	45012	45043	260	60	15	26	7.5	
SA -B 7.5 t – 300	45013	45044	300	60	15	26	7.5	
SA -B 7.5 t – 340	64545	64546	340	60	15	26	7.5	
SA -B 7.5 t – 420	45014	45045	420	60	15	26	7.5	
SA -B 10.0 t – 300	45015	45046	300	60	20	26	10	
SA -B 10.0 t – 370	45016	45047	370	60	20	26	10	
SA -B 10.0 t – 435	64547	64548	435	60	20	26	10	
SA -B 10.0 t – 520	45017	45048	520	60	20	26	10	
Lifting clutch load group 26 t								
SA -B 14.0 t – 370	45018	45049	370	80	20	35	14	15
SA -B 14.0 t – 460	45019	45050	460	80	20	35	14	
SA -B 22.0 t – 500	45020	45051	500	90	25	35	22	
SA -B 22.0 t – 620	45021	45052	620	90	25	35	22	

SPREAD ANCHOR SA-B - INSTALLATION AND REINFORCEMENT IN THIN WALL PRECAST CONCRETE ELEMENTS



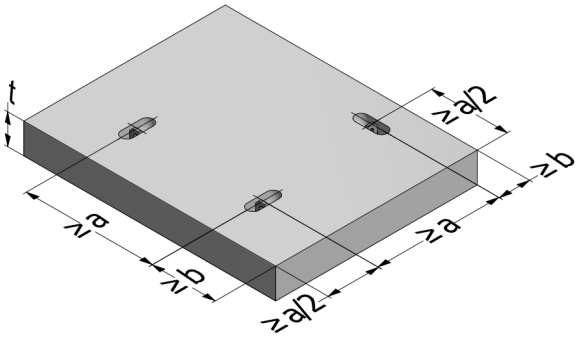
Note: *Always place the diagonal pull reinforcement opposite to the direction of the load.*
The bend radius according to EN 1992-1-1 is not mandatory for diagonal reinforcement.
The diagonal reinforcement must be placed as close as possible to the recess former and installed in contact with the lifting anchor.
The reinforced zone must be $\geq 3 \times$ anchor lenght "L".
Length $l_s = l_1$ ***+Anchor length***
The dimensions in the illustrations are in [mm]

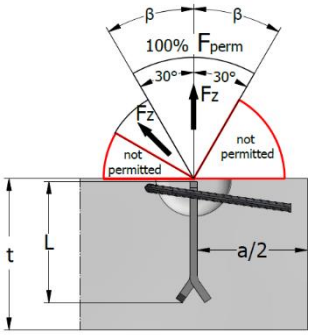
Spread Anchor SA-B - Reinforcement in thin wall precast element							
Anchor Type	Load range	Pull $\beta < 30°$	Edge reinforcement	Diagonal pull $30° < \beta \leq 45°$			
		Mesh reinforcement (both sides) ①	②	Stirrups ③			Diagonal pull reinforcement Ø x l_{s1} ④
				Ø	l_1	Number of stirrups	
	[t]	[mm²/m]	d_{s1} [mm]	[mm]	[mm]	[pcs.]	[mm]
Lifting clutch load group 2.5 t							
SA -B 0.7 t	0.7	2x131	Ø 8	Ø 6	400	4	Ø 6 x 900
SA -B 1.4 t	1.4		Ø 8	Ø 6	400	4	Ø 6 x 900
SA -B 2.0 t	2.0		Ø 8	Ø 6	500	4	Ø 8 x 1000
SA -B 2.5 t	2.5		Ø 10	Ø 8	600	4	Ø 8 x 1200
Lifting clutch load group 5 t							
SA -B 3.0 t	3.0	2x131	Ø 10	Ø 8	700	4	Ø10 x 1150
SA -B 4.0 t	4.0		Ø 12	Ø 8	800	4	Ø10 x 1500
SA -B 5.0 t	5.0		Ø 12	Ø10	800	4	Ø12 x 1550
Lifting clutch load group 10 t							
SA -B 5.3 t	5.3	2x188	Ø 12	Ø10	800	4	Ø14 x 1800
SA -B 7.5 t	7.5		Ø 12	Ø10	800	4	Ø14 x 2000
SA -B 10.0 t	10.0		Ø 14	Ø10	1000	6	Ø16 x 2300
Lifting clutch load group 26 t							
SA -B 14.0 t	14.0	2x377	Ø 14	Ø10	1000	8	Ø20 x 2600
SA -B 22.0 t	22.0		Ø 16	Ø10	1200	8	Ø28 x 3450

SPREAD ANCHOR SA-B - INSTALLATION IN SLABS

For the lifting procedure, the position of the anchor in the concrete element is very important. The axial spacing for SA-B anchors in slabs can be seen in the table below.

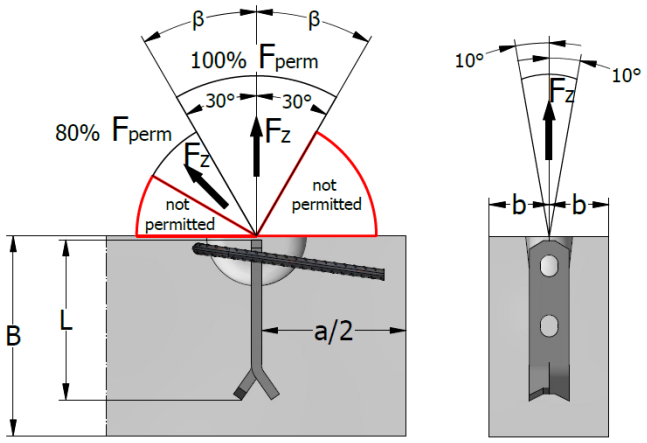
Note: *The minimum accepted concrete cover is 25 mm. A thinner slab can only be permitted if there is special corrosion protection.*
For diagonal reinforcement dimensions, please see page 24.

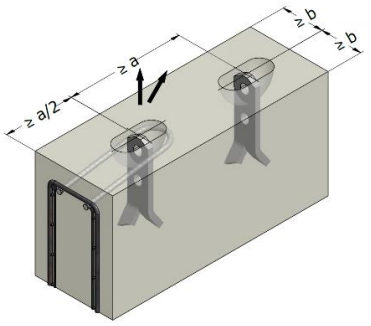




Spread Anchor SA-B in slabs – Load capacity, installation dimensions									
Anchor Type	Anchor length	Load range	Minimum thickness of precast unit	Minimum edge distance „b"			Load capacity f_{cu}≥ 15 MPa		Minimum spacing between anchors
	„L"		„t"	f_{cu} ≥ 15 MPa	f_{cu} ≥ 25 MPa	f_{cu} ≥ 35 MPa	Axial pull 100 % F_{perm} $\beta < 30°$	Diagonal pull 80 % F_{perm} $30° < \beta \leq 45°$	"a"
	[mm]	[t]	[mm]	[mm]	[mm]	[mm]	[kN]	[kN]	[mm]
Lifting clutch load group 2.5 t									
SA -B 0.7 t – 110	110	0.7	145	45	40	35	7	5.6	280
SA -B 1.4 t – 110	110	1.4	145	70	50	40	14	11.2	380
SA -B 1.4 t – 160	160	2.0	195	50	40	35	14	11.2	540
SA -B 2.0 t – 130	130	2.0	165	100	70	55	20	16.0	440
SA -B 2.0 t – 160	160	2.0	195	85	65	45	20	16.0	520
SA -B 2.0 t – 210	210	2.0	245	70	55	45	20	16.0	770
SA -B 2.0 t – 250	250	2.0	285	70	55	45	20	16.0	900
SA -B 2.5 t – 150	150	2.5	185	120	85	70	25	20.0	530
SA -B 2.5 t – 200	200	2.5	235	90	65	50	25	20.0	720
SA -B 2.5 t – 250	250	2.5	285	75	60	50	25	20.0	920
Lifting clutch load group 5.0 t									
SA -B 3.0 t – 160	160	3.0	195	145	100	80	30	24.0	550
SA -B 3.0 t – 220	220	3.0	255	110	80	60	30	24.0	750
SA -B 3.0 t – 280	280	3.0	315	105	75	55	30	24.0	950
SA -B 4.0 t – 180	180	4.0	215	190	135	105	40	32.0	610
SA -B 4.0 t – 215	215	4.0	250	165	120	90	40	32.0	750
SA -B 4.0 t – 240	240	4.0	275	145	100	80	40	32.0	850
SA -B 4.0 t – 320	320	4.0	355	110	75	65	40	32.0	1170
SA -B 5.0 t – 180	180	5.0	215	260	180	145	50	40.0	600
SA -B 5.0 t – 240	240	5.0	275	195	140	110	50	40.0	840
SA -B 5.0 t – 265	265	5.0	300	180	130	100	50	40.0	920
SA -B 5.0 t – 400	400	5.0	435	115	85	75	50	40.0	1480
Lifting clutch load group 10.0 t									
SA -B 5.3 t – 220	220	5.3	260	240	175	155	53	42.4	660
SA -B 5.3 t – 260	260	5.3	300	200	145	135	53	42.4	780
SA -B 5.3 t – 340	340	5.3	380	170	120	110	53	42.4	1020
SA -B 7.5 t – 260	260	7.5	300	300	215	175	75	60.0	900
SA -B 7.5 t – 300	300	7.5	340	265	190	150	75	60.0	1060
SA -B 7.5 t – 340	380	7.5	380	240	170	140	75	60.0	1170
SA -B 7.5 t – 420	420	7.5	460	190	135	110	75	60.0	1540
SA -B 10.0 t – 300	300	10.0	340	390	275	220	100	80.0	1030
SA -B 10.0 t – 370	370	10.0	410	315	225	180	100	80.0	1310
SA -B 10.0 t – 520	520	10.0	560	225	160	130	100	80.0	1910
Lifting clutch load group 26.0 t									
SA -B 14.0 t – 370	370	14.0	410	500	355	285	140	112.0	1230
SA -B 14.0 t – 460	460	14.0	500	400	285	230	140	112.0	1590
SA -B 22.0 t – 500	500	22.0	540	675	480	385	220	176.0	1700
SA -B 22.0 t – 620	620	22.0	660	540	385	310	220	176.0	2180

INSTALLATION OF SA-B IN BEAMS AND WALLS – NO SPECIAL REINFORCEMENT REQUIREMENTS





The diagonal pull reinforcement must be mounted opposite the direction of the load. *For diagonal reinforcement dimensions, please see page 24.*
The diagonal reinforcement must be placed as close as possible to the recess former and installed in contact with the lifting anchor

- ***Angled pull of 30° ≤ β ≤ 45° with no angled pull reinforcement is only permitted for:***
- *f_{cu} ≥ 15 MPa and 3 times minimum wall thickness*
- *f_{cu} ≥ 25 MPa and 2.5 times minimum wall thickness*
- *f_{cu} ≥ 35 MPa and 2 times minimum wall thickness*

- ***Angled pull with cable/chain spread of β > 45° is not permitted***

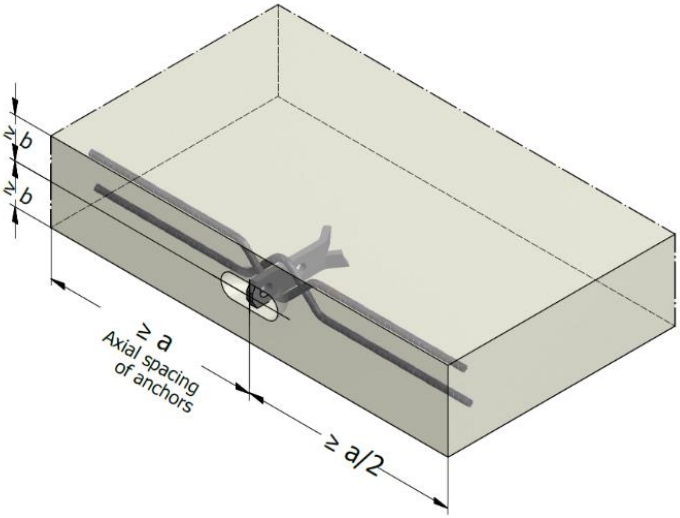
Spread anchor SA-B in beams and walls without special reinforcements – Load capacity, installation dimensions

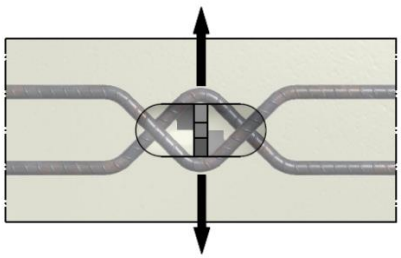
Product Name	Anchor length	Load range	Minimum height of beams	Wall thickness	Load capacity				Spacing between anchors
					Axial pull β < 30°	Diagonal pull 30° < β ≤ 45°	Axial pull and diagonal pull 30° < β ≤ 45°		
	„L"		"B"	"2 × b"	f_{cu} ≥ 15 MPa	f_{cu} ≥ 15 MPa	f_{cu} ≥ 25 MPa	f_{cu} ≥ 35 MPa	"a"
	[mm]	[t]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]	[mm]
Lifting clutch load group 2.5 t									
SA -B 0.7 t – 110	110	0.7	240	70	7	5.6	7	7	280
SA -B 1.4 t – 110	110	1.4	240	80	10.3	8.2	13.4	14	375
				100	11.8	9.4	14		
				120	13.3	10.6			
SA -B 1.4 t – 160	160	1.4	340	70	14	11.2	14	14	540
				80	14	11.2			
				100	14	11.2			
SA -B 2.0 t – 130	130	2.0	280	100	14	11.2	18.1	20	440
				120	15.6	12.5	20		
				150	18.1	14.5			
SA -B 2.0 t – 160	160	2.0	340	80	16	12.8	20	20	520
				100	17.6	14.1			
				120	19.3	15.4			
SA -B 2.0 t – 210	210	2.0	440	80	17.1	13.7	20	20	770
				100	18.5	14.8			
				120	19.9	15.9			
SA -B 2.0 t – 250	250	2.0	520	80	16.5	13.2	20	20	900
				100	17.6	14.1			
				120	18.8	15			
SA -B 2.5 t – 150	150	2.5	320	120	18	14.4	23.3	25	520
				150	20.7	16.6	20		
				180	23.5	18.8			
SA -B 2.5 t – 200	200	2.5	420	100	22.9	18.3	25	25	720
				120	24.7	19.8			
				150	25	20			
SA -B 2.5 t – 250	250	2.5	520	100	21.9	17.5	25	25	920
				120	23.4	18.7			
				140	24.9	19.9			

Spread anchor SA-B in beams and walls without special reinforcements – Load capacity, installation dimensions									
Product Name	Anchor length	Load range	Minimum height of beams	Wall thickness	Load capacity				Spacing between anchors
					Axial pull $\beta < 30°$	Diagonal pull $30° < \beta \leq 45°$	Axial pull and diagonal pull $30° < \beta \leq 45°$		
	„L"		"B"	"2 × b"	$f_{cu} \geq 15$ MPa	$f_{cu} \geq 15$ MPa	$f_{cu} \geq 25$ MPa	$f_{cu} \geq 35$ MPa	"a"
	[mm]	[t]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]	[mm]
Lifting clutch load group 5.0 t									
SA -B 3.0 t – 160	160	3.0	340	150	22	17.6	28.4	30	550
				200	26.9	21.5	30		
				240	30	24			
SA -B 3.0 t – 220	220	3.0	450	120	27.6	22.1	30	30	750
				150	30	24			
				200	30	24			
SA -B 3.0 t – 280	280	3.0	580	100	27.5	22	30	30	950
				120	29.9	23.9			
				150	30	24			
SA -B 4.0 t – 180	180	4.0	380	180	27.7	22.2	35.8	40	610
				240	34.2	27.4	40		
				300	36.5	29.2			
SA -B 4.0 t – 215	215	4.0	450	180	32.9	26.3	40	40	720
				240	39.6	31.7			
				300	40	32			
SA -B 4.0 t – 240	240	4.0	500	150	33.6	26.9	40	40	850
				180	36.8	29.4			
				200	39	31.2			
SA -B 4.0 t – 320	320	4.0	660	120	36.2	28.9	40	40	1170
				150	39	31.2			
				180	40	32			
SA -B 5.0 t – 180	180	5.0	380	240	34.2	27.4	44.1	50	600
				300	36.5	29.2	50		
				400	36.5	29.2			
SA -B 5.0 t – 240	240	5.0	500	200	39	31.2	50	50	840
				240	43.7	34.9			
				300	50	40			
SA -B 5.0 t – 265	265	5.0	550	200	43.1	34.5	50	50	920
				240	47.9	38.2			
				300	50	40			
SA -B 5.0 t – 400	400	5.0	820	150	41.9	33.5	50	50	1480
				180	44.5	35.6			
				200	46.3	37			
Lifting clutch load group 10.0 t									
SA -B 5.3 t – 220	220	5.3	460	200	35.8	28.6	46.3	53	710
				240	40.4	32.3	52.2		
				300	47.9	38.3	53		
SA -B 5.3 t – 260	260	5.3	540	200	42.3	33.8	53	53	835
				240	47.1	37.7			
				300	53	42.4			
SA -B 5.3 t – 340	340	5.3	700	150	50.2	40.2	53	53	1080
				180	53	42.4			
				200	53	42.4			
SA -B 7.5 t – 260	260	7.5	550	300	54.7	43.8	70.7	75	900
				400	63.4	50.7	75		
				500	63.4	50.7			
SA -B 7.5 t – 300	300	7.5	630	250	55.4	44.3	71.5	75	1060
				300	62	49.6	75		
				400	75	60			
SA -B 7.5 t – 340	380	7.5	790	250	62.8	50.24	75	75	1280
				300	69.6	55.7			
				400	75	60			
SA -B 7.5 t – 420	420	7.5	870	180	65.7	52.6	75	75	1540
				240	73.5	58.8			
				300	75	60			
SA -B 10.0 t – 300	300	10.0	630	400	76.5	61.2	98.7	100	1030

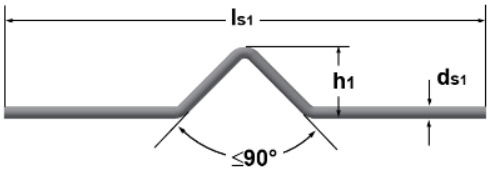
Spread anchor SA-B in beams and walls without special reinforcements – Load capacity, installation dimensions									
Product Name	Anchor length	Load range	Minimum height of beams	Wall thickness	Load capacity				Spacing between anchors
					Axial pull $\beta < 30°$	Diagonal pull $30° < \beta \leq 45°$	Axial pull and diagonal pull $30° < \beta \leq 45°$		
	„L"		"B"	"2 × b"	$f_{cu} \geq 15$ MPa	$f_{cu} \geq 15$ MPa	$f_{cu} \geq 25$ MPa	$f_{cu} \geq 35$ MPa	"a"
	[mm]	[t]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]	[mm]
				500	78.6	62.9	100		
				600	78.6	62.9			
SA -B 10.0 t – 370	370	10.0	770	300	75.5	60.4	100	100	1310
				400	90.6	72.5			
				500	100	80			
SA -B 10.0 t – 520	520	10.0	1070	240	71.4	57.1	100	100	1910
				300	78.1	62.4			
				400	89.9	71.9			
Lifting clutch load group 26.0 t									
SA -B 14.0 t – 370	370	14.0	770	500	107.1	85.7	138.3	140	1230
				600	107.7	86.2	140		
				750	107.7	86.2			
SA -B 14.0 t – 460	460	14.0	950	400	110.1	88.1	140	140	1590
				500	127.3	101.8			
				600	140	112			
SA -B 22.0 t – 500	500	22.0	1030	600	155.4	124.3	200.7	220	1700
				800	169.1	135.3	220		
				1000	169.1	135.3			
SA -B 22.0 t – 620	620	22.0	1270	500	148.4	118.7	215.2	220	2180
				600	165.8	132.6	220		
				800	203.5	162.8			

SPREAD ANCHOR SA-B - INSTALLATION AND REINFORCEMENT FOR TILTING AND TURNING

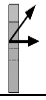
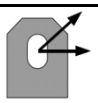




①

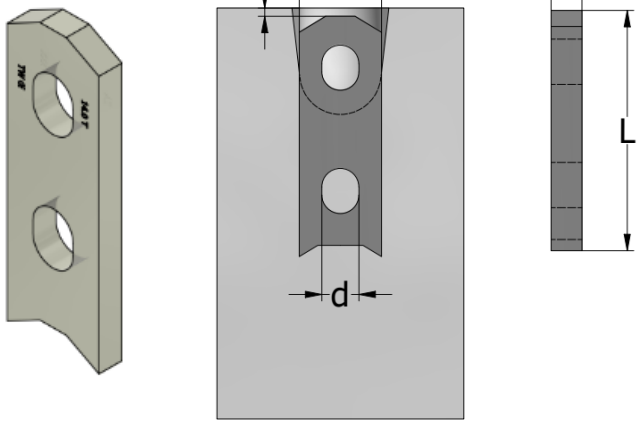


Note: *The bend radius and length l_s will be determined according to EN 1992-1-1.*
The additional reinforcement and the anchor position will be as in the illustration above.
The h1 dimension will be determined in function of the thickness of the element.
Other required reinforcement – minimum standard reinforcement.

Spread anchor SA-B – Load capacities, installation dimensions and reinforcement for tilting and turning								
Anchor Type	Load range	$f_{cu} \geq 15$ MPa			Tilting and turning reinforcement ①		$f_{cu} \geq 15$ MPa	
		Axial pull 100 % F_{perm} $\beta < 30°$	Diagonal pull 80 % F_{perm} $30° < \beta \leq 45°$	Tilting 50 % F_{perm}			Axial spacing between anchors	Minimum edge distance
					ds_1	ls_1	"a"	"b"
	[t]	[kN]	[kN]	[kN]	[mm]	[mm]	[mm]	[mm]
Lifting clutch load group 2.5 t								
SA -B 0.7 t – 110	0.7	7	5.6	3.5	Ø 8	600	700	100
SA -B 1.4 t – 160	1.4	14	11.2	7	Ø 10	700	700	100
SA -B 2.0 t – 210	2.0	20	16	10	Ø 10	750	800	100
SA -B 2.5 t – 250	2.5	25	20	12.5	Ø 12	800	875	100
Lifting clutch load group 5.0 t								
SA -B 3.0 t – 280	3.0	30	24	15	Ø 12	850	950	150
SA -B 4.0 t – 320	4.0	40	32	20	Ø 14	950	1050	150
SA -B 5.0 t – 400	5.0	50	40	25	Ø 16	1000	1435	150
Lifting clutch load group 10.0 t								
SA -B 5.3 t – 340	5.3	53	42.4	26.5	Ø 16	1000	1200	150
SA -B 7.5 t – 420	7.5	75	60	37.5	Ø 20	1200	1470	250
SA -B 10.0 t – 520	10.0	100	80	50	Ø 20	1500	1820	300
Lifting clutch load group 26.0 t								
SA -B 14.0 t – 460	14.0	140	112	70	Ø 25	1800	1800	525
SA -B 22.0 t – 620	22.0	220	176	110	Ø 28	1800	2200	710

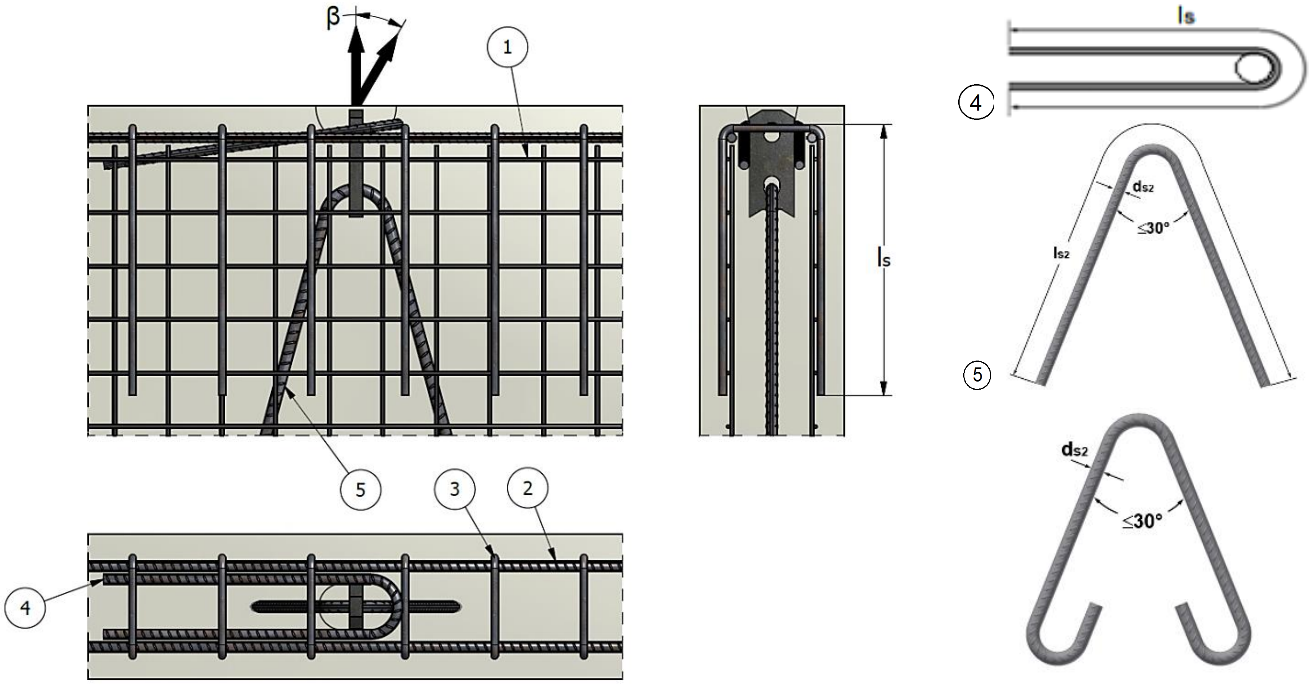
STRIP ANCHOR SA - ST

The **SA - ST anchors** are designed for load range 0.7t to 26t. This type of anchor is used for prestressed trusses, thin walls, and low strength concrete. The anchorage in concrete is achieved using an additional reinforcement bar, which must be mounted in the second hole from the lower part of the anchor.



Strip Anchor SA-ST – Dimensions								
Anchor Type	Product number		L	l	s	d	Load range	e
	Black	Hot dip galvanized	[mm]	[mm]	[mm]	[mm]	[t]	[mm]
Lifting clutch load group 2.5 t								
SA -ST 0.7 t – 90	45053	45066	90	30	5	14	0.7	10
SA -ST 1.4 t – 90	45054	45067	90	30	6	14	1.4	
SA -ST 2.0 t – 90	45055	45068	90	30	8	16	2.0	
SA -ST 2.5 t – 90	45056	45069	90	30	10	16	2.5	
Lifting clutch load group 5.0 t								
SA -ST 3.0 t – 120	45057	45070	120	40	10	18	3.0	10
SA -ST 4.0 t – 120	45058	45071	120	40	12	20	4.0	
SA -ST 5.0 t – 120	45059	45072	120	40	15	20	5.0	
Lifting clutch load group 10 t								
SA -ST 5.3 t – 160	45060	45073	160	60	12	26	5.3	15
SA -ST 7.5 t – 160	45061	45074	160	60	15	26	7.5	
SA -ST 10.0 t – 170	45062	45075	170	60	20	30	10	
Lifting clutch load group 26 t								
SA -ST 14.0 t – 240	45063	45076	240	80	20	35	14	15
SA -ST 22.0 t – 300	45064	45077	300	90	25	35	22	
SA -ST 26.0 t – 300	45065	45078	300	120	30	65	26	

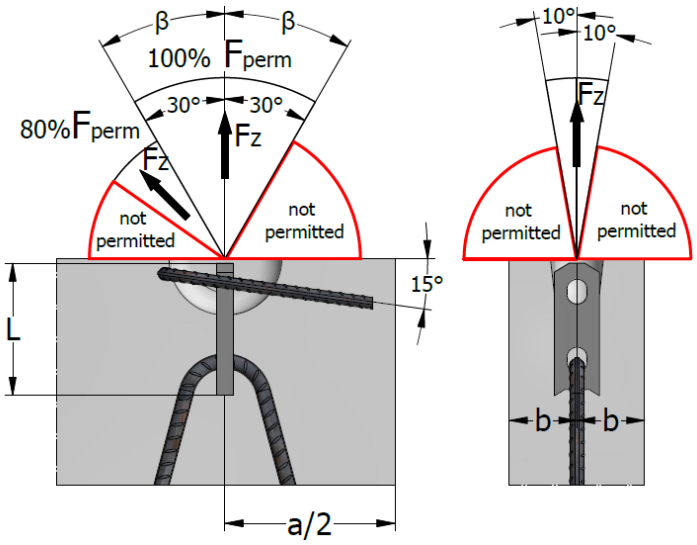
STRIP ANCHOR SA-ST - INSTALLATION AND REINFORCEMENT

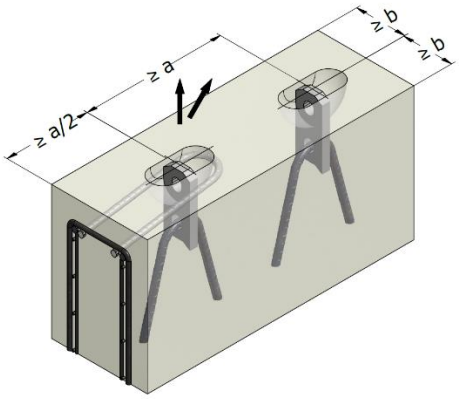


Note: *Always place diagonal pull reinforcement opposite to the direction of the load.*
The bend radius according to EN 1992-1-1 is not mandatory for diagonal reinforcement.
The diagonal reinforcement must be placed as close as possible to the recess former and installed in contact with the lifting anchor.
The reinforced zone must be $\geq 3 \times$ anchor lenght "L".
Length for stirrups $l_s = l_1$ *+Anchor length*
For concrete strength $\mathbf{f_{cu} \geq 25\ MPa}$, the length $\mathbf{l_{s2}}$ of the reinforcement bar can be reduced by 20% in relation to the permissible bond stress.
Angled pull using cable or chain with $\beta > 45°$ *is* ***not permitted***.

Strip Anchor SA-B – Installation and reinforcement										
Anchor Type	Load range	Mesh reinforce-ment (both sides) ①	Axial pull β < 30°			Diagonal pull 30° < β ≤ 45°				Additional reinforcement for lifting d_{s2} x l_{s2} ⑤
			Edge reinforce-ment ②	Stirrups ③		Edge reinforce ment ②	Stirrups ③		Diagonal pull reinforcement Ø x l_s ④	
				Ø x l_1	No. of stirrups		Ø x l_1	No. of stirrups		
	[t]	[mm²/m]	d_{s1} [mm]	[mm]	[pcs.]	d_{s1} [mm]	[mm]	[pcs.]	[mm]	[mm]
Lifting clutch load group 2.5 t										
SA -ST 0.7 t-90	0.7	2x131	Constructi-ve	Ø 6 x 400	2	Ø 8	Ø 6 x 400	4	Ø 6 x 900	Ø 10 x 650
SA -ST 1.4 t-90	1.4			Ø 6 x 400	2	Ø 8	Ø 6 x 400	4	Ø 6 x 900	Ø 10 x 650
SA -ST 2.0 t-90	2.0			Ø 6 x 500	2	Ø 8	Ø 6 x 500	4	Ø 8 x 1000	Ø 12 x 800
SA -ST 2.5 t-90	2.5			Ø 8 x 600	2	Ø 10	Ø 8 x 600	4	Ø 8 x 1200	Ø 12 x 1000
Lifting clutch load group 5.0 t										
SA -ST 3.0 t-120	3.0	2x131	Constructi-ve	Ø 8 x 700	2	Ø 10	Ø 8 x 700	4	Ø10 x 1150	Ø14 x 1000
SA -ST 4.0 t-120	4.0			Ø 8 x 800	2	Ø 12	Ø 8 x 800	4	Ø10 x 1500	Ø16 x 1200
SA -ST 5.0 t-120	5.0			Ø10 x 800	2	Ø 12	Ø10 x 800	4	Ø12 x 1550	Ø16 x 1500
Lifting clutch load group 10.0 t										
SA -ST 5.3 t-160	5.3	2x188	Ø 10	Ø10 x 800	2	Ø 12	Ø10 x 800	4	Ø12 x 1550	Ø16 x 1500
SA -ST 7.5 t-160	7.5		Ø 10	Ø10 x 800	2	Ø 12	Ø10 x 800	4	Ø14 x 2000	Ø20 x 1750
SA -ST 10.0 t-170	10.0		Ø 12	Ø10 x1000	4	Ø 14	Ø10 x1000	6	Ø16 x 2300	Ø25 x 1850
Lifting clutch load group 26.0 t										
SA -ST 14.0 t-240	14.0	2x257	Ø 14	Ø10 x1000	4	Ø 14	Ø10 x1000	8	Ø20 x 2600	Ø28 x 2350
SA -ST 22.0 t-300	22.0		Ø 14	Ø12 x1200	4	Ø 16	Ø10 x1200	8	Ø25 x 3000	Ø28 x 3000
SA -ST 26.0 t-300	26.0		Ø 14	Ø12 x1200	6	Ø 16	Ø12 x1200	8	Ø28 x 3450	2xØ28 x 3050

INSTALLATION OF STRIP ANCHOR SA-ST IN BEAMS AND WALLS





The diagonal pull reinforcement must be mounted opposite the direction of the load, as closed as possible to the recess former and in direct contact with the anchor.
This type of anchor is not suitable for floor slabs, stairs or other elements which do not have enough space for additional pull reinforcement.

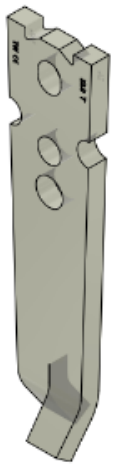
- ***Angled pull of 30° ≤ β ≤ 45° with no angled pull reinforcement is only permitted for:***
- *f_{cu} ≥ 15 MPa and 3 times minimum wall thickness*
- *f_{cu} ≥ 25 MPa and 2.5 times minimum wall thickness*
- *f_{cu} ≥ 35 MPa and 2 times minimum wall thickness*

- ***Angled pull with cable/chain spread of β > 45° is not permitted***

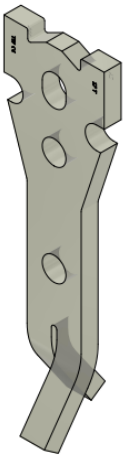
Strip Anchor SA-ST in beams and walls – load capacity, installation dimensions							
Anchor Type	Anchor length	Load range	Minimum thickness of precast unit	f_{cu} ≥ 15 MPa		f_{cu} ≥ 25 MPa	Spacing between anchors
	„L"		"2 × b"	Axial pull 100 % F_{perm} β < 30°	Diagonal pull 80 % F_{perm} 30° < β ≤ 45°	Axial pull and diagonal pull	"a"
	[mm]	[t]	[mm]	[kN]	[kN]	[kN]	[mm]
Lifting clutch load group 2.5 t							
SA -ST 0.7 t – 90	90	0.7	80	7	5.6	7	500
SA -ST 1.4 t – 90	90	1.4	80	14	11	14	500
SA -ST 2.0 t – 90	90	2.0	90	20	16	20	600
SA -ST 2.5 t – 90	90	2.5	100	25	20	25	600
Lifting clutch load group 5.0 t							
SA -ST 3.0 t – 120	120	3.0	100	30	24	30	650
SA -ST 4.0 t – 120	120	4.0	110	40	32	40	700
SA -ST 5.0 t – 120	120	5.0	120	50	40	50	750
Lifting clutch load group 10.0 t							
SA -ST 5.3 t – 160	160	5.3	120	53	42.4	53	800
SA -ST 7.5 t – 160	160	7.5	130	75	60	75	1200
SA -ST 10.0 t – 170	170	10.0	140	100	80	100	1200
Lifting clutch load group 26.0 t							
SA -ST 14.0 t – 240	240	14.0	160	140	112	140	1500
SA -ST 22.0 t – 300	300	22.0	180	220	176	220	1500
SA -ST 26.0 t – 300	300	26.0	200	260	208	260	1500

TILT-UP ANCHOR SA-TTU

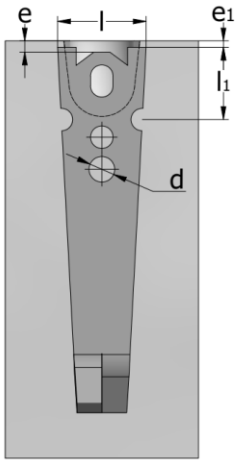
The **SA - TTU anchors** are designed for load range 1.4 t to 22 t. The main applications for this anchor are thin-walled concrete elements, being lifted from horizontal to vertical position. The special shape of the anchor head prevents the concrete from cracking. This kind of anchor is typically used with additional reinforcement, which is required for tilting and turning operations.

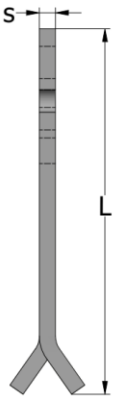


1.4 – 10 t



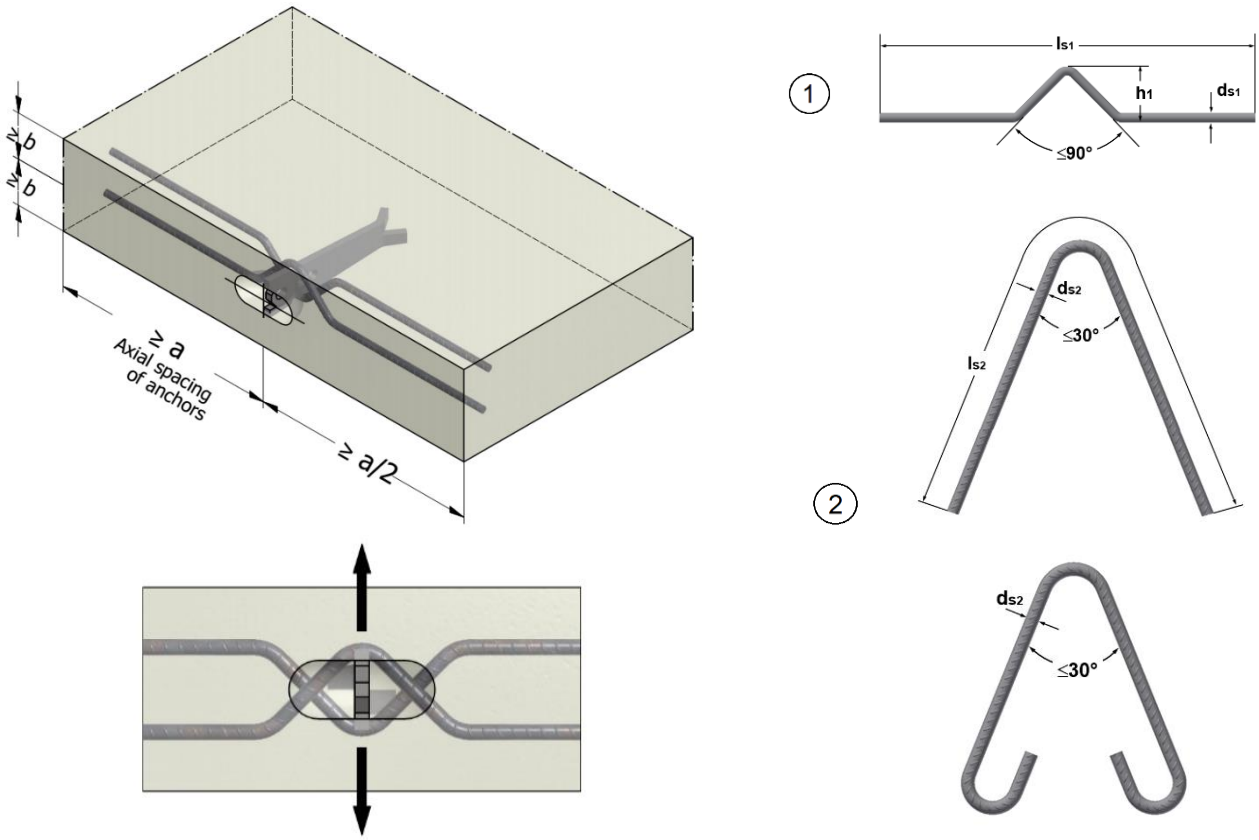
12.5 – 22 t





Tilt-up anchor SA – TTU - Dimensions										
Anchor Type	Product number		L	l	s	l1	d	Load range	e	e_1
	Black	Hot dip galvanized	[mm]	[mm]	[mm]	[mm]	[mm]	[t]	[mm]	[mm]
Lifting clutch load group 2.5 t										
SA - TTU 1.4 t – 200	46887	46888	200	55	6	45	14	1.4	10	7
SA - TTU 2.5 t – 230	46885	46886	230	55	10	45	16	2.5		
Lifting clutch load group 5.0 t										
SA - TTU 4.0 t – 270	46883	46884	270	70	12	70	20	4.0	10	7
SA - TTU 5.0 t – 290	46881	46882	290	70	15	70	20	5.0		
Lifting clutch load group 10 t										
SA - TTU 7.5 t – 320	46879	46880	320	95	18	90	26	7.5	15	12
SA - TTU 10.0 t – 390	46877	46878	390	95	20	90	30	10		
Lifting clutch load group 26 t										
SA - TTU 12.5 t – 500	62454	62455	500	148	20	90	35	12.5	15	11
SA - TTU 17.0 t – 500	62456	62457	500	148	25	90	35	17		
SA - TTU 22.0 t – 500	62458	62459	500	148	30	90	35	22		

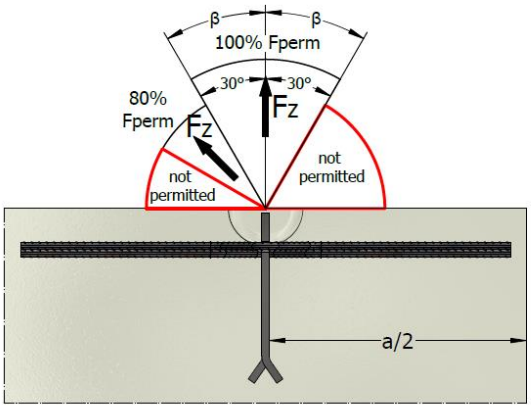
TILT UP ANCHOR SA-TTU - INSTALLATION AND REINFORCEMENT FOR TURNING AND TILTING

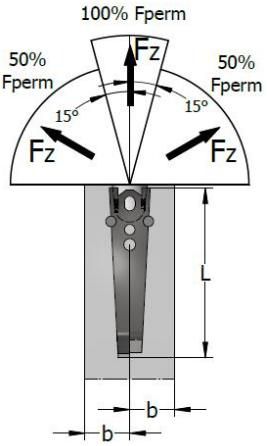


Note: *The bend radius and the length l_s will be determined according to EN-1992-1-1.*
The additional reinforcement and the anchor position will be as in the illustration above. Tilting reinforcement must be inserted in the anchor lateral notches.
The h1 dimension will be determined in function of the element thickness.
For other additional reinforcement, please see page 24. Diagonal reinforcement is not required, because a pair of tilting reinforcements acts as diagonal pull reinforcement.
The sizes and positions of the mesh, stirrups and edge reinforcement are similar to those indicated for the SA-ST anchor if SA-TTU anchor is installed with additional reinforcement for lifting (pull).
If SA-TTU anchor is installed without additional reinforcement for pull, for the mesh, stirrups and edge reinforcement, please see the SA-B anchor tables.

Anchor Type	Load range	Tilting and turning reinforcement ① $f_{cu} \geq 15$ MPa		Additional reinforcement for lifting (pull) ② $f_{cu} \geq 15$ MPa	
		ds_1	ls_1	ls_2	ds_2
	[t]	[mm]	[mm]	[mm]	[mm]
SA - TTU 1.4 t	1.4	Ø 10	700	650	Ø 10
SA - TTU 2.5 t	2.5	Ø 12	800	1000	Ø 12
SA - TTU 4.0 t	4.0	Ø 14	950	1200	Ø 16
SA - TTU 5.0 t	5.0	Ø 16	1000	1500	Ø 16
SA - TTU 7.5 t	7.5	Ø 20	1200	1750	Ø 20
SA - TTU 10.0 t	10.0	Ø 20	1500	1900	Ø 20
SA - TTU 12.5 t	12.5	Ø 25	1800	2200	Ø 25
SA - TTU 17.0 t	17.0	Ø 28	1800	2500	Ø 28
SA - TTU 22.0 t	22.0	Ø 28	1800	3000	Ø 28

TILT-UP ANCHOR SA-TTU - INSTALLATION





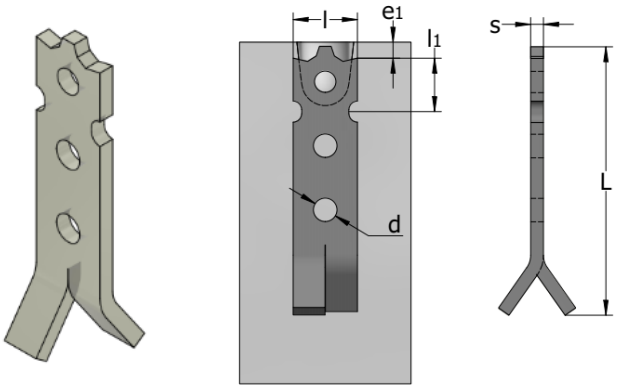
For tilting and tilting operations, the additional reinforcement must be mounted as in the illustration.

Tilt-up anchor SA-TTU – Load capacity, installation dimensions									
Anchor Type	Anchor length	Load range	Minimum thickness of precast unit "2 × b"		f_{cu} ≥ 15 MPa		f_{cu} ≥ 25 MPa	f_{cu} ≥ 15 MPa	Spacing between anchors
			With additional reinforcement for pull	Without additional reinforcement for pull	Axial pull 100 % F_{perm} $\beta < 30°$	Diagonal pull 80 % F_{perm} $30° < \beta \leq 45°$	Axial pull and angled pull	Tilting 50 % F_{perm}	
	„L"								"a"
	[mm]	[t]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]	[mm]
Lifting clutch load group 2.5 t									
SA - TTU 1.4 t	200	1.4	100	100	14	11	14	7	700
SA - TTU 2.5 t	230	2.5	120	120	25	20	25	13	800
Lifting clutch load group 5.0 t									
SA - TTU 4.0 t	270	4.0	150	160	38	30	40	20	950
SA - TTU 5.0 t	290	5.0	160	180	47	38	50	25	1000
Lifting clutch load group 10.0 t									
SA - TTU 7.5 t	320	7.5	175	220	65	52	75	38	1200
SA - TTU 10.0 t	390	10.0	240	280	85	68	100	50	1500
Lifting clutch load group 26.0 t									
SA - TTU 12.5 t	500	12.5	240	350	120	96	125	62.5	1800
SA - TTU 17.0 t	500	17.0	300	400	140	110	170	85	1800
SA - TTU 22.0 t	500	22.0	380	500	200	160	220	110	1800

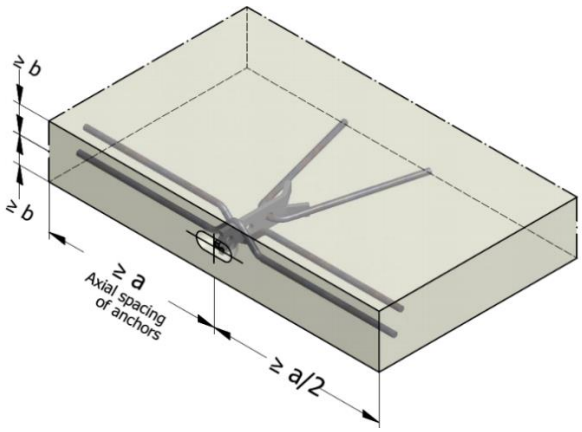
Note: *Angled pull using cable or chain with* $\beta > 45°$ *is* ***not permitted****.*

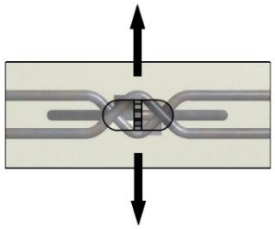
UNIVERSAL ANCHOR 1.25 T

For handling (tilting, turning, and lifting), very thin precast concrete units, a UNIVERSAL ANCHOR-1.25 t are required



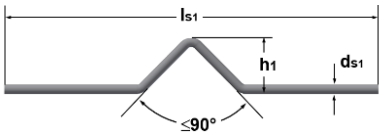
Universal Anchor 1.25 t - Dimensions									
Anchor type	Product number		L	l	s	l_1	d	Load range	e_1
	Black	Hot dip galvanised	[mm]	[mm]	[mm]	[mm]	[mm]	[t]	[mm]
Universal Anchor 1.25 t	49094	49095	120	30	6	25	11	1.25	9





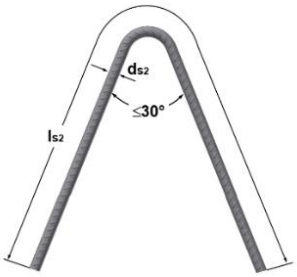
Tilting reinforcement

ds_1 = 8 mm, ls_1 = 650 mm



Additional reinforcement for pull

ds_2 = 8 mm, ls_2 = 700 mm

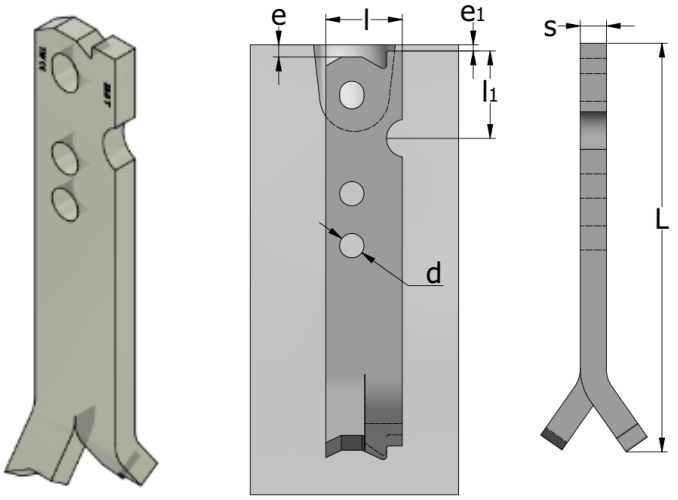


Note: *The bend radius and the length l_s will be determined according to EN 1992-1-1. Additional reinforcement and the anchor position will be as in the illustration above. The h1 dimension will be determined in function of the thickness of the element.*

Universal Anchor 1.25 t– Load capacity, installation dimensions								
Anchor type	Minimum thickness of precast unit	Minimum spacing between anchors	Axial pull $\beta < 30°$	Diagonal pull $30° < \beta < 45°$		Tilting and turning 50 % F_{perm}		
			$f_{cu} \geq 15$ MPa	$f_{cu} \geq 15$ MPa	$f_{cu} \geq 25$ MPa	$f_{cu} \geq 15$ MPa	$f_{cu} \geq 25$ MPa	$f_{cu} \geq 35$ MPa
	"2 × b"	"a"						
	[mm]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]	[kN]
UNIVERSAL ANCHOR 1.25 t	80	240	12.5	10.0	12.5	4.1	4.6	5.0
	100		12.5	10.0	12.5	4.5	5.2	5.6
	120		12.5	12.5	12.5	4.8	5.6	6.0
	140		12.5	12.5	12.5	6.0	6.25	6.25
	160		12.5	12.5	12.5	6.25	6.25	6.25

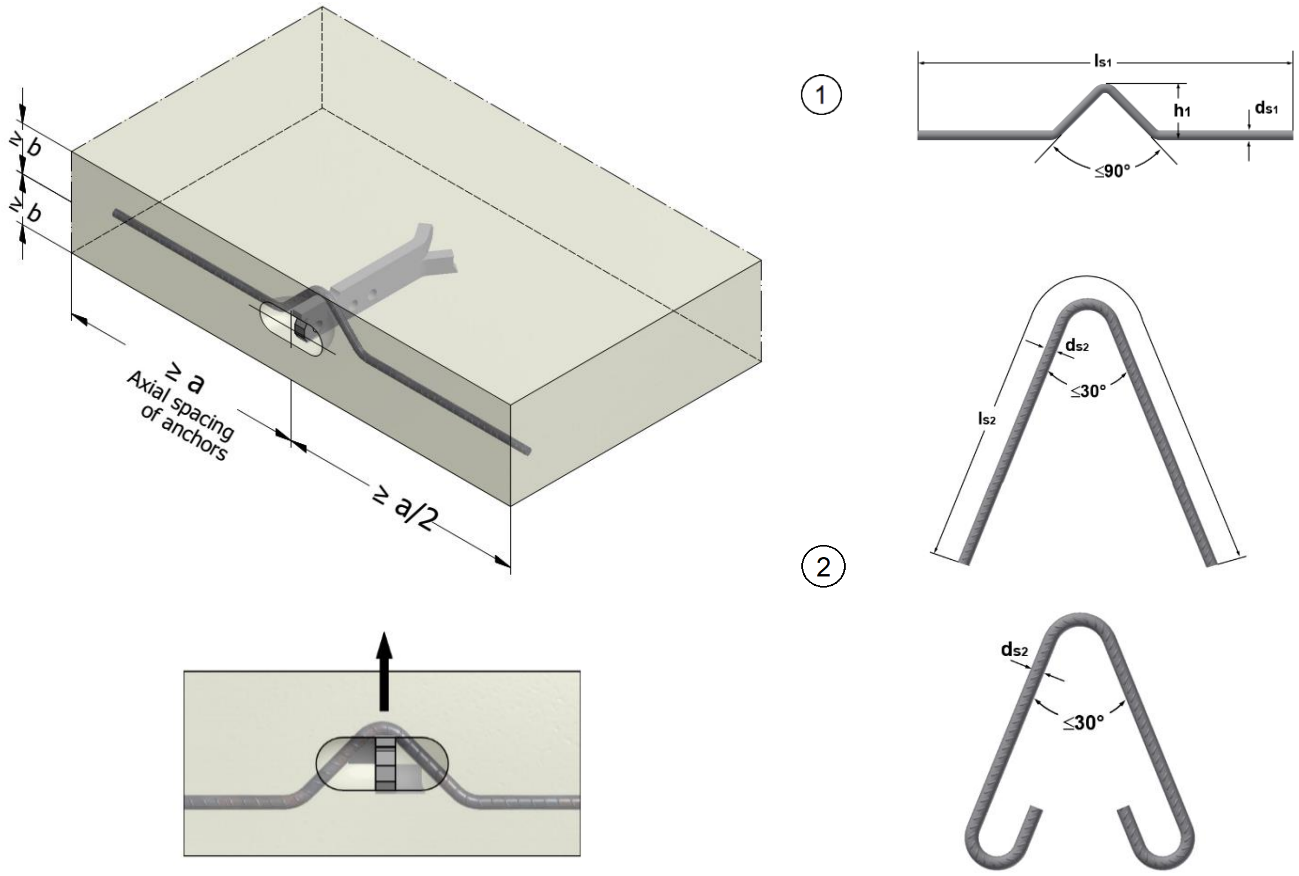
TILT-UP ANCHOR SA-TU-HP

The **SA- TU - HP anchors** are designed for load range 1.4 t to 10 t. The main applications for this anchor are thin-walled concrete elements, being lifted from horizontal to vertical position. The special shape of the anchor head prevents the concrete from cracking. This kind of anchor is typically used with additional reinforcement, which is required for tilting and turning operations.



Tilt-up Anchor SA-TU-HP - Dimensions										
Anchor type	Product number		L	l	s	l_1	d	Load range	e	e_1
	Black	Hot dip galvanised	[mm]	[mm]	[mm]	[mm]	[mm]	[t]	[mm]	[mm]
Lifting clutch load group 2.5 t										
SA-TU-HP 1.4 t – 200	61625	61626	200	40	6	43	14	1.4	10	7
SA-TU-HP 2.5 t – 230	61190	61385	230	40	10	43	14	2.5		
Lifting clutch load group 5.0 t										
SA-TU-HP 4.0 t – 270	61627	61628	270	55	12	51	18	4.0	10	7
SA-TU-HP 5.0 t – 290	61301	61386	290	55	15	51	18	5.0		
Lifting clutch load group 10.0 t										
SA-TU-HP 7.5 t – 320	61302	61387	320	80	18	78	26	7.5	15	12
SA-TU-HP 10.0 t – 390	61303	61388	390	80	20	78	26	10.0		

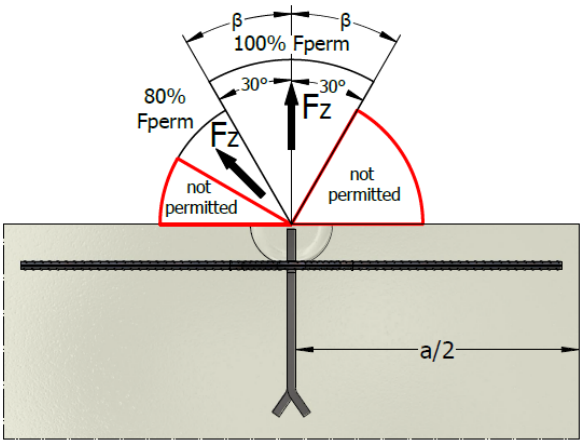
TILT UP ANCHOR SA-TU-HP - INSTALLATION AND REINFORCEMENT FOR TURNING AND TILTING

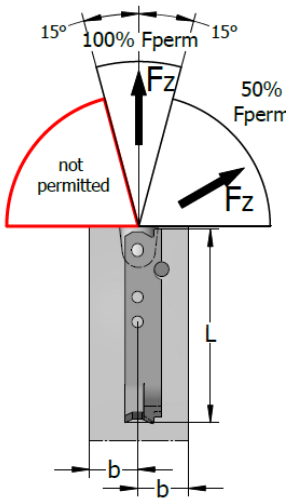


Note: *The bend radius and length l_s will be determined according to EN 1992-1-1.*
The additional reinforcement and the anchor position will be as in the illustration above. Tilting reinforcement must be inserted in the anchor lateral notches.
The h1 dimension will be determined in function of the thickness of the element.
For other additional reinforcement, please see page 24.
The sizes and positions of the mesh, stirrups and edge reinforcement are similar to those indicated for the SA-ST anchor if the SA-TU-HP anchor is installed with additional reinforcement for lifting (pull).
If the SA-TU-HP anchor is installed without additional reinforcement for pull, the mesh, stirrups and edge reinforcement, please see the SA-B anchor tables.

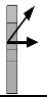
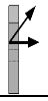
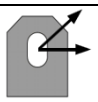
Anchor type	Load range	Tilting reinforcement ① $f_{cu} \geq 15$ MPa		Additional reinforcement for lifting (pull) ② $f_{cu} \geq 15$ MPa	
		ds_1	ls_1	ls_2	ds_2
	[t]	[mm]	[mm]	[mm]	[mm]
SA-TU-HP 1.4 t	1.4	Ø 10	700	650	Ø 10
SA-TU-HP 2.5 t	2.5	Ø 12	800	1000	Ø 12
SA-TU-HP 4.0 t	4.0	Ø 14	950	1200	Ø 16
SA-TU-HP 5.0 t	5.0	Ø 16	1000	1500	Ø 16
SA-TU-HP 7.5 t	7.5	Ø 20	1200	1750	Ø 20
SA-TU-HP 10.0 t	10.0	Ø 20	1500	1900	Ø 20

TILT-UP ANCHOR SA-TU-HP - INSTALLATION





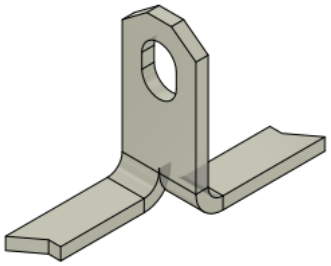
The additional reinforcement and the anchor must be mounted in the correct position as shown in the illustration.

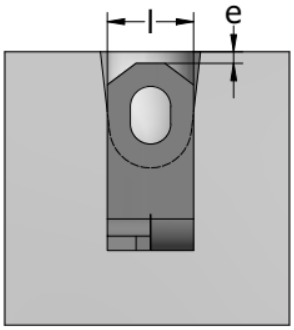
Tilt-up anchor SA-TU-HP – Load capacity, installation dimensions									
Anchor Type	Anchor length	Load range	Minimum thickness of precast unit "2 × b"		$f_{cu} \geq 15$ MPa		$f_{cu} \geq 25$ MPa	$f_{cu} \geq 15$ MPa	Spacing between anchors
			With additional reinforcement for pull	Without additional reinforcement for pull	Axial pull 100 % F_{perm} $\beta < 30°$	Diagonal pull 80 % F_{perm} $30° < \beta \leq 45°$	Axial pull and Diagonal pull	Tilting 50 % F_{perm}	
	„L"								"a"
	[mm]	[t]	[mm]	[mm]	[kN]	[kN]	[kN]	[kN]	[mm]
Lifting clutch load group 2.5 t									
SA – TU-HP 1.4 t	200	1.4	90	90	14	11	14	7	700
SA – TU-HP 2.5 t	230	2.5	100	110	25	20	25	13	800
Lifting clutch load group 5.0 t									
SA – TU-HP 4.0 t	270	4.0	120	150	38	30	40	20	950
SA – TU-HP 5.0 t	290	5.0	140	170	47	38	50	25	1000
Lifting clutch load group 10.0 t									
SA – TU-HP 7.5 t	320	7.5	160	200	65	52	75	38	1200
SA – TU-HP 10.0 t	390	10.0	200	250	85	68	100	50	1500

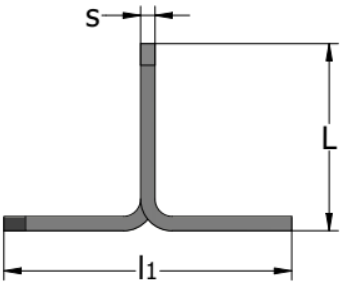
Note: *Angled pull using cable or chain with* $\beta > 45°$ *is* ***not permitted****.*

FLAT FOOT ANCHOR SA-FA

The **SA-FA "Flat foot anchor"** is designed for load range 1.4 t to 5.0 t. The main applications for this anchor are de-moulding panels, lifting thin slabs and concrete pipes. These elements must have a concrete strength at lifting of up to 20 MPa. Placing reinforcements above the anchor legs is highly recommended.

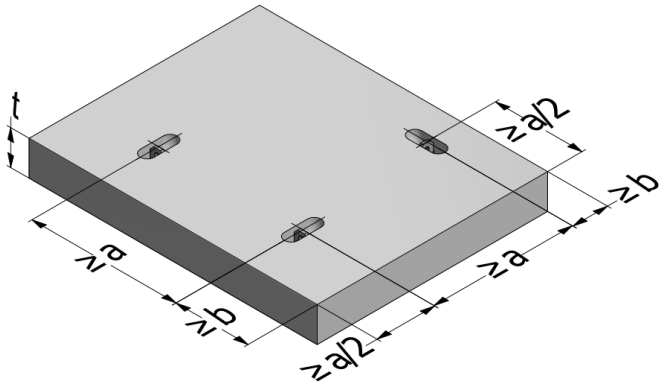


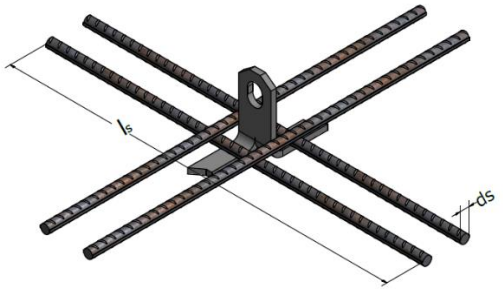




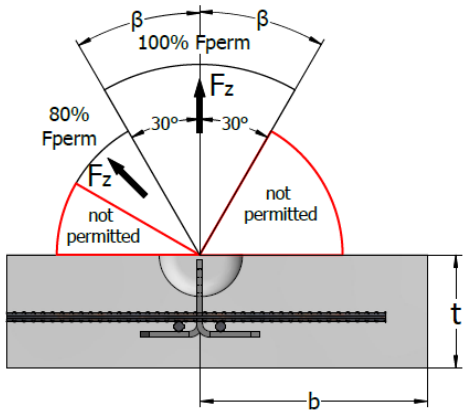
Flat foot anchor SA-FA - Dimensions								
Anchor type	Product number		L	l	s	l_1	Load range	e
	Black	Hot dip galvanised	[mm]	[mm]	[mm]	[mm]	[t]	[mm]
Lifting clutch load group 2.5 t								
SA -FA 0.7 t – 65	45924	45925	65	30	5	100	0.7	
SA-FA 1.4 t – 68	45922	45923	68	30	6	100	1.4	
SA-FA 2.0 t – 70	45926	45927	70	30	8	100	2.0	10
SA -FA 2.0 t – 100	48362	48363	100	30	8	100	2.0	
SA-FA 2.5 t – 75	45928	45929	75	30	10	100	2.5	
Lifting clutch load group 5.0 t								
SA-FA 3.0 t – 90	45930	45931	90	40	10	120	3.0	
SA-FA 4.0 t – 110	45932	45933	110	40	12	120	4.0	10
SA-FA 5.0 t – 125	45934	45935	125	40	15	120	5.0	
Lifting clutch load group 10.0 t								
SA-FA 10.0 t - 200	63185	63179	200	60	20	145	10.0	15

FLAT FOOT ANCHOR SA-FA – INSTALLATION





①



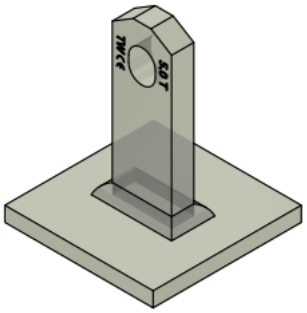
- *The reinforcement bars must be as close as possible to the anchor*
- ***Angled pull of 30° ≤ β ≤ 45° with no angled pull reinforcement is only permitted for:***
- *f_{cu} ≥ 15 MPa and 3 times minimum element thickness*
- *f_{cu} ≥ 25 MPa and 2.5 times minimum element thickness*
- *f_{cu} ≥ 35 MPa and 2 times minimum element thickness*
- ***Angled pull with cable/chain spread of β > 45° is not permitted***

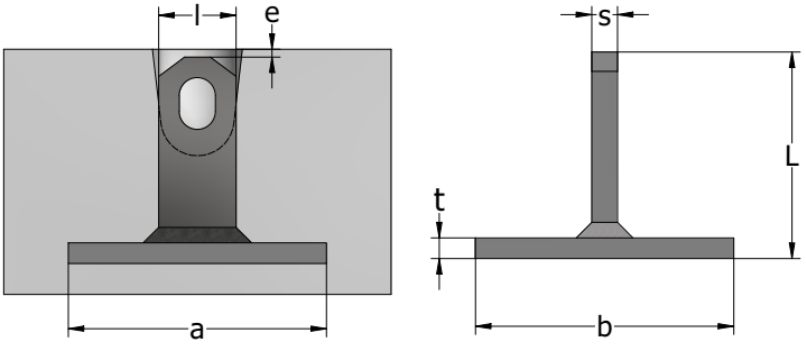
Flat Foot Anchor SA-FA – Load capacity, installation dimensions										
Anchor type	Anchor length	Load range	Minimum thickness of precast unit	Mesh reinforcement (both sides)	Additional reinforcement for lifting (pull) ①		f_{cu} ≥ 20 MPa		Minimum spacing between anchors	Minimum distance from the edge
	"L"		"t"		ls	ds	Axial pull 100 % F_{perm} $\beta < 30°$	Diagonal pull 80 % F_{perm} $30° < \beta \leq 45°$	"a"	"b"
	[mm]	[t]	[mm]		[mm]	[mm]	[kN]	[kN]	[mm]	[mm]
Lifting clutch load group 2.5 t										
SA-FA 0.7 t – 65	65	0.7	92	2x131	250	Ø 8	7	5.6	280	140
SA-FA 1.4 t – 68	68	1.4	95	2x131	250	Ø 8	14	11	280	140
SA-FA 2.0 t – 70	70	2.0	100	2x131	300	Ø 8	20	16	300	150
SA-FA 2.0 t – 100	100	2.0	135	2x131	300	Ø 8	20	16	380	190
SA-FA 2.5 t – 75	75	2.5	105	2x131	300	Ø 8	25	20	320	160
Lifting clutch load group 5.0 t										
SA-FA 3.0 t – 90	90	3.0	120	2x131	400	Ø 10	30	24	380	190
SA-FA 4.0 t – 110	110	4.0	140	2x131	450	Ø 12	40	32	460	230
SA-FA 5.0 t – 125	125	5.0	160	2x131	500	Ø 12	50	40	520	260
Lifting clutch load group 10.0 t										
SA-FA 10.0 t - 200	200	10.0	245	2x188	600	Ø 14	100	100	800	400

Note: Required reinforcement for diagonal pull - please see page 24.

FLAT ANCHOR SA-FAW

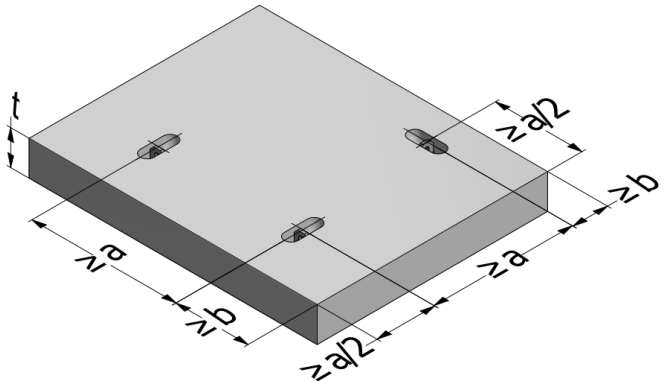
The **SA-FAW Anchor** is designed for load range 1.4 t to 10 t. The main applications for this anchor include de-moulding panels and lifting thin slabs and concrete pipes. These elements must have a concrete strength at lifting of up to 20 MPa. Placing reinforcements above the anchor legs is highly recommended.

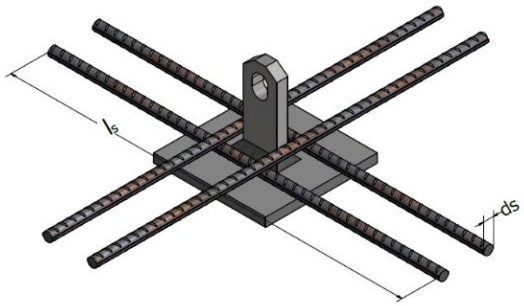


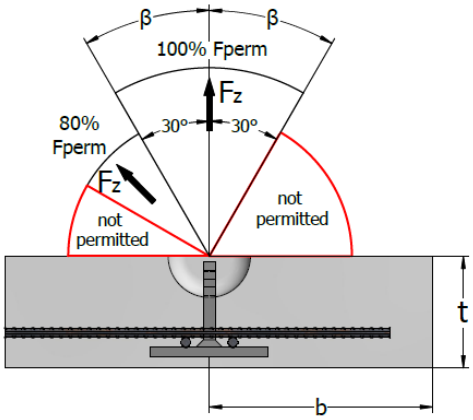


Anchor SA-FAW - Dimensions									
Anchor type	Product number		L	l	s	t	a x b	Load range	e
	Black	Hot dip galvanised	[mm]	[mm]	[mm]	[mm]	[mm]	[t]	[mm]
Lifting clutch load group 2.5 t									
SA-FAW 1.4 t – 55	62094	61580	55	30	6	8	80x80	1.4	10
SA-FAW 2.5 t – 80	62095	61581	80	30	10	8	80x80	2.5	
Lifting clutch load group 5.0 t									
SA-FAW 5.0 t – 120	62096	61582	120	40	15	10	100x100	5.0	10
Lifting clutch load group 10.0 t									
SA-FAW 10.0 t – 160	62097	61583	160	60	20	12	140x140	10.0	15

FLAT ANCHOR SA-FAW – INSTALLATION







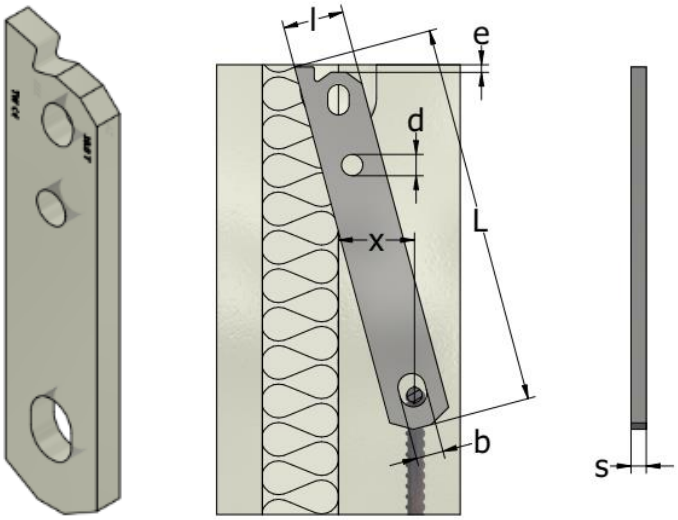
(1)

- *The reinforcement bars must be in direct contact with the anchor plate*
- ***Angled pull of 30° ≤ β ≤ 45° with no angled pull reinforcement is only permitted for:***
  - *f_{cu} ≥ 15 MPa and 3 times minimum element thickness*
  - *f_{cu} ≥ 25 MPa and 2.5 times minimum element thickness*
  - *f_{cu} ≥ 35 MPa and 2 times minimum element thickness*
- ***Angled pull with cable/chain spread of β > 45° is not permitted***

Flat Anchor SA-FAW – Load capacity, installation dimensions										
Anchor type	Anchor length	Load range	Minimum thickness of precast unit	Mesh reinforcement (both sides)	Additional reinforcement for lifting (pull) (1)		f_{cu} ≥ 20 MPa		Minimum spacing between anchors	Minimum distance from the edge
	"L"		"t"		ls	ds	Axial pull 100 % F_{perm} $\beta < 30°$	Diagonal pull 80 % F_{perm} $30° < \beta \leq 45°$	"a"	"b"
	[mm]	[t]	[mm]	[mm²/m]	[mm]	[mm]	[kN]	[kN]	[mm]	[mm]
Lifting clutch load group 2.5 t										
SA-FAW 1.4 t – 55	55	1.4	85	2x131	210	Ø 8	14	11	230	115
SA-FAW 2.5 t – 80	80	2.5	110	2x131	300	Ø 8	25	20	330	165
Lifting clutch load group 5.0 t										
SA-FAW 5.0 t – 120	120	5.0	150	2x131	450	Ø 12	50	40	480	240
Lifting clutch load group 10.0 t										
SA-FAW 10.0 t – 160	160	10.0	195	2x188	600	Ø 16	100	80	660	330

SANDWICH PANEL ANCHOR SA-SP

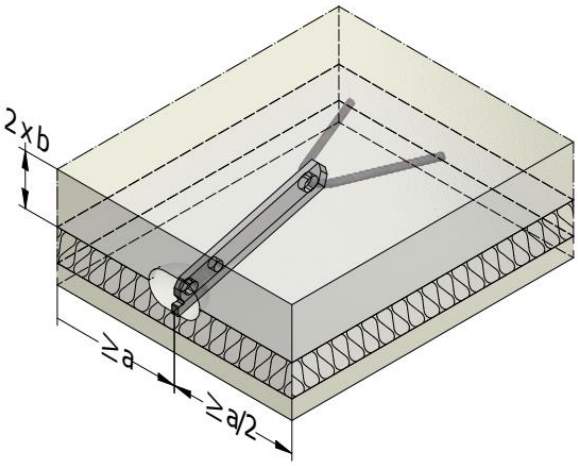
The **SA-SP sandwich panel anchor** is designed for load range 2.5 t to 10 t. The main applications for this anchor are lifting and transporting sandwich panels in upright position. These elements must have a concrete strength at lifting of up to 20 MPa. This type of anchor must be used with additional lifting reinforcement and tilting reinforcement.

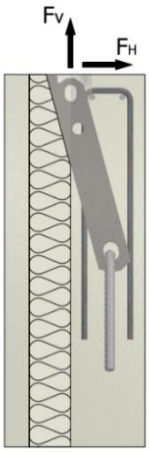


Sandwich Panel Anchor SA-SP - Dimensions										
Product name	Product number		L	l	s	b	d	x	Load range	e
	Black	Hot dip galvanised	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[t]	[mm]
Lifting clutch load group 2.5 t										
SA-SP 2.5 t – 250	61461	61462	250	40	10	18	Ø14	48	2.5	10
Lifting clutch load group 5.0 t										
SA-SP 5.0 t – 300	61463	61464	300	60	16	26	Ø17.5	53	5.0	10
Lifting clutch load group 10.0 t										
SA-SP 7.5 t – 350	61465	61466	350	80	16	35	Ø25	55	7.5	15
SA-SP 10.0 t – 350	61467	61468	350	80	20	35	Ø25	55	10.0	
Lifting clutch load group 26.0 t										
SA-SP 17.0 t - 400	63186	61470	400	100	25	35	Ø30	66	17.0	15

SANDWICH PANEL ANCHOR SA-SP – INSTALLATION

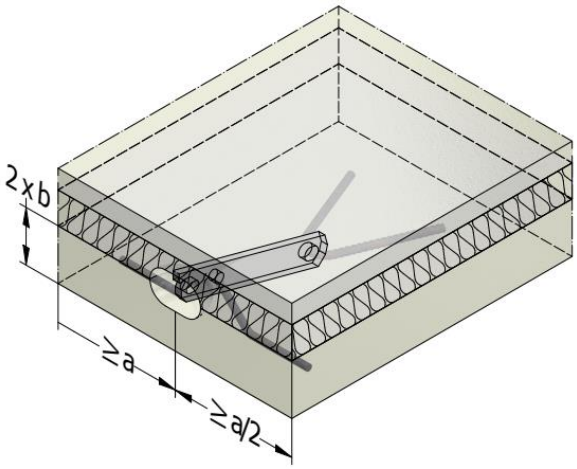
Face-down production (standard production)





The special designed head provides a suspension point close to the gravity axis. The sandwich panel hangs nearly upright during transport and installation.

Face-up production

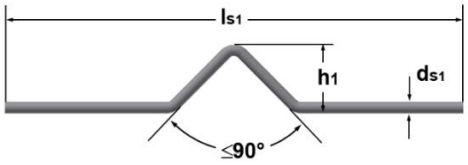


Tilt up reinforcement is required if F_H is oriented towards the façade layer

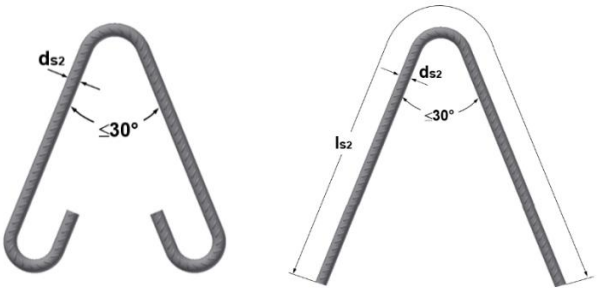
Sandwich Panel Anchor SA-SP – Load capacity, installation dimensions						
Anchor type	**L**	**Thickness of load-bearing precast element**	**Minimum distances from edge**	**Minimum spacing between centres**	**Axial and diagonal pull β ≤ 30°**	**Transverse pull**
		"2 x b"	**"a/2"**	**"a"**	**f_{cu}≥ 20 MPa**	
	[mm]	**[mm]**	**[mm]**	**[mm]**	**[kN]**	**[kN]**
Lifting clutch load group 2.5 t						
SA -SP 2.5 t – 250	250	100	300	600	25	8
Lifting clutch load group 5.0 t						
SA -SP 5.0 t – 300	300	120	375	750	50	18
Lifting clutch load group 10.0 t						
SA -SP 7.5 t – 350	350	130	600	1200	75	26
SA -SP 10.0 t – 350	350	140	600	1200	100	35
Lifting clutch load group 26.0 t						
SA-SP 17.0 t - 400	400	180	750	1500	170	50

Sandwich panel anchor sa-sp – additional reinforcement

Tilting reinforcement

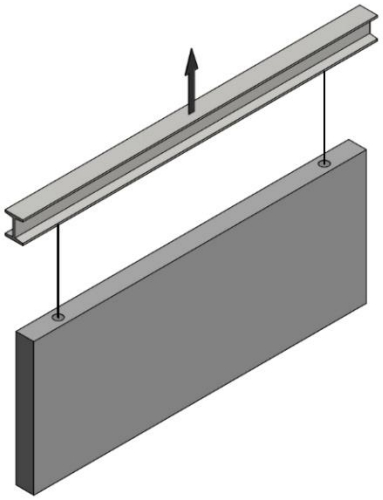


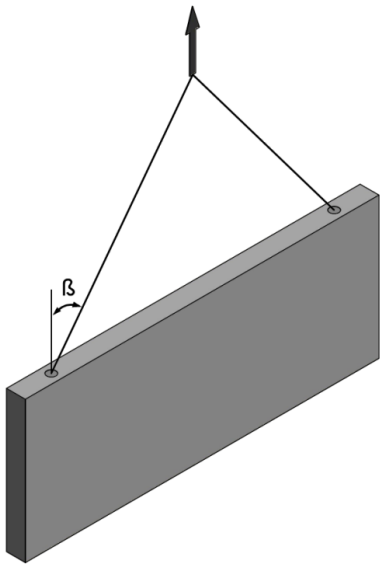
Additional reinforcement for lifting (pull)



Anchor type	Load range	Reinforcements - Concrete strength f_{cu}≥ 20 MPa		
		Stirrups n x Ø x L	Tilting reinforcement ds_1 x ls_1	Reinforcement tail for lifting ds_2 x ls_2
	[t]	[mm]	[mm]	[mm]
Lifting clutch load group 2.5 t				
SA -SP 2.5 t – 250	2.5	2 x Ø 8 x 600	Ø 10 x 600	Ø 14 x 800
Lifting clutch load group 5.0 t				
SA -SP 5.0 t – 300	5.0	2 x Ø8 x 800	Ø14 x 700	Ø16 x 1200
Lifting clutch load group 10.0 t				
SA -SP 7.5 t – 350	7.5	2 x Ø10 x 800	Ø16 x 800	Ø25 x 1400
SA -SP 10.0 t – 350	10.0	4 x Ø10 x 800	Ø20 x 900	Ø25 x 1800
Lifting clutch load group 26.0 t				
SA-SP 17.0 t - 400	17.0	4 x Ø12 x 1200	Ø20 x 1100	Ø28 x 2500

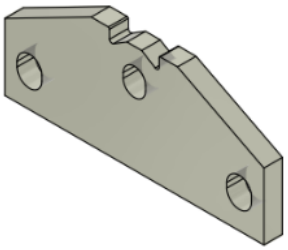
Note: *The bend radius and length l_s will be determined according to EN 1992-1-1.*
The h1 dimension will be determined in function of the thickness of the element.
For tilting and transport, using a spreader beam is highly recommended.
*The maximum angled pull (***f_{cu} ≥ 25 MPa***) is* **β ≤ 30°**

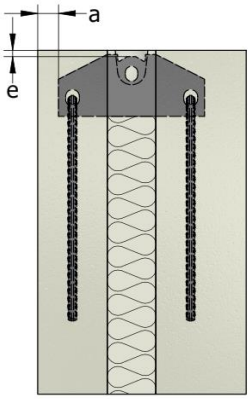


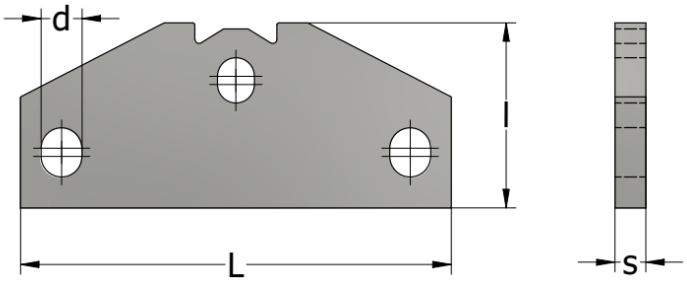


STRIP ANCHOR SA-LSP

The SA-LSP anchors are specifically designed for edge lifting sandwich concrete panels. The special form of the anchor head provides protection against concrete spalling. Rotation of the lifting clutch shackle is also restricted.
Reinforcement is required as shown. All anchors have the CE marking and all data necessary for traceability and load classes. SA-LSP anchors are designed to resist at a minimum safety factor of 3x the load range. Horizontally cast sandwich panels can be lifted from the tilt-up table only in an almost vertical position, at an angle of at least 80°. The design of the SA-LSP anchor allows it to distribute the anchor loads evenly to both concrete layers because of the use of two specially bent rebars per SA-LSP anchor.

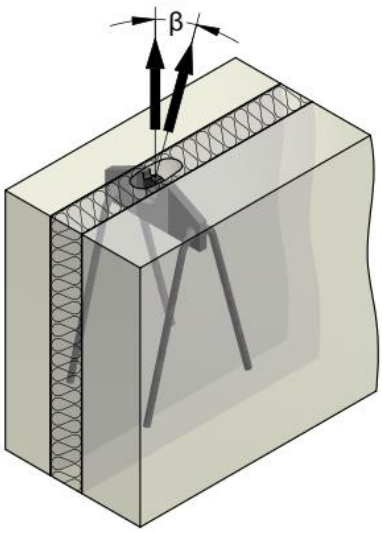




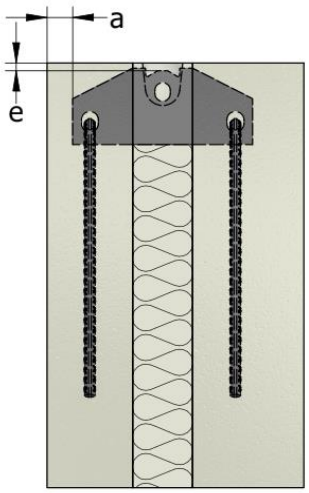


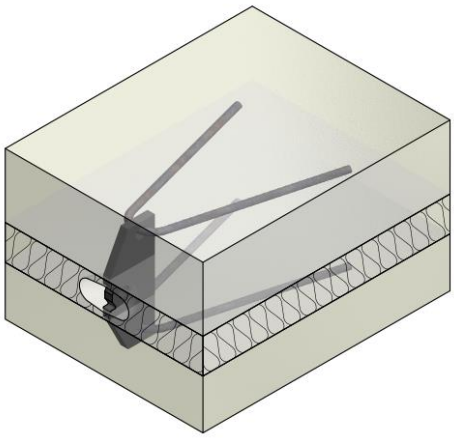
SA-LSP ANCHOR – DIMENSIONS AND LOAD CAPACITY								
Anchor Type	Product number		L	l	s	d	Load range	e
	Black	Hot dip galvanised	[mm]	[mm]	[mm]	[mm]	[t]	[mm]
Lifting clutch load group 2.5 t								
SA -LSP 2.5 t – 130	64356	68254	130	80	10	16	2.5	10
SA -LSP 2.5 t – 150	64357	68255	150	80	10	16	2.5	
SA -LSP 2.5 t – 190	64358	68256	190	80	10	16	2.5	
SA -LSP 2.5 t – 210	64359	68257	210	80	10	16	2.5	
SA -LSP 2.5 t – 240	64360	68258	240	80	10	16	2.5	
Lifting clutch load group 5.0 t								
SA -LSP 5.0 t – 150	64344	68259	150	90	15	20	5.0	10
SA -LSP 5.0 t – 190	64345	68260	190	90	15	20	5.0	
SA -LSP 5.0 t – 210	64323	68261	210	90	15	20	5.0	
SA -LSP 5.0 t – 230	64324	68262	230	90	15	20	5.0	
SA -LSP 5.0 t – 240	64355	68263	240	90	15	20	5.0	
SA -LSP 5.0 t – 260	64325	68264	260	90	15	20	5.0	
SA -LSP 5.0 t – 280	64326	68265	280	90	15	20	5.0	
SA -LSP 5.0 t – 320	64327	68266	320	90	15	20	5.0	
SA -LSP 5.0 t – 360	64328	68267	360	90	15	20	5.0	
Lifting clutch load group 10.0 t								
SA -LSP 7.5 t – 210	64329	68268	210	120	18	26	7.5	15
SA -LSP 7.5 t – 230	64330	68269	230	120	18	26	7.5	
SA -LSP 7.5 t – 260	64331	68270	260	120	18	26	7.5	
SA -LSP 7.5 t – 280	64332	68271	280	120	18	26	7.5	
SA -LSP 7.5 t – 320	64333	68272	320	120	18	26	7.5	
SA -LSP 7.5 t – 360	64334	68273	360	120	18	26	7.5	

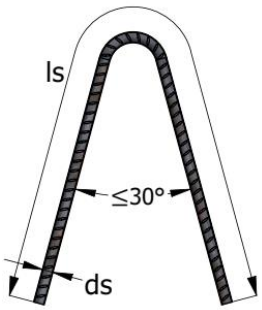
Sandwich panel anchor sa-lsp – additional reinforcement



Preferred option ß ≤ 30°





Anchor Type	Load group	Installation dimensions Concrete cover	Additional reinforcement for lifting (pull) $f_{cu} \geq 15$ MPa		
		a min	ls	ds	
	[t]	[mm]	[mm]	[mm]	
SA -LSP 2.5 t	2.5	30	1000	Ø 12	
SA -LSP 5.0 t	5.0	30	1500	Ø 16	
SA -LSP 7.5 t	7.5	30	1750	Ø 20	

The bend radius will be determined according to EN 1992.

To transport the concrete units, the appropriate lifting system for the load group TF1 or TF2 is inserted above the anchor head.

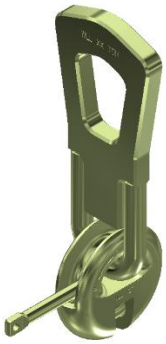
2D LIFTING CLUTCHES

Load group [t]	Lifting system	Anchor group [t]	Load range anchor [t]
1.25 (1.25 t)	**TF1 - 0125**	1.25	1.25
2.5 (0.7 t – 2.5 t)	**TF1 - 025** **TF2 - 025**	1.4 – 2.5	0.7 1.4 2.0 2.5
5.0 (3.0 t – 5.0 t)	**TF1 - 050** **TF2 - 050**	3.0 – 5.0	3.0 4.0 5.0
10.0 (5.3 t – 10.0 t)	**TF1 - 100** **TF2 - 100**	5.3 – 10.0	5.3 7.5 10.0
26.0 (12.5 t – 26.0 t)	**TF1 - 260** **TF2 - 260**	12.5 – 26.0	12.5 14.0 22.0 26.0

Only components in the same load group can be combined.

TF1 – 1.25 t
TF1 – 2.5 t
TF1 – 5.0 t
TF1 – 10.0 t

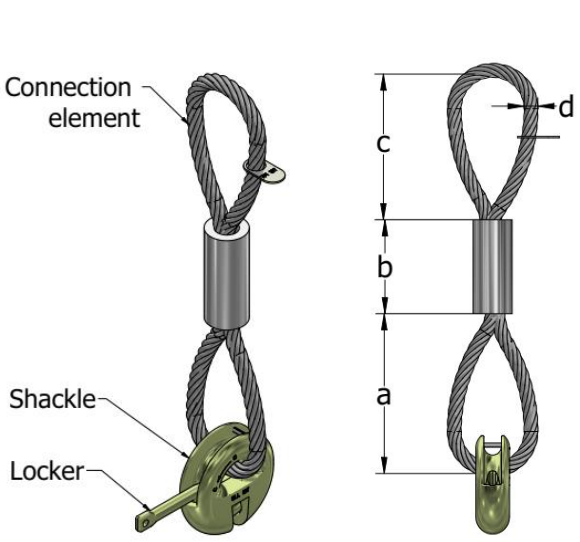
TF1 – 26.0 t



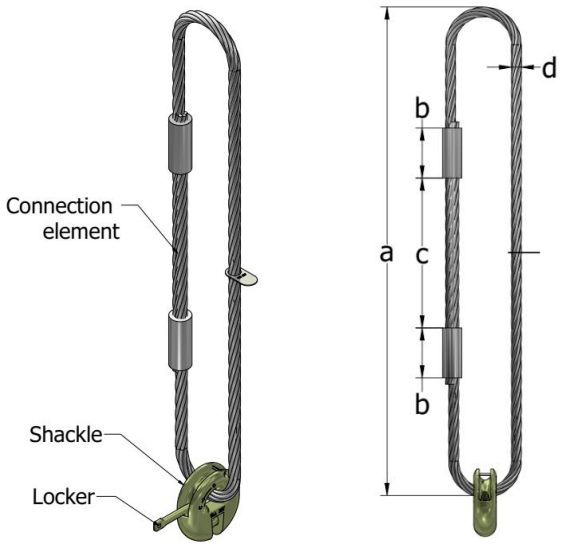
TF2 – 2.5 t
TF2 – 5.0 t
TF2 – 10.0 t
TF2 – 26.0 t

The lifting systems TF1 are made of high-grade steel wire rope according EN 12385-4, swaged in a ferrule made of AlMg1.8, and a shackle produced from high-strength steel. TF2 are made of high-quality steel and are designed with a safety factor c= 5. When TF1 and TF2 systems are assembled with the corresponding anchor, together they have the anchor minimum safety factor of c= 3.
Before delivery, the working load of each system is tested three times, and individual testing certificates are attached.
TF2s are different from TF1s due to the connection element (bracket) to the crane hook: the TF1 system's connection element is made with heavy-duty wire cable according EN12385-4.
The clutch head (shackle) in each load group matches the shape of the recess former RBF and incorporates a locker, which is inserted in the appropriate head anchor hole.

2D LIFTING CLUTCHES – DIMENSIONS AND COMPONENTS



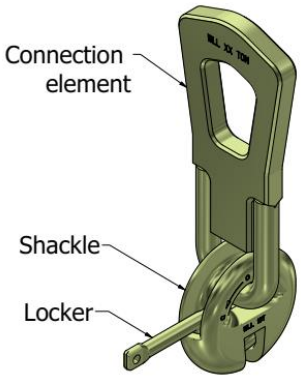
TF1-0125 / TF1-025 / TF1-050 / TF1-100

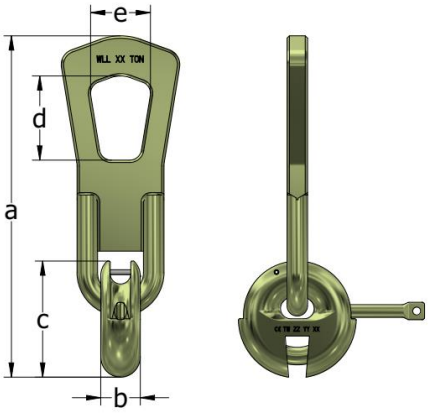


TF1-260

Note: Each lifting clutch TF1 is marked with the anchor load group, the CE marking, the manufacturer, and identification number.

TF1 (Zinc plated)		Load class	Load Range	Dimensions			
				a	b	c	d
		[t]	[t]	[mm]	[mm]	[mm]	[mm]
TF1 -0125	49524	1.25	1.25	100	54	176	9
TF1 -025	45948	2.5	0.7 – 2.5	120	90	195	14
TF1 -050	45949	5.0	3.0 – 5.0	200	100	295	18
TF1 -100	45950	10.0	5.3 – 10.0	240	140	325	22
TF1 -260	45951	26.0	12.5 – 26.0	1570	160	480	32





Note: Each lifting clutch TF2 is marked with the anchor load group, the CE marking, the manufacturer, and identification number.

TF2 (Zinc plated)		Load class	Load Range	Dimensions				
				a	b	c	d	e
		[t]	[t]	[mm]	[mm]	[mm]	[mm]	[mm]
TF2 -025	44843	2.5	0.7– 2.5	259	27	78,5	70	50
TF2 -050	44844	5.0	3.0 – 5.0	325	36	105	86	58
TF2 -100	44845	10.0	5.3 – 10.0	431	50	146,7	107	75
TF2 -260	44846	26.0	12.5 – 26.0	620	72	216	154	110

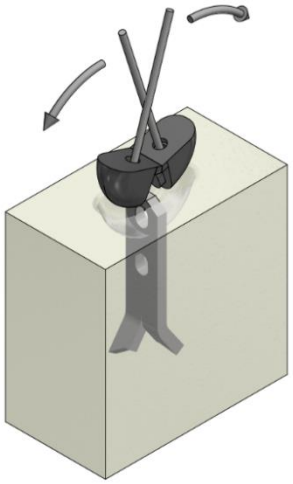
2D LIFTING CLUTCHES – APPLICATION INSTRUCTIONS

1) De-mould

Before lifting the precast concrete element, removing as many parts of the formwork as possible to minimise adhesion to the mould is recommended. In the de-mould process, the forces acting on the lift system are considerably greater than the actual weight of the precast element. In the opposite case, the precast concrete unit may flake.

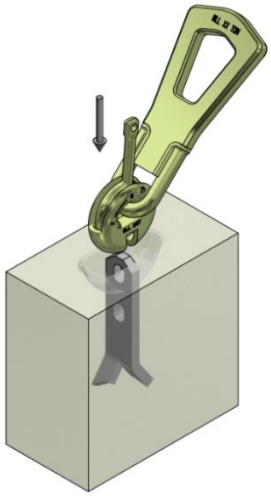
2) Removing the recess former

To remove the recess former, two rods are inserted in the holes in the recess former, after which they are levered out by scissoring action. Do not use a hammer to remove the recess former as that may destroy the former.



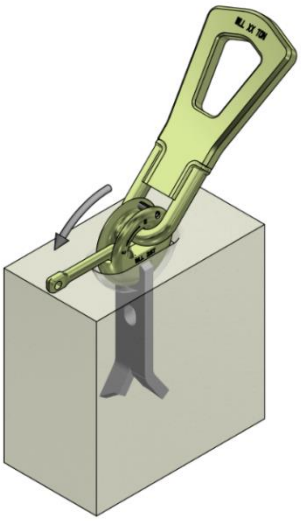
3) Attaching the lifting system

To transport the concrete units, the appropriate lifting system for the load group is inserted above the anchor head. Only matching components will fit together.



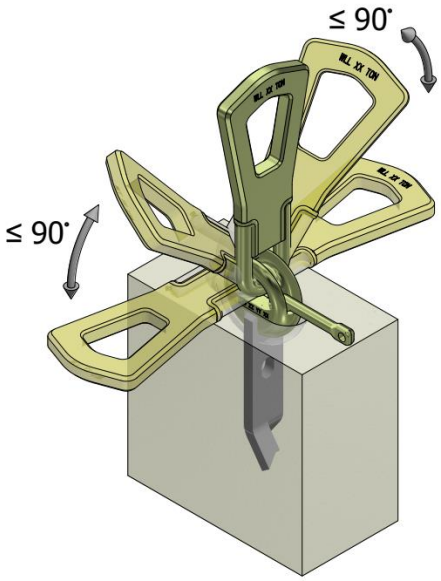
4) Locking the lifting system

The lifting system is locked using a simple handle on the locker. The lifting system is now free to move in any direction. From this moment, the precast concrete unit can be lifted out of the formwork and transported to the storage site.
As a rule, the lifting angle should be 30°, but it can be up to 45°.



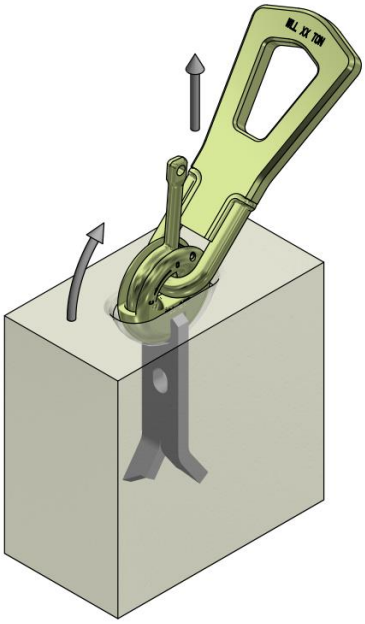
5) Handling the system

The clutch's 2D lifting bracket can be moved in any direction. Overloading the lifting anchor is not permitted (see the 2D lifting anchors conditions).



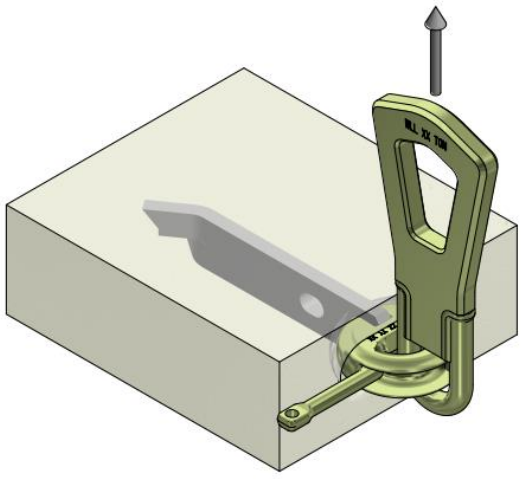
6) Releasing the lifting system

After the lifting/transport of the precast element, the lifting system can be easily released by pushing back the locker after the system is off load. The lifting clutch can remain attached to the crane hook until further use.



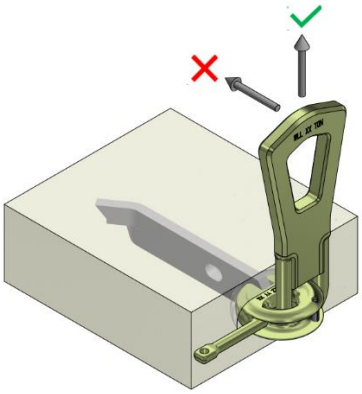
7) Moving slabs from the horizontal to vertical position

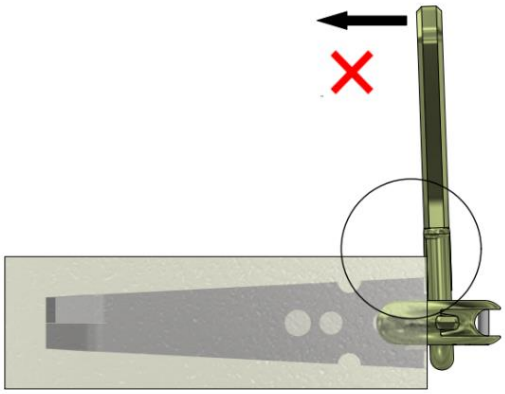
The flat precast concrete units can be moved from the horizontal to vertical position by using TILT UP anchor SA -TU or SA -TTU with additional reinforcement embedded in concrete. The direction of pull is at right angles to the cast-in anchor. Using a crossbeam for lifting to avoid angular and torsion forces is recommended.



MISUSE OF THE LIFTING SYSTEM

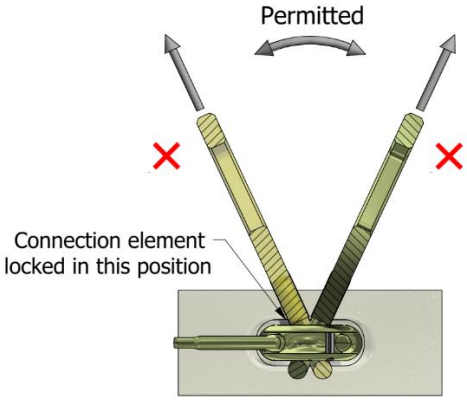
If the lifting direction is not heeded, the precast element or the lifting clutch can suffer major damage. Proper use can prevent damage and extend the service life of the lifting system.

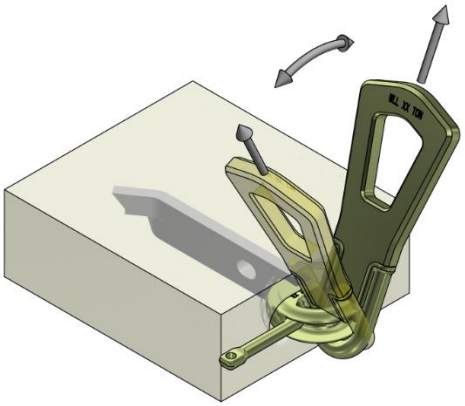


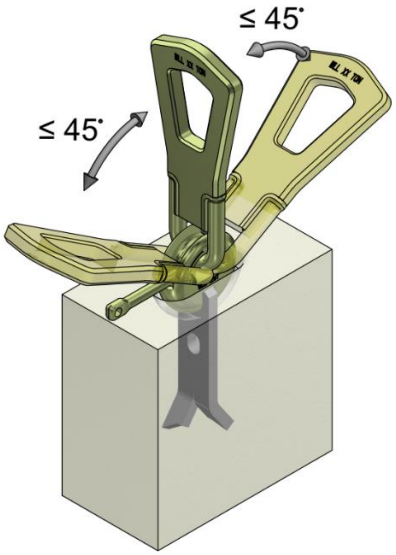


If the connection element is pulled towards the upper surface of the slab during the lifting operations, it may bend at the slab edge.

In this position, the connection element may lock inside the shackle.
A small angle of the lifting cable angle will determine the bracket to bend.

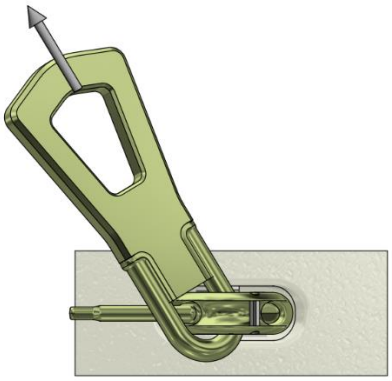






Angled pull using cable or chain with $\beta > 45°$ *is* ***not allowed****.*

The problem can be overcome by turning the connection element approx. 45° The connection element cannot lock in this position



CHECKING THE LIFTING SYSTEM

Just as with all lifting devices, trained personnel must inspect the TF1, TF2 lifting system at least twice a year. Any deformation of a locker indicates that the permitted load has been exceeded at least three times. A damaged locker can be replaced. No other repairs are permitted.

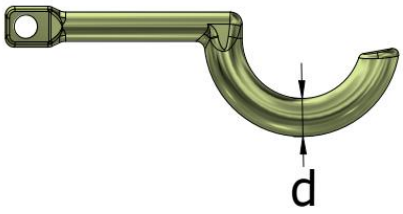
- ***Any deformation to the wire rope (see the type of damages mentioned on page 55), shackle, or metal structural elements weakens the lifting device with the risk of the precast element falling. Do not perform any repair work. The lifting device must be discarded. Lifting loops with broken strands or other signs of damage, kinking, bird caging, corrosion that require discarding according EN 13414-1 must not be used for further lifting.***

- ***Damage, distortions, cracks, and extensive corrosion can reduce the load-carrying capacity and lead to failure. This causes a hazard to life and limb. If necessary, any affected parts must be taken out of service immediately.***

Cables must not come into contact with acids, caustic solutions, or other aggressive substances.
Combining products from different companies is not recommended.

- **The locker**

A lifting system with a worn or bent locker must be taken out of use. The wear on the locker must be less than the limits shown in the following table.



Load group	Nominal dimension d	Minimum dimension d
[t]	[mm]	[mm]
1.25	Ø 8 +0.3/0	7.5
2.5	Ø 13 +0.5/0	12
5.0	Ø 17 +0.5/0	16
10.0	Ø 22 +0.5/0	21
26.0	Ø 32 +0.5/0	31

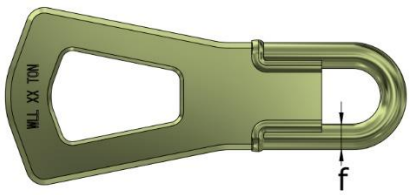
- **The shackle**

If the shackle is deformed or the opening “e” is enlarged, the lifting system must be taken out of use and cannot be repaired. The wear on the shackle must be less than the limits shown in the following table.

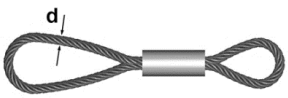
Load group	Nominal dimension e	Maximum dimension e
[t]	[mm]	[mm]
1.25	7 +0.5/0	8
2.5	13 +0.5/0	14
5.0	20 +0.5/0	21
10.0	22 +0.5/0	23
26.0	33 +1.0/0	35

- **The connection element**

Connection elements (bracket) to the crane hook which have visible signs of damage or excessive wear must be immediately taken out of use. The wear on the bracket must be less than the limits shown in the following tables.



Load group	Nominal dimension f	Minimum dimension f
[t]	[mm]	[mm]
2.5	14	13
5.0	20	19
10.0	26	25
26.0	40	38.5



Cable type	Number of visible broken wires over a length of		
	3d	6d	30d
Stranded rope	4	6	16

d = cable diameter

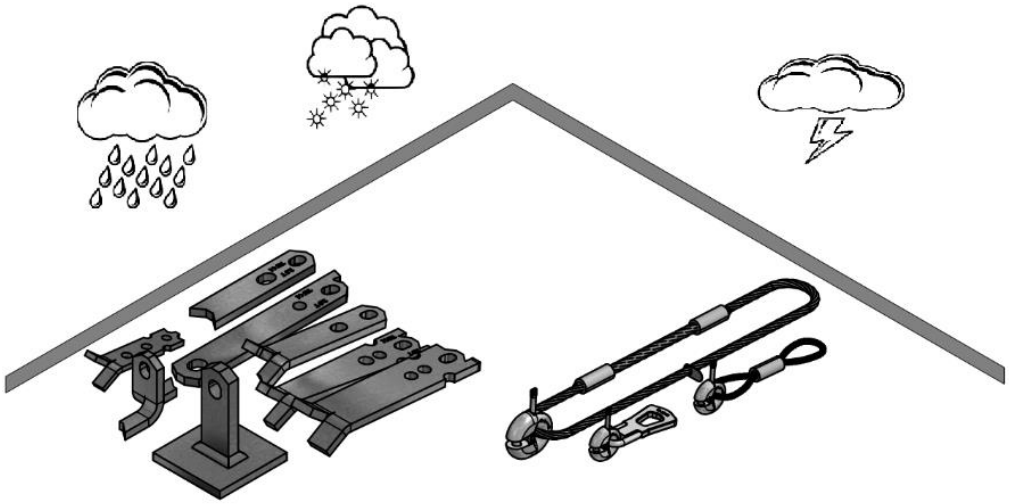
Wire cables should be inspected and discarded according EN 13414-1 when the following flaws occur:

- Kinking
- One strand is broken.
- Separation of the outer layer of braids
- Crushed strands
- Crushing at the shackle contact point with more than 4 ruptured wires on braided cables or more than 10 ruptured wires on cable-laid rope
- Signs of corrosion
- Damage to or severe wear of the closing bush.
- Signs of slipping between the cable and the closing bush
- A cable with several broken wires mentioned in the table above must be taken out of use

Types of wire rope damages		
		
Kinking	**Severe wear**	**Bird caging**
		
Broken wire	**Corrosion**	**Closing bush damage**

STORAGE REQUIREMENTS

Lifting systems and anchors must be stored and protected in dry conditions, under a roof. Large temperature variations, snow, ice, humidity, or salt and saltwater impact may cause damage to anchor and shorten the service life.



SAFETY INSTRUCTIONS

Warning: Use only trained personnel. Use the anchor and the lifting device by untrained personnel poses the risk of incorrect use or falling, which may cause injury or death. The lifting systems must be used only for lifting and moving precast concrete elements.

Obligatory instructions for safe working:

- All lifting anchors and lifting devices must be operated manually.
- Visually inspect lifting anchors before use; check and clean all lifting anchor prior to use.
- Hook in all lifting systems separately, without using force. Never use a hammer to close the lifting device.

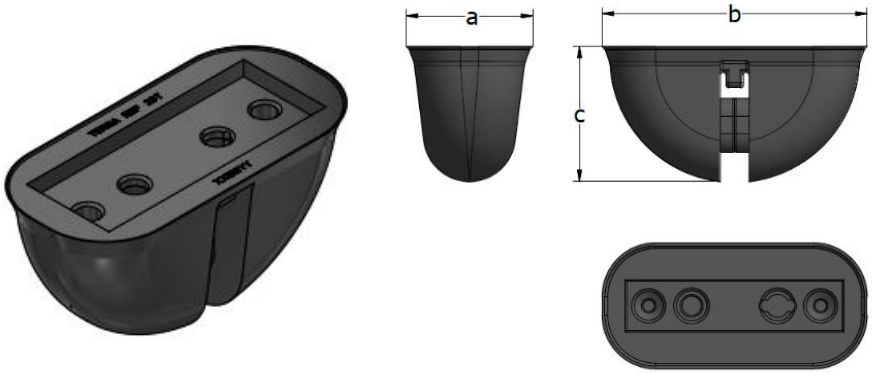
Respect local regulations for safe lifting and hoisting at all times.

Incorrect use may result in safety hazards and reduced load-carrying capacity. This may cause the lifted object to fall and pose a hazard to life and limb. Lifting anchor systems must be used only by suitable trained personnel.

ACCESSORIES

RECESS FORMER “RBF”

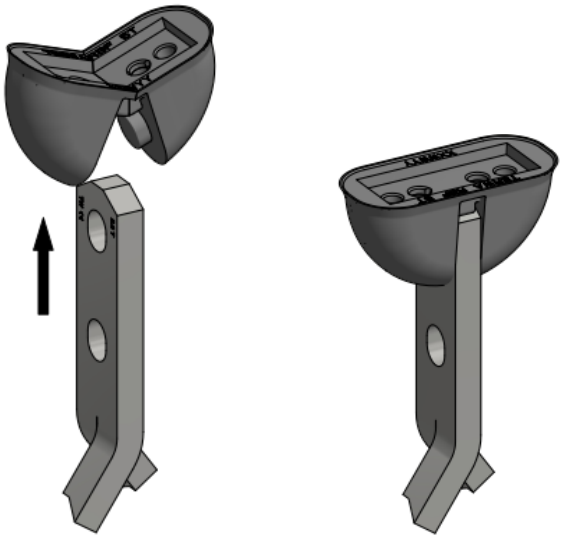
The recess former RBF is made of rubber. It is used to create cavities in concrete round the anchor head. The recess formers are available for load range 1.25 t – 26.0 t



TYPE	Product number	Load group	Dimensions			
			“a”	“b”	“c”	Thread
		[t]	[mm]	[mm]	[mm]	[Metric]
RBF -015	49098	1.25	29	62	35	M 8
RBF -025	45131	0.7– 2.5	43	104	45	M 8
RBF -050	45132	3.0 – 5.0	49	126	59	M 8
RBF -100	45433	7.5 – 10.0	67	188	85	M 12
RBF -260	45134	12.5– 26.0	112	233	121	M 16

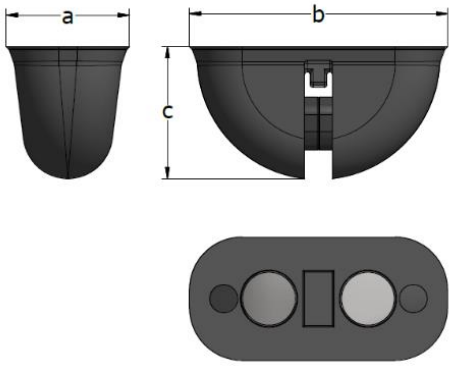
Recess former installation

1) The RBF recess former is opened and placed over the anchor head.
2) Close the RBF recess former to fix the anchor.
3) The recess former and the anchor are then fixed to the formwork.

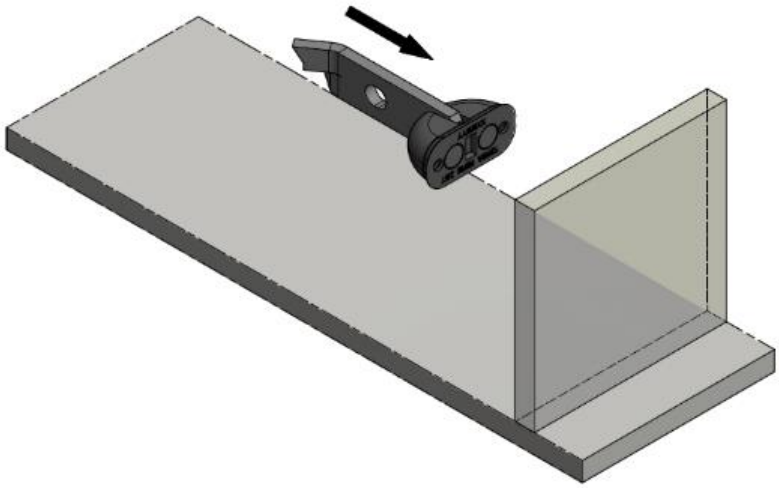


RECESS FORMER “RBFM”

The recess former with magnets RBFM is made of rubber. It is used to create cavities in concrete round the anchor head. The recess formers are available for load range 2.5 t – 10.0 t



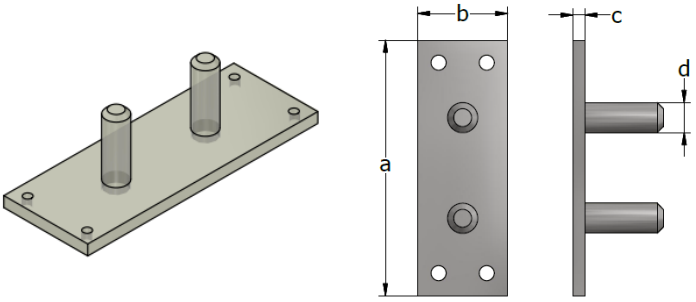
TYPE	Product number	Load group	Dimensions		
			“a”	“b”	“c”
		[t]	[mm]	[mm]	[mm]
RBFM -025	62154	0.7– 2.5	43	104	45
RBFM -050	63083	3.0 – 5.0	49	126	59
RBFM -100	63084	7.5 – 10.0	67	188	85



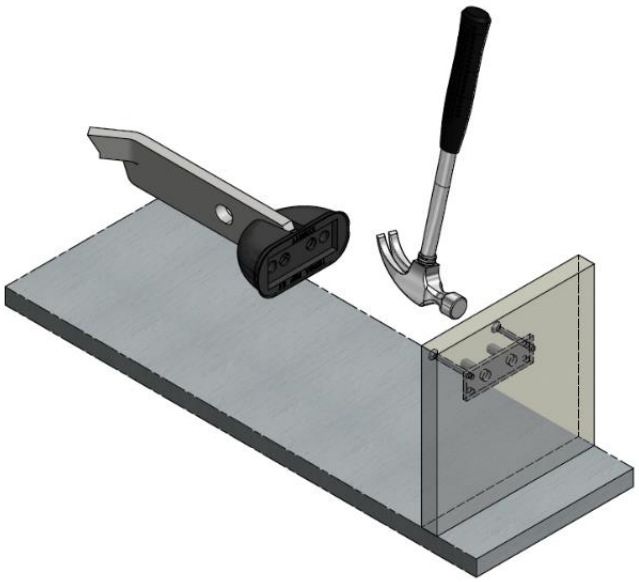
The RBFM magnetic recess former is used in applications where drilling holes in the steel formwork is undesirable.

HOLDING PLATE “TMP”

The holding plate TMP consists of a plate with two studs and four holes for nails. The TMP can be nailed or welded to the formwork. For assembly, the recess former is fitted on the studs. The formwork can then be easily removed without taking the plate off.



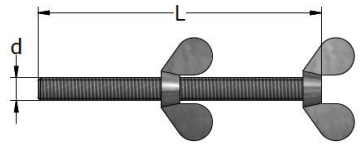
TYPE	Product number	Load group	Dimensions			
			“a”	“b”	“c”	“d”
		[t]	[mm]	[mm]	[mm]	[mm]
TMP -015	49096	1.25	45	15	3	6
TMP -025	45213	0.7– 2.5	73	15	4	10
TMP -050	45169	3.0 – 5.0	85	30	4	10
TMP -100	45170	7.5 – 10.0	128	40	6	12
TMP -260	45171	12.5– 26.0	178	65	8	16



Nail or screw the TMP product to the wooden formwork and press the RBF with the anchor inserted into the holding plate.

THREADED HOLDING BOLT “TDV”

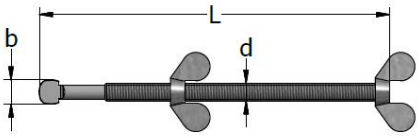
The threaded holding bolt TDV is used for attaching the recess former to the steel formwork. It has a locked wing nut at its upper end. There is another (loose) nut on the thread.



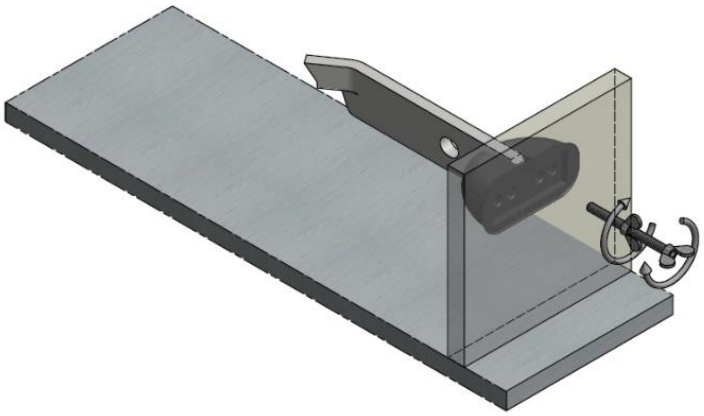
TYPE	Product number	Load group	Dimensions	
			“L”	“diameter”
		[t]	[mm]	[Metric]
TDV - 025	44575	0.7- 2.5	160	M 8
TDV - 050	44576	3.0 – 5.0	160	M 8
TDV - 100	44577	7.5 – 10.0	160	M 12
TDV - 200	44578	12.5 – 26.0	180	M 16

THREADED HOLDING BOLT “TBV” WITH BAYONET END

The threaded holding bolt TBV consists of a threaded bolt with a pressed bayonet end. It is inserted in the bayonet fitting of the recess former and turned 90°.

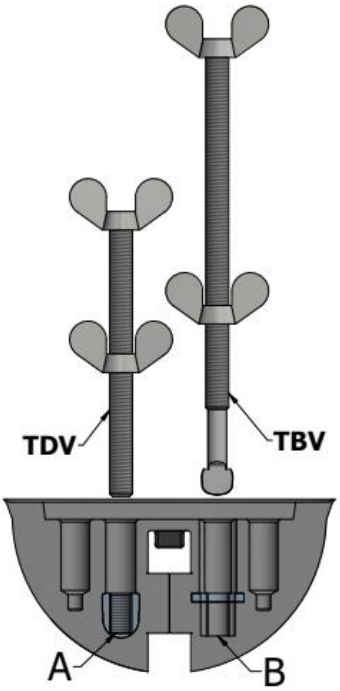


TYPE	Product number	Load group	Dimensions		
			“L”	“b”	“diameter”
		[t]	[mm]	[mm]	[Metric]
TBV - 025	48299	07 – 2.5	160	11	M 8
TBV - 050	48300	3.0 – 5.0	160	11	M 8
TBV - 100	48301	7.5 – 10.0	180	16	M 12
TBV - 200	48302	12.5 – 26.0	180	16	M 16

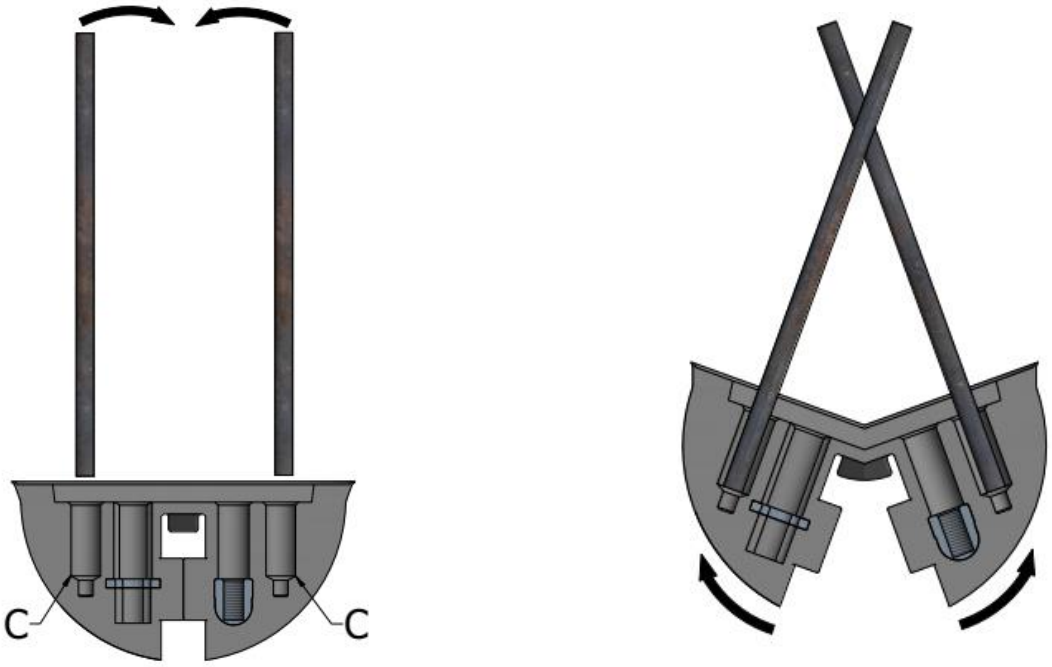


Drill the formwork and push the TBV or TDV into the designated hole, screw the recess former RBF in with the anchor mounted. Pull to formwork and tighten against the formwork using the second nut.

- For fixing with TDV, use the threaded hole **A**
- For fixing with TBV, use the threaded hole **B**



Removal of RBF



To remove the recess former, insert two rods in holes **C** and move towards each other. Do not use a hammer to remove the recess former as that may destroy the former.

SYMBOLS

For the purposes of this Technical Documentation the following symbols apply.

Latin upper-case letters

A_f	the contact area between the formwork and the concrete element when starting to lift
B	minimum height concrete beam
D	diameter
E	design value of the effects of actions
F	acting load in general
F_{adh}	action due to adhesion and form friction
F_G	the deadweight of the precast concrete element
F_Q	shear load acting on the lifting anchor directed perpendicular to the longitudinal axis of the concrete element when lifting from horizontal position with a lifting beam
F_{QZ}	shear load acting on the lifting anchor inclined and perpendicular to the longitudinal axis of the concrete element when lifting from horizontal position with a lifting beam
F_{tot}	total load
F_z	load acting on the lifting anchor in direction of the sling axis
L	length
R	radius
R_d	admissible load (resistance)
R_k	characteristic resistance of the anchoring of lifting inserts or lifting insert system
V	volume of precast unit

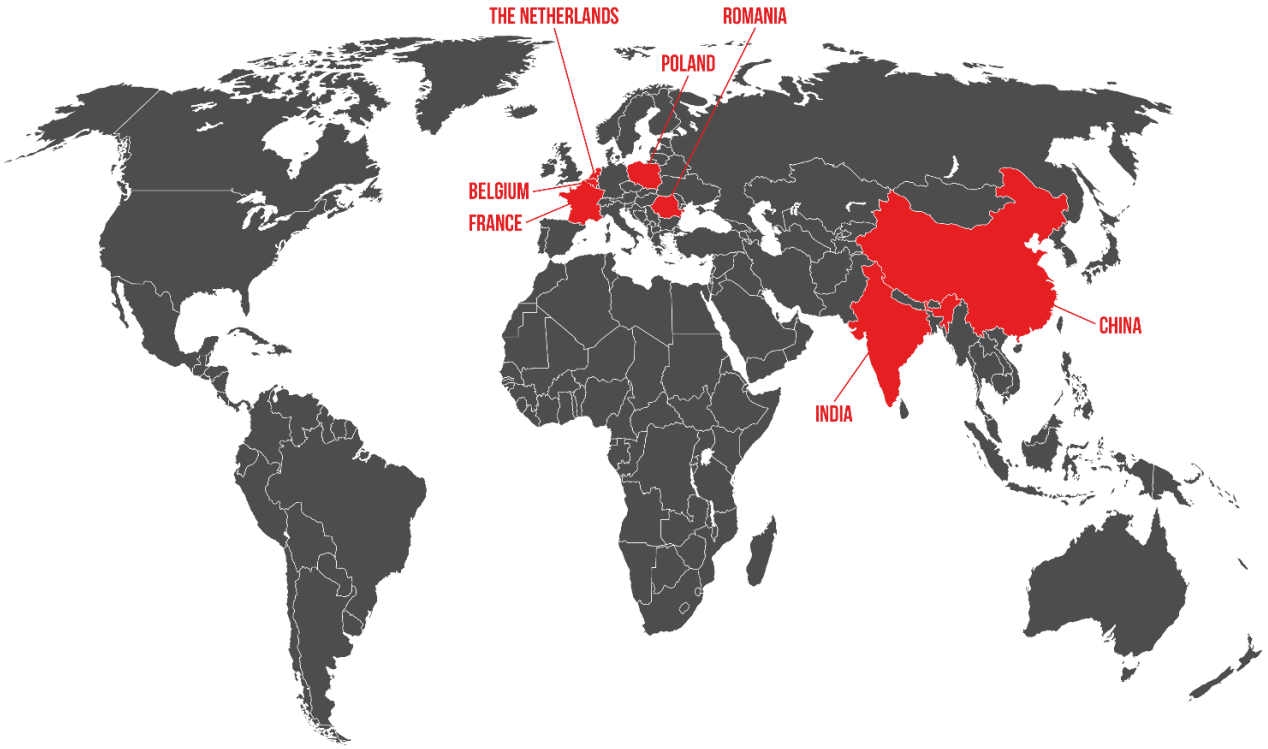
Latin lower-case letters

2 x b	minimum element thickness, for beams and walls
a	the minimum distance between anchors
a x b	the dimensions of the footplate
a/2	minimum edge distance, for beams, walls and slabs
a_g	acceleration of gravity (9.807 [m/s^2], under normal conditions)
b	minimum edge distance for slabs
d	diameter
d_{s1}/d_{s2}	rebar diameter
e	cover to anchor head
h	height of the tilting and turning reinforcement
t	thickness
l	anchor width
l_s	rebar length
n	number of load-bearing anchors
q_{adh}	the adhesion to formwork and form friction factor corresponding to the material of the formwork
s	anchor thickness
w	width
z	cable angle coefficient

Greek lower-case letters

Ψ_{dyn}	dynamic factor
γ_G	specific concrete weight
ρ_G	concrete density
α	rope inclination
β	inclination between the axis of the rope and the longitudinal axis for the lifting insert
γ	global safety factor, factor covers uncertainties in action and resistance

CONTACT



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