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R-System

CE

Lifting system
with spherical head

R-System
Lifting system with spherical head

What is R-System?

Thousands of heavy precast concrete items are lifted and handled on a daily basis.

R-System is the lifting system, tested and certified, mostly used in Italy, and guarantees **highest safety, speed, efficiency, and functionality** at every stage, from design to assembly on site.
The **R-System** lifting system is the result of Ruredil's fifty years experience in special building technology.

Ruredil has completely renewed the original German system with spherical head, introducing a kind of steel to its entire production the **mechanical performances of which are significantly higher that all standards currently available on the market**.






Innovative and unique system in Italy

R-System is the Italian evolution of the original system with spherical head, which solves the problem of tipping and handling of precast concrete panels.

To improve the system, a **special** casted-in plastic **sheath** was created that is specially adaptable and easy to use, which binds the anchor in the cast and allows covering the housings used for hooking.

R-System is innovative because, with its **50% increased efficiency**, it simplifies the designer's work by introducing, **the only one in Italy**, the criterion of **rated capacity = bearable weight**.

From now, reliability on building site has always and everywhere the right weight.

To handle everything at best, there is a real innovation: **R-System, the spherical head lifting system**.




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1 Safety criteria

The lifting anchor is a metal item, a part of which is still in the concrete, thus forming a real "insert".
The part that protrudes from the concrete is instead engaged by a metal "handle" (spherical head) for lifting.

The safety factor for breaking of concrete which surrounds the anchor, which is confirmed by experimental tests, is $\gamma_c > 3{,}00$. The anchor is dimensioned in accordance with the calculation standards for steel $\gamma_a = 2{,}50$ (safety factor for steel failure) and the safety factor for the spherical head, subject to many reuses, is $\gamma > 4{,}00$.

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2 Rated capacity

The rated capacity of the anchor (Pn) is defined as the weight portion of the anchor, the anchor being dimensioned to support a 50% stress increase ($\gamma_{R\text{-}System}$), u which can be used for friction at draft, dynamic actions in handling and assembly with inclined ropes up to 45°.
It is therefore required that the rated capacity is equal to the bearable weight load with a failure safety factor of γ_t, which includes already a 50% traction increase, therefore:0

$\gamma_t = \gamma_{R\text{-}System} \times \gamma_a = 1{,}50 \times 2{,}50 = 3{,}75$
for the protruding metal part;
$\gamma_t = \gamma_{R\text{-}System} \times \gamma_c = 1{,}50 \times 3{,}00 = 4{,}50$
for the part that is anchored in the concrete.

2.1 For tractions in line with the anchor

In the case of line axis, the anchor supports, in addition to the weight of the structure, also dynamic actions with $\gamma_d = 1{,}50$ factor, or adhesion of the structure on the formwork during draft that does not exceed 50% of its weight.

$\gamma_i \times \gamma_d = 1 \times 1{,}50 = 1{,}50 = \gamma_{R\text{-}System}$
the failure safety factor;
$\gamma_t = \gamma_{R\text{-}System} \times \gamma_a = 1{,}50 \times 2{,}50 = 3{,}75$
for the protruding metal part.
γ_i = mark-up for inclined tractions.

Bearable weight
=
rated capacity

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2.2 For Tractions with 45° Angle on the vertical line (during handling)

The weight that the anchor can bear must be, like for the traction in line with the anchor, equal to the rated capacity.
In this case, there is a weight increase coefficient for inclined traction that is γ_i = 1,30.
This coefficient is justified by laboratory failure tests. During handling, a contemporary dynamic coefficient γ_d = 1,15minimum dynamic coefficient is assumed (if specialized cranes are used for prefabricated items and ground stabilizers). Therefore:

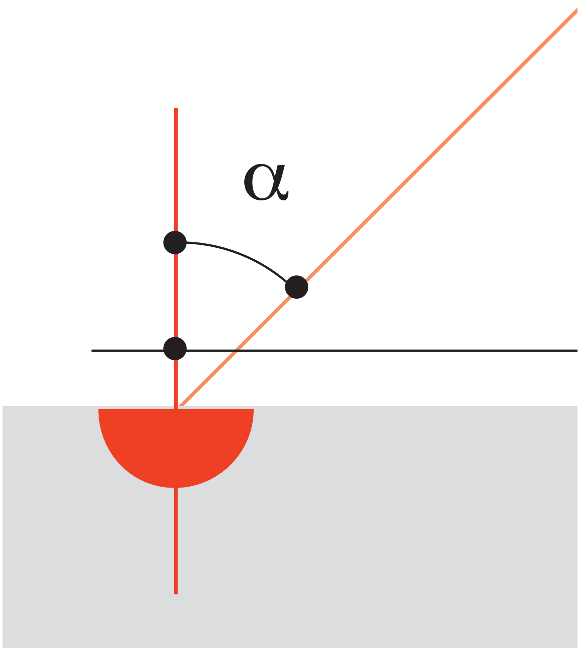
$\gamma_i \times \gamma_d$ = 1,30 x 1,15 = 1,50 = $\gamma_{R\text{-System}}$
and then, as in the case of the traction in the anchor axis,
a failure safety factor;
$\gamma_t = \gamma_{R\text{-System}} \times \gamma_a$ = 1,50 x 2,50 = 3,75
for the protruding metal part.

2.3 For tractions with angle a on the vertical line between 0° and 45°

For α values between 0° e 30° can be safely assumed, while for γ_i = 1 / cos α, while for α = 45° it was seen that γ_i = 1,30.

	0°	15°	30°	45°
γ_i	1,00	1,03	1,15	1,30
γ_d	1,50	1,46	1,30	1,15
$\gamma_{R\text{-System}}$	1,50	1,50	1,50	1,50

From this table it is possible to deduct how to divide the coefficient $\gamma_{R\text{-System}}$ between dynamic loads and loads due to the traction angle on the vertical line. For example, to carry a structure with a crane truck, if the inclination on the vertical line of the traction can be limited to 15°, a dynamic coefficient γ_d equal to 1.46 remains available; that way, it is possible to take advantage of the characteristics of the anchor without going to a higher Pn..



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2.4 Determination of rated capacity Pn

With the preamble made up to now, as an item the weight of which is 100 kN is to be handled, the rated capacity of two anchors symmetrically arranged of 50 kN allows:

- If traction is vertical, to have available a friction to de-molding or a dynamic coefficient in handling and assembly equal to 1.50;
- If the direction of traction is between 0° and 15° on the anchor axis, to have available a friction to de-molding or a dynamic coefficient equal to 1.46;
- If the direction of traction is between 16° and 30° on the anchor axis, to have available a friction to de-molding or a dynamic coefficient equal to 1.30;
- If the direction of traction is between 30° and 45° on the anchor axis, to have available a friction to de-molding or a dynamic coefficient equal to 1.15.

If instead it is possible to apply the minimum dynamic coefficient (γ_d = 1,15), for example when the crane truck is placed on stabilizers for assembly, the rated capacity can be increased by a factor c, which is $c = \gamma_{R\text{-System}} / (\gamma_i \cdot \gamma_d)$.

	0°	15°	30°	45°
$\gamma_{R\text{-System}}$	1,50	1,50	1,50	1,50
$\gamma_i \cdot \gamma_d$	1,15	(1,03·1,15)	(1,15·1,15)	(1,30·1,25)
χ	1,30	1,26	1,13	1,00

For example, two tilting anchors with Pn = 50 kN can lift, with vertical traction, a panel of 50 · 1,30 · 2 = 130 kN.

2.5 Adherence to the formwork

The adherence of the structure to the formwork is difficult to determine, because the friction mainly depends on the effectiveness of the release agent (chemical composition, type, quantity, temperature, surface cleaning, etc.) and the roughness of the material used to make the formwork.
Furthermore, the prestressed structures take on a mount that cancels or greatly reduces the adhesion to the formwork, while the friction may become very high in the presence of little flared surfaces, as in TTs.
Adherence to the formwork and the dynamic action are never simultaneous, but it is recommended that traction is vertical during de-molding; in this case, an adhesion strength equal to 50% of the weight borne by the anchor remains available (suction effect coefficient γ_i = 1,50).
If the adhesion is more than 50% of the weight, the anchor must be dimensioned for a rated capacity increased by the difference between actual adhesion and γ_v = 1,50. As it is not possible to give an adhesion value in m2 for each formwork, it is appropriate to assess any adhesions greater than 50% of the weight during de-molding and possibly act with the vibrators in the formwork to facilitate the detachment of the item.

(For any issues of adherence to the formwork of a structure hooked with four lifting points, see Section 2.7).

2.6 Dynamic loads

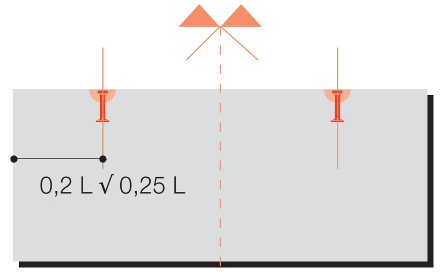
The coefficient that increases the weight of the item for dynamic effects may assume even high values (up to 2.20) as a function of several factors, the most important of which is the movement speed of the artifact.
If, for example, an artifact suspended to its anchors is handled by a vehicle with more or less high speed, it is clear that the dynamic coefficient can take values between 1.30 and 2.20.

During assembly, using crane trucks that are appropriate for prefabricated items with ground stabilizers, and assuming as usual that inclined ropes at no more than 45° are used, the minimum dynamic coefficient γ_d = 1,15 is available, as specified in the standards on prefabricated structures DM 7/12/87.

2.7 Criteria for placement of anchors

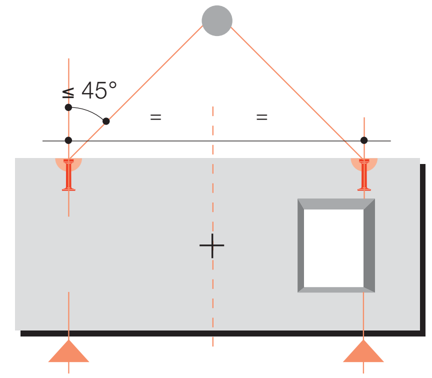
Case of two anchors

● In a symmetrical item, where the vertical line on the center of gravity is on mid-side, it is possible to place the two anchors symmetrically relative to the axis, i.e. at equal distance from the end.
Among the many solutions, it is preferable, in the case of a loose reinforcement, to place the lifting points at a distance between 0.2 L and 0.25 L, so that bending due to its own weight is minized.

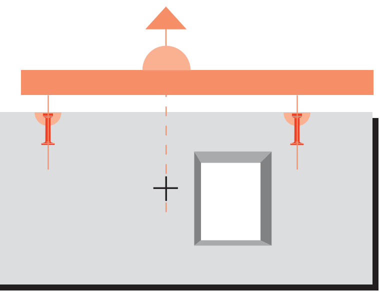


● In the case of prestressed items, the anchors instead should be placed at a distance from the head that is compatible with the shear stresses induced by the weight of protrusions, and in any case not more than 0.2 L.

● In a non-symmetrical item, the anchors should be arranged with the previously exposed criteria, but symmetrical with respect to the vertical line passing through the center of gravity, so that the total weight is split in equal parts on the two anchors.

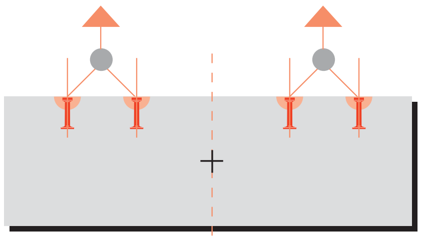


● The use of a self-centering sling, which positions the lifting point on the vertical line of the center of gravity, involves that an anchor bears more weight than the other.
On the other hand, in this case, with a sling with tractions on the anchor axis, the rated capacity of each individual anchor can be considered as increased by 30% (*see Section 02.4*).

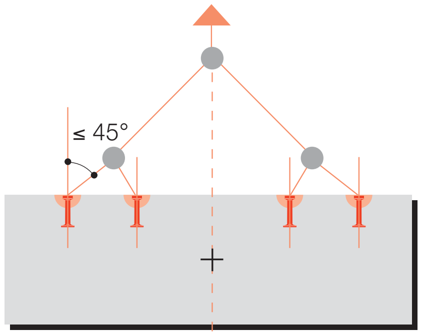


Case of four anchors

- To avoid the danger of uncontrollable load distribution, the case of four in-line anchors must be reduced to two anchors, connecting them two by two.



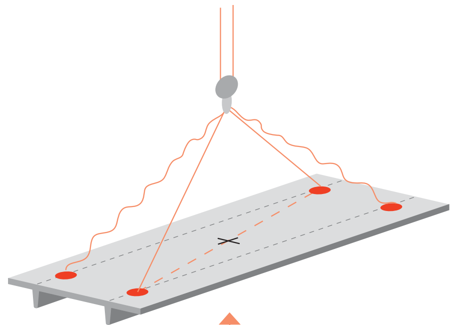
- Also in the case of inclined traction, the maximum inclination of a single rope that starts from the anchor should be ≤ 45°.

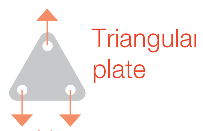


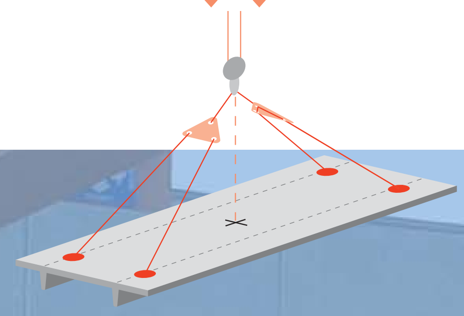
- In the case of four offset anchors, two anchors should be connected by a pulley or a triangular plate or a sling, so that the system is isostatic and a minor error in positioning of anchors does not lead to the great danger of a load distribution on only two of the four anchors.

Between pulley, triangular plate, and sling, it is in any case preferable, upon de-molding, to have a triangular plate with reduced distance between the two points of arrival of the ropes, so that there is a limit in the load distribution; with this solution, it is possible to avoid, upon de-molding, that an adherence force on one rib causes the breaking of the piece during the extraction.

In case de-molding is not possible from the side of the triangular plate, it is simply necessary to reposition the plate on the other two anchors.







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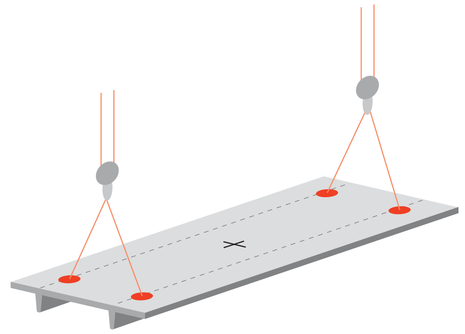
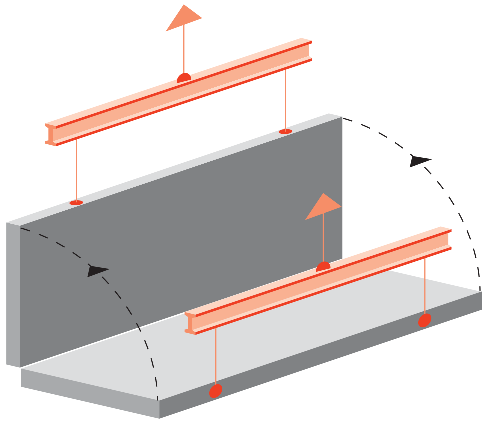
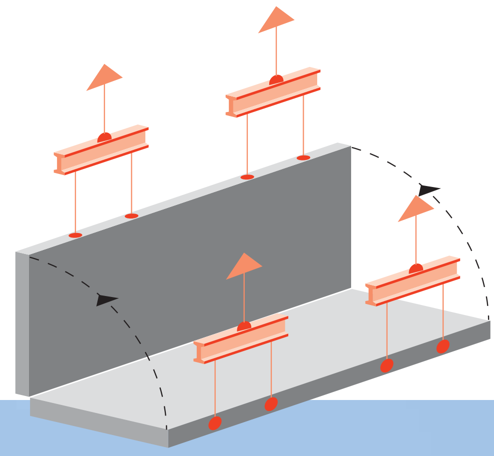
- If two bridge cranes are available for de-molding, four equal independent ropes are required



- In the event of rollover, the traction of the ropes should always act vertically, using two bridge cranes or special sling..



- In case of overturning panels with four anchoring points, it is convenient to use a sling between two neighboring points, thus imposing that the distance between the two neighboring points does not change with the variation of the panel length, to always have the same sling.



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2.8 Verticalization of panels for assembly

● **Initial step**
At this stage, TF is > P/2, but assuming the dynamic load γ_d = 1,15 and vertical or inclined traction of maximum $\alpha/2$ = 15° s° on the vertical line, a traction 30% greater than rated traction is acceptable.
If a = L/5

$$T_F = \frac{P \cdot \frac{L}{2}}{(L - \frac{L}{5})\cos(\alpha/2)} = P \cdot \frac{0{,}625}{0{,}966} =$$

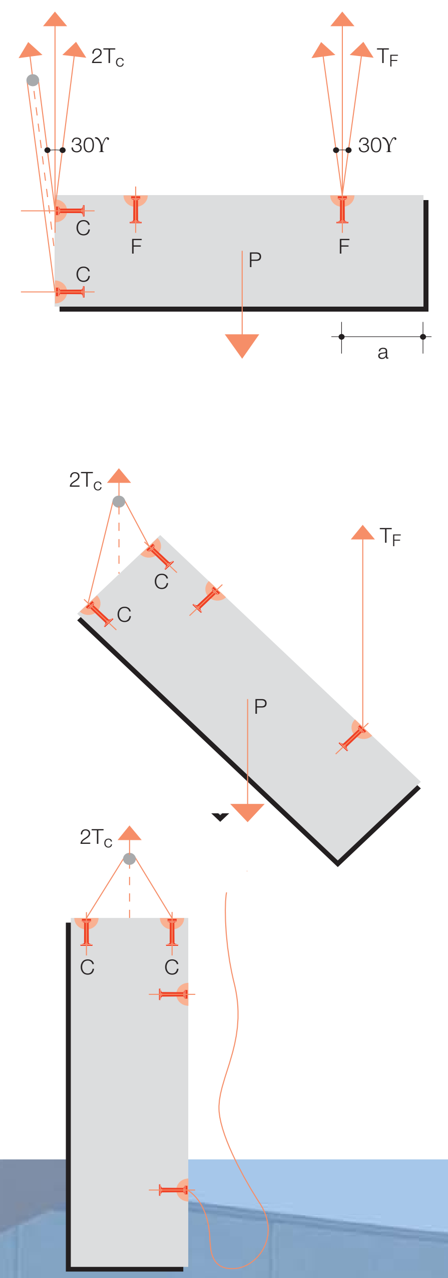
$$= P \cdot 0{,}647 < \frac{P}{2} \cdot 1{,}3 = P \cdot 0{,}65$$

Traction $2T_c$ is lower than P/2 and the two head anchors are each subjected to a traction T_c < P/4.
If a > L/5 5 or traction is more inclined by 15° on the vertical axis, the dimensioning of anchor F should be done in the initial step of rollover.

● **Intermediate straightening step**
Raise the pulley connected to the points C, while the rope F is fixed, with the panel raised from the floor.
On the anchor F, traction T_F is reduced by approaching P/2, while on anchors C the T_c gets progressively closer to P/4.

● **Final step**
When, continuing to recover, the T_F rope is disengaged, the panel has been straightened and the T_c value changes from P/4 to P/2.

To summarize, if at ≤ L/5 and if the traction has an inclination on the vertical line not greater than 15°, the dimensioning of the two anchors F is done during de-molding, with the panel placed horizontally. The dimensioning of the two anchors C is done at the end of verticalization, with T_F = 0.
It should be noted that the requirements for the choice of the type and rated capacity of anchors are those relating to the use with reduced thicknesses.



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3 Types of anchors and accessories

The anchors of the R-System are:
● protruding anchor (DH),
● plate anchor (DP),
● tilting anchor (RS),
● anchor with hole (DF).

For all the anchors, a "special" material is used, which is specially designed to obtain high strength, ductility, and resilience (no strength reduction at low temperatures).

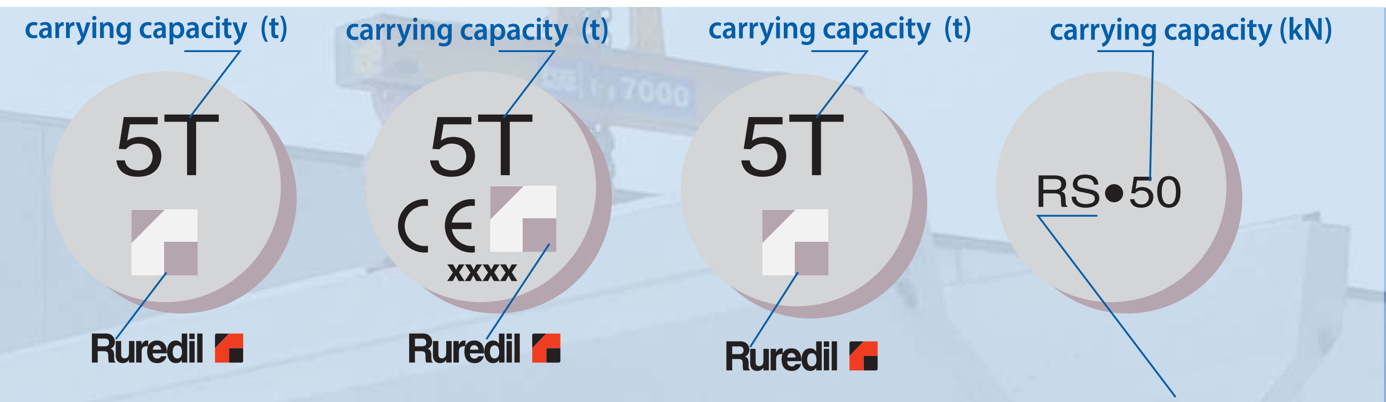
This material guarantees:
● High characteristic tension under controlled rupture and certified for each production batch,
● High ductility,
● High resilience guaranteed KV > 27 J (- 20° C),
● Safety factor ≥ 3.75.

The spherical heads are accessories with maximum six rated capacities, namely:

Spherical head Item	Pn Spherical head kN	Pn anchor kN
6102 - 1,3	13	13
6102 - 1,5/2,5	25	25
6102 - 3/5	50	40
		50
6102 - 6/10	100	75
		100

Identification of anchors – Types of marking

All Ruredil spherical head anchors can be identified by markings stamped on the head.



Protruding anchors with CE marking plate and batch on lower protrusion

Adhering anchors CE marking and batch logo on head

Anchors with hole CE marking and batch on stem

Tilting anchors (RS) CE marking, batch and logo on side

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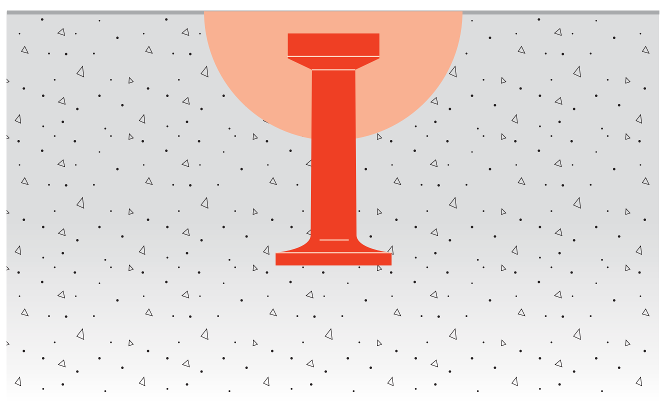
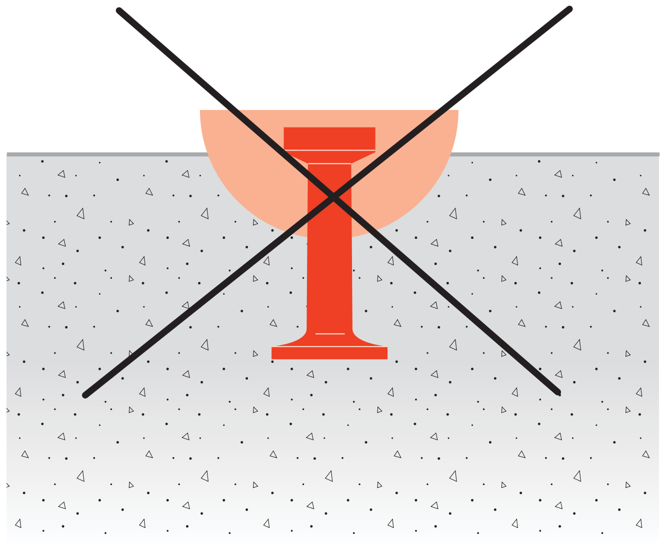
4 Positioning of anchors

Specific sheaths should be mounted before molding on the anchor to produce a semispherical seat in which to introduce the spherical head. It is necessary that the sheath is at the same level as the concrete, so that there is proper coupling between the spherical head and anchor.



Yes



No

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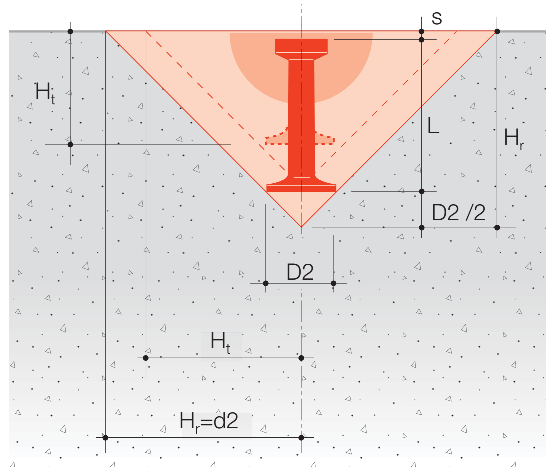
5 Protruding anchors

The concrete in which the anchor is placed is dimensioned with a calculation criterion derived from the Eurocodes and verified with experimental tests to obtain a Safety Factor 3 for traction in the same axis as the anchor, increased by the $\gamma_{R\text{-}System}$ = 1,5 coefficient, that is with:

$$\gamma_t = 3 \times 1{,}5 = 4{,}5$$



5.1 Protruding anchors in non-reinforced concrete

The hypothesis is formulated, which is confirmed by breaking tests carried out, that the spread of efforts during the operation load (that is, not rupture load) occurs with a spread at 45°, starting from the external edge of the protrusion.

Along the surface of the diffusion cone, tensile stresses perpendicular to the surface are supposed, where the vertical components, multiplied by the circular area of diameter 2Ht, result in traction applied on the axis.

The dimensioning of the depth of protrusion derives from the strength of concrete when it is used, which is assumed as:

for reinforced concrete structures upon de-molding	$R_{ckj} \geq 15$ N/mm²
for prestressed structures when cables are released or reinforced concrete structures that have reached the required degree of maturity	$R_{ckj} \geq 30$ N/mm²

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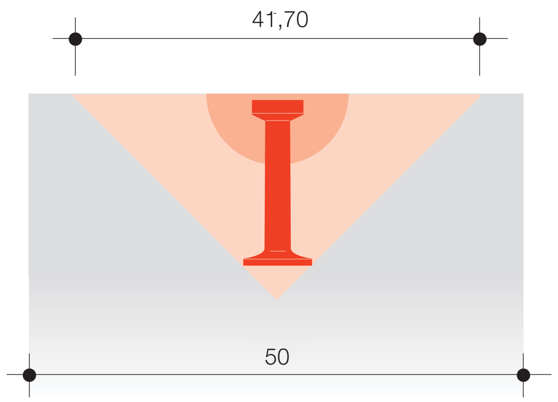
For the range of rated carrying capacities, there are the following values, in centimeters, of Ht (minimum distance required between the anchor and the edge), in the case of items that have no reinforcements in the anchor diffusion cone.

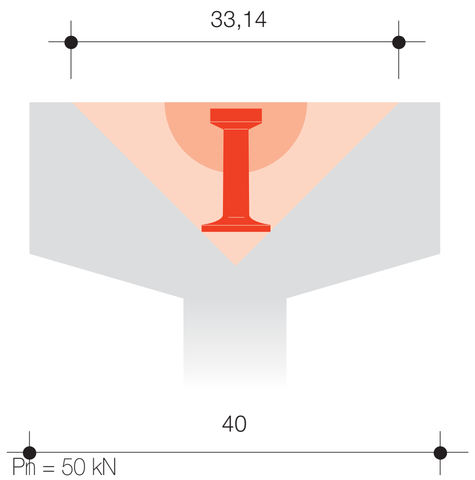
Pn (kN)	13	25	40	50	75	100	150	200	320
H_t per $R_{ckj} \geq 15$ N/mm²	10,63	14,74	18,65	20,85	25,54	29,50	36,11	41,70	52,75
H_t per $R_{ckj} \geq 30$ N/mm²	8,45	11,72	14,82	16,57	20,30	23,44	28,71	32,14	41,93

For example, using a 50 kN anchor for pillars (Rckj ≥ 15 N/mm²) size 50x50, there is no need to worry about the slightest additional reinforcement because Ht = 20,85 cm < 50/2 = 25 cm.



Pn = 50 kN
$R_{ckj} \geq 15$ N/mm²

Similarly, in the case of prestressed flat beams (Rckj ≥ 30 N/mm²), f Spessore minimo necessario per calcestruzzo for Pn = 50 kN there is 2 H = 16.57x2 = 33.14 < 40 cm, therefore no additional reinforcement is required.



Pn = 50 kN
$R_{ckj} \geq 30$ N/mm²

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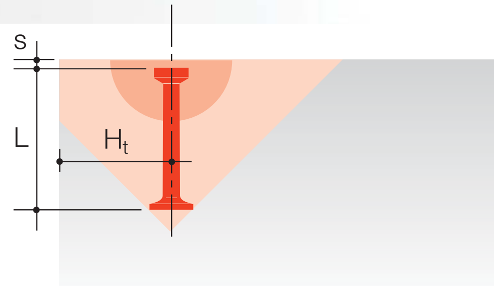
Protruding anchors

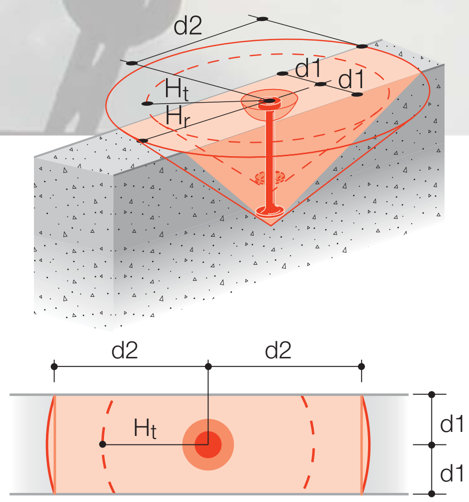
Geometric requirements for standard anchors



Item	Pn kN	L cm	Minimum distance from the edge H_t (cm)	
			R_{ckj} = 15 N/mm²	R_{ckj} = 30 N/mm²
6000 - 1,3 - 85		8,50		
6000 - 1,3 - 120	13	12	10,63	8,45
6000 - 1,3 - 240		24		
6000 - 2,5 - 120		12		
6000 - 2,5 - 170	25	17	14,74	11,72
6000 - 2,5 - 280		28		
6000 - 4,0 - 120		17		
6000 - 4,0 - 170	40	21	18,65	14,82
6000 - 4,0 - 340		34		
6000 - 5,0 - 180		18		
6000 - 5,0 - 240	50	24	20,85	16,67
6000 - 5,0 - 340		34		
6000 - 7,5 - 200		20		
6000 - 7,5 - 300	75	30	25,54	20,30
6000 - 7,5 - 540		54		
6000 - 10,0 - 250		25		
6000 - 10,0 - 340	100	34	29,50	23,44
6000 - 10,0 - 680		68		
6000 - 15,0 - 300		30		
6000 - 15,0 - 400	150	40	36,11	28,71
6000 - 15,0 - 1000		100		
6000 - 20,0 - 340		34		
6000 - 20,0 - 500	200	50	41,70	32,14
6000 - 20,0 - 1000		100		

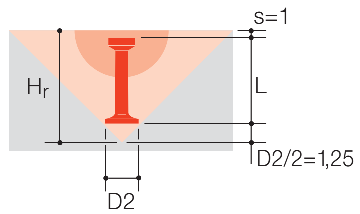
5.2 Minimum thickness required for non-reinforced concrete with no carrying capacity reduction

Sometimes, with an anchoring length greater than the minimum anchoring length, it is possible to reduce the thickness in which the anchor is inserted, provided that a rectangular diffusion area is available that is not smaller than the area shown in the following tables.



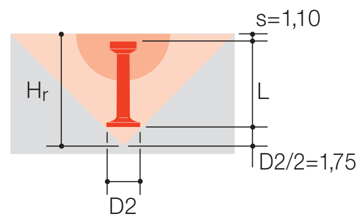
Pn = 13 kN

Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 1,3 - 85	8,50	10,75	10,63	10,00	8,45	5,54
6000 - 1,3 - 120	12	14,25	10,63	6,50	8,45	4,00
6000 - 1,3 - 240	24	26,25	10,63	3,40	8,45	2,10*



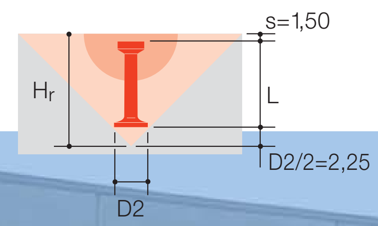
Pn = 25 kN

Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 2,5 - 120	12	14,85	14,74	14,10	11,72	7,70
6000 - 2,5 - 170	17	19,85	14,74	9,00	11,72	5,60
6000 - 2,5 - 280	28	30,85	14,74	6,20	11,72	3,90



Pn = 40 kN

Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 4,0 - 170	17	20,75	18,65	15,50	14,82	9,40
6000 - 4,0 - 210	21	24,75	18,65	11,50	14,82	7,10
6000 - 4,0 - 340	34	37,75	18,65	7,40	14,82	4,60*



** The use with d1 ≥ D2 = 3.0 cm is recommended*

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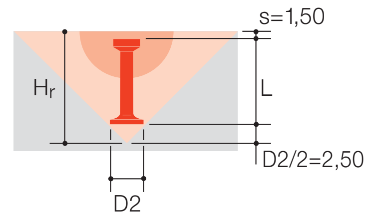
Pn = 50 kN

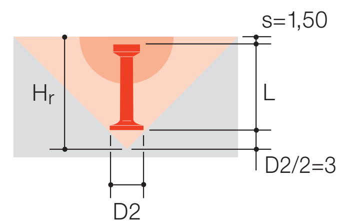
Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 5,0 - 180	18	22	20,85	17,70	16,67	10,40
6000 - 5,0 - 240	24	28	20,85	12,70	16,67	8,00
6000 - 5,0 - 340	34	38	20,85	10,20	16,67	6,50



Pn = 75 kN

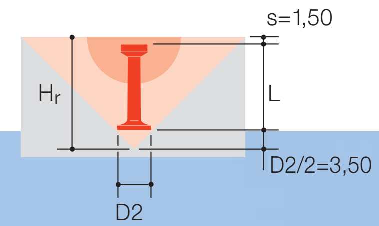
Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 7,5 - 200	20	24,50	25,54	-	20,30	14,20
6000 - 7,5 - 300	30	34,50	25,54	15,40	20,30	9,60
6000 - 7,5 - 540	54	58,50	25,54	8,80	20,30	5,60*

** The use with d1 ≥ D2 = 6.0 cm is recommended*



Pn = 100 kN

Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 10,0 - 250	25	30	29,50	23,80	23,44	14,95
6000 - 10,0 - 340	34	39	29,50	18,30	23,44	11,50
6000 - 10,0 - 680	68	73	29,50	10,10	23,44	6,00*

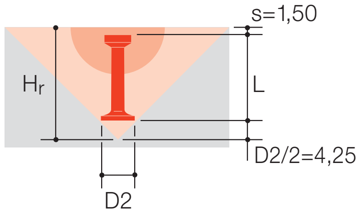


** The use with d1 ≥ D2 = 7.0 cm is recommended*

R-System
Protruding anchors

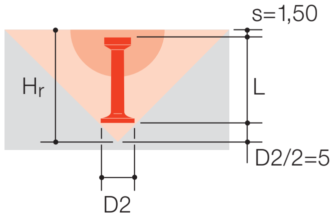
Pn = 150 kN

Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 15,0 - 300	30	35,75	36,11	-	28,71	21,20
6000 - 15,0 - 400	40	45,75	36,11	25,10	28,71	14,60
6000 - 15,0 - 1000	100	105,75	36,11	12,80	28,71	7,70*



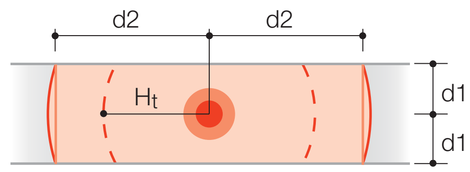
Pn = 200 kN

Item	L cm	$H_r = d_2$ cm	R_{ckj} = 15 N/mm²		R_{ckj} = 30 N/mm²	
			H_t cm	d1 cm	H_t cm	d1 cm
6000 - 20,0 - 340	34	40,50	41,70	-	32,14	21,10
6000 - 20,0 - 500	50	56,50	41,70	25,10	32,14	14,60
6000 - 20,0 - 1000	100	106,50	41,70	12,90	32,14	7,70*



R-System

5.3 Rated capacity reduction for thickness below 2D1 in non-reinforced concrete



Given the rectangle that characterizes the rated capacity, area 2d1 · 2d2, for values d* lower that table values, the rated capacity (P*) is reduced in the d*/d1 ratio

$$P^* = Pn \cdot d^*/ d1$$

Example
Considering an anchor with Pn = 50 kN,
if R_{ckj} = 15 N/mm² → d1 = 17,7 cm.
Having d* = 15 cm available, the following is obtained:

$$P^* = 50 \cdot 15/17{,}7 = 42{,}4 \text{ kN}$$

5.4 Rated capacity reduction for characteristic strength lower than non-reinforced concrete

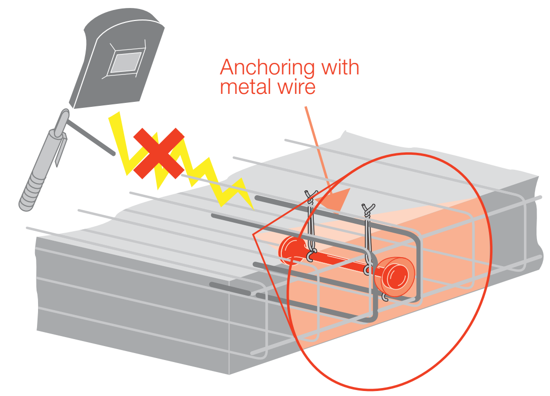
Two characteristic strengths were used: Rckj = 15 N/mm² mm2 (non-prestressed items upon de-molding), and R_{ckj} = 30 N/mm² (prestressed items or reinforced concrete items matured when lifted). For lower values, the rated capacity Pn is proportional to fctk, in turn proportional to R_{ckj} 2/3 therefore $R_{ckj}^* = K \cdot R_{ckj}$ table, with K between 0.75 and 1, is therefore:

$$Pn^* = Pn \cdot (R_{ckj}^* / R_{ckj})2/3$$

Example
If R_{ckj}^* = 25 N/mm², instead of 30 N/mm²
for a Pn = 50 kN anchor, the result is:

$$Pn^* = 50\ (25/30)^{2/3} = 44 \text{ kN}$$

5.5 Strengthening reinforcement to obtain rated capacity in lower thicknesses



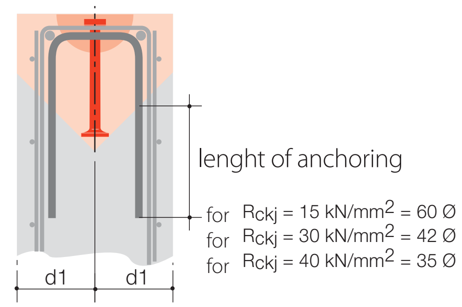
If the diffusion cone is not complete, appropriate reinforcement can be used, provided that all the rated capacity is assigned to the reinforcement only. Therefore:

$$A_f = Pn \cdot 1{,}5 / \sigma_{amm}$$

For example, if Pn = 50 kN, in a thickness of 15 cm, using steel type FeB44k

$$A_f = 50 \cdot 1{,}5 / 26 = 2{,}88 \text{ cm}^2 = 4\ Ø\ 10$$

Usually two U-shaped rods are placed as shown in the Figure.



R-System

5.6 Geometrical prescriptions for short anchors

The anchors listed below can still be used without additional reinforcement, provided that their distance from the edge is ≥ Ht and provided that it is R_{ckj} ≥ 40 N/mm². The additional reinforcement allows using such protruding anchors of reduced length for both R_{ckj} < 40 N/mm², for distances from the edge of less than H_t.

Item	Pn kN	L cm	H_r	d1 = H_t = distance from the edge	Additional reinforcement for reduced thickness and R_{ck} > 15 and < 40 N/mm²	
				with R_{ck} ≥ 40 N/mm² f_{ctk} = 2,20 N/mm²	A_f cm²	4 Ø ...
6000 - 1,3 - 65	13	6,50	8,75	7,69	0,75	4 Ø 6
6000 - 2,5 - 85	25	8,50	11,35	10,66	1,44	4 Ø 8
6000 - 4,0 - 100	40	10,00	13,75	13,48	2,30	4 Ø 10
6000 - 5,0 - 120	50	12,00	16,00	15,08	2,88	4 Ø 10
6000 - 7,5 - 165	75	16,50	21,00	18,46	4,32	4 Ø 12
6000 - 10,0 - 170	100	17,00	22,00	21,32	5,77	4 Ø 14
6000 - 15,0 - 210	150	21,00	26,00	26,11	8,65	4 Ø 18

5.7 Use limits of protruding anchors

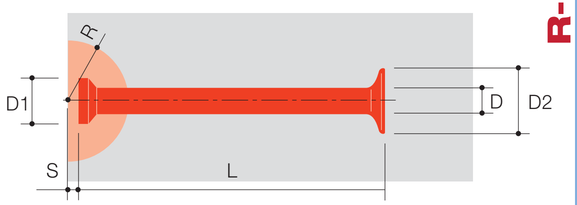
In any case, a limit should be put to the distance d1 between the axis of the anchor and the outer surface by imposing, for example, that this value does not exceed the greater between the diameter of the lower projection (D2) and the radius of the hemispherical seat (Ø / 2), then:

	Pn (kN)	13	25	40	50	75	100	150	200	272
d1 (min)	cm	3,0	3,7	4,7	5	6	6,9	8,5	9,8	13,5

In the case the thickness is lower than these values, an anchor with hole (DF) should be used.
It should also be remembered that the anchor, in the case of reduced thickness, must be positioned with accuracy and, therefore, it cannot be inserted after casting has been completed. Also, it should not move during casting and/or vibration.

R-System
Protruding anchors

Hot galvanizing UNI EN ISO 1461

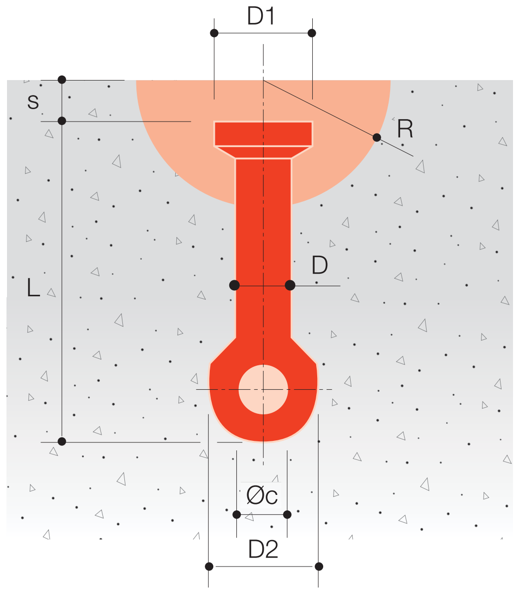


Code Black	Code Galvanized	Item	Pn kN	L mm (±3)	D mm (±0,5)	D1 mm	D2 mm	s mm	R mm	Pack. pieces
0301001010	0301002003	6000 - 1,3 - 65	13	65	10	19 (±1)	25 (+2/-3)	10	30	300
0301001011	0301002004	6000 - 1,3 - 85	13	85	10	19 (±1)	25 (+2/-3)	10	30	200
0301001012	0301002005	6000 - 1,3 - 120	13	120	10	19 (±1)	25 (+2/-3)	10	30	200
0301001014	0301002006	6000 - 1,3 - 240	13	240	10	19 (±1)	25 (+2/-3)	10	30	100
0301001022	0301002011	6000 - 2,5 - 85	25	85	14	26 (±1)	35 (+2/-4)	11	37	100
0301001023	0301002012	6000 - 2,5 - 120	25	120	14	26 (±1)	35 (+2/-4)	11	37	50
0301001024	0301002013	6000 - 2,5 - 170	25	170	14	26 (±1)	35 (+2/-4)	11	37	50
0301001025	0301002014	6000 - 2,5 - 280	25	280	14	26 (±1)	35 (+2/-4)	11	37	40
0301001028	0301002025	6000 - 4,0 - 100	40	100	18	36 (±1)	45 (+2/-5)	15	47	50
0301001030	0301002027	6000 - 4,0 - 170	40	170	18	36 (±1)	45 (+2/-5)	15	47	40
0301001031	0301002028	6000 - 4,0 - 210	40	210	18	36 (±1)	45 (+2/-5)	15	47	25
0301001032	0301002029	6000 - 4,0 - 240	40	240	18	36 (±1)	45 (+2/-5)	15	47	25
0301001033	0301002030	6000 - 4,0 - 340	40	340	18	36 (±1)	45 (+2/-5)	15	47	20
0301001037	0301002045	6000 - 5,0 - 120	50	120	20	36 (±1)	50 (+2/-5)	15	47	40
0301001038	0301002046	6000 - 5,0 - 180	50	180	20	36 (±1)	50 (+2/-5)	15	47	25
0301001039	0301002047	6000 - 5,0 - 240	50	240	20	36 (±1)	50 (+2/-5)	15	47	25
0301001040	0301002048	6000 - 5,0 - 340	50	340	20	36 (±1)	50 (+2/-5)	15	47	15
0301001044	0301002069	6000 - 7,5 - 165	75	165	25	46 (±1)	60 (+3/-6)	15	59	20
0301001045	0301002067	6000 - 7,5 - 200	75	200	25	46 (±1)	60 (+3/-6)	15	59	10
0301001046	0301002068	6000 - 7,5 - 300	75	300	25	46 (±1)	60 (+3/-6)	15	59	10
0301001047	0301002070	6000 - 7,5 - 540	75	540	25	46 (±1)	60 (+3/-6)	15	59	5
0301001051	0301002084	6000 - 10,0 - 170	100	170	28	46 (±1)	69 (+3/-7)	15	59	10
0301001052	0301002085	6000 - 10,0 - 250	100	250	28	46 (±1)	69 (+3/-7)	15	59	15
0301001054	0301002086	6000 - 10,0 - 340	100	340	28	46 (±1)	69 (+3/-7)	15	59	10
0301001056	0301002090	6000 - 10,0 - 680	100	680	28	46 (±1)	69 (+3/-7)	15	59	1
0301001058	0301002092	6000 - 15,0 - 210	150	210	36	69 (±1)	85 (+3,5/-8)	15	80	1
0301001059	0301002093	6000 - 15,0 - 300	150	300	36	69 (±1)	85 (+3,5/-8)	15	80	1
0301001060	0301002094	6000 - 15,0 - 400	150	400	36	69 (±1)	85 (+3,5/-8)	15	80	1
0301001070	0301002096	*6000 - 15,0 - 1000	150	1000	36	69 (±1)	85 (+3,5/-8)	15	80	1
0301001066	0301002104	6000 - 20,0 - 340	200	340	39,5	69 (±1)	98 (+4/-9)	15	80	1
0301001067	0301002105	6000 - 20,0 - 500	200	500	39,5	69 (±1)	98 (+4/-9)	15	80	1
0301001068	0301002106	*6000 - 20,0 - 1000	200	1000	39,5	69 (±1)	98 (+4/-9)	15	80	1

** Items on demand*

6 Anchors with hole

For the external part, the information described in chapters 1 to 5 is applicable, while for the part in concrete, anchoring is achieved by placing a bar in the anchor hole, which can be either straight or shaped with appropriate curvatures.



Item	Pn kN	Hole diameter mm	Straight bar Feb 44k		2 brackets with 2 arms diameter o As Ø mm
			Ø mm	L cm	
6001 - 1,3	13	10	8	16	5
6001 - 2,5	25	13	12	24	8
6001 - 5,0	50	18	16	32	10
6001 - 10,0	100	25	22	44	14
6001 - 20,0	200	37	32	64	20

The total area A_s of the brackets that pass through the diffusion cone is dimensioned with the following formula::

$$A_s = Pn \,.\, 1{,}5 \,/ \sigma_f$$

Using two brackets with two arms, i.e. four bars that cross the diffusion cone, the diameter of the two brackets A_s, can be determined, as per the example on page 88.

6.1 Anchors with hole with straight reinforcement

In the case of straight reinforcement to be inserted into the hole, it is possible to use a bar with improved adherence FeB44k, and a strand section.

However, the dimensioning of the anchors with hole made as described above cannot be designed for non-reinforced concrete, as the hole itself and the bar that passes inside get the same effect as a protruded anchoring, but with insufficient height of the stem.

Therefore, it should be checked that the surface of the cone is crossed by anchored vertical bars, the overall area A_s iof which is able to support the whole of the rated load multiplied by 1.5.

The bar dimensioning is carried out, for the rated load, with 50% increase (dynamic coefficient or friction on the formwork), i.e. in the condition of traction in the axis. For inclined tractions, dimensioning made for traction in the axis is precautionary. The operating tension in the case of FeB44k is σ_{amm} = 260 N/mm² = 26 kN/cm².

The required area is dimensioned by assuming that the projection on the eyelet is able to directly absorb one third of the load:

$$A_f\ (cm^2) = Pn \cdot 1{,}5 \cdot 2/3 \cdot \sqrt{3} \,/\, (2 \cdot \sigma_{amm}) =$$

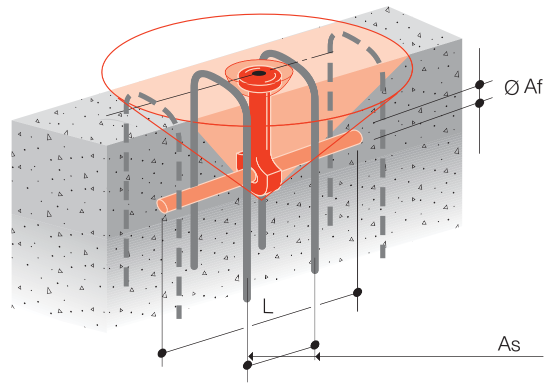
$$= 0{,}866 \cdot Pn \,/\, \sigma_{amm} = 0{,}033 \cdot Pn$$

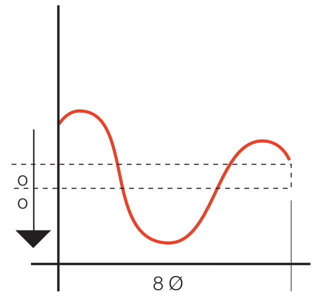
$$Ø_t\ (mm) = 10 \cdot \sqrt{0{,}033 \cdot Pn \cdot 4 / TT} = 2{,}05 \cdot \sqrt{Pn}$$

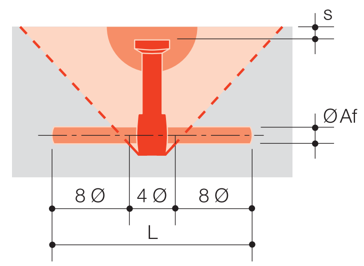
The minimum length of the bar is calculated with the following formula:

$$L = 4\,Ø + 2 \cdot 8\,Ø = 20\,Ø$$

It is possible to use strand sections, where, however, it is necessary to limit the tension to values that are double the tension of FeB44k.







Example:
consider 6001 - 5,0 con Pn = 50 kN and calculate the diameter and length of the straight bar and/or strand,

$$A_f = 50 \cdot 0{,}033 = 1{,}65 \text{ cm}^2 \text{ pari a } 1\ Ø\ 16 = 2 \text{ cm}^2$$

or

$$A_{tr} = \frac{50 \cdot 0{,}033}{2} = 0{,}83 \text{ cm}^2$$

equal to approximately the area of the 1/2" strand.

The length of the bar Ø 16 is:

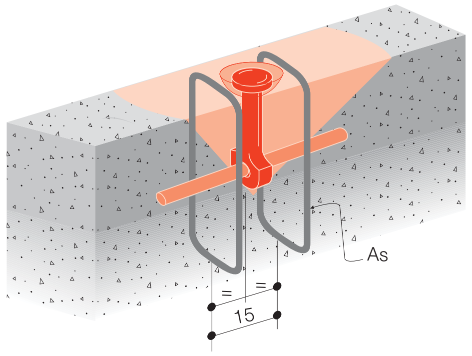
$$L = 20 \cdot 1{,}6 = 32 \text{ cm}$$

The area of one of the four As bars is:

$$L = 20 \cdot 1{,}5 = 30 \text{ cm}$$

The area of one of the four As bars is:

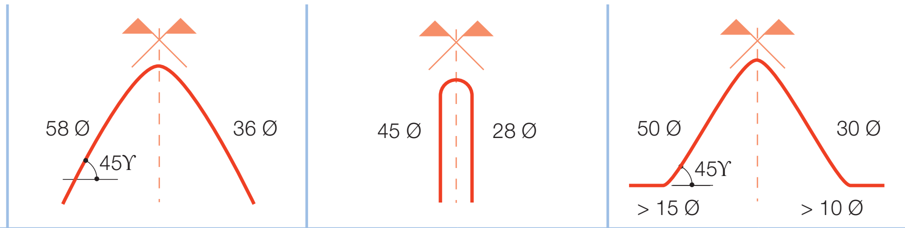
$$A_s = 50 \cdot 1{,}5 / 26 \cdot 4 = 0{,}72 \text{ cm}^2 = 1\ Ø\ 10$$



$$L = 4\,Ø + 2{\cdot}8\,Ø = 20\,Ø$$

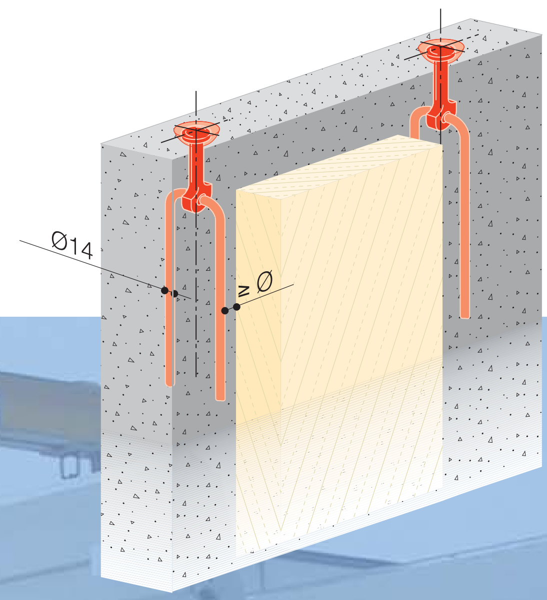
6.2 Anchors with hole with shaped reinforcement

If the geometry allows it, anchoring can be brought to depth by shaping, according to EC2, the bar in three ways *(see the table shown below)*, such as to be able to transfer the traction much lower and therefore without requiring any other additional reinforcement.



Item	Pn kN	Diameter of the shaped bar Feb44k mm	15 N/mm²	30 N/mm²	15 N/mm²	30 N/mm²	15 N/mm²	30 N/mm²
6001 - 1,3	13	8	80	50	65	40	75	45
6001 - 2,5	25	10	110	70	95	60	100	65
6001 - 5,0	50	14	160	95	130	80	140	90
6001 - 10,0	100	20	220	135	185	115	200	125
6001 - 20,0	200	28	315	190	265	160	285	175

Example:
for a vertical panel (R_{ckj} = 30 N/mm² because it is stressed only for mounting), for Pn = 50 kN, , it is assumed Ø 14 L_{tot} = 80 cm.



R-System

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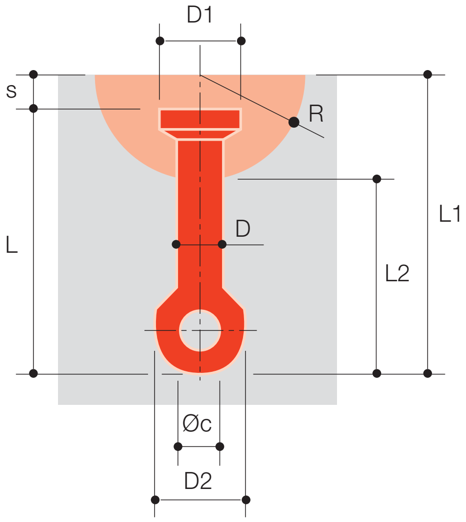
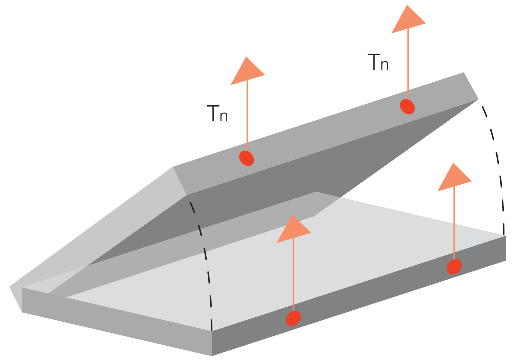


Code		Item	Pn kN	L mm (±3)	L1 mm (±3)	L2 mm	s mm	D mm (±0,5)	D1 mm	D2 mm (-0/+1)	Ø c mm (-0/+1)	R mm	Pack. pieces
Black	Galvanized												
0301005001	0301054001	6001 - 1,3	13	65	75	45	10	10	19 (+0,8/-1)	19	10	30	250
0301005002	0301054002	6001 - 2,5	25	90	101	64	11	14	26 (+0,8/-1)	32	13,50	37	100
0301005003	0301054003	6001 - 5,0	50	120	135	88	15	20	36 (+0,8/-1)	42	18	47	50
0301005004	0301054004	6001 - 10,0	100	180	195	136	15	28	46 (+1/-1)	57	25	59	20
0301005005	0301054005	6001 - 20,0	200	250	265	185	15	39,5	69 (+0,5/-1,5)	76	37	80	1

R-System

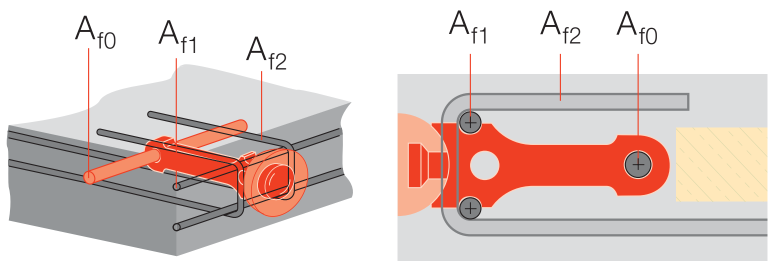
7 Anchors for RS tipping

These anchors are suitable to roll-over and handling of all prefabricated concrete panels $R_{ckj} \geq 15$ N/mm^2 and minimum thickness ≥ 16 cm.
Tilting anchors are designed to withstand, in addition to the rated load Pn, which acts in the same direction of the anchor axis, a traction Tn = 0.5 Pn that is normally achieved by overturning the prefabricated item onto the formwork.
As regards the reinforcement referred to a load Pn acting on the anchor axis, reference is made to the dimensioning criteria described for anchors with hole (*see Section 06*).
The special configuration of the anchor was designed to prevent the lifting handle to apply pressure against low-strength concrete (usually R_{ckj} = 15 N/mm^2), thus causing exposed lesions on the panel.
A special reinforcement must be able to transfer the traction in the bottom part of the panel. To this end, two methods are suggested, as shown in the next page.



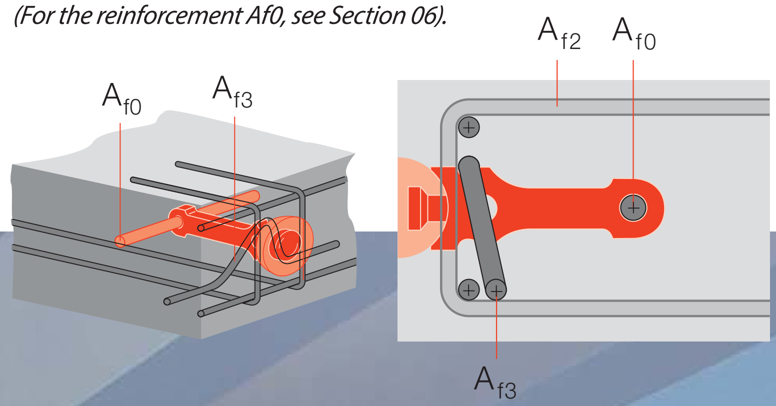
R-System
Tilting anchors RS

First method: the reinforcement Af1 of the panel is used, in the case the seat of the anchor corresponds to the position of the reinforcement. *(For the reinforcement Af0, see Section 06)*.



Item	Pn kN	Straight bar Feb 44k		Bracket A_{f2} (cm)	
		Theoretical A_{f1} (cm²)	Ø (mm)	Theoretical A_{f1} (cm²)	Ø (mm)
6003 - 2,5 RS	25	0,625	1 Ø 10	0,36	2 Ø 6
6003 - 5,0 RS	50	1,25	1 Ø 14	0,72	2 Ø 8

Second method: when the panel strength reinforcement cannot be placed on the appropriate location of the anchor, use a shaped rod with two arms at 45°, as shown in the Figure below.
(For the reinforcement Af0, see Section 06).



Item	Pn kN	Straight bar Feb 44k			
		A_{f3} cm²	Ø mm	= 15 N/mm²	= 30 N/mm²
				L cm	
6003 - 2,5 RS	25	0,51	8	80	50
6003 - 5,0 RS	50	1,10	12	120	70

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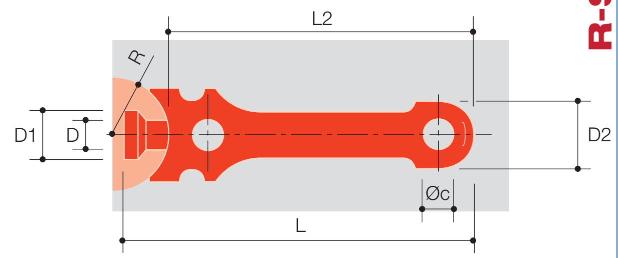
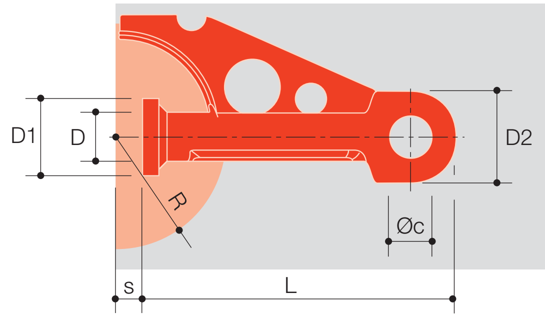
Hot galvanization UNI EN ISO 1461



Code		Item	Pn kN	L mm (±1)	D mm (-0/+1)	D1 mm (+0,5/-1)	D2 mm (±1)	Ø c mm (+0,5/-1)	Pack. pieces
Black	Galvanized								
0301083001	0301082001	6003 - 2,5 RS	25	200	14	26	36	15	25
0301083002	0301082002	6003 - 5,0 RS	50	200	20	36	46	20	15

7.1 Special anchor for tipping of panels (with a comb)

Sometimes, with an anchoring length greater than the minimum length, the thickness in which the anchor is inserted can be reduced, provided that a rectangular diffusion area not lower than the area shown is available.

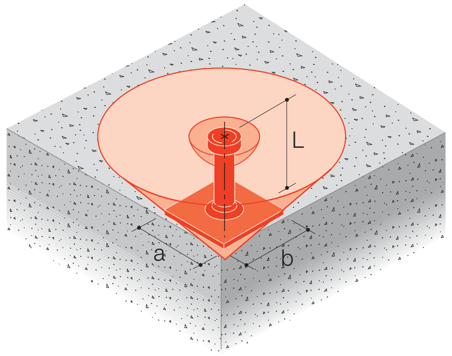


Code		Item	Pn kN	L mm (±1)	D mm (-0/+1)	D1 mm (+0,5/-1)	D2 mm (±1)	Ø c mm (+0,5/-1)	Pack. Pieces
Black	Galvanized								
0301050004	0301052004	6002 - 10,0 - 215	100	215	28	46	25	25 (±5)	10

R-System
Plate anchors

8 Plate anchors without additional rods

When the thickness is reduced, a plate can be engaged on a short anchor. With its stiffness, the plate is able to create a cone having a sufficient strength.
The plate anchors without additional rods can only be used with high-strength concrete, i.e. with $R_{ckj} \geq 40$ N/mm². They are available in three capacity levels, namely 25, 50, and 100 kN.

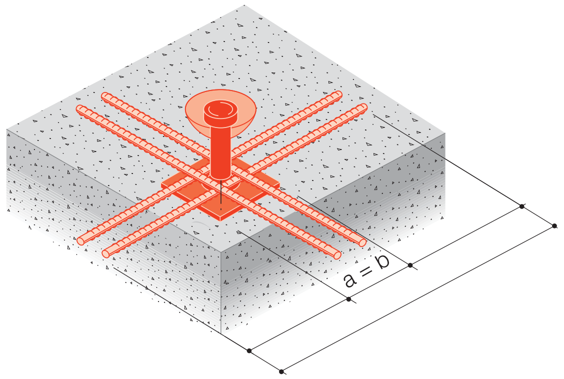


Item	Pn kN	R_{ckj} = 40 N/mm² f_{ctk} = 0,246 kN/cm²			
		plate dimensions a x b mm	Actual L mm		
6010 - 2,5	25	70x70	5,5		12
6010 - 5,0	50	90x90	(5,5)	(6,5)	11,00
6010 - 10,0	100	90x90		(11,5)	

The actual heights in brackets cannot be used without an additional reinforcement.

8.1 Plate anchors with additional rods

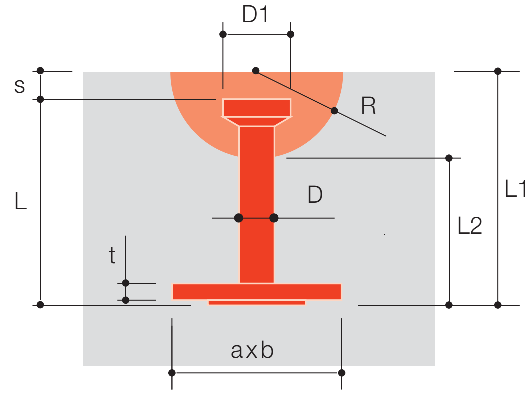
The shear dimensioning of bars is done as follows: in the case of low resistance, but with $R_{ckj} \geq 30$N/mm² and anyhow for each actual L, anchoring can be ensured by four additional bars positioned above the plates.



Pn kN	Theoretical A_f cm²	Ø of rods mm	L cm
25	0,625	10	30
50	1,250	12	40
100	2,500	18	50

R-System

Electrolytic galvanization ≥ 12 □m



Code		Item	Pn kN	L mm (±3)	L1 mm (±3)	L2 mm	s mm	D mm (±0,5)	D1 mm (±1)	a x b x t mm (±2)	R mm	Pack. pieces
Black	Galvanized											
0301006001	0301055001	6010 - 2,5 - 55	25	55	66	29	11	14	26	70x70x6	37	50
0301006002	0301055002	6010 - 2,5 - 120	25	120	131	94	11	14	26	70x70x6	37	25
0301006003	0301055003	6010 - 5,0 - 55	50	55	70	23	15	20	36	90x90x8	47	25
0301006004	0301055004	6010 - 5,0- 65	50	65	80	33	15	20	36	90x90x8	47	25
0301006005	0301055005	6010 - 5,0 - 110	50	110	125	78	15	20	36	90x90x8	47	20
0301006007	0301055006	6010 - 10,0 - 115	100	115	130	71	15	28	46	90x90x10	59	10
0301086001	0301055008	6010 - 7,5 - 160	75	160	175	116	15	25	46	90x90x10	59	10

9 Sheaths for anchor positioning

The anchor shall be positioned with its recess sheaths. With few exceptions, the lifting anchors with spherical head are mounted with hemispherical sheaths. The sheaths have various functions: among others, they allow lifting with oblique tractions with no need for reductions, and avoid the need to insert joints with different carrying capacity.
The recess sheaths have different diameters, depending on the different capacities, which are printed on the upper face of the sheath.

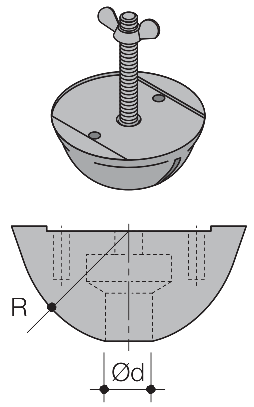
9.1 Circular rubber sheaths

Round rubber sheaths are suitable for all types of prefabricated items. They can also be used in hot concrete castings or concrete castings heated up to 120 °C.

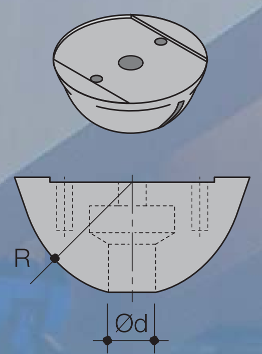
Full circular rubber sheath

Code	Item	Carrying capacity group kN	d mm (±1)	R mm (±1)	Package pieces
0301010001	6140 - 1,0/1,3	10/13	10	30	1
0301010002	6140 - 1,5/2,5	15/25	14	37	1
0301010003	6140 - 3,0/5,0	30/50	20	47	1
0301010005	6140 - 8,0/10,0	80/100	28	59	1
0301010007	6140 - 16,0/20,0	160/200	39	80	1
0301010008	*6140 - 32,0	320	50	107	1

** Item on demand*



Circular rubber sheath



Code	Item	Carrying capacity group kN	d mm (±1)	R mm (±1)	Package pieces
0301014001	6139 - 1,0/1,3	10/13	10	30	1
0301014002	6139 - 1,5/2,5	15/25	14	37	1
0301014003	6139 - 3,0/5,0	30/50	20	47	1
0301014005	6139 - 8,0/10,0	80/100	28	59	1
0301014007	6139 - 16,0/20,0	160/200	39	80	1
0301014008	*6139 - 32,0	320	50	107	1

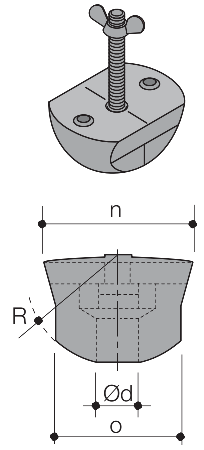
** Item on demand*

9.1.1 Molded rubber sheaths

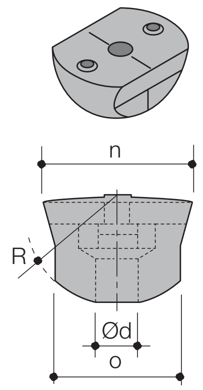
Molded rubber sheaths are suitable for thin prefabricated items, as circular rubber sheaths, and can also be used for hot concrete castings or concrete castings heated up to 120 °C.

Full molded rubber sheath

Code	Item	Carrying capacity group kN	d mm (±1)	R mm (±1)	n mm (±1)	o mm (±1)	Pack. pieces
0301012001	6138 - 1,0/1,3	10/13	10	30	42	34	1
0301012002	6138 - 1,5/2,5	15/25	14	37	52	43	1
0301012003	6138 - 3,0/5,0	30/50	20	47	69	58	1
0301012005	6138 - 8,0/10,0	80/100	28	59	85	78	1
0301012007	6138 - 16,0/20,0	160/200	39	80	124	116	1



Molded rubber sheath



Code	Item	Carrying capacity group kN	d mm (±1)	R mm (±1)	n mm (±1)	o mm (±1)	Pack. pieces
0301013001	6137 - 1,0/1,3	10/13	10	30	42	34	1
0301013002	6137 - 1,5/2,5	15/25	14	37	52	43	1
0301013003	6137 - 3,0/5,0	30/50	20	47	69	58	1
0301013005	6137 - 8,0/10,0	80/100	28	59	85	78	1
0301013007	6137 - 16,0/20,0	160/200	39	80	124	116	1

9.1.2 Mounting of rubber sheaths

The rubber sheath must be placed over the anchor head.
The lifting anchor can be inserted with the sheath rubber also from above, directly in fresh concrete (with workability ≥ S4).

REMOVAL OF RUBBER SHEATHS

The rubber sheaths are provided with two holes. To remove the sheath from hardened concrete, reinforcement bars are inserted in the holes. The sheath is then extracted by leveraging.

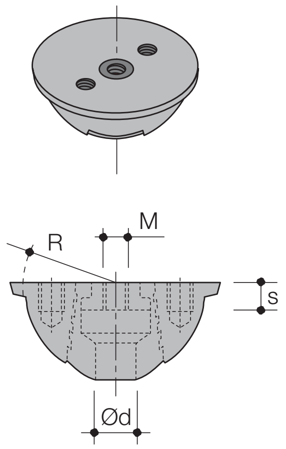
R-System

9.2 Conical steel sheath for tubes

The steel sheath for tubes with inner cone is dimensioned so as to ensure secure fastening of lifting anchors with spherical head.
The head of the lifting anchor and steel plate with internally threaded holes for fixing to the mold must be arranged between the two inner half-cones. After it has been assembled, the inner cone is then inserted into the steel sheath. The steel sheath can be fixed to the formwork with a standard screw. The thread sizes are shown in the table. If a steel formwork is used, the sheath can also be fixed to a closure lid. In this case, the advantage is that the sheath can be removed before the removal of the mold.

Conical steel sheath for tubes

Code	Items	Carrying capacity group kN	s mm	d mm (±1)	R mm (±1)	M mm (±1)	Pack. pieces
0301063001	6144 - 1,0/1,3	10/13	10	11	30	8	1
0301063002	6144 - 1,5/2,5	15/25	11	15	37	10	1
0301063003	6144 - 3,0/5,0	30/50	15	21	47	12	1
0301063004	6144 - 6,0/7,5	60/75	15	25	59	16	1
0301063005	6144 - 8,0/10,0	80/100	15	29	59	16	1
0301063006	6144 - 12,0/15,0	120/150	15	36	80	16	1
0301063007	6144 - 16,0/20,0	160/200	15	41	80	16	1



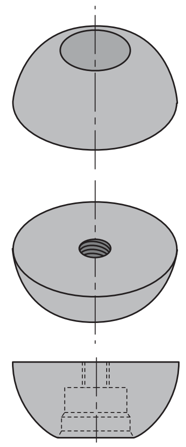
R-System

9.3 Conical steel sheath with rubber reducer

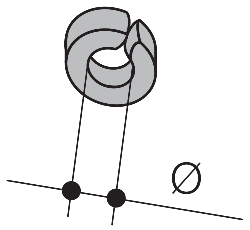
Sometimes it is necessary to release the lifting anchor with spherical head from an inaccessible sheath. This occurs when a prefabricated item must be turned upside down after the removal of the mold.
In this case, the anchors with spherical head can only be used after the end of tipping operations.
For this purpose, or for similar uses, a steel sheath with rubber reducer is required. The lifting anchor with spherical head is placed with the head in the internal hollow to the sheath and locked in its position by a rubber reducer.
If steel sheath is used for horizontal mounting of a lifting anchor, measures must be taken to avoid that the lifting anchor disengages inadvertently during vibration (for example, by fixing the anchor to the reinforcement or locking it with spacers)..

Circular steel sheath

Code	Item	Carrying capacity group kN	s mm	R mm (±1)	M mm (±1)	Pack. pieces
0301019001	6150 - 1,0/1,3	10/13	10	30	8	1
0301019002	6150 - 1,5/2,5	15/25	11	37	12	1
0301019003	6150 - 3,0/5,0	30/50	15	47	12	1



Neoprene reducer for steel sheath



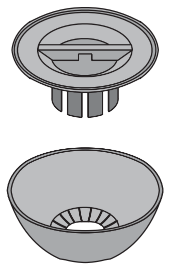
Code	Item	Carrying capacity kN	Internal diameter mm (±1)	Conf. pezzi
0301003001	6151 - 1,0/1,3	10/13	10	100
0301003002	6151 - 1,5/2,5	15/25	14	100
0301003003	6151 - 3,0/5,0	30/50	20	100

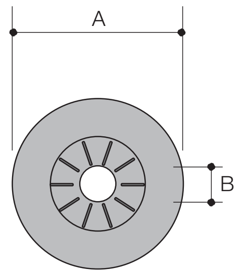
R-System

9.4 Embedded sheaths

In some cases, for positioning of the anchors, it may be more convenient to use embedded sheaths.

9.4.1 Normal embedded sheaths (art. 6101)



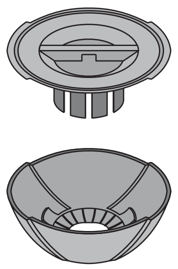


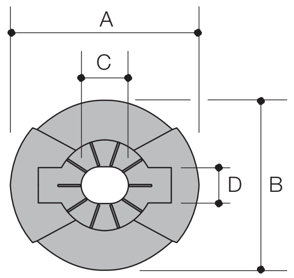
Hemispherical embedded sheaths are suitable for all types of prefabricated items. They are particularly appreciated for the practical result (cleaning of the recess). The lid provided can be reused to close the exposed recesses of the pillars.
They are available in two versions and can be used for 25, 40, and 50 kN anchors..

Embedded sheaths

Code	Item	Carrying capacity kN	Diameter of recess A mm (±1)	Diameter of hole B mm (±1)	Package pieces
0301085001	6101 - 1,5/2,5	25	79	16	200
0301085002	6101 - 3,0/5,0	50	99	22	150
0301085003	6101 - 7,5	75	119	27	100
0301085004	6101 - 10,0	100	119	30	100

9.4.2 RS Embedded sheaths (item 6100)





RS embedded sheaths have a special hemispherical shape with two rays and are suitable for prefabricated panels that have to be overturned at the time of de-molding (tipping side).
They are available in two versions for tipping anchors (Item 6003 RS); the cover is reusable.

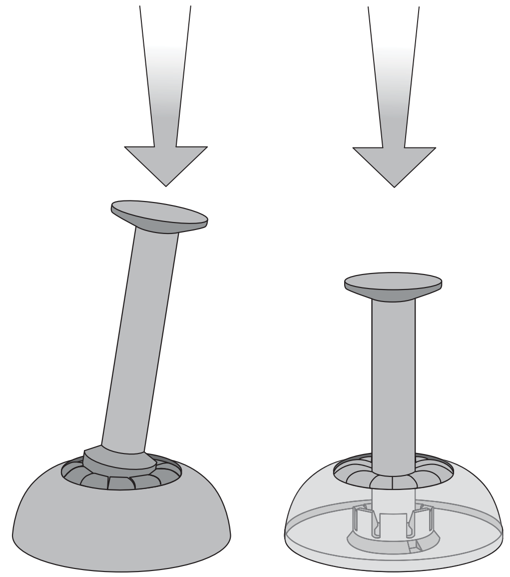
Embedded sheaths R-System

Code	Item	Carrying capacity kN	Diameter of recess A mm (±1)	Diameter of recess B mm (±1)	Diameter of hole CxD mm (±1)	Package pieces
0301084001	6100 - 1,5/2,5 RS	25	85	79	21x16	200
0301084002	6100 - 3,0/5,0 RS	50	100	99	28x22	150

R-System

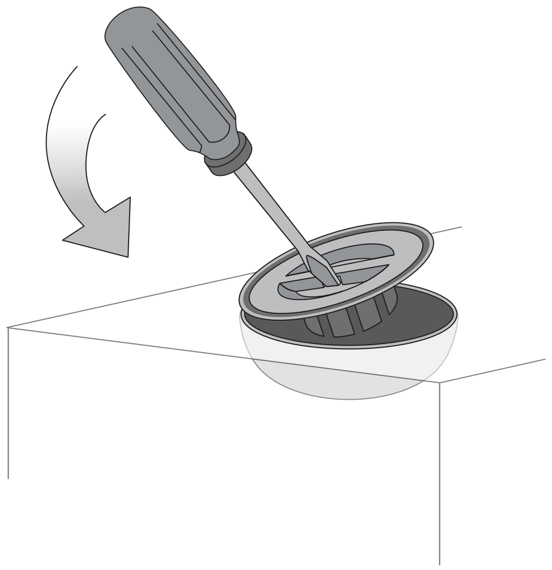
9.4.3 Mounting of embedded sheaths

The embedded sheaths were designed to facilitate the user.
It is recommended to fit the cover on the spherical cap, holding the sheath with one hand; press with the anchor head at an angle, on the wings installed in the spherical part. When the anchor head has passed the inlet hole, make sure that the wings have elastically returned to their original position. If not, just slightly retract the anchor and the wings will return.
To lock the anchor head, just press firmly against the lid. In the case of embedded sheaths for tilting, insert the comb into the sheath housing. With embedded sheaths it is possible to insert the anchors directly into fresh concrete (with workability ≥ S4)..



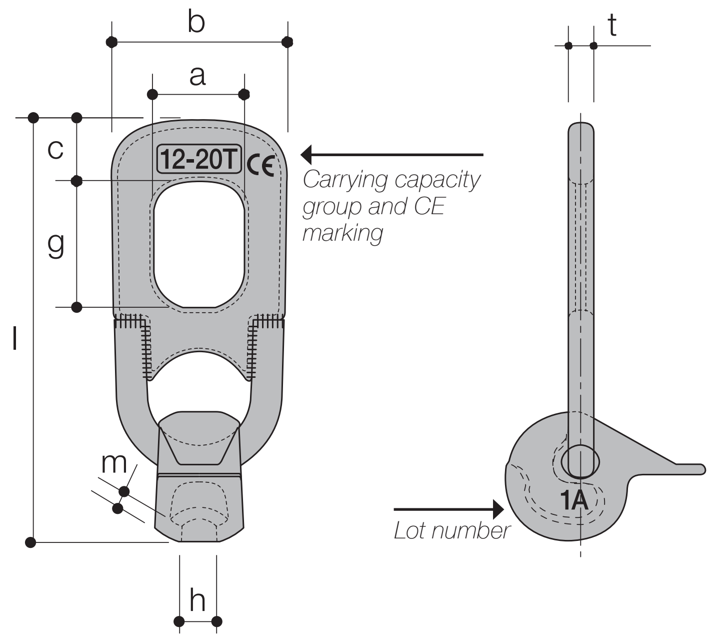
9.4.4 Removal of embedded sheath lid

The lid was designed to securely retain the anchors in their seat; it is recommended to use it also for aesthetic closing of exposed anchors (for example in the pillars).
The top surface of the lid has a groove; to remove the cover upon de-molding, just leverage with a screwdriver, or any other flat and rigid pin, into the housing.



10 Operating instructions for universal spherical head

Universal spherical heads should be used as described in these operating instructions together with the installation instructions.
The complete system is certified only if it consists of the universal spherical head and lifting anchors with spherical head R-System; **no different use is allowed** (for example, with non-original R-System anchors).
The universal spherical head is manually operated and is supplied in the versions shown in the following table.

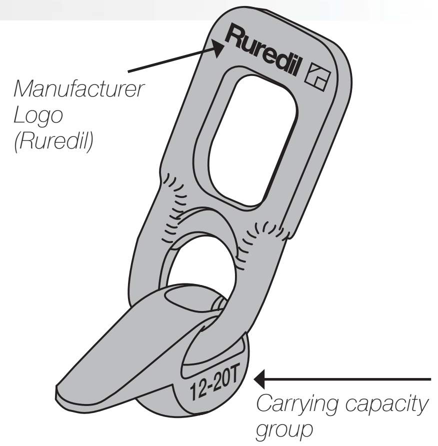


Universal spherical head

Code	Item	Carrying capacity group kN	a mm	b mm	c mm	g mm	h mm	l mm	m mm	t mm	Pack. pieces
0301004012	6102 - 1,0/1,3	10/13	44	74	20	70	11,5 ± 0,5	192	6,5	12	1
0301004013	6102 - 1,5/2,5	15/25	56	88	25	85	16 ± 0,5	233	9	14	1
0301004010	6102 - 3,0/5,0	30/50	68	118	37	88	21,75 ± 0,75	283	10	16	1
0301004014	6102 - 6,0/10,0	60/100	82	160	50	112	30 ± 1	397	14	26	1
0301004015	6102 - 12,0/20,0	120/200	113	191	75	135	42,5 ± 1,5	522	21	30	1

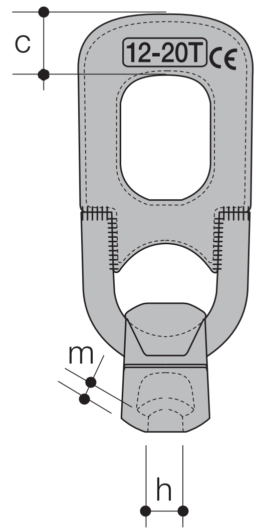
10.1 Identification marking of universal spherical head

Each universal spherical head is identified by the marking. The front of the safety closure is characterized by the manufacturer's name. On the back, carrying capacity and operation symbol are shown.
The ball is marked with the load group, the serial number, or batch identifier. The universal spherical head can be used with all R-System lifting anchors reported in this manual.



10.2 Regular check of universal spherical head

The user is responsible for ensuring that the universal ball heads are used only after they have been properly checked.
The user shall ensure an annual inspection of the universal ball heads by qualified staff, who will report the data of specific registers.
It is very important that not only any kind of damage but also the degree of wear are detected.
If the limit values shown in the table are exceeded in the case of "h", if the limit values shown in the table are exceeded in the case of "m" and "c", the universal spherical head must be replaced immediately.



Carrying capacity group kN	Maximum dimensions h mm	Minimum dimensions m mm	Minimum dimensions c mm
1,0/1,3	13,0	5,5	14,0
1,5/2,5	18,0	6,0	17,5
3,0/5,0	25,0	8,0	28,0
6,0/10,0	32,0	12,0	36,0
12,0/20,0	46,0	18,0	56,0

R-System

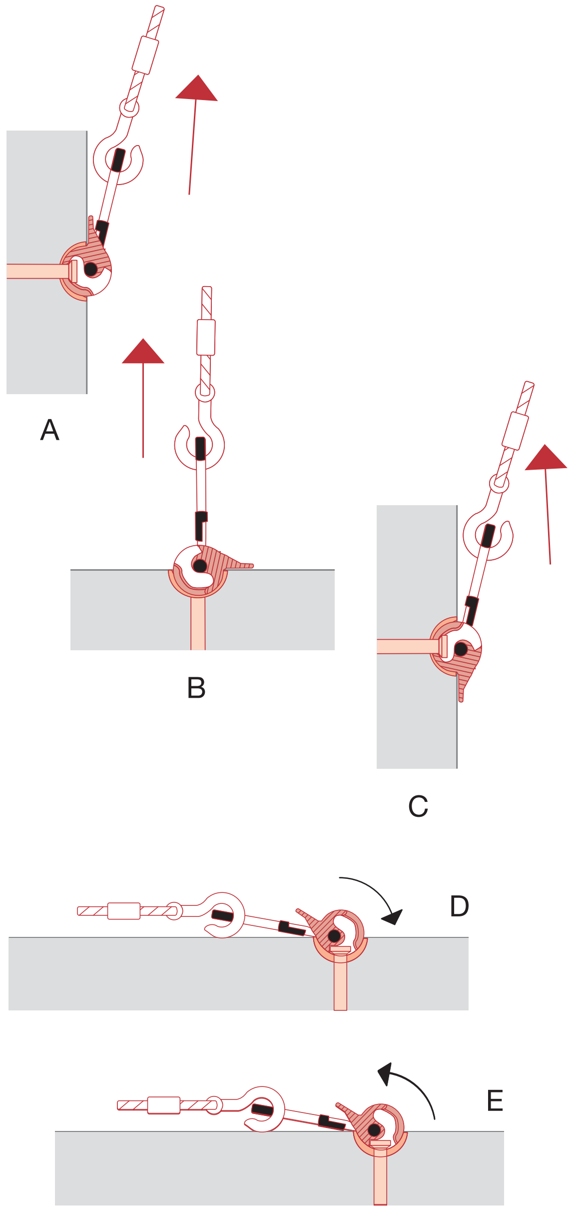
10.3 Operation of the universal spherical head

In general, the required safety measures in force must be applied during lifting and carrying operations, especially those relating to the use of cranes.
The staff in charge of the engagement and release of lifting anchors and accessories must be properly trained and informed about legal provisions and requirements contained in this manual.

Engagement
To engage the universal spherical head with the anchor, the crane ropes should not be under tension; insert the ball to the anchor with the opening facing downwards *(Figure D)*. The ball coupling tooth is then rotated down. Always make sure that the rotation is complete *(Figure A and Figure B)*.
When lifting with angled traction or tilting, the safety lock must be in the right position *(Figure A)*.
Avoid lifting operations with the safety lock in the position opposite to traction *(Figure C)*.

In subsequent stages, thanks to the counterweight of the safety closure, the ball is always maintained in the right position.
With the universal head, any turning, tipping, and rotation movement is allowed and completely safe.

Release
To release the anchor, release the load and make sure that the cables are not under tension.
To unlock, rotate the ball upwards and extract the spherical head *(Figure E)*.



R-System
Calculation examples

Vertical panel

1. DATA
A) concrete at de-molding, R_{ckj} 15 N/mm^2;
B) concrete during handling, R_{ckj} 30 N/mm^2;
C) removable side panels and separators;
D) own weight = 100 kN.

2. TRACTION
A) de-molding stage, with sling and tipping;
B) handling stage, ropes inclined at 45° on the vertical line.

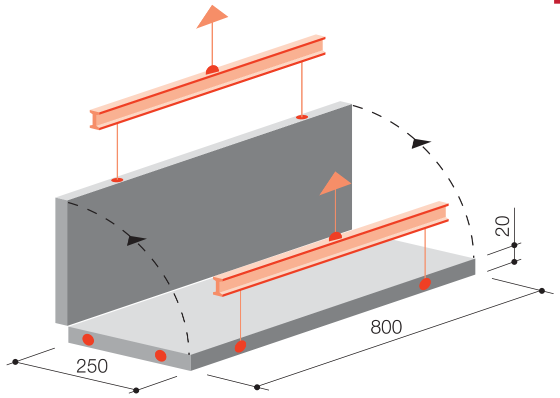
3. LIFTING DEVICES
A) de-molding stage, bridge crane on rails;
B) handling stage, prefabricated item crane on stabilizers.

4. DIMENSIONING DURING DE-MOLDING
A) check of dynamic actions
$\chi = \gamma i \times \gamma d = 1x1{,}5 = 1{,}5 \leq 1{,}5\ (\gamma t)$
The condition $\chi \leq \gamma t$ was checked
B) determination of rated capacity
$Pn = \frac{PP}{2} = \frac{100\ kN}{2} = 50\ kN$
therefore, two anchors item 6003 – 5.0 RS are used

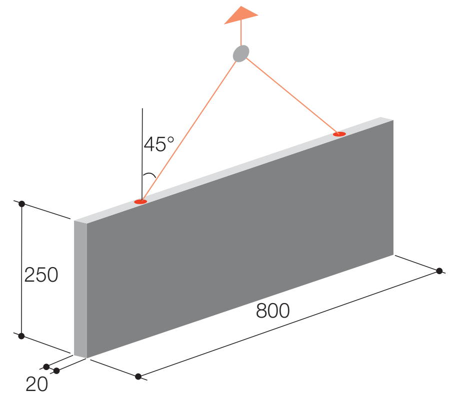
5. DIMENSIONING DURING HANDLING
A) check of dynamic actions (ref. item 2.3)
$\chi = \gamma i \times \gamma d = 1{,}3x1{,}15 = 1{,}5 \leq 1{,}5\ (\gamma t)$
The condition $\chi \leq \gamma t$ was checked
B) determination of rated capacity
$Pn = \frac{PP}{2} = \frac{100\ kN}{2} = 50\ kN$

- the anchors of de-molding stage long side are confirmed;
- two anchors item 6000 – 5.0 – 240 are used for verticalization, short side.

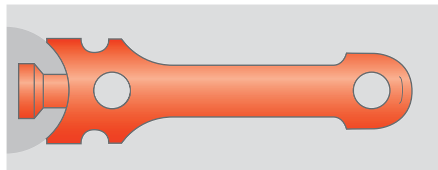
TILTING DE-MOLDING



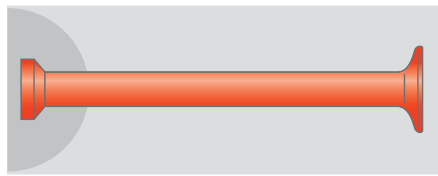
HANDLING



TILTING ANCHOR
ART. 6003 - 5,0 - RS



PROTRUDING ANCHOR
ART . 6000 - 5,0 - 240



C.A.P. Beam

1. DATA
A) concrete at de-molding, R_{ckj} 15 N/mm²;
B) concrete during handling, R_{ckj} 30 N/mm²;
C) removable side panels and separators;
D) own weight PP = 100 kN.

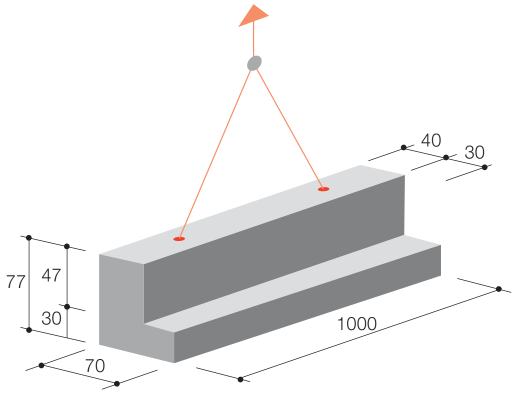
2. TRACTION
A) de-molding stage, ropes inclined at 45° on the vertical line;
B) handling stage, ropes inclined at 45° on the vertical line.

3. LIFTING DEVICES
A) de-molding stage, bridge crane on rails;
B) handling stage, prefabricated item crane on stabilizers.

4. DIMENSIONING DURING DE-MOLDING
A) check of dynamic actions
$\chi = \gamma i \times \gamma d = 1{,}3x1{,}15 = 1{,}5 \leq 1{,}5\ (\gamma t)$
The condition $\chi \leq \gamma t$ was checked
B) determination of rated capacity
$Pn = \frac{PP}{2} = \frac{100\ kN}{2} = 50\ kN$
therefore, two anchors item 6000 – 5.0 - 240 are used.

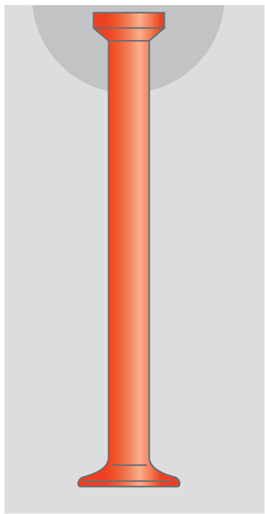
5. DIMENSIONING DURING HANDLING
A) check of dynamic actions
$\chi = \gamma i \times \gamma d = 1{,}3x1{,}15 = 1{,}5 \leq 1{,}5\ (\gamma t)$
The condition $\chi \leq \gamma t$ was checked
B) determination of rated capacity
$Pn = \frac{PP}{2} = \frac{100\ kN}{2} = 50\ kN$
- the anchors of de-molding stage are confirmed, two anchors item 6000 – 5.0 - 240.

DE-MOLDING AND HANDLING



PROTRUDING ANCHOR

ART . 6000 - 5,0 - 240



Vertical Panel

1. DATA
A) concrete at de-molding, R_{ckj} 30 N/mm²;
B) Removable side panels and separators;
C) own weight PP = 44.3 kN.

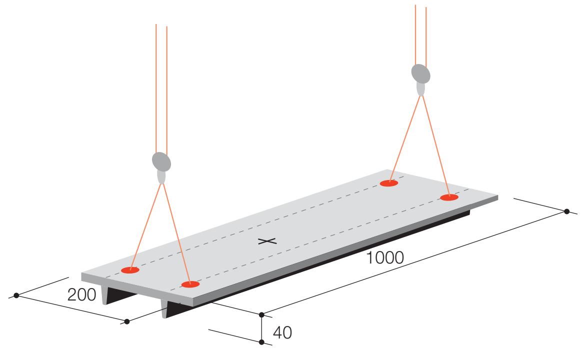
2. TRACTION
A) de-molding stage, ropes inclined at 15° on the vertical line, same and independent;
B) handling stage, converging ropes with triangular plate inclined at 45° on the vertical line.

3. LIFTING DEVICES
A) de-molding stage, double bridge crane on rails;
B) handling stage, prefabricated item crane on stabilizers.

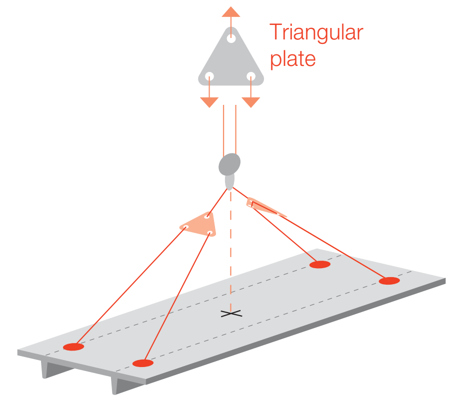
4. DIMENSIONAMENTO FASE DI SCASSERO
A) check of dynamic actions
$\chi = \gamma i \times \gamma d = 1{,}03x1{,}46 = 1{,}5 \leq 1{,}5\ (\gamma t)$
The condition $\chi \leq \gamma t$ was checked
B) determination of rated capacity
$Pn = \frac{PP}{4} = \frac{44{,}3\ kN}{4} = 11\ kN$
therefore four anchors item 6000 – 1.30 – 120 are used

5. DIMENSIONAMENTO FASE DI MOVIMENTAZIONE
A) check of dynamic actions
$\chi = \gamma i \times \gamma d = 1{,}3x1{,}15 = 1{,}5 \leq 1{,}5\ (\gamma t)$
The condition $\chi \leq \gamma t$ was checked
B) determination of rated capacity
$Pn = \frac{PP}{4} = \frac{44{,}3\ kN}{4} = 11\ kN$
- the anchors item 6000 – 1.3 - 120 are confirmed.

DE-MOLDING



HANDLING



PROTRUDING ANCHOR

ART. 6000 - 1.3 - 120