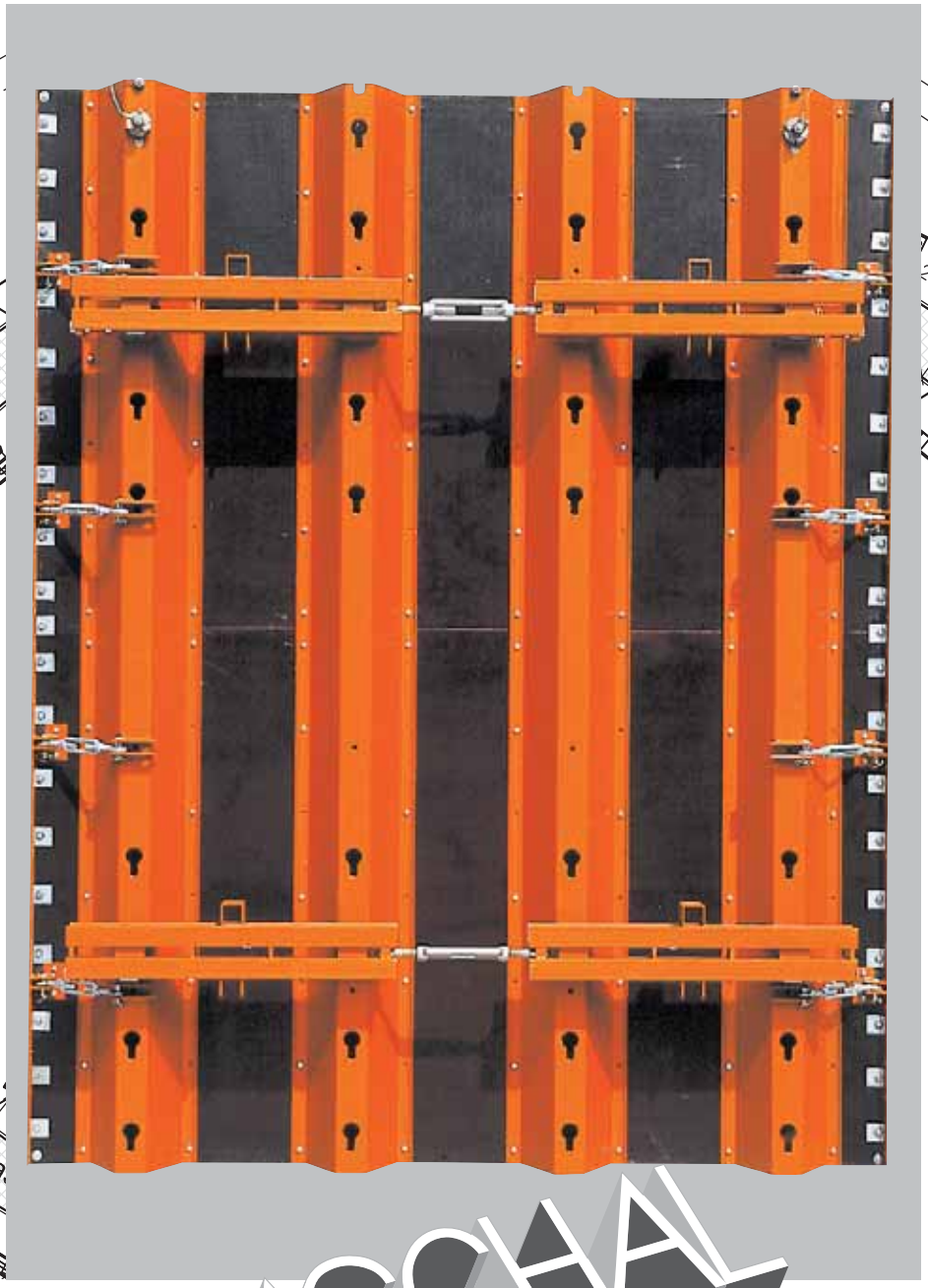
Trapezoidal Girder Formwork TTR

Technical information



PASCHAL

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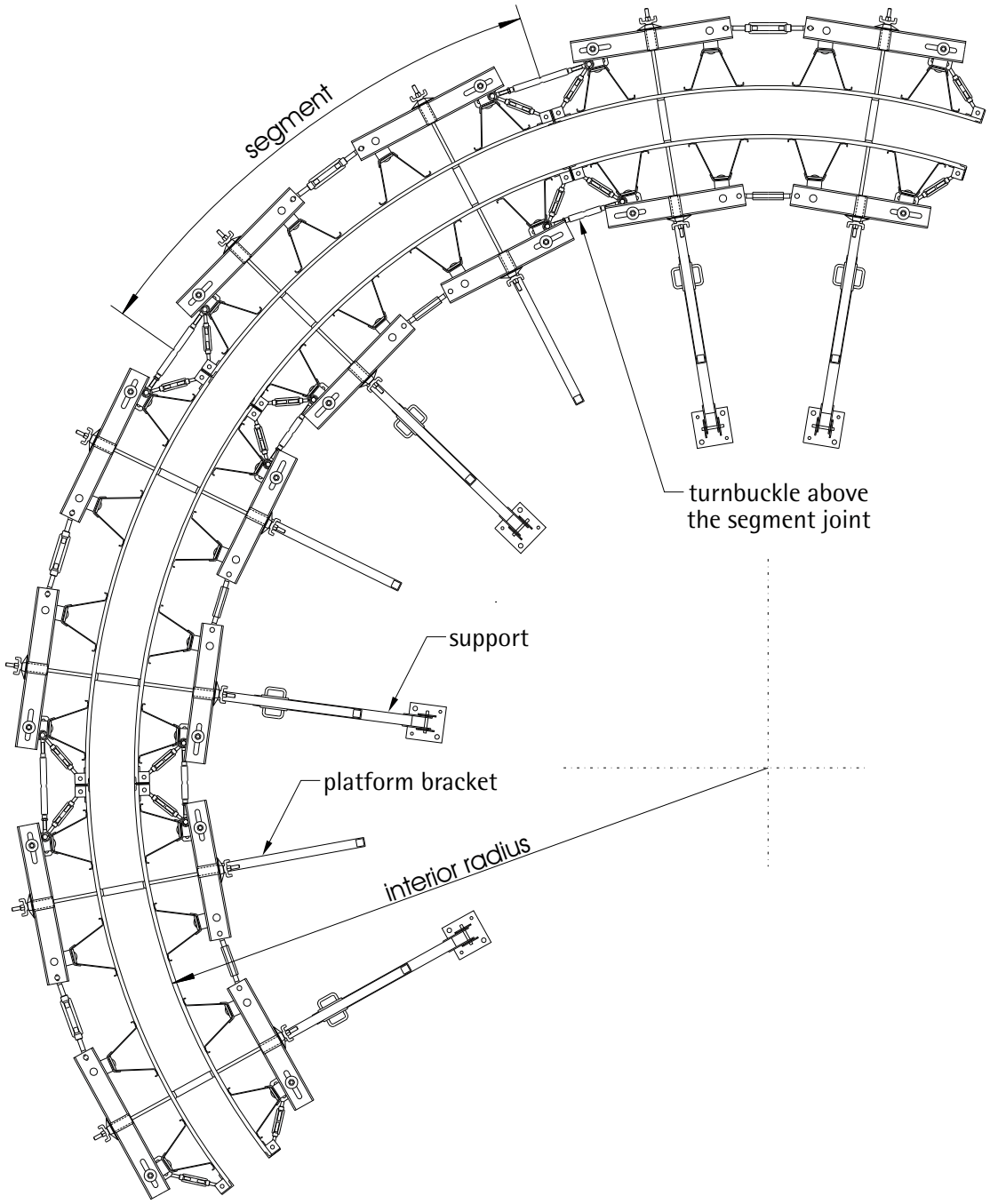
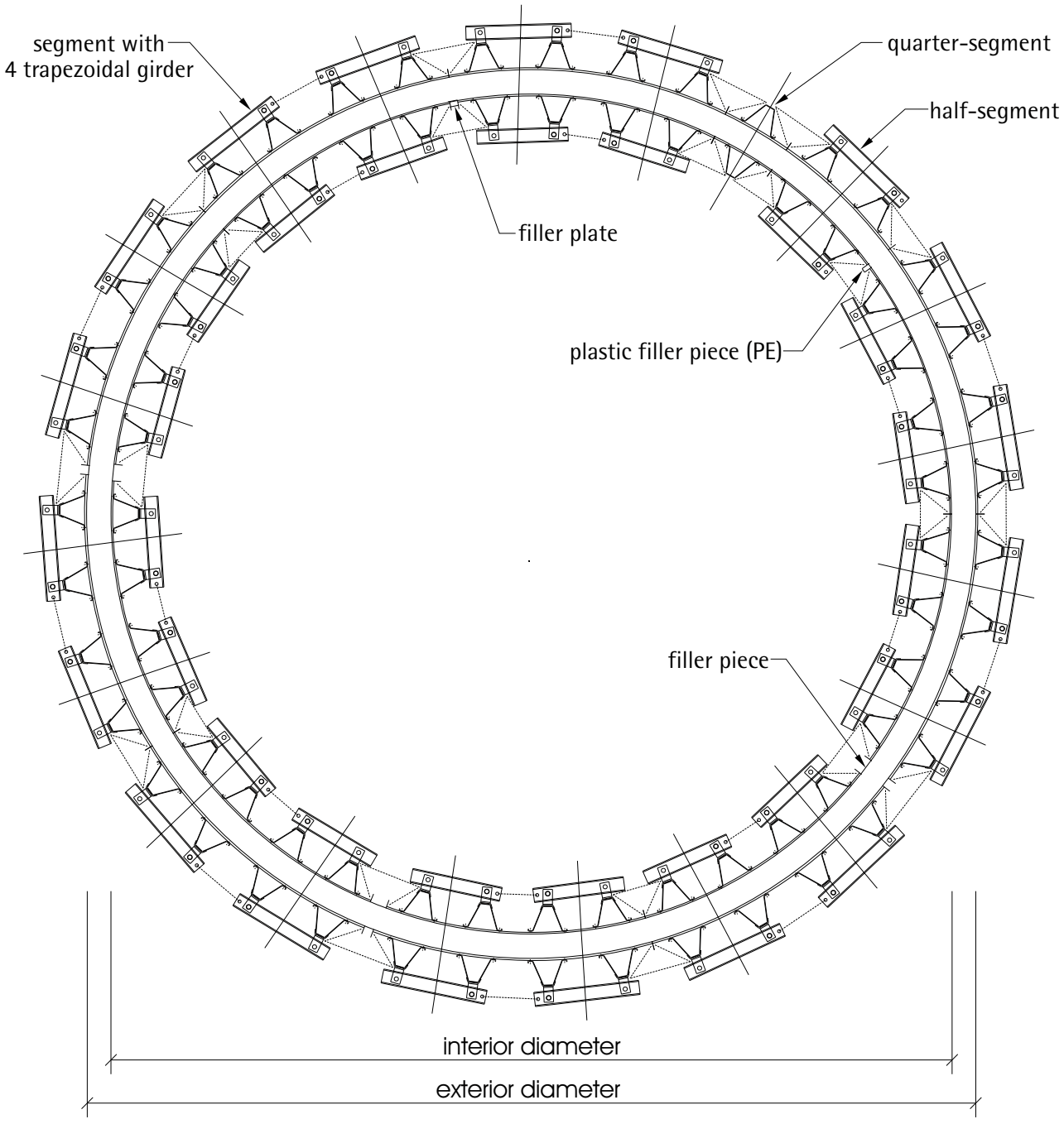
Subjet to technical modifications !



ill.1

The Trapezoidal Girder Formwork is used to form curved walls sections or circular tanks. There are exists segments for interior diameter 2.00m-5.00m and other segments for interior diameter 5.00m and greater.
The max. safe working pressure is 60kN/m², obeying the tolerances of deflection stated in DIN 18202, table 3, line 7.

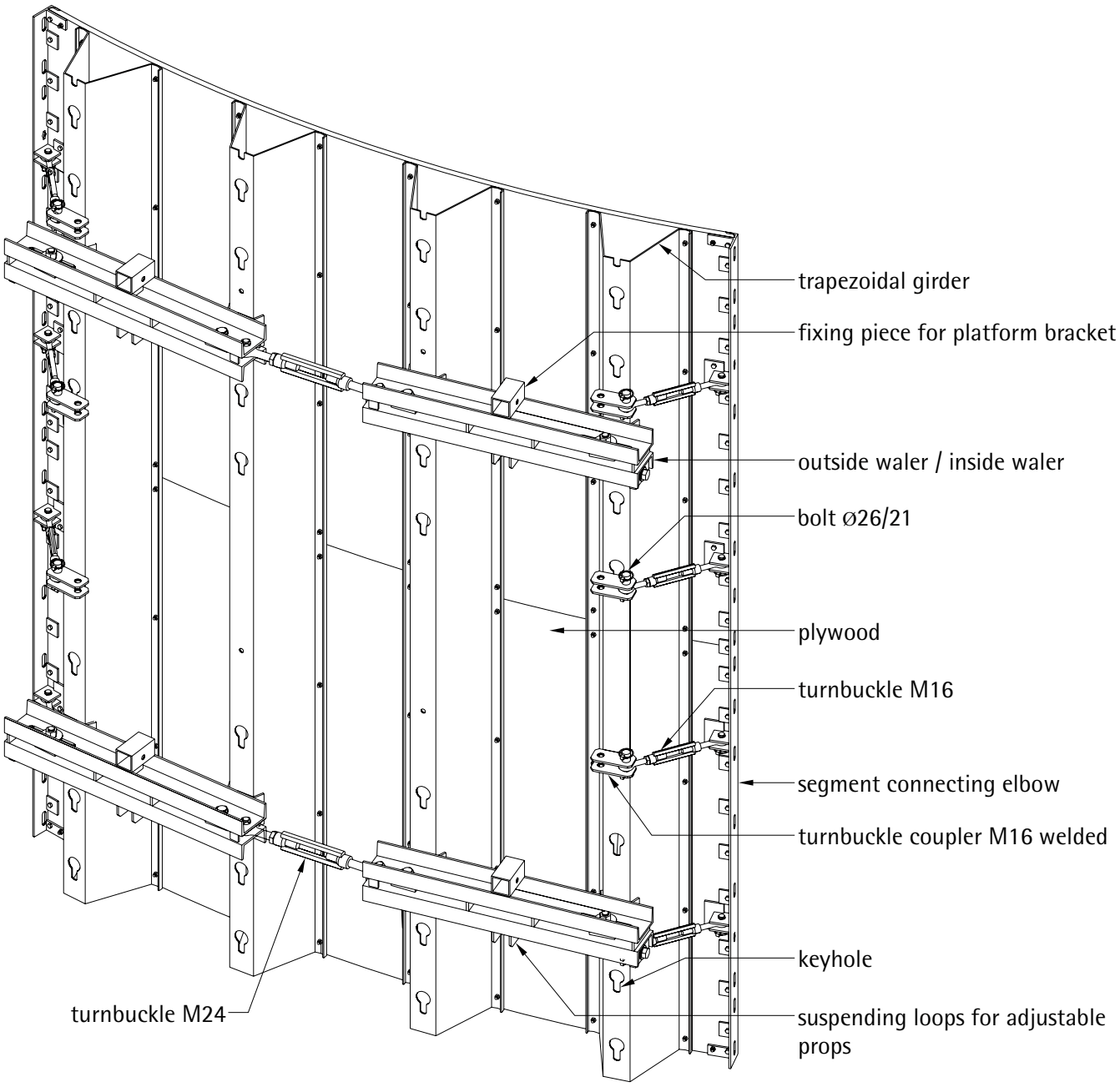
For fixing of the platform brackets and adjustable props, waler are assembled to the segments. Two platform brackets per segment (240/230/222) must be planed.
When erecting the first segment (240/230/222) two adjustable props are used in order to bring the segment into line. Each further segment needs one adjustable prop.
The Trapezoidal Girder Formwork consists of distinguishable outside and inside segments. For the outside formwork one segment width is available and for the inside formwork there are two segment widths.



ill.2

Each segment has four trapezoidal girders. Moreover, there are half-segments with two trapezoidal girders and quarter-segments with one trapezoidal girder.
These trapezoidal girders serve as supporting construction for the plywood. Different diameters to be formed need different bending of the plywood. This achieved by means of adjustable walers and turnbuckles on the girders.
Due to different requirements regarding diameters and wall thickness, compensations between the segments can become necessary.

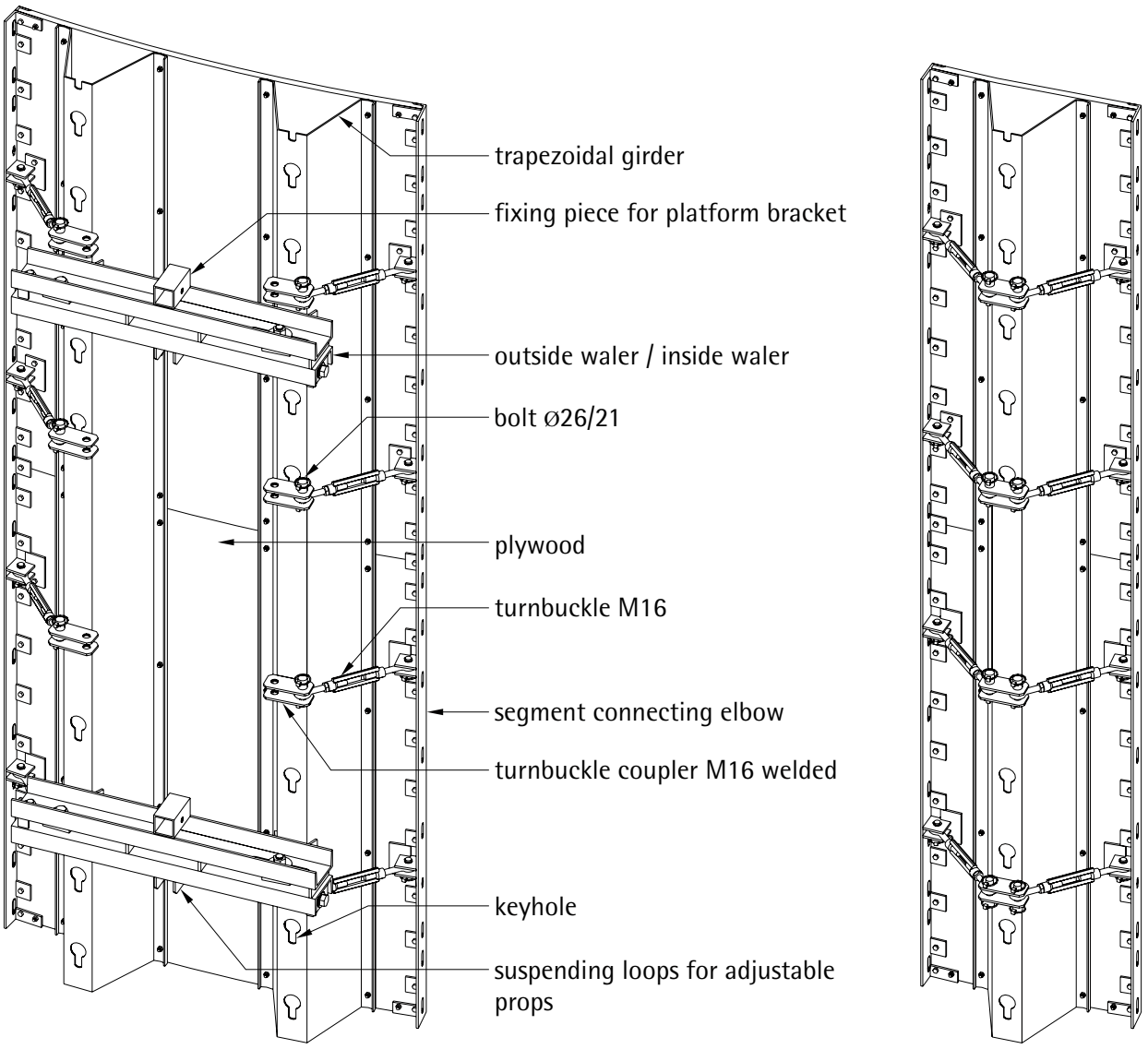
Suitable plastic fillers and filler pieces are available to be positioned between the segments.
Tanks can be formed in one or several phases. When forming closed tanks in one phase, a filler plate must be used on the inner formwork side, as this is indispensable for dismantling.
In the circumference of the wall is longer than the total width of all segments, additional filler pieces must be used.
For the extension of the segments special extension post are available.



Segments for inside diameter 5,0m-∞

Art.N°	Item	Weight
122.101.0222	Outside segment 240x300cm	540,00kg
122.101.0122	Inside segment 230x300cm	524,00kg
122.101.0022	Inside segment 222x300cm	521,00kg

General outlay of segments

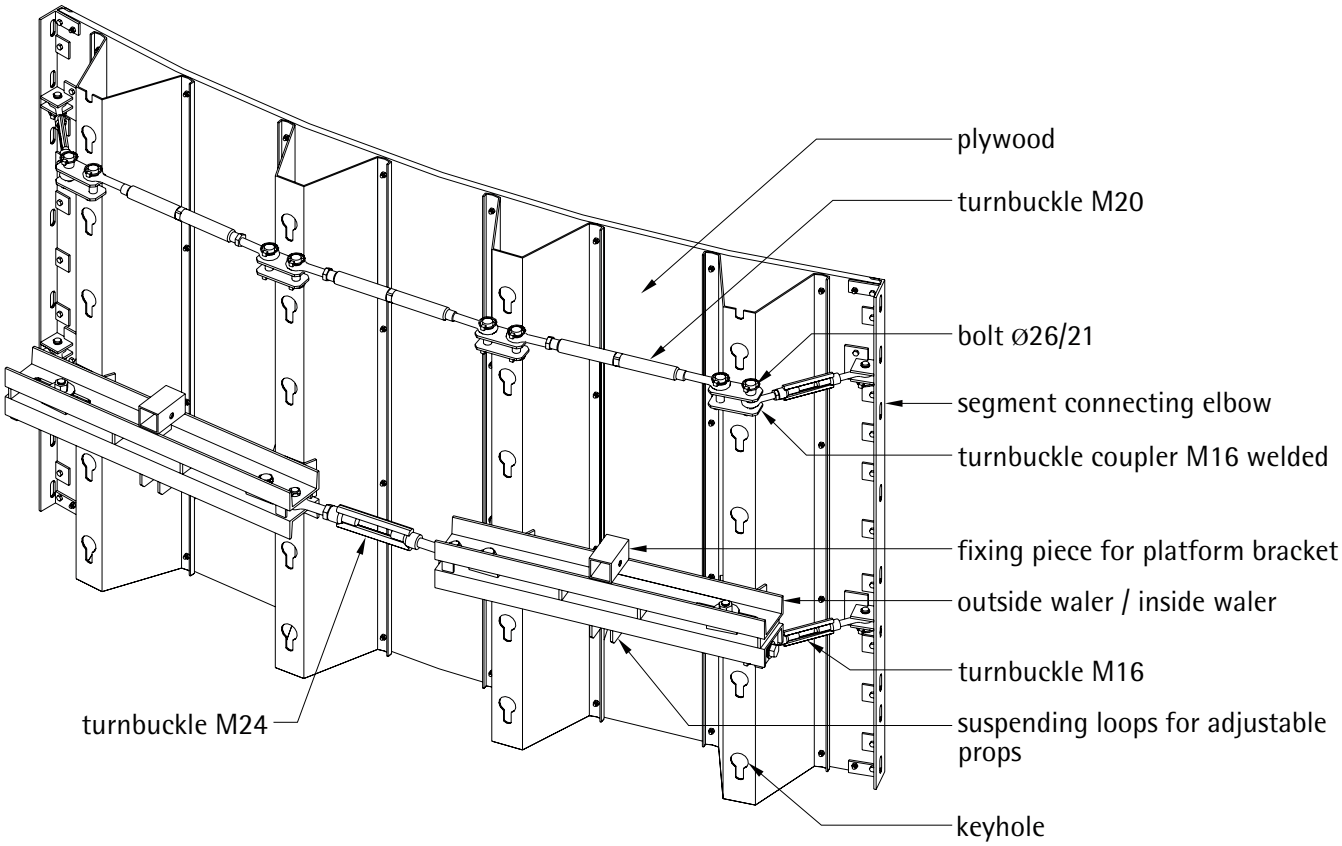


Segments for inside diameter 5,0m-∞

Art.-N°	Item	Weight
122.101.0233	Outside segment 120x300cm	286,00kg
122.100.0241	Outside segment 60x300cm	135,00kg
122.101.0133	Inside segment 115x300cm	280,00kg
122.100.0141	Inside segment 57,5x300cm	134,00kg

Segments for inside diameter 2,0-5,0m

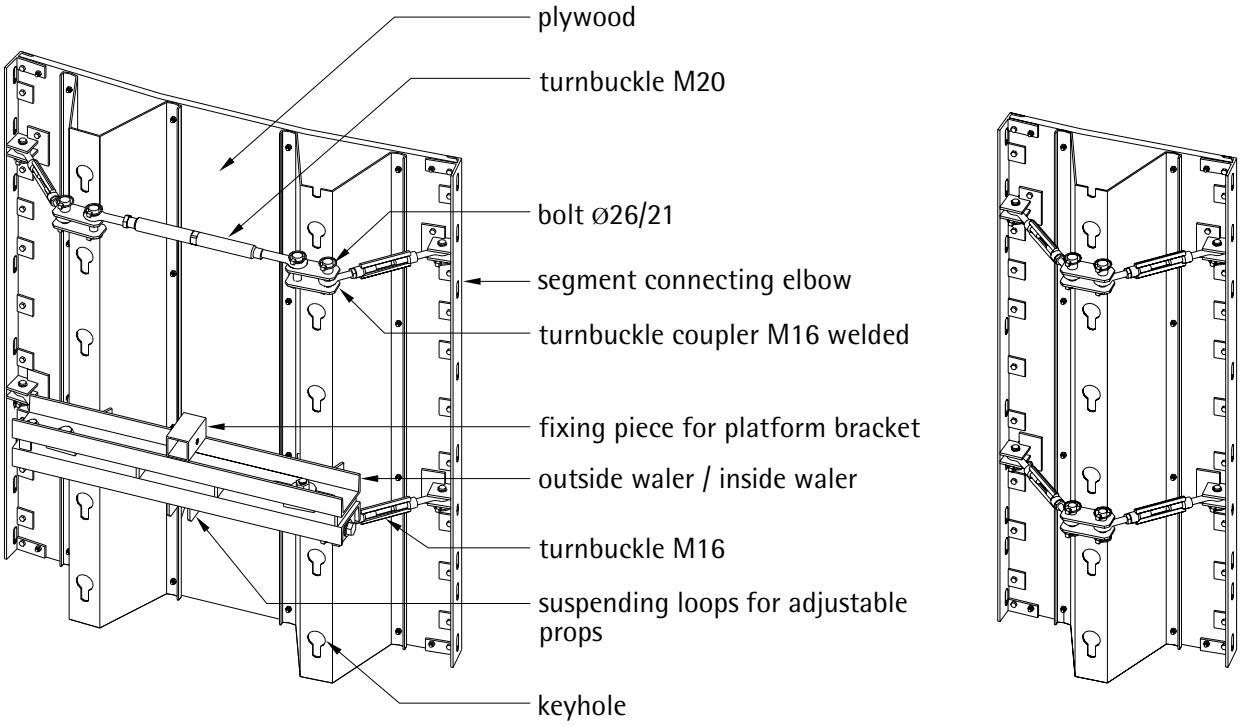
Art.-N°	Item	Weight
122.112.0001	Outside segment 125,5x300cm	303,00kg
122.112.0003	Outside segment 62,5x300cm	134,00kg
122.112.0011	Inside segment 110,5x300cm	279,00kg
122.112.0013	Inside segment 55,5x300cm	130,00kg



Segments for inside diameter 5,0m-∞

Art.N°	Item	Weight
122.101.0231	Outside segment 240x150cm	297,00kg
122.101.0131	Inside segment 230x150cm	290,00kg
122.101.0031	Inside segment 222x150cm	288,00kg

General outlay of segments

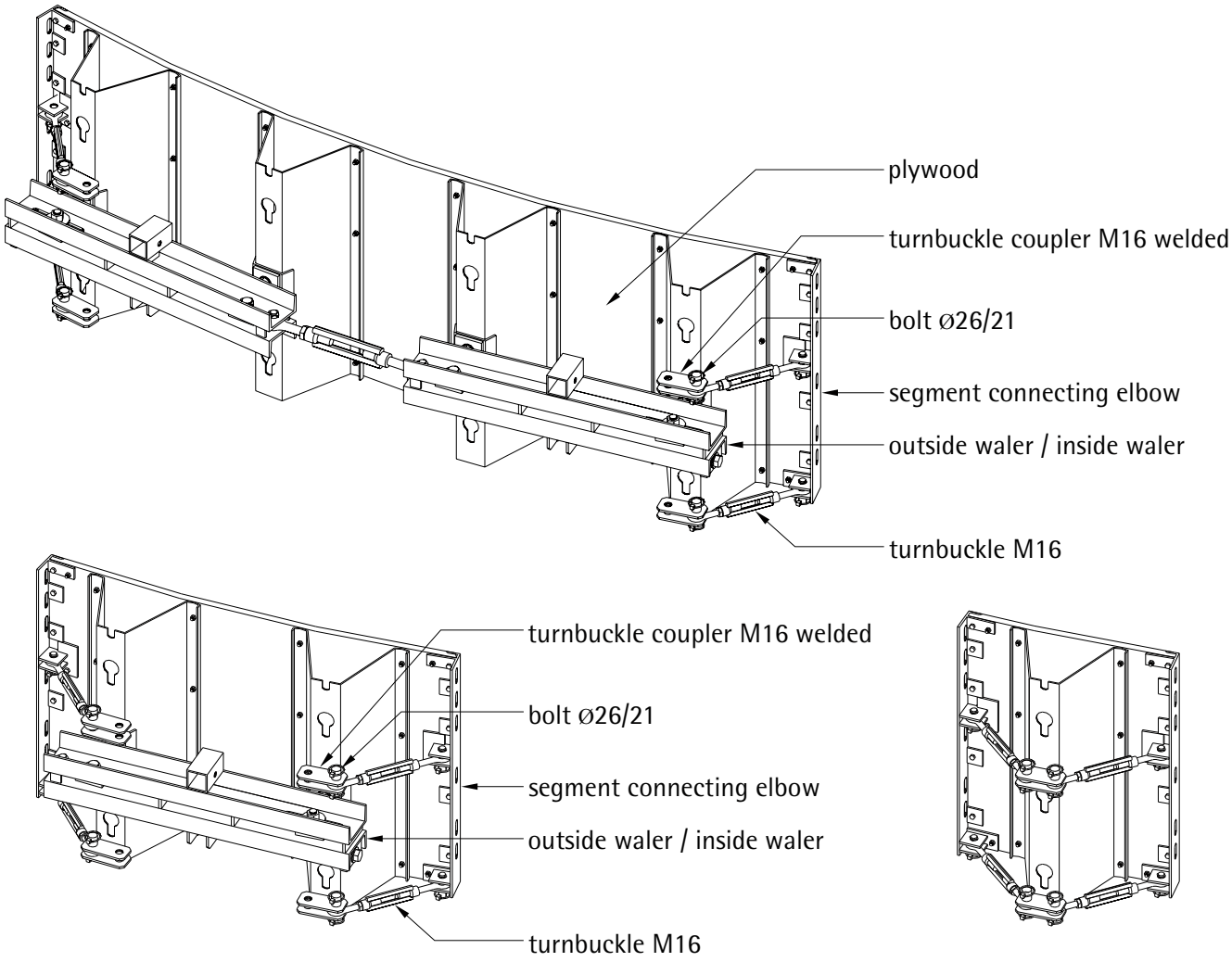


Segments for inside diameter 5,0m-∞

Art.-N°	Item	Weight
122.101.0236	Outside segment 120x150cm	159,00kg
122.100.0246	Outside segment 60x150cm	67,50kg
122.101.0136	Inside segment 115x150cm	156,00kg
122.100.0146	Inside segment 57,5x150cm	64,50kg

Segments for inside diameter 2,0-5,0m

Art.-N°	Item	Weight
122.112.0006	Outside segment 125,5x150cm	156,00kg
122.112.0020	Outside segment 62,5x150cm	50,00kg
122.112.0016	Inside segment 110,5x150cm	139,00kg
122.112.0030	Inside segment 55,5x150cm	48,00kg



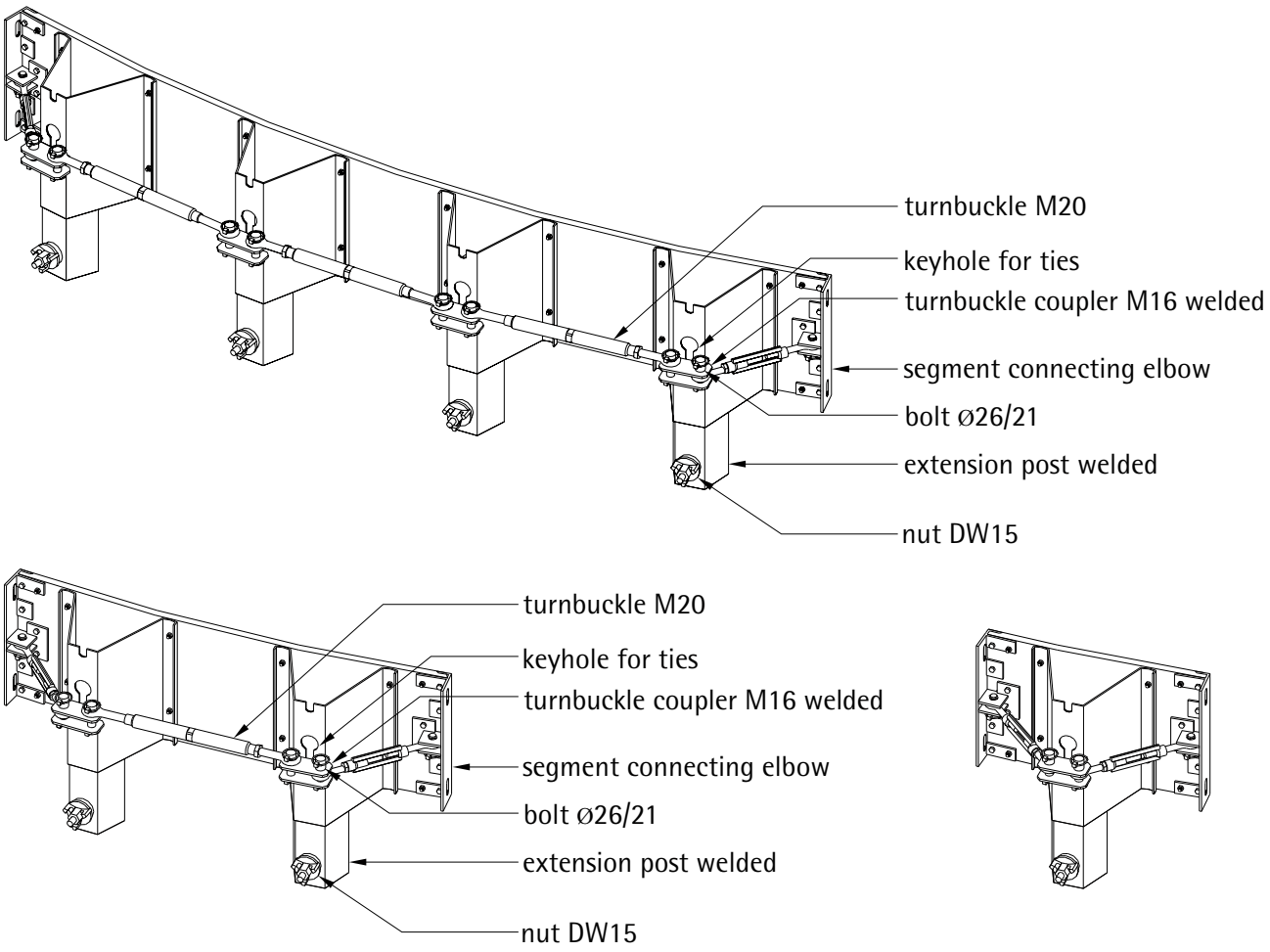
Segments for inside diameter 5,0m-∞

Art.-N°	Item	Weight
122.101.0239	Outside segment 240x75cm	168,00kg
122.101.0237	Outside segment 120x75cm	90,00kg
122.100.0247	Outside segment 60x75cm	45,30kg
122.101.0139	Inside segment 230x75cm	162,00kg
122.101.0039	Inside segment 222x75cm	161,00kg
122.101.0137	Inside segment 115x75cm	87,00kg
122.100.0147	Inside segment 57,5x75cm	35,00kg

Segments for inside diameter 2,0-5,0m

Art.-N°	Item	Weight
122.112.0009	Outside segment 125,5x75cm	90,00kg
122.112.0021	Outside segment 62,5x75cm	41,00kg
122.112.0019	Inside segment 110,5x75cm	88,00kg
122.112.0031	Inside segment 55,5x75cm	40,00kg

General outlay of segments



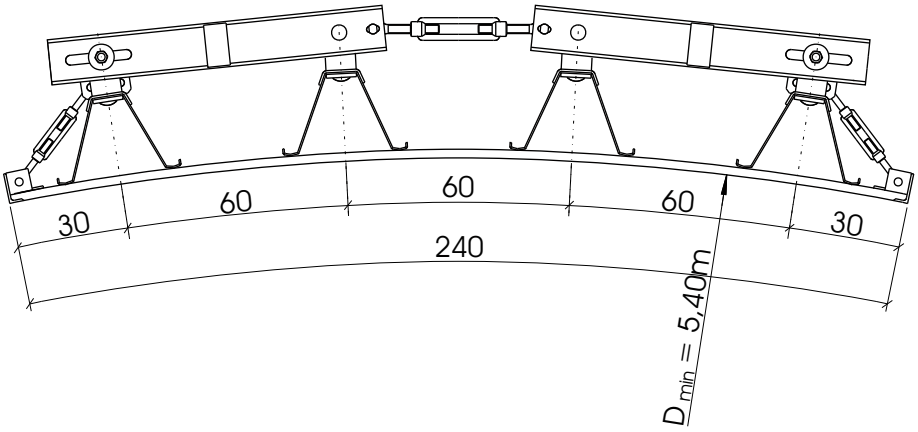
Segments for inside diameter 5,0m-∞

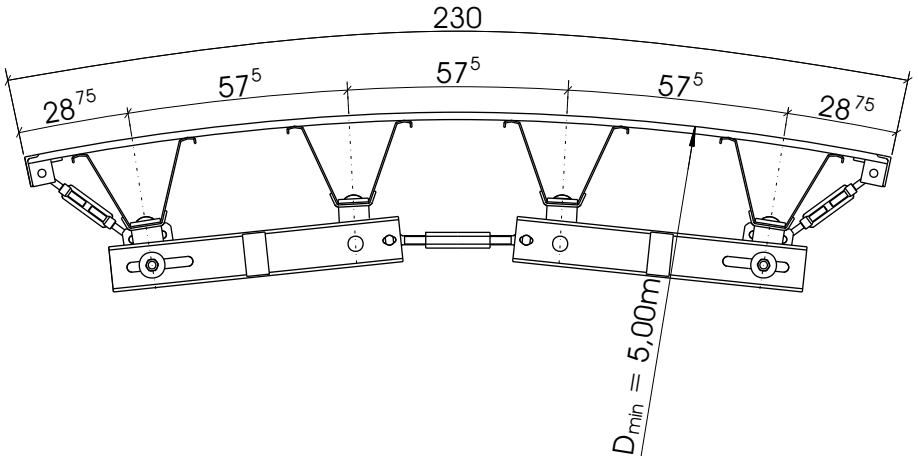
Art.-N°	Item	Weight
122.100.0232	Outside segment 240x37,5cm	90,00kg
122.100.0240	Outside segment 120x37,5cm	47,00kg
122.100.0245	Outside segment 60x37,5cm	26,00kg
122.100.0132	Inside segment 230x37,5cm	88,00kg
122.100.0032	Inside segment 222x37,5cm	87,50kg
122.100.0140	Inside segment 115x37,5cm	47,00kg
122.100.0145	Inside segment 57,5x37,5cm	26,00kg

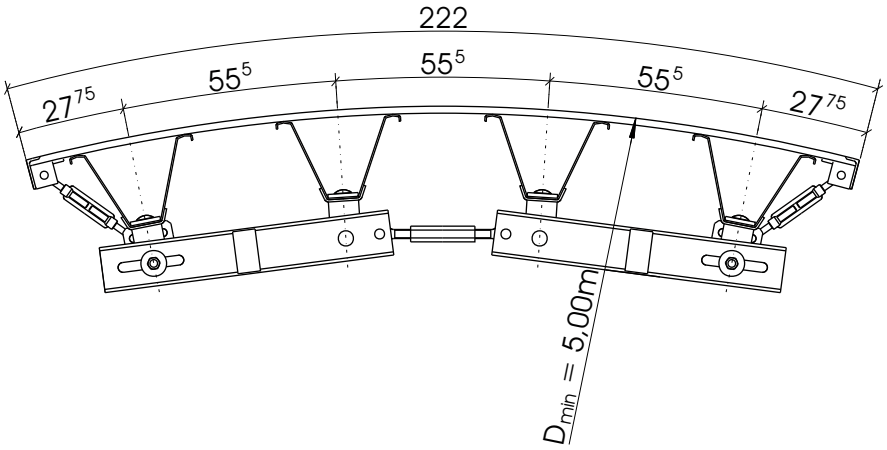
Segments for inside diameter 2,0-5,0m

Art.-N°	Item	Weight
122.112.0034	Outside segment 125,5x37,5cm	52,50kg
122.112.0035	Outside segment 62,5x37,5cm	27,00kg
122.112.0036	Inside segment 110,5x37,5cm	46,50kg
122.112.0037	Inside segment 55,5x37,5cm	25,00kg

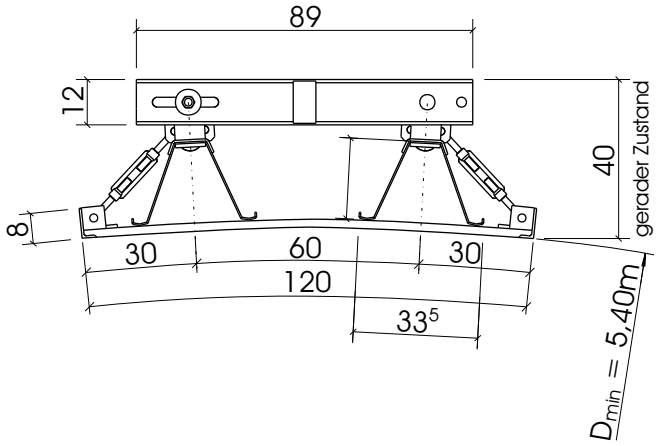
Segments for interior diameter 5,0m-∞

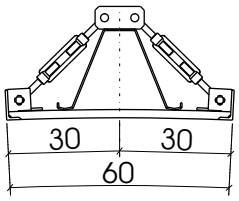


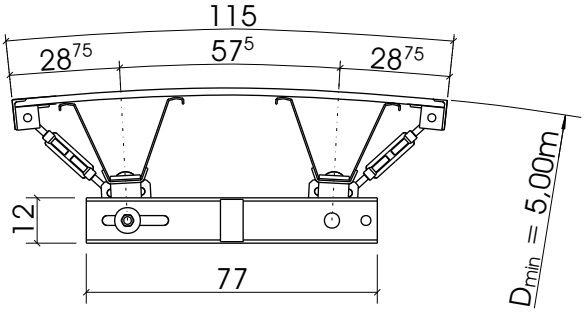


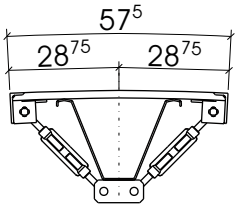


General outlay of segments

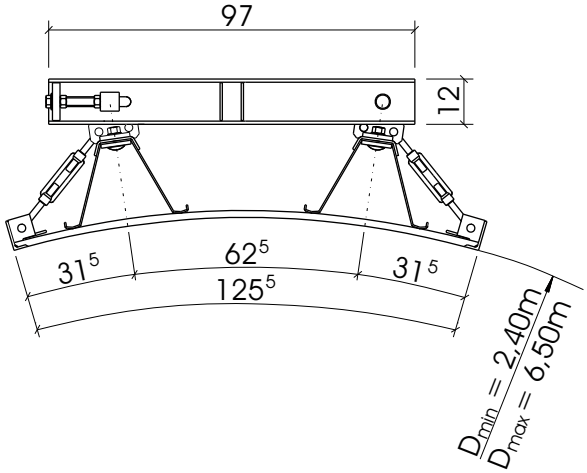


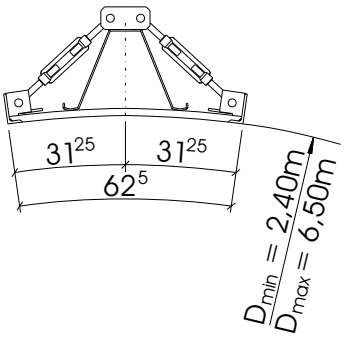


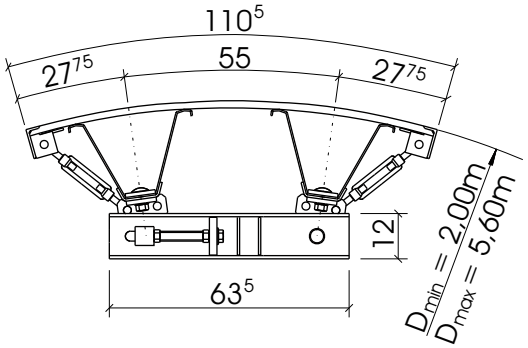


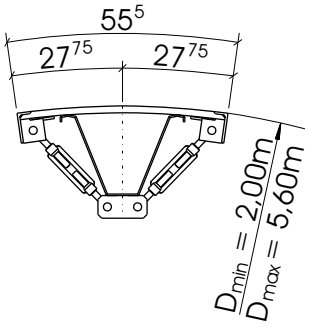


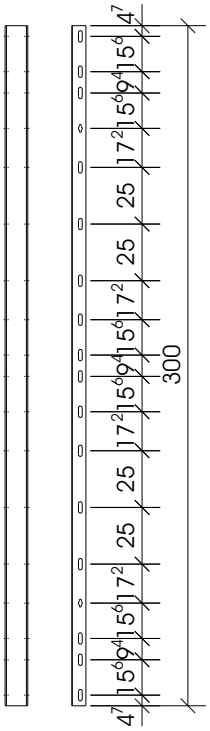
Segments for interior diameter 2,0-5,0m

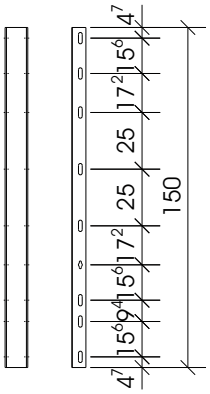


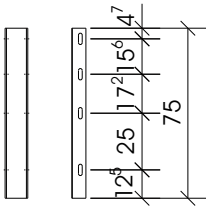


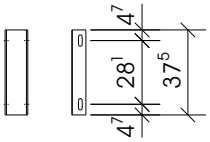




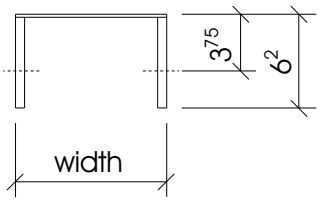






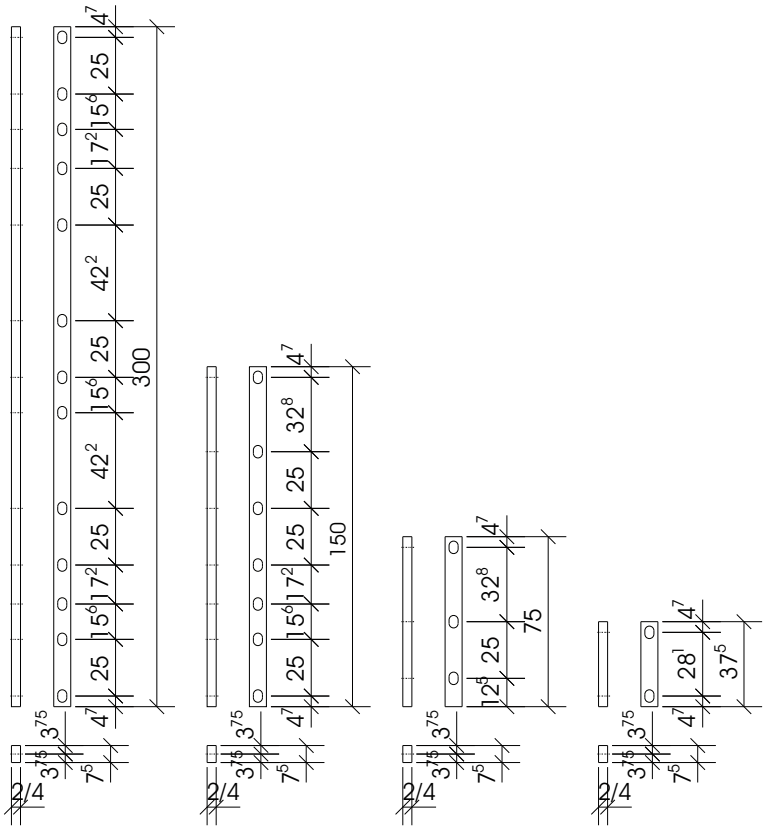


Art.-N°	Item	Weight
182.000.0185	filler piece 6x37,5cm	2,40kg
182.000.0186	filler piece 8x37,5cm	2,50kg
182.000.0187	filler piece 10x37,5cm	2,70kg
182.000.0188	filler piece 12x37,5cm	2,80kg
182.000.0189	filler piece 14x37,5cm	2,90kg
182.000.0193	filler piece 16x37,5cm	3,00kg
182.000.0194	filler piece 18x37,5cm	3,10kg
182.000.0195	filler piece 20x37,5cm	3,30kg
182.000.0141	filler piece 6x75cm	4,85kg
182.000.0142	filler piece 8x75cm	5,05kg
182.000.0143	filler piece 10x75cm	5,35kg
182.000.0144	filler piece 12x75cm	5,60kg
182.000.0145	filler piece 14x75cm	5,80kg
182.000.0146	filler piece 16x75cm	6,05kg
182.000.0174	filler piece 18x75cm	6,30kg
182.000.0175	filler piece 20x75cm	6,55kg
182.000.0115	filler piece 6x150cm	9,75kg
182.000.0108	filler piece 8x150cm	10,20kg
182.000.0107	filler piece 10x150cm	10,55kg
182.000.0137	filler piece 12x150cm	11,05kg
182.000.0138	filler piece 14x150cm	11,60kg
182.000.0106	filler piece 16x150cm	12,05kg
182.000.0172	filler piece 18x150cm	12,55kg
182.000.0173	filler piece 20x150cm	13,50kg
182.000.0114	filler piece 6x300cm	19,45kg
182.000.0111	filler piece 8x300cm	20,40kg
182.000.0110	filler piece 10x300cm	21,30kg
182.000.0139	filler piece 12x300cm	22,20kg
182.000.0140	filler piece 14x300cm	23,25kg
182.000.0109	filler piece 16x300cm	24,10kg
182.000.0170	filler piece 18x300cm	25,20kg
182.000.0171	filler piece 20x300cm	25,55kg

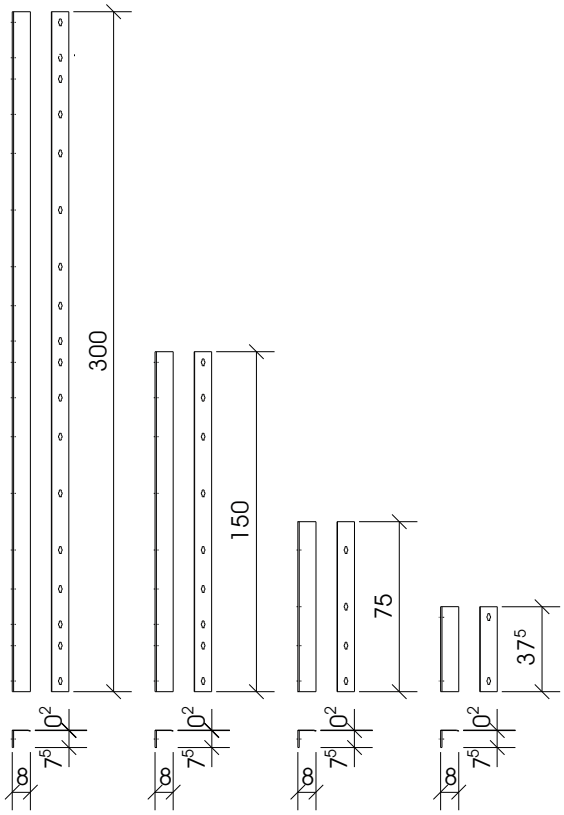


Plastic filler piece, filler plate and filler post

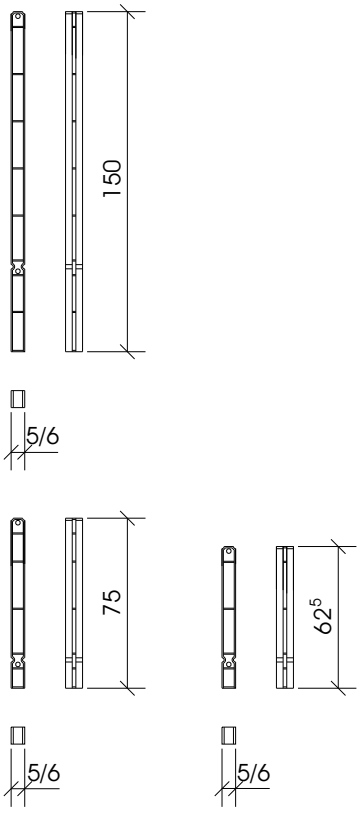
Plastic filler piece (PE)



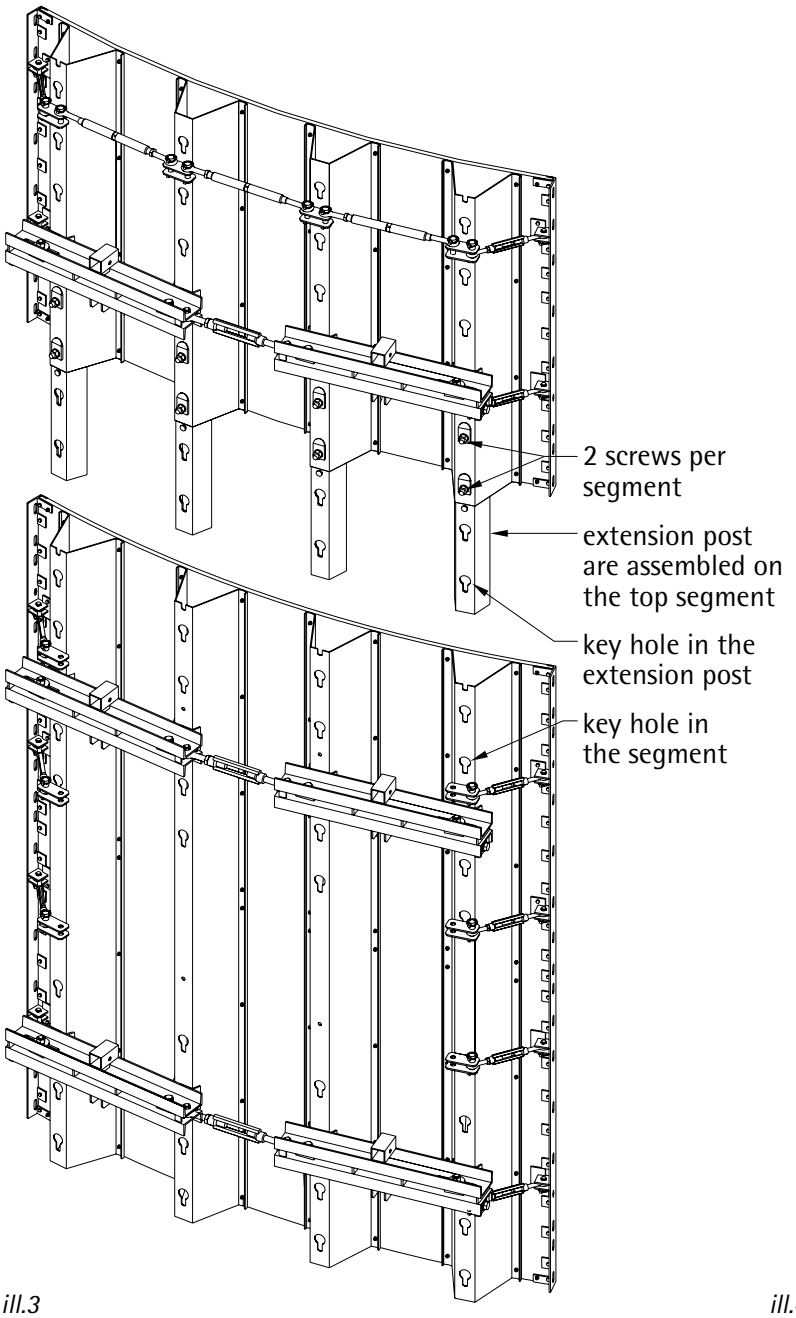
Filler plate



Filler post



Art.-N°	Item	Weight
182.000.0132	plastic filler piece 2 x 37,5cm	0,50kg
182.000.0162	plastic filler piece 4 x 37,5cm	1,00kg
182.000.0129	plastic filler piece 2 x 75cm	1,00kg
182.000.0131	plastic filler piece 4 x 75cm	2,00kg
182.000.0125	plastic filler piece 2 x 150cm	2,00kg
182.000.0127	plastic filler piece 4 x 150cm	4,00kg
182.000.0121	plastic filler piece 2 x 300cm	4,00kg
182.000.0123	plastic filler piece 4 x 300cm	8,00kg
182.000.0273	filler plate 8 x 37,5cm	1,95kg
182.000.0147	filler plate 8 x 75cm	3,90kg
182.000.0148	filler plate 8 x 150cm	7,80kg
182.000.0149	filler plate 8 x 300cm	14,30kg
100.003.0050	filler post 5x62,5cm	4,70kg
100.003.0060	filler post 6x62,5cm	5,00kg
101.003.0050	filler post 5x75cm	5,40kg
101.003.0060	filler post 6x75cm	5,80kg
104.003.0050	filler post 5x150cm	11,00kg
104.003.0060	filler post 6x150cm	11,60kg



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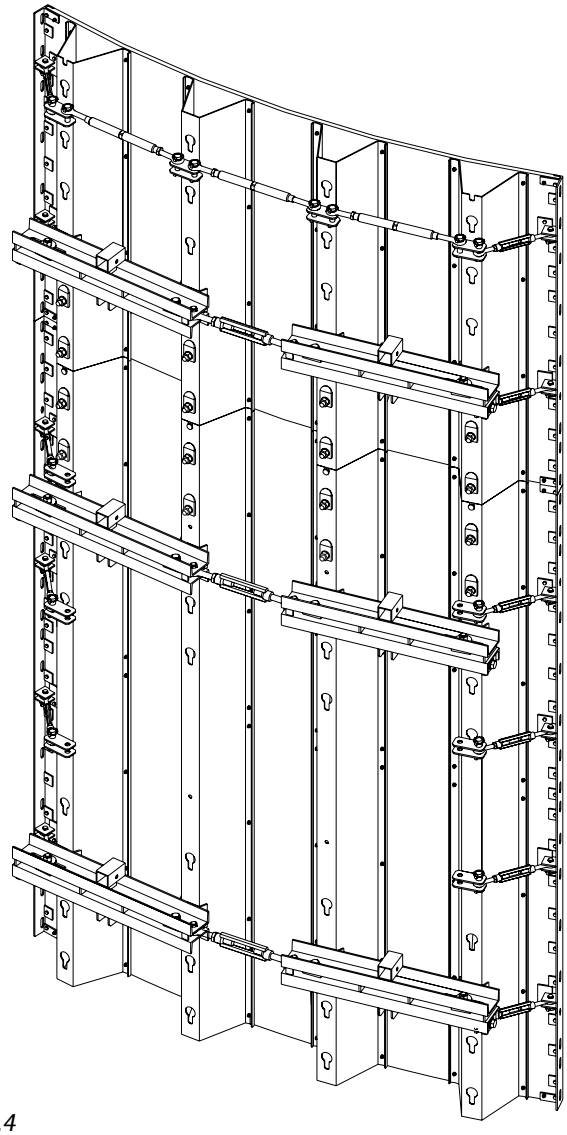

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The assembly of a segment on top of an other segment can be effected in vertical position if the diameter is exceeding 14m.

In case of smaller diameters, it is recommended to effect the height extension in horizontal position, in order to guarantee an accurate fitting. For this purpose the segments are placed on horses. There, all turnbuckles are relieved from tension until the segments assume a plane shape.

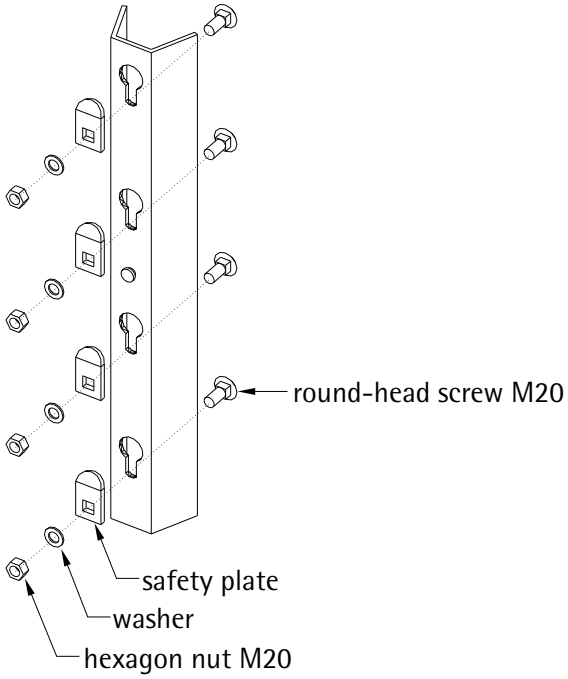
At first the extension post must be connected at one segment. In most case these is the segment on the top. Insert the half extension post in the girders of the segment. When the key holes of the segment and the key holes of the extension post have the same position, it is posible to connect them with the round-head screws M20, safety plates and hexagon nuts M20. Then each extension post is connected with 2 screws to the segment.

Now the segment with the extension post is inserted into the girders of the other segment.

If the 2 segments are now exactly on the top of each other they are connected at the 2 upper holes of the

Extension post for girders

Art.N° : 182.000.0009
Weight : 17.00kg



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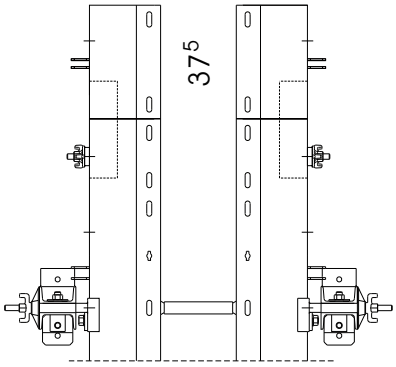
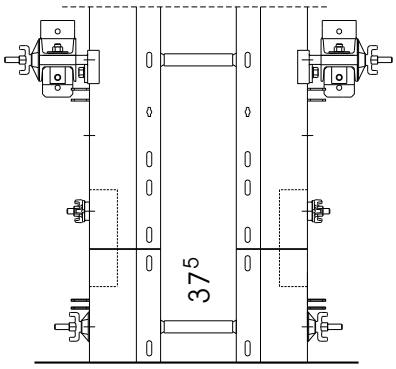
Segment as top extension segment



Segment as bottom extension segment



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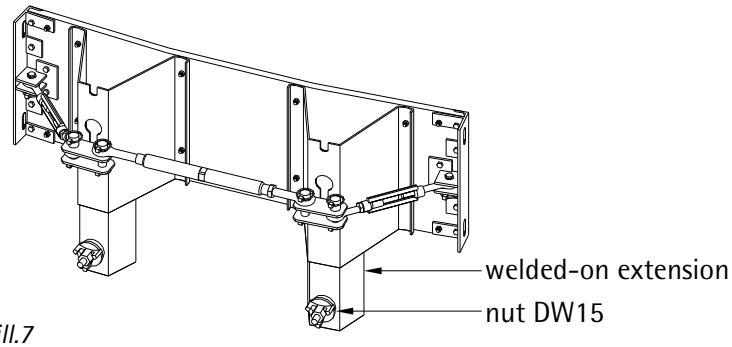

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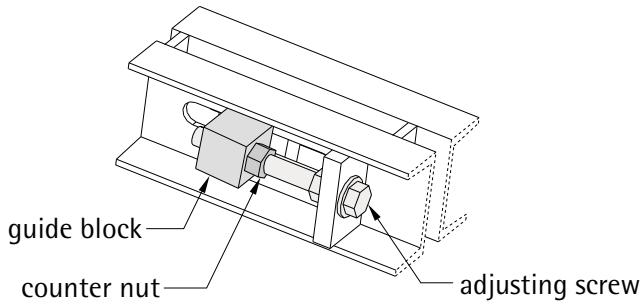
segment at the bottom by means of safety plates, round-head screws M20 and hexagon nuts M20.

Attention for vertical height extension!
The crane lifting eyes may only be loosened after all the round-head screws have been firmly tightened.

For formworking heights of 9.00m and more a extension post, reinforced (Art.N° : 282.000.0085) is necessary.
On a 75cm high segment the extension post can be assembled only of one side.

The 37.5cm high segments have welded-on extension and don't need additional extension post.
Insert the welded-on extension parts into an other segment with are not yet adjusted to the required radius. For this the welded-on tie rod DW15 has to be inserted into the uppermost or the bottom tie passage and each segment has to be tightened with a DW15 tie nut.



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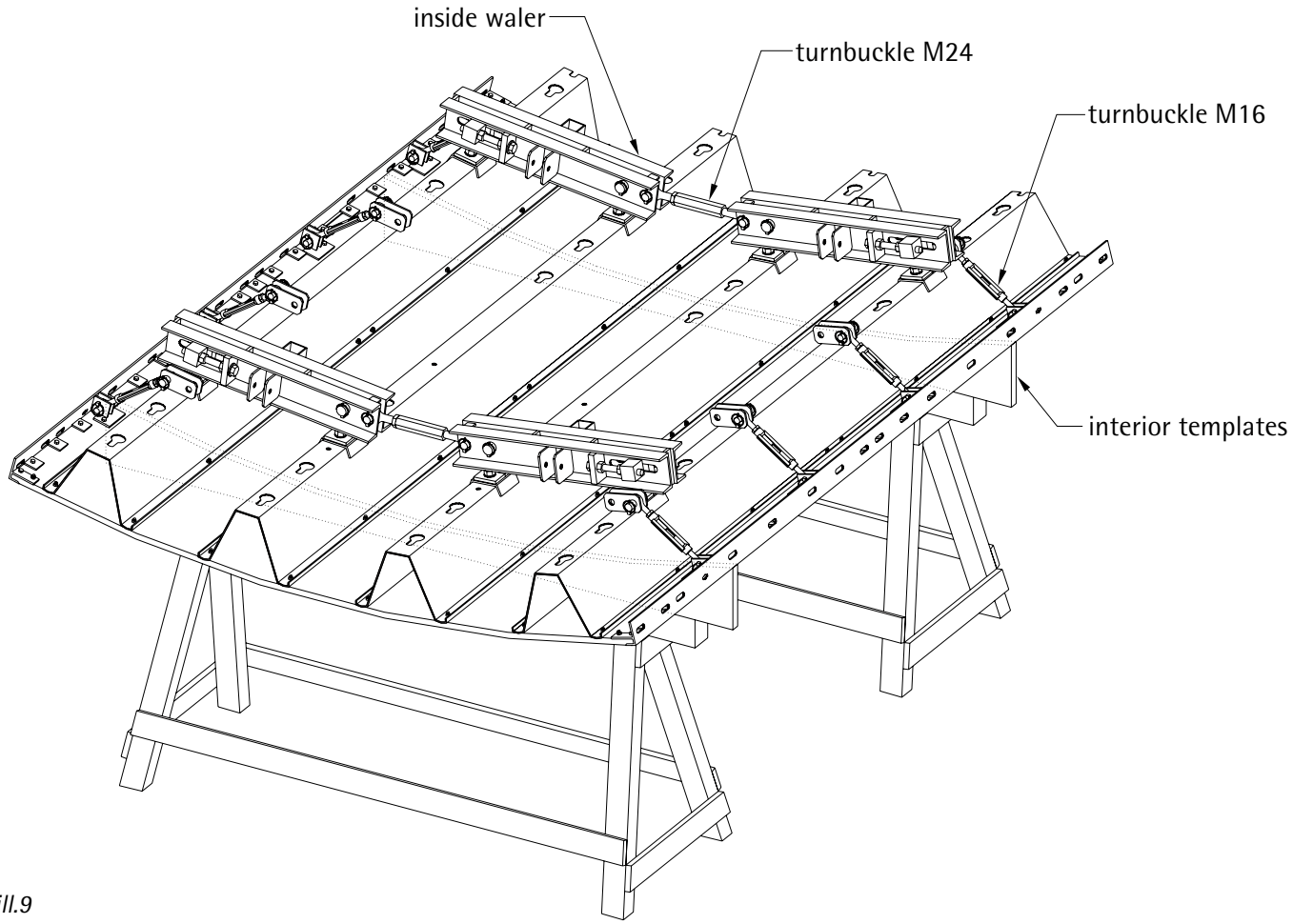

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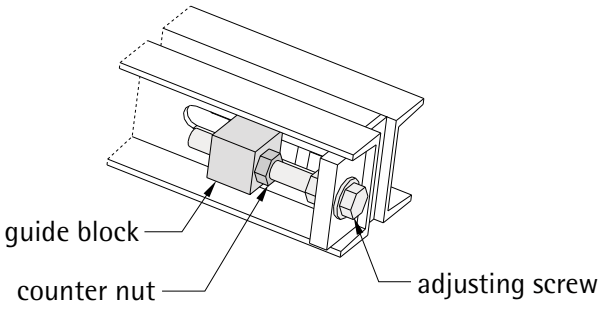
In case the radius of the segments has to be changed on the construction site, please follow the operations below:

Preparations

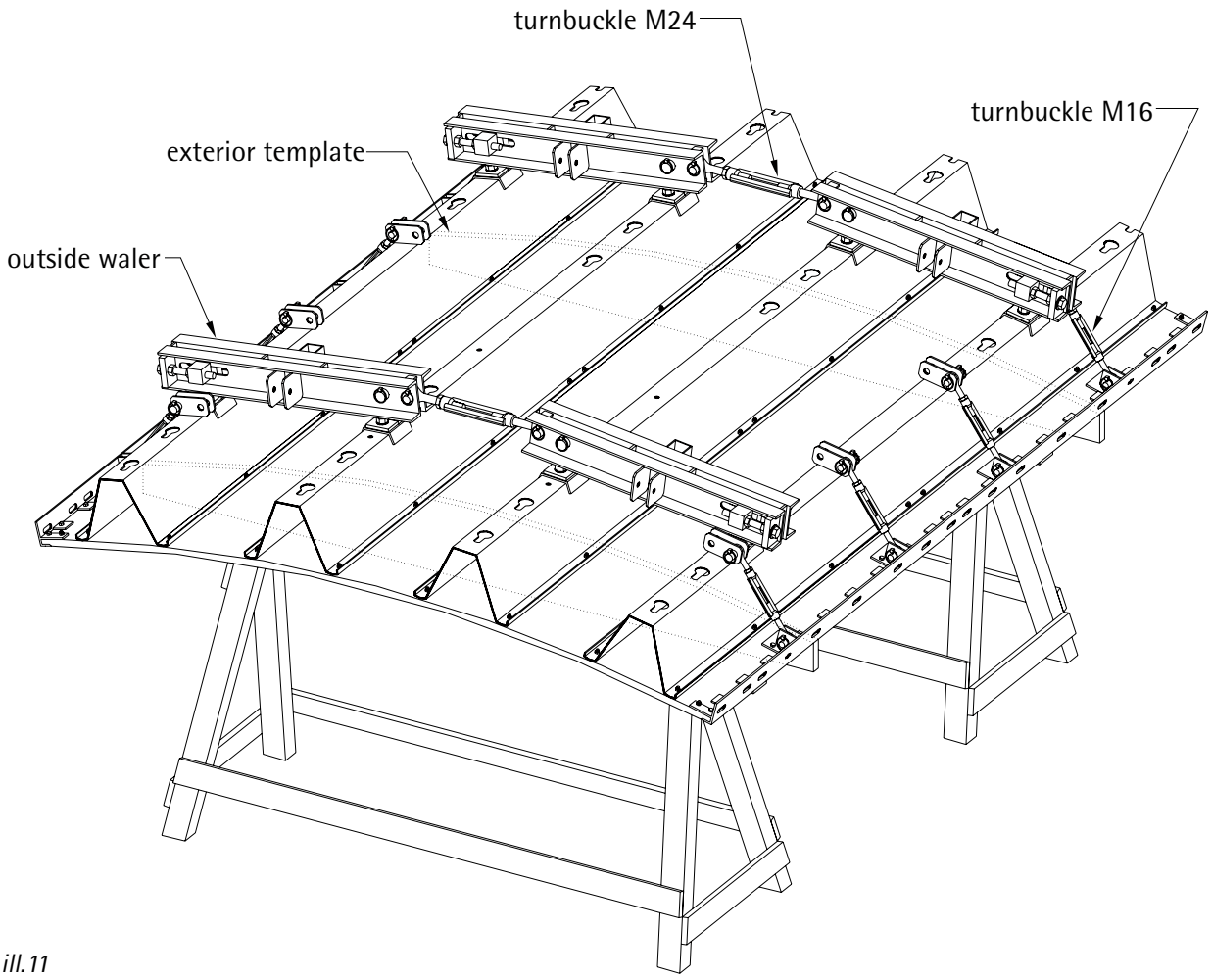
1.) make available a sufficient support (horses)
2.) prepare 4 load-bearing radius-templates (2 interior templates and 2 exterior templates)
for segment heights exceeding 5m 6 templates are needed (3 interior templates and 3 exterior ones)
3.) suspend the segment at 4 points and lift it on the horses.

Adjustment to the new radius :

4.) On the inside or outside waler, the counter nut of the adjusting screw has to be loosened at first.
5.) Rough adjustment is made by turning the turnbuckles M24 of the vertical row 2 or 3 times in the same direction. Use a special key SW36 for this purpose.
6.) Then, the adjusting screws of the inside or outside walers are turned by help of a ratchet key



ill.10



ill.11

SW30 and in a way that the bending of the segment is regular.

7.) Fine adjustment is made by moving on the turnbuckle row by ½ to 1 turn and the adjusting screws as well.

8.) Just check the radius an repeat this operation until the exact radius is obtained.

9.) The outer parts of the segment are adjusted by means of the turnbuckles M16 which are diagonally assembled between the outer girder and the segment connecting elbow.

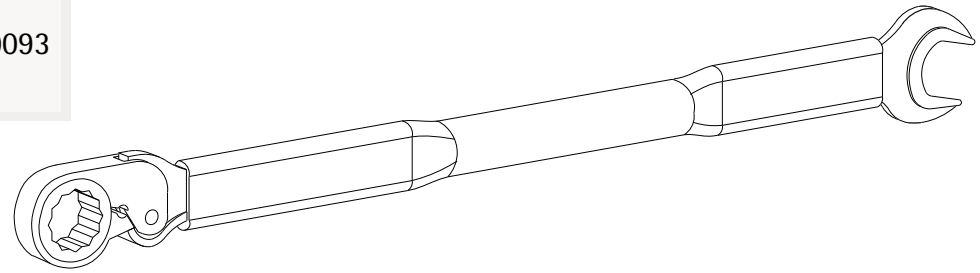
10.) The radius adjustment is finished by tightening the counter nut of the adjusting screw.

Finish

11.) Now suspend the segment again at 4 points and shift it to the storage place by means of a crane.

Ratchet key SW30

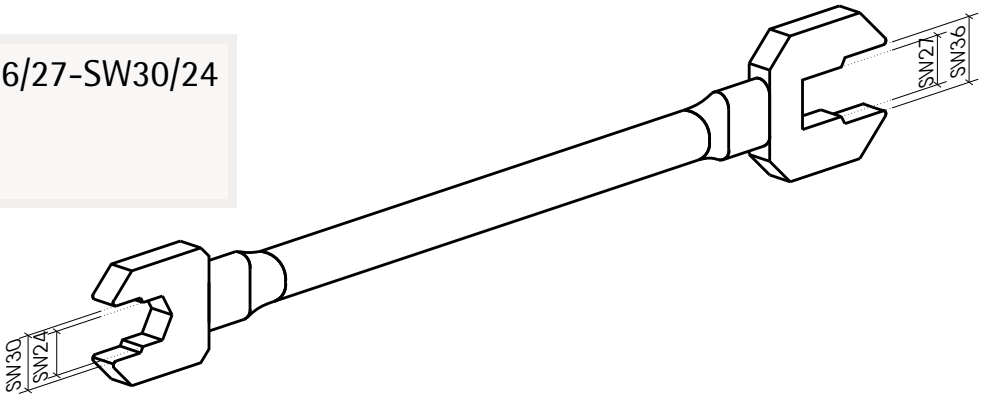
Art.N° : 182.000.0093
Weight : 1.51kg



ill.12

Multi key spanner SW36/27-SW30/24

Art.N° : 182.000.0215
Weight : 1.40kg



ill.13

spanner gap	function	example of use
SW36	- adjust turnbuckle M24 - adjust counter nut M24	- turnbuckle M24 between inside and outside waler by segments 222/230/240cm - turnbuckle M24 between turnbuckle coupler 2 holes for extension with telescopic girder
SW27	- adjust turnbuckle M20	- turnbuckle M20 above the segment joint - turnbuckle M20 on segmentheights 37.5/150cm
SW30	- adjust counter nut M20 - adjust adjusting screw M20 - assemble assembly with screw M20	- counter nut on turnbuckle M20 - adjusting screw M20 and counter nut on inside and outside waler - assembly the extension post - assembly the turnbuckle coupler 2-holes - assembly the stop end guide
SW24	- adjust turnbuckle M16 - adjust counter nut M16	- turnbuckle M16 between segment elbow and segment girder

tab.1

The tools for the radius adjustment are the ratchet key SW30 and the multi key spanner SW36/27-SW30/24.
The number of the necessary keys depends on the formwork height.

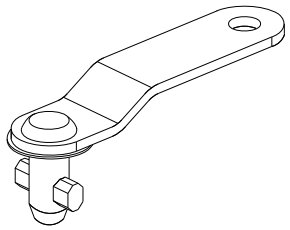
300cm high segment : - 2 ratchet keys
- 2 multi key spanners
150cm high segment : - 1 ratchet key
- 2 multi key spanners
75cm high segment : - 1 ratchet key
- 1 multi key spanner
37.5cm high segment : - 1 multi key spanner

For 60/57.5cm or 62.5/55.5cm wide segments is no ratchet key necessary.

Segment connection

Keybolt

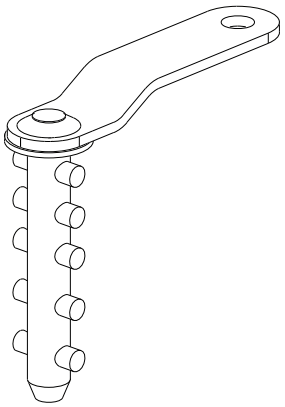
Art.N° : 189.001.0100
Weight : 0.19kg



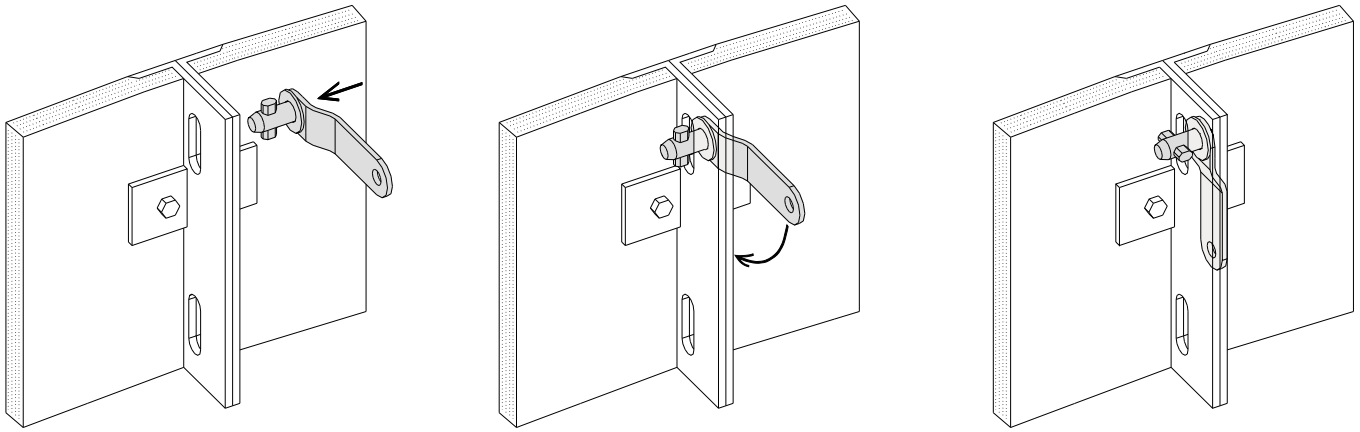
ill.14

5-pin keybolt

Art.N° : 189.001.0105
Weight : 0.30kg



ill.15



put the keybolt through the hole turn the keybolt by 90º

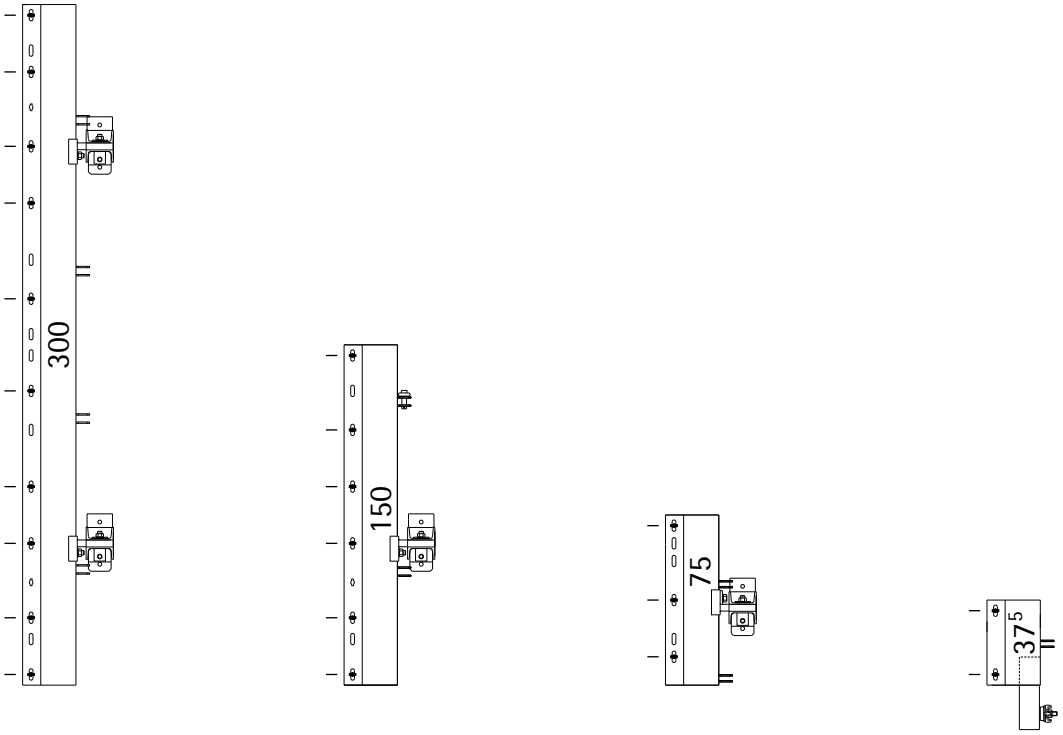
ill.16

The segments are connected by closing the keybolt holes non-positively with the PASCHAL keybolt.

Horizontal compensations can be effected by means of filler posts, plastic filler pieces (PE), filler pieces of polygonal filler posts.
The filler pieces, the filler posts and the polygonal filler posts are connected with the PASCHAL keybolt.

The connection of the plastic filler pieces is made by the 5 pin keybolt.

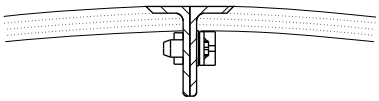
Assembly:
The keybolt is put through the holes of the segment elbow and turned by 90 degrees.



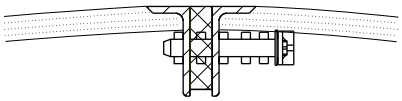
10 keybolts | 6 keybolts | 3 keybolts | 2 keybolts

ill.17

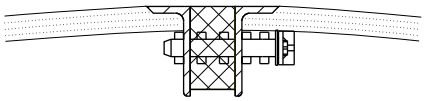
Connection of segments without compensation pieces



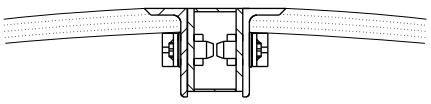
Connection of segments with 2cm plastic filler piece (PE)



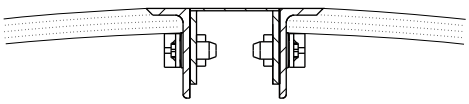
Connection of segments with 4cm plastic filler piece (PE)



Connection of segments with filler post 5cm or 6 cm



Connection of segments with filler pieces

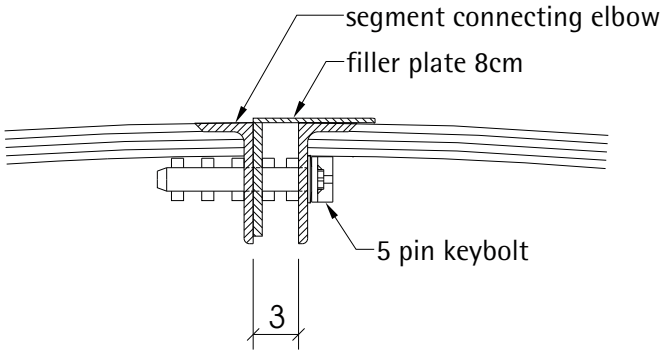


ill.18

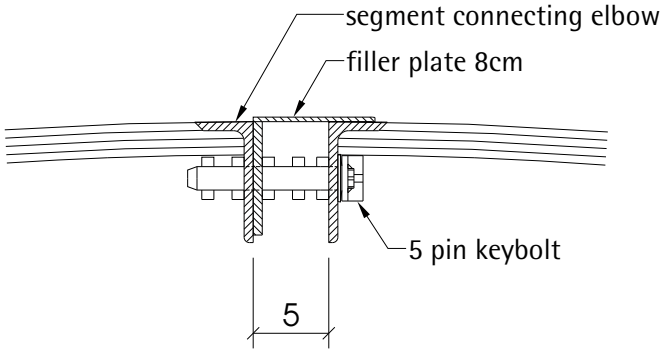
The number of the keybolts depends on the height of the segments.
Because of the different length from the inside wall and the outside wall there is a compensation necessary.
For compensations 5cm or 6cm, filler posts of the Modular Formwork System can be used.
Plastic filler pieces are available in widths 2cm and 4cm.
Filler pieces are available in widths 6cm, 8cm, 10cm, 12cm, 14cm, 16cm, 18cm and 20cm.

The max. posible compensation is 20cm. For greater compensation between the segments there is an additinal ties necessary. For these case you need a polygonal filler piece.

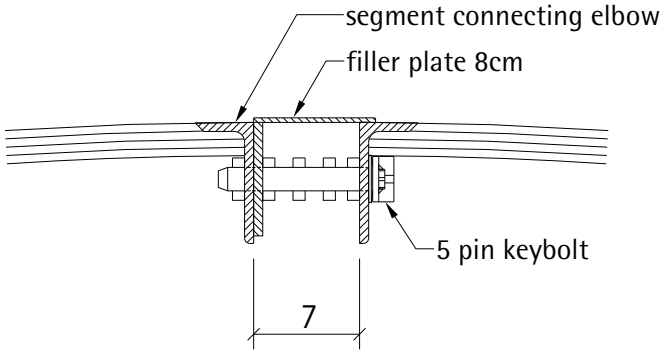
Filler plate / dismantling



ill.19



ill.20



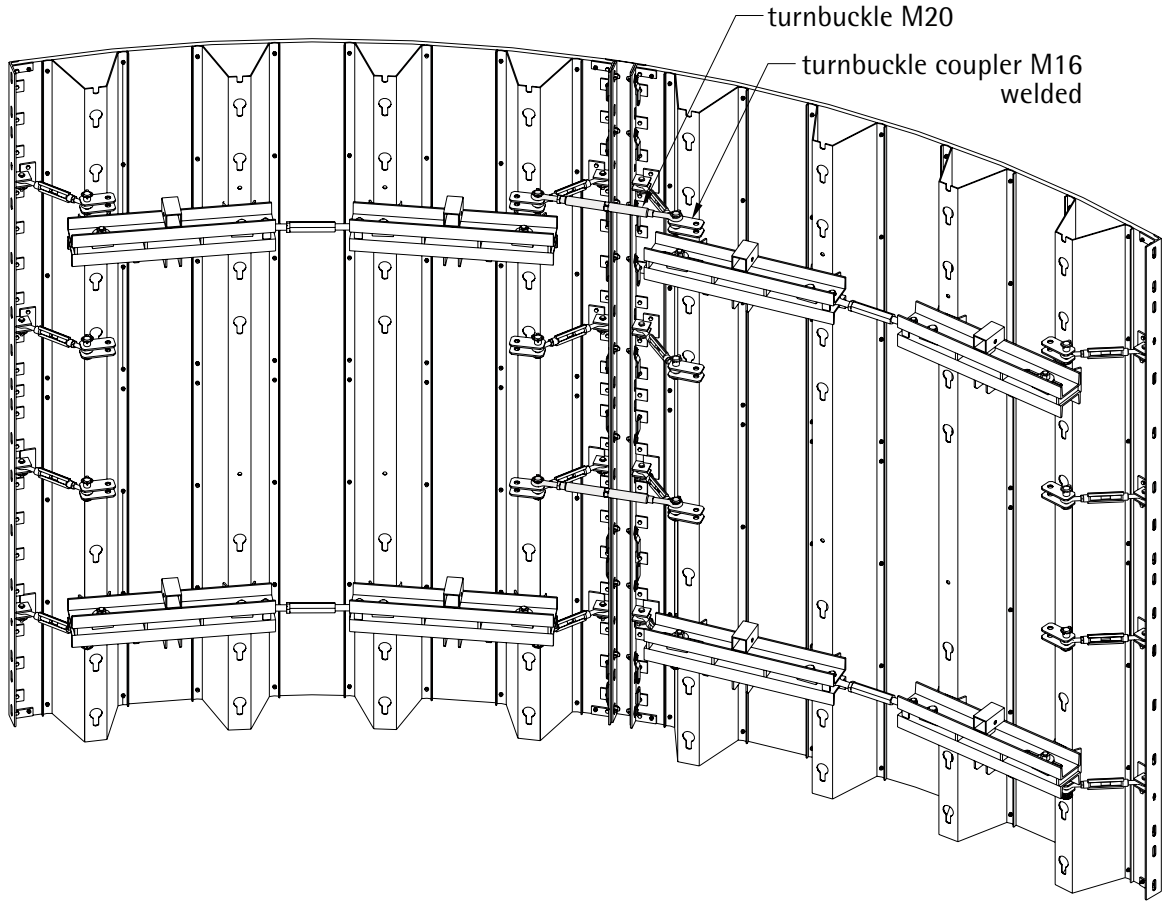
ill.21

When concreting a complete circle the arising stresses make a dismantling of the interior formwork difficult. For this reason a small clearance has to be provided at one segment joint at least.

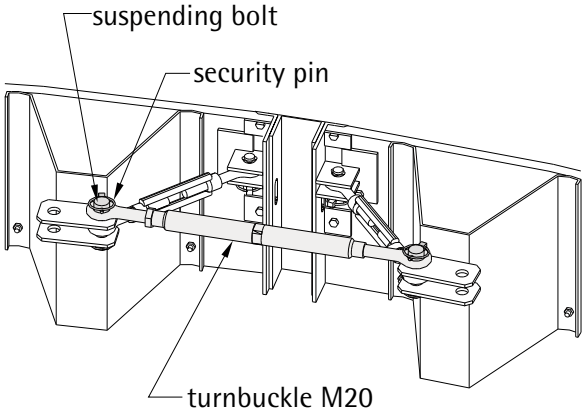
Assemble the filler plate 8cm with a 5 pin keybolt to the segment connecting elbow.

The dismantling is effected by removing the 5 pin keybolts.
A clearance of 3cm, 5cm or 7cm is achieved in this way which allows now an easy dismantling of the trapezoidal girder segments.

For circular structures which are concreted in several phases you don't need a filler plate 8cm.



ill.22



ill.23

Art. N°	Item	Weight
182.000.0210	turnbuckle M20 320-470 mm	1.60 kg
182.000.0211	turnbuckle M20 450-600 mm	2.10 kg
182.000.0212	turnbuckle M20 600-750 mm	2.70 kg
182.000.0213	turnbuckle M20 750-900 mm	3.30 kg
182.000.0209	suspending bolt ∅ 26/21 mm	0.26 kg
930.007.0008	security pin for bolt	0.02 kg

tab.2

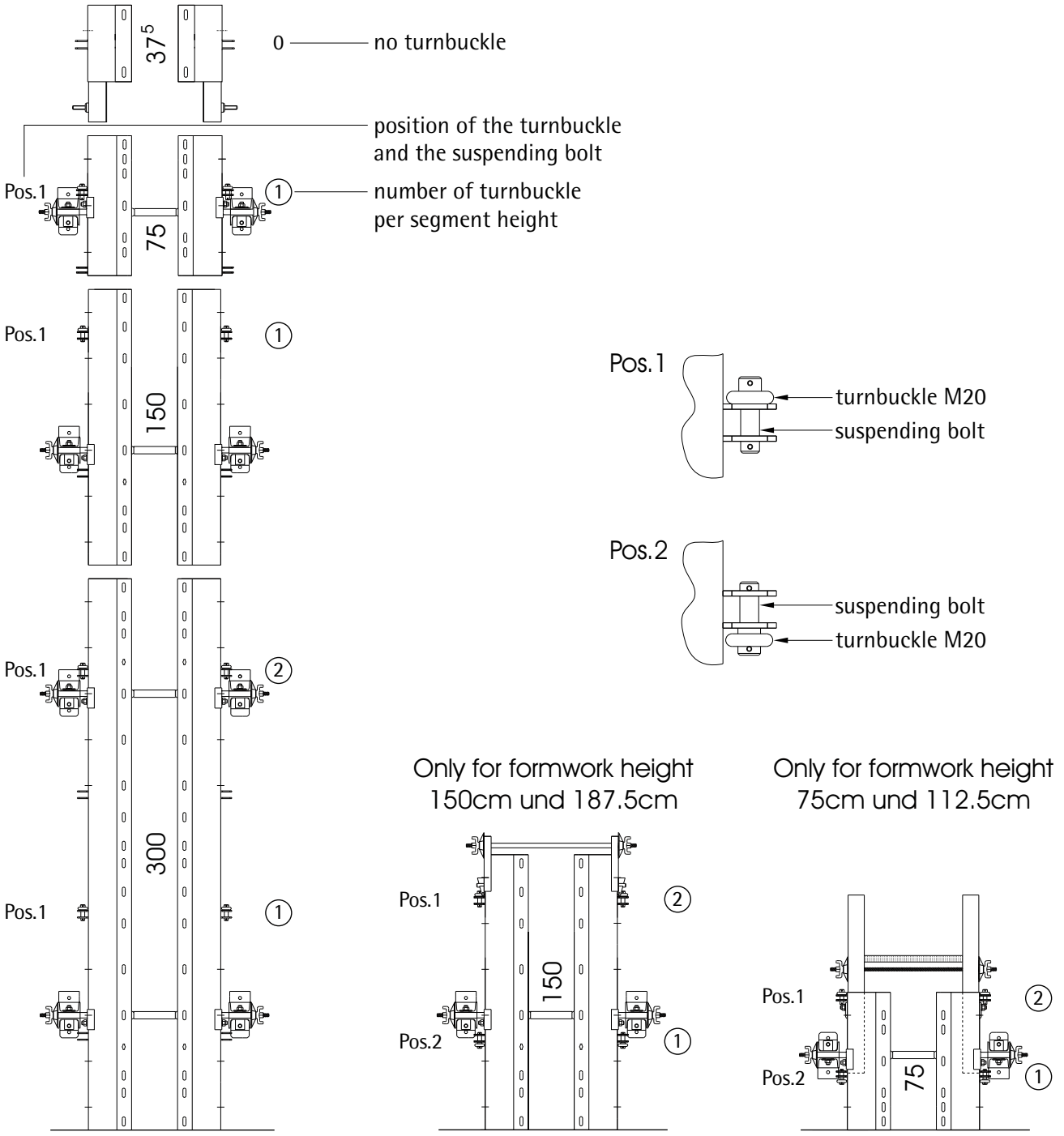
Turnbuckles above every segment joint are necessary.

Especially if 2 or more segments will transported with the crane and a filler piece is between the segments the turnbuckles are important.

The turnbuckle is also a great help when you bring the segments with a small diameter in right position.

The turnbuckle M20 will assembled on the turnbuckle coupler M16 welded. At first you remove the security pin of the suspending bolt. Then place the turnbuckle of the suspending bolt and safe the turnbuckle with the security pin.

Turnbuckle above the segment joint



ill.24

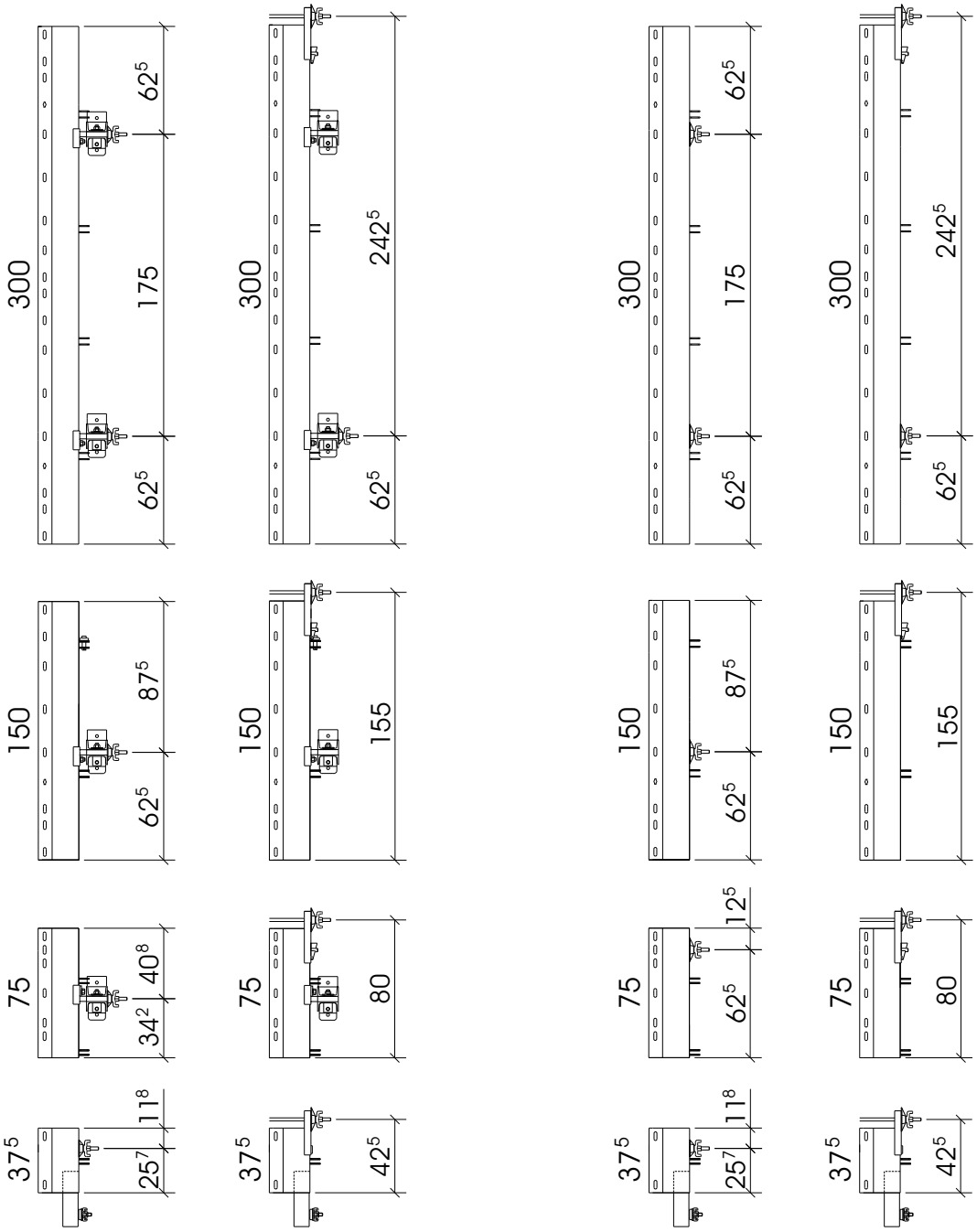
The number of the turnbuckle is depending from the segment height.

3.00m high segment ➔ 2 turnbuckles
1.50m high segment ➔ 1 turnbuckle
0.75m high segment ➔ 1 turnbuckle
0.375m high segment ➔ no turnbuckle

The min. number of turnbuckles on every segment joint is 2.
If the forming height 1.50m or 1.875m, then it is necessary to assembled 2 turnbuckles on the 1.50m high segment. For a formwork height of 0.75m or 1.125m are also 2 turnbuckles necessary. If the 37.5cm high segment is used alone, then there are 1 turnbuckle necessary.

Segmentwidth 222/230/240cm
115/120cm and 110.5/125.5cm

Segmentwidth 57.5/60cm
and 55.5/62.5cm



ill.25

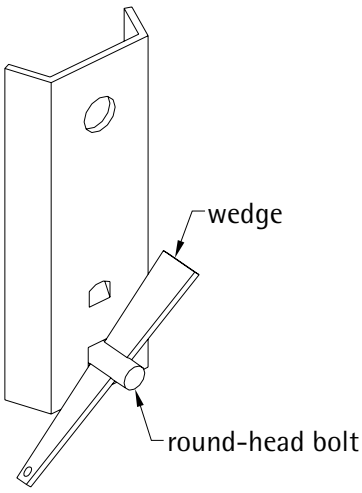
In the trapezoidal girder segment the ties are placed between two trapezoidal girders. That's why the segment have inside waler and outside waler.
The tie rod must be inserted through the tie holes in the plywood and through the waler. The plate with ball-and-socket joint DW15 is to used for the tie rod.

Segment with one trapezoidal girder (57.5/60cm or 55.5/62.5cm) have no waler. There the tie rod is insert through the key holes of the girder. In the plywood there are also tie holes.

When using the 37.5cm high segment as bottom extension segment ties have to be applicated whereas for the use as top extension segment there is no need for ties.

Tie rod guide with wedge

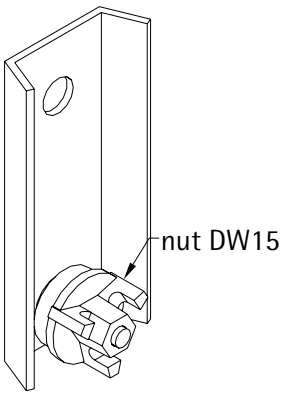
Art.N° : 182.000.0089
Weight : 2.51kg



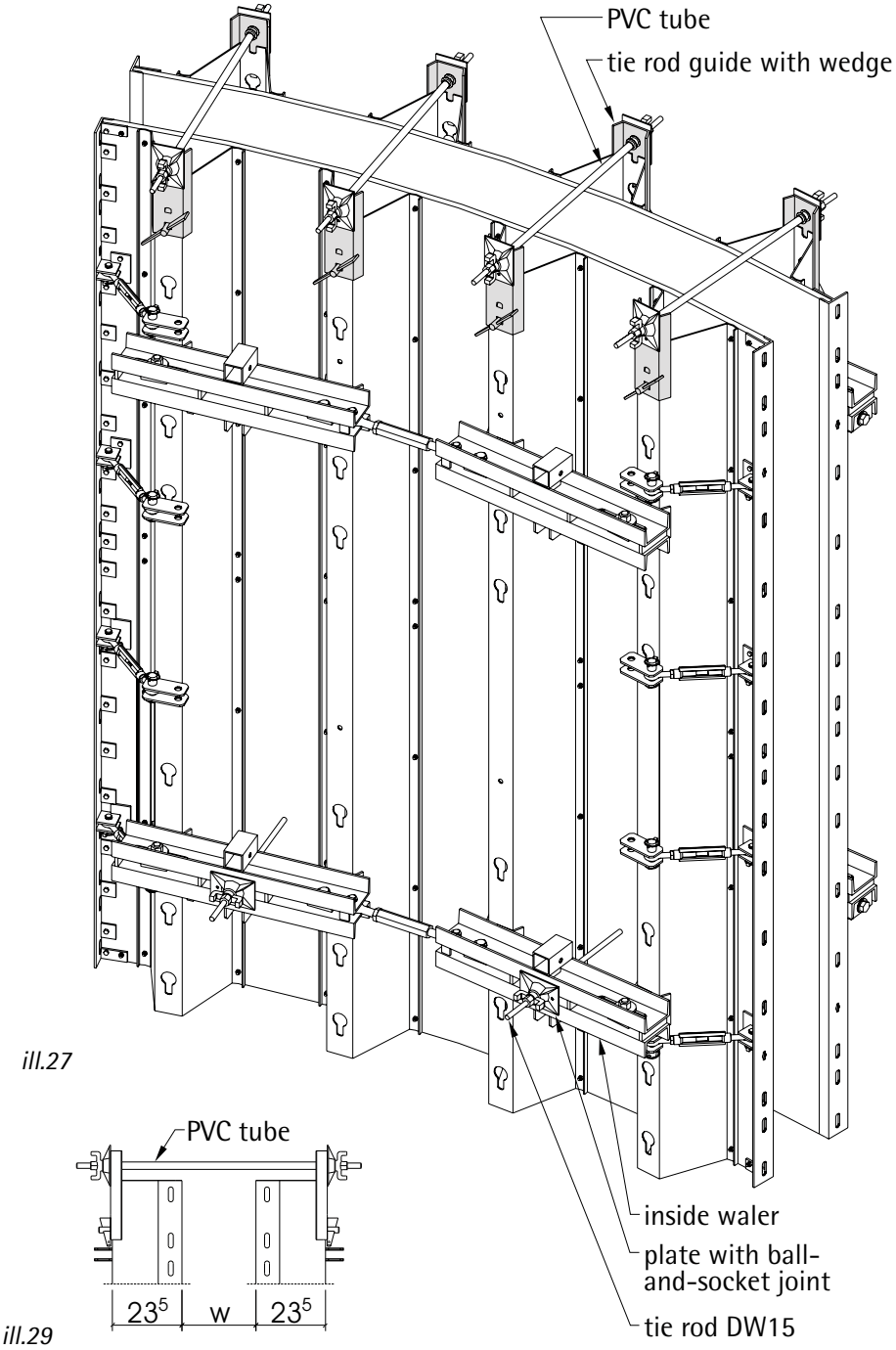
ill.26

Tie rod guide for segment height 37.5cm

Art.N° : 182.000.0263
Weight : 1.80kg



ill.28



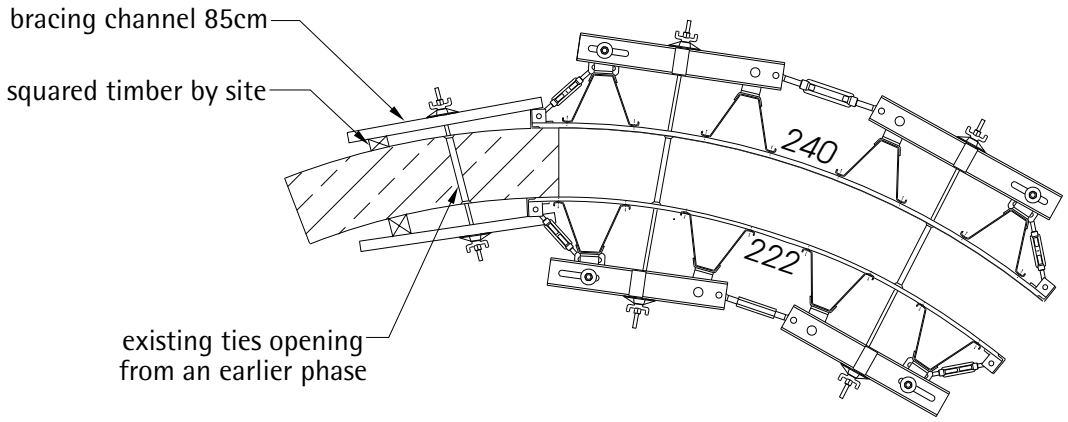
ill.27

ill.29

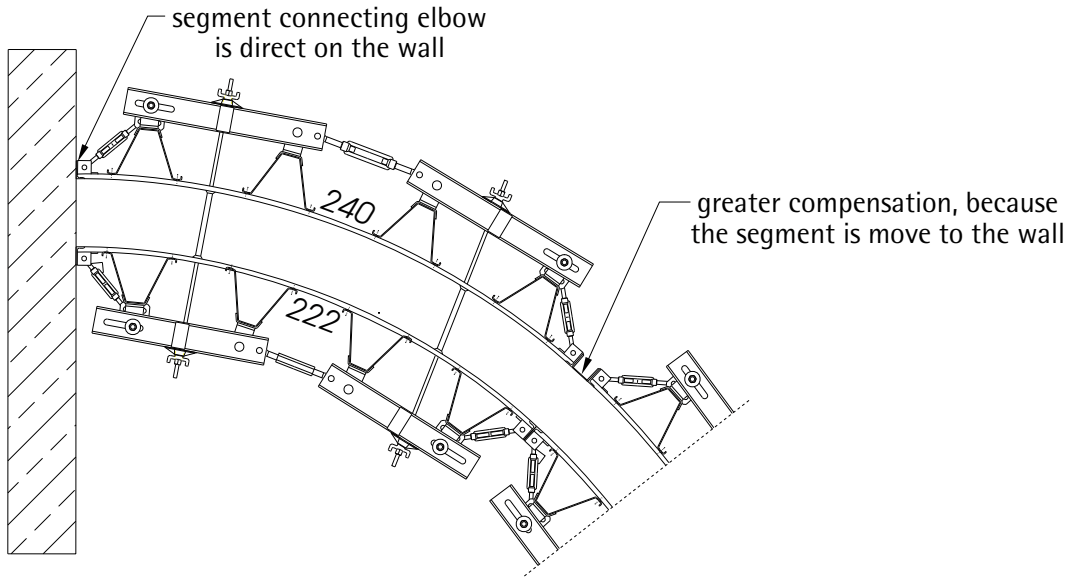
If it is not allowed to place ties in the upper concreting section, they can be placed above the formwork.
In case of segment heights of 0.75m, 1.50m or 3.00m, tie rod guides with wedge are attached to the upper hole in the girder.
For the 37.5cm high segment a specially tie rod guide is necessary.

The tie rod guide is assembled on the upper key holes of the trapezoidal girder.

Tie rod DW15 with PVC tubes or tie rods DW15 with hexagon nuts DW15 are used for keeping the distance. For the tie rod guide the PVC tube is 47cm longer as the wall thickness.



ill.30



ill.31

The edges of the existing wall can be overlapped with the segment.
The first tie rod holes of the existing wall are used for an additional tensioning the segments through a bracing channel 85cm or an other waler.

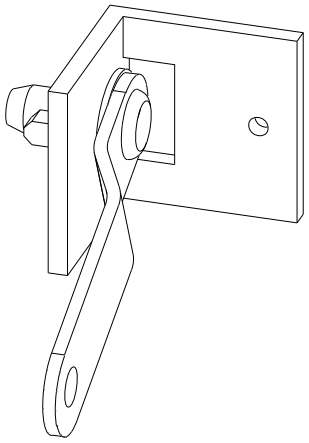
On rectangular wall connections the segments where placed directly on the existing wall.
Normally on one side is a compensation necessary. These compensation was added to the compensation of the next segment joint. So on the first segment joint after the existing wall a greater compensation at one side is necessary.

Connection to existing concrete walls

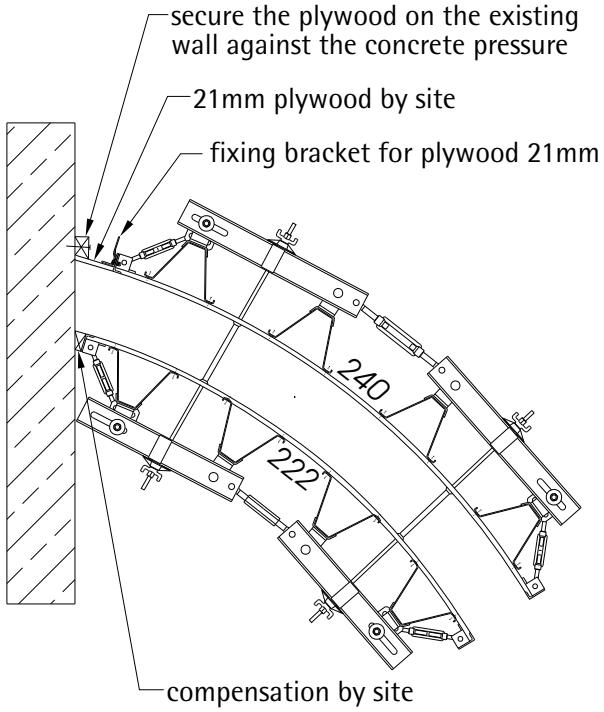
Fixing bracket
for plywood 21mm

Art.N° : 189.001.0017

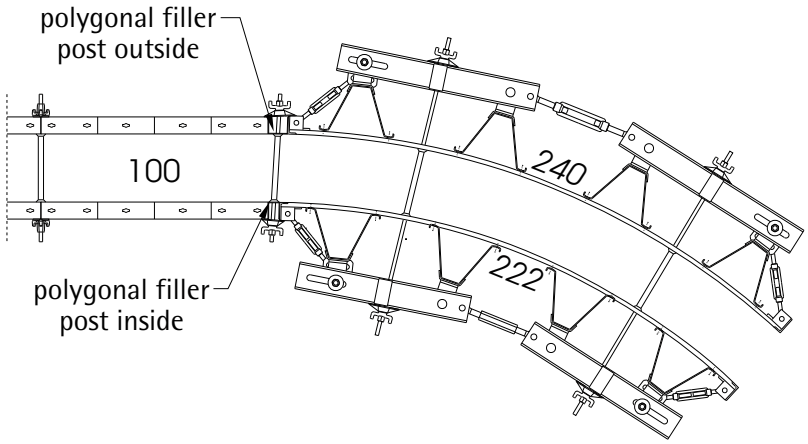
Weight : 0.45kg



ill.32



ill.33



ill.34

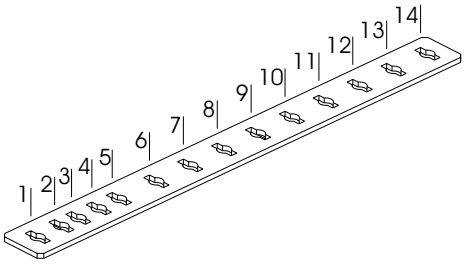
On other angular wall connections the remaining space between segment and existing wall are formed with a 21mm plywood filling.
The connection to the segments is effected with the fixing bracket for plywood 21mm.
On the inside segment it is most possible to used a compensation by site.

The Trapezoidal Girder Formwork can be connected with other formwork systems from PASCHAL.
The position of the keybolt holes in the segment connecting elbow is the same as the position in the frame from the Modular panel. That's why the connection of 300cm, 150cm and 75cm high segments with Modular panels is no problem.
For other heights the filler post 5cm or 6cm is necessary.

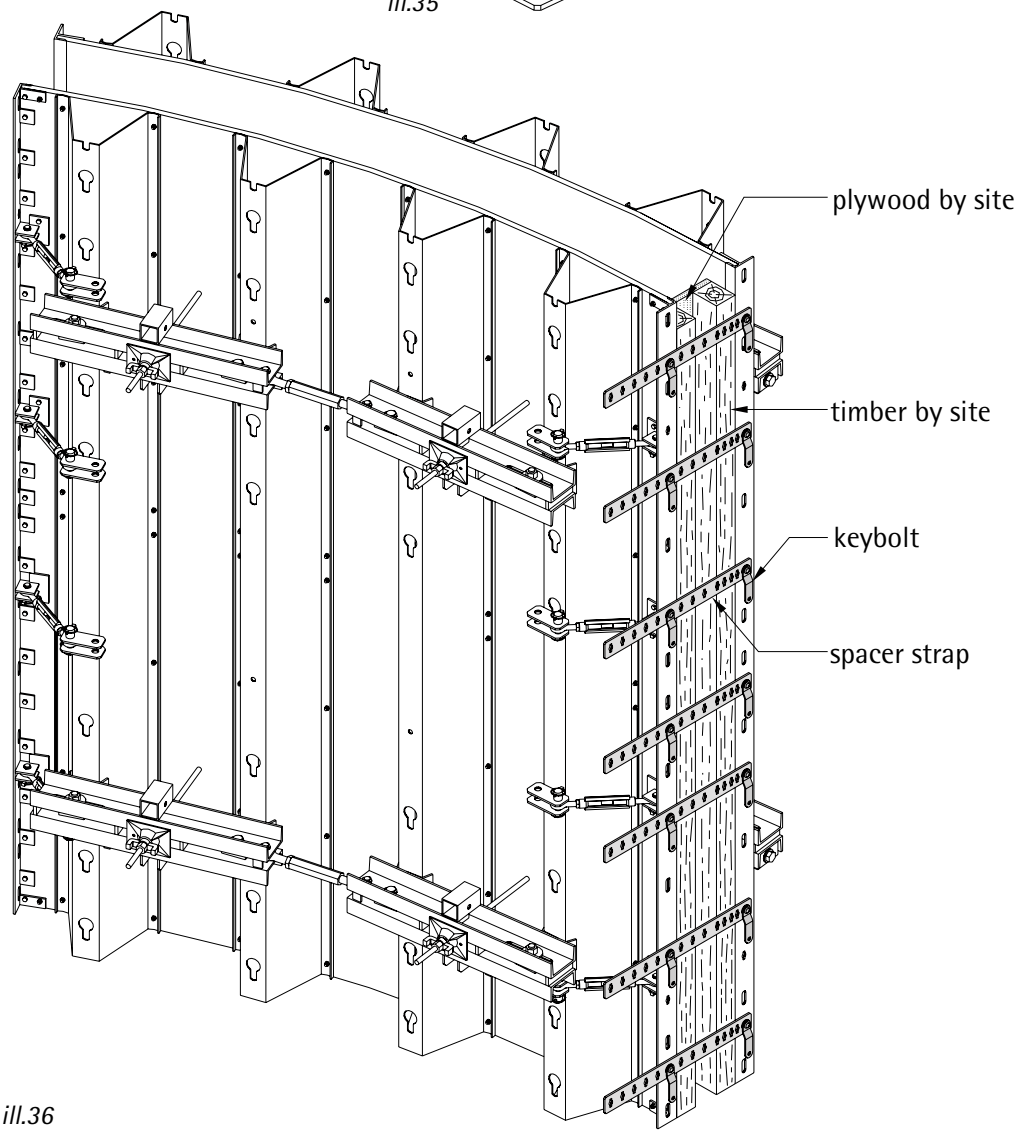
Spacer strap 6-50cm

Art.N° : 189.001.0020

Weight : 1.50kg



ill.35



ill.36

wall tickness [cm]	holes N°
6	4 - 7
6,5	2 - 6
7,5	6 - 9
8	5 - 8
9	3 - 7
10	1 - 6
11	4 - 8
11,5	2 - 7
12,5	6 - 10
13	5 - 9
14	3 - 8
15	1 - 7
16	4 - 9
16,5	2 - 8
17,5	6 - 11
18	5 - 10
19	3 - 9
20	1 - 8
21	4 - 10
21,5	2 - 9
22,5	6 - 12
23	5 - 11
24	3 - 10
25	1 - 9
26	4 - 11
26,5	2 - 10
27,5	6 - 13
28	5 - 12
29	3 - 11
30	1 - 10
31	4 - 12
31,5	2 - 11
32,5	6 - 14
33	5 - 13
34	3 - 12
35	1 - 11
36	4 - 13
36,5	2 - 12
38	5 - 14
39	3 - 13
40	1 - 12
41	4 - 14
41,5	2 - 13
44	3 - 14
45	1 - 13
46,5	2 - 14
50	1 - 14

tab.3

When concreting in phases, sealing strips have to be installed in the construction joints. The reinforcement has to be extended through a stop end are transferred to spacer straps.

Spacer straps are fixed vertically to the segment connecting elbows by keybolts.

2 squared timbers are placed behind the spacer straps as support for the face material. The squared timbers must be great enough.

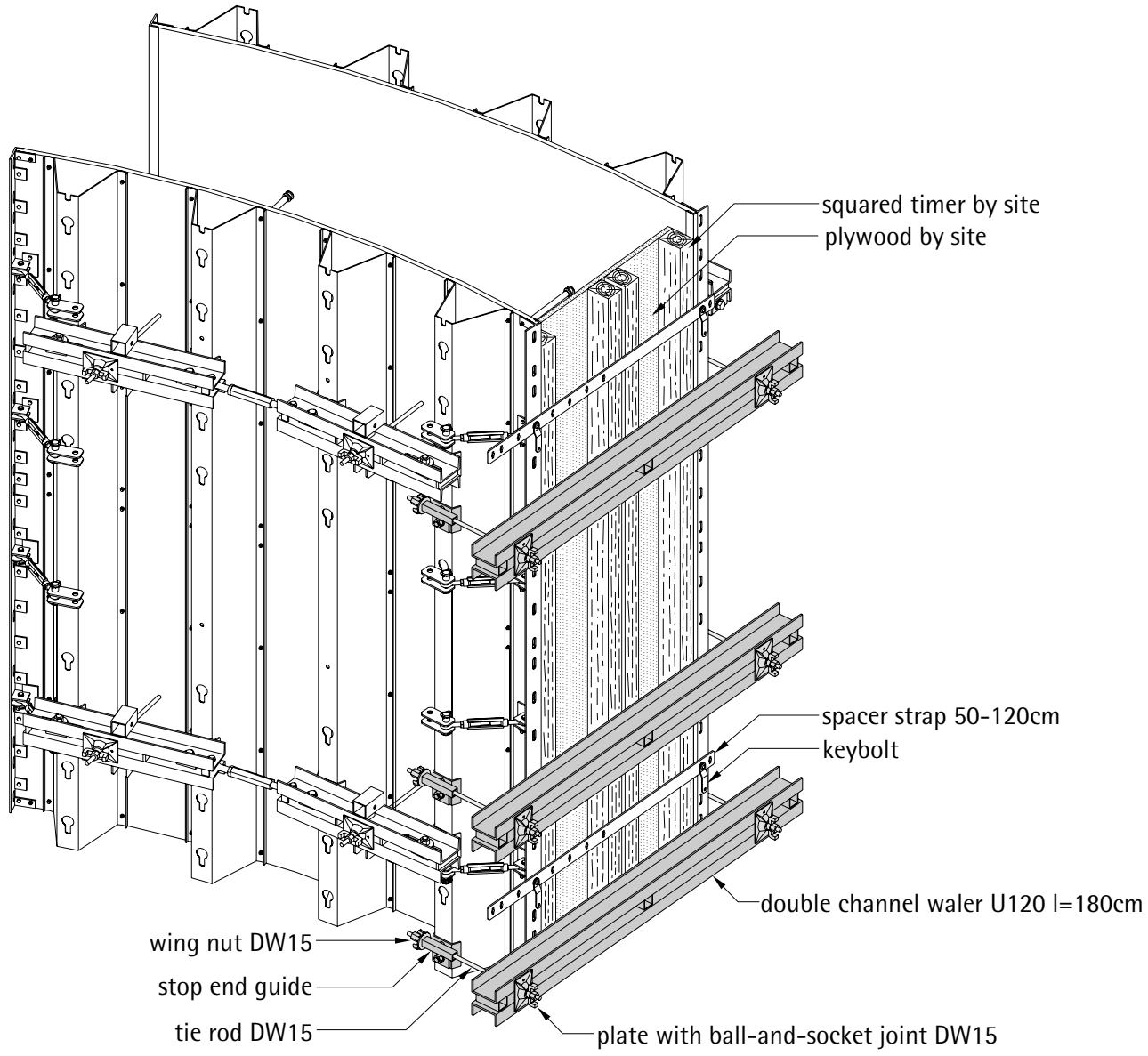
Table 3 show the possible wall thickness of a stop end with the spacer strap.

The end of a wall is also formed on the same way.

The number of the spacer straps is depending of the formwork height.

forming height 1.50m ➔ 3 spacer straps
forming height 2.25m ➔ 5 spacer straps
forming height 3.00m ➔ 7 spacer straps
forming height 3.75m ➔ 9 spacer straps
forming height 4.50m ➔ 11 spacer straps
forming height 6.00m ➔ 13 spacer straps
forming height 7.50m ➔ 17 spacer straps

Stop end



ill.37

The transfer of the loads on wall thickness bigger than 50cm, and on conical shaped walls is taken by double channel waler U120 with it's infinitely variable adjustment.
It is fitted with a tie rod DW15 and a stop end guide.
The stop end guide is connected with the first trapezoidal girder of the inside or outside segment.

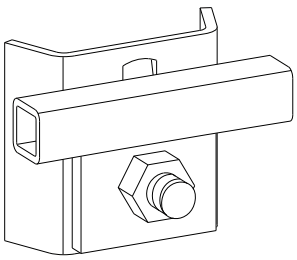
These type of stop end is possible to a wall thickness of 120cm and smaller. For greater wall thickness you need an additional support for the stop end.

The stop end with the stop end guide is also used for wall thickness, which can't make with the spacer strap 6-50cm.

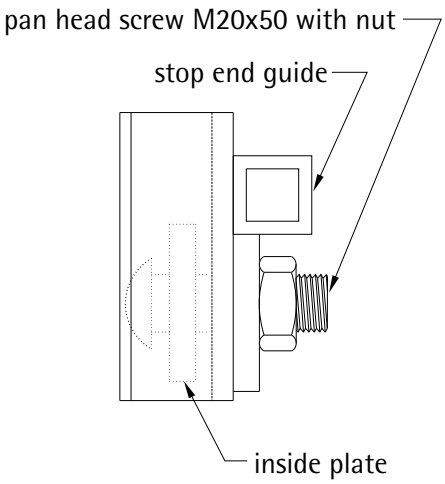
The stop end guide must be assembled to the trapezoidal girder before you make the height extension or positioning the segments for concreting.

Stop end guide cpl.

Art.N° : 182.000.0032
Weight : 2.90kg



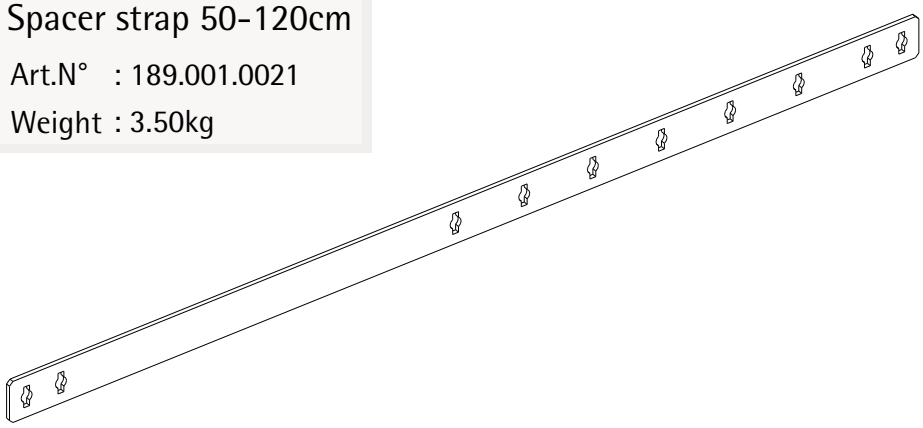
ill.38



ill.39

Spacer strap 50-120cm

Art.N° : 189.001.0021
Weight : 3.50kg



ill.40

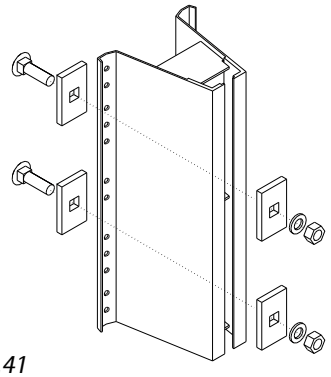
The spacer strap 50-120cm is a help for a better forming and guarantee the exact wall thickness on the end of the wall. The spacer strap 50-120cm can be used for wall thickness from 50 to 120cm in step of 5cm.

The squared timber and the distance between the timber must be great enough.

The number of the double channel waler U is depending from the segment height.
3.00m high segment ➔ 3 walers
1.50m high segment ➔ 2 walers
0.75m high segment ➔ 1 waler

Telescopic girder 56.5cm

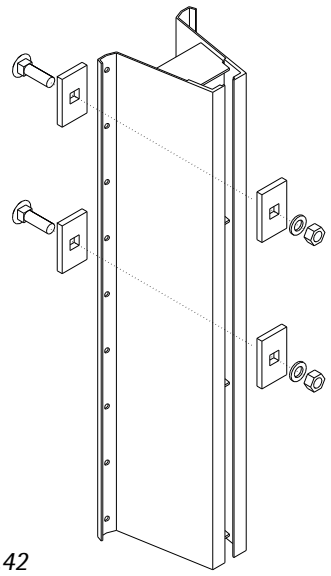
Art.N° : 182.000.0100
Weight : 13.00kg



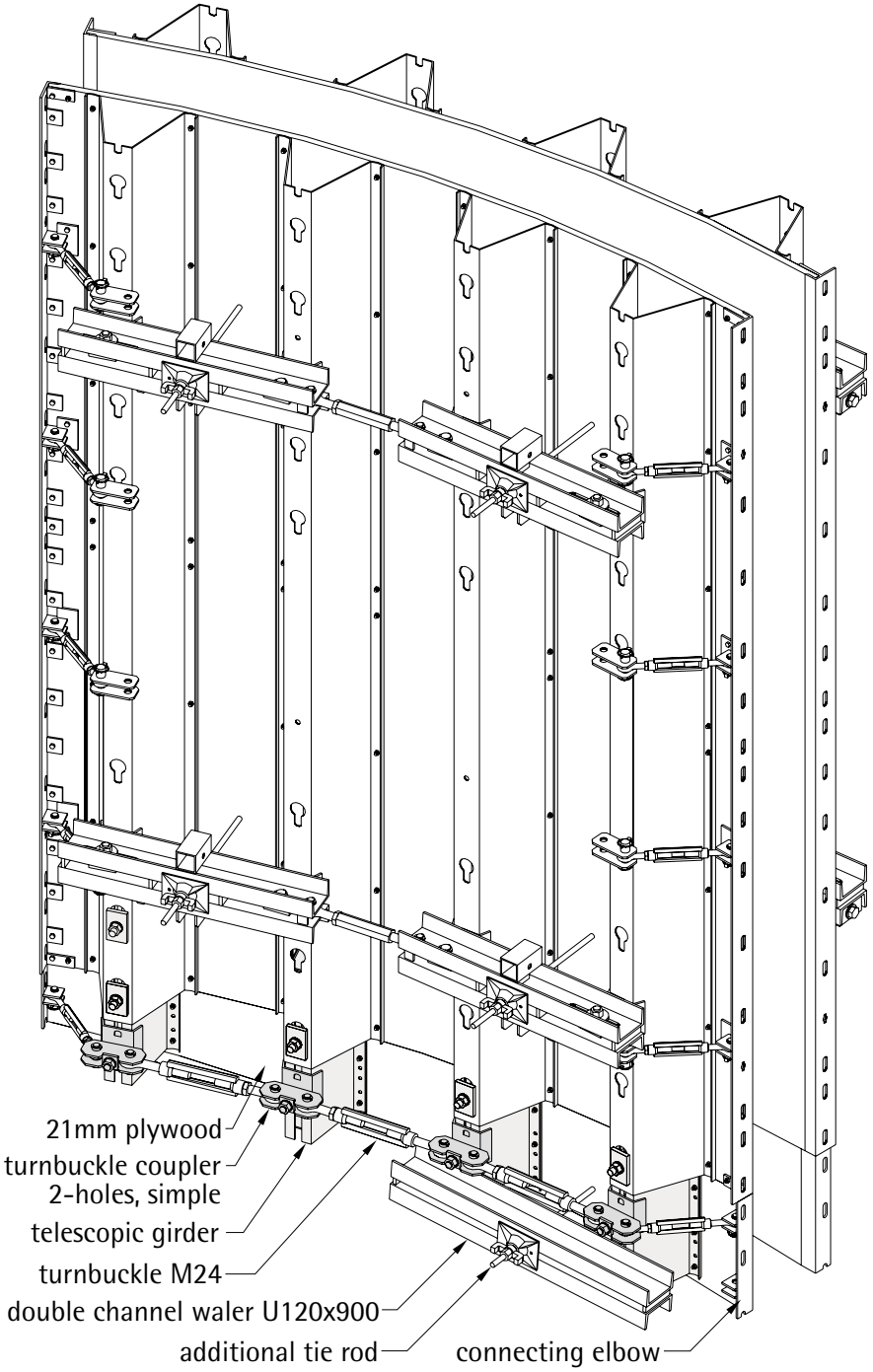
ill.41

Telescopic girder 100cm

Art.N° : 182.000.0099
Weight : 18.00kg



ill.42



ill.43

The telescopic girder is used by incline walls.
The telescopic girder is a variable unit.

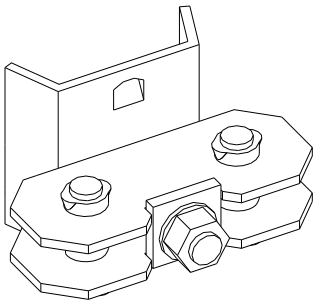
Assembly

The telescopic girder is insert in the trapezoidal girder from the top or from the bottom and fixed by pan head screws and plates.
Is the extension length greater than 15cm additional turnbuckles and turnbuckle couplers 2 holes are necessary. The turnbuckle secure the exact circular form of the extension. The turnbuckle was connected with turnbuckles coupler 2-holes to the telescopic girder.
Once the telescopic girder are assembled the plywood is attached according to the size of the segment mould and to the angle of inclination.
The plywood can be fixed with countersunk screw to the telescopic girder.
For extensions more than 27cm an additional tie rod is required.

Turnbuckle coupler
2 holes, simple

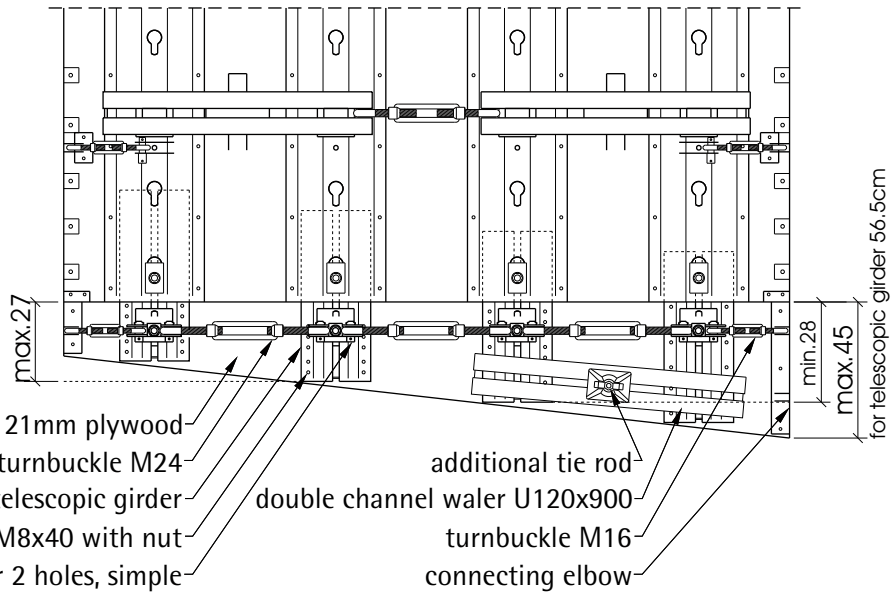
Art.N° : 182.002.0015

Weight : 3.20kg



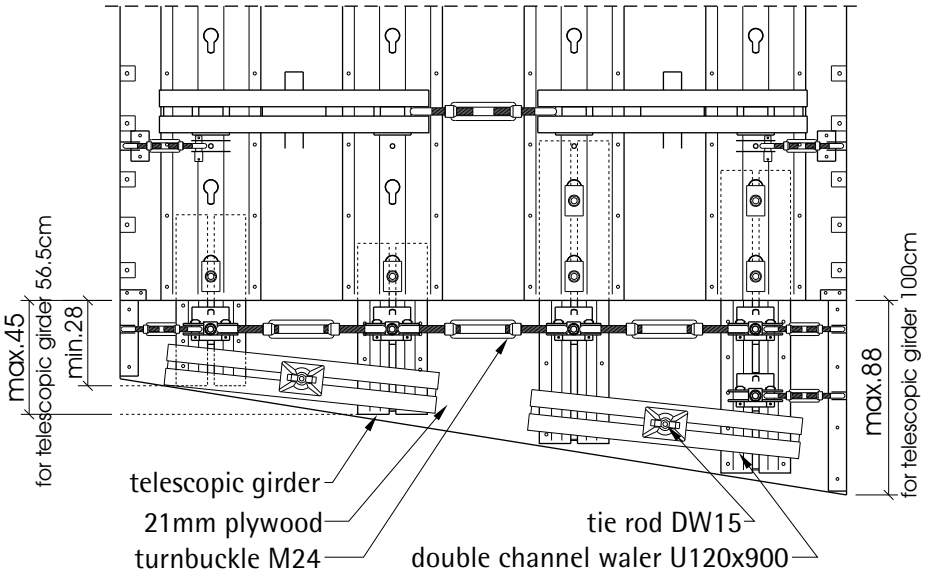
ill.44

Telescopic girder 56.5cm with additional tie rod

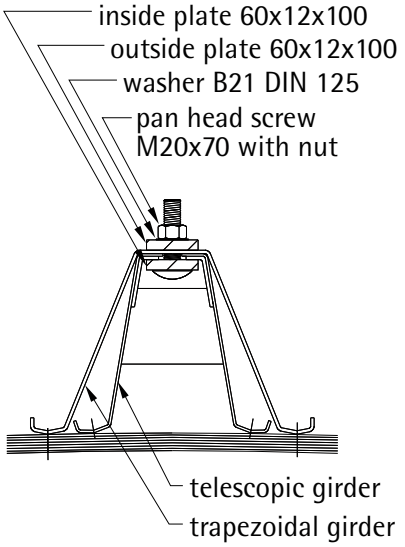


ill.45

Telescopic girder 100cm with additional tie rod



ill.46



ill.47

Extension length for telescopic girder

Telescopic girder 56.5cm – bottom
without additional tie rod 3 – 27 cm
with additional tie rod 27 – 45 cm

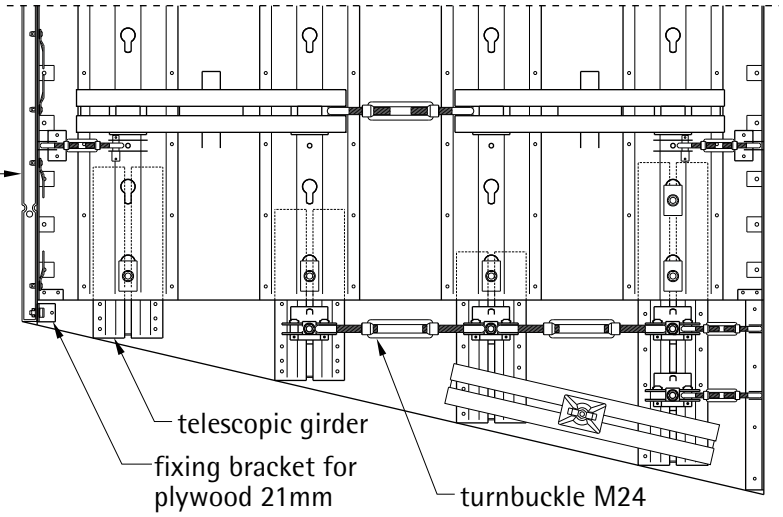
Telescopic girder 56.6cm – top
without additional tie rod 0 – 36.5 cm

Telescopic girder 100cm – bottom
without additional tie rod 3 – 30 cm
with additional tie rod 30 – 88 cm

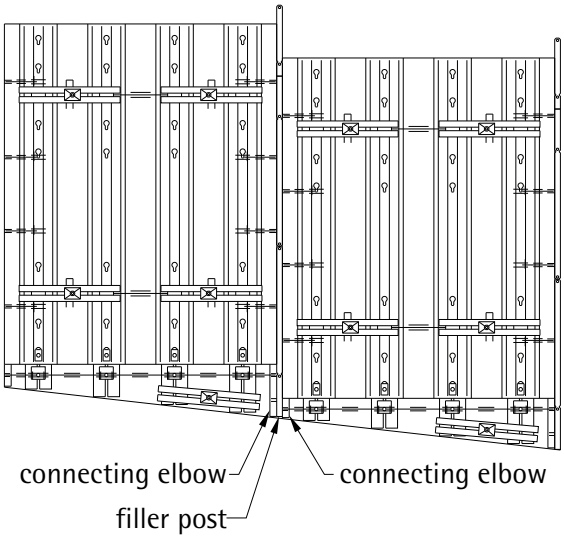
Telescopic girder 100cm – top
without additional tie rod 38 – 80 cm

Telescopic girder 56.5cm – top
with additional tie rod 25.5 – 36.5 cm
for segment heights 75cm

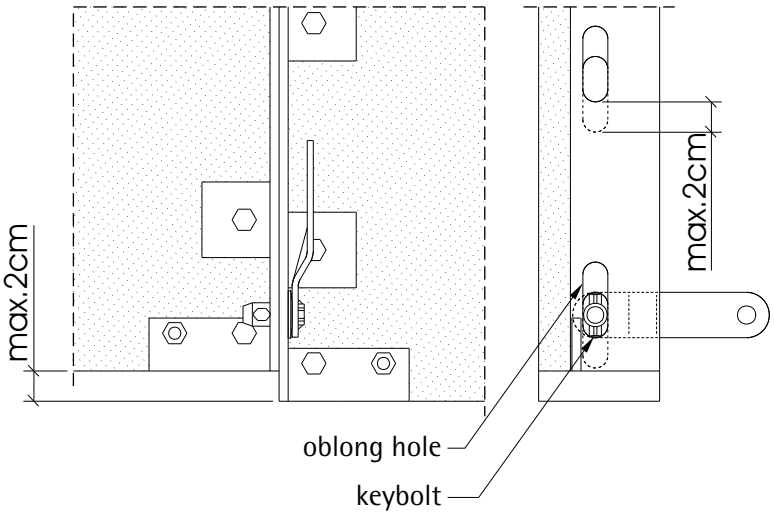
Walls on slopes / steped walls



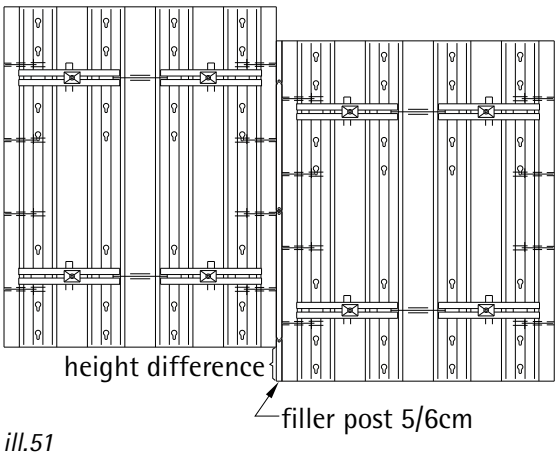
ill.48



ill.49



ill.50

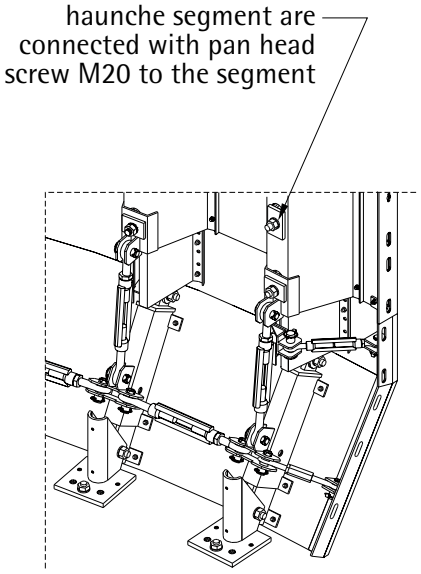


ill.51

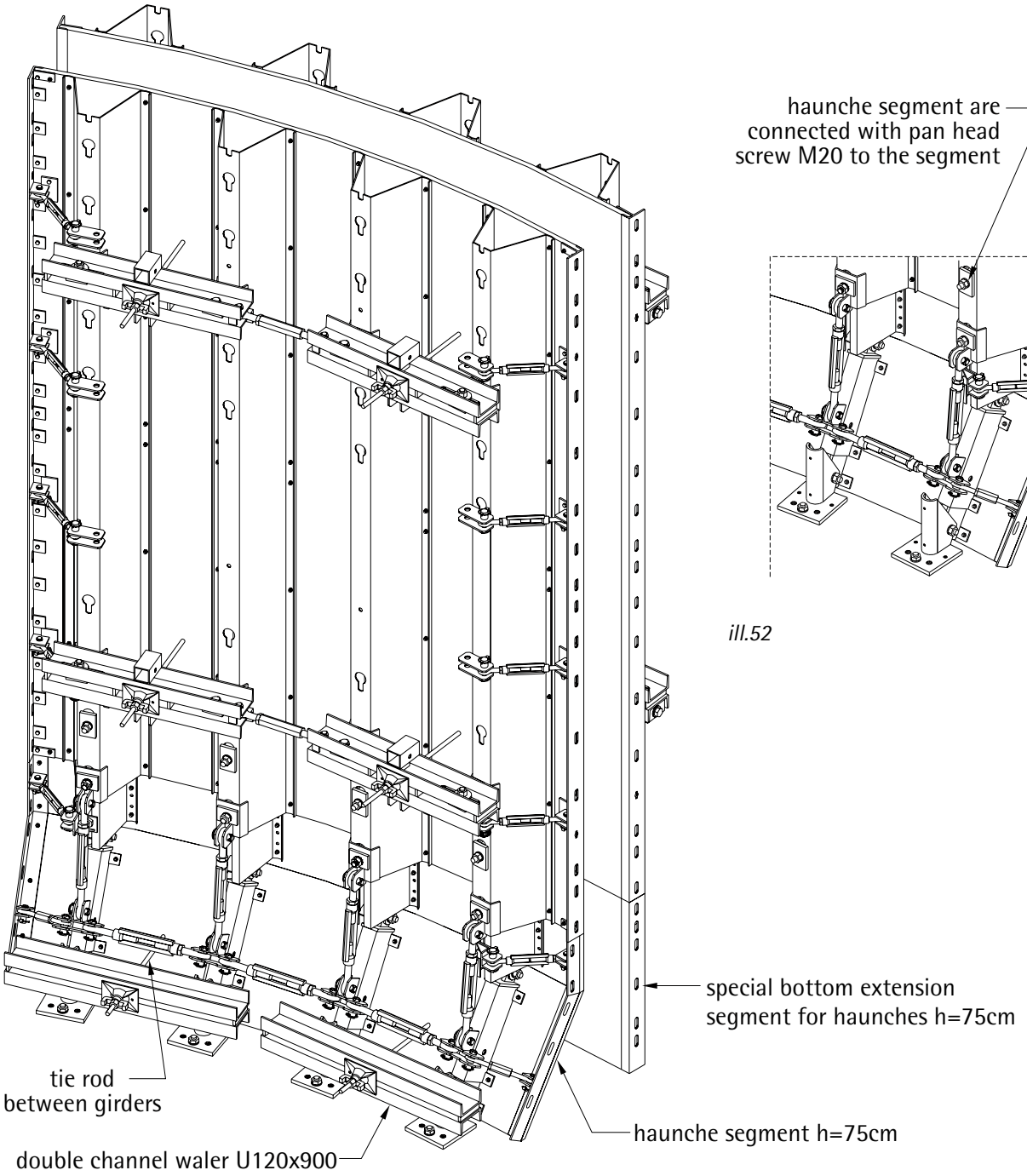
On both sides of the segment should be placed a connecting elbow. The min. length of these elbow is 16cm. For smaller length should be used a fixing bracket for plywood 21mm.

For walls on slope or steped walls you need a filler post 5cm or 6cm on every segment joint, because on different heights the holes in the connecting elbow have an other position and you can't connect the segment with the keybolts.
The filler post makes it possible to connect the segment with the filler post on each position.

In the segment connecting elbow are oblong holes. With these holes is a height difference of 2cm possible.



ill.52



ill.53

Walls with haunches at the footing are formed with variable haunches segments.
The two different haunches segments are 75cm and 112.5cm high.

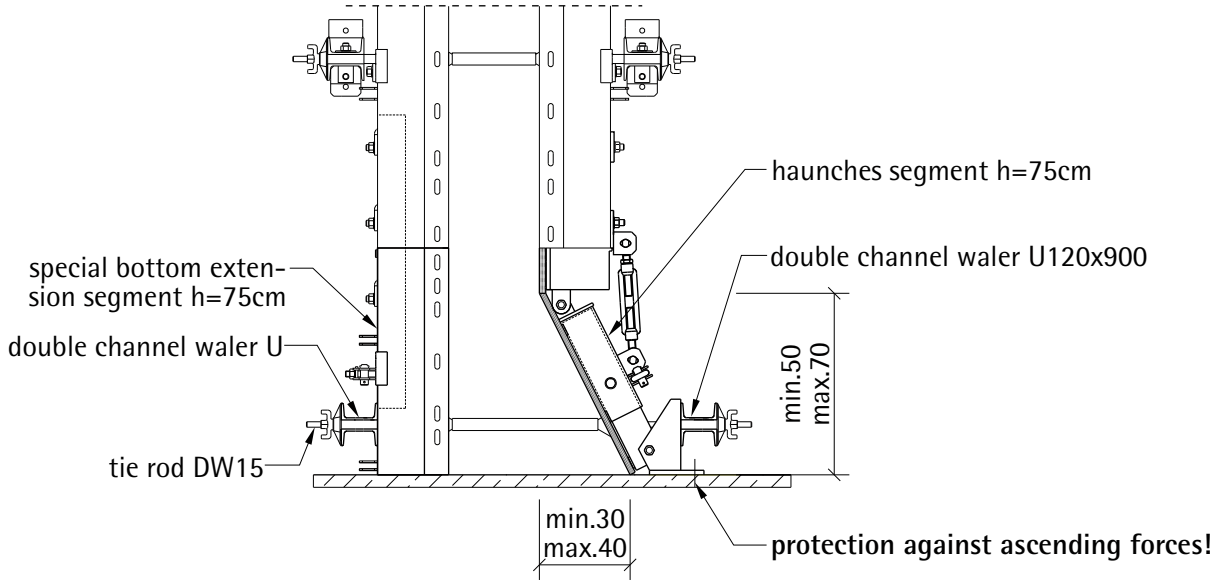
The small (75cm) haunches segment can be used for widths of 20-50cm and for heights of 50-70cm.

The big (112.5cm) haunches segment can be used for widths of 20-60cm and for heights of 80-100cm.

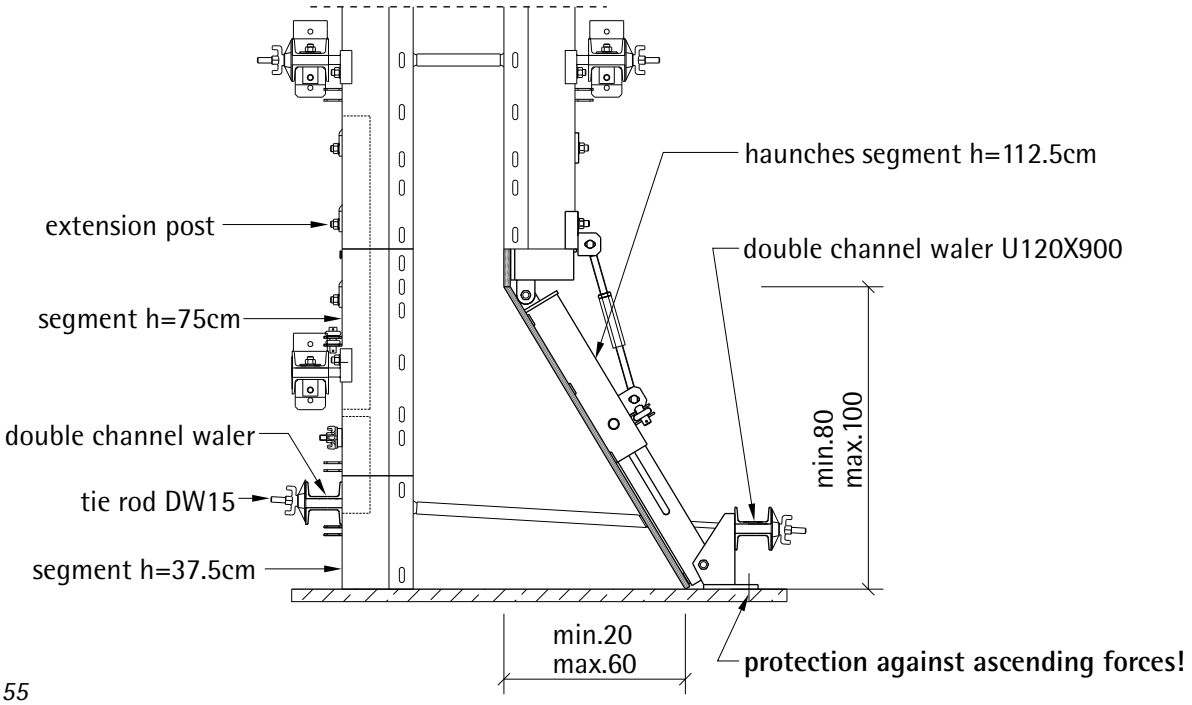
For the outside formwork of the 75cm high haunch segment exist a specially bottom extension segment. The extension post are including in these outside segment. The segment have no waler, so that additional double channel waler U120 are necessary for ties.

For the outside of the 112.5cm high haunch segment normally segments can be used.

Haunches



ill.54

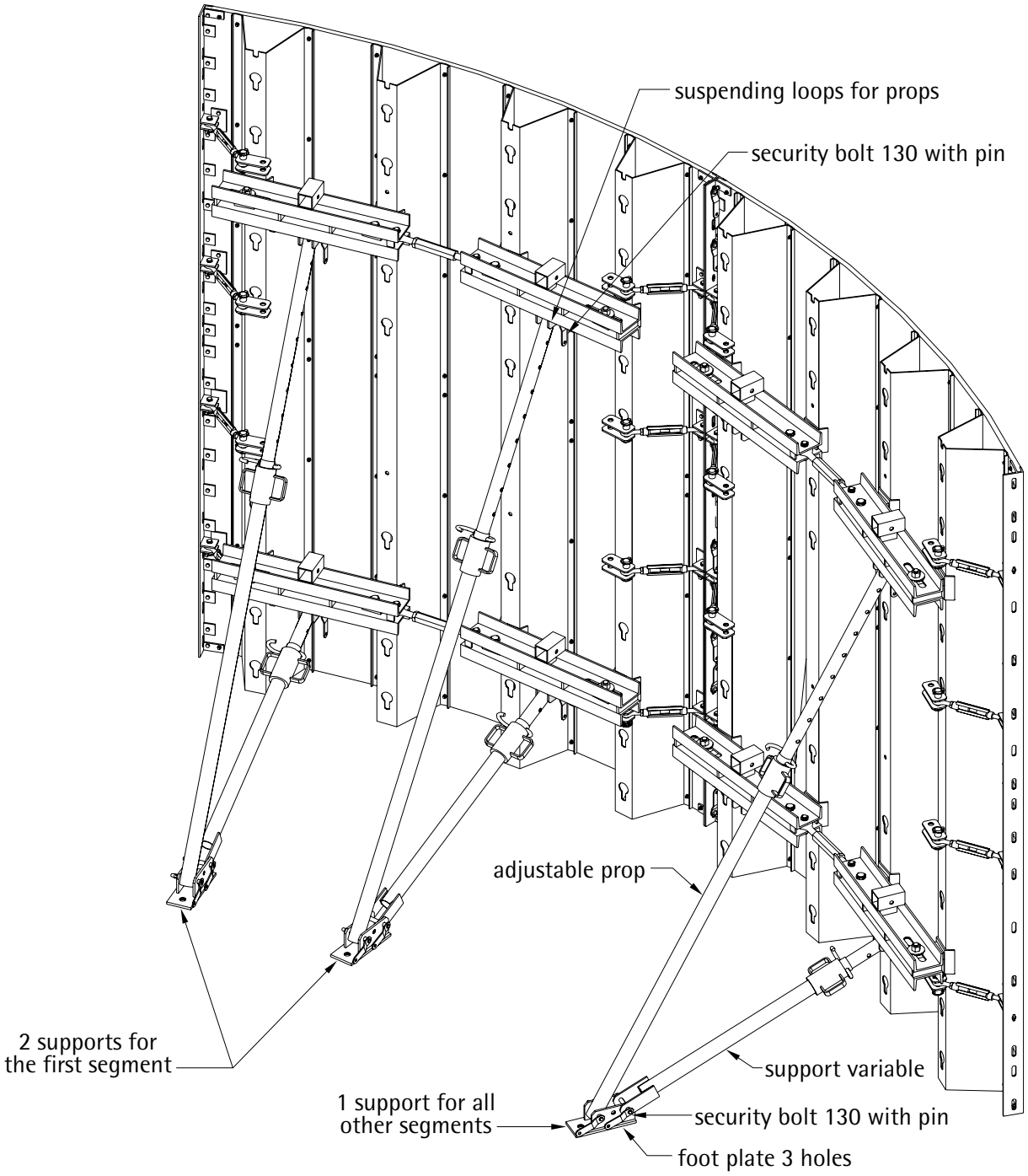


ill.55

An additional tie rod is necessary in the haunches segment.

Attention !

The haunches segment must be protected against ascending forces.



ill.56

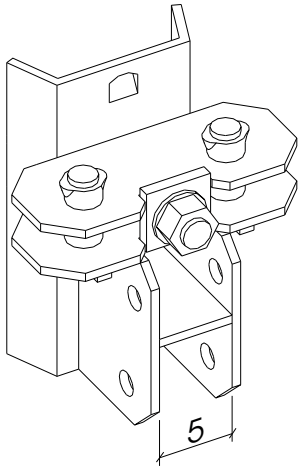
After the segments being erected, the formwork has to be supported.
This is made in the upper part of the formwork by adjustable props and at the bottom by variable supports or adjustable props.
The connection of the props is made at the inside waler (or outside waler).
Adjustable props and variable supports are joined in the same foot plate using two security bolts with pins. This foot plate, which is anchored th the ground, guarantees the stability of the formwork.

For the alignment of the formwork just turn the pipe spindles of the adjustable props and of the supports.

When erecting the first segment (240/230/222 cm) two adjustable props are used in order to bring the segment into line. Each further segment needs one adjustable prop.

turnbuckle coupler 2-holes

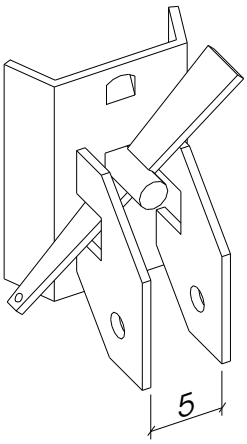
Art.N° : 182.000.0055
Weight : 5.40kg



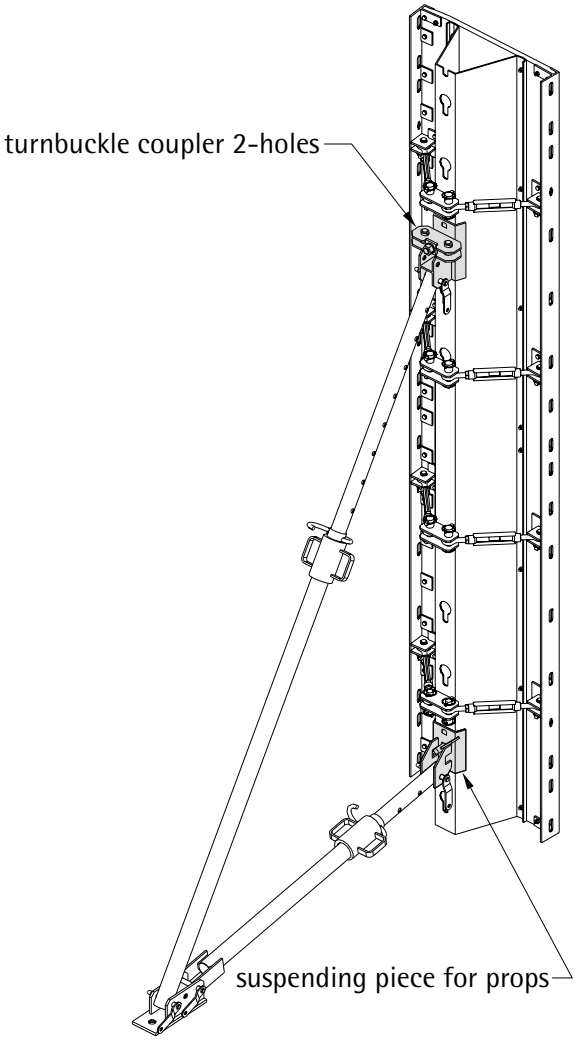
ill.57

Suspending piece for props

Art.N° : 182.000.0096
Weight : 3.00kg



ill.59



ill.58

admissible loads of adjustable props

length [cm]		pressure [kN]	tension [kN]	forming height [m]
RS2	180-290	37.0-22.0	15.0	2.25 - 3.75
	400-620	36.9-12.6	36.9	4.125 - 4.875
RSK6	460-600	24.6-12.5	40.0	5.25 - 6.375
RSK8	620-760	30.0-21.0	40.0	6.75 - 7.875

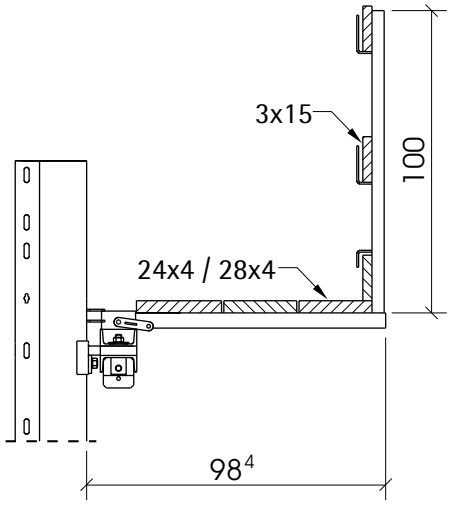
tab.4

In some cases it is necessary to assembled the adjustable prop direct on the trapezoidal girder, for example formworkheight is 150cm or 187.5cm or the adjustable prop must be placed on a quarter segment.
The adjustable prop can connected with a turnbuckle coupler 2-holes or a suspending piece for props to the trapezoidal girder.

Platform bracket

Art.N° : 182.000.0053

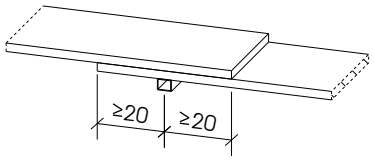
Weight : 11.10kg



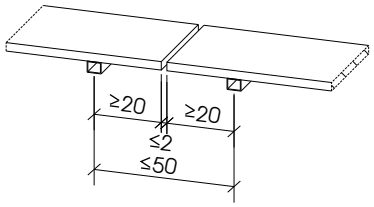
ill.60

planks have to be tightened, they should neither move nor escape

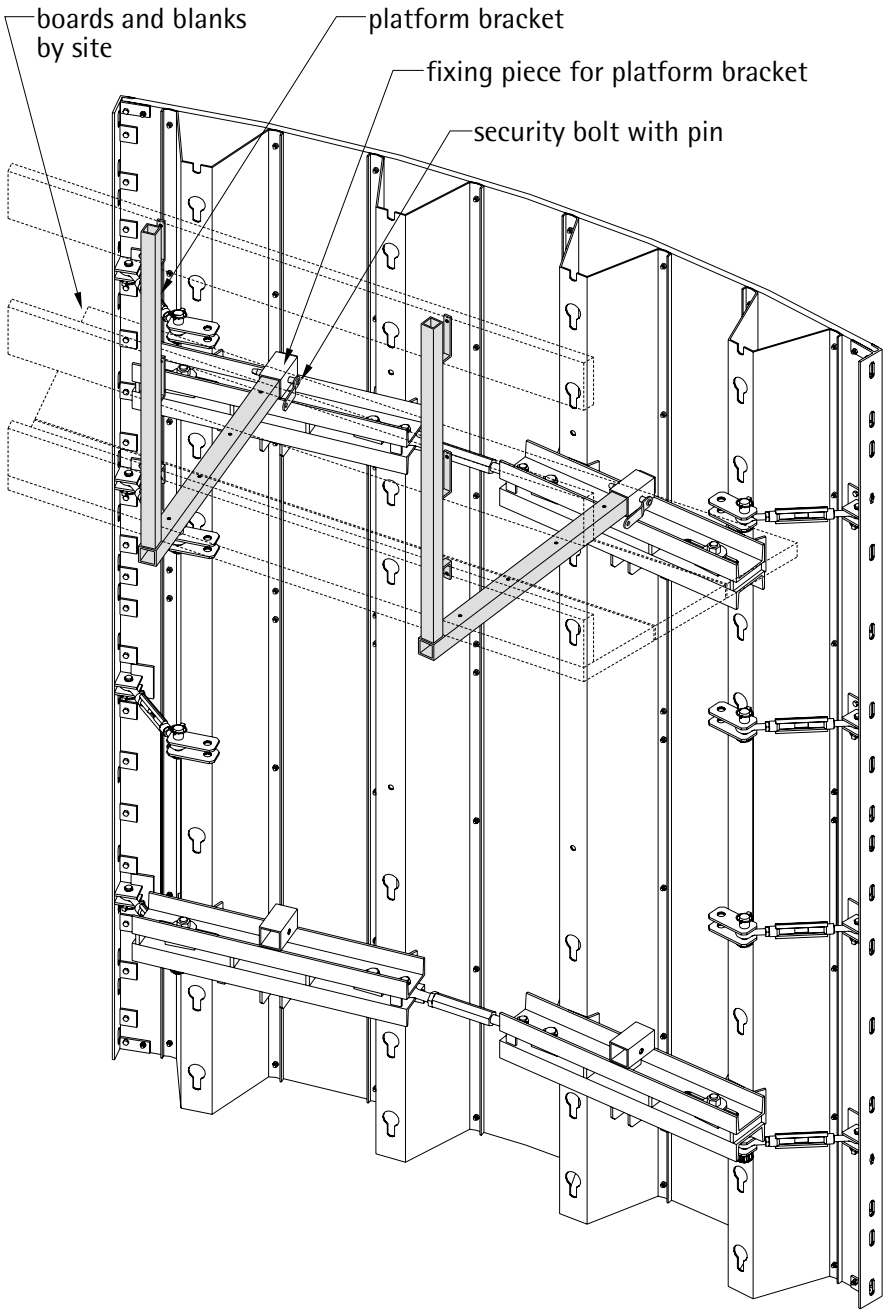
a) overlapping



b) flush



ill.61



ill.62

Working platforms are needed for concreting, vibrating, finishing works at the surface etc..
Normally the platform brackets are assembled to the interior formwork.
They are fixed to the insider waler.
In case of formwork heights exceeding 5m, an intermediate platform has to be installed.

Assembly:
Before aligning the formwork, the rectangular tube of the platform bracket is inserted into the square opening of the insider waler and secured by bolt with pin.

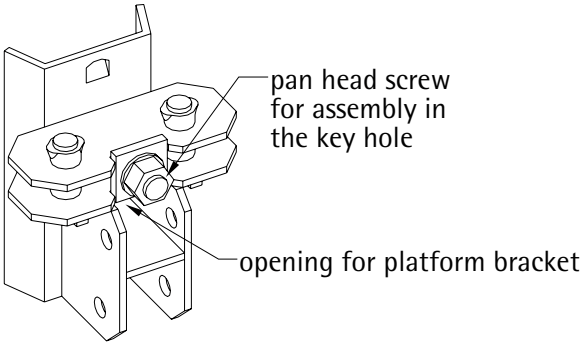
After the erection of the formwork, the platform brackets have immediately to be equipped with boards and blanks for the gangway and the guard-railing.
This gangway and guard-railing have to correspond with DIN 4420 (standard for working and security scaffolds).

Platform bracket

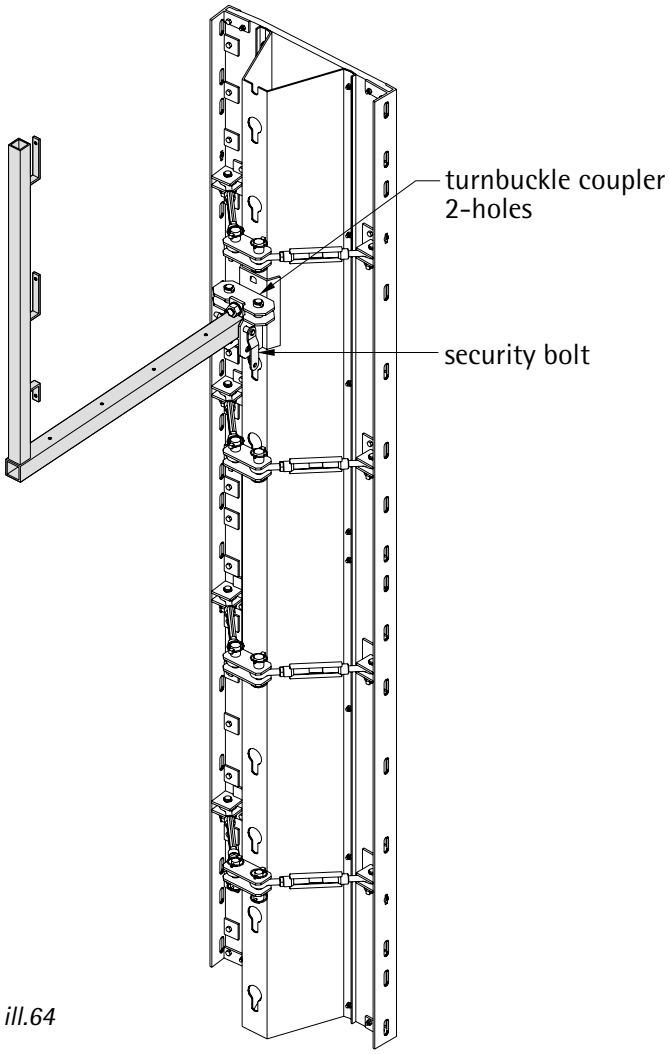
Turnbuckle coupler 2-holes

Art.N° : 182.000.0055

Weight : 5.40kg



ill.63

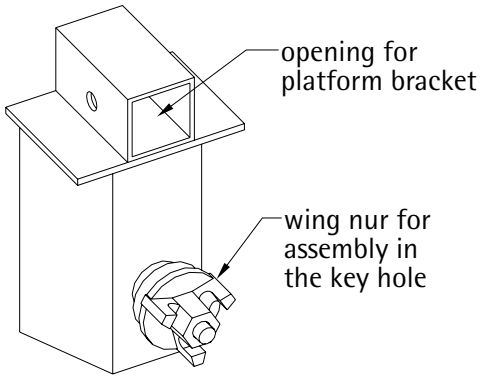


ill.64

Connecting piece for platform bracket

Art.N° : 182.000.0133

Weight : 5.50kg



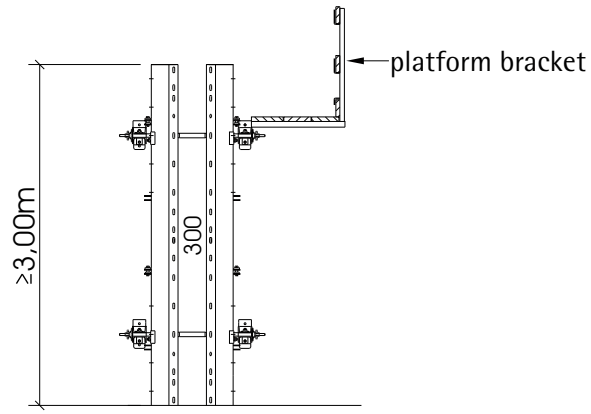
ill.65

tab.5

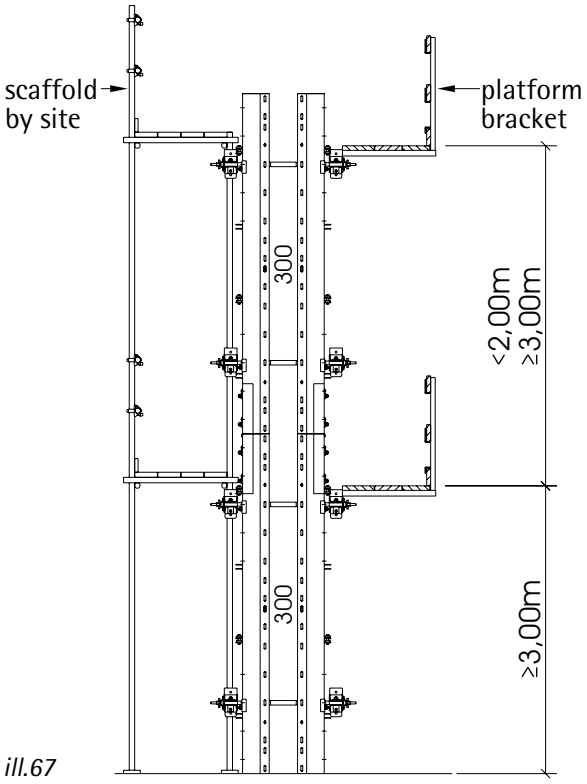
The maximum distance between the platform brackets is 2.00m.

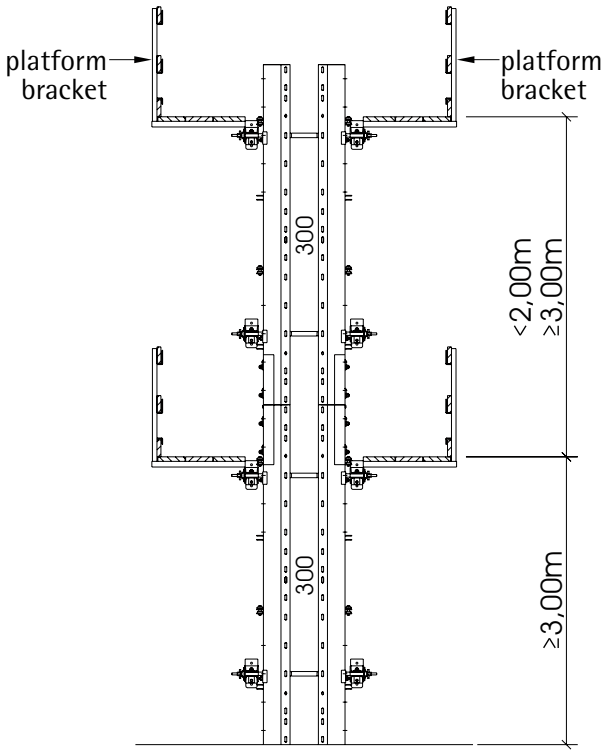
The admissible load is of 2kN/m².
A concentrated load in the most unfavourable position however may not exceed 1.5kN (scaffold category III).

For 57.5cm/60cm or 55.5/62.5cm wide segments an additional turnbuckle coupler 2 holes is necessary for the platform bracket. This kind of connection from the platform bracket to the trapezoidal girder is also used, when the top segments are a 150cm high segment plus an 37.5cm high segment (formwork height 187.5cm or 487.5cm).



ill.66

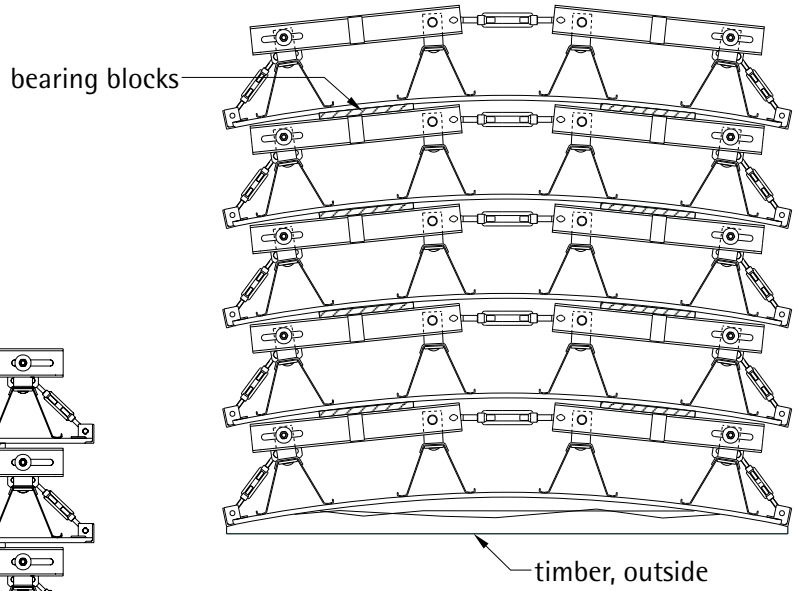




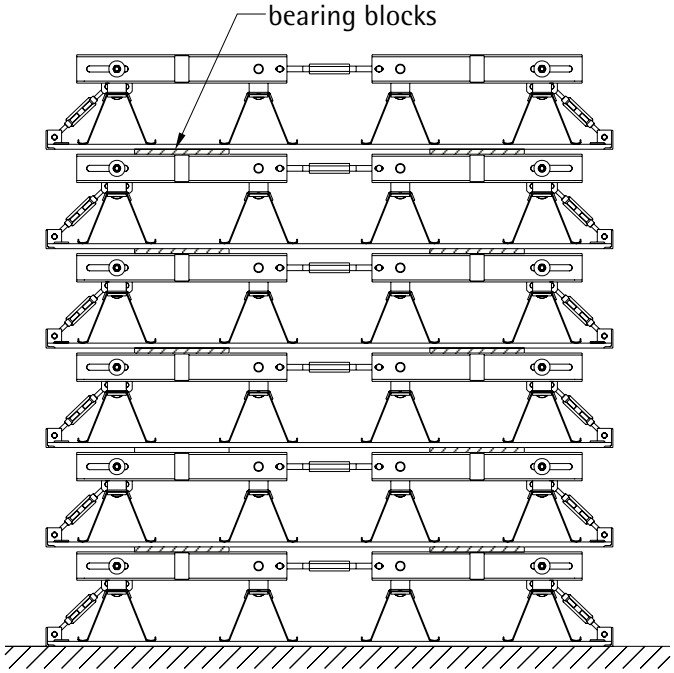
ill.67

By great forming height there is a danger of falling. In these case it is necessary to have platform brackets on both sides or to have on the second side an additional scaffold.

Outside formwork

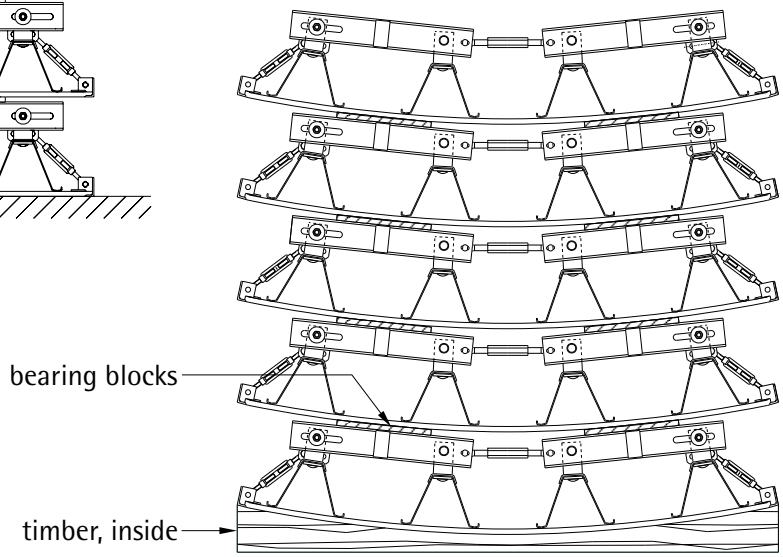


ill.68



ill.69

Inside formwork

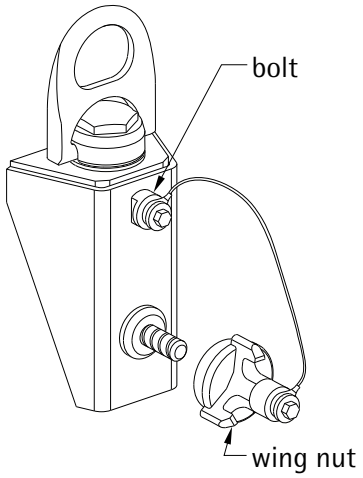


ill.70

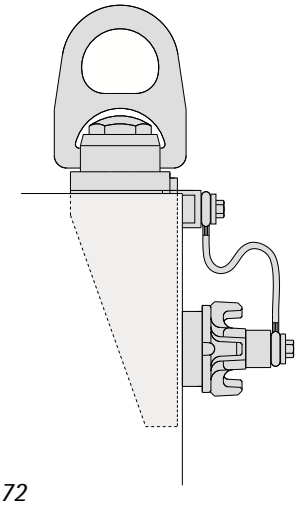
In order to avoid the plywood getting damaged, it is indispensable to put bearing blocks between the segments.

Crane lifting eye KBT

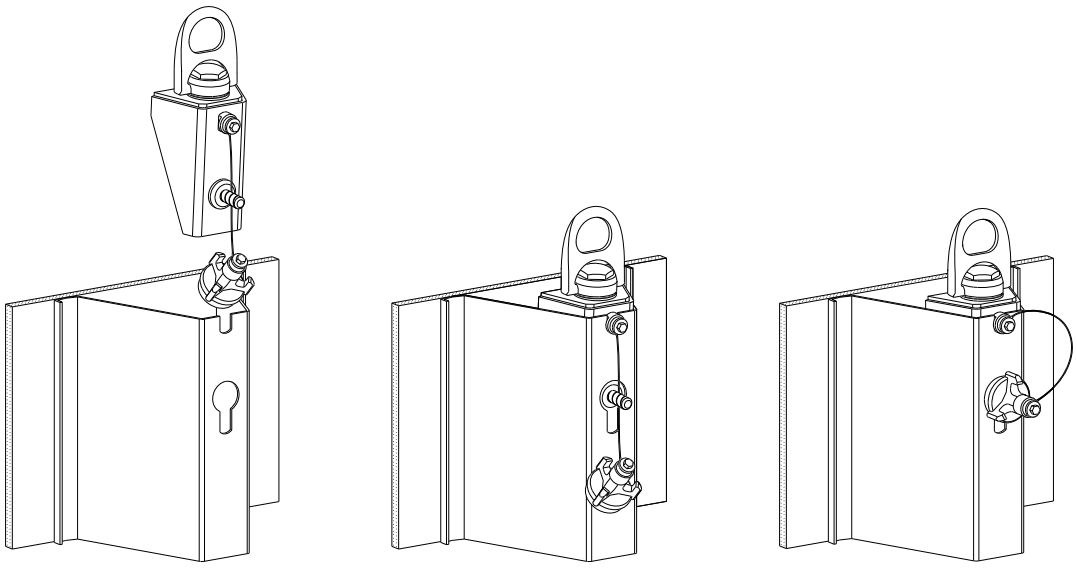
Art.N° : 182.000.0069
Weight : 5.50kg



ill.71



ill.72



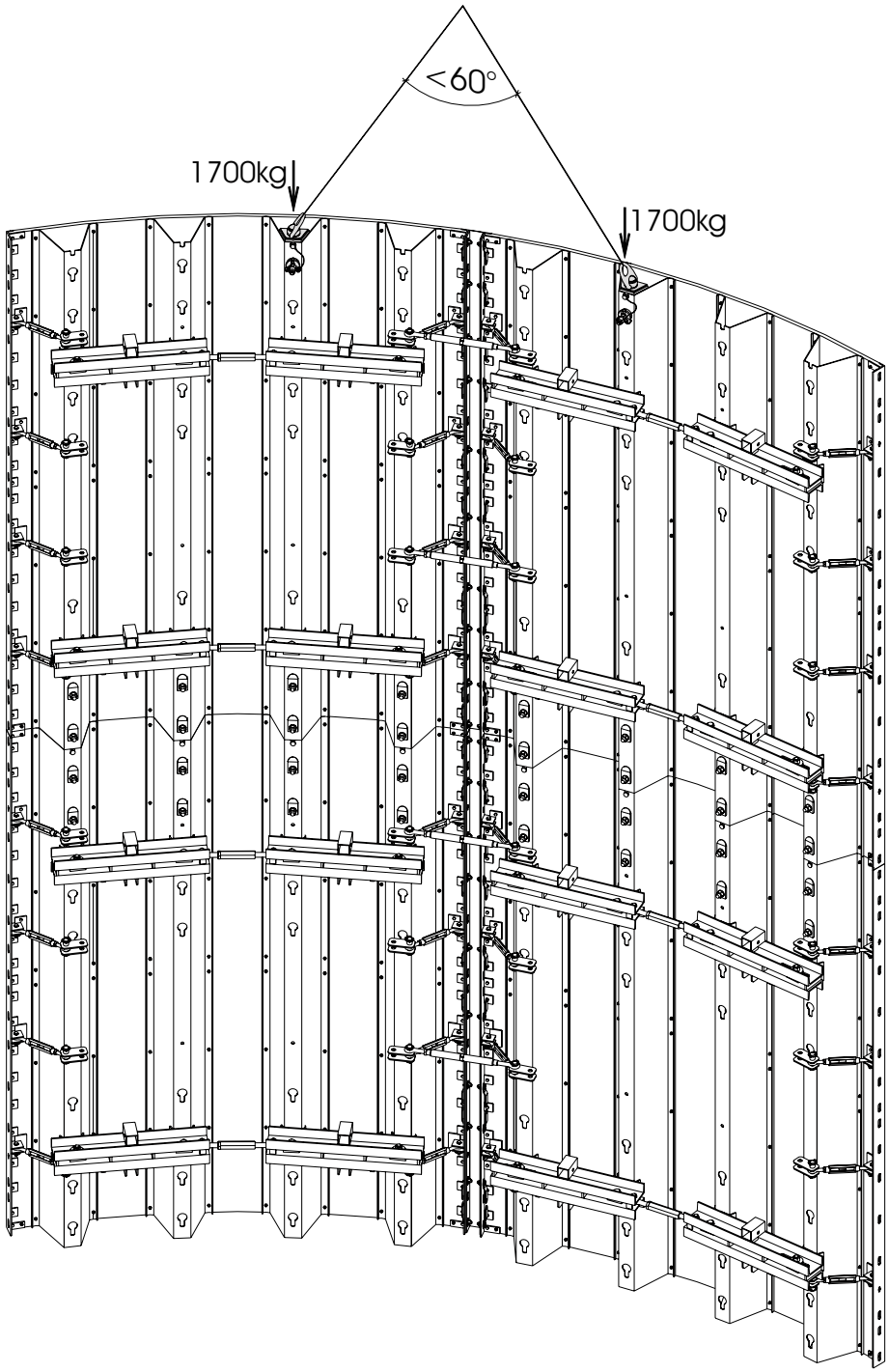
ill.73

Load capacity
The load capacity of every crane lifting eye KBT is 1700kg.
The attachment strings are not to be spread more than 60°.

Application
The crane lifting eye KBT is to be used exclusively for the displacement of single trapezoidal segments or preassembled trapezoidal segment units.
It is not to be applied on other formwork systems, nor for any other lifting operations on site including transportation of formwork piles.

Putting into service
Only qualified staff, familiar with lifting devices, are allowed to handle this equipment.
Before using lifting devices, they have to be checked and tested by an expert. Any defects have to be repaired before operation. These regulations have to be strictly observed before the first use or after working interruptions!

Crane transportation

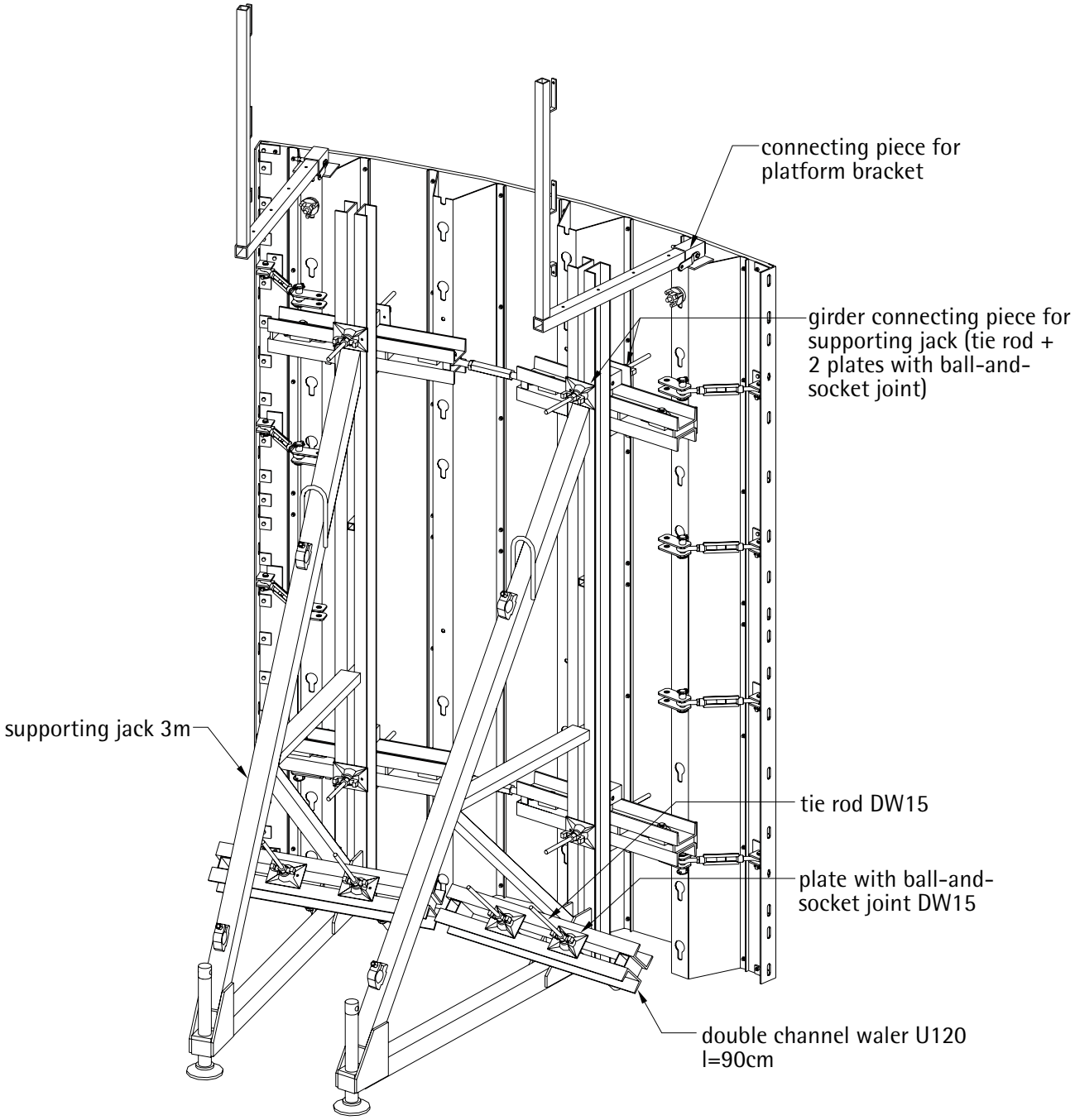


ill.74

Attention!
Please check if our crane lifting eye KBT is in conformity with the standards and the quality requirements prevailing in your country.
Please keep in mind that all national and local safety regulations, instructions, quality standards and prescriptions are binding and have to be strictly observed in regard to: stay in dangerous areas within the lifting device, permanent examination and testing of lifting equipment, maintenance, repair, welding works and safety regulations for dismantling of forms.

Assembly
Remove the wing nut and insert the crane lifting eye KBT in the interior parts of the girder (depending on position of formwork vertical or horizontal).
Push the crane lifting eye KBT outwards until the bolt, with tie rod DW, appears in the upper hole of the girder.
Screw the wing nut on the tie rod and tighten is solidly by means of a hammer.

Supporting jack, One-sided forming



ill.75

If a one-sided wall formwork cannot be anchored in an existing wall or otherwise, the pressure can be transfered to the floor slab through supporting jacks. The anchors, necessary for the load transfer, must be embedded in the floor slab.

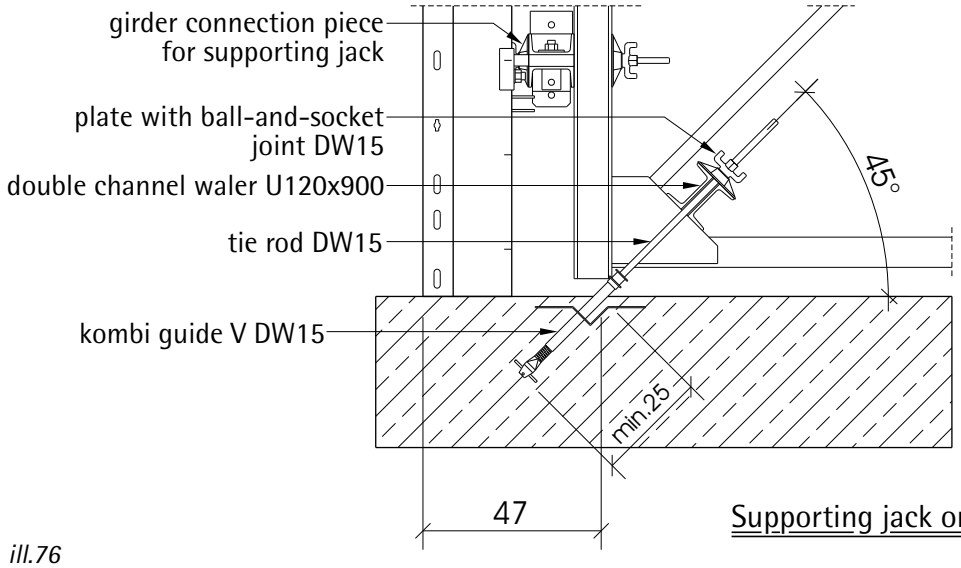
The anchor itself is a kombi guide V or consists of a tie rod and an fixing anchor which are screwed together. The kombi guide V DW15 can only used for supporting jack 3m. The tie rod is connected with the kombi guide V.

The anchor plate exists for tie rod DW15, DW20 and DW26.5. The tie rod is covered with a PVC tube and can therefore be reused. Two anchors have to be embedded, each at about 15cm left and right of the supporting jack and at an angle of 45°.

After setting up supporting jacks and formwork, a 90cm long waler is put on the corresponding support and fixed to the embedded rod, either with a plate with ball-and-socket joints or a wing nut and counterplate.

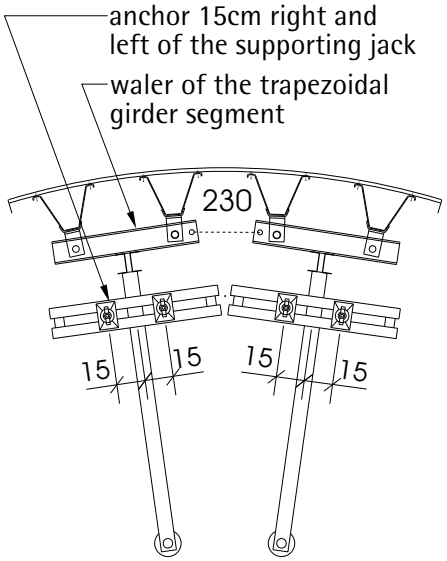
Other anchoring possibilities are wave anchors and anchor loops.

Anchoring for supporting jack 3m

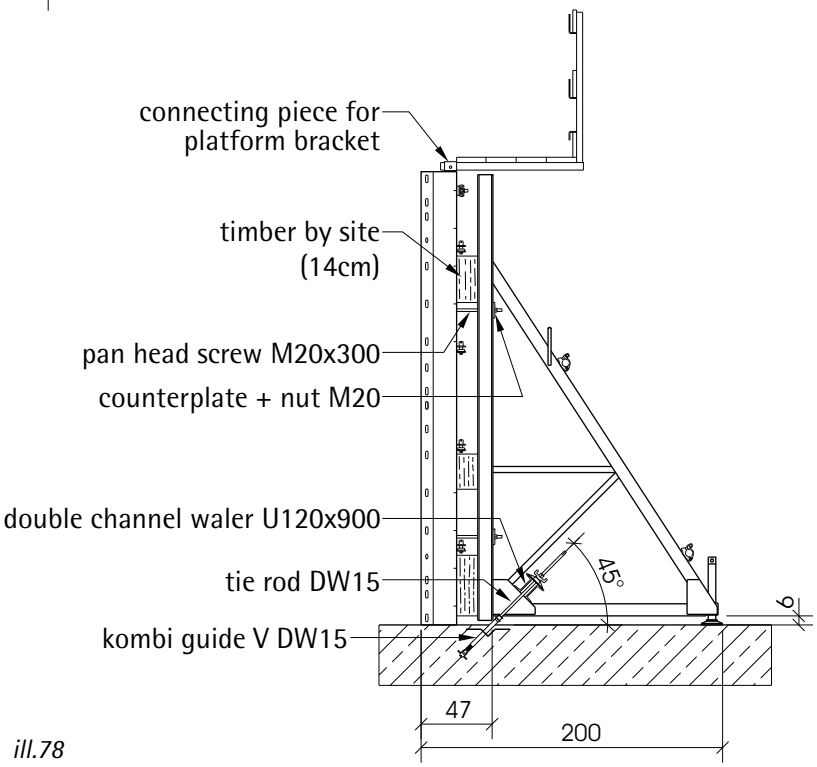


ill.76

Supporting jack on the quarter segment (57.5cm)



ill.77



ill.78

Attention:

Very often there is a little information on reinforcement and details about depth of embedment or about additional reinforcement should be discussed with the structural engineer.

The spacing between the supporting jacks should take the tie rod locations into consideration in order to obtain the same structural system.

The supporting jacks are fixed to the walers of the segments with tie rod DW15 and 2 plates with ball-and-socket joint.

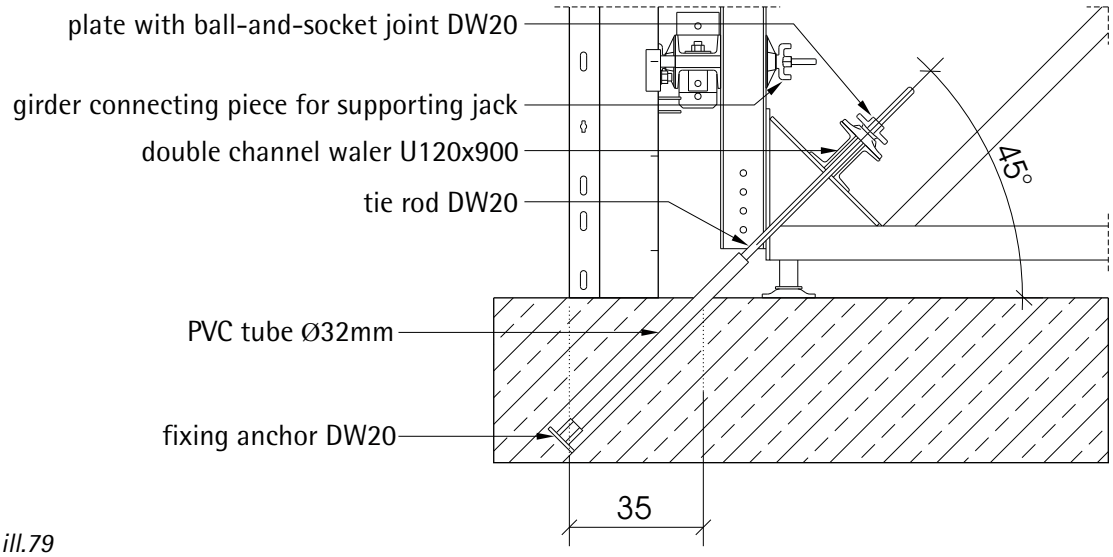
Anchoring of the supporting jack 3m

Placing of the anchoring before concreting the bottom plate!

Assembling the combi V-guide DW15 about 15cm right and left from the axis of the supporting jack and fixing it on the top of the reinforcement

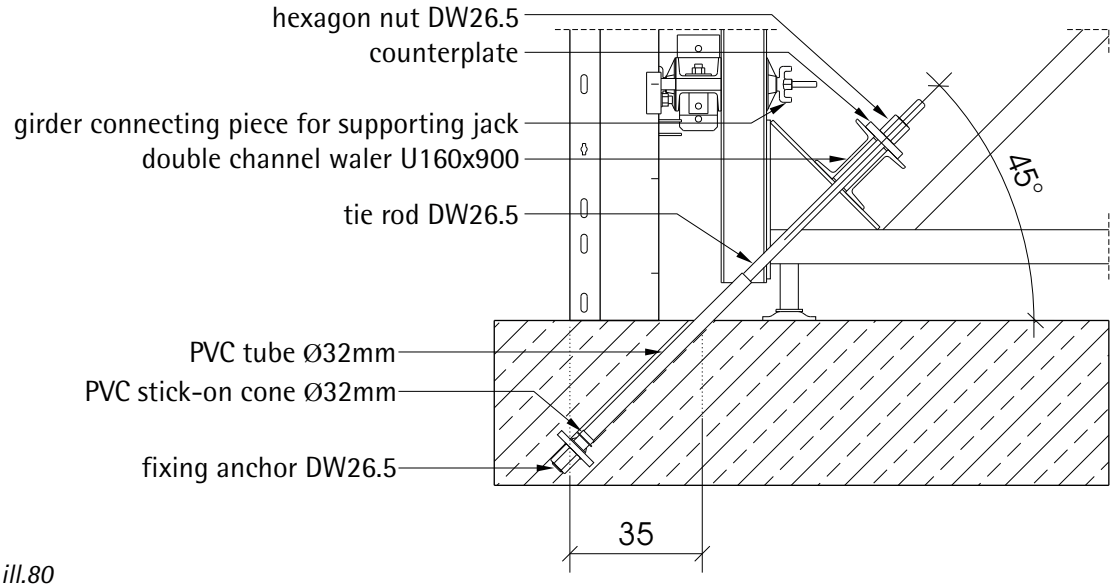
After 5 days of concreting or a min. strength of 20 N/mm^2 the combi V-guide is fully loadable.

Anchoring for supporting jack 4m



ill.79

Anchoring for supporting jack 6m



ill.80

Anchoring for supporting jack 4m

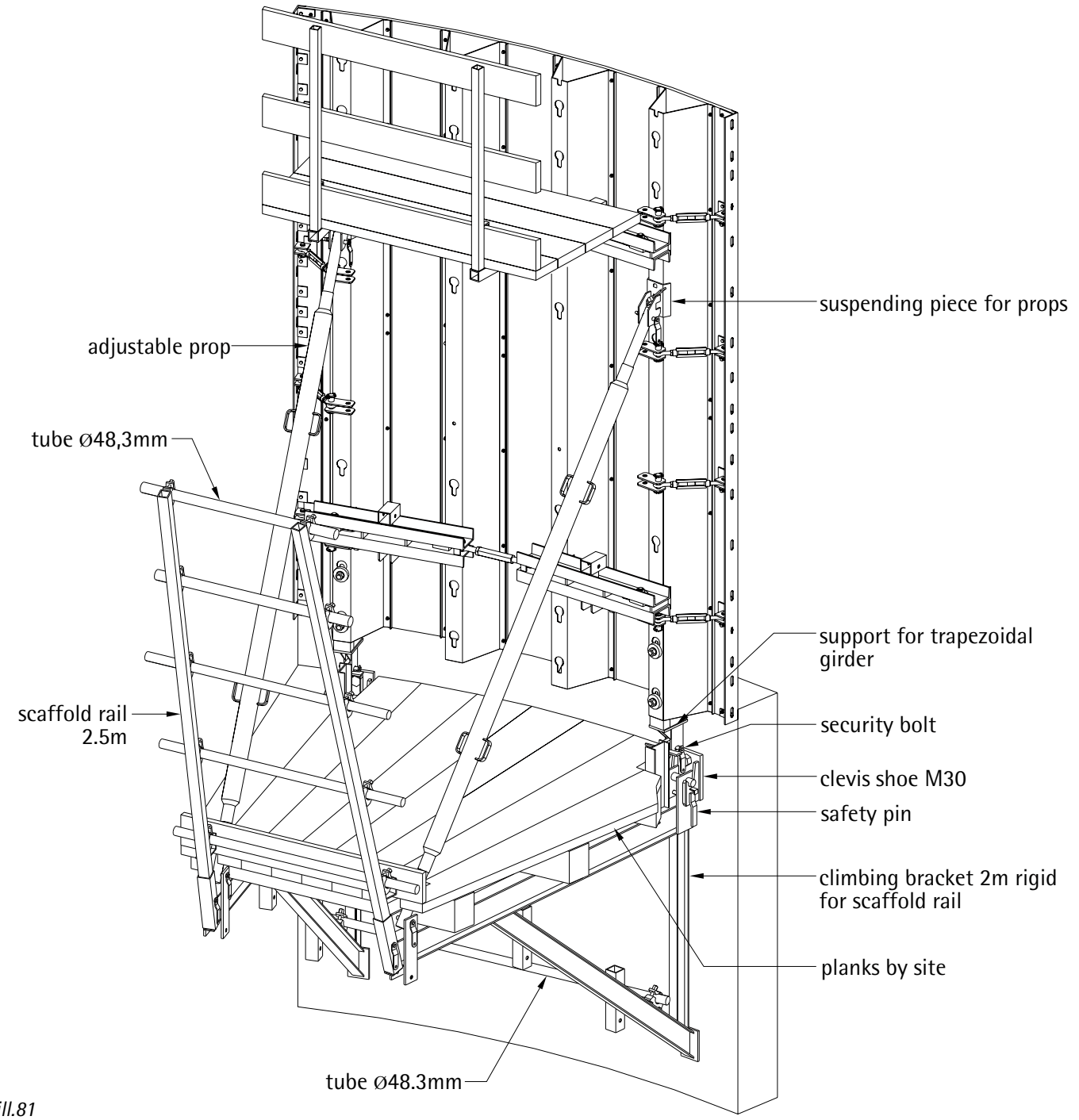
Placing of the anchoring before concreting the bottom plate!

1.) screwing the tie rod with fixing anchor
2.) inserting the tie rod into the PVC-tube
3.) screwing the plate with ball-and-socket joint DW20 on the tie rod and tightening slightly
4.) concreting the anchoring about 15cm right and left from the axis of the supporting jack up to 45°

Anchoring for supporting jack 6m

Placing of the anchoring before concreting the bottom plate!

1.) screwing the tie rod with fixing anchor
2.) inserting the tie rod into the PVC-tube with stick-on cone
3.) screwing the counter-plate and hexagon nut on the tie rod and tightening slightly
4.) concreting the anchoring about 15cm right and left from the axis of the supporting jack up to 45°



ill.81

Trapezoidal girder segments, fixed to 2m wide rigid or slideable brackets can be employed for climbing, either on one side or on both sides. Admissible loads and construction of these climbing brackets are in conformity with DIN 4420 part 1.

Please check if our equipment meets your national and local structural / statical quality standards!

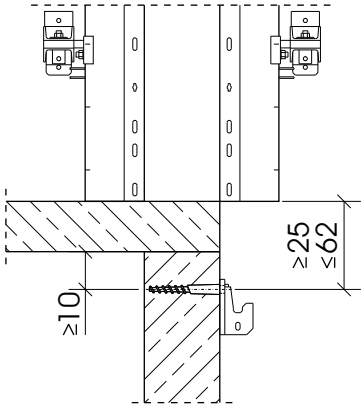
The climbing brackets with planking, provided and screwed on by site, are utilized as working platform. The formwork is attached to it. It also transfers all loads resulting of dead loads and wind loads through special anchors to the previously poured concrete (ill.81).

The anchors for fixing the brackets have to be embedded before, i.e. they have to be set on the first pour for the first lift.

Embedment of anchors

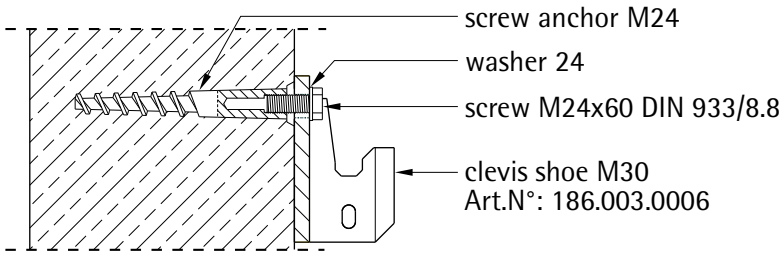
The height level of the embedded anchors are shown on page 51 ill.83+85.

vertical position of anchor
for one sided climbing

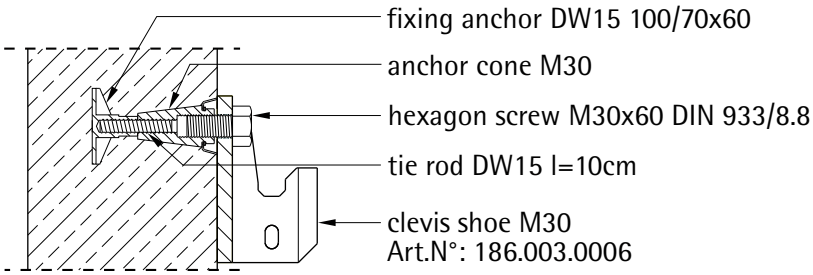


ill.83

Screw anchor

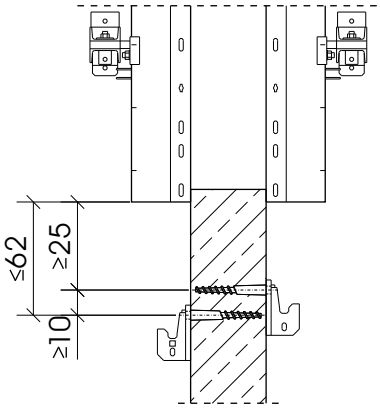


ill.82

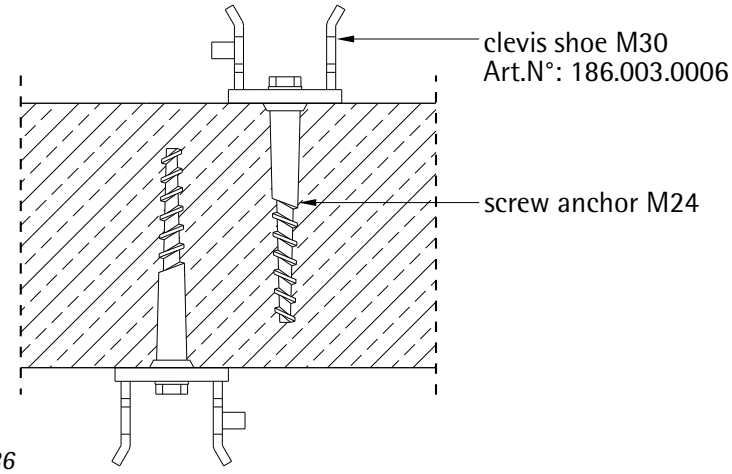


ill.84

vertical position of anchor
for both sided climbing



ill.85



ill.86

Clevis shoes are attached to screw anchors (ill.82) with screws M24x60, according to DIN 933/8.8 or anchor cone (ill.84) with screws M30x60, according to DIN 933/8.8 after striking of the first pour.

Attention:

Please observe installation instructions of the corresponding manufacturer of anchors!

For climbing on both sides, every clevis shoe has to be anchored individulally in the concrete with a screw anchor or an anchor cone.

If the wall thickness is big enough, both clevis shoes can be attached opposite to each other.

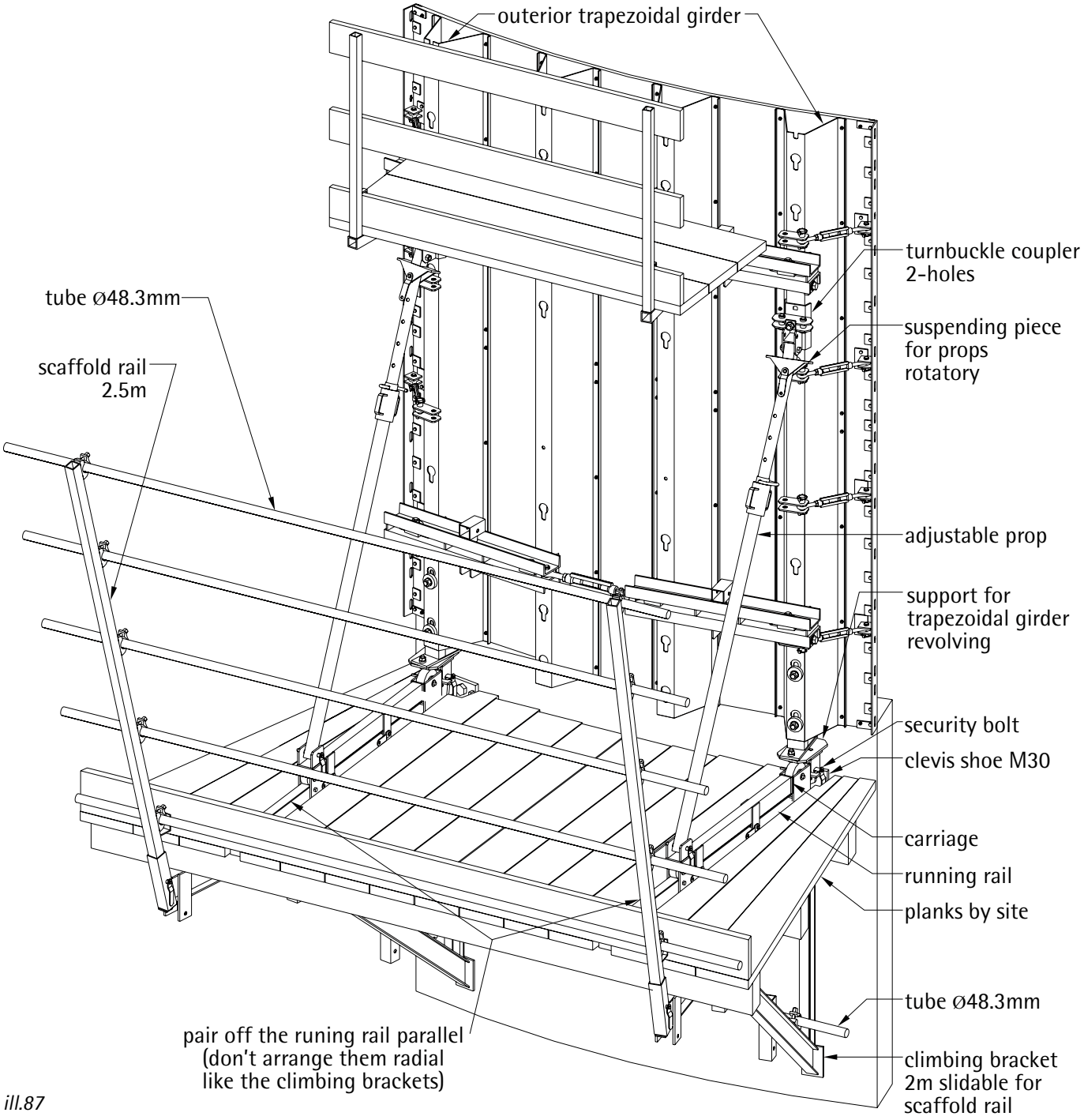
Otherwise they have to be set on different vertical or horizontal levels (ill.86). The spacing of anchors with a different height level must be at least 10cm.

Installation of clevis shoes

The climbing brackets can be suspended after installation of the clevis shoes.

Suspension of climbing brackets

The climbing bracket have to be protected with the safety pin against unhooking.



ill.87

Once the climbing brackets are completely assembled to unit(s), the formwork can be set up on it. The attachment to the brackets is effected with supports for trapzoidal girder. 2 climbing brackets are necessary for each segment (222/230/240).

Supports for trapezoidal girder are fixed to the segment with pan head screws in the key holes of the trapezoidal girder. Both are attached to the climbing brackets with security bolts.

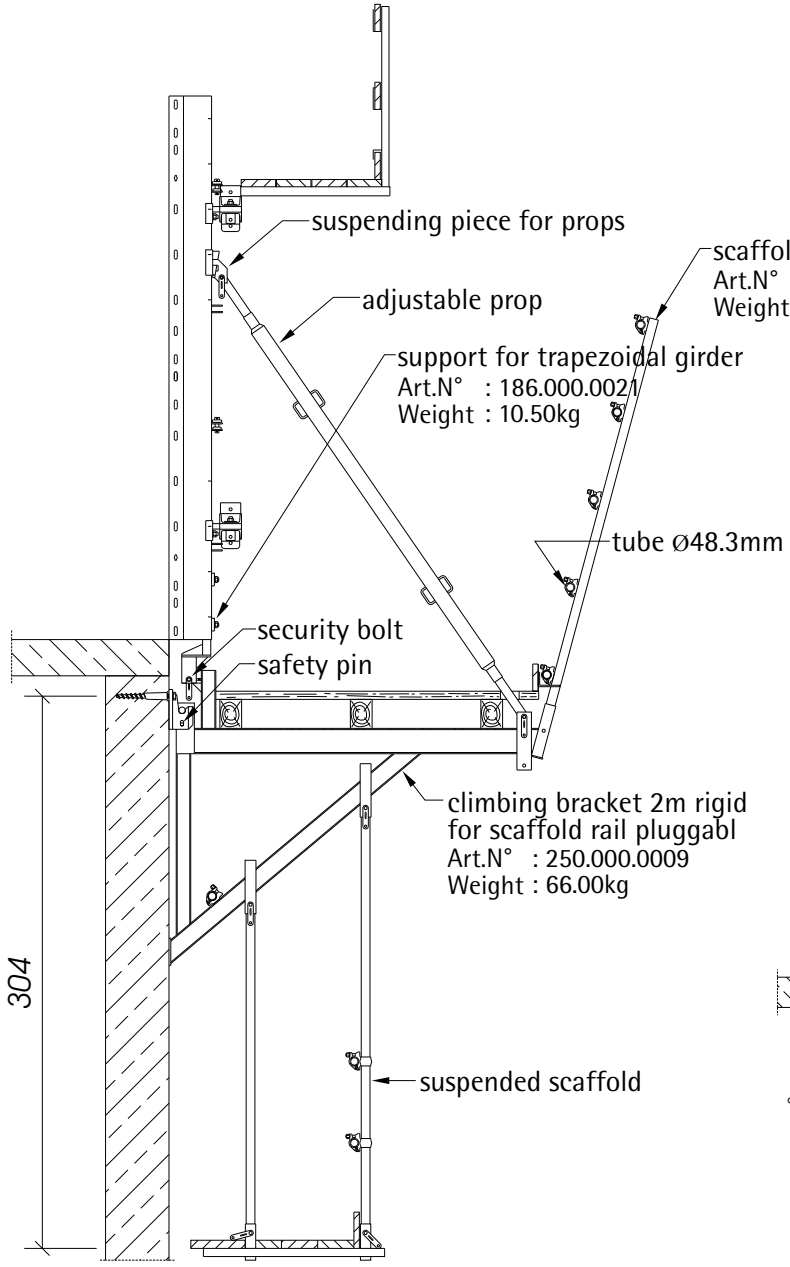
Adjustable props fitted to segments and brackets facilitate the alignment of the props.

Installation of formwork on climbing brackets

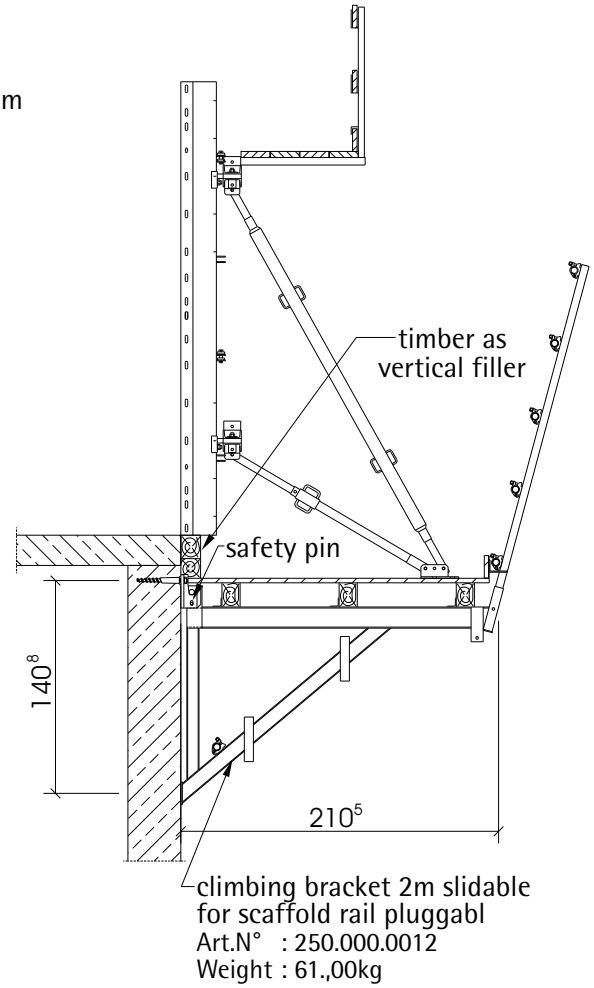
When climbing on both sides, the same procedure applies to both of them. Otherwise the inner formwork will be put on the existing slab.

The slideable 2m climbing brackets allow a displacement of one form, when climbing on both sides. For the slidable 2m climbing brackets are more pieces necessary, see ill.87.

In case of repeated vertical lifts, it is adviseable to attach a suspended scaffold for removing of clevis shoes and closing of tie rod openings.



ill.88



ill.89

Planking and guard rail of the suspended scaffold have to be procured by customer.

attachment of suspended scaffold

A climbing unit consists of 3 levels:
1.) formwork with platform bracket
2.) climbing bracket with platform
3.) suspended scaffold.

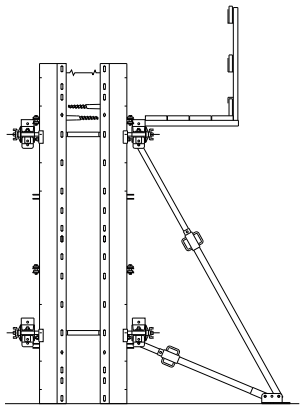
All three can be connected together and can be (without dismantling) displaced completely with a single crane operation.

For the climbing give attention of the load capacity of the crane, the forming height and the height above the ground.

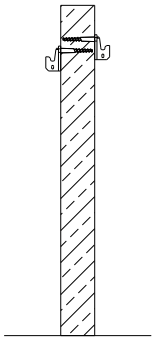
The climbing brackets are connected on the exterior trapezoidal girder of a segmant.

When utilizing climbing brackets only as working platform, support for trapezoidal girder and may be even the suspended scaffold can be omitted.

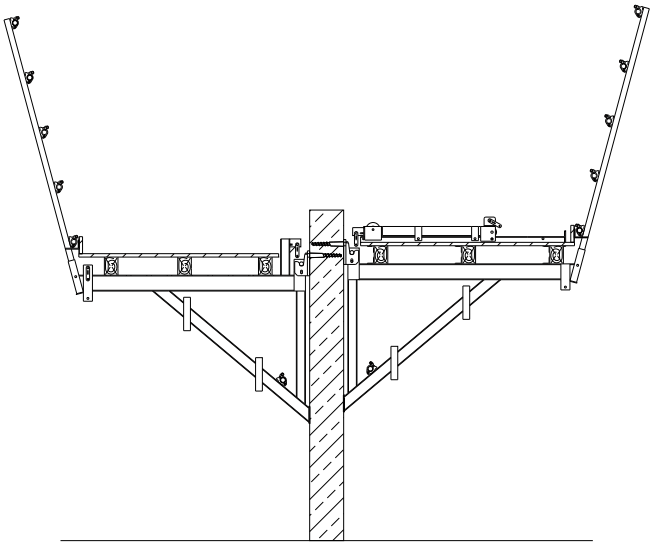
The formwork then is – without direct connection – simply set on the brackets and braced. Formwork and working platform are displaced seperately.



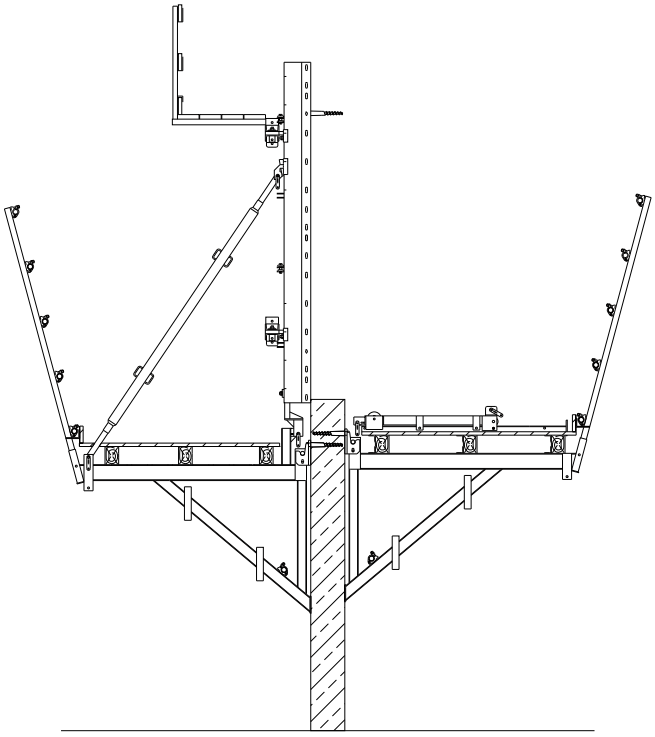
ill.90



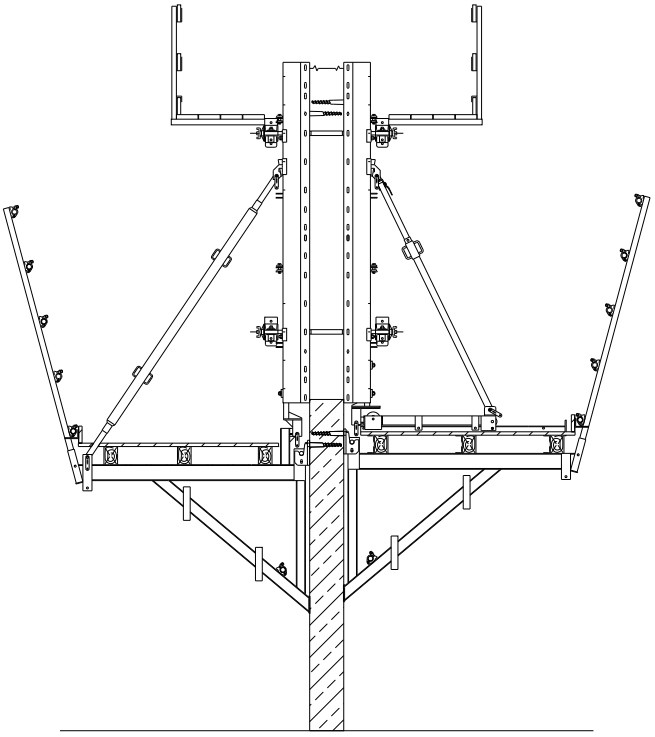
ill.91



ill.92



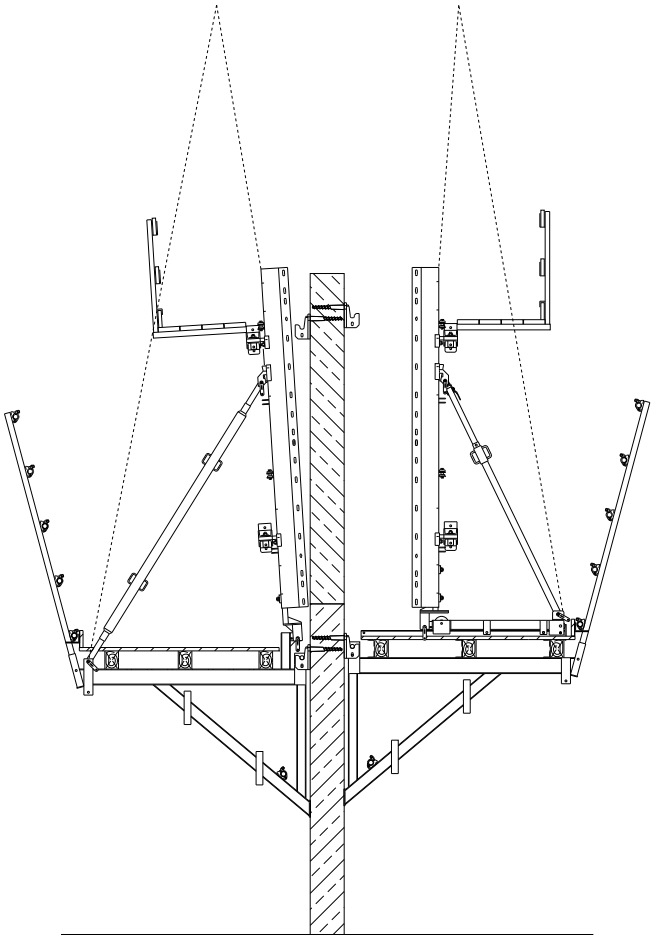
ill.93



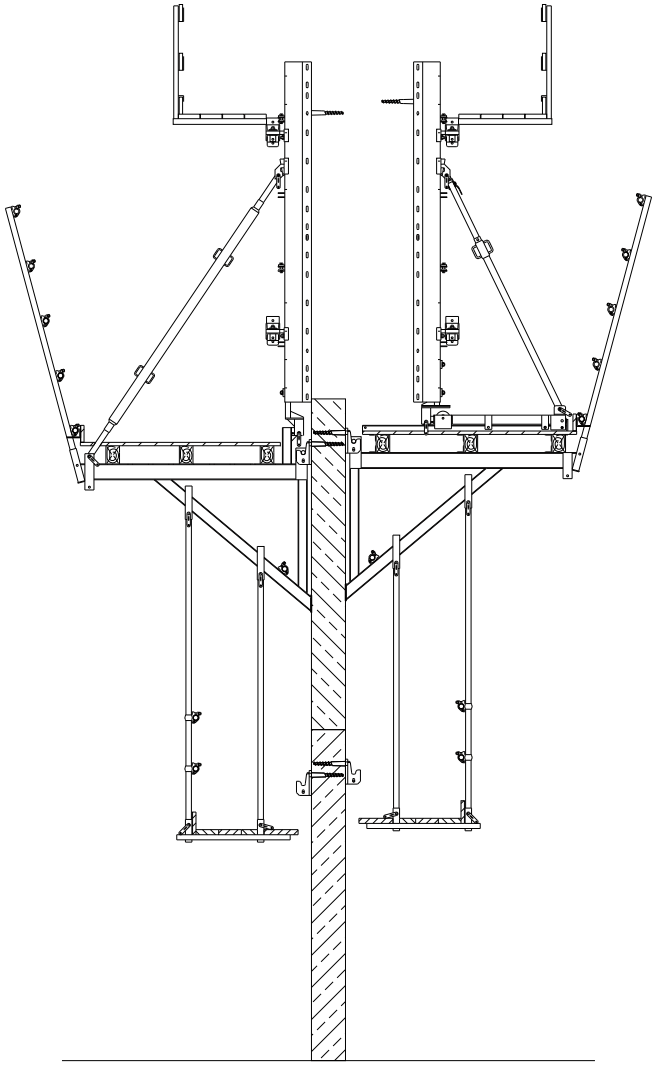
ill.94

Assembly Instruction for both-sided climbing:

1.) Fixing the anchor to the formwork (ill.90).
2.) Assembling the clevis shoes after concreting (ill.91).
3.) Assembling the climbing bracket, scaffold rail and timber (ill.92).
   Either fixing the climbing bracket, then assembling the timber.
   Or pre-assembling the climbing bracket and the timber on the bottom, then fixing it as a unit, e.q. for great heights.
4.) Assembling the formwork with support for trapezoidal girder to one climbing bracket, then fixing the adjustable prop (ill.93).
5.) Reinforcing.
6.) Assembling the opposite formwork as well with support for trapezoidal girder to the climbing bracket, the fixing the adjustable prop (ill.94).
7.) Placing the anchor for the next climbing phase.



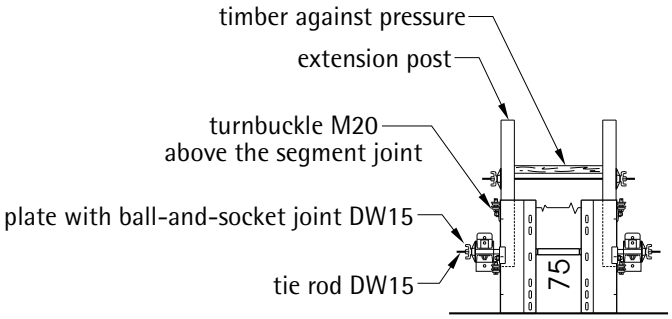
ill.95

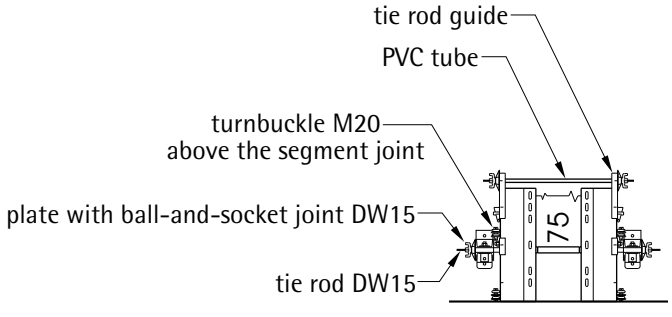


ill.96

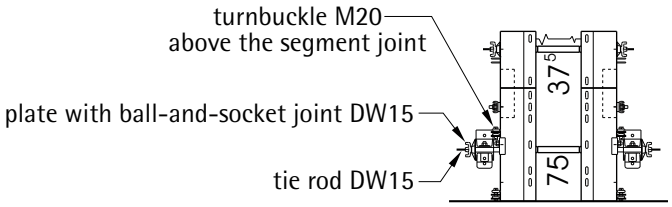
7.) Inclining the formwork at the rigid climbing brackets to the back after conreting (loosening the wedge and pulling the adjustable prop together).
8.) Moving the formwork at the slidable climbing bracket away from the wall with the carriage.
9.) Assembling the clevis shoes for the next climbing phase (ill.95).
10.) Moving the formwork and climbing installation as a unit and fixing the unit in the top clevis shoes.
11.) Spindling the formwork at the rigid climbing brackets into vertical position and assembling the suspended scaffold (ill.96).
12.) Reinforcing, because there is a working space of 60cm on the slidable climbing bracket.
13.) Placing the anchor for the next climbing phase. Moving the formwork at the slidable climbing brackets back to the wall with the carriage.

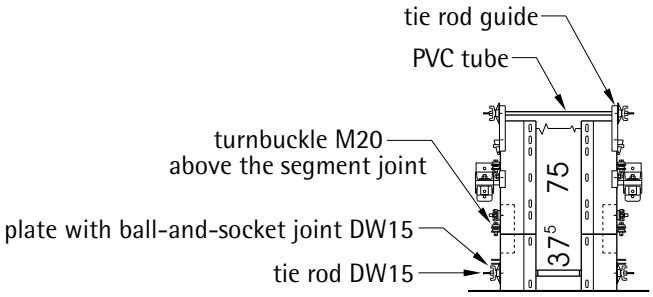
Trapezoidal girder formwork : height 75cm

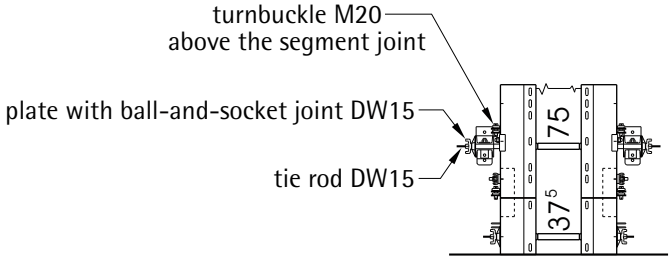




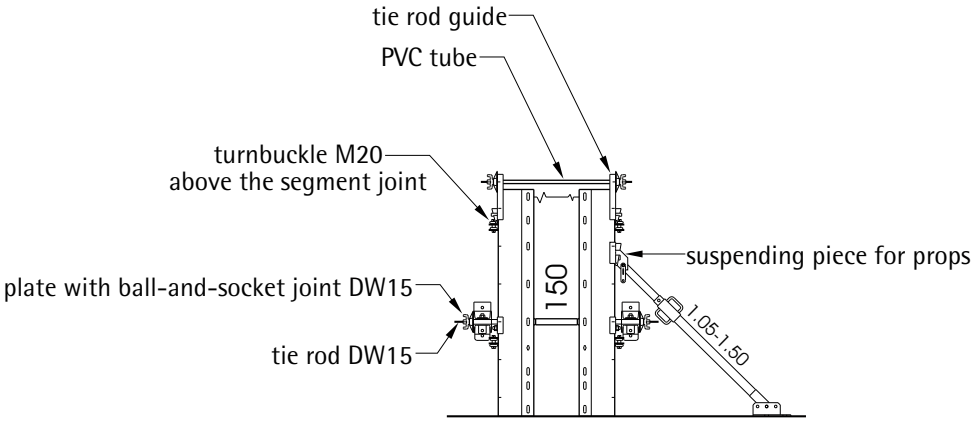
Trapezoidal girder formwork : height 112.5cm

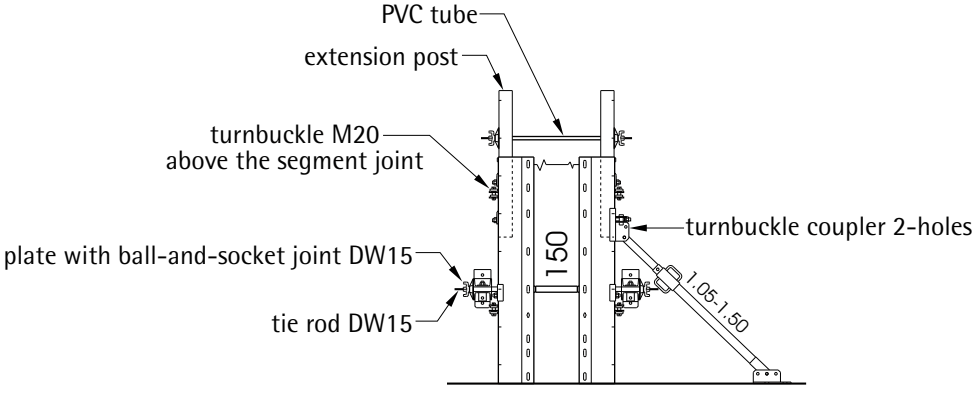




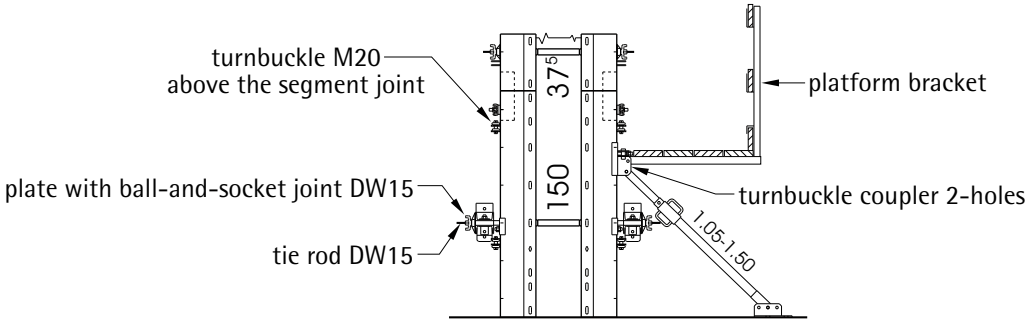


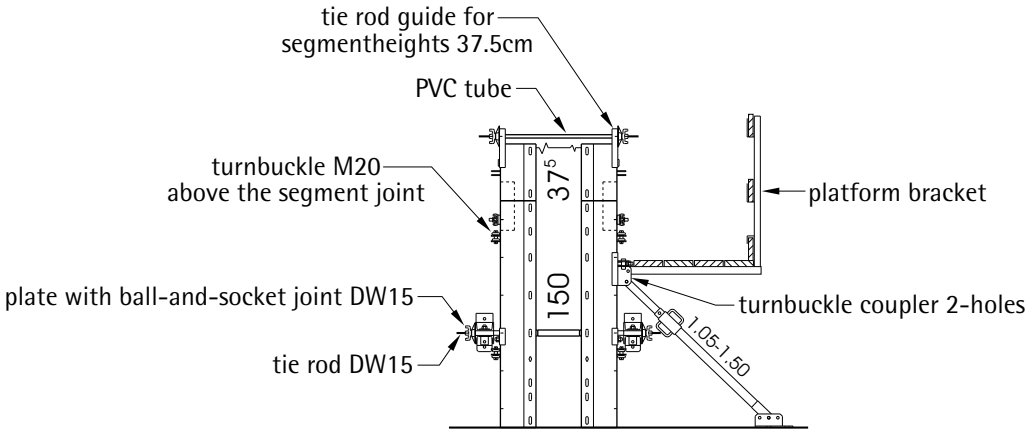
Trapezoidal girder formwork : height 150cm



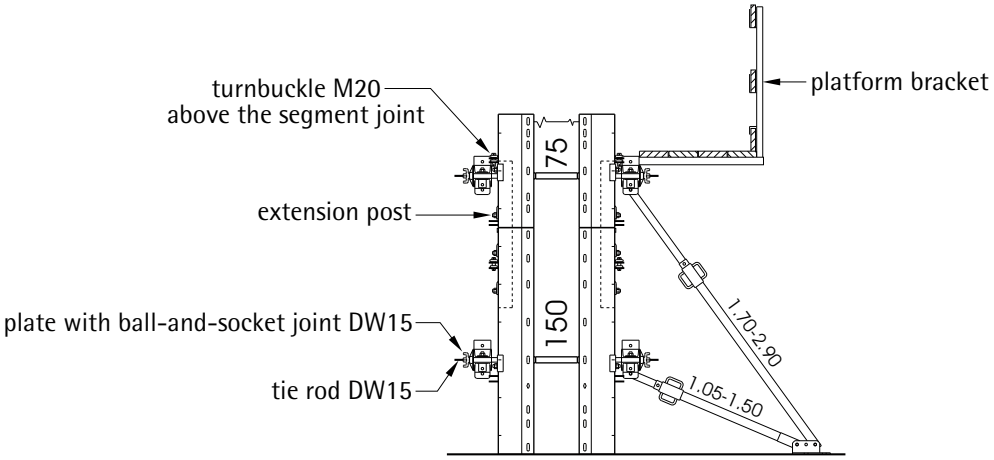


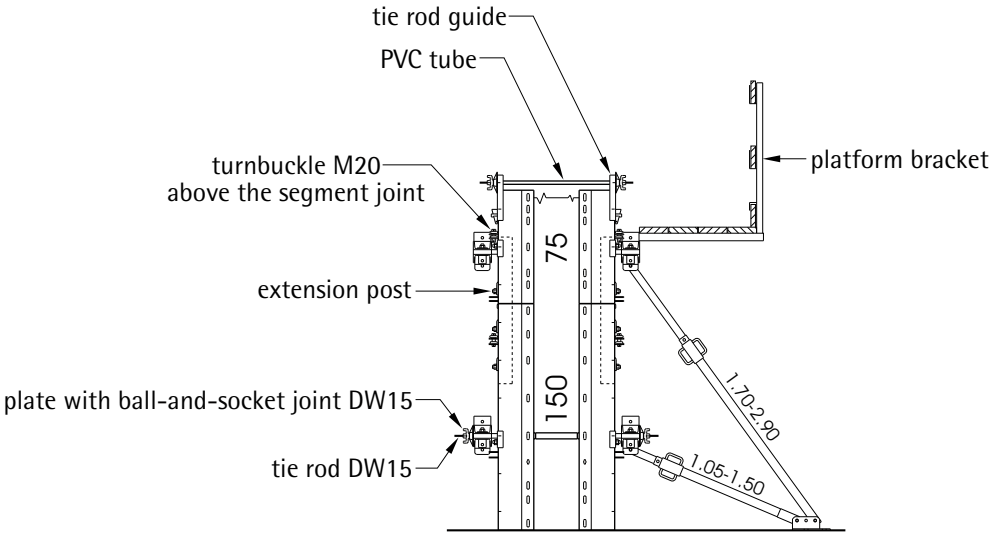
Trapezoidal girder formwork : height 187.5cm



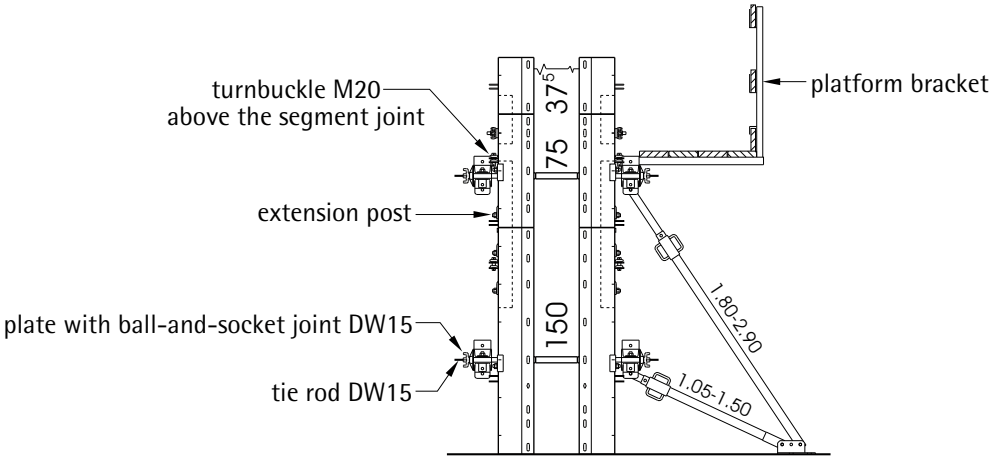


Trapezoidal girder formwork : height 225cm

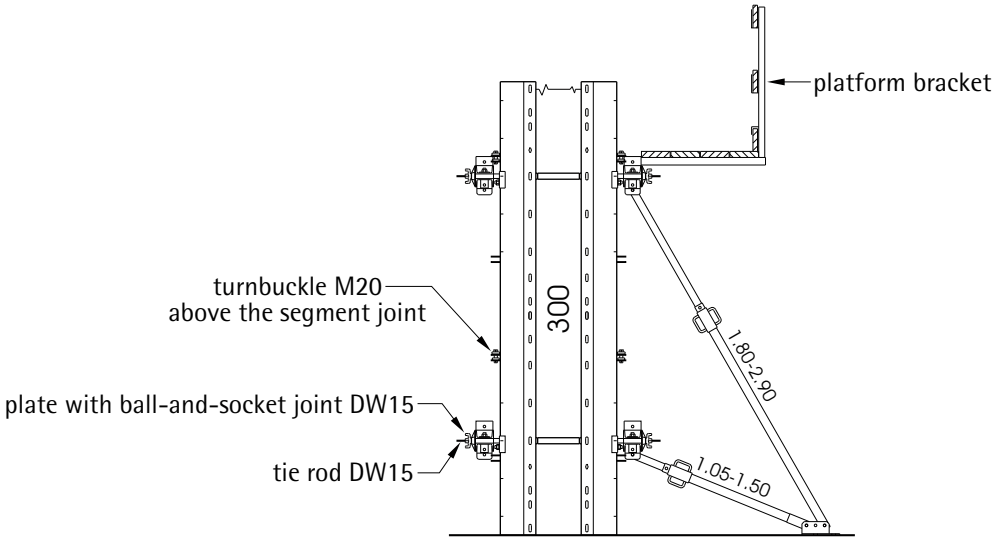


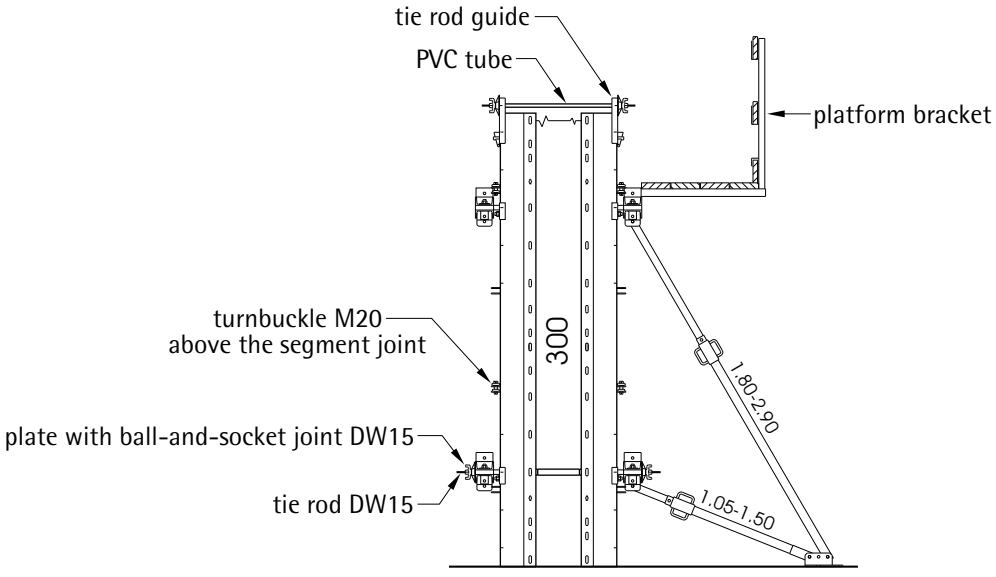


Trapezoidal girder formwork : height 262.5cm

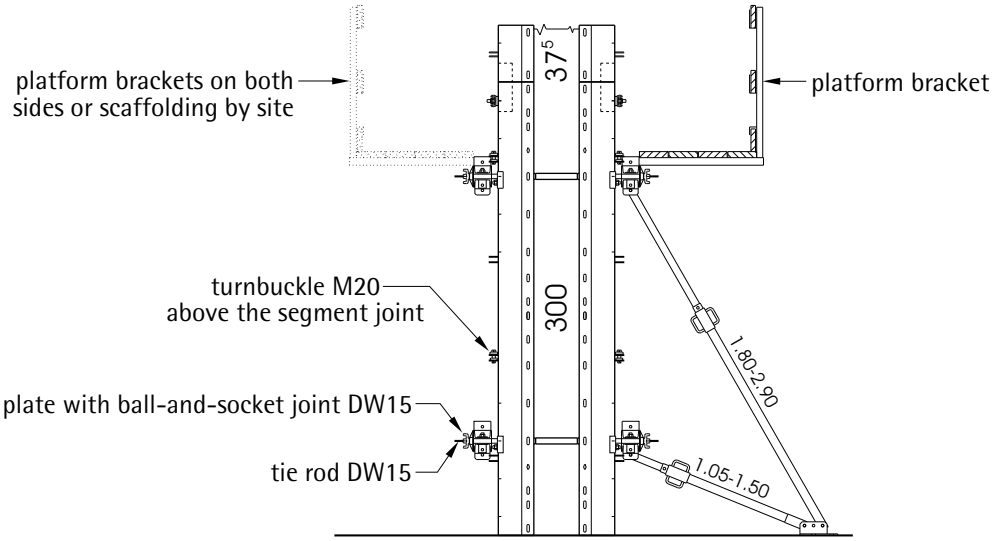


Trapezoidal girder formwork : height 300cm

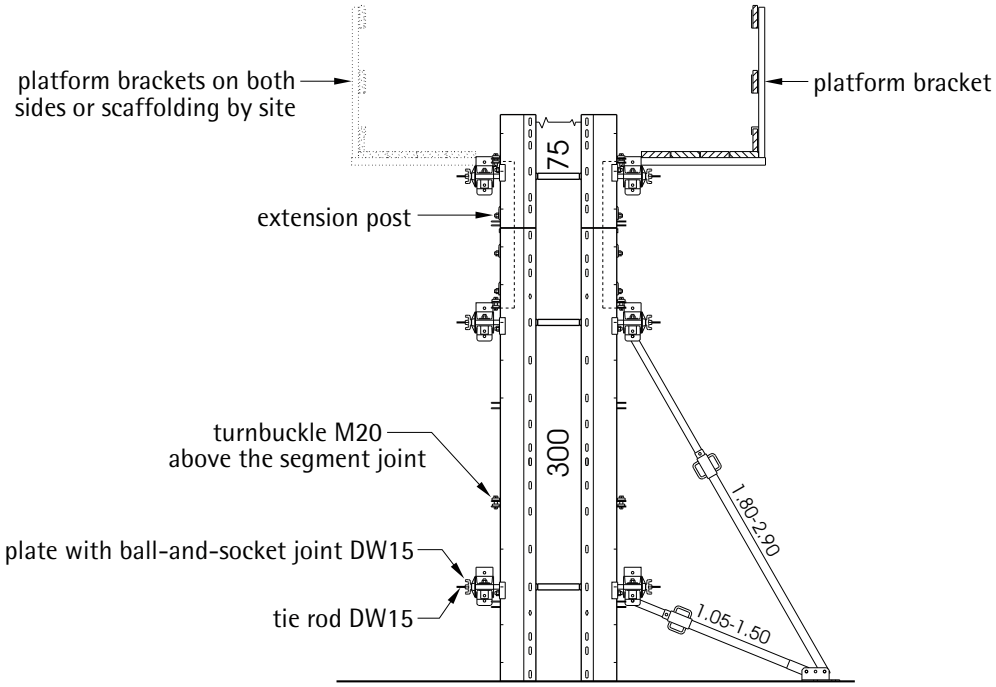


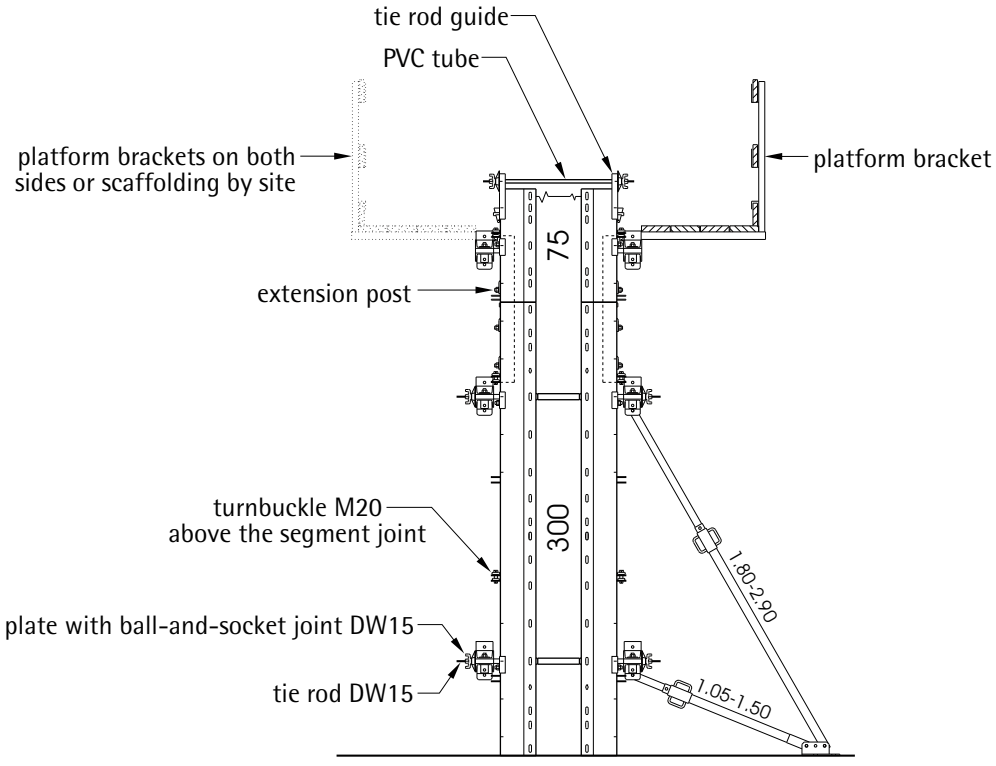


Trapezoidal girder formwork : height 337.5cm

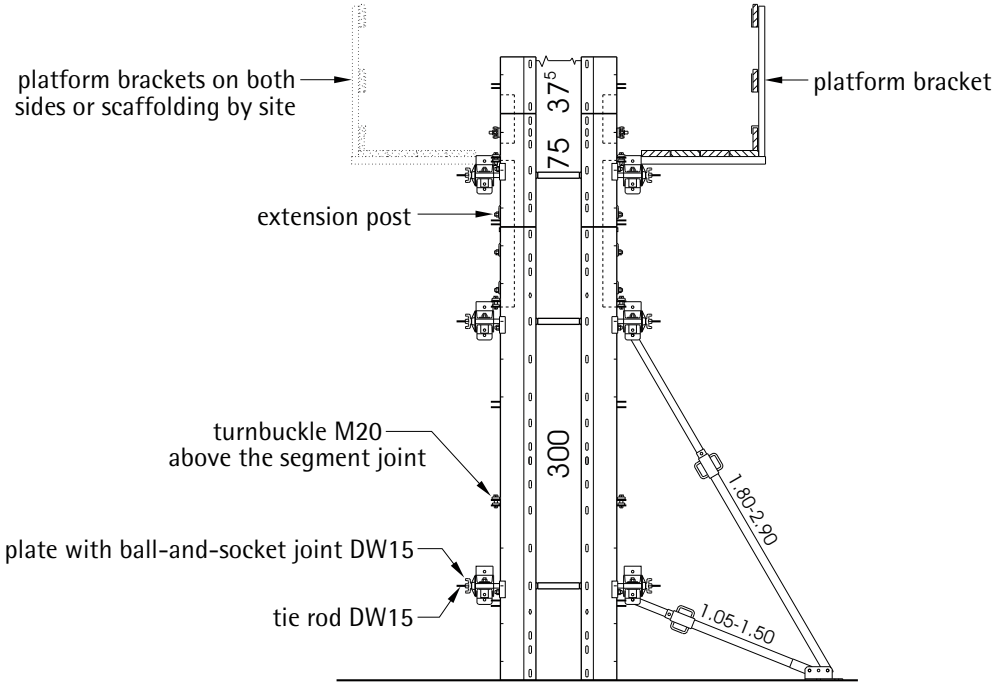


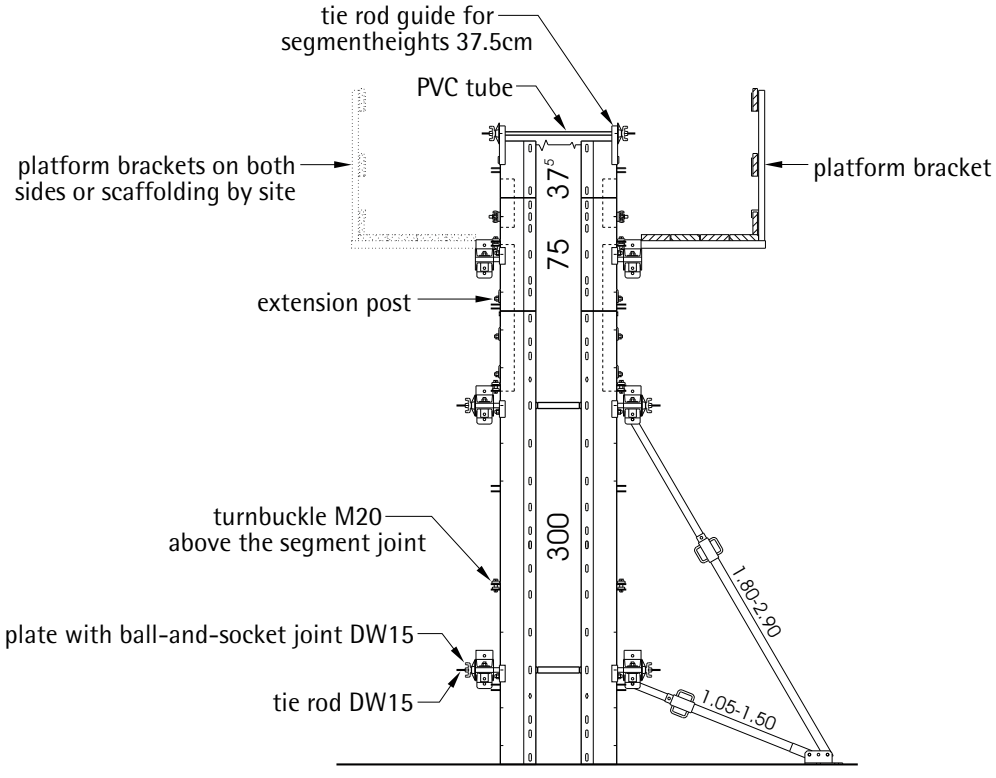
Trapezoidal girder formwork : height 375cm



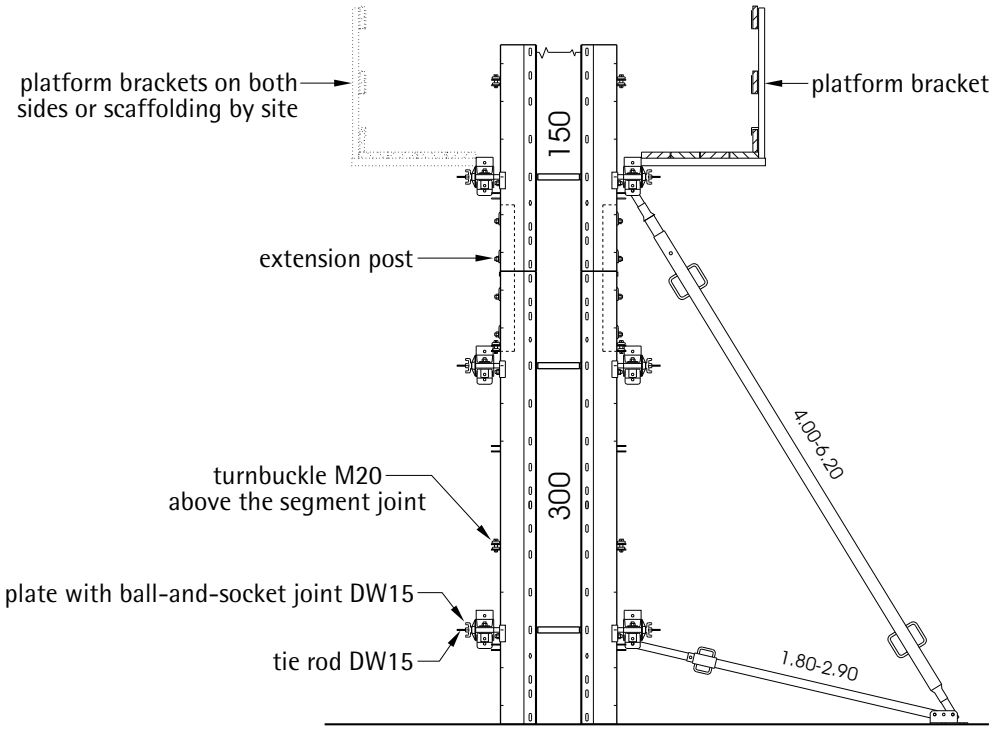


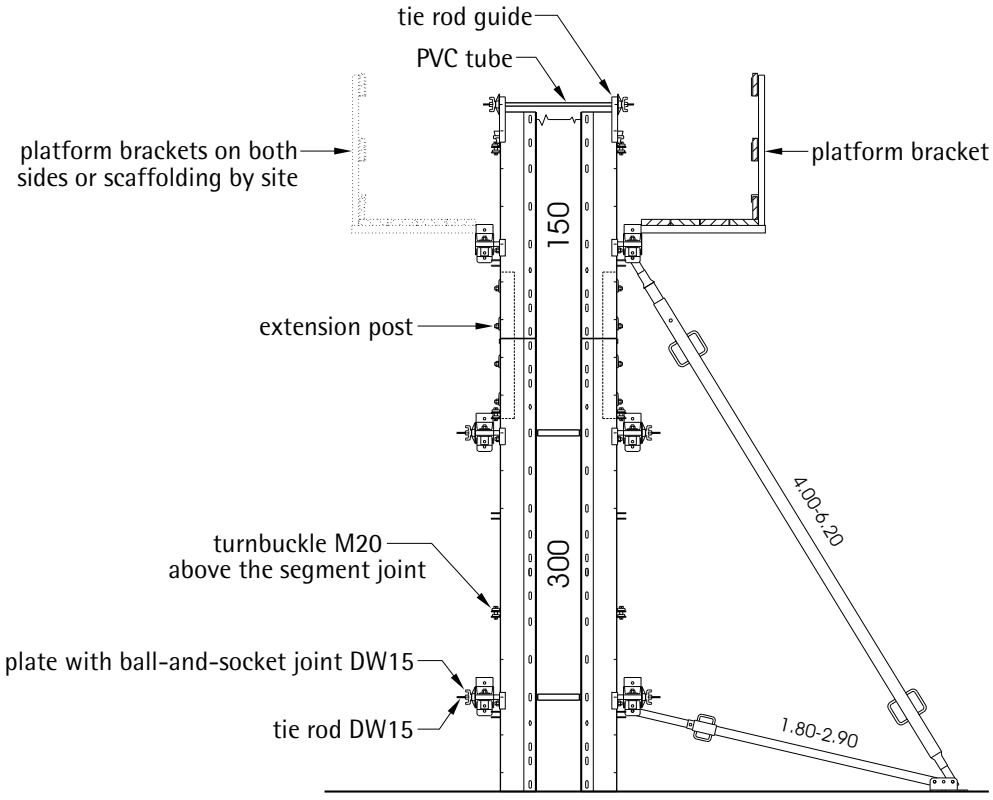
Trapezoidal girder formwork : height 412.5cm



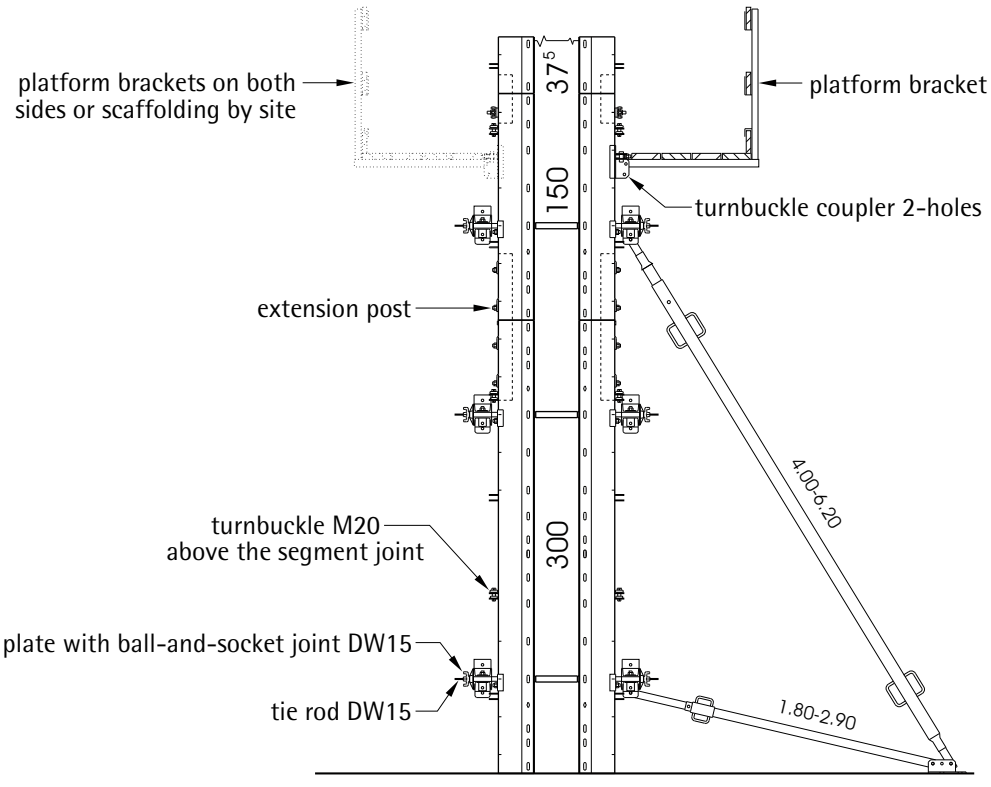


Trapezoidal girder formwork : height 450cm

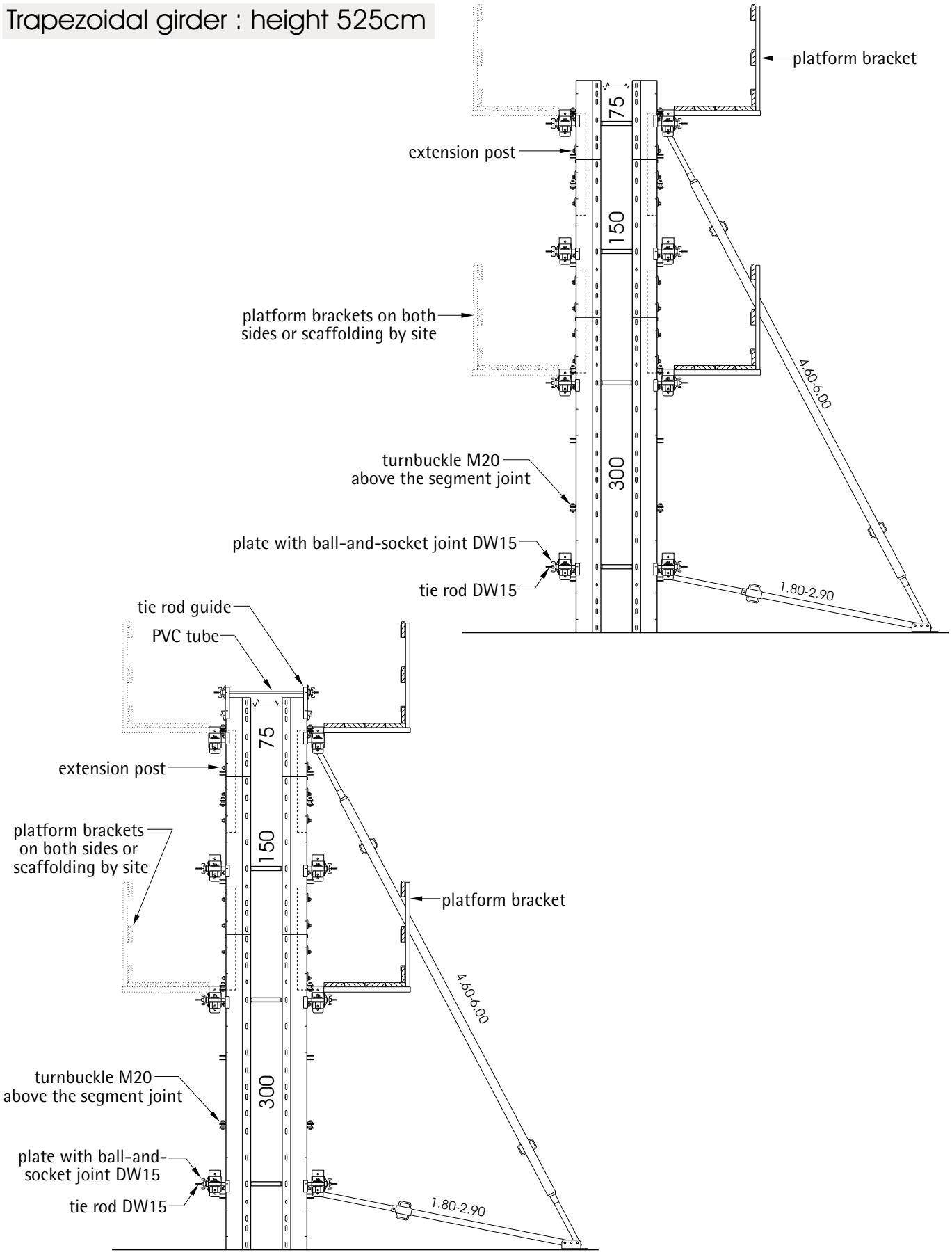




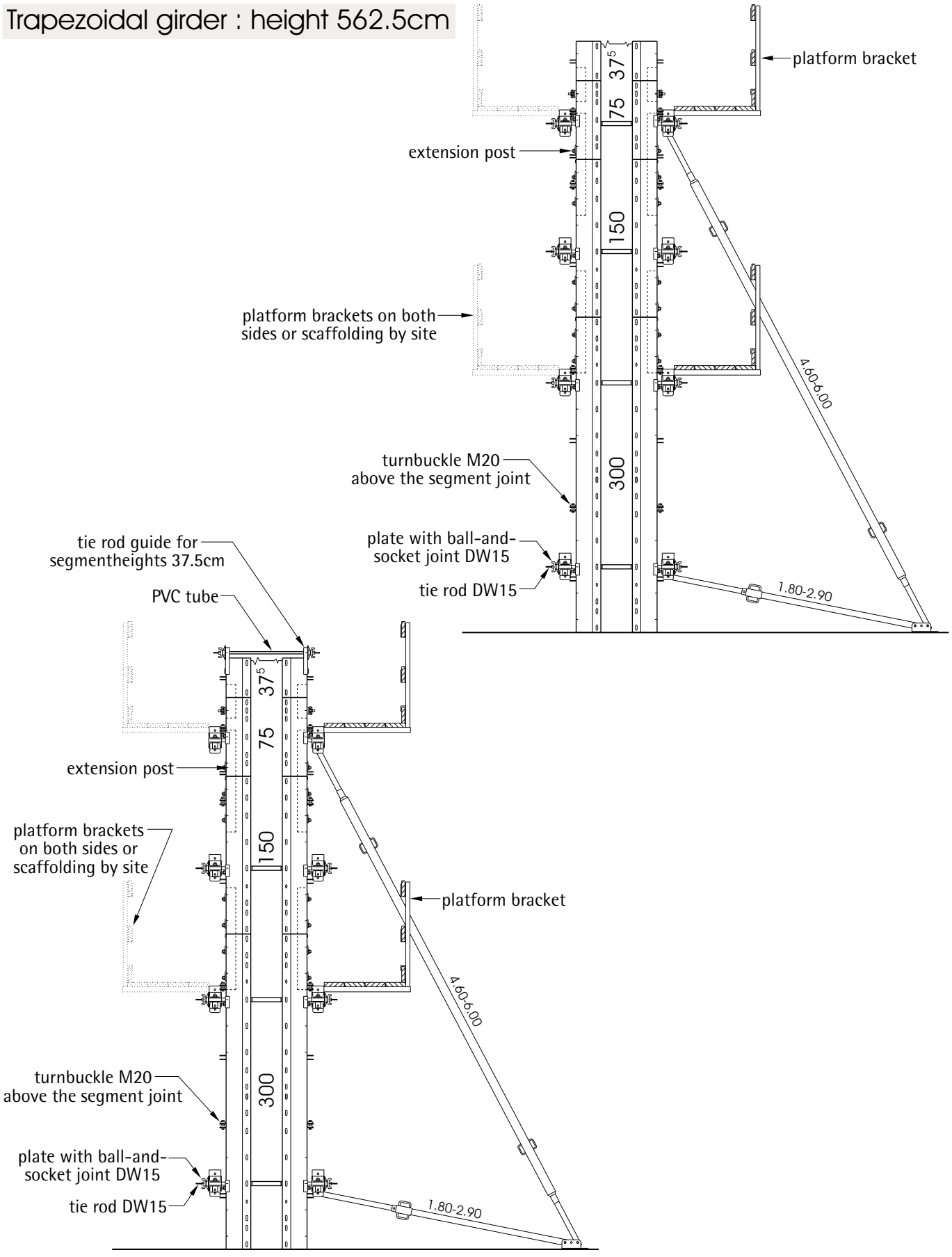
Trapezoidal girder formwork : height 487.5cm



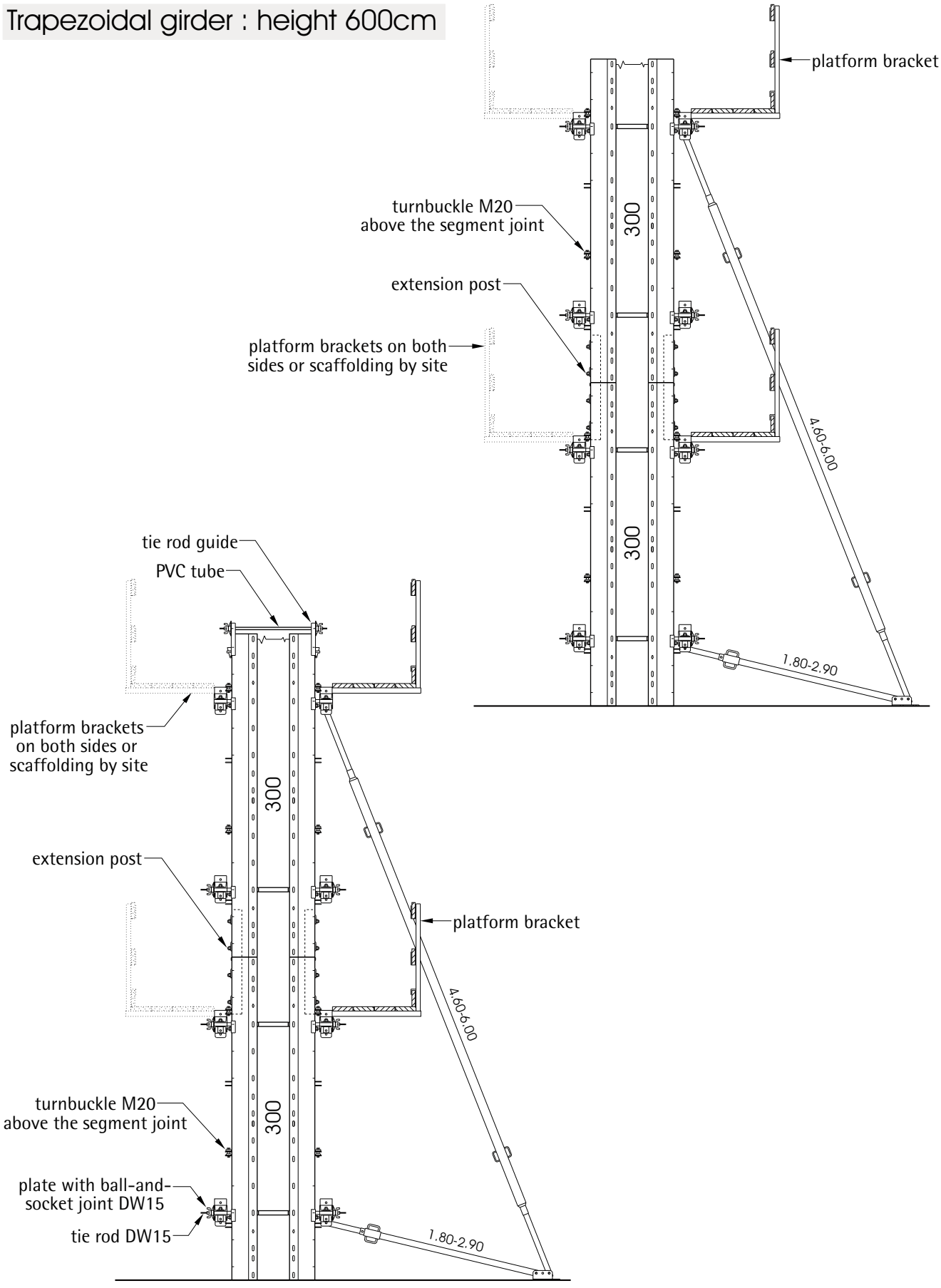
Trapezoidal girder : height 525cm



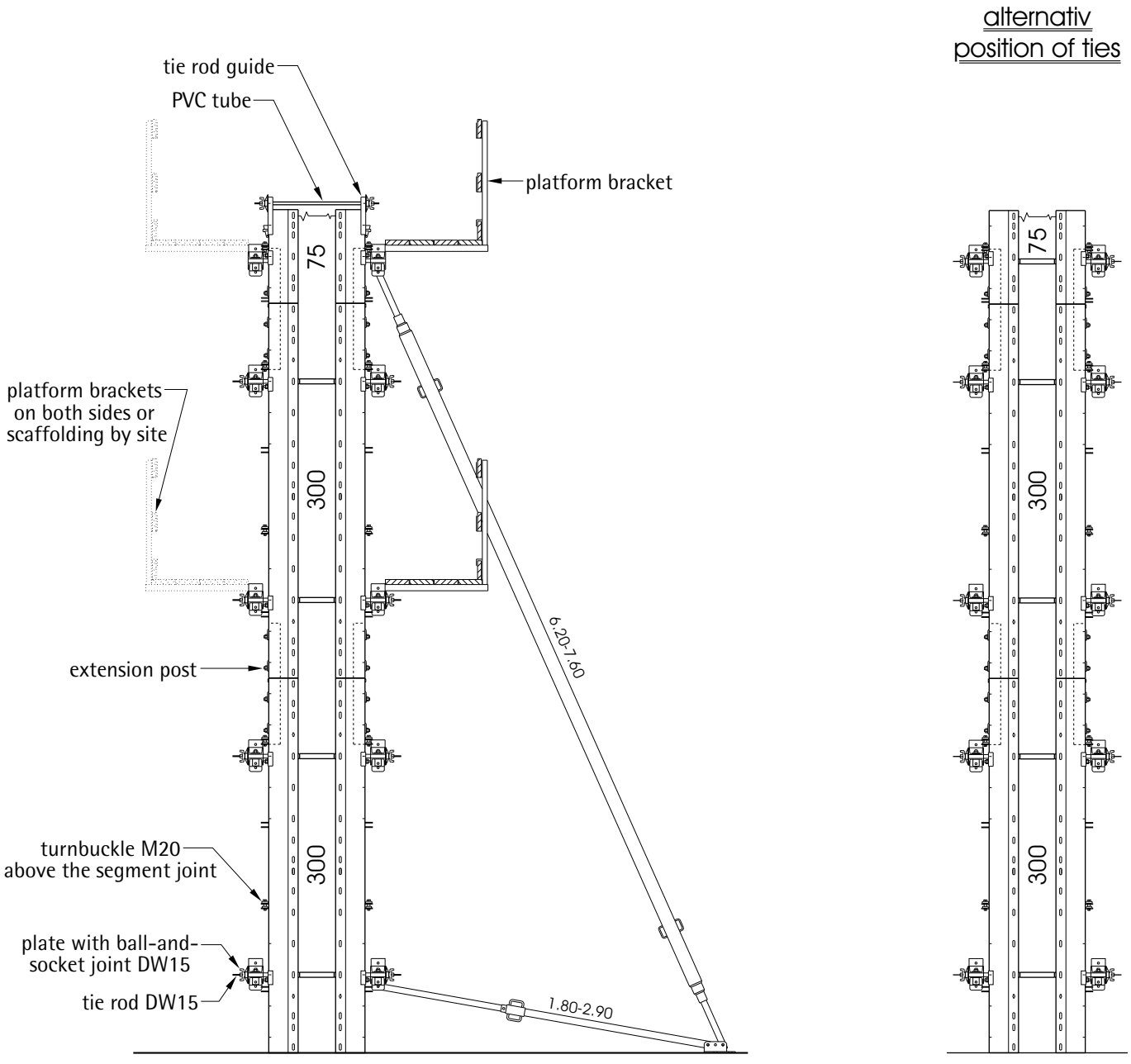
Trapezoidal girder : height 562.5cm



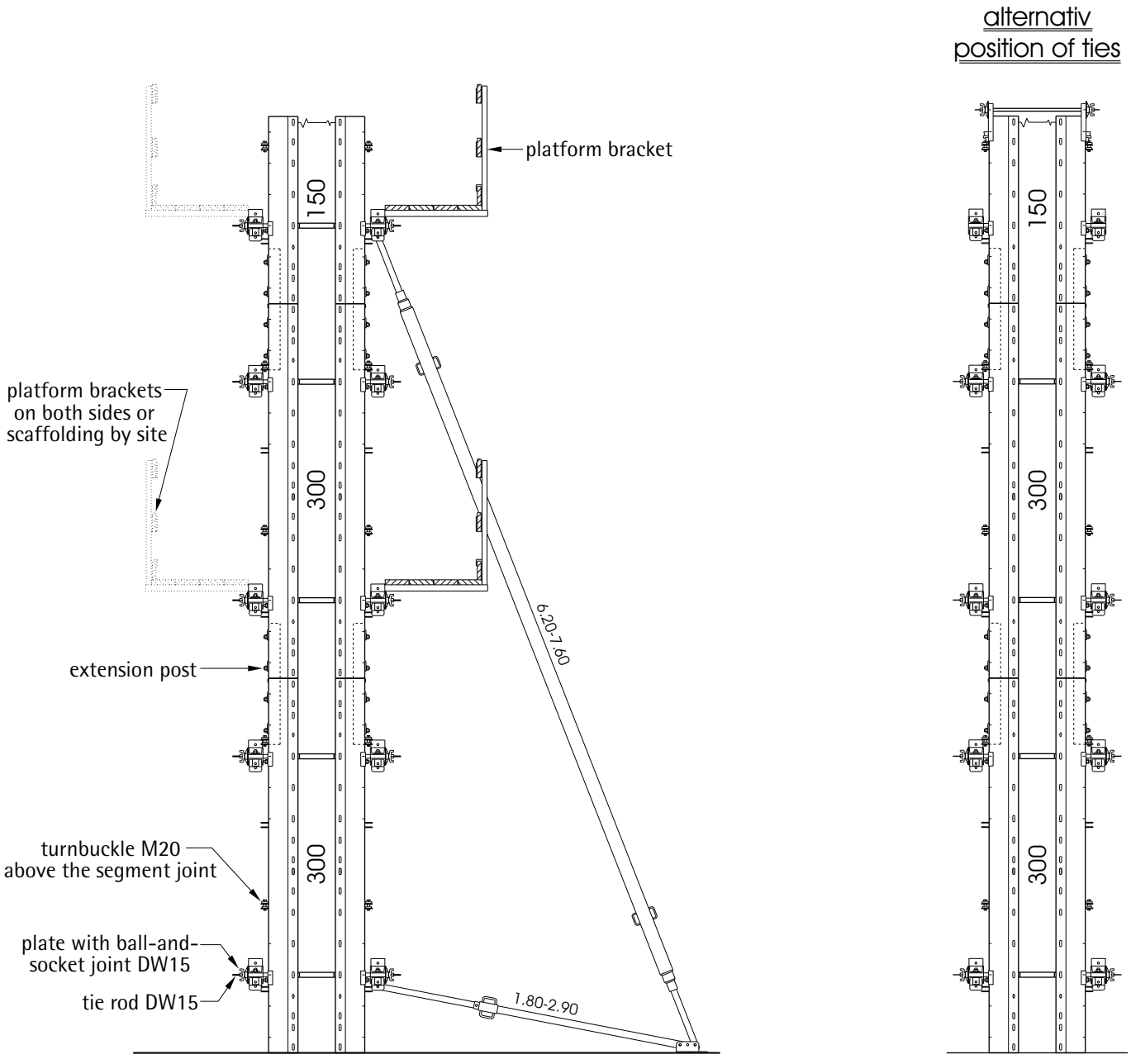
Trapezoidal girder : height 600cm



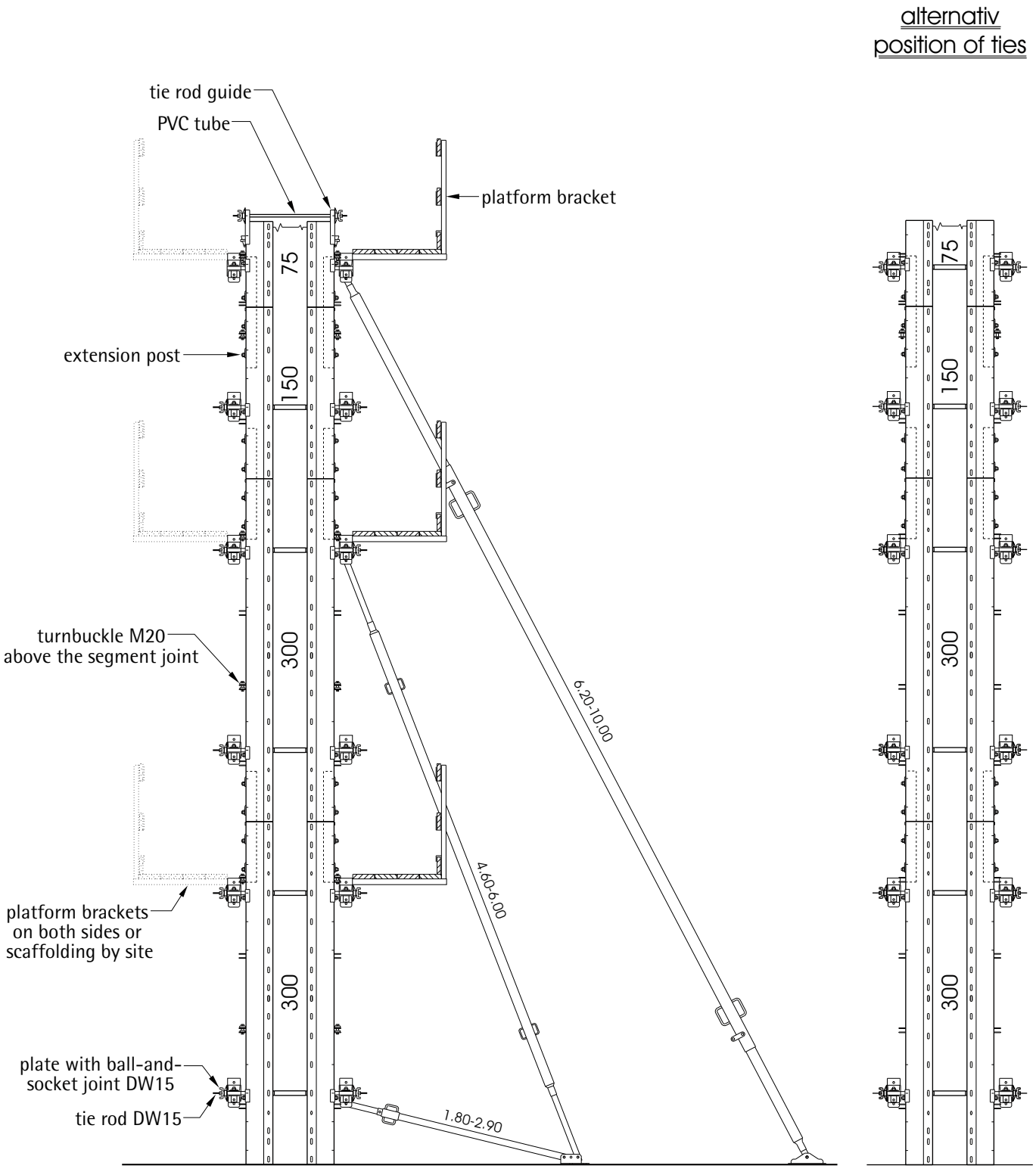
Trapezoidal girder formwork : height 675cm



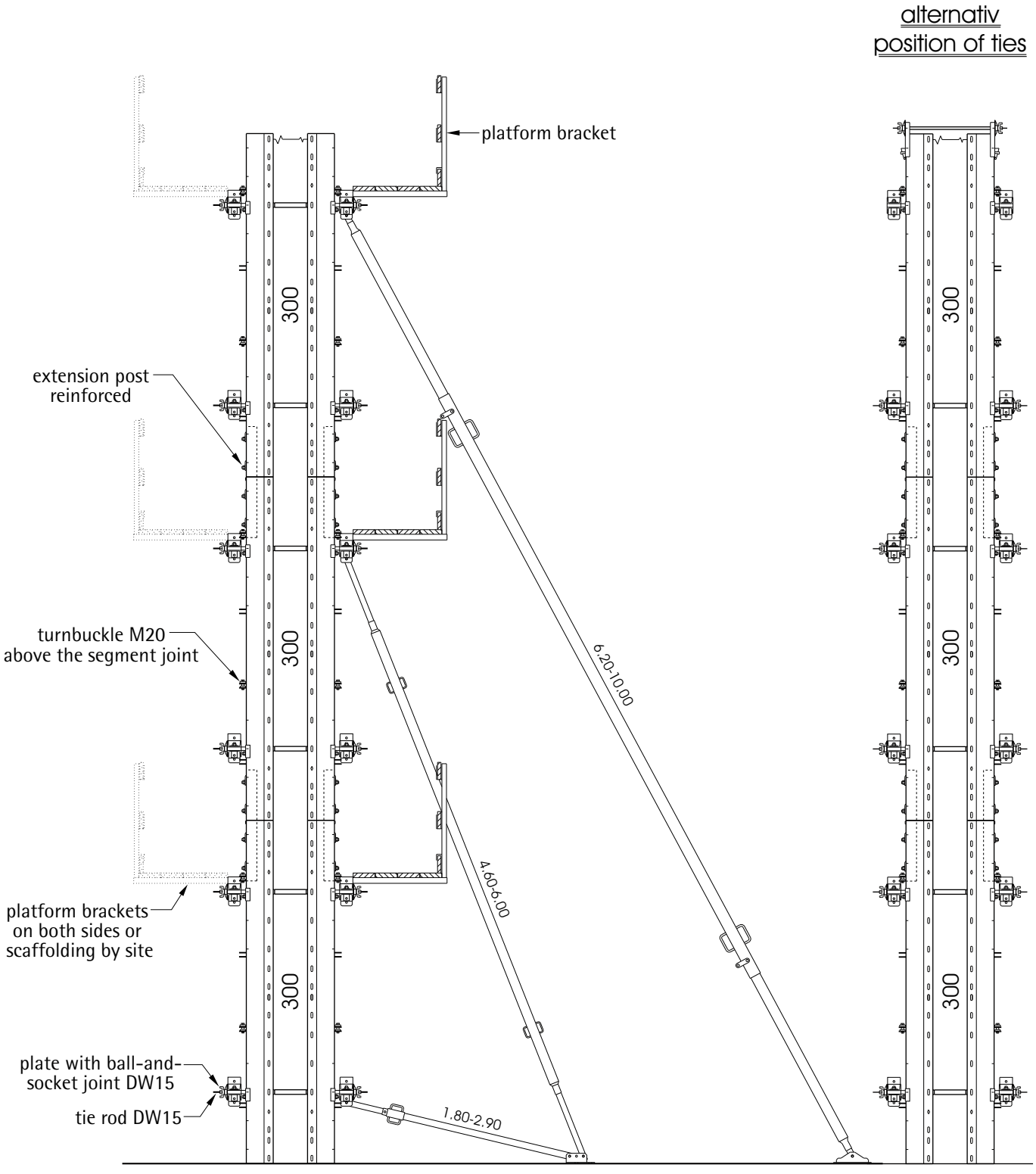
Trapezoidal girder formwork : height 750cm



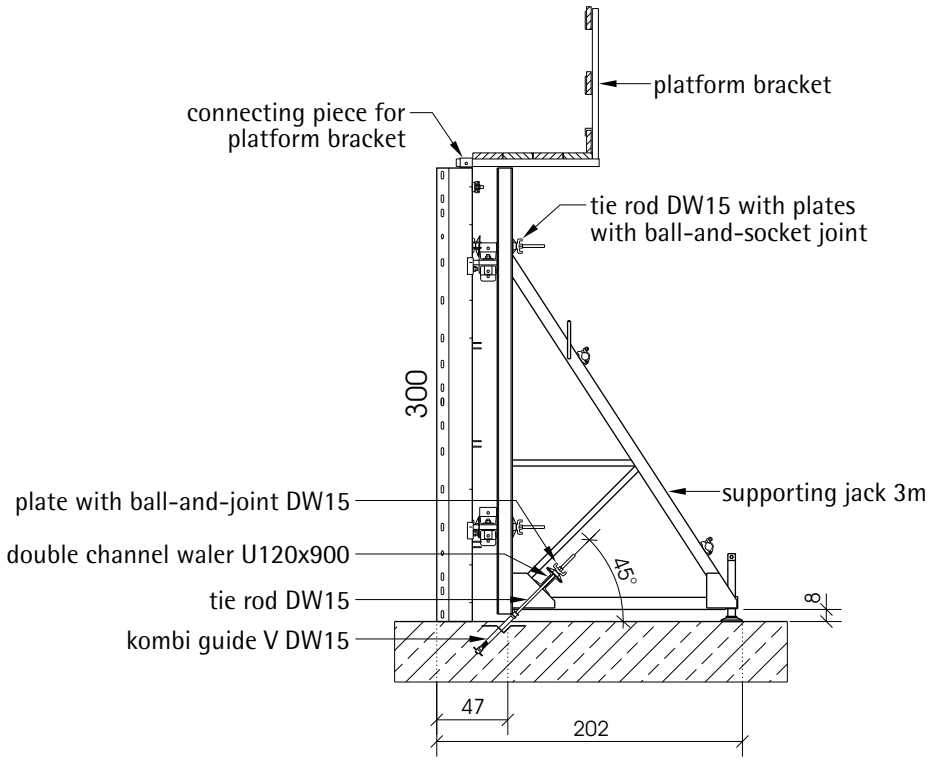
Trapezoidal girder formwork : height 825cm



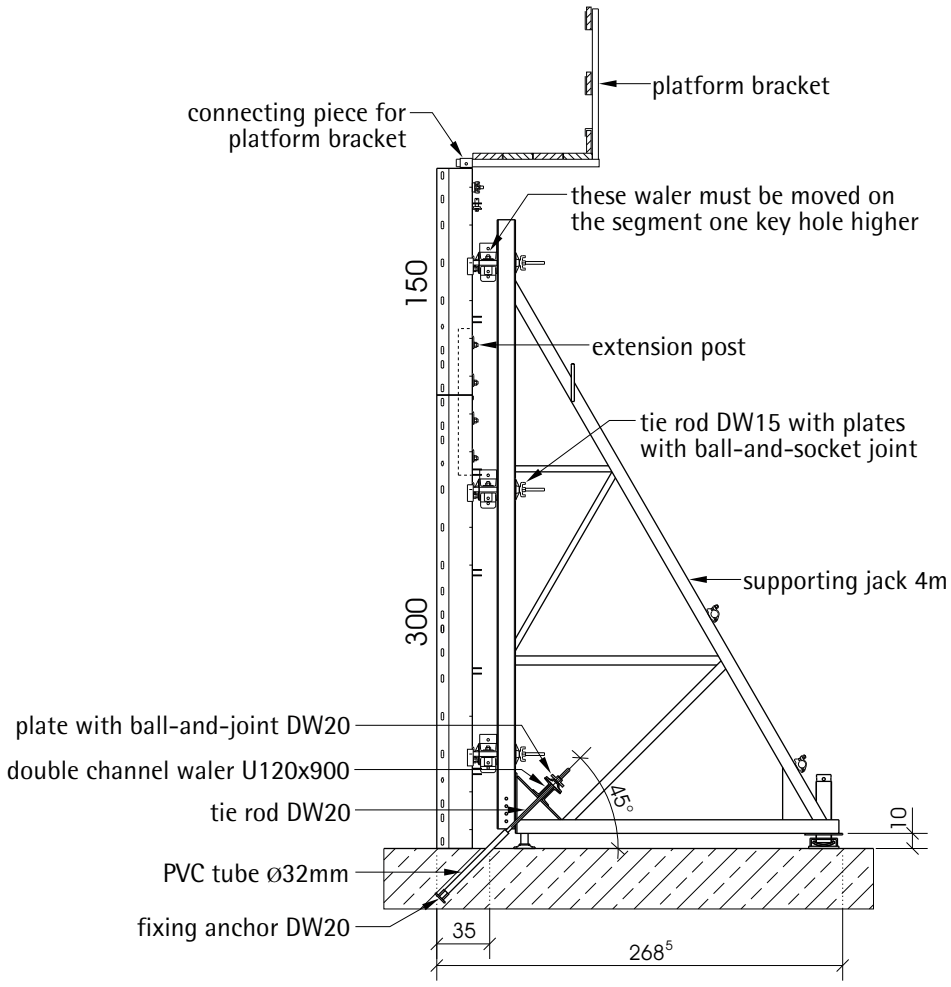
Trapezoidal girder formwork : height 900cm



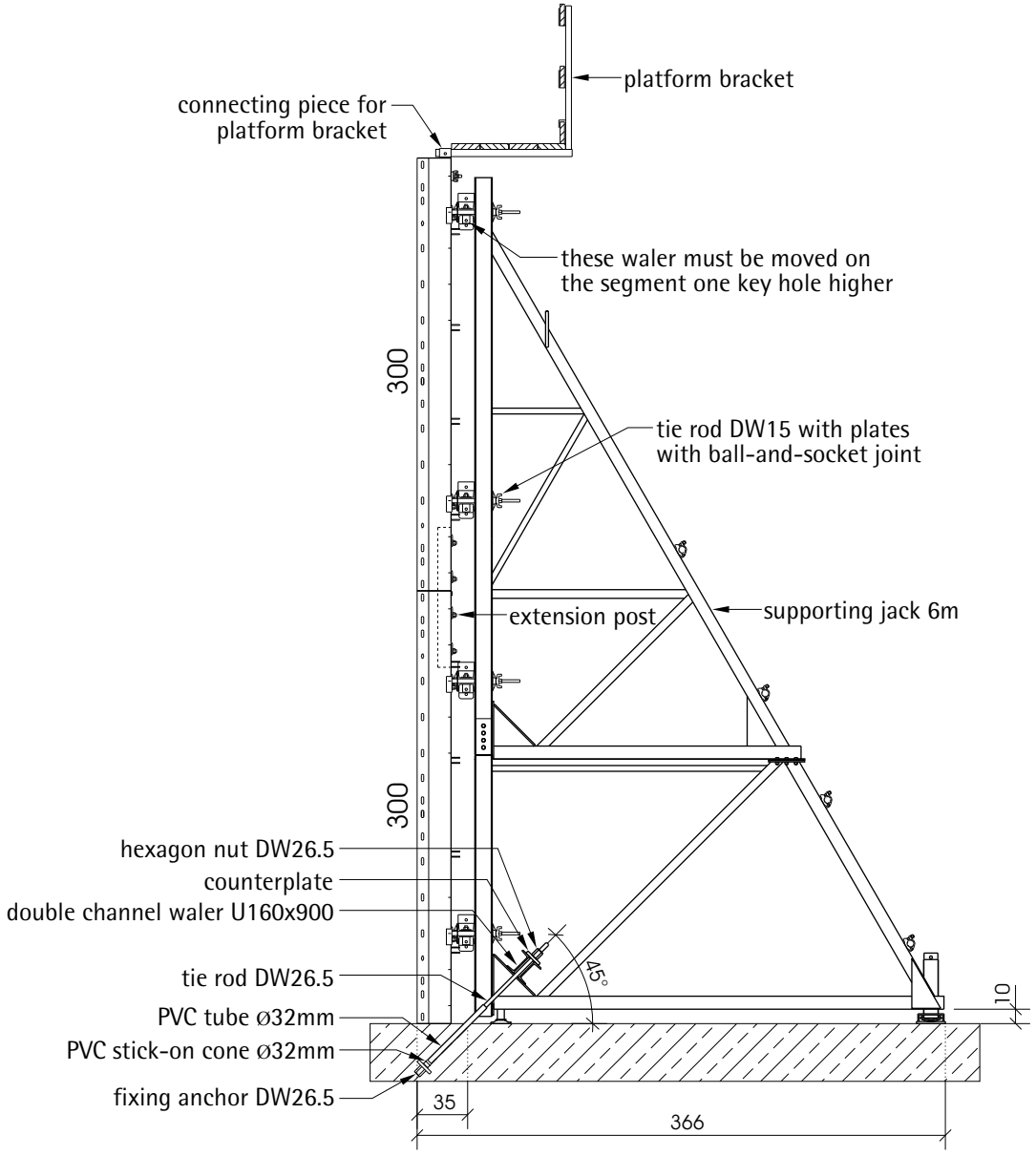
Trapezoidal girder formwork with supporting jack 3m



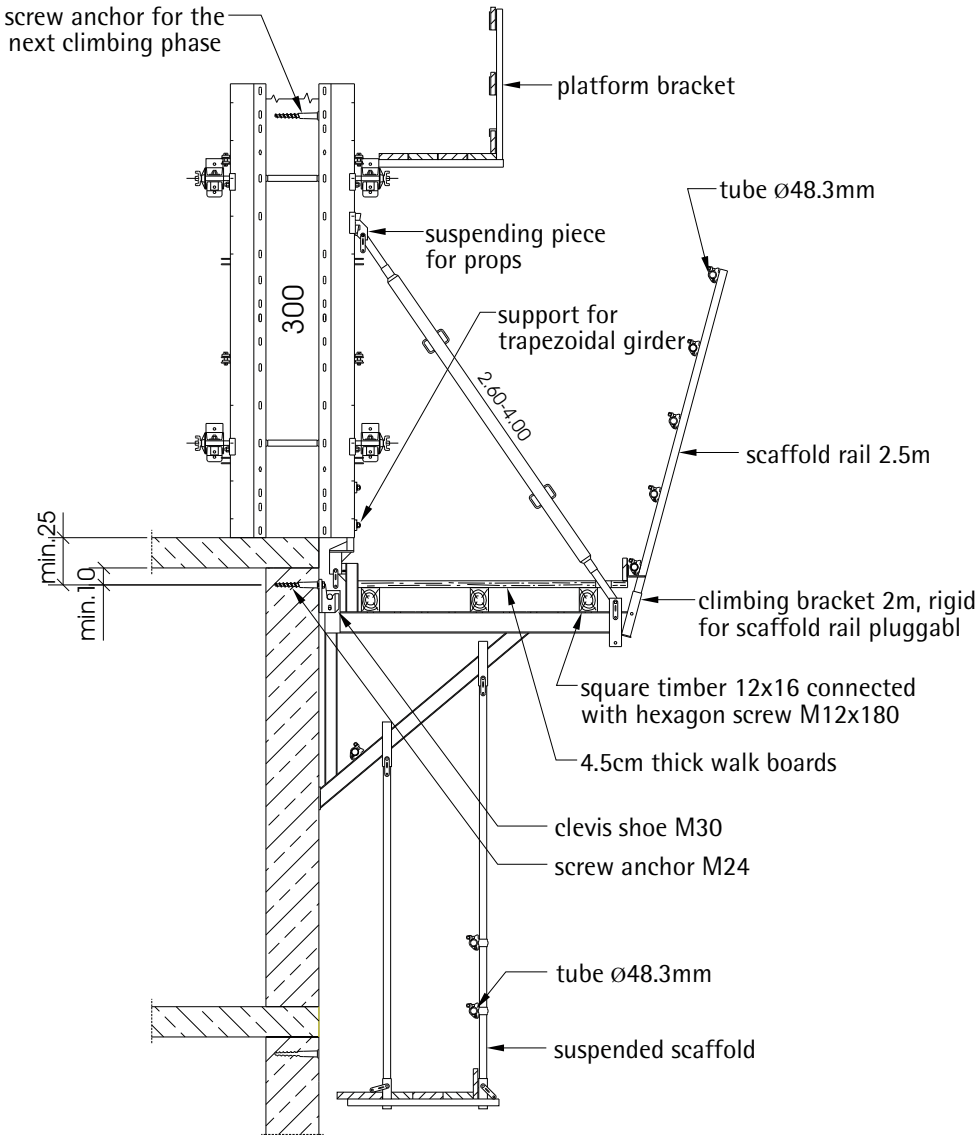
Trapezoidal girder formwork with supporting jack 4m



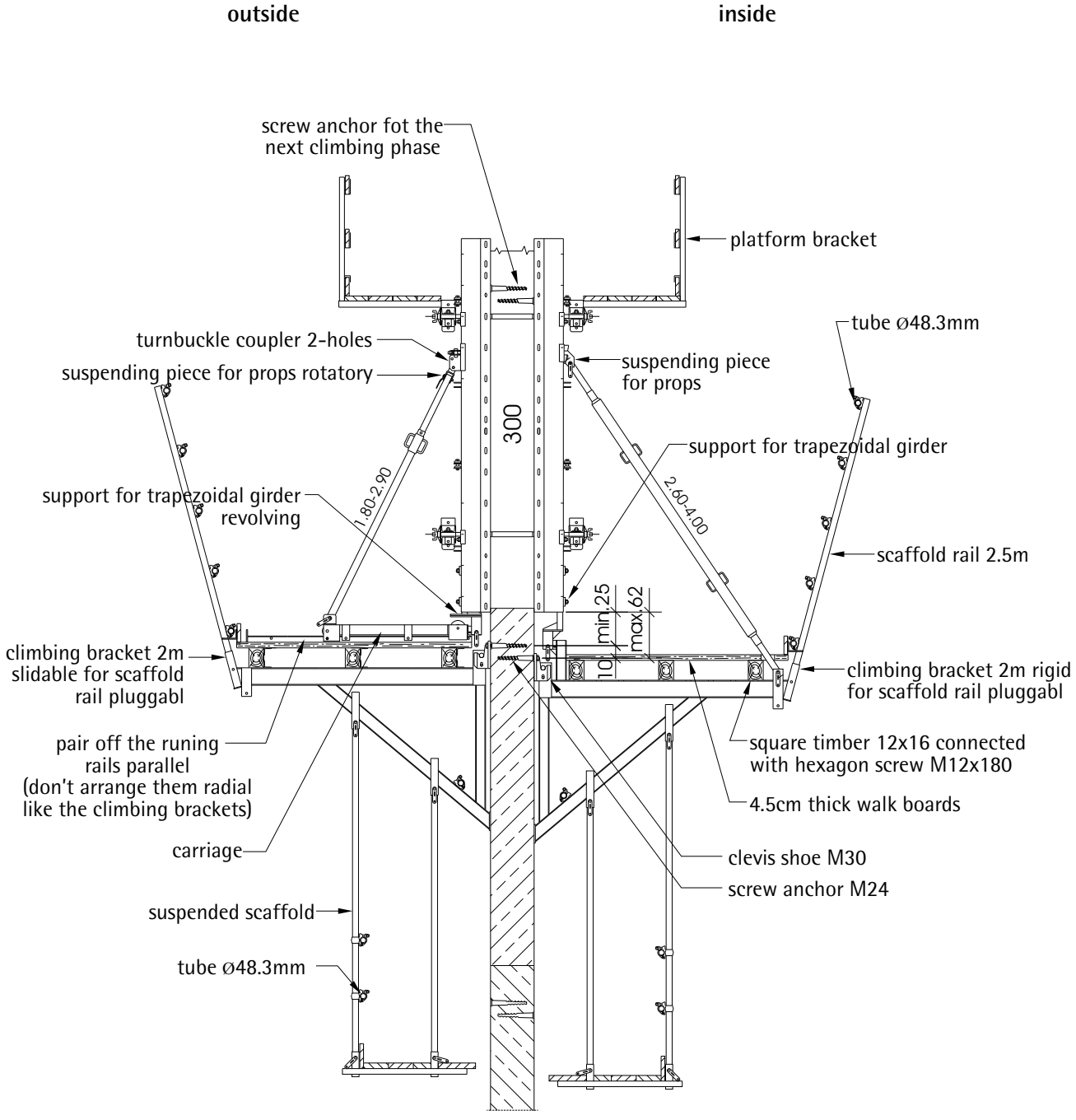
Trapezoidal girder formwork with supporting jack 6m

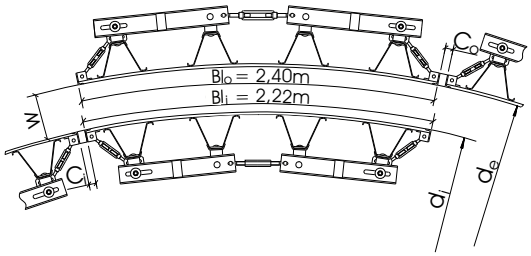


Trapezoidal Girder with climbing bracket 2m rigid, one-sided climbing



Trapezoidal girder with climbing bracket rigid and slidable, both-sided





ill.97

$$C_i = \frac{d_i * Sl_o}{d_e} - Sl_i$$

$$C_o = \frac{d_e * Sl_i}{d_i} - Sl_o$$

- Bl_o - basic length, outside, straight position
- Bl_i - basic length, intside, straight position
- Sl_o - length of segment, outside, curved position
- Sl_i - length of segment, inside, curved position
- C_o - Compensation outside
- C_i - Compensation inside
- d_e - exterior diameter
- d_i - interior diameter

Compensation between 2 segments for segment 222/240

d_i [m]	w=15 [cm]	w=20 [cm]	w=25 [cm]	w=30 [cm]	w=35 [cm]	w=40 [cm]	w=50 [cm]
5	2,5 i	1,8 o	6,3 o				
6	4,6 i	1,1 i	2,6 o	6,3 o	10,0 o		
7	6,2 i	2,9 i	0,2 o	3,4 o	6,2 o	9,4 o	
8	7,5 i	4,8 i	2,1 i	0,5 o	3,3 o	6,1 o	11,7 o
9	8,6 i	6,1 i	3,6 i	1,2 i	1,3 o	3,8 o	8,5 o
10		7,2 i	5,0 i	2,9 i	0,8 i	1,4 o	5,8 o
11		8,1 i	6,1 i	4,1 i	2,1 i	0,1 i	3,9 o
12			7,0 i	5,2 i	3,4 i	1,6 i	2,0 o
13				6,1 i	4,5 i	2,7 i	0,6 o
14				7,7 i	5,4 i	3,9 i	0,8 i
15					6,2 i	4,8 i	1,9 i
16						5,6 i	2,9 i
17						6,3 i	3,7 i
18						7,0 i	4,6 i
19							5,3 i
20							6,0 i

tab.6

Length of segments depending from diameter

	Bl_o 2.40	Bl_i 2.22m
d_i [m]	Sl_o [cm]	Sl_i [cm]
5	239,00	223,00
6	239,00	223,00
7	239,05	222,95
8	239,10	222,90
9	239,15	222,85
10	239,20	222,80
11	239,25	222,75
12	239,30	222,70
13	239,35	222,65
14	239,40	222,60
15	239,45	222,55
16	239,50	222,50
17	239,55	222,45
18	239,60	222,40
19	239,65	222,35
20	239,70	222,30
21	239,75	222,25
22	239,80	222,20
23	239,85	222,15
24	239,90	222,10
25	239,95	222,05
26	240,00	222,00

tab.7

On curved walls the length on the inside formwork is smaller as the length of the outside formwork.
The length of the segments are fixed. That means, that for different diameters and wall thickness are different compensation necessary.
The compensation can made with plastic filler pieces (PE) and filler pieces.

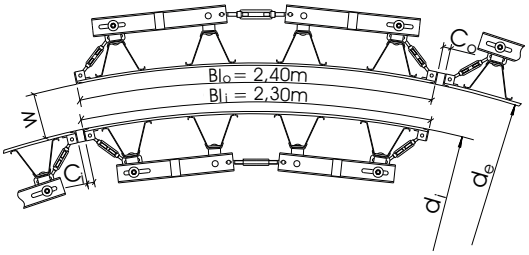
The max. length between 2 segments are 20cm.
Is the compensation bigger, then it is necessary to used smaller segments (half segments and quarter segments).
An other way is to bring a tie rod between the segments. These is possible with the Modular polygonal filler post (page 83) or make a hole in the plastic filler piece.

Calculation of fillers

Compensation between 2 segments for segment 230/240

d_i [m]	w=15 [cm]	w=20 [cm]	w=25 [cm]	w=30 [cm]	w=35 [cm]	w=40 [cm]	w=50 [cm]
5	5,8 o	10,5 o					
6	3,5 o	7,4 o	11,2 o				
7	1,8 o	5,4 o	8,4 o	11,7 o			
8	0,5 o	3,3 o	6,2 o	9,1 o	12,0 o		
9	0,6 i	2,1 o	4,7 o	7,1 o	9,6 o	12,0 o	
10	1,4 i	0,8 o	3,1 o	5,4 o	7,8 o	10,1 o	
11	2,1 i	0,0	2,1 o	4,2 o	6,2 o	8,3 o	
12	2,8 i	0,9 i	1,0 o	3,0 o	5,0 o	6,8 o	10,6 o
13	3,3 i	1,5 i	0,2 o	2,1 o	3,8 o	5,5 o	9,0 o
14	3,8 i	2,2 i	0,5 i	1,1 o	2,7 o	4,4 o	7,7 o
15	4,2 i	2,7 i	1,1 i	0,4 o	2,0 o	3,4 o	6,5 o
16	4,6 i	3,2 i	1,7 i	0,3 i	1,1 o	2,5 o	5,4 o
17	4,9 i	3,6 i	2,2 i	0,9 i	0,4 o	1,8 o	4,5 o
18	5,3 i	4,0 i	2,7 i	1,5 i	0,2 i	1,0 o	3,6 o
19	5,6 i	4,3 i	3,1 i	1,9 i	0,8 i	0,4 o	2,9 o
20	5,8 i	4,7 i	3,6 i	2,4 i	1,3 i	0,2 i	2,1 o
21	6,1 i	5,0 i	3,9 i	2,8 i	1,7 i	0,7 i	1,5 o
22	6,4 i	5,3 i	4,3 i	3,2 i	2,2 i	1,2 i	0,9 o
23	6,6 i	5,6 i	4,6 i	3,6 i	2,6 i	1,6 i	0,3 o
24	6,8 i	5,8 i	4,9 i	3,9 i	3,0 i	2,1 i	0,2 i
25	7,0 i	6,1 i	5,1 i	4,3 i	3,5 i	2,4 i	0,7 i
26	7,2 i	6,3 i	5,5 i	4,6 i	3,7 i	2,8 i	1,8 i
27	7,3 i	6,5 i	5,6 i	4,8 i	3,9 i	3,1 i	1,4 i
28	7,4 i	6,6 i	5,8 i	5,0 i	4,1 i	3,3 i	1,7 i
29	7,5 i	6,7 i	5,9 i	5,1 i	4,3 i	3,5 i	2,0 i
30	7,6 i	6,8 i	6,0 i	5,3 i	4,5 i	3,8 i	2,3 i
31	7,7 i	6,9 i	6,2 i	5,4 i	4,7 i	4,0 i	2,5 i
32	7,8 i	7,0 i	6,3 i	5,6 i	4,8 i	4,1 i	2,7 i
33	7,8 i	7,1 i	6,4 i	5,7 i	5,0 i	4,3 i	2,9 i
34	7,9 i	7,2 i	6,5 i	5,8 i	5,1 i	4,5 i	3,1 i
35	8,0 i	7,3 i	6,6 i	5,9 i	5,3 i	4,6 i	3,3 i
36	8,0 i	7,3 i	6,7 i	6,0 i	5,4 i	4,8 i	3,5 i
37	8,1 i	7,4 i	6,8 i	6,1 i	5,5 i	4,9 i	3,7 i
38	8,1 i	7,5 i	6,9 i	6,2 i	5,6 i	5,0 i	3,8 i
39	8,2 i	7,5 i	7,0 i	6,3 i	5,7 i	5,2 i	4,0 i
40	8,2 i	7,6 i	7,0 i	6,4 i	5,9 i	5,3 i	4,1 i

tab.8



ill.98

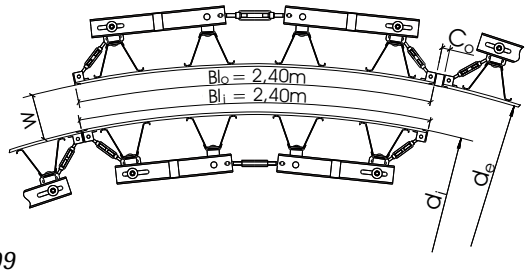
Length of segments depending from diameter

d_i [m]	Bl_o 2,40 Sl_o [cm]	Bl_i 2,30m Sl_i [cm]
5	239,00	231,00
6	239,00	231,00
7	239,05	230,95
8	239,10	230,90
9	239,15	230,85
10	239,20	230,80
11	239,25	230,75
12	239,30	230,70
13	239,35	230,65
14	239,40	230,60
15	239,45	230,55
16	239,50	230,50
17	239,55	230,45
18	239,60	230,40
19	239,65	230,35
20	239,70	230,30
21	239,75	230,25
22	239,80	230,20
23	239,85	230,15
24	239,90	230,10
25	239,95	230,05
26	240,00	230,00

tab.9

The values in the tables are valid only for new segments with exactly lengths of 2.40, 2.30 and 2.22m. For segments which have changed in length because of a higher moisture content (multiple use), the compensations have to be calculated with the actual length.

For interior diameters of 5.00m - 6.60m and exterior diameters of 5.40m - 7.00m only use segments already multiple used.



ill.99

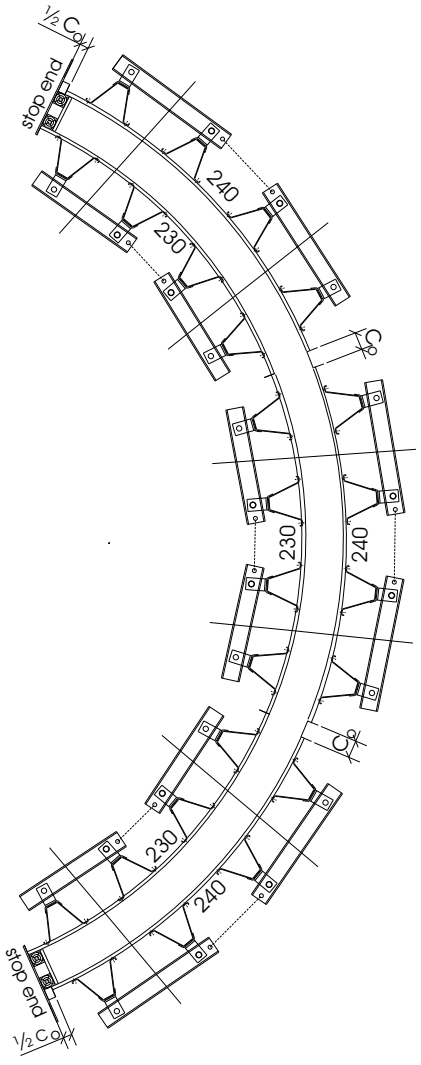
$$C_o = \frac{d_e * Sl_i}{d_i} - Sl_o$$

- Bl_o - basic length, outside, straight position
- Bl_i - basic length, intside, straight position
- Sl_o - length of segment, outside, curved position
- Sl_i - length of segment, inside, curved position
- C_o - Compensation outside
- C_i - Compensation inside
- d_e - exterior diameter
- d_i - interior diameter

Ausgleich zwischen 2 Segmenten für Segmente 240/240

d_i [m]	w=15 [cm]	w=20 [cm]	w=25 [cm]	w=30 [cm]	w=35 [cm]	w=40 [cm]	w=50 [cm]
30	2,4 o	3,2 o	4,0 o	4,8 o	5,6 o	6,4 o	8,0 o
31	2,3 o	3,1 o	3,9 o	4,6 o	5,4 o	6,2 o	7,7 o
32	2,2 o	3,0 o	3,7 o	4,5 o	5,2 o	6,0 o	7,5 o
33	2,2 o	2,9 o	3,6 o	4,4 o	5,1 o	5,8 o	7,3 o
34	2,1 o	2,8 o	3,5 o	4,2 o	4,9 o	5,6 o	7,0 o
35	2,0 o	2,7 o	3,4 o	4,1 o	4,8 o	5,5 o	6,8 o
36	2,0 o	2,6 o	3,3 o	4,0 o	4,7 o	5,3 o	6,7 o
37	1,9 o	2,6 o	3,2 o	3,9 o	4,5 o	5,2 o	6,5 o
38	1,9 o	2,5 o	3,1 o	3,8 o	4,4 o	5,1 o	6,3 o
39	1,8 o	2,5 o	3,0 o	3,7 o	4,3 o	4,9 o	6,1 o
40	1,8 o	2,4 o	3,0 o	3,6 o	4,2 o	4,8 o	6,0 o
41	1,7 o	2,3 o	2,9 o	3,5 o	4,1 o	4,7 o	5,8 o
42	1,7 o	2,3 o	2,9 o	3,4 o	4,0 o	4,6 o	5,7 o
43	1,7 o	2,2 o	2,8 o	3,3 o	3,9 o	4,5 o	5,6 o
44	1,6 o	2,2 o	2,7 o	3,3 o	3,8 o	4,4 o	5,5 o
45	1,6 o	2,1 o	2,7 o	3,2 o	3,7 o	4,3 o	5,3 o

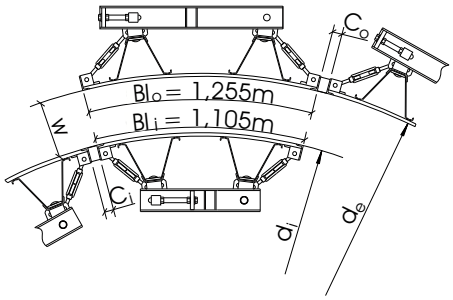
tab.10



ill.100

For great diameters the outside segment 240cm can also used as a inside segment. In these case the compensation will be smaller. The min. inside diameter for the 240cm wide segment is 17.50m.

On a pitch circle are on the start and the end of the wall an stop end. On the stop end is the half compensation necessary (ill.100).
It is also possible to move the segment on the stop end and make a greater compensation on the segment joint after the segment on the stop end.



ill.101

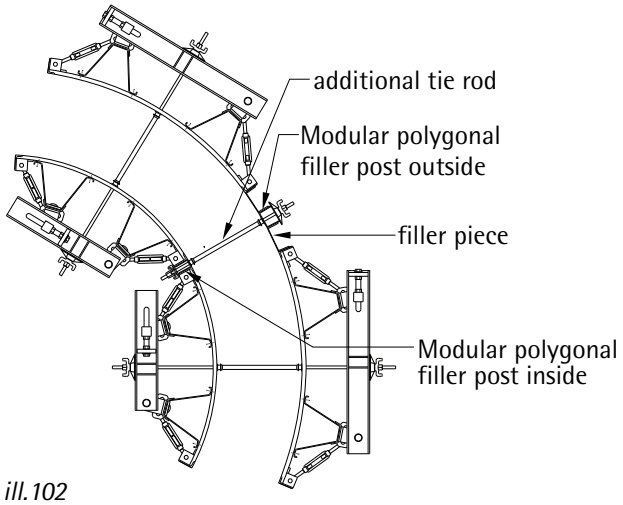
Length of segments depending from diameter

inside segment Bl_i = 110,5cm		outside segment Bl_o= 125,5cm	
d_i [m]	Sl_i [cm]	d_a [m]	Sl_a [cm]
2,0	111,0	2,5	125,6
3,0	110,6	3,5	125,8
4,0	110,4	4,5	126,0
5,0	110,2	5,5	126,2

$$C_i = \frac{d_i * Sl_o}{d_e} - Sl_i$$

$$C_o = \frac{d_e * Sl_i}{d_i} - Sl_o$$

tab.11



ill.102

Compensation between 2 segments for segment 110.5/125.,5cm

d_i [m]	w=15 [cm]	w=20 [cm]	w=25 [cm]	w=30 [cm]	w=35 [cm]	w=40 [cm]
2,0	1,1 o	6,6 o	13,1 o	18,7 o		
2,1	0,2 o	6,5 o	11,7 o	17,0 o		
2,2	0,4 o	5,5 o	10,5 o	15,5 o	20,5 o	
2,3	0,3 i	4,5 o	9,3 o	14,1 o	18,9 o	
2,4	0,9 i	3,7 o	8,3 o	12,8 o	17,4 o	
2,5	1,6 i	2,8 o	7,3 o	11,7 o	16,1 o	20,5 o
2,6	2,2 i	2,1 o	6,3 o	10,6 o	14,8 o	19,0 o
2,7	2,7 i	1,4 o	5,5 o	9,6 o	13,6 o	17,7 o
2,8	3,2 i	0,8 o	4,7 o	8,6 o	12,6 o	16,5 o
2,9	3,7 i	0,1 o	3,9 o	7,7 o	11,5 o	15,3 o
3,0	4,1 i	0,4 i	3,2 o	6,9 o	10,6 o	14,2 o
3,1	4,5 i	1,0 i	2,6 o	6,1 o	9,7 o	13,2 o
3,2	4,9 i	1,4 i	2,0 o	5,4 o	8,9 o	12,3 o
3,3	5,2 i	1,9 i	1,4 o	4,8 o	8,1 o	11,4 o
3,4	5,6 i	2,3 i	0,9 o	4,1 o	7,4 o	10,6 o
3,5	5,9 i	2,8 i	0,4 o	3,5 o	6,7 o	9,8 o
3,6	6,2 i	3,1 i	0,1 i	3,0 o	6,0 o	9,1 o
3,7	6,5 i	3,5 i	0,6 i	2,4 o	5,4 o	8,3 o
3,8	6,8 i	3,9 i	1,0 i	1,9 o	4,8 o	7,7 o
3,9	7,0 i	4,2 i	1,4 i	1,4 o	4,2 o	7,0 o
4,0	7,3 i	4,5 i	1,8 i	0,9 o	3,7 o	6,4 o
4,1	7,5 i	4,9 i	2,2 i	0,5 o	3,2 o	5,8 o
4,2	7,8 i	5,1 i	2,5 i	0,1 o	2,7 o	5,3 o
4,3	8,0 i	5,4 i	2,9 i	0,3 i	2,2 o	4,7 o
4,4	8,2 i	5,7 i	3,2 i	0,7 i	1,8 o	4,2 o
4,5	8,4 i	6,0 i	3,5 i	1,1 i	1,3 o	3,7 o
4,6	8,6 i	6,2 i	3,9 i	1,5 i	0,9 o	3,3 o
4,7	8,8 i	6,5 i	4,1 i	1,8 i	0,5 o	2,8 o
4,8	9,0 i	6,7 i	4,4 i	2,2 i	0,1 o	2,4 o
4,9	9,2 i	6,9 i	4,7 i	2,5 i	0,3 i	2,0 o
5,0	9,3 i	7,2 i	5,0 i	2,8 i	0,6 i	1,6 o

tab.12

With new segments are interior diameters from 2.50m to 5.00m and exterior diameters from 2.70m to 5.50m possible. With used segments are interior diameters from 2.00m to 5.60m and exterior diameters from 2.40cm to 6.50m possible.
Table 11 is valid for new segments. For used segments the width of the segments increase ca. 2-4cm.

The max. length between 2 segments are 20cm.
Is the compensation bigger, then it is necessary to used smaller segments (55.5/62.5cm). Then you get more segment joints and smaller compensations.
An other way is to bring a tie rod between the segments. These is possible with the Modular polygonal filler post (ill.102) or make a hole in the plastic filler piece.

circumference exterior : $U_e = d_e * \pi$

circumference interior : $U_i = d_i * \pi$

number of whole segments outside : $n_{wo} = \frac{U_e}{Sl_o}$

number of whole segments inside : $n_{wi} = \frac{U_i - 3cm}{Sl_i}$

number of whole segments : n_w = whole-numbered part from Min (n_{wi},n_{wo})

number of half segments outside : $n_{ho} = \frac{U_e - Sl_o * n_w}{Sl_{ho}}$

number of half segments inside : $n_{hi} = \frac{U_i - 3cm - Sl_i * n_w}{Sl_{hi}}$

number of half segments : n_h = whole-numbered part from Min (n_{hi},n_{ho})

number of quarter segments outside : $n_{qo} = \frac{U_e - Sl_o * n_w - Sl_{ho} * n_h}{Sl_{qo}}$

number of quarter segments inside : $n_{qi} = \frac{U_i - 3cm - Sl_i * n_w - Sl_{hi} * n_h}{Sl_{qi}}$

number of quarter segments : n_q = whole-numbered part from Min (n_{qi},n_{qo})

Compensation outside (per whole segment): $C_o = \frac{U_e - Sl_o * n_w - Sl_{ho} * n_h - Sl_{qo} * n_q}{n_w + 0.5*n_h + 0.25*n_v}$

Compensation inside (per whole segment) : $C_i = \frac{U_i - l_{fp} - Sl_i * n_w - Sl_{hi} * n_h - Sl_{qi} * n_q}{n_w + 0.5*n_h + 0.25*n_q - 1}$ l_{fp} = 3/5/7cm

Compensation outside (per half segment) : $C_{ho} = 0.5 * C_o$

Compensation inside (per half segment) : $C_{hi} = 0.5 * C_i$

Compensation outside (p. quarter segment): $C_{ho} = 0.5 * C_o$

Compensation inside (per quarter segment) : $C_{hi} = 0.5 * C_i$

Sl_o - length of outside segment, whole segment in curved position
Sl_i - length of inside segment, whole segment in curved position
Sl_{ho} - length of outside segment, half segment in curved position
Sl_{hi} - length of inside segment, half segment in curved position
Sl_{qo} - length of outside segment, quarter segment in curved position
Sl_{qi} - length of inside segment, quarter segment in curved position

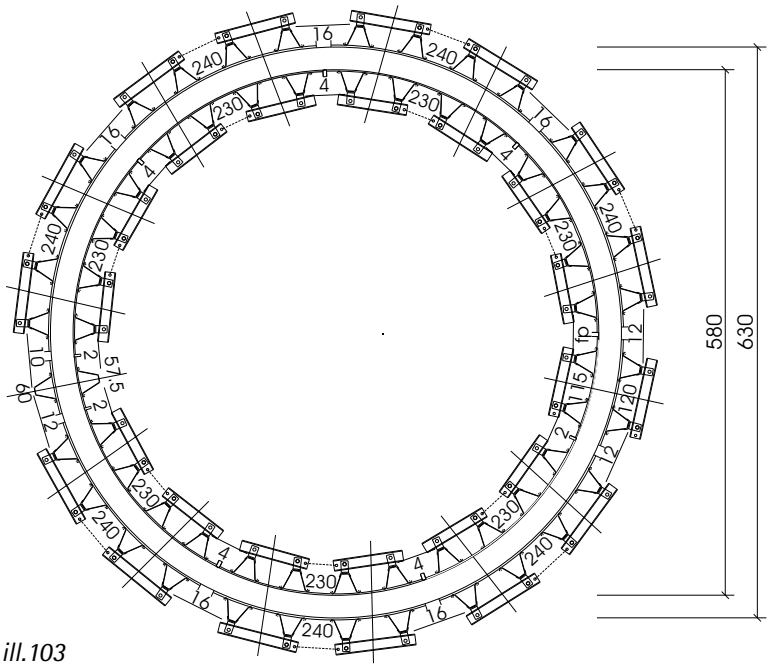
By the calculation of a whole circle you use so much segment as you can. For the rest are compensation necessary.

At first you calculate the circumference and then the number of whole, half and quarter segments.
On the inside formwork a filler plate is necessary.
The difference from circumference and the length of all segments is the length of all compensations.

Compensations are available on all 2cm.

Now you can choose the compensations.
The max. number of compensations is the number of segment joints. For inside formwork there is one joint less, because of the filler plate.
The compensation should be distribute equable, so that the greatest compensation of the inside is on the opposite side of the greatest compensation of the outside.

Calculation of fillers



ill.103

$U_e = 630cm * \pi = 1979.2cm$

$U_i = 580cm * \pi = 1822.1cm$

$$n_{wo} = \frac{1979.2cm}{239.0cm} = 8.3$$

$$n_{wi} = \frac{1822.1cm - 3cm}{231.0cm} = 7.9$$

$n_w = 7$ $\quad$ Min(7.9,8.3) = 7.9 ; Integer(7.9) = 7

$$n_{ho} = \frac{1979.2cm - 7*239cm}{119.5cm} = 2.6$$

$$n_{hi} = \frac{1822.1cm - 3cm - 7*231cm}{115.5cm} = 1.7$$

$n_h = 1$ $\quad$ Min(2.6,1.7) = 1.7 ; Integer(1.7) = 1

$$n_{qo} = \frac{1979.2cm - 7*239cm - 1*119.5cm}{59.75cm} = 3.1$$

$$n_{qi} = \frac{1822.1cm - 3cm - 7*231cm - 1*115.5cm}{57.75cm} = 1.5$$

$n_q = 1$ $\quad$ Min(3.1,1.5) = 1.5 ; Integer(1.5) = 1

$$C_o = \frac{1979.2cm - 7*239cm - 119.5cm - 59.75cm}{7 + 0.5*1 + 0.25*1} = 16.38cm$$

$$C_i = \frac{1822.1cm - 5cm - 7*231cm - 115.5cm - 57.75cm}{7 + 0.5*1 + 0.25*1 - 1} = 3.98cm$$ $\quad$ chose : $l_{fp} = 5cm$

Compensation outside : 1979.2cm - 7*239cm - 119.5cm - 59.75cm = 126.95cm

➡ 5 x 16cm filler piece (between whole segments)
3 x 12cm filler piece (on half and quarter segment)
1 x 10cm filler piece (on quarter segment)
➡ 126cm compensation on 9 segment joints

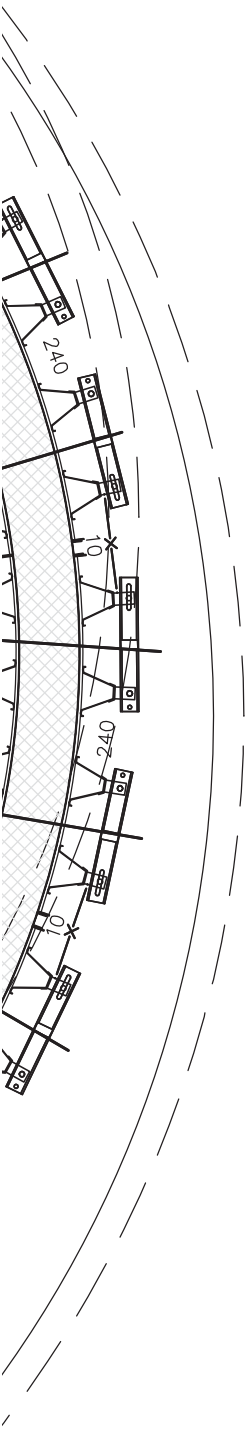
Compensation inside : 1822.1cm - 5cm - 7*231cm - 115.5cm - 57.75cm = 26.85cm

➡ 5 x 4cm plastic filler piece (between whole segments)
3 x 2cm plastic filler piece (PE) (on half and quarter segment)
1 x 5cm filler plate
➡ 26cm compensation on 8 segment joints + filler plate

Subjet to technical modifications !

Art.-No.: 953.002.0077

Status: 23.04.2008



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