

# RONDA

Circular Formwork

Instructions for assembly and use

February 2004



**HÜNNEBECK** 

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## 1.0 Product Features

Hünnebeck's RONDA formwork is a radii-adjustable circular formwork which consists of ready-to-use shuttering elements.

Adjustment of shuttering-radii can be performed on the job-site by means of the integrated turnbuckles. Any desired radius greater than 4.0 metres is possible.

An optimum adaptation to the given structure will be assured through two different widths for the inner elements as well as for the outer ones and also by three element heights (3.0 m, 2.0 m, 1.50 m).

The maximum permissible concrete pressure is 60 kN/m<sup>2</sup>.

The RONDA shuttering element is provided with a ductile high-quality plywood sheet (14 mm thick) which is connected to stiffening trapezoid profiles by means of flat-headed screws. The edges of the plywood sheet are protected by the special vertical edge profiles.

All vertical steel members are connected by means of turn-buckles which can take either tension or compression forces.

The arrangement of the adjusting turnbuckles between the stiffening profiles results in a very low construction height and assures an optimum storage of the shuttering elements.

Fine adjustment of the crane-positioned shuttering elements is made possible through a lever edge at the ends of the stiffened profiles. Crane eyes are integrated in each shuttering element for shifting by crane.

Vertical joints of elements are closed by means of element clamps. They can be attached at any height of the edge profiles and because of their adjustable clamping widths, it is possible to use them even for infill sections of up to approx. 15 cm in the element joint.

Horizontal element joints between height-extended RONDA elements are connected by the proven MANTO aligning panel clamps which are positioned on the trapezoid profiles and assure a tight connection due to the special design of the end sections.

Tying of RONDA circular formwork can be executed either directly through the stiffening trapezoid profiles or by using additional tie walers which reduce the number of wall ties by about 50 %.

Walkway brackets and aligning props for the different shuttering heights round off the RONDA formwork system.

All steel parts are hot-dip galvanized and, therefore, require low maintenance but guarantee a long duration of life.

## Important notes

The following instructions for assembly and use include detailed information on the handling and proper application of the products that are described and depicted. All instructions regarding technical operation and function have to be observed carefully. Exceptional use requires a separate design calculation.

With regard to safe and technically correct use of our products abroad, all relevant safety rules, regulations and safety instructions of national institutes and/or local authorities have to be followed.

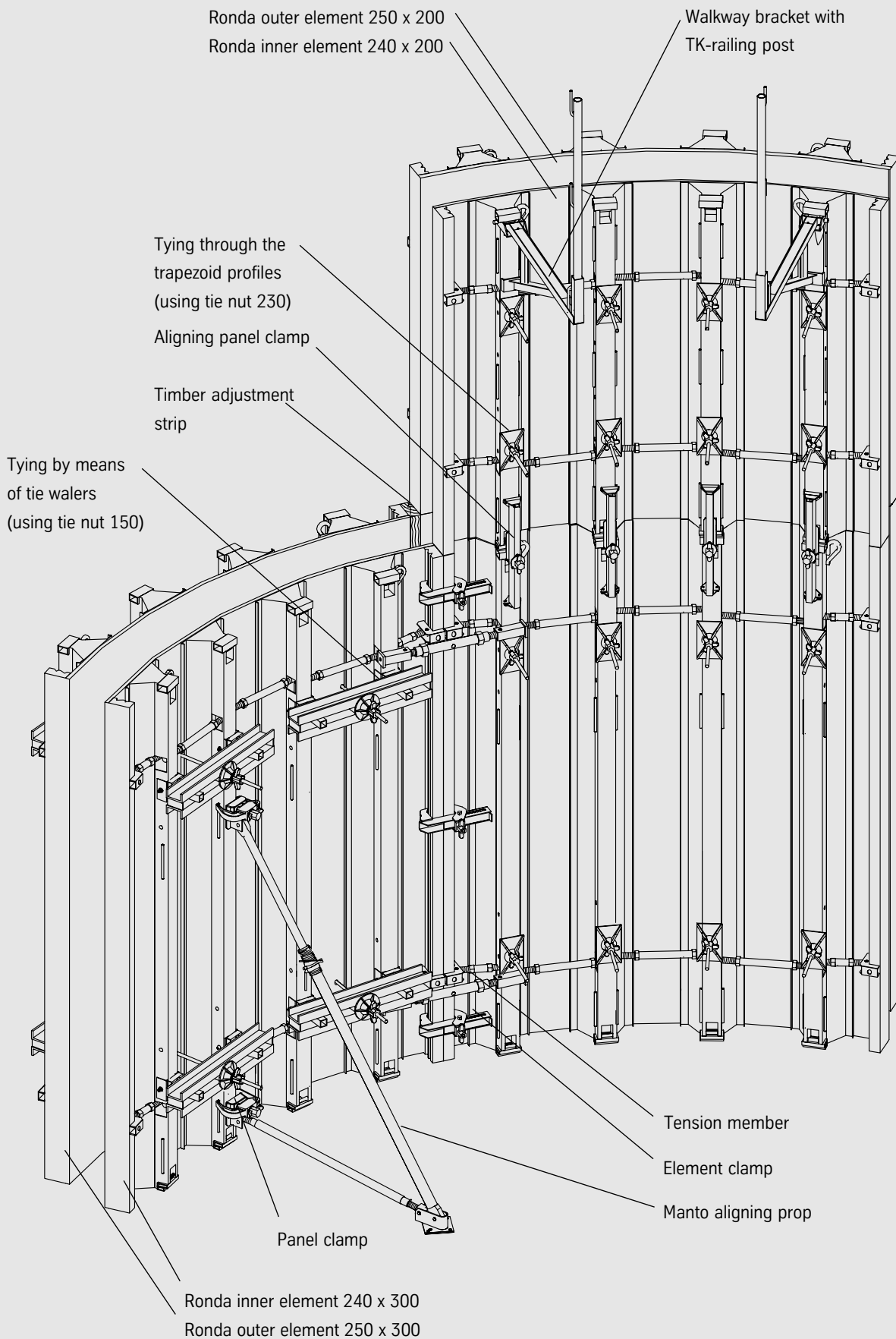
Generally, only flawless material must be used.

Damaged components have to be sorted out. In case of repairs, only original spare parts of the Hünnebeck Company may be used.

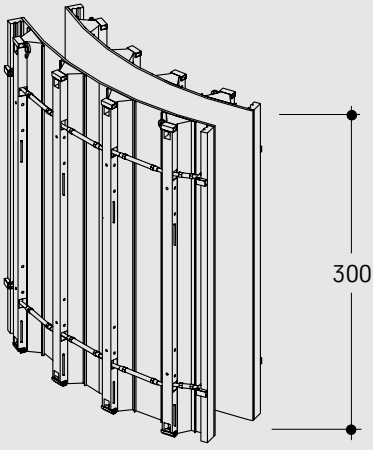
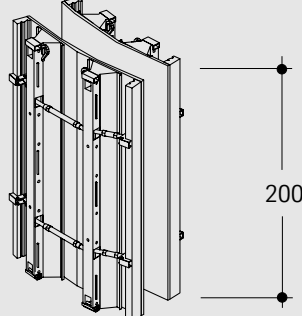
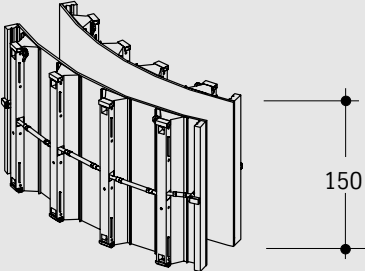
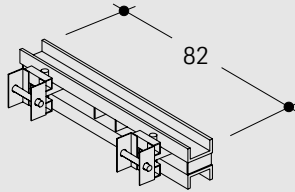
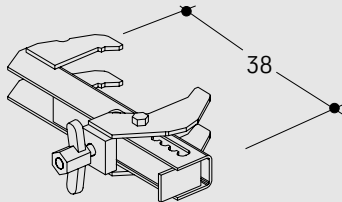
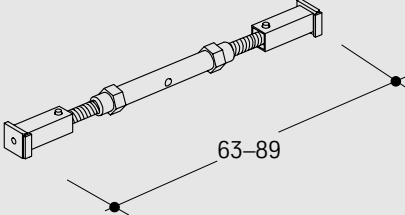
Combined use of our formwork system with equipment from other suppliers may involve certain dangers and, therefore, requires an additional checkup.

For reasons of further technical development we emphatically reserve the right to revise, change or modify any of the product's components at any time without prior notice.

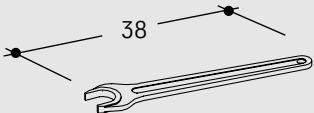
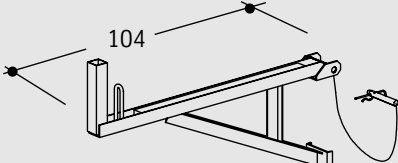
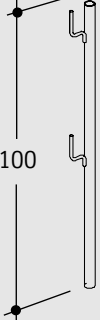
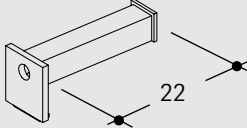
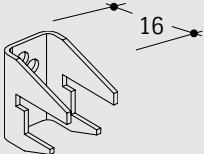
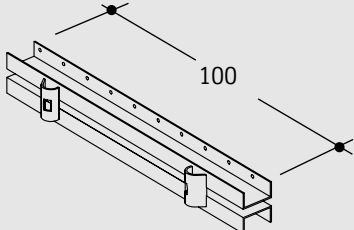
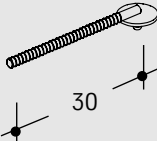

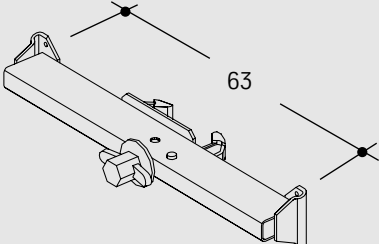
## 2.0 General survey



# 3.0 Components

	Description	Art. No.	Weight kg/item
	<b>Outer element 250 x 300</b>	529 600	367.2
	<b>Outer element 128 x 300</b>	529 610	213.8
	<b>Inner element 240 x 300</b>	529 621	362.7
	<b>Inner element 123 x 300</b>	529 632	211.5
	<b>Outer element 250 x 200</b>	529 643	264.2
	<b>Outer element 128 x 200</b>	529 654	153.2
	<b>Inner element 240 x 200</b>	529 665	260.6
	<b>Inner element 123 x 200</b>	529 676	150.9
	<b>Outer element 250 x 150</b>	529 687	190.9
	<b>Outer element 128 x 150</b>	529 698	111.2
	<b>Inner element 240 x 150</b>	529 702	188.6
	<b>Inner element 123 x 150</b>	529 713	110.1
<p>The 14 mm thick shuttering skin is supported by hot-dip galvanized stiffening profiles. The required radius has to be adjusted via the integrated turnbuckles (designed for tension and compression loads). Every formwork element is provided with crane eyes for transport by crane. All elements are equipped with a lever edge for fine adjustment on the ground.</p>			
	<b>Tie waler</b>	524 949	24.2
<p>Distributes the tie load onto 2 neighbouring trapezoid profiles. Connecting bolts with spring cotters are attached and cannot be lost.</p>			
	<b>Element clamp</b>	526 000	5.2
<p>Used for the connection of elements. Can also be applied with timber infill up to 15 cm.</p>			
	<b>Tension member</b>	548 387	7.2
<p>Used for overlapping the panel joint of the inner formwork when exceeding radii of more than 10.0 m. The tension member has to be installed on the trapezoid profiles at the level of the turnbuckles.</p>			

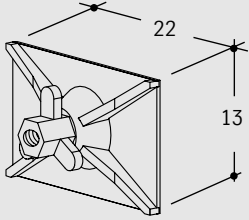
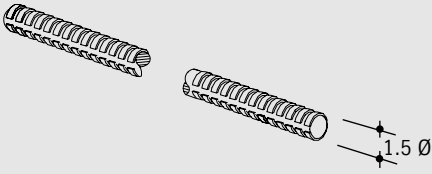
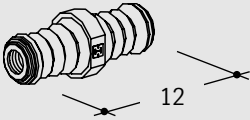

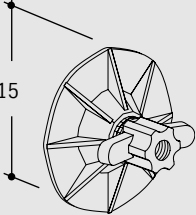
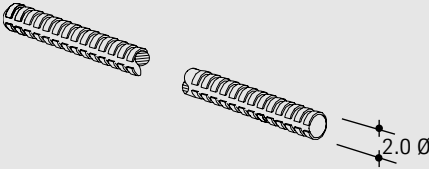
## 3.0 Components

	Description	Art. No.	Weight kg/item
	<p><b>Single-headed spanner (w.a.f. 46)</b> Facilitates the operation of turnbuckles.</p>	542 460	0.8
	<p><b>Walkway bracket</b> To be attached to the trapezoid profile and secured by means of the integrated bolt.</p>	524 950	13.1
	<p><b>TK-railing post</b> Inserted into the walkway bracket, it serves as support for railing boards. (provided by site).</p>	193 220	4.5
	<p><b>Head tie-bearing</b> Serves as guiding device when placing a tie rod directly above the shuttering element. (Permissible load <math>F = 12 \text{ kN}</math>). (DW 15)</p>	526 547	1.4
	<p><b>Edge tie fastener MR</b> Used for module-independent tying in the region of the stopend (tie rods DW15). Perm. load = 10.0 kN</p>	566 667	2.3
	<p><b>Manto multi-purpose waler</b> Used for stopends. Fastened to the elements by means of each 2 waler spanners and tension nuts.</p>	450 764	13.1
	<p><b>Waler spanner</b> Required for fastening the Manto MP waler. (To be provided 2 times per waler).</p>	452 053	0.7
	<p><b>Tension nut</b> To be provided 1 time per waler spanner. Perm. load = 40.0 kN</p>	197 332	0.6
	<p><b>Aligning panel clamp</b> Connects height-extended shuttering elements. Arrangement at each stiffening trapezoid profile to be required.</p>	448 000	5.5

## 3.0 Components

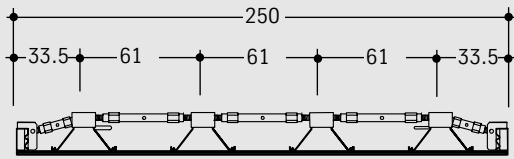
	Description	Art. No.	Weight kg/item
	<p><b>Manto aligning prop</b></p> <p>Used for aligning and supporting the formwork. Applicable to shuttering heights of up to 4.5 m at a horizontal spacing of maximum 2.5 metres. The aligning prop has to be connected to the backside of the trapezoid profiles by means of 2 panel clamps.</p> <p>Perm load: 8 kN at maximum extension.</p>	453 070	25.6
	<p><b>M-prop adapter</b></p> <p><b>Strut base joint</b></p> <p>Standard tubular steel props can be applied to from inclined props by using these parts. Each steel prop connection requires 4 bolts M12x30 with nut at the top plate and base plate. Counter nuts have to be provided additionally to make the props tensile-proof.</p> <p>M-prop adapter is attached to the Ronda elements by means of a panel clamp.</p> <p><b>To be provided additionally:</b> Steel prop (required size)</p>	453 080 566 369	3.2 7.7
	<p><b>Counter nut A/DB 260/300</b> (for Europlus props 260 and 300)</p>	107 107	0.9
	<p><b>Counter nut AS/DB 350/410</b> (for AS-props and Europlus 350 and 410)</p>	107 118	1.0
	<p><b>Counter nut 350 EC/450 DB</b> (for Europlus props 350 EC and 450 DB)</p>	562 051	1.5
	<p><b>Bolt and nut M12 x 30</b> (8 pcs. required)</p>	005 210	0.1
	<p><b>Ronda / BKS Connector</b></p> <p>Used for making the connection of BKS- props or similar heavy props possible when bracing greater shuttering heights.</p> <p>To be provided for the connection of the prop (in addition): 2 panel clamps 1 hexagon bolt M20 x 80 with nut</p>	533 138	3.1
	<p><b>Panel clamp</b></p> <p>For the connection of all aligning props to the Ronda formwork.</p>	489 801	0.4
		448 010	3.0

# 3.0 Components

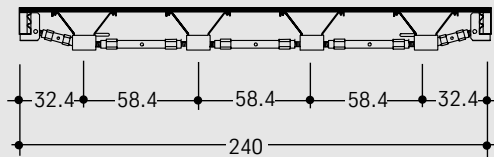
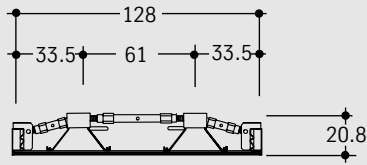
Description	Art. No.	Weight kg/item
	<p><b>Tie nut 230</b></p> <p>Has to be used when tying directly through the trapezoid profiles because of its large supporting area.</p>	<p>048 344</p> <p>2.4</p>
	<p><b>Tie rod 100</b></p> <p><b>Tie rod 130</b></p> <p>Permissible load acc. to DIN 18216, Loading Class 90-DIN (not weldable).</p>	<p>024 387</p> <p>020 481</p> <p>1.4</p> <p>1.9</p>
	<p><b>Water stop 15</b></p> <p>Used for watertight concrete (D+W 15). Lost material.</p>	<p>164 400</p> <p>0.6</p>
	<p><b>1 Packet of plugs 24-27K</b></p> <p>For sealing the tie holes in the shuttering skin after use. 100 pcs./ packet.</p>	<p>581 483</p> <p>0.4</p>
	<p><b>Tie nut 150 / D+W 20</b></p> <p>To be required when using tie walers because of the higher bearing loads due to the double distance of the tie rods.</p>	<p>531 481</p> <p>1.5</p>
	<p><b>Tie rod 100 / D+W 20</b></p> <p><b>Tie rod 130 / D+W 20</b></p> <p>Permissible load acc. to DIN 18216, Loading Class 150-DIN (not weldable).</p>	<p>531 600</p> <p>531 610</p> <p>2.6</p> <p>3.3</p>

# 4.0 Measures of elements

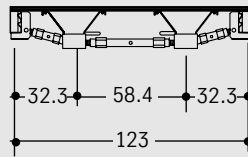
**Outer element 250**



**Outer element 128**



ill. 2

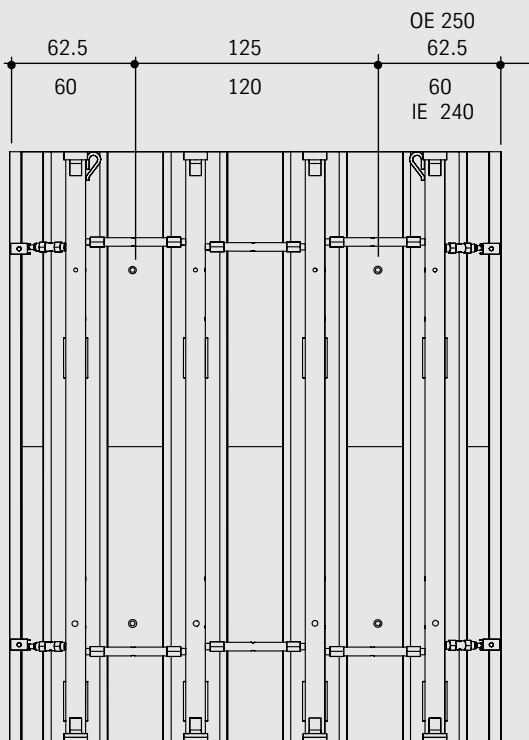


ill. 3

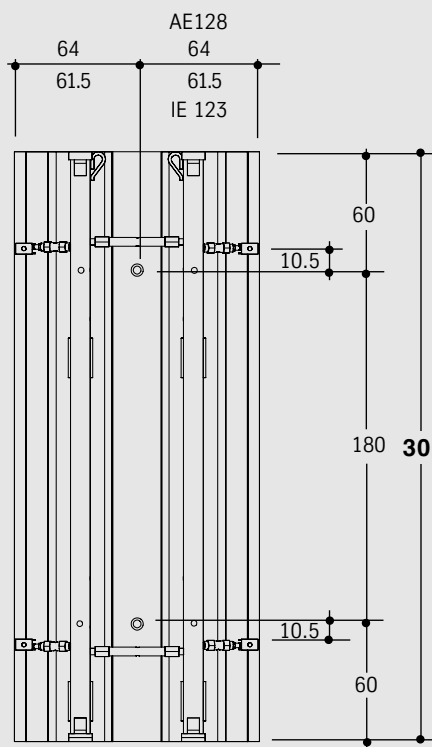
**Inner element 240**

**Inner element 123**

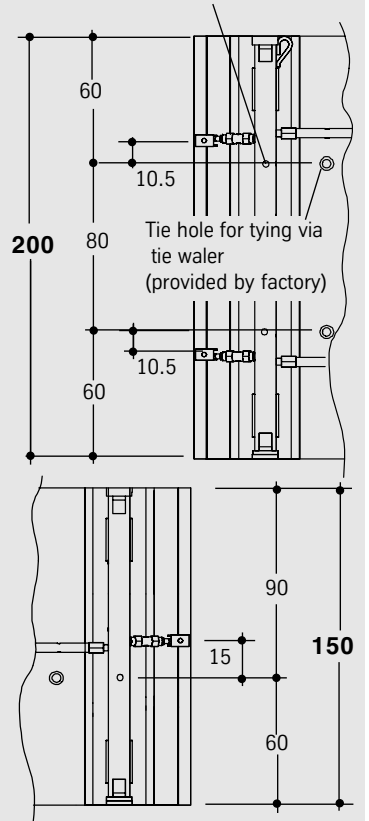
Drill-hole only in the trapezoid profile (for tying purposes, the shuttering skin has to be drilled additionally).



ill. 4



ill. 5

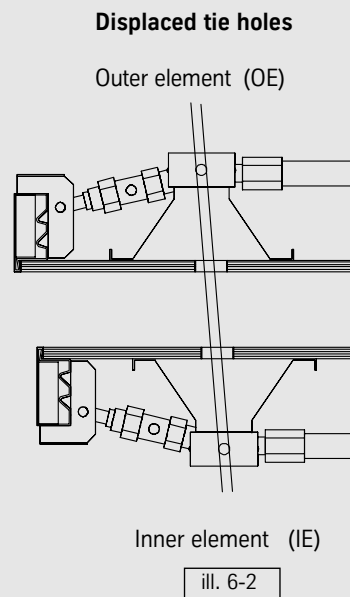
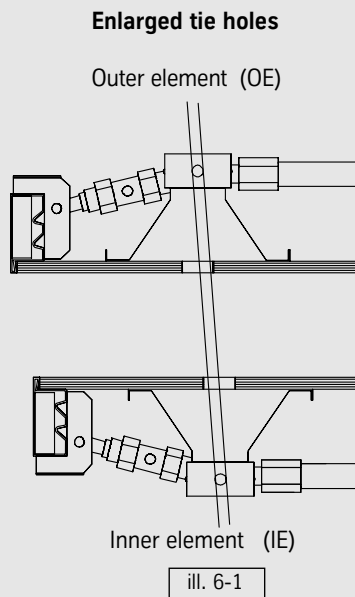


ill. 6



## Drill-hole in the plywood

(required for profile tying)



### Concerning displacement of tie-holes shown in the table (at bottom):

- (-) = at (IE): tie-hole displaced to edge profile
- = at (OE): tie-hole displaced to centre of panel (see also ill. 6-2).
  
- (+)= at (IE): tie-hole displaced to centre of panel
- = at (OE): tie-hole displaced to edge profile

All Ronda shuttering elements are already equipped with tie holes in the shuttering skin for "tying through tie walers" (see also page 14). If it is necessary to arrange tie rods in the stiffening trapezoid profiles to get a narrower spacing, then the holes will have to be drilled additionally by site. The predrilled holes in the steel profiles define the position of the tie holes for tying. Required drill size: 24 mm dia. All other tie holes must be covered by means of Manto plugs K for this application.

- Drill-hole **35** dia. with normal plastic tie sleeve and cone **46** dia.
- Drill-hole **40** dia. with fiber concrete sleeve **60** dia.
- Drill-holes in displaced position (mm): **35** dia. with normal plastic tie sleeve and cone **46** dia. on outer trapezoid profiles and drill-hole **40** dia. with fiber concrete sleeve **60** dia. on inner trapezoid profiles.

**Table**                      **Wall thickness [m]**

<b>Radius [m]</b>	≥ 0.1	≥ 0.2	≥ 0.3	≥ 0.35	≥ 0.4	≥ 0.5
≥ 35.0	- 15					
≥ 30.0	- 15					
≥ 25.0	- 14					
≥ 20.0	- 13					
≥ 15.0	- 12					
≥ 10.0	- 12					
≥ 8.0	- 10					
≥ 6.0						
≥ 4.0				+ 10	+ 12	+ 15

### Preparations for work

All Ronda elements are delivered to the job-site as straight elements. These elements can be placed onto two assembling trestles by crane for the adjustment of radii.

The assembling trestles must be stable and strong enough to bear the loads from the elements.

The supporting main bearers of the trestles should be arranged parallel with the trapezoid profiles of the shuttering elements (as shown right).

The main bearers of the trestles must be shorter than the height of the element to be adjusted.

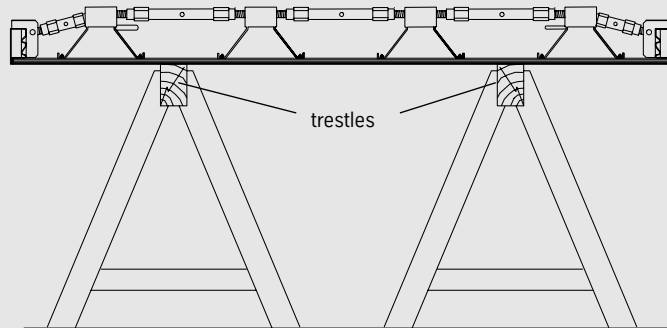
That means it will be possible to check the adjustment procedure constantly by means of radius-shaped templates.

The adjustment of radii should always be carried out by 2 persons who will then be able to operate the turnbuckles in both rows at the same time. There are 2 possibilities of adjusting the turnbuckles:

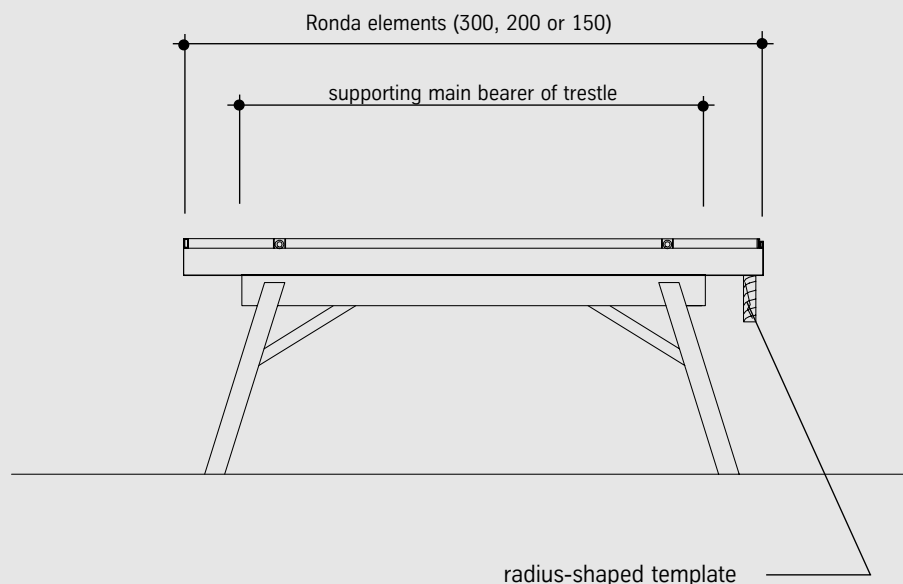
1. Using the single-headed spanner (w.a.f.46)
2. Using a round bar or a short tie rod (18 mm dia.)

Exactly fabricated radius-shaped templates (longer than 2.5 metres, made from plywood) have to be provided by site for checking the precise adjustment of elements. The inner and outer elements require different templates.

ill. 7-1



ill. 7-2



### Adjusting procedure

At first, all turnbuckles have to be screwed up to tight fitting without clearance.

Afterwards, the curvature has to be adjusted step by step.

The turnbuckles should be operated accordingly to the numbered working steps given in the illustrations 7-3 and 7-4.

At every working step the intermediate turnbuckles should be turned by half rotations and the two outer turnbuckles only by quarter-turns. Both rows of turnbuckles must be screwed simultaneously.

This working procedure has to be repeated until the curvature has the correct shape of the template. Between the different steps, the actual curve should always be controlled. (Checking on the plywood side).

The adjusted ready-to-use Ronda element will then be lifted from the trestles by crane and shifted to the place of use or another place for intermediate storage.

Every Ronda element is equipped with 2 crane eyes for this procedure.

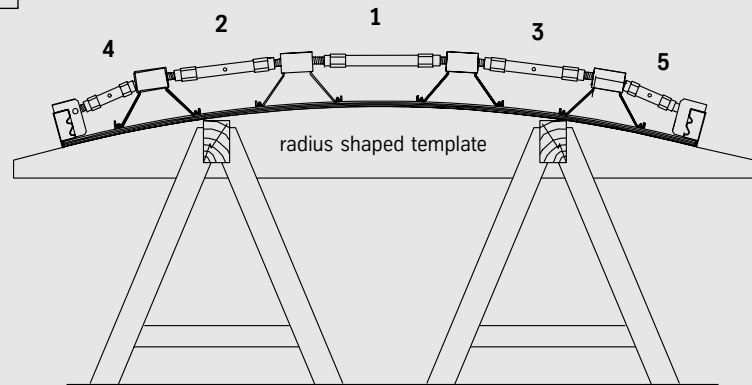
### Adjustment of upright elements

Generally, all Ronda elements can also be adjusted to the relevant radii in standing (upright) position.

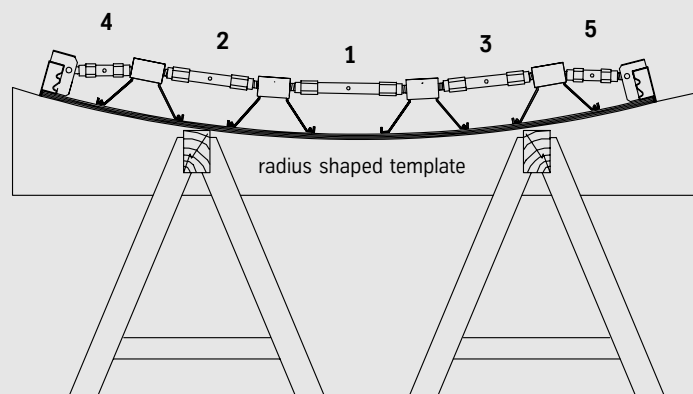
The adjusting procedure is the same as described before.

But, in this case for safety reasons, it is very important to brace the standing elements by inclined props or other types of struts to avoid tilting at working procedure.

ill. 7-3



ill. 7-4



The Ronda elements are connected at the vertical joint by means of element clamps. These clamps can be positioned at any desired height on the edge profiles.

As a rule, one element clamp has to be arranged per linear metre of vertical joint (e. g. 5 clamps at a formwork height of 4.5m).

The element clamp connects elements without or with timber adjustment strip.

The adjustment range of the element clamp allows timber adjustments of up to 15 cm. For tightening or releasing the clamp, it is recommended to use the Manto-ratchet (Art.no.408780), size w.a.f.36.

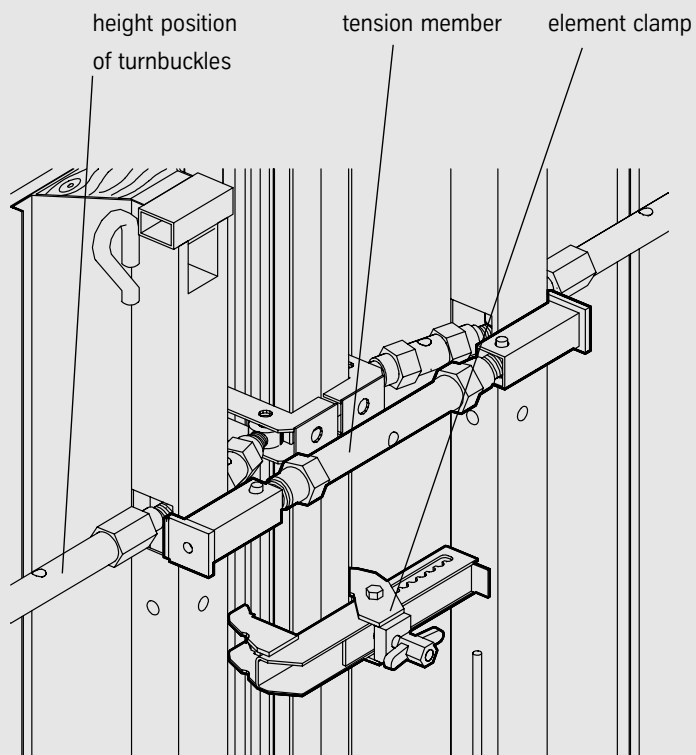
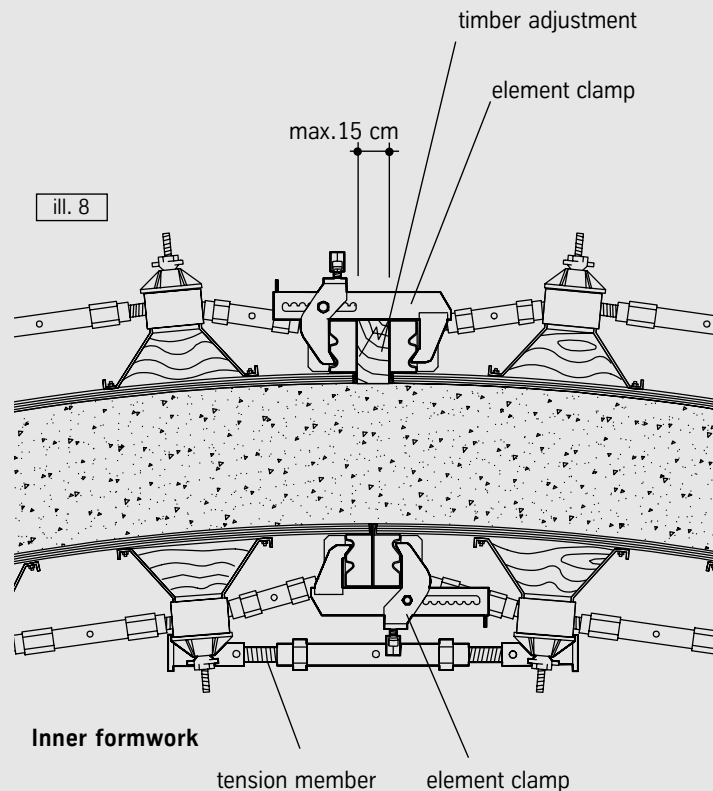
By using this ratchet, all tie nuts can be operated comfortably, too. And, in addition to that, the use of the ratchet goes gently on the material in contrast with operations by means of a hammer

The element joints of the inner formwork have to be provided with tension members at the levels of the turnbuckles in case of radii greater than 10 metres.

The crooked ends of this component are inserted into the openings of the trapezoid profiles. Then, the threaded spindle has to be turned as far as to get a tight seat and that the tension member will not have any clearance.

**A strong tightening of the tension member is not necessary.**

Outer formwork with timber adjustment



ill. 9

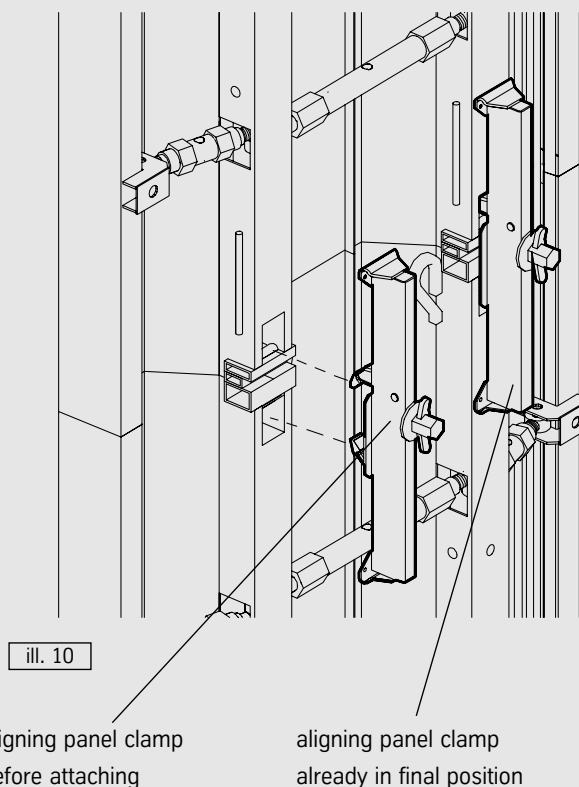
## 7.0 Height extension and adjustment

Three different element heights (1.5 m, 2.0 m, 3.0 m) of the Ronda circular formwork are available for the adaptation to the required height of the concrete structure. The Ronda elements can be combined in steps of 50 cm. Only elements with the same widths can be placed on top of one another.

The one-piece Manto aligning panel clamp is used for the connection of elements at the horizontal element joints.

Generally, one aligning panel clamp has to be positioned on every trapezoid profile as shown in the illustrations.

The claws of the aligning panel clamp mesh with the reinforced ends of the trapezoid profiles. There are special openings in the backside of each profile for this connection. The extended Ronda elements will get a perfect alignment and be tension-proof by tightening the wing nut with the help of a Manto-ratchet or a hammer.



**600** [cm]

**550**

**500**

**450**

**400**

**350**

**300**

**200**

**150**

head tie-bearing

ill. 11

\*= aligning panel clamp

It is possible to choose between 2 tying variants when using the Ronda circular formwork.

You can either use the tie walers or the holes in the trapezoid profiles.

By using tie walers with Ronda elements, you will be able to save every second wall tie. This means a saving of about 50 per cent.

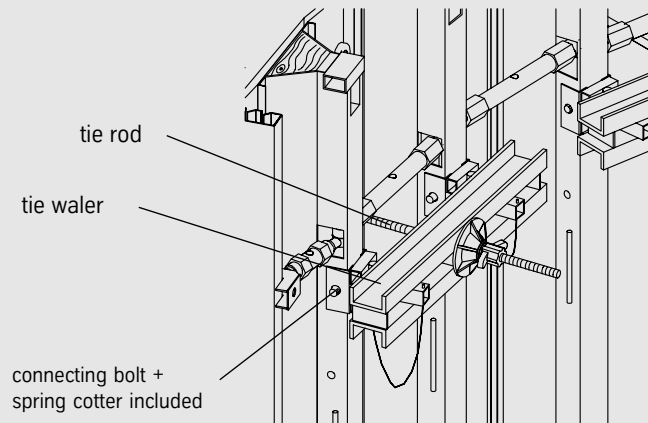
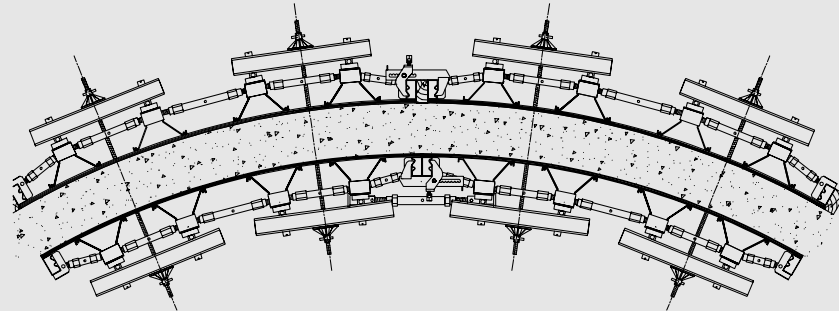
That is why the Ronda elements are already equipped with these relevant tie holes for economical reasons.

But, in this case, the application of 20 mm thick tie rods is absolutely necessary when assuming a concrete pressure of more than 50 kN/m<sup>2</sup> because of the large influence area per wall tie.

The tie waler is attached to 2 trapezoid profiles at the level of the tie holes and connected by means of the integrated bolts which have to be secured with the spring cotters. The tie waler rests on swivelling support plates which belong to this component.

## Tying with tie walers

ill. 12



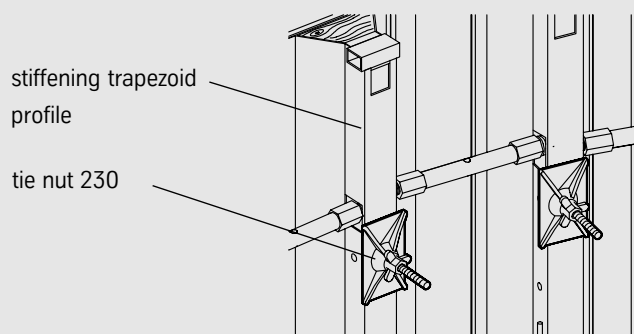
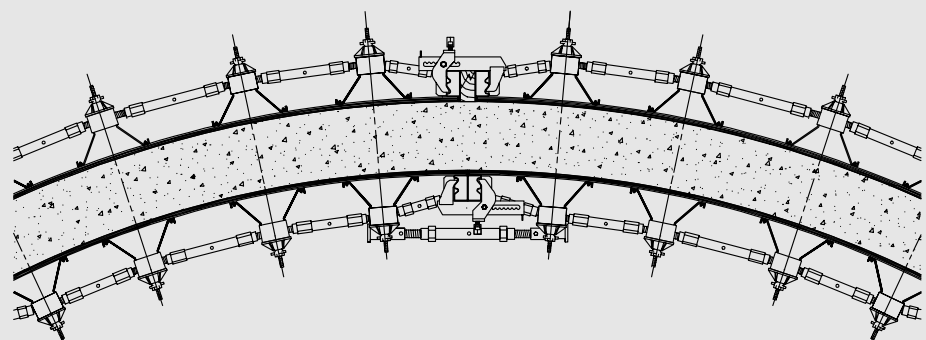
ill 12-1

With this tying variant the wall ties are directly positioned in the middle of the trapezoid profiles.

That means tying of each trapezoid profile inside and outside is necessary. All trapezoid profiles are already provided with tie holes, but the plywood sheet has to be drilled additionally, on site (tie holes 24 mm in dia.).

## Tying without tie walers

ill 13



ill 13-1

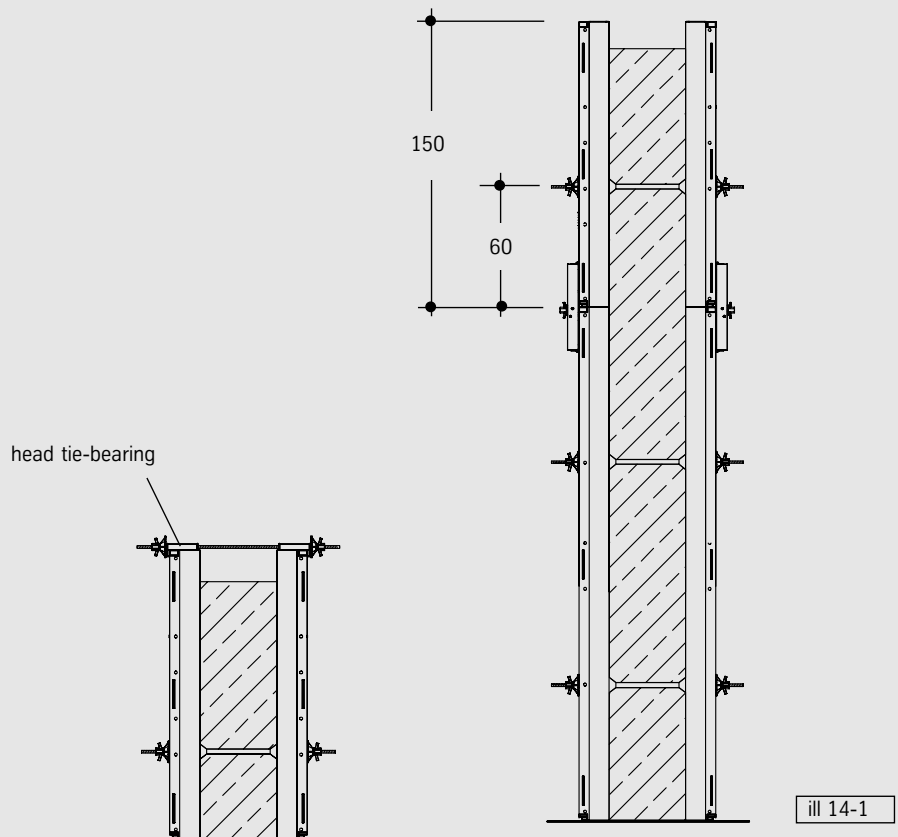
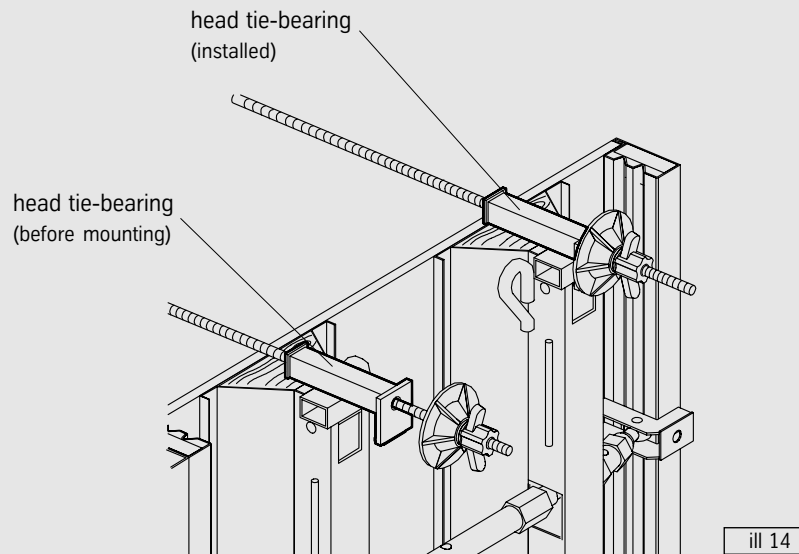
When tying is executed directly through the trapezoid profiles, the large tie nut 230 has to be used.

The positions of the tie rods are already defined by the factory-made holes in the plywood or in the trapezoid profiles. But it is possible to displace the top tying spot by means of the head tie-bearing.

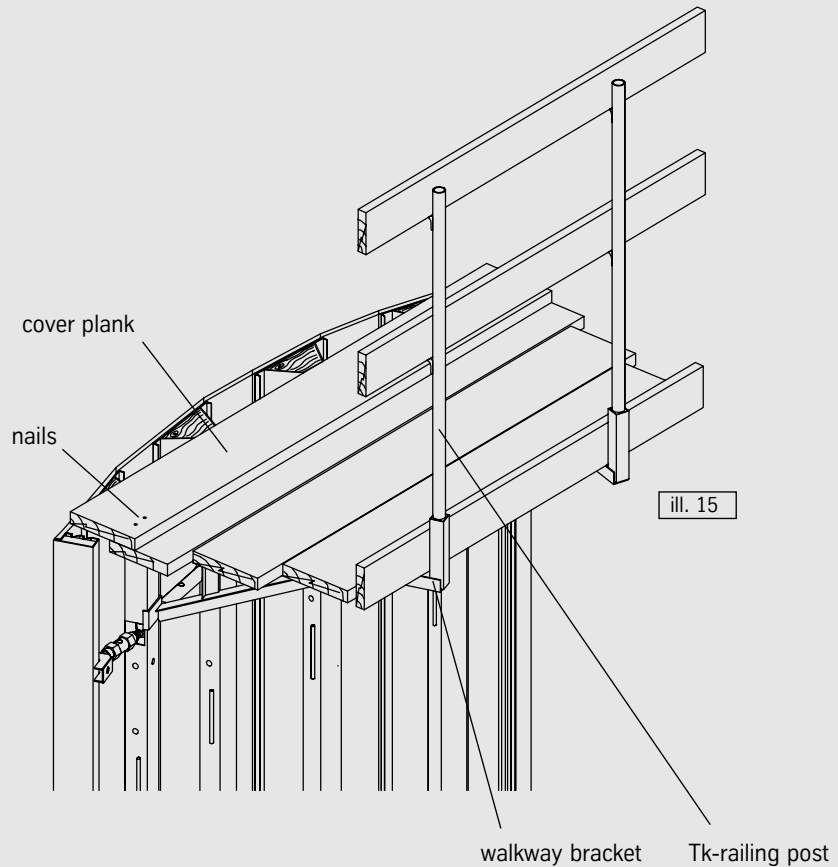
\*= The 1.50 m high elements have always to be applied with the head tie-bearing at top (ill 14).

In case of height extension through 1.50 m high Ronda elements, the upper tie rod (head tie-bearing) can be left out with this element (ill 14-1).

## Use of head tie-bearings



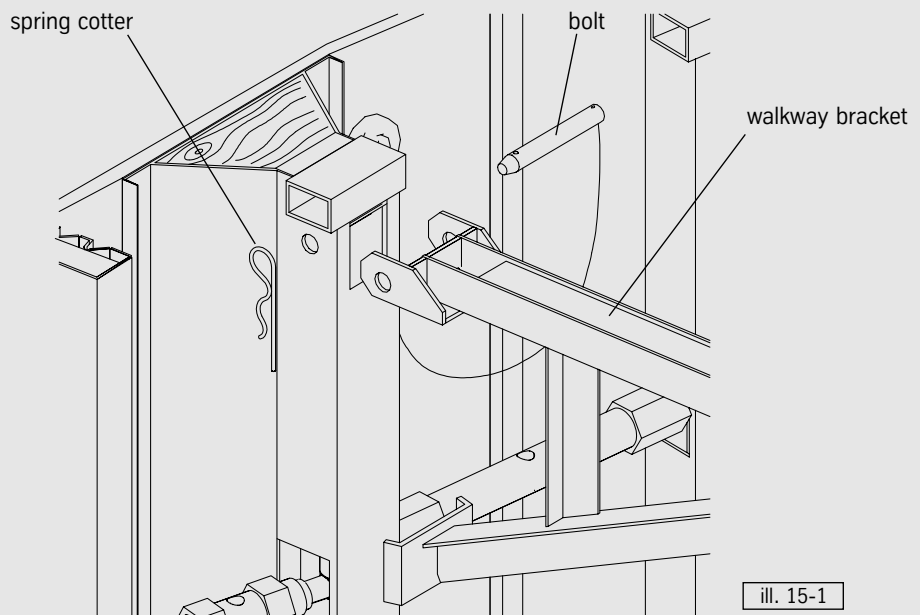
Normally, the walkway platform is arranged on the formwork elements inside. The connection of the walkway bracket is achieved by using the upper connection hole of the trapezoid profile and by fastening the suspension claw of the bracket with the integrated bolt and spring cotter.



The maximum distance between the walkway brackets should not be more than 2.0 m. After inserting the railing posts, the walkway brackets must immediately be covered with planks and provided with the three-part railing. Planks and railing components have to be supplied by site and must be executed in accordance with local regulations and safety rules. The gap between the inner elements of the Ronda formwork and the platform planking has to be covered by means of a cover plank.

The cover plank should be secured by nails. It protects the Ronda element against dirt and slurry from concrete.

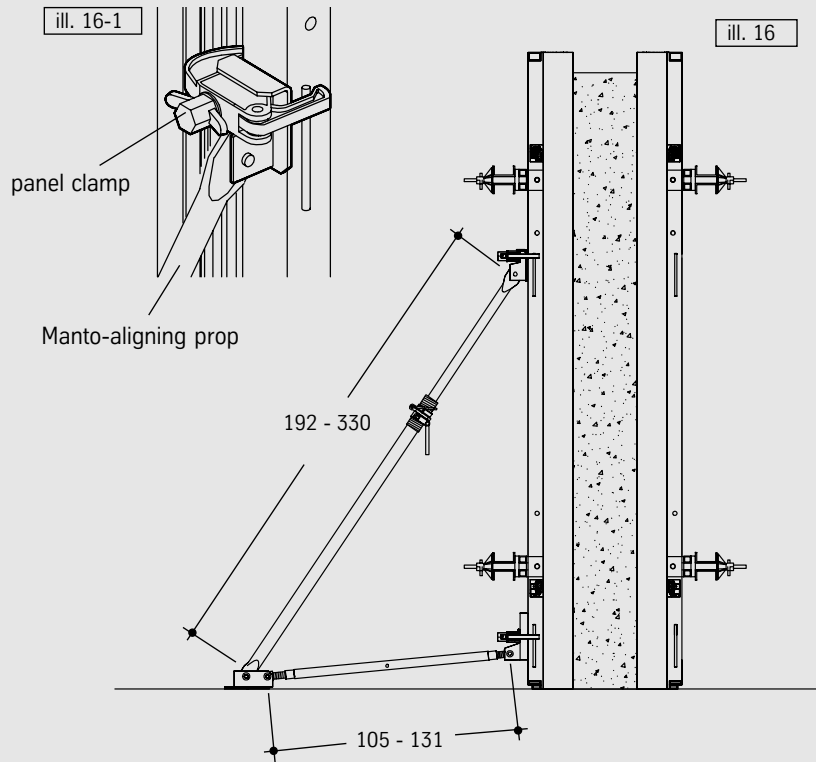
The permissible load of the walkway platform is **1.50 kN/m<sup>2</sup>**.



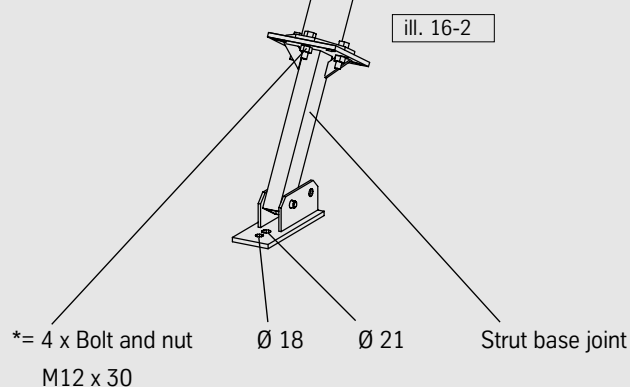
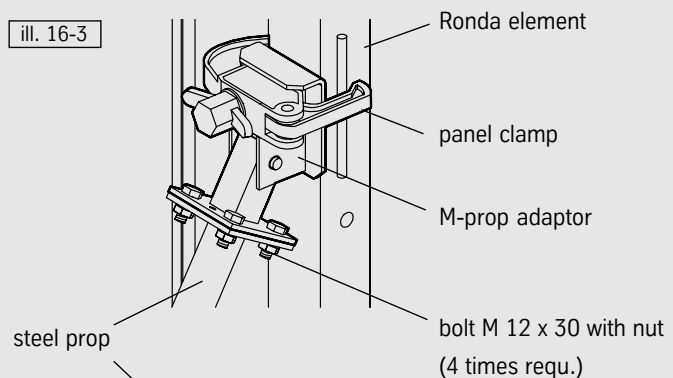


# 10.0 Aligning props

The Ronda circular elements can be braced and aligned by means of Manto aligning props up to heights of approx. 4.0 m. The aligning props can either be fastened each with 2 panel clamps to the trapezoid profiles or at the element joint (without timber infill).



Bracing and aligning of higher Ronda elements ( $H > 4.0$  m) should be executed by means of standard tubular steel props. The steel props have to be provided with an additional counter nut which allows the props to take tension and compression loads. The M-prop adaptor and the panel clamp are required for the connection of each steel prop to the Ronda formwork. At the base of the steel props the strut base joint is needed for fixing the braced elements. 4 bolts M12 x 30 are required for each head plate and base plate of the steel props, additionally.



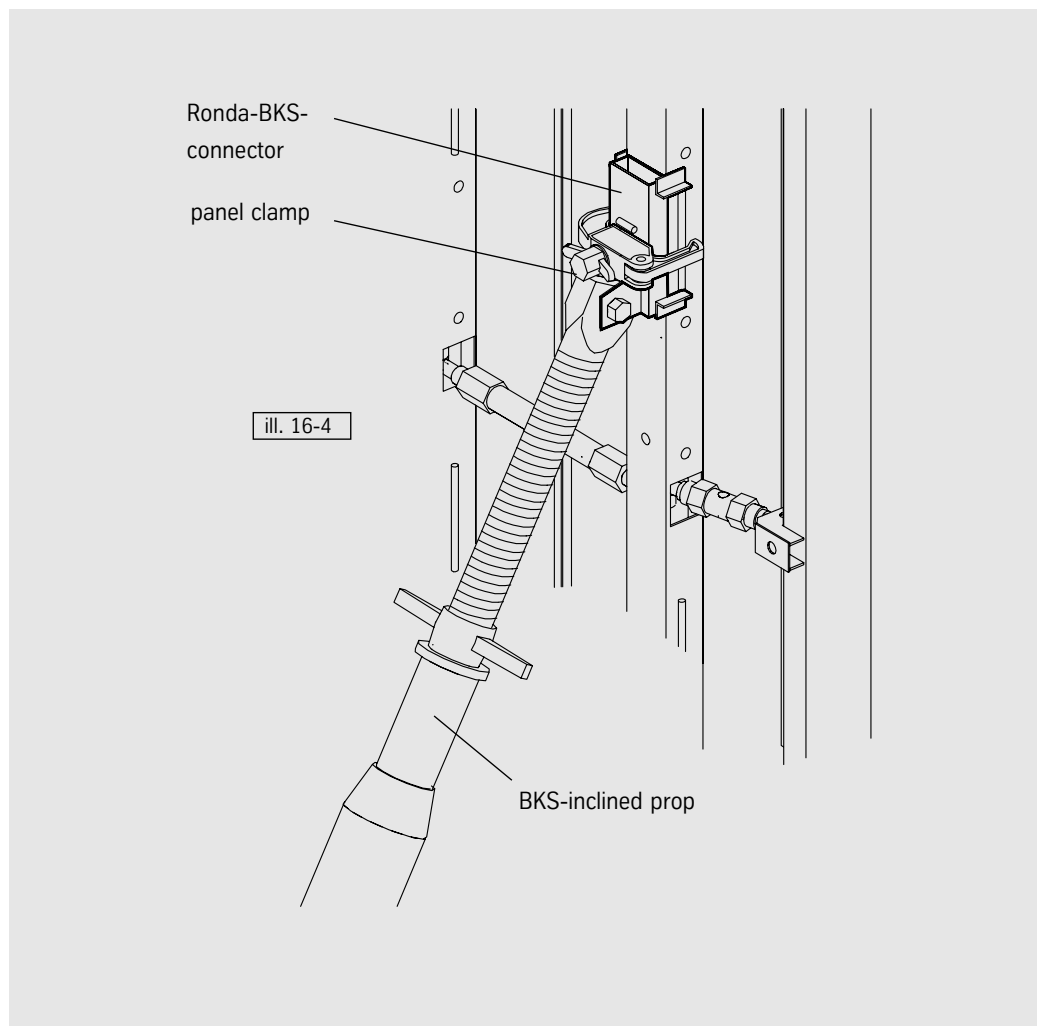
The permissible tension load of the steel props (with counter nut) is **15 kN**. Compression loads acc. to load table.

## 10.0 Aligning props

BKS-props can be combined up to maximum lengths of approx. 12.0 m.

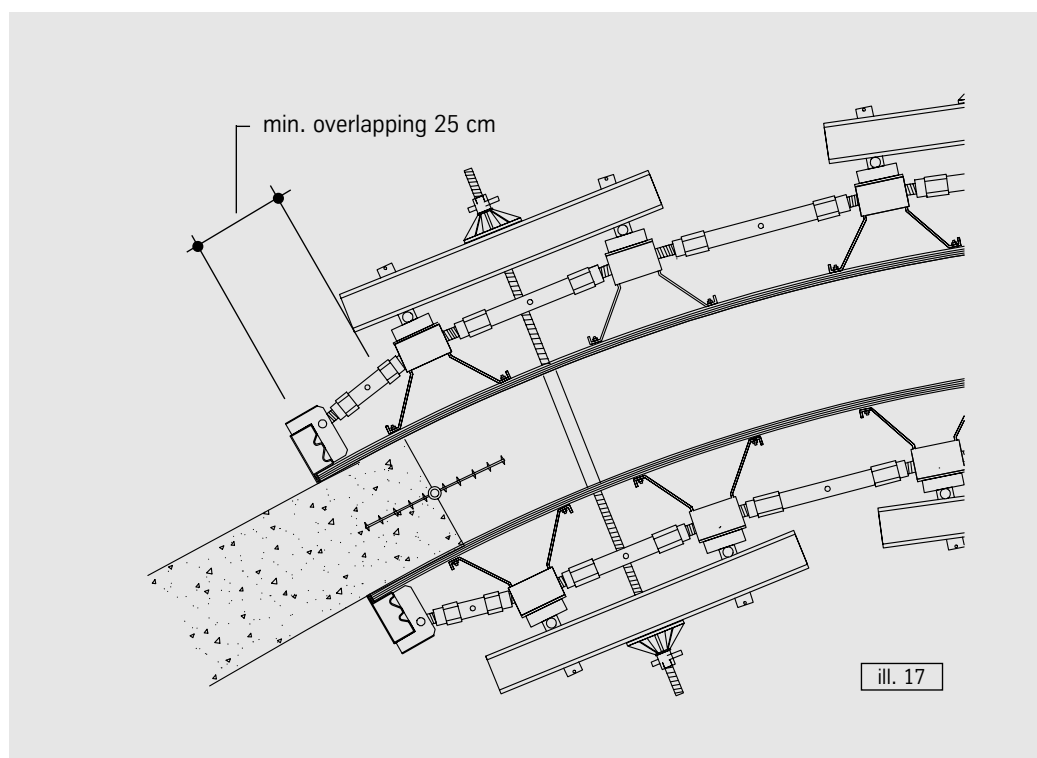
12.0 m.

Further information can be taken from the erection instructions of the Manto formwork.



## 11.0 Wall connection

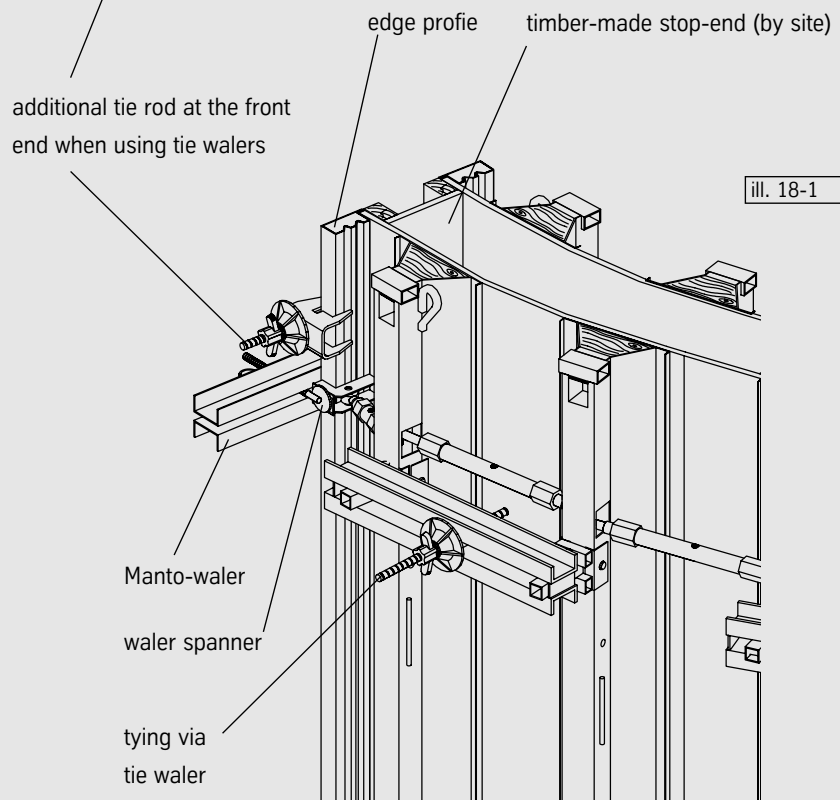
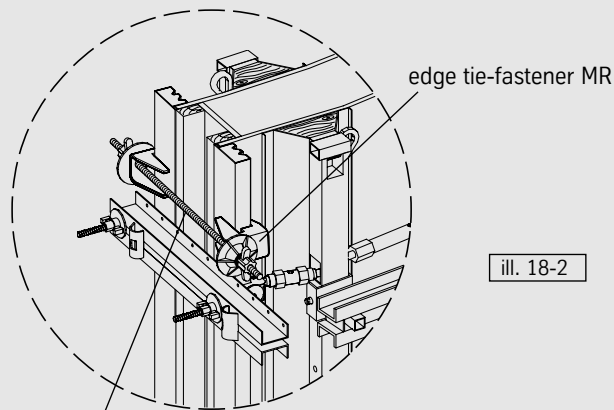
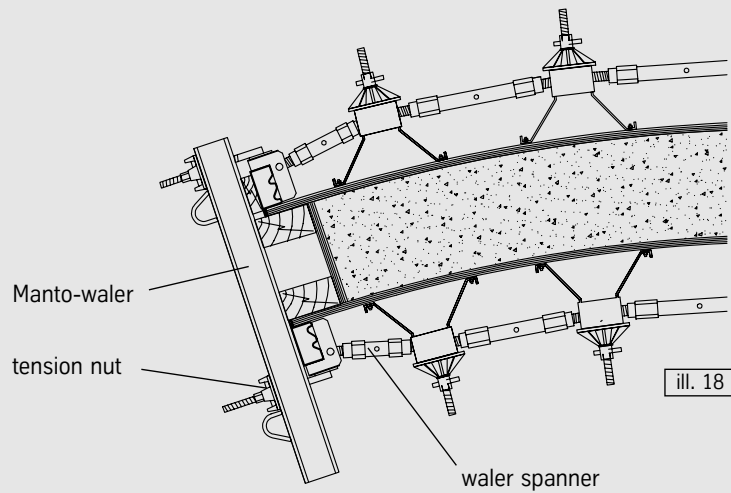
When connecting Ronda elements to an existing wall, the elements must overlap by at least 25 cm.



# 12.0 Stopend

Loads resulting from the stopend design will be transferred via cross walers (e. g. Manto-waler) and waler spanners into the Ronda elements. The waler is connected by means of 2 waler spanners and 2 tension nuts and has to be installed at the level of the turn-buckles.

When applying Ronda elements according to the method "tying with tie waler", then additional tie rods will have to be arranged at the front end of formwork. These additional tie rods have to be installed by means of edge tie-bearings at the heights of the stopend walers.



All Ronda elements are equipped with 2 crane eye-bolts which are welded to the steel profiles. The eye-bolts allow attachment of crane ropes for lifting and shifting of individual elements or combined units.

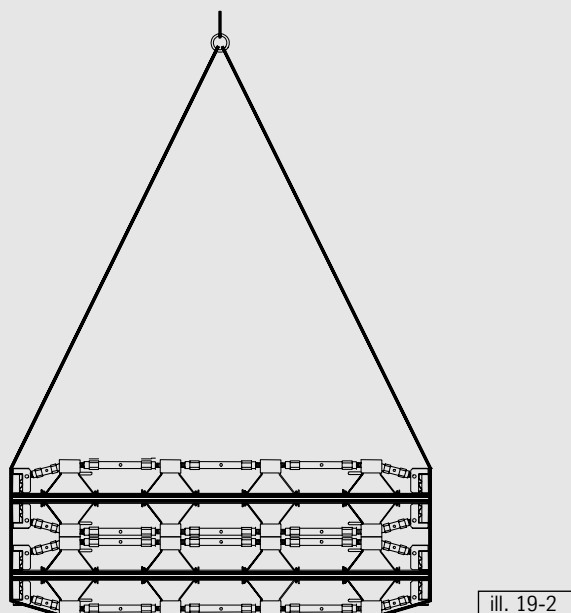
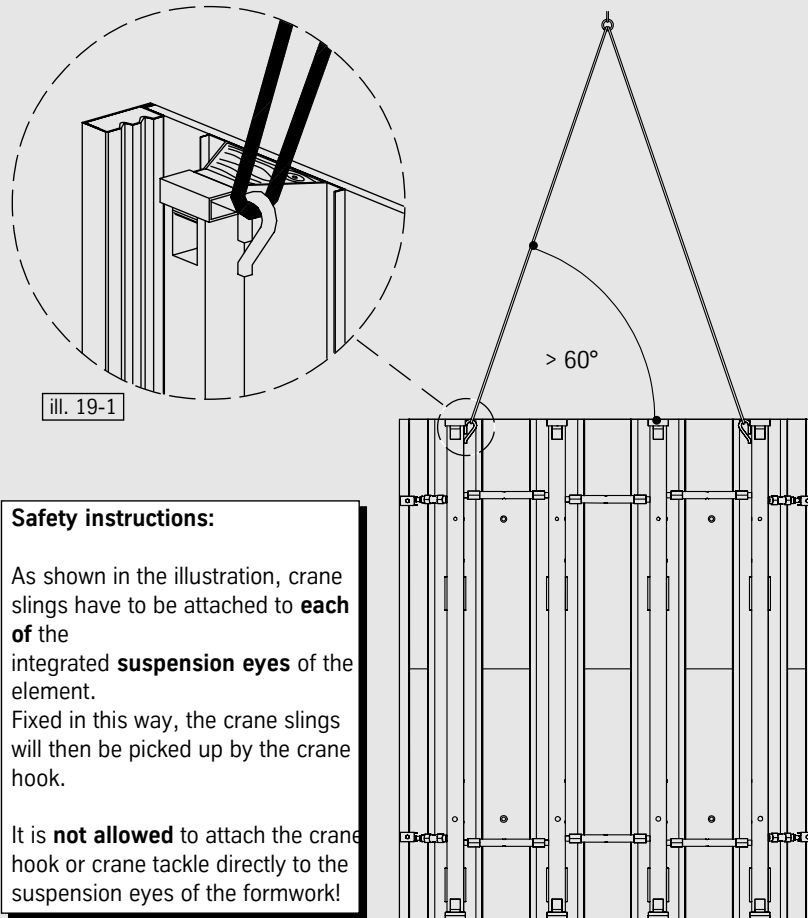
The maximum weight of one combined unit for shifting is limited to 1,000 kgs (=10.0 kN).

This permissible load is equal to approx. 20 m<sup>2</sup> of Ronda formwork. The lengths of the crane ropes have to be chosen so, that no high horizontal forces will be caused (angle of ropes > 60°).

When transporting elements of the Ronda formwork in bundles (e. g. 2,3, or 4 individual elements), then the crane ropes will have to be attached in rectangular position regarding the stiffening trapezoid profiles of the elements.

Max. 4 Ronda elements should be arranged in one bundle as transportation unit. The elements have to be put together as straight pieces (i. e. without curvature) as shown in the picture.

Plywood face to plywood face must be the arrangement for transportation when being delivered to the job-site and the other way round.



## Minimum radius

**min. R = 2.75 m**

When using Ronda elements with plywood **14 mm thick** at a max. concrete pressure of **40 kN/m<sup>2</sup>**.

## Minimum radius

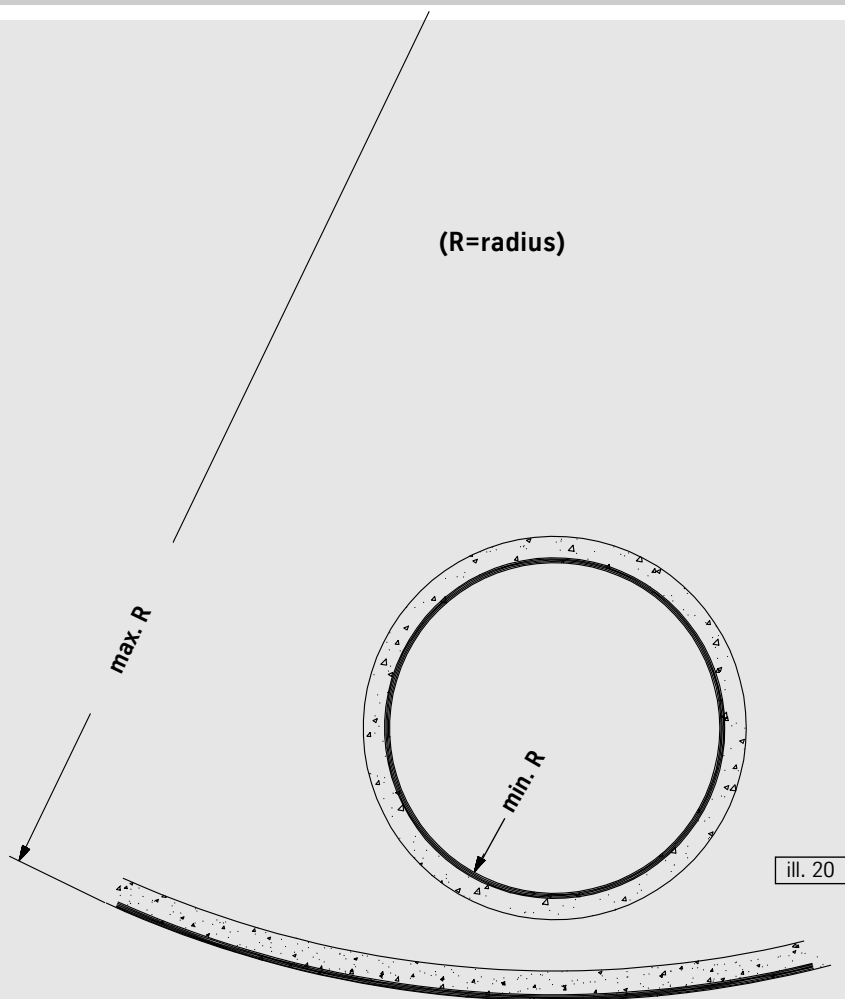
**min. R = 3.00 m**

When using Ronda elements with plywood **18 mm thick** at a max. concrete pressure of **40 kN/m<sup>2</sup>**.

## Minimum radius

**min. R = 4.00 m**

When using Ronda elements with plywood **14 mm thick** at a max. concrete pressure of **60 kN/m<sup>2</sup>**.

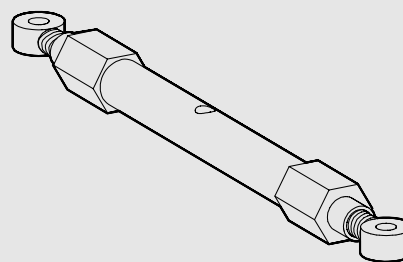


## maximum radius

**max R = 35.0 m\***

\*= when using Ronda elements as of production year 4/1994.

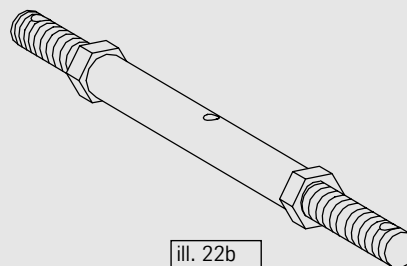
They can be identified by the execution of the turnbuckles as depicted in ill. 22a.



ill. 22a

The **maximum radius** is limited to **25.0 m** when using Ronda elements produced before this date.

Type of turnbuckles as shown in ill. 22b.



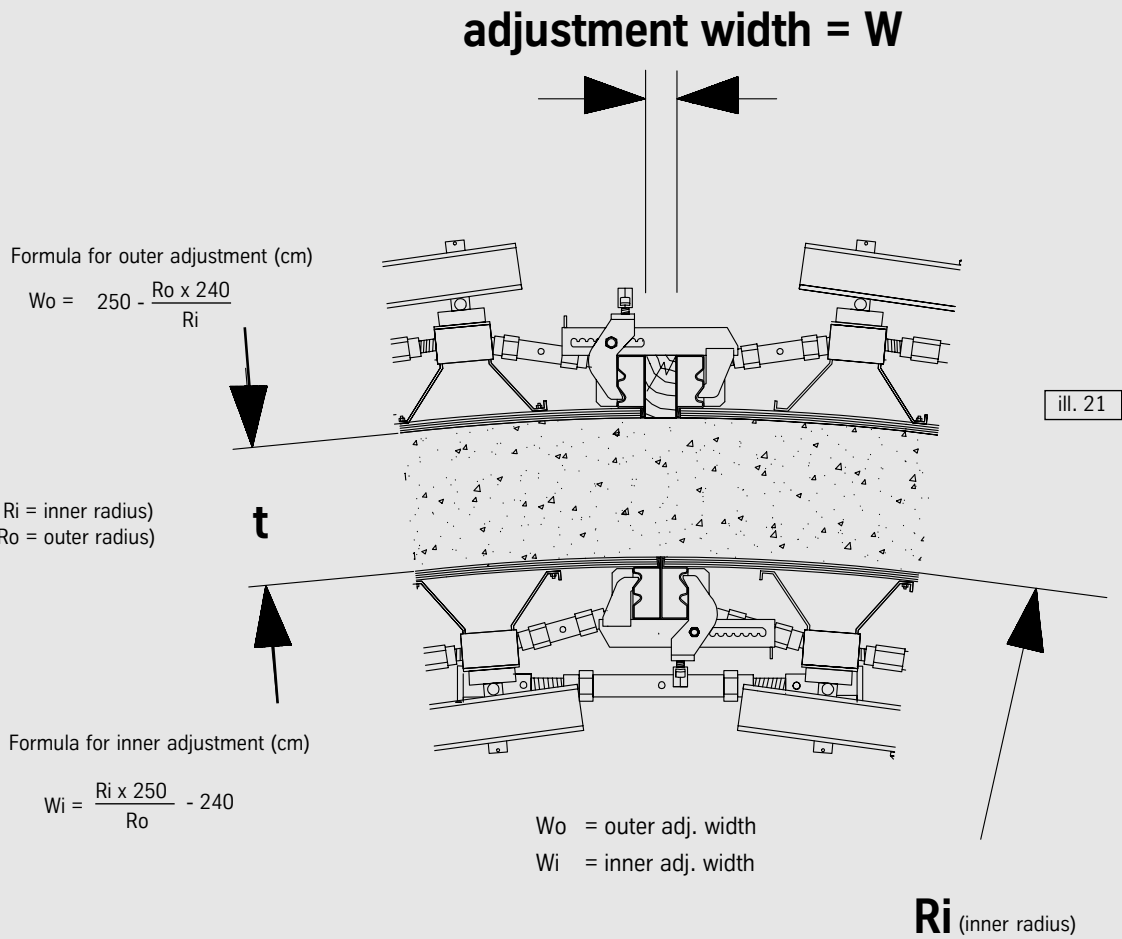
ill. 22b

### Note:

Regular cleaning and greasing of the turnbuckles facilitates the adjusting procedure later on.

The exact length adjustment of the curved Ronda elements to existing ground plans of circular structures is made possible by using small timber adjustments in the joint of two neighbouring panels. The width of the timber adjustment depends on the radius and wall thickness. The adaptation to the exact measure may be necessary either within the inner formwork or outer formwork.

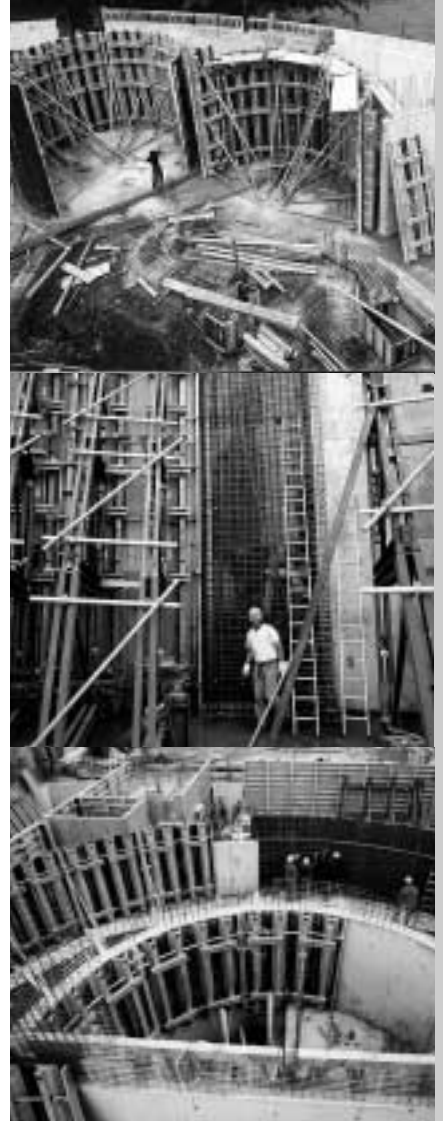
Timber adjustments of the outer formwork are marked in the table by "minus-sign" (e.g. -6.0 cm). Adjustment widths for radii and wall thicknesses which are not contained in the table, have to be calculated either acc. to the given formulas or must be found by interpolation.



## widths of timber adjustments (cm)

The adjustment widths shown in the table may not be taken for shuttering a complete circle.

Ri = inner radius (cm)	t = thickness of concrete wall (cm)													
	10	15	20	25	30	35	40	45	50	55	60	65	70	75
275	1.2	-3.1	-7.5	-11.8										
400	3.9	1.0	-2.0	-5.0	-8.0	-11.0	-14.0							
500	5.1	2.7	0.4	-2.0	-4.4	-6.8	-9.2	-11.6	-14.0					
600	5.9	3.9	1.9	—	-2.0	-4.0	-6.0	-8.0	-10.0	-12.0	-14.0			
700	6.5	4.8	3.1	1.4	-0.3	-2.0	-3.7	-5.4	-7.1	-8.9	-10.6	-12.3	-14.0	
800	6.9	5.4	3.9	2.4	1.0	-0.5	-2.0	-3.5	-5.0	-6.5	-8.0	-9.5	-11.0	-12.5
900	7.3	5.9	4.6	3.2	1.9	0.6	-0.7	-2.0	-3.3	-4.7	-6.0	-7.3	-8.7	-10.0
1000	7.5	6.3	5.1	3.9	2.7	1.5	0.4	-0.8	-2.0	-3.2	-4.4	-5.6	-6.8	-8.0
1100	7.7	6.6	5.5	4.4	3.4	2.3	1.2	0.2	-0.9	-2.0	-3.1	-4.2	-5.3	-6.4
1200	7.9	6.9	5.9	4.9	3.9	2.9	1.9	1.0	—	-1.0	-2.0	-3.0	-4.0	-5.0
1300	8.1	7.1	6.2	5.3	4.4	3.4	2.5	1.6	0.7	-0.2	-1.1	-2.0	-2.9	-3.8
1400	8.2	7.3	6.5	5.6	4.8	3.9	3.1	2.2	1.4	0.5	-0.3	-1.1	-2.0	-2.9
1500	8.3	7.5	6.7	5.9	5.1	4.3	3.5	2.7	1.9	1.2	0.4	-0.4	-1.2	-2.0
1600	8.4	7.7	6.9	6.2	5.4	4.6	3.9	3.2	2.4	1.7	1.0	0.2	-0.5	-1.3
1700	8.5	7.8	7.1	6.4	5.7	5.0	4.3	3.6	2.9	2.2	1.5	0.8	0.1	-0.6
1800	8.6	7.9	7.3	6.6	5.9	5.2	4.6	3.9	3.2	2.6	1.9	1.3	0.6	—
1900	8.7	8.0	7.4	6.8	6.1	5.5	4.8	4.2	3.6	3.0	2.3	1.7	1.1	0.5
2000	8.8	8.1	7.5	6.9	6.3	5.7	5.1	4.5	3.9	3.3	2.7	2.1	1.5	1.0
2100	8.8	8.2	7.6	7.1	6.5	5.9	5.3	4.8	4.2	3.6	3.1	2.5	1.9	1.4
2200	8.9	8.3	7.7	7.2	6.6	6.1	5.5	5.0	4.4	3.9	3.4	2.8	2.3	1.8
2300	8.9	8.4	7.8	7.3	6.8	6.3	5.7	5.2	4.7	4.2	3.6	3.1	2.6	2.1
2400	9.0	8.4	7.9	7.4	6.9	6.4	5.9	5.4	4.9	4.4	3.9	3.4	2.9	2.4
2500	9.0	8.5	8.0	7.5	7.0	6.5	6.1	5.6	5.1	4.6	4.1	3.7	3.2	2.7
2600	9.0	8.6	8.1	7.6	7.1	6.7	6.2	5.7	5.3	4.8	4.4	3.9	3.4	3.0
2700	9.1	8.6	8.2	7.7	7.3	6.8	6.4	5.9	5.5	5.0	4.6	4.1	3.7	3.2
2800	9.1	8.7	8.2	7.8	7.3	6.9	6.5	6.0	5.6	5.2	4.8	4.3	3.9	3.5
2900	9.1	8.7	8.3	7.9	7.4	7.0	6.6	6.2	5.8	5.3	4.9	4.5	4.1	3.7
3000	9.2	8.8	8.3	7.9	7.5	7.1	6.7	6.3	5.9	5.5	5.1	4.7	4.3	3.9
3100	9.2	8.8	8.4	8.0	7.6	7.2	6.8	6.4	6.0	5.6	5.3	4.9	4.5	4.1
3200	9.2	8.8	8.4	8.1	7.7	7.3	6.9	6.5	6.2	5.8	5.4	5.0	4.6	4.3
3300	9.2	8.9	8.5	8.1	7.7	7.4	7.0	6.6	6.3	5.9	5.5	5.2	4.8	4.4
3400	9.3	8.9	8.5	8.2	7.8	7.5	7.1	6.7	6.4	6.0	5.7	5.3	5.0	4.6
3500	9.3	8.9	8.6	8.2	7.9	7.5	7.2	6.8	6.5	6.1	5.8	5.4	5.1	4.8



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