User´s Guide

ENKOFORM VMK

E02FFR

ULMA

Construcción

IMPORTANTE:

Para el uso y utilización de nuestros productos, han de respetarse las disposiciones vigentes en materia de seguridad de organismos estatales o profesionales de cada país.

Las imágenes que contiene este documento, representan instantáneas de situaciones o fases de montaje, por lo tanto no son imágenes completas a efectos de seguridad y no deben tomarse como definitivas.

Todas las indicaciones que, en materia de seguridad y funcionamiento, recoge este documento, así como los datos de esfuerzos y cargas, deben ser respetados. Cualquier cambio o montaje singular, requerirá un cálculo o solución especial.

Los pesos que figuran en este documento, de los diferentes elementos básicos que componen el producto, son aproximados.

Nuestros equipos están diseñados para funcionar con los accesorios y componentes de nuestra empresa. Puede resultar peligrosa su utilización junto con sistemas de otros fabricantes, sin haber realizado las correspondientes verificaciones.

La empresa se reserva el derecho de introducir cualquier modificación que el desarrollo técnico del producto requiera.


Indicación de seguridad


Indicación de control


Indicación de advertencia


Indicación de información

"Documento original" elaborado y aprobado por ULMA Construcción.

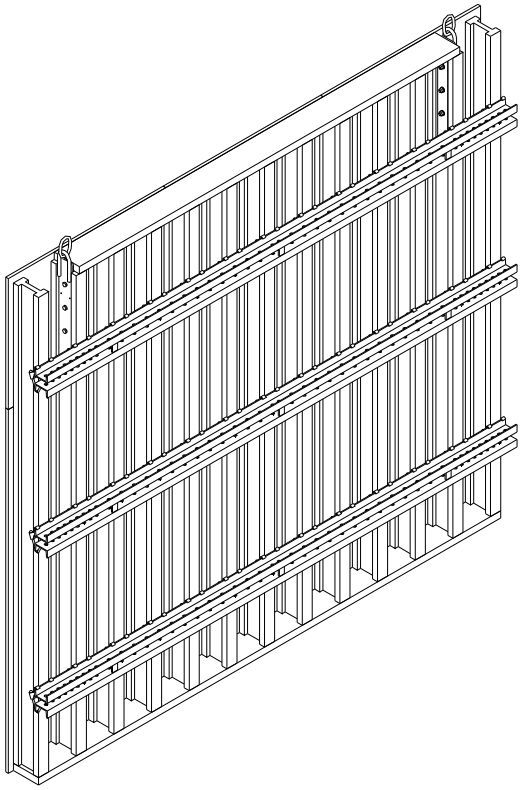
1. Product description

The system MK is a product designed for heavy duty structures, mainly used in civil engineering.

Its main feature is its versatility: structures for gantries, trolleys, tunnels and shoring, horizontal and vertical formwork, formwork supporting structures, climbing systems, façade protection structures and similar solutions can be made by means of this product.

The component used in all these solutions is the WALER MK. Its design and the proper accessories make it possible for the system MK to give such different configurations.

ENKOFORM VMK is a vertical formwork designed for vertical building (non-residential and residential building) and civil engineering (piers).



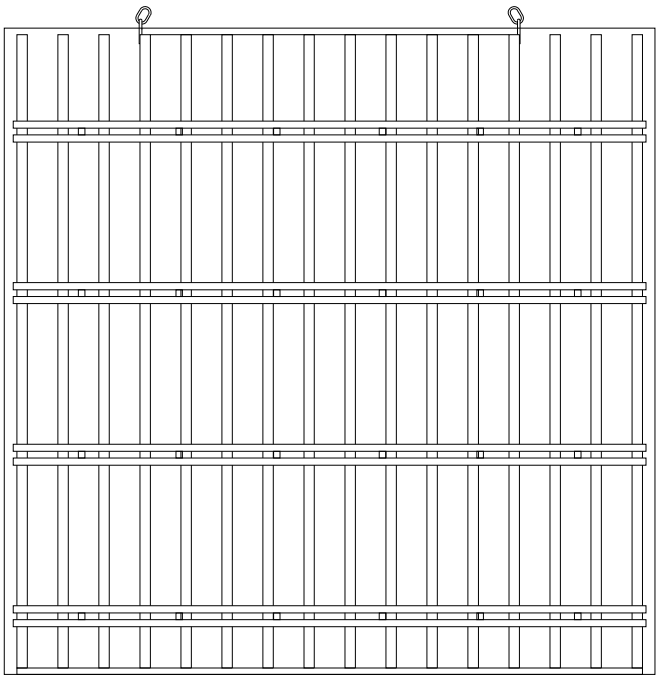
PANEL formed by BOARD, VM20 BEAMS and MK-120 WALERS.

1.1. CONCEPT OF THE SYSTEM

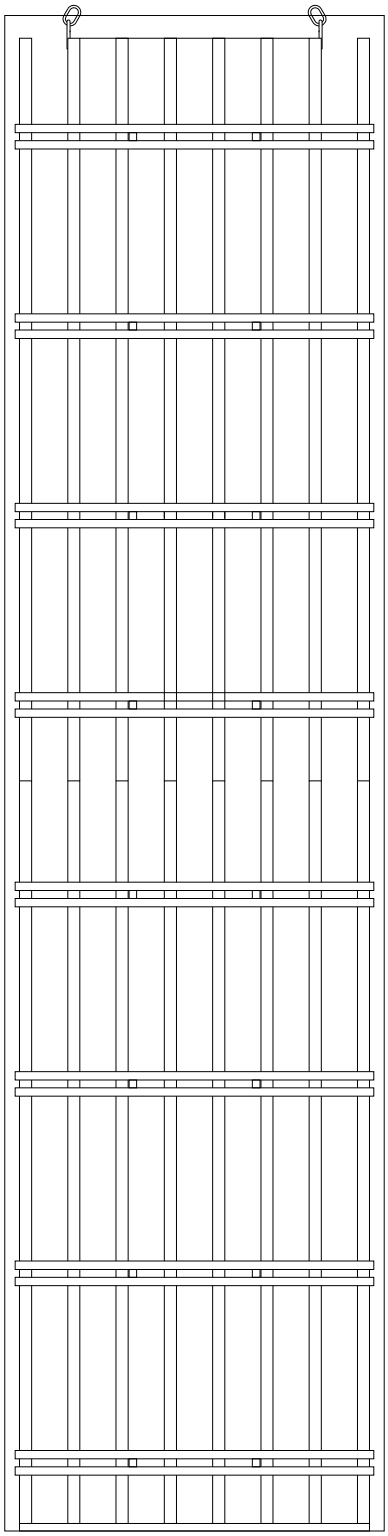
The main feature of this system is its unlimited flexibility. This system offers to assemble the PANELS depending on the:

- **Shape:** This system enables to assemble customized PANELS with the needed dimensions, always with standard components.

- **Size:** the maximum area of each PANEL is 25 m^2: it can be 10 m high and 2,5 wide, or 5 m high and 5 wide.

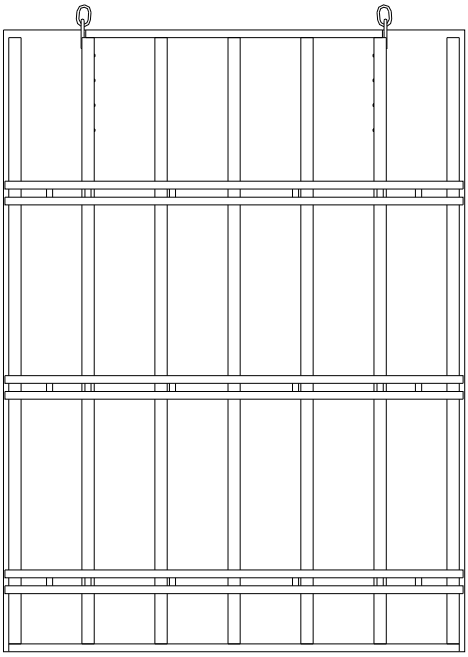


A 5x5 m PANEL.

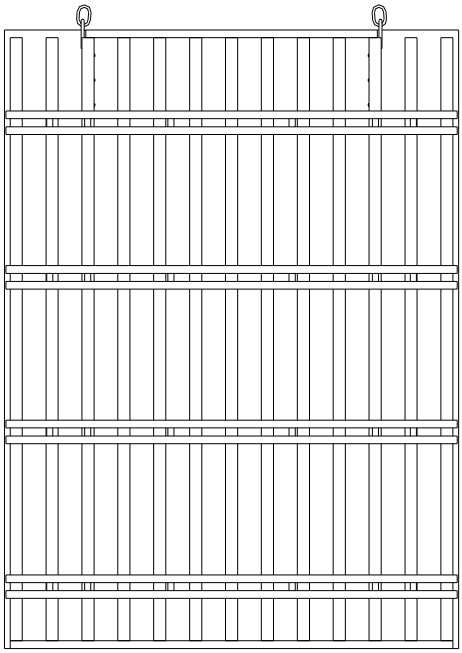


A 2,5x10m PANEL.

- **Formwork BOARD:** the type of BOARD will be selected depending on the number of times it will be used and the desired concrete-end quality.
- **Concrete pressure:** depending on the concrete pressure, the gap between the VM20 BEAMS and MK-120 WALERS in the PANELS will be bigger or smaller.



Configuration of a PANEL for a 30 kN/m2 concrete pressure.



Configuration of a PANEL for a 90 kN/m2 concrete pressure.

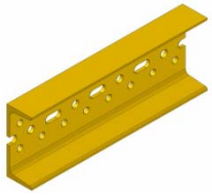
The main advantage of this system is that PANELS will be assembled with the required shape. This provides the possibility of adjusting them to the concrete pressure and the geometry of the wall.

In contrast to modular PANELS such as ORMA, ENKOFORM VMK PANELS of both sides do not need to be the same. Therefore, the solutions for corners, pilasters and closures are easier with ENKOFORM VMK.

In ENKOFORM VMK, the system unit is the PANEL.

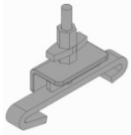
2. Components and accessories

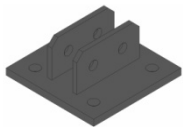
2.1. GRAPHIC DESCRIPTION

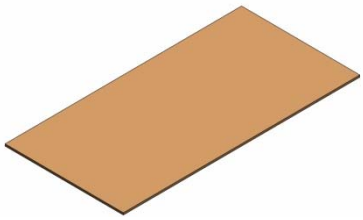
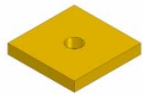
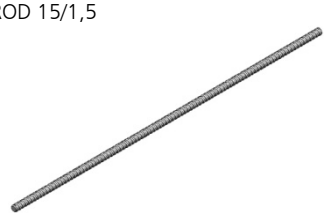
Code	Weight kg.	Name
		MK-120 WALERS AND PROFILES
1990104 1990105 1990106 1990107 1990163	6 7,5 9,1 10,7 97,6	PROFILE MK-120 / 0,5 PROFILE MK-120 / 0,625 PROFILE MK-120 / 0,75 PROFILE MK-120 / 0,875 PROFILE MK-120 / 7,875 
1990209 1990211 1990213 1990215 1990217 1990219 1990221 1990225 1990229 1990233 1990237 1990239 1990245	29,4 35,4 41,9 48,3 54,3 60,5 68,6 80,9 93,4 107,6 120,1 126,3 146,7	WALER MK-120 / 1,125 WALER MK-120 / 1,375 WALER MK-120 / 1,625 WALER MK-120 / 1,875 WALER MK-120 / 2,125 WALER MK-120 / 2,375 WALER MK-120 / 2,625 WALER MK-120 / 3,125 WALER MK-120 / 3,625 WALER MK-120 / 4,125 WALER MK-120 / 4,625 WALER MK-120 / 4,875 WALER MK-120 / 5,625 
1990200	0,46	SPACER TUBE MK-120 / 52 
0241690	0,19	BOLT M16x90 DIN-931-8.8 
0241600	0,04	SCREW M16 DIN-934-8 

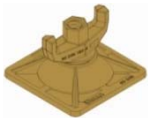
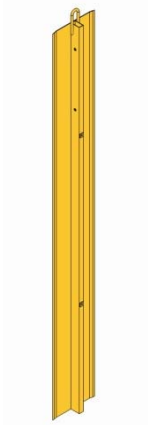
Code	Weight kg.	Name
		CONNECTION AND LIFTING COMPONENTS
1960220	10,2	LIFTING BRACKET E V-100 
1990700	12,3	WALER CONNECTOR MK 
1990801	0,6	WEDGE MK 
1990800	9,5	PANEL CONNECTOR MK 
1990810	11,1	ADJUSTABLE CONNECTOR MK 
1990811	1,81	C-VM20 COUPLING MK 
1990890	16,7	CORNER CONNECTOR MK 

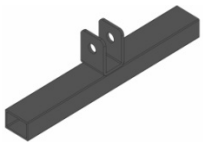
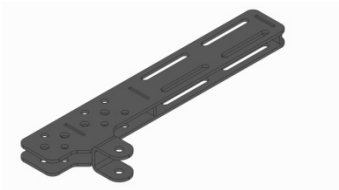
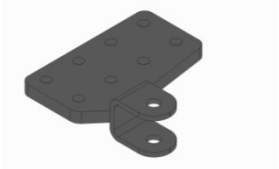
Code	Weight kg.	Name
1990895	10,35	POSTIZO RIOSTRA MK 
1990730	15,7	ARTICULATED ADJUS. CONNECTOR MK 
1990830	12,9	ARTICULATED CONNECTOR MK 
1990845	3,13	OUTSIDE CORNER HEAD MK 
1990850	1,4	BULKHEAD HEAD MK 
		BEAMS VM20
1940172	9,5	BEAM VM20 / 1,9
1940197	10,8	BEAM VM20 / 2,15
1950129	12,3	BEAM VM20 / 2,45
1940196	13,3	BEAM VM20 / 2,65
1940144	14,5	BEAM VM20 / 2,9
1950130	16,5	BEAM VM20 / 3,3
1940146	18	BEAM VM20 / 3,6
1950112	19,5	BEAM VM20 / 3,9
1950113	24,5	BEAM VM20 / 4,9
1940149	29,5	BEAM VM20 / 5,9 
1960305	13,2	UNIÓN LONGITUDINAL VM20 

Code	Weight kg.	Name
1960375	0,95	WALER-VM20 CLAMP 2T 
1960345	1,30	WALER-VM20 ANGULAR CLAMP 
1960450	2,3	TOOLKIT CASE 
		PUSH-PULL PROPS
1960275	4	BRACE HEAD 
1900147	51,3	PUSH-PULL PROP 5-6
1908168	43,3	PUSH-PULL PROP 3,6-4,8
1900123	24,3	PUSH-PULL PROP 2,4-3,5
1900134	7,70	PUSH-PULL PROP 1,1-1,7 
1900207	99	PUSH-PULL PROP 6-10 
1900144	3,6	PUSH-PULL PROP SHOE 

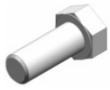
Code	Weight kg.	Name
1960172	2,20	RIGHT ANGLE HEAD 
0212100	2,40	PUSH-PULL PROP 1" 0.36-0.52 (D20) 
0212125	6,19	PUSH-PULL PROP 1,5" 0.44-0.66 (D20) 
1960210	10,6	PUSH-PULL PROP E 0,51-0,75
1960100	14,1	PUSH-PULL PROP E 0,75-1,05
1960110	18,8	PUSH-PULL PROP E 1-1,55
1960115	24,1	PUSH-PULL PROP E 1,51-2,2
1960130	33,4	PUSH-PULL PROP E 2,15-2,75
1960125	38,1	PUSH-PULL PROP E 2,7-3,3
1960410	45	PUSH-PULL PROP E 3,25-4 
1960545	6,80	PUSH-PULL PROP E SHOE 
0252070	0,29	PIN E20x70 
0250000	0,030	COTTER PIN R/5 
		BOARDS
7251131	11,4	3 LAYER PLYWOOD 2000x503x21
7251132	15	3 LAYER PLYWOOD 2000x503x27
7251136	18,9	3 LAYER PLYWOOD 2500x503x27
1860650	13,4	3 LAYER PLYWOOD 1970x503x27
1940156	14,6	PLYWOOD 2,5x1,25x0,009 SPRUCE
1940160	19,5	PLYWOOD 2,5x1,25x0,012 SPRUCE
1940154	29,2	PLYWOOD 2,5x1,25x0,018 SPRUCE
1940150	34,1	PLYWOOD 2,5x1,25x0,021 SPRUCE

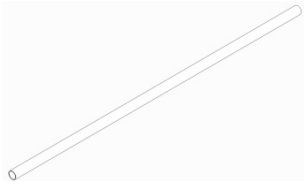
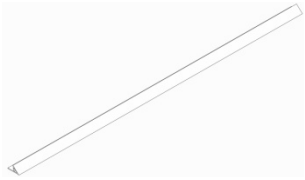
Code	Weight kg.	Name
1940157	19,1	PLYWOOD 2,5x1,25x0,009 BIRCH
1940161	25,5	PLYWOOD 2,5x1,25x0,012 BIRCH
1940155	38,2	PLYWOOD 2,5x1,25x0,018 BIRCH
1940151	44,6	PLYWOOD 2,5x1,25x0,021 BIRCH
1940198	34,9	PLYWOOD 1,25x2,5x0,018 BETO
1940166	40,7	PLYWOOD 1,25x2,5x0,021 BETO
2211064	12,6	PLYWOOD 0,5x2x0,021 BETO
2211065	26,5	PLYWOOD 1,05x2x0,021 BETO
2211066	31,5	PLYWOOD 1,25x2x0,021 BETO
2211067	15,75	PLYWOOD 0,5x2,5x0,021 BETO
2211068	33,1	PLYWOOD 1,05x2,5x0,021 BETO 
9371434	0,008	COUNTERSUNK SCREW 6x50 DIN7505-A
9371436	0,014	COUNTERSUNK SCREW 6x80 DIN7505-A
9371421	0,019	COUNTERSUNK SCREW 6x110 DIN7505-A 
		TYING ELEMENTS
0261000	1,2	BASE PLATE 100x100x15 (D22)
0261001	2,65	BASE PLATE 150x150x15 (D22)
0261004	2,65	BASE PLATE 150x150x15 (D30) 
0261005	2,43	OPEN PLATE 150x150x15 (D22) 
0230100	1,70	TIE ROD 15/1
0230120	2	TIE ROD 15/1,2
0230150	2,16	TIE ROD 15/1,5 
0230000	0,33	WING NUT 15 

Code	Weight kg.	Name
1900256	1,40	PLATE WASHER NUT 15 
7238000	0,73	PLATE NUT 15 
7238001	0,22	HEXAGONAL NUT 15 
0234100	2,56	TIE ROD 20/1
0234120	3,07	TIE ROD 20/1,2
0234150	3,84	TIE ROD 20/1,5
0234200	5,12	TIE ROD 20/2 
1905160	1,20	PLATE WASHER NUT 20 
		COMPENSATIONS
0122324	57,0	COMPENSATION PLATE H=3,2x0,4
0122424	75,0	COMPENSATION PLATE H=4,2x0,4
0122000	92,0	COMPENSATION PLATE H=5,2x0,4
0122335	70,0	COMPENSATION PLATE H=3,2x0,5
0122435	77,0	COMPENSATION PLATE H=4,2x0,5
0122525	127,0	COMPENSATION PLATE H=5,2x0,5 

Code	Weight kg.	Name
0122001	2,08	TUBE 40x40x3 L=600 (D18)
0122002	1,39	TUBE 40x40x3 L=400 (D18) 
1861033	0,60	SHORT PIN 0,35 
7238000	0,73	PLATE NUT 15 
0122010	3,10	COMPENSATION PLATE FILTING TUBE 
1990770	10,1	REGLETA REGUL. COMPENSACIÓN MK 
1990765	5,23	CABEZAL REGUL. COMPENSACIÓN MK 
1861627	0,166	PIN 16x100 
9370571	0,006	COTTER PIN R/3 

Code	Weight kg.	Name
		SAFETY PLATFORMS
1960255	16,2	WALKWAY BRACKET E V-100 
1861122	0,39	PANEL BOLT 
7238001	0,22	HEXAGONAL NUT 15 
2211225	16,8	TOE BOARD 4000x200x50 
2211156	9,6	SAFETY HANDRAIL 1,50 
0121000	7,2	HANDRAIL POST D50/1,5 

Code	Weight kg.	Name
0121004	2,9	HANDRAIL SOCKET D50 
2211165	6,9	VM HANDRAIL SUPPORT 
0241200	0,02	NUT M12 DIN-934-5.6 
0241201	0,01	WASHER A12 DIN-125 
0241230	0,04	BOLT M12x30 DIN-933-8.8 
		CONSUMABLE
1861799	0,003	PLUG 20 (250 units) 
1900159	0,003	PLUG 22 (250 units) 
7238050	0,004	PLUG 26 (250 units) 
7238046	0,004	PLUG 30 (250 units) 

Code	Weight kg.	Name
7230264	0,006	CONE 22(250 units) 
7238048	0,007	CONE 26(250 units) 
9371967	0,03	CONE 32 
7238049	0,009	WATER STOP CAP 26 (250 units) 
7230455 7238047 1905814 9371968	0,16 0,23 0,19 0,30	SPACER TUBE 22/25 (75 ml) SPACER TUBE 22/26 (100 ml) SPACER TUBE 26/29 (50 ml) SPACER TUBE 32/36 (50 ml) 
7238029	0,40	CHAMFER STRIP 20x20 (50 ml) 
9900013	0,32	T STRIP 20/42 2 m 

2.2. ELEMENTS DESCRIPTION

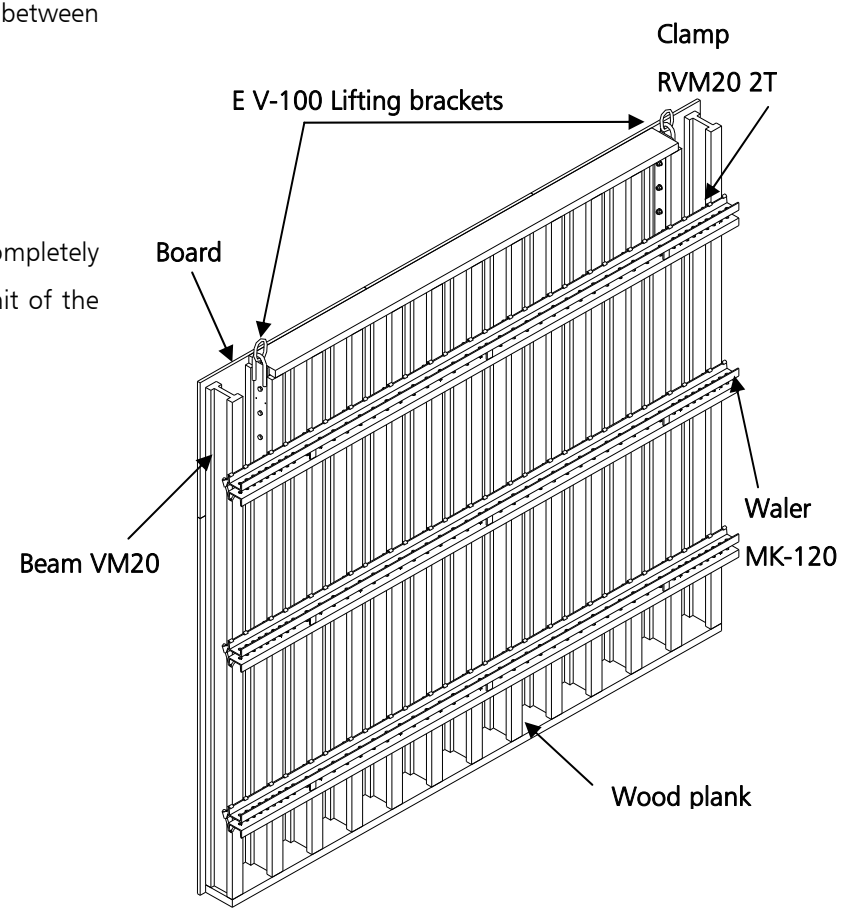
2.2.1 PANEL IN DETAIL

The unit element of the system is the PANEL. Although this system is formed by many components, the unit of the system will be the PANEL. The placement of some PANELS next to each other will make possible to adjust to the required geometry of the wall.

The PANEL is made up of:

- MK-120 WALERS (1st line beams)
- VM 20 BEAMS (2nd line beams)
- WALER-VM20 CLAMPS 2T (clamp between the two beams)
- LIFTING BRACKET E V-100
- BOARD
- WOOD PLANKS

The assembly formed this way makes a completely stiff component, ready to be used as the unit of the system.



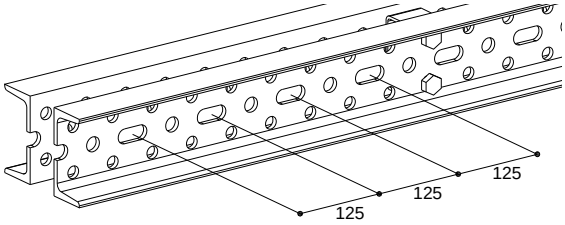
PANEL made up of BOARD, VM20 BEAMS and MK-120 WALERS.

The functions of the PANEL's basic components are explained in the following lines:

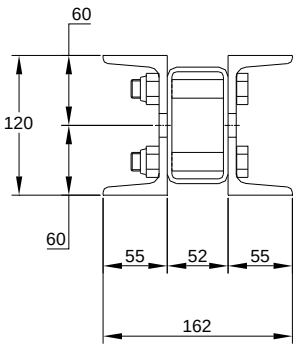
WALERS MK-120:

The real length is 12 mm shorter than the one indicated in the name.

They have long and round holes along the profiles. In vertical formwork, the mainly used holes (with WEDGES MK) are the long ones (125 mm gap between them).

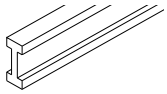


Distances between the long holes.



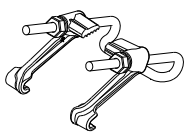
Geometry of the section.

VM20 BEAMS:



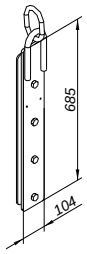
The BOARD of the PANEL will lay on the VM20 BEAMS.

WALER-VM20 CLAMP 2T:



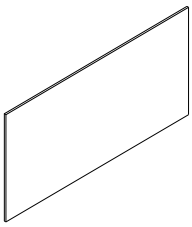
It joins the BEAM VM20 to the WALER MK-120.

LIFTING BRACKET E V-100:



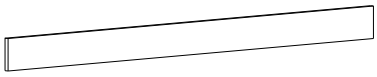
It makes possible to shift the PANELS. Each PANEL will have 2 E V-100 LIFTING BRACKETS.

BOARD:



It is the PANEL surface in contact with the concrete. It can be 3 layer (27mm) or plywood (18-21 mm). Depending on the type of BOARD, it can be used more or fewer times.

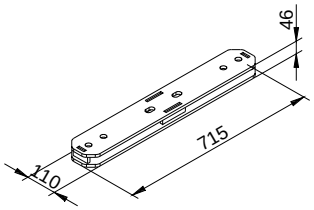
WOOD PLANK:



- It is placed on the upper part of the PANEL to absorb the horizontal forces when lifting.
- It is placed on the bottom part of the PANEL to protect the ends of the VM20 BEAMS from a possible damage.

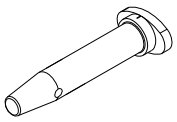
Other components of the system:

WALER CONNECTOR MK:



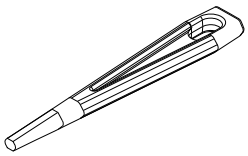
It joins 2 MK-120 WALERS lengthwise to form a third one. It is connected by means of 4 PINS E20x70.

PIN E20x70:



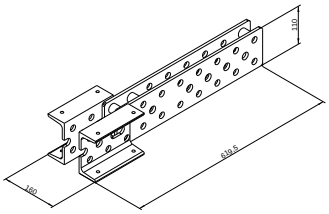
It is used with the WALER CONNECTOR MK and the ARTICULATED ADJUS. CONNECTOR MK.
Each PIN E20x70 will always have a COTTER PIN R/5.

WEDGE MK:



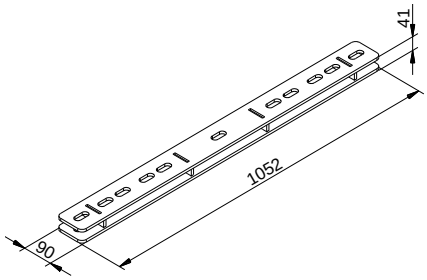
It is the mainly used component to connect different components between them.

WALER EXTENSION MK:



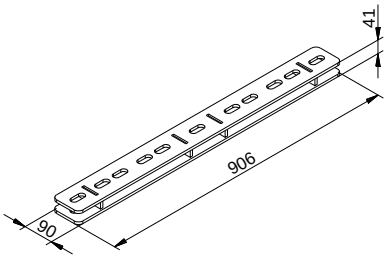
This component makes it possible to form corner PANELS, as well as to solve pilasters.

ADJUSTABLE CONNECTOR MK:



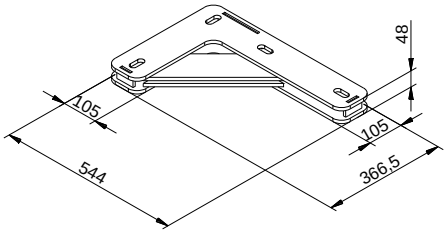
It joins 2 MK-120 WALERS to form a third one: similar function to the WALER CONNECTOR, but with a very accurate regulation (1mm). (min. gap: 135 mm and max. gap: 152 mm).
It connects PANELS with a closure between them.

PANEL CONNECTOR MK:



It joins two PANELS lengthwise.
It guarantees a hermetic joint.

CORNER CONNECTOR MK:

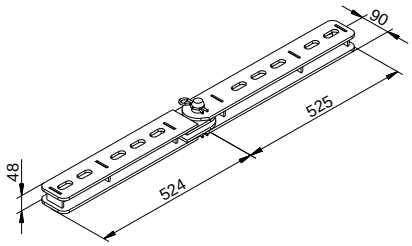


It connects 2 walers perpendicular to each other.

It will be used to solve:

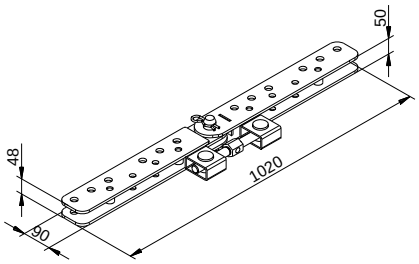
- 90º corners.
- Pilasters.
- Elevator cores.
- Columns.

ARTICULATED CONNECTOR MK:



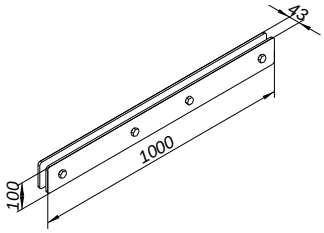
It joins 2 PANELS that form a non 90º angle between them.

ARTICULATED ADJUS. CONNECTOR MK:



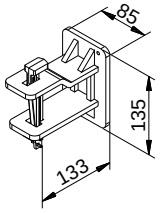
It joins 2 WALERS that form a non 90º angle between them inside a PANEL.

BEAM VM20 CONNECTION PLATE:



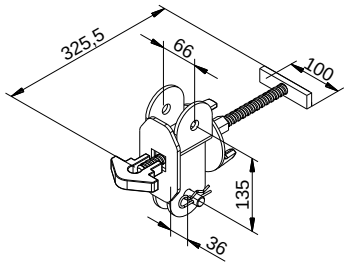
It joins 2 VM20 BEAMS lengthwise.

C-VM20 COUPLING MK:



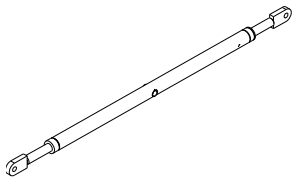
It creates extra supports of the BEAM VM20 on the ADJUSTABLE CONNECTOR MK.

PUSH-PULL PROP HEAD:



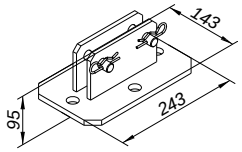
It allows the joint of PUSH-PULL PROPS to MK-120 WALERS to plumb and stabilise PANELS.

PUSH-PULL PROP:



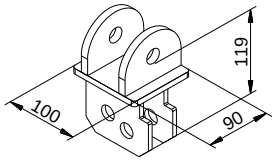
It plumbs the PANELS and supports the strength of wind.

PUSH-PULL PROP SHOE:



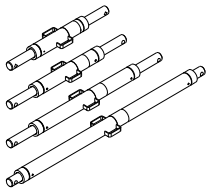
- It connects PUSH-PULL PROPS to the ground.
- 2 PUSH-PULL PROPS can be connected to the ground at the same time.

RIGHT ANGLE HEAD:



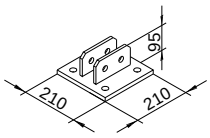
It allows the joint of E PUSH-PULL PROPS to DU-100 or DU-120 WALERS.

PUSH-PULL PROPS E:



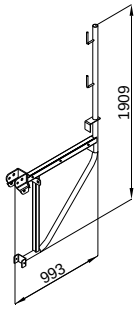
They stand higher loads than the PUSH-PULL PROPS (if necessary).

PUSH-PULL PROP E SHOE:



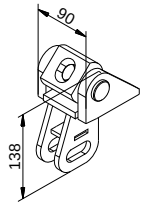
It connects PUSH-PULL PROPS E to the ground.

WALKWAY BRACKET E V-100:



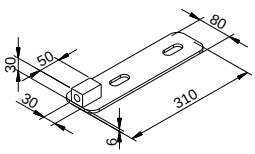
It makes possible to assemble walkway platforms.

OUTSIDE CORNER HEAD MK:



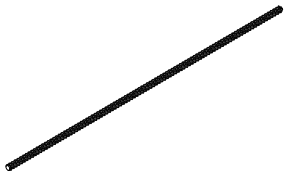
- It joins two outer PANELS that form a certain angle between them.
- Application range: 25º to 65º.

BULKHEAD HEAD MK:



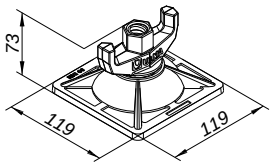
It allows bulkhead solutions.

TIE RODS:



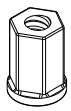
They are used to join two PANELS both in front of each other (with the BOARD face to face).

PLATE WASHER NUT 15:



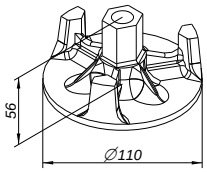
- It is used to join TIE RODS 15.
- It allows a maximum inclination of 15º.

HEXAGONAL NUT:



It is a fixing component for TIE RODS 15.

PLATE NUT 15:

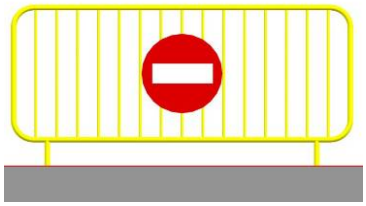
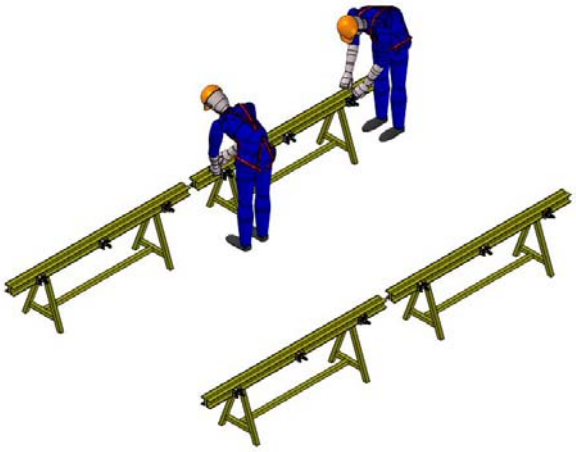


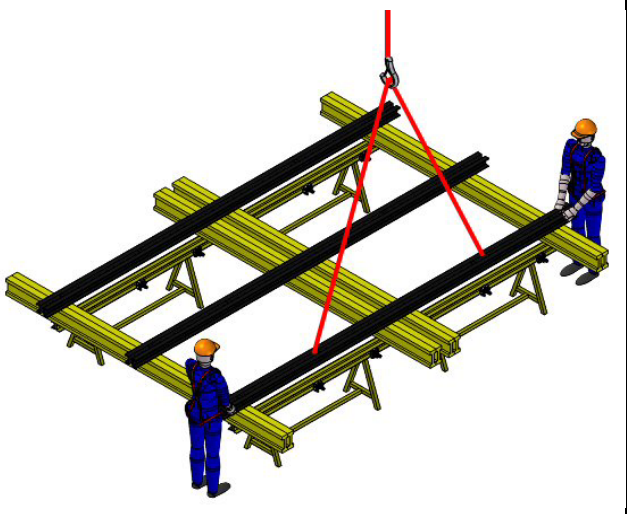
- It is used to join TIE RODS 15.
- It does not allow any inclination.

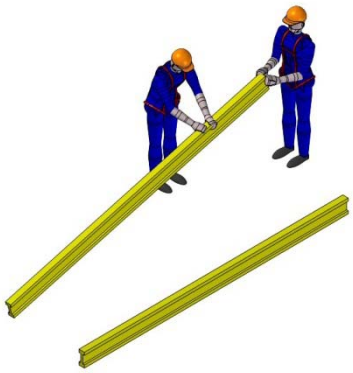
3. Assembly, Use and Disassembly

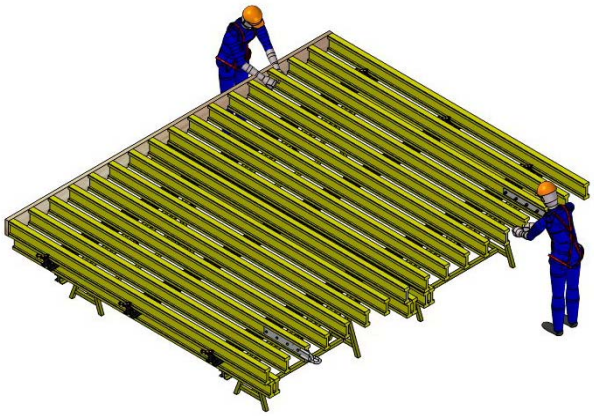
3.1. PROP: BASIC ASSEMBLY INSTRUCTIONS

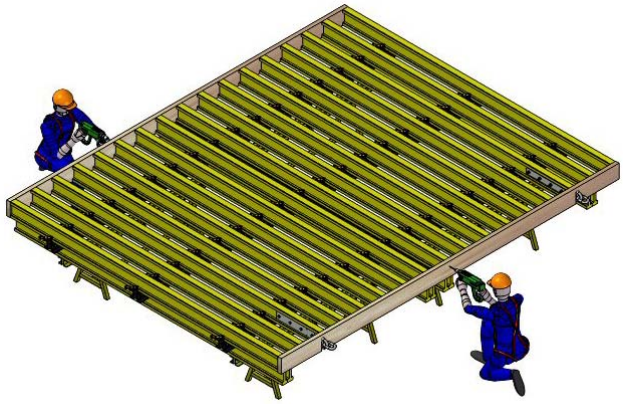
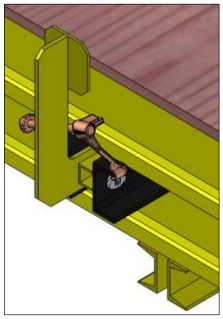
The steps for assembling a standard PANEL are:

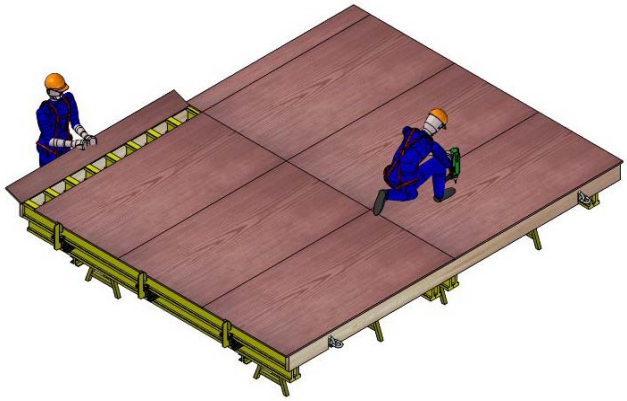
1	2
	
Protect the working area.	Prepare a flat surface and place the needed BIRA trestles for each case.

3	4
	
Place VM 20 BEAMS as a base.	Place the needed MK-120 WALERS. Check the squaring.

5	6
	
Place 2 VM 20 BEAMS of both corners as indicated in the drawing. The joint between VM 20 BEAMS and MK-120 WALERS will be carried out by means of the WALER-VM20 CLAMP. Place a plank in the bottom of the PANEL.	Place the E V-100 LIFTING BRACKETS to the VM 20 BEAMS.

7	8
	
Place the VM 20 BEAMS that are left.	Join all the VM 20 BEAMS to the WALERS (manually, or with an electrical screwer) by means of the RVM20 CLAMPS.

9	10
	
Place the planks of the E V-100 LIFTING BRACKETS.	Place the ASSEMBLY SQUARE.

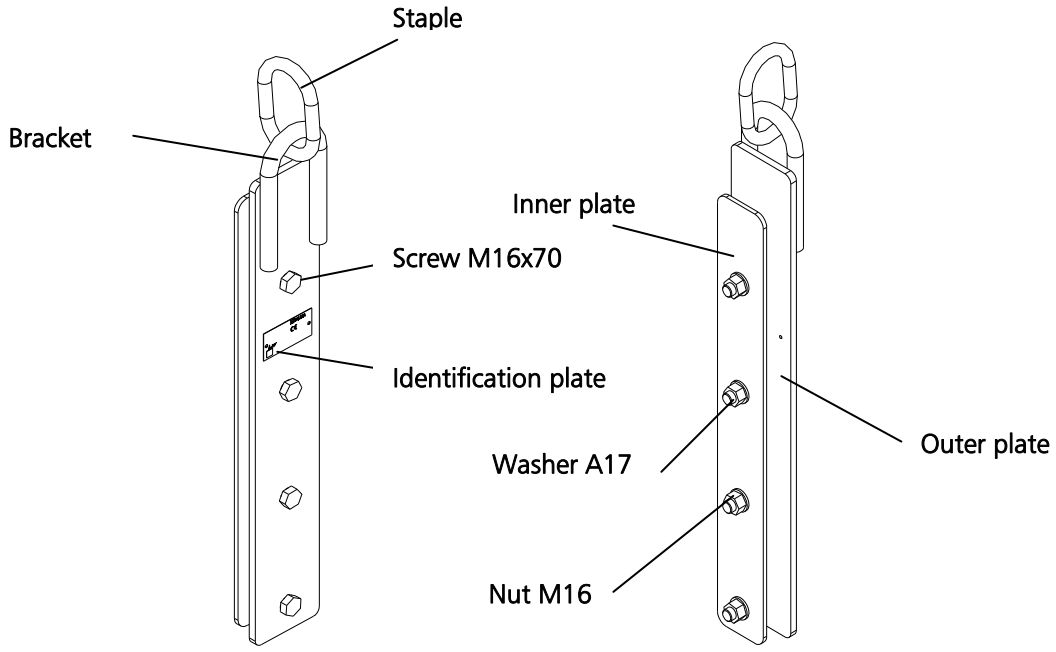
11	12
	
Cover the PANELS with BOARD.	Screw the BOARD to the VM20 BEAMS.

3.2. LIFTING BRACKET E V-100

This component is part of the PANEL of the system ENKOFORM VMK. I.e., **it is not a removable bracket, but each PANEL will have two brackets.**

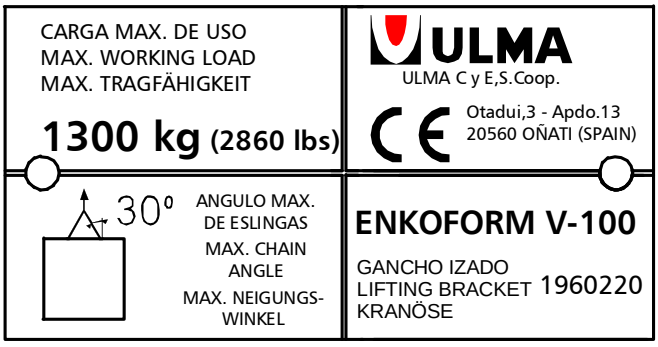
E V-100 LIFTING BRACKETS will be placed when assembling the PANEL.

Each LIFTING BRACKET E V-100 is designed for a maximum load of 13 kN (i.e. the maximum weight of a PANEL will be 26 kN (2653 kg)), although it might be much lower, depending on the geometry configuration of the PANEL. See chapter 5.1.7 to calculate the working load of the LIFTING BRACKET E V-100.



General view of the LIFTING BRACKET E V-100.

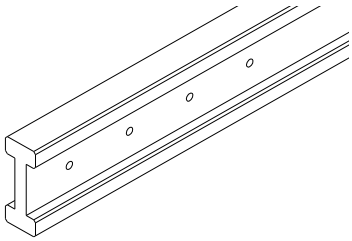
IDENTIFICATION PLATE:



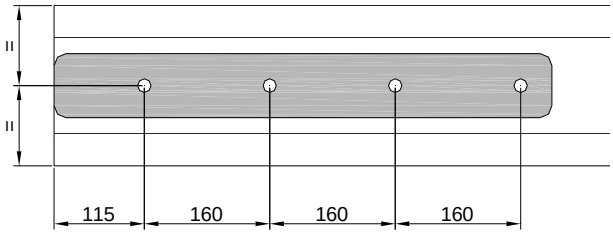
Detail of IDENTIFICATIVE PLATE.

3.2.1 Assembly of LIFTING BRACKET E V-100:

1. Make 4 holes of 17 mm diameter in the centre to the BEAM VM20 (in case the BEAM VM20 has no holes). The gap between the holes is 160 mm, and the gap from the 1st hole to the corner of the BEAM VM 20 will be 115 mm.
   (The inner plate (the one of the lifting bracket with no ring) will be used as pattern. This plate will be placed levelled with the corner of the BEAM VM 20). *(Repeat this operation with 2 VM 20 BEAMS per PANEL).*

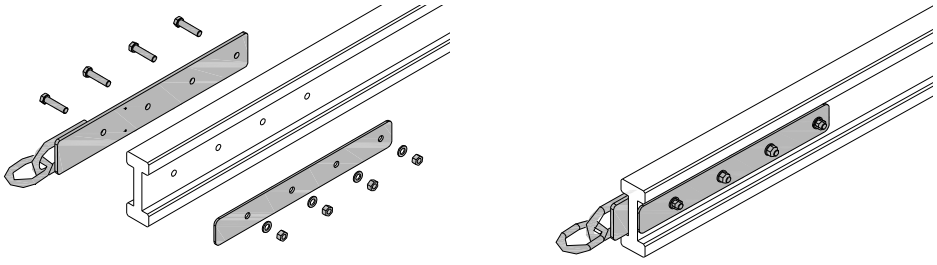


BEAM VM 20 with 4 holes of 17 mm.



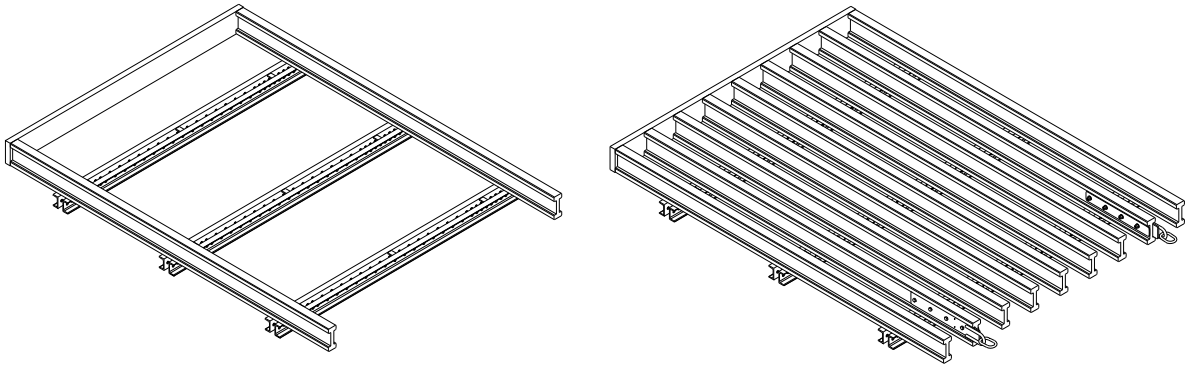
BEAM VM 20 with the plate of the LIFTING BRACKET E V-100 that will be used as pattern to make the holes.

2. E V-100 LIFTING BRACKETS will be assembled on the BEAM VM 20 where previously 4 holes have been done. To do so, the nuts of the E V-100 LIFTING BRACKETS will be previously released and the plate removed. The stem of the BEAM VM 20 will be between the two plates of the E V-100 LIFTING BRACKETS. Finally, the nuts are tied up. The bracket will be assembled in such a way that the ring will be 5 cm out of the BEAM VM 20, and the other plate levelled. (Repeat this operation in 2 BEAMS VM20 per PANEL).

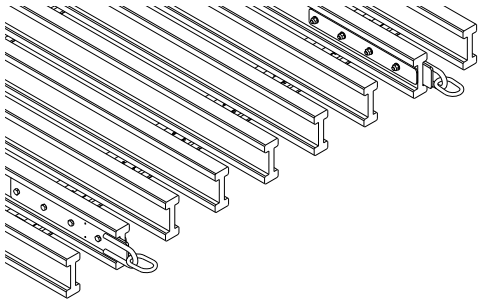


Placement of the E V-100 LIFTING BRACKETS in a BEAM VM 20 where holes have been previously made.

3. Continue assembling the PANEL according to what it is indicated in the assembly draft. Place the VM20 BEAMS that have the E V-100 LIFTING BRACKETS included in the indicated position. Take into account that the VM20 BEAMS that have the E V-100 LIFTING BRACKETS will have to be placed in such a way that the plates with rings will be in the outwards on both sides.



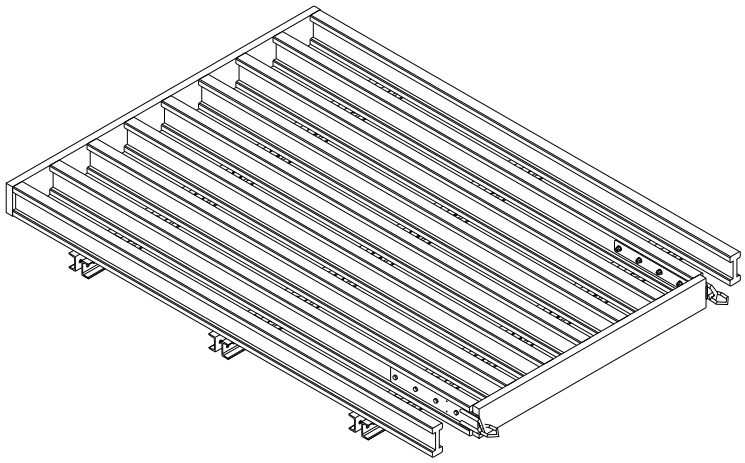
Assembly of PANEL, first with just 2 VM 20 BEAMS joined to MK-120 WALER and then will all the BEAMS.



The E V-100 LIFTING BRACKETS are placed in such a way that the plates remain faced outwards.

4. Place a 200x50 mm section wood plank between the E V-100 LIFTING BRACKETS. This plank will be screwed to all the VM 20 BEAMS.

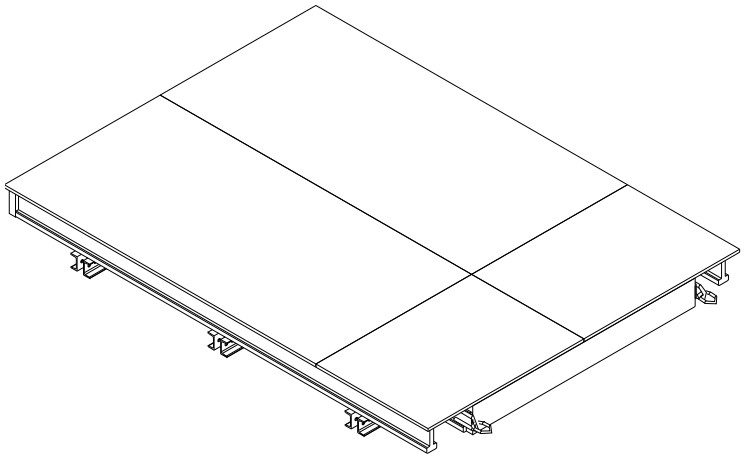
   Screw type: D6x80 mm with countersinking head.



PANEL with a PLANK placed between the E V-100 LIFTING BRACKETS.

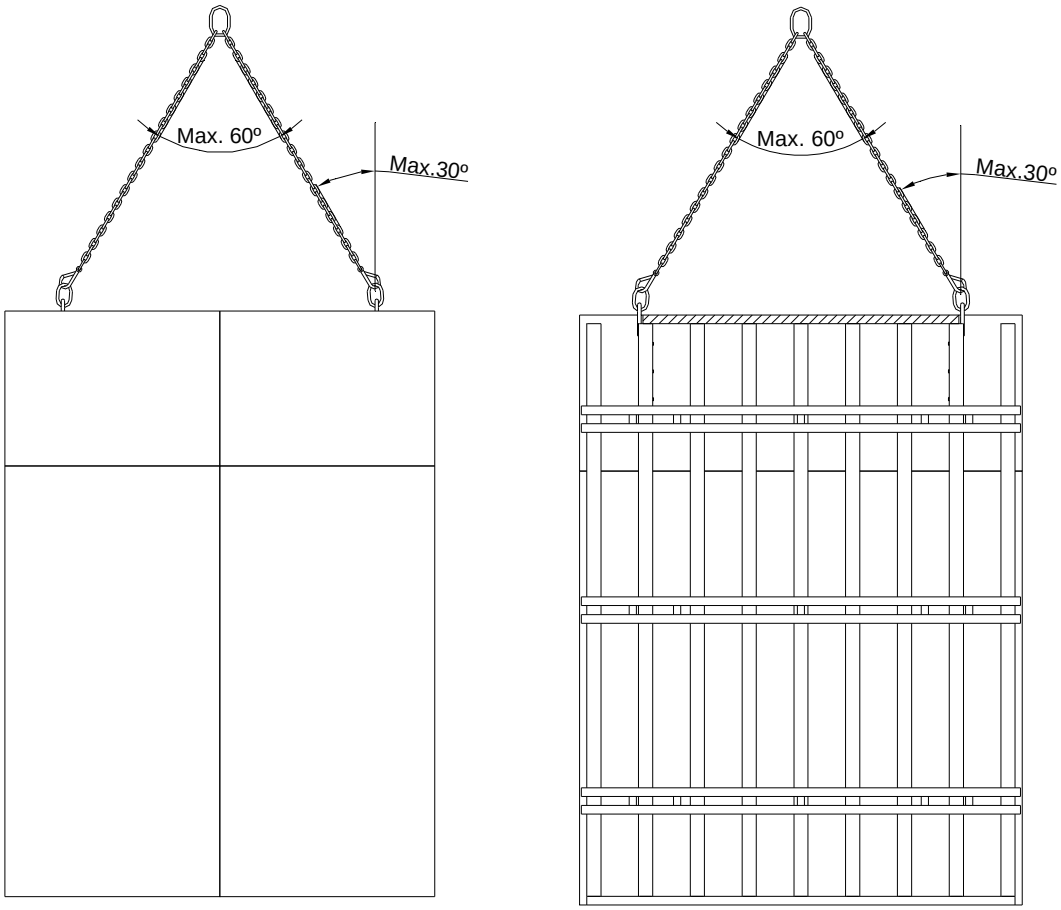
5. Place the BOARD on the VM20 BEAMS.

   Screw type: D6x50 mm with countersinking head.



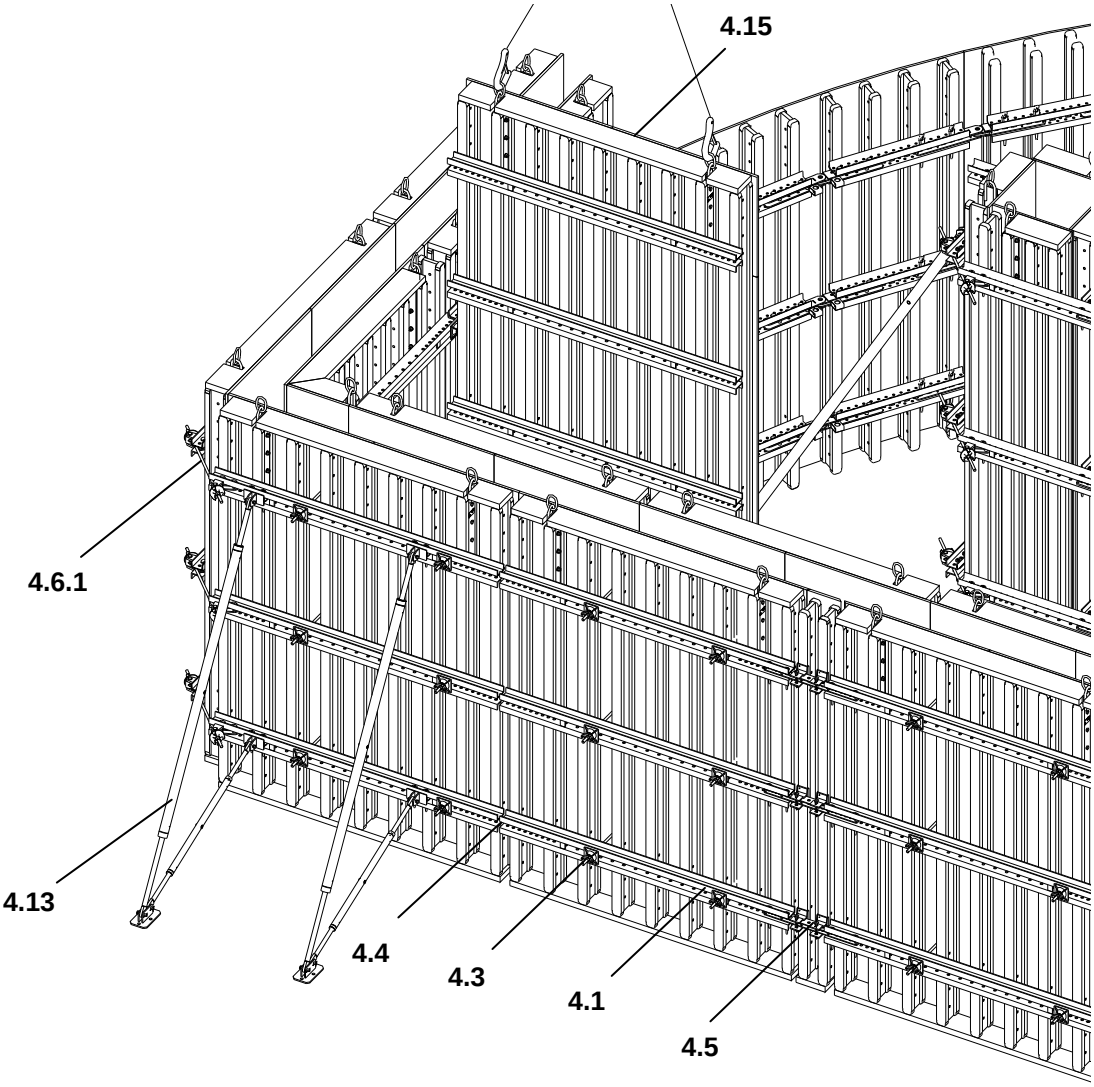
Completed PANEL.

6. The slings that go to the E V-100 LIFTING BRACKETS should form a **maximum angle of 60º** between them. I.e., the sling or chain that goes to each LIFTING BRACKET E V-100 will have at least the same length of the separation between the two brackets.

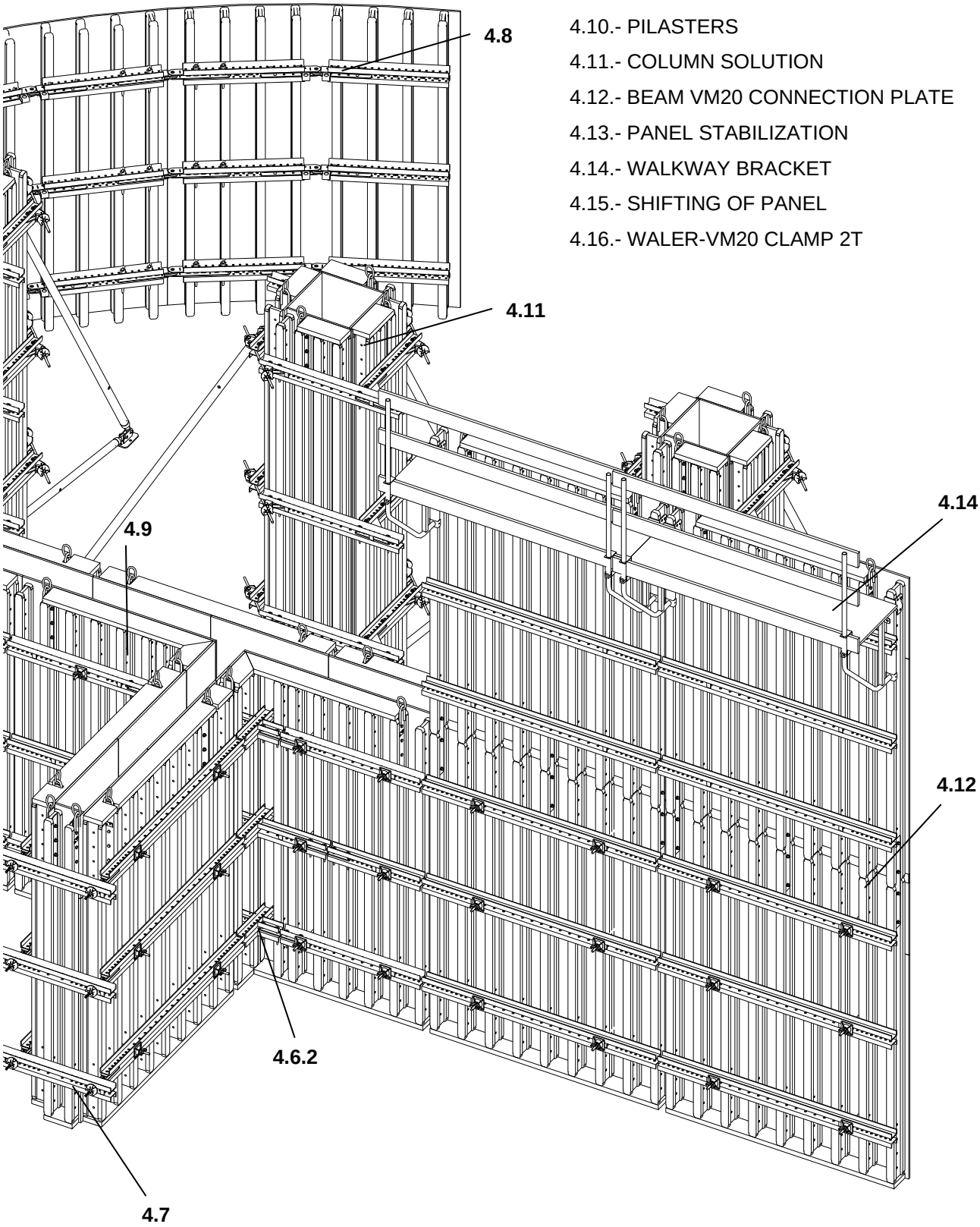


The angle between the raising chains will be of maximum 60º.

4. Solutions



4.9.- PIERS OR LIFT SHAFTS
4.10.- PILASTERS
4.11.- COLUMN SOLUTION
4.12.- BEAM VM20 CONNECTION PLATE
4.13.- PANEL STABILIZATION
4.14.- WALKWAY BRACKET
4.15.- SHIFTING OF PANEL
4.16.- WALER-VM20 CLAMP 2T



4.1. WALER MK-120

The range of MK-120 WALERS is:

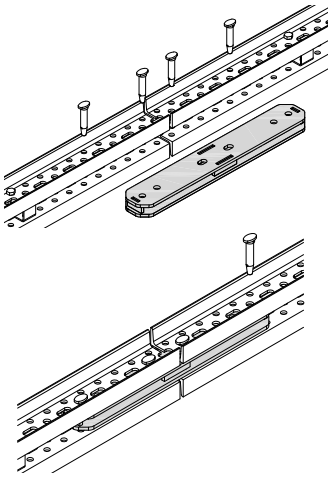
1.125 / 1.25 / 1,375 / 1.625 / 1,875 / 2.125 / 2.375 / 2.625 / 3.125 / 3.625 / 4.125 / 4.625 / 4.875 / 5.625 / m.

But this range can be extended by means of the WALER CONNECTOR MK, PANEL CONNECTOR MK and ADJUSTABLE CONNECTOR MK.

4.1.1 WALER CONNECTOR MK. Waler range every 25 cm.

The WALER CONNECTOR makes it possible to join 2 MK-120 WALERS to form a third one of a different length.

The WALER CONNECTOR and the standard range of MK-120 WALERS, make up a range of walers at least every 250 mm. (there are quite a lot of lengths with a 125mm gap between them in this range).



MK-120 WALERS joined by means of the WALER CONNECTOR MK.

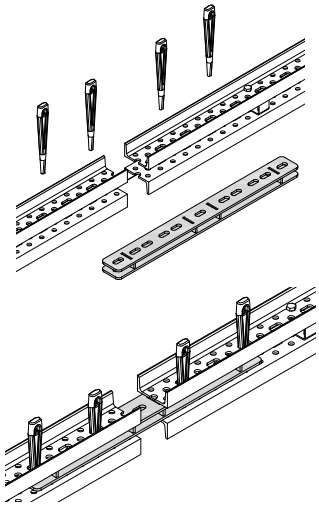
The joint will be carried out with 4 E20x70 PINS. (Each PIN will have a COTTER PIN 5).

4.1.2 PANEL CONNECTOR MK for connecting walers.

The PANEL CONNECTOR MK can be used to connect 2 WALERS to form a 3rd one.

This component can lengthen the result of connecting 2 walers between 0 and 165 mm. It is used in a similar way to the WALER CONNECTOR, but it makes possible to achieve more lengths.

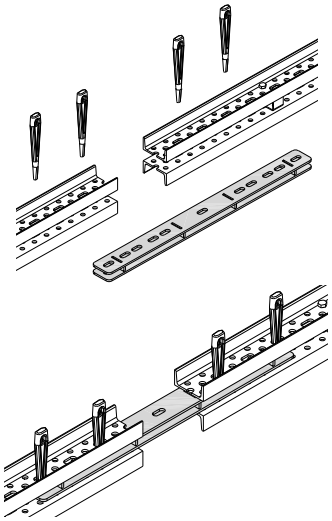
The PANEL CONNECTOR MK together with the range of MK-120 WALERS make up a very accurate range (it can be adjusted every 1 mm).



Joint of 2 MK-120 WALERS by means of the PANEL CONNECTOR MK.

4.1.3 ADJUSTABLE CONNECTOR MK for connecting walers.

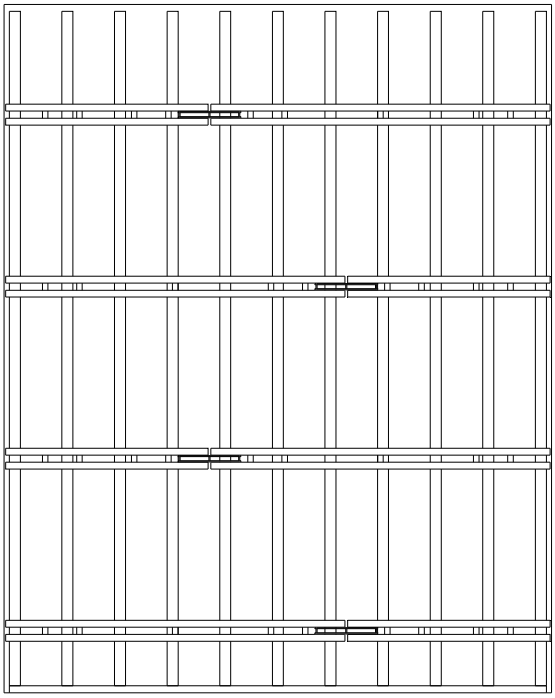
The ADJUSTABLE CONNECTOR MK connects 2 WALERS MK-120 to form a 3rd one. It lengthens the result of connecting 2 walers between 165 and 310 mm.



Joint of 2 MK-120 WALERS by means of the ADJUSTABLE CONNECTOR MK.

4.1.4 Criterion to be followed

- Whenever PANELS are assembled by means of WALER CONNECTORS MK or ADJUSTABLE CONNECTORS MK, the BOARD must be placed before shifting the PANEL.
- **Whenever it is possible, MK-120 WALERS will be assembled in zigzag, always trying to be different in length, i.e.: it is better a WALER MK-120 of 3.125+2.125 than another of 2.625+2.625. This way, the joint will never be in the same point.**



Position of WALER CONNECTOR or ADJUSTABLE CONNECTOR in a PANEL.

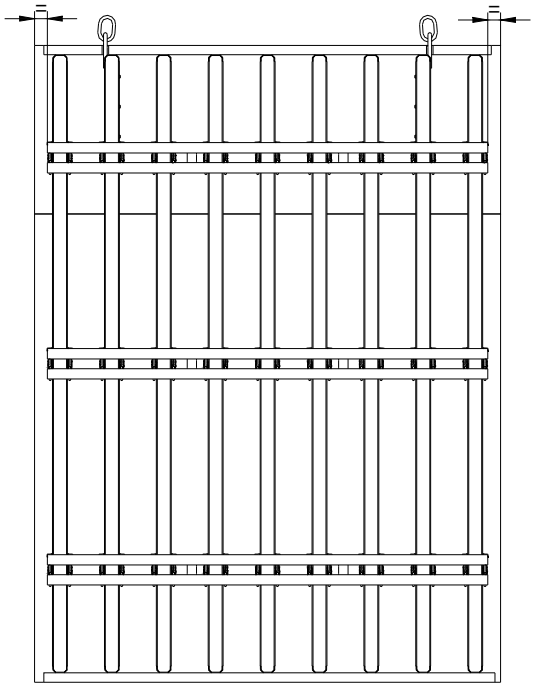
4.2. BOARD PLACEMENT IN PANELS

The width of the PANEL is delimited by the width of the BOARD. When a PANEL is 5 m wide, that means that its BOARD is 5 m wide.

Nevertheless, as seen in chapter 4.1, the length of the WALER MK-120 is 125 mm shorter than the width of the PANEL.

Example: a 5 m wide PANEL has a 5 m wide BOARD. Nevertheless, the WALER MK-120 will be 2,375 m long.

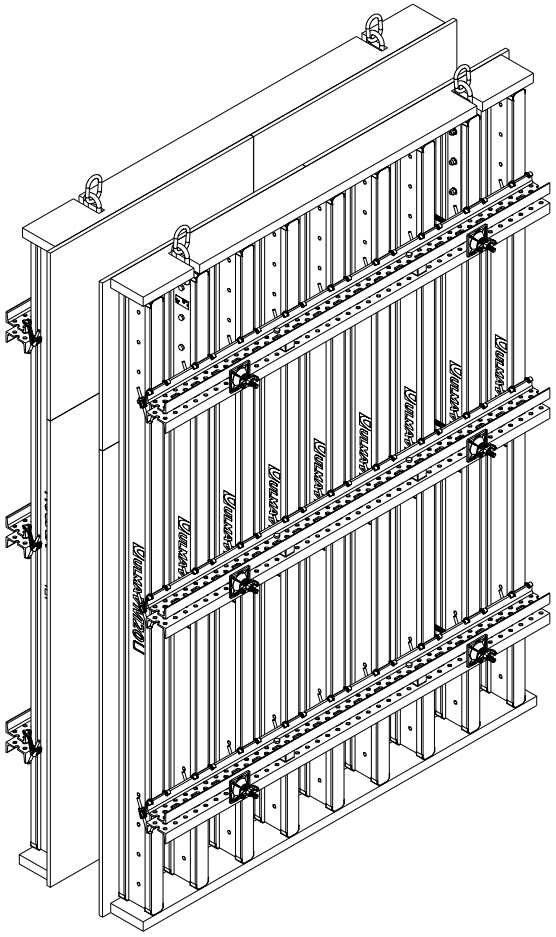
The 125 mm difference between the length of the WALER MK-120 and the width of the BOARD will be shared equally on both sides of the PANEL (i.e., the BOARD will be 6,25 cm out from both sides of the WALER MK-120).



The BOARD must be centred in the PANEL.

4.3. TIE ROD PLACING

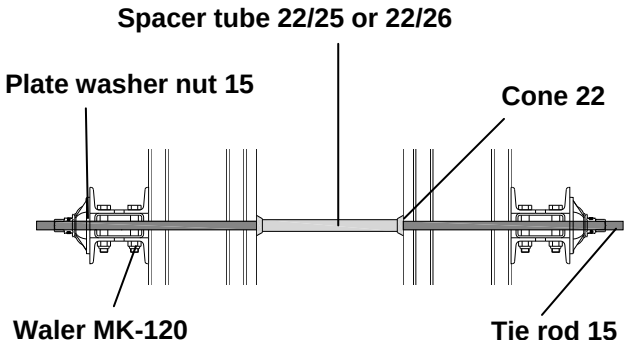
The TIE RODS used in ENKOFORM VMK are mainly TIE RODS 15.



2 PANELS with TIE RODS 15 and PLATE WASHER NUTS 15.

TIE RODS 15 will always be placed through the gap between the two UPN profiles of the MK-120 WALERS and they are tied up by NUT WASHER PLATES 15.

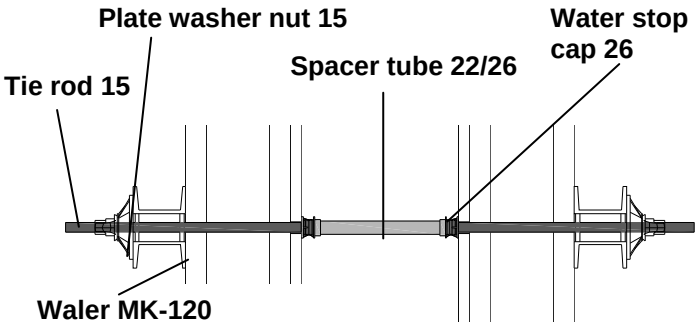
Between the PANELS of both sides, a SPACER TUBE 22 will be introduced, with CONES 22 on both sides.



Detail of the joint of two face-to-face-PANELS with SPACER TUBES 22 and CONES 22 between them.

In case of liquid-hold-back, WATER STOP CAPS 26 will be used instead of CONES 22. The SPACER TUBE 22/26 will be placed between the 2 WATER STOP CAPS 26. The PLUG 26 will be introduced in the WATER STOP CAP 26 to avoid water leak.

This system lasts a liquid limit pressure of a 10 m height.

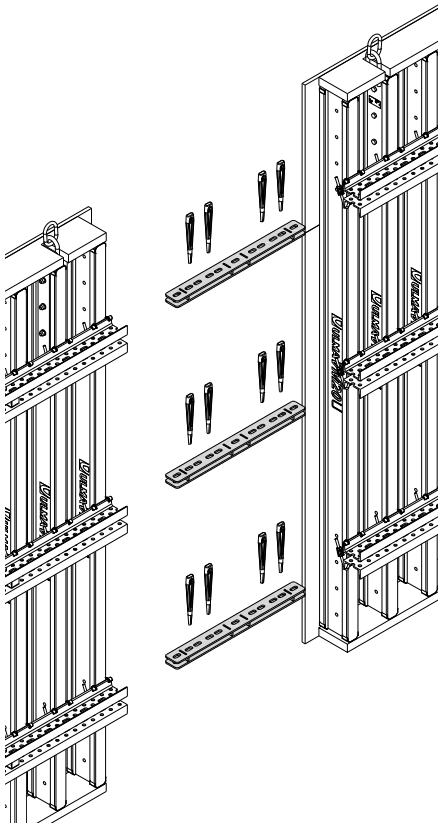


Detail of the joint of two face-to-face-PANELS with SPACER TUBES 22/26 and WATER STOP CAPS.

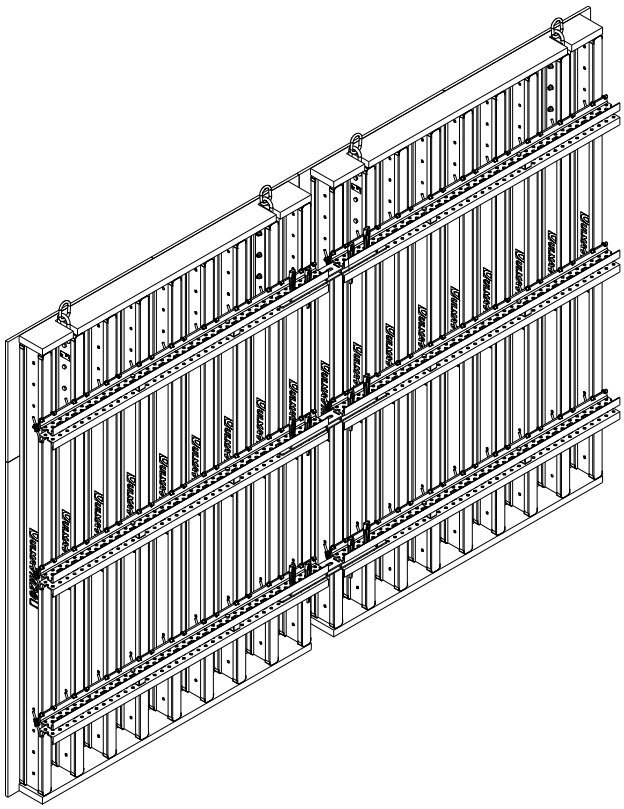
The maximum working load of TIE RODS 15 is 90 kN.

4.4. JOINT BETWEEN PANELS (WITH NO FILLER)

The component used to join two PANELS together (with no filler between them) is the PANEL CONNECTOR MK.



Joint between 2 PANELS by means of the PANEL CONNECTOR MK.



Two PANELS joined by means of the PANEL CONNECTOR MK.

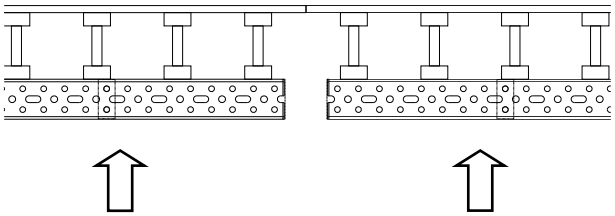
Main functions of the PANEL CONNECTOR MK:

- Bring the PANELS over and link them together hermetically when positioning them in their right place. It warranties the hermetic nature of the joint.
- Correct possible assembling errors of the PANELS.

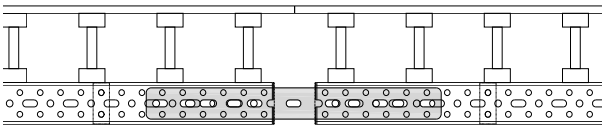
4.4.1 Bring panels over. Tightness

The easiest way of using the PANEL CONNECTOR MK is to tie it first to the already fixed and plumbed PANEL. Place the PANEL CONNECTOR MK keeping its centre to the joint and fix it by means of two WEDGES MK.

The adjoining PANEL will be some millimetres away from the plumbed one. It is better if the BOARDS do not touch each other yet.

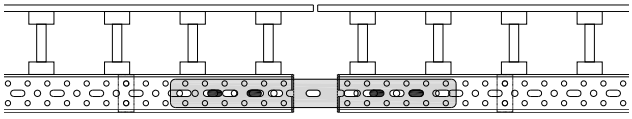


The PANEL CONNECTOR MK is placed on the PANEL that is already fixed and plumbed.

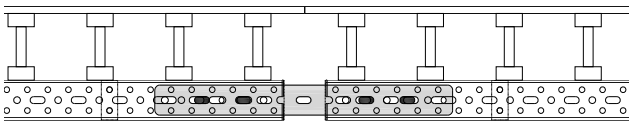


2 WEDGES MK are introduced in the PANEL CONNECTOR MK and the already plumbed PANEL.

In the left PANEL, insert the wedge in the 1st hole of the WALER and in the 2nd (starting from the centre) of the PANEL CONNECTOR.



The other 2 WEDGES MK are introduced in the holes of the other PANEL.

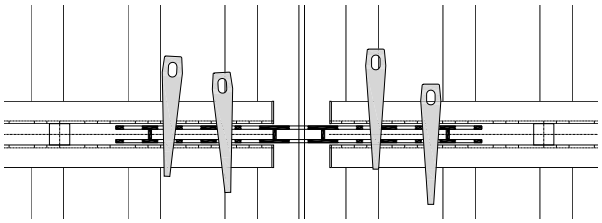


The WEDGES MK are introduced more.

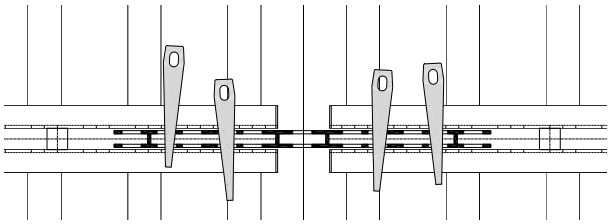
If there is a gap of some millimetres between the two BOARDS, it will go diminishing every time one of the WEDGES MK of each side is introduced more.

Depending on the gap between the BOARDS, it may be necessary to change the WEDGE MK from the hole.

The joint will be finished and fixed when the BOARDS of both PANELS have no gap between them.



4 WEDGES MK are introduced in the holes.



By introducing one of the WEDGES MK even more, the PANELS come together.

4.4.2 Correction of errors when placing the Board

The position of the WALER MK-120 inside a PANEL can change from its theoretical position (centralized with regard to the BOARD). This is known as assembling interval or tolerance.

The PANEL CONNECTOR MK guarantees that PANELS can be assembled when the gap between the WALERS is between 0 and 150 mm.

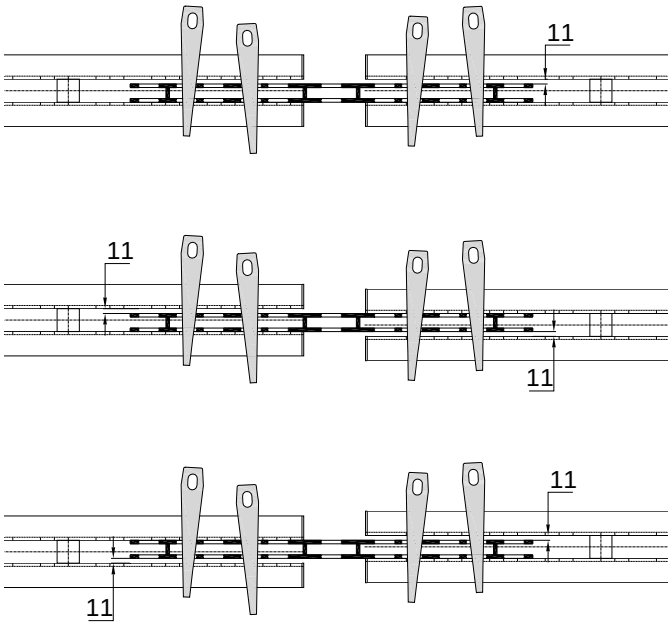
If the gap is bigger than 150 mm, the PANEL CONNECTOR will not be able to close it.

4.4.3 Correction of errors when assembling walers in panels.

It may happen that PANELS have an assembling error in the position of MK-120 WALERS. So, when 2 of these PANELS were placed next to each other, MK-120 WALERS would not be in the same height, and there would be problems to join PANELS with each other.

The gap between the width of the PANEL CONNECTOR MK and the hollow of the WALER MK-120 is 1.1 cm. That is the maximum possible error in the distance between two walers.

The PANEL CONNECTOR MK is designed in such a way that it will work without any problem within this range.



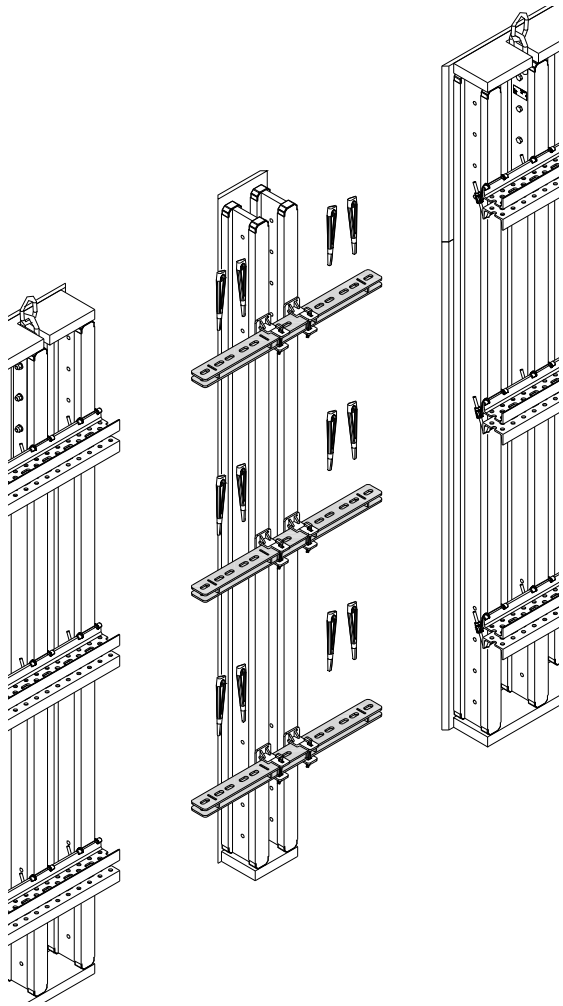
Allowed error range of the PANEL CONNECTOR.

It is suggested that PANELS should be assembled on a flat surface, on a pattern tool. The assembling errors can be reduced considerably if PANELS are assembled in prepared installations, with appropriate tables or patterns.

4.5. JOINT BETWEEN PANELS (WITH FILLER)

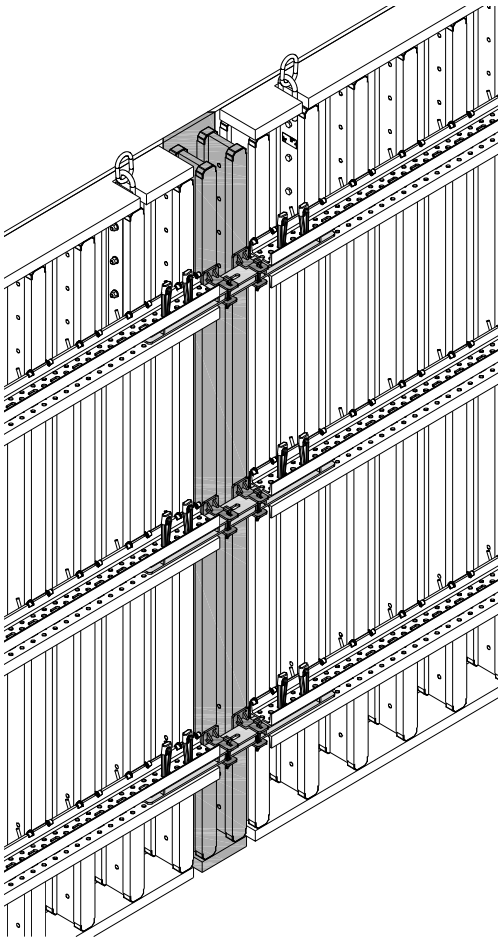
4.5.1 By means of BOARD and VM20 BEAMS

The component used to join two PANELS with a filler between them is the ADJUSTABLE CONNECTOR MK.



Joint between two PANELS with a filler PANEL between them.

When it is required to join 2 PANELS with a filler PANEL between them, they will be joined by means of the ADJUSTABLE CONNECTOR MK. The FILLER PANEL is usually used for stripping (after concreting).



Two PANELS joined with a FILLER PANEL between them.

Main functions of the ADJUSTABLE CONNECTOR MK:

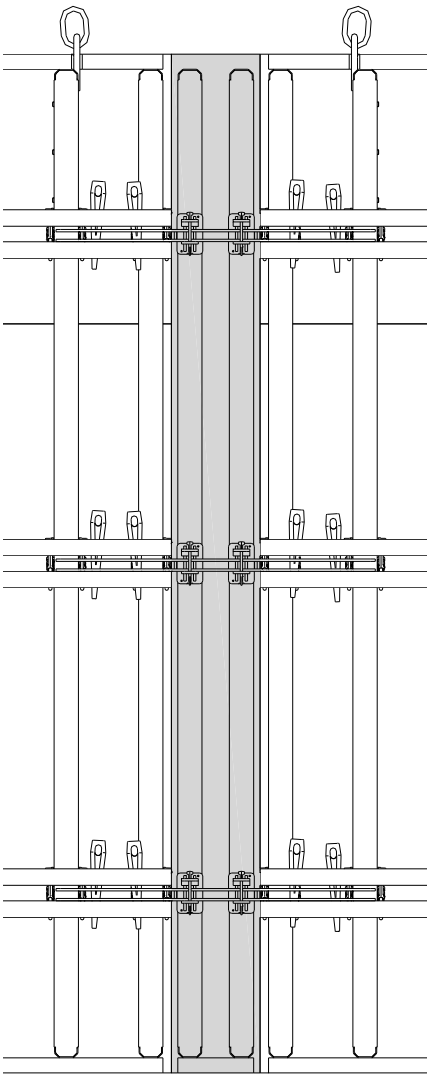
- To form FILLER PANELS.
- Correct the possible errors of PANEL assembling.

4.5.1.1 *Making filler panels*

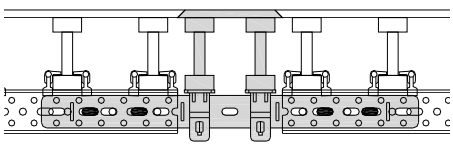
FILLER PANELS are formed by ADJUSTABLE CONNECTOR MK, WALER-VM20 CLAMPS, VM20 BEAMS and BOARD.

FILLER PANELS will have the corners of the BOARD cut in chamfer (on both sides).

Both PANELS will also have corners cut in chamfer. This allows an easier stripping.



FILLER PANEL between 2 PANELS.



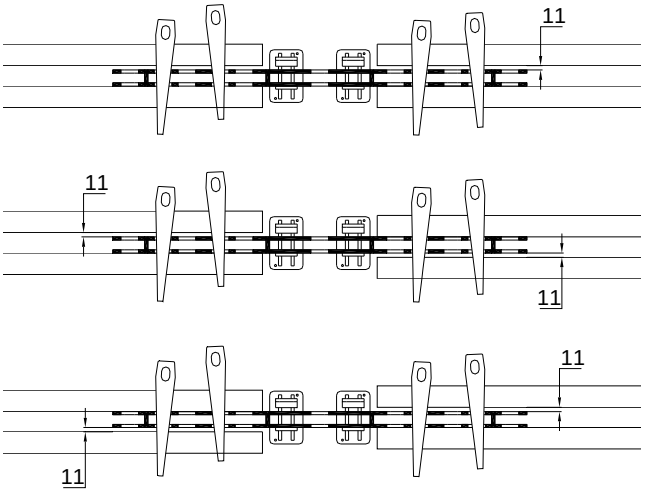
Detail of the FILLER PANEL.

4.5.1.2 *Correction of the assembling errors of the walers in panels*

Some errors could be made when assembling PANELS (for example, misplacing the WALER MK-120 in height). Therefore, when 2 of these PANELS were placed next to each other, their MK-120 WALERS would not match in height, and it would bring problems to join the two PANELS.

The gap between the width of the ADJUSTABLE CONNECTOR MK and the hollow of the WALER MK-120 allows an 1,1 cm error tolerance.

The PANEL CONNECTOR is designed in such a way that whenever it works in this range, the CONNECTOR will work in a proper way. If the assembling error is bigger, it will not be possible to introduce the PANEL CONNECTOR in the joint.

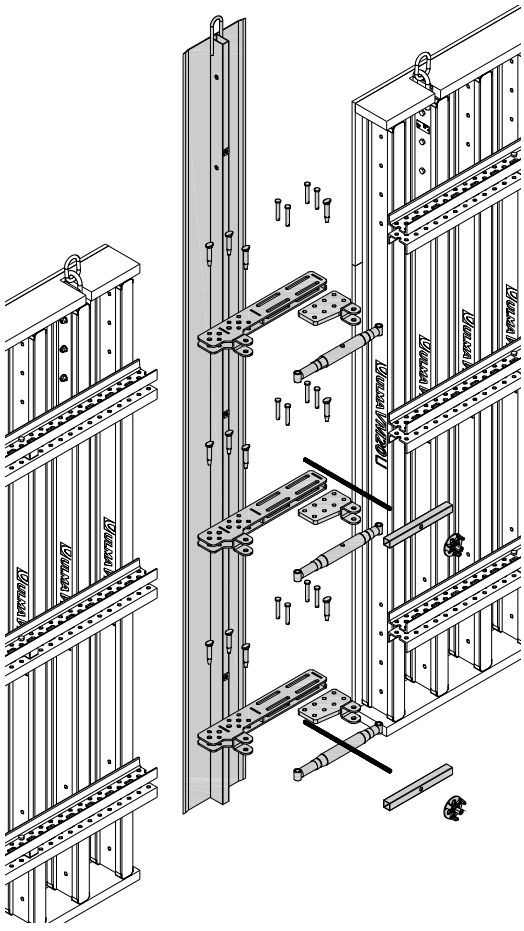


Error range of assembly that absorbs the ADJUSTABLE CONNECTOR MK.

The gap between the width of the ADJUSTABLE CONNECTOR MK and the hollow of the WALER MK-120 allows an 1,1 cm error tolerance.

4.5.2 By means of the compensation plate

Components used to connect two PANELS with a COMPENSATION PLATE between them are: ADJUS. COMPENSATION CONNECTOR MK, ADJUS. COMPENSATION HEAD MK, and 1" PUSH-PULL PROP. They are connected by means of the PIN E20x70.

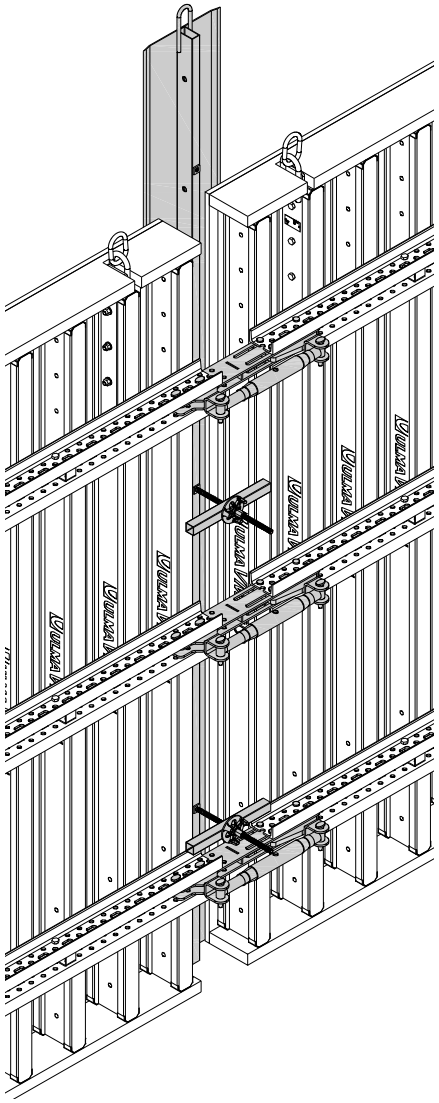


Connection between two PANELS by means of a COMPENSATION PLATE between them.

The COMPENSATION PLATE is usually used for the stripping (once the wall has been concreted), when it is a non-fair-faced wall.

The main functions of the ADJUS. COMPENSATION CONNECTOR MK with the ADJUS. COMPENSATION HEAD MK and the PUSH-PULL PROPS are:

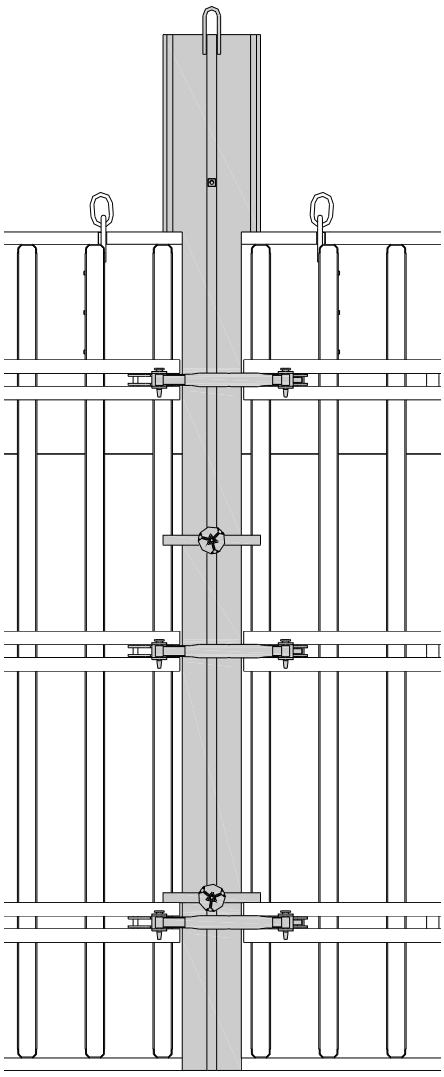
- To connect 2 PANELS with a gap between them.
- To correct possible errors that may be made in the assembly of the PANELS.



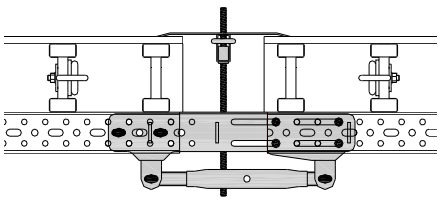
Two PANELS connected to each other with a COMPENSATION PLATE placed between them.

4.5.2.1 *To connect 2 PANELS with a COMPENSATION PLATE between them*

PANELS on both sides do not need to have the edges cut in chamfer. The COMPENSATION PLATE is leaned on the concreting face of the BOARD.



COMPENSATION PLATE between 2 PANELS.



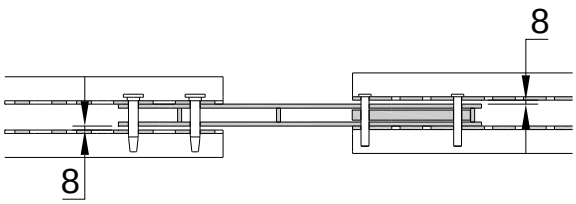
Detail of the COMPENSATION PLATE.

4.5.2.2 *To correct assembly errors of walers in PANELS*

Some errors could be made when assembling PANELS (for example, misplacing the WALER MK-120 in height). Therefore, when 2 of these PANELS were placed next to each other, their MK-120 WALERS would not match in height, and it would bring problems to join the two PANELS.

The gap between the width of the ADJUS. COMPENSATION CONNECTOR MK and the hollow of the WALER MK-120 allows an 8 mm error tolerance.

The PANEL CONNECTOR is designed in such a way that whenever it works in this range, the CONNECTOR will work in a proper way. If the assembling error is bigger, it will not be possible to introduce the PANEL CONNECTOR in the joint.

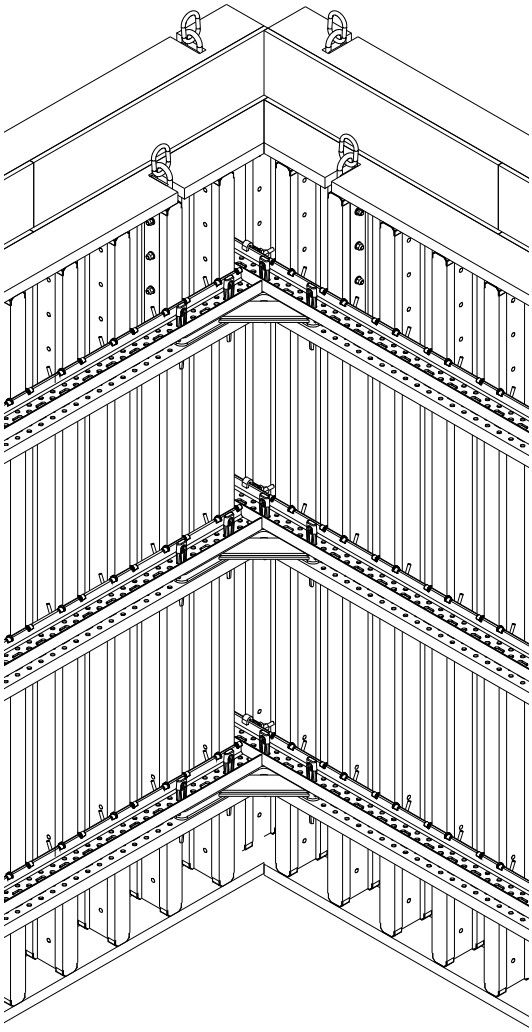


Error range of assembly that absorbs the ADJUS. PLATE CONNECTOR MK.

4.6. 90º CORNERS

In 90º corners, the outer and inner parts will be solved in different ways:

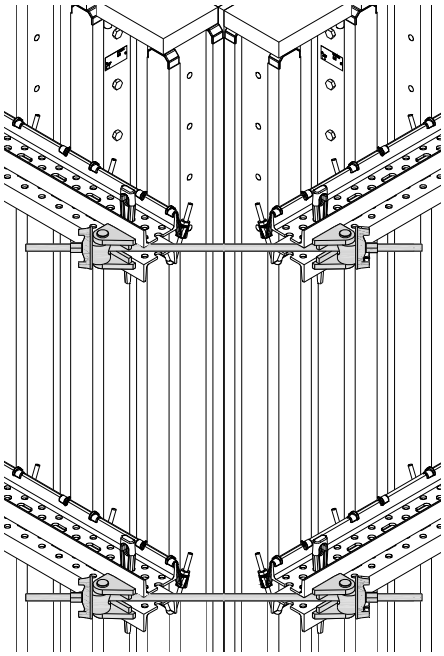
- The outer part is solved by means of MK OUTSIDE CORNER HEADS.
- The inner one is solved by means of the CORNER CONNECTOR MK:



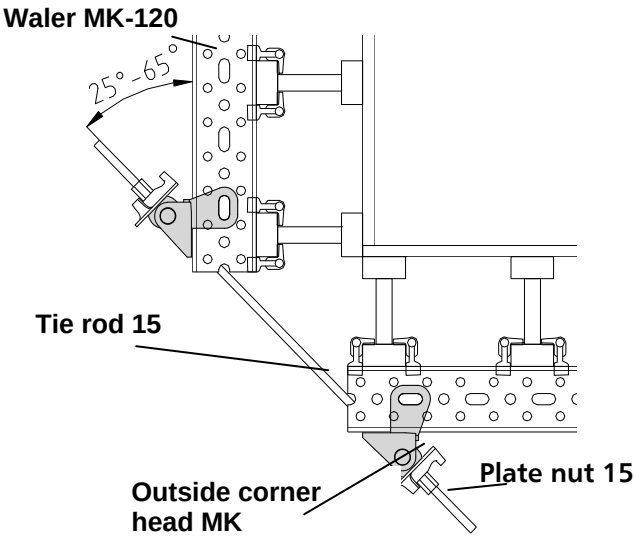
Example of solution to inner 90º corners.

4.6.1 Outer solution. Outside corner head

The outer part of the joint of two PANELS is solved with the OUTSIDE CORNER HEAD MK.



Solution of the outer part of 90º corners with the OUTSIDE CORNER HEAD.



Detail of the joints of the PANEL.

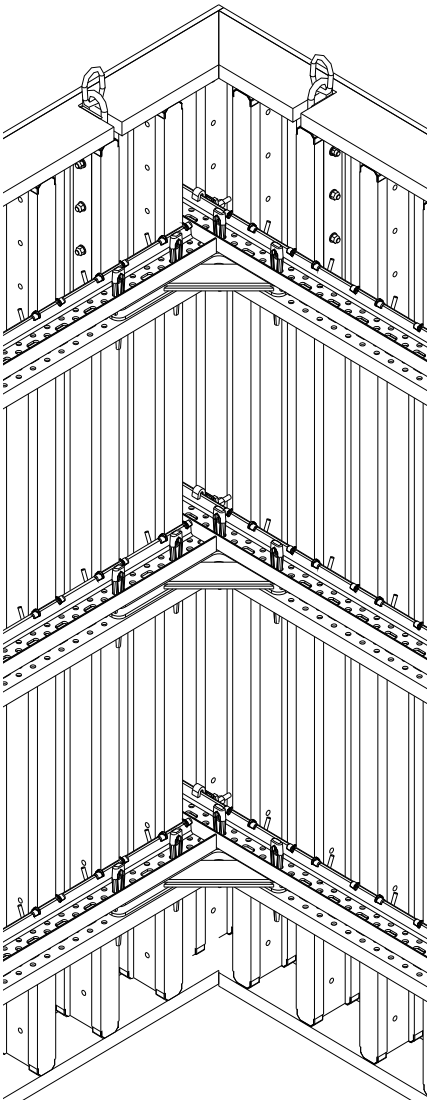
The optimum working angle is 45º. The working range of the OUTSIDE CORNER HEAD MK is between 25 and 65º.

Each OUTSIDE CORNER HEAD will have 1 WEDGE MK.

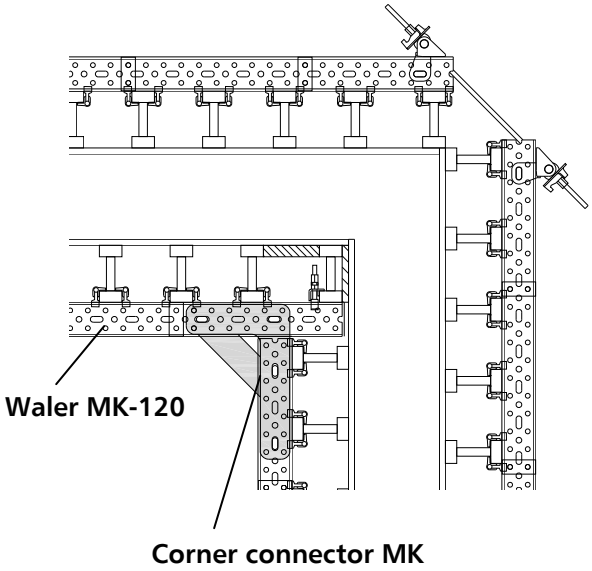
4.6.2 Inner solution. Corner connector MK

4.6.2.1 *Corner connector MK*

The CORNER CONNECTOR MK makes it possible to connect 2 different MK-120 WALERS perpendicular to each other.



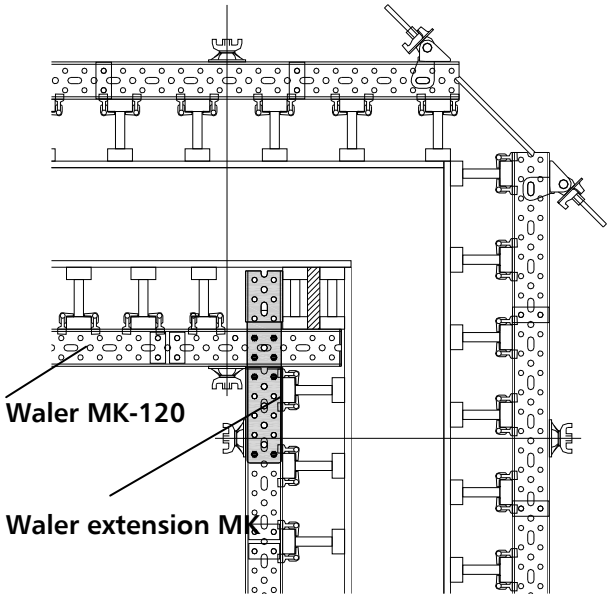
2 PANELS connected by the CORNER CONNECTOR.



The CORNER CONNECTOR MK connects 2 PANELS perpendicular to each other.

4.6.2.2 *Waler extension MK*

L-shaped PANELS can be formed by means of the WALER EXTENSION. This component makes it possible to form PANELS with different lengths on each side. It also gives the possibility of adjusting the length in one of the sides.



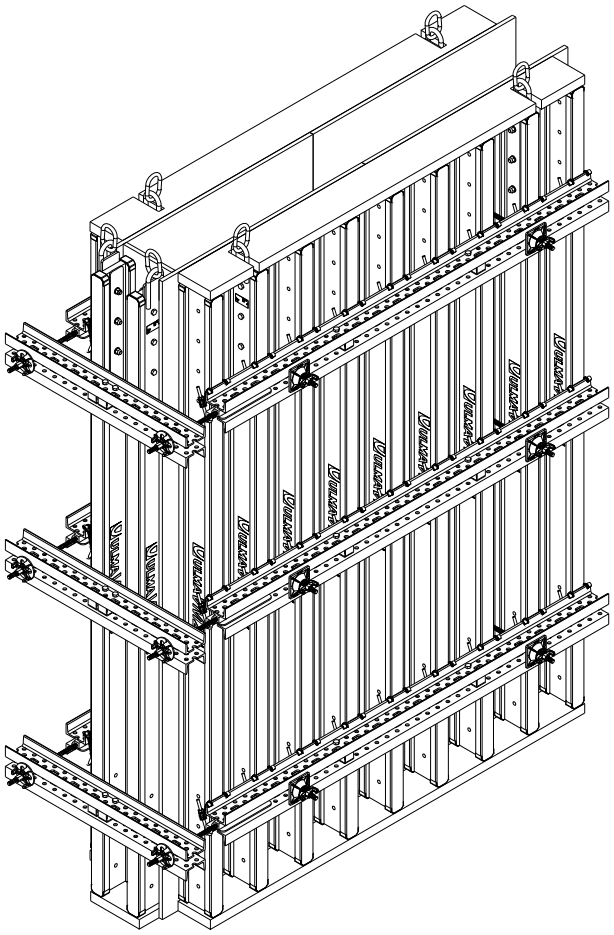
An L-shaped PANEL can be formed by means of the WALER EXTENSION MK.

4.7. BULKHEADS

ENKOFORM VMK offers an easy and useful solution to bulkheads.

The BULKHEAD PANEL will be placed perpendicular to the other 2 PANELS.

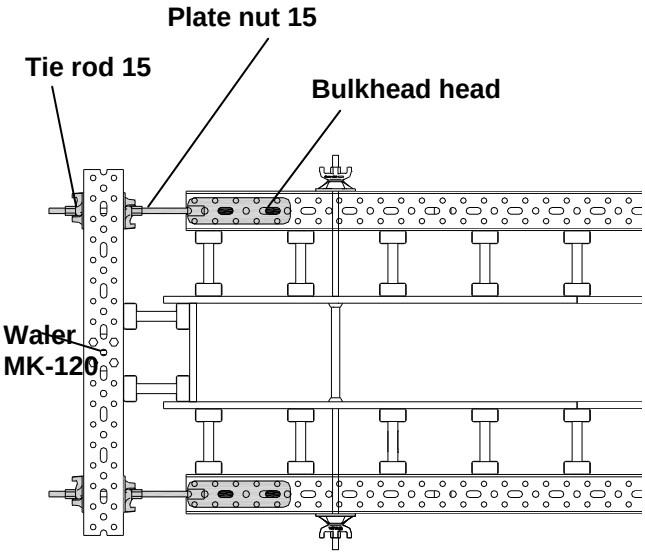
The joint between the BULKHEAD PANEL and the other 2 PANELS will be carried out by means of BULKHEAD HEADS MK, TIE RODS 15 and PLATE NUTS 15.



A general solution of BULKHEADS.

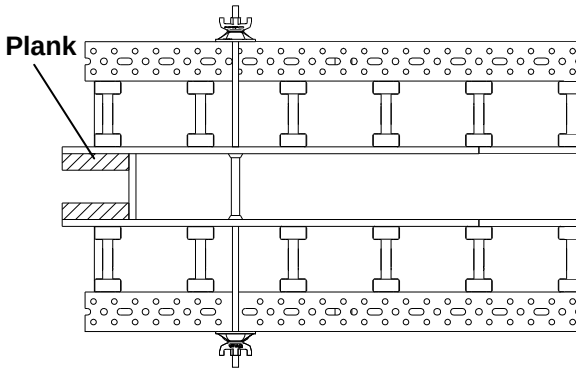
The solution depends on the width of the wall. The width limit to solve the wall in one or another way is 20 cm.

4.7.1 Wide walls



Solution to wide bulkheads by means of BULKHEAD HEADS MK.

4.7.2 Thin walls

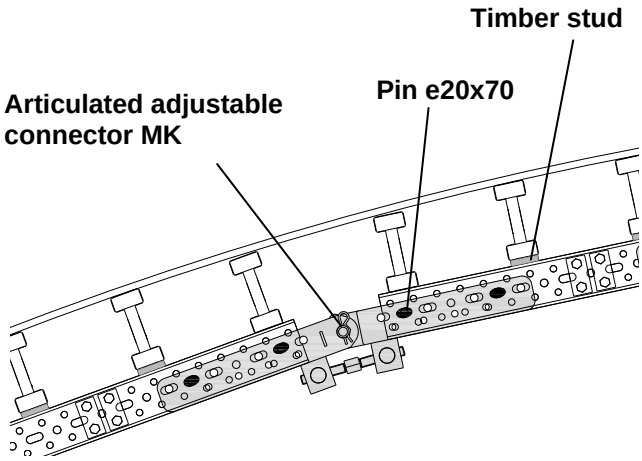


Solution to thin bulkheads by means of planks.

4.8. ROUND FORMWORK

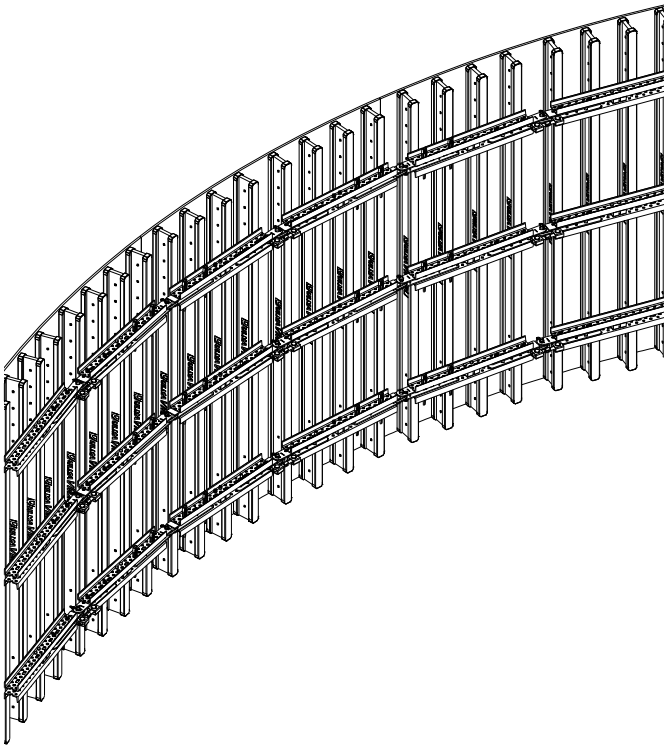
This type of formwork will be used in walls with radius bigger than 20 m.

2 different CONNECTORS are used in round formwork. The ARTICULATED ADJUSTABLE CONNECTOR MK is used for connecting 2 WALERS MK inside a round PANEL. The ARTICULATED CONNECTOR MK is used for connecting 2 round panels.



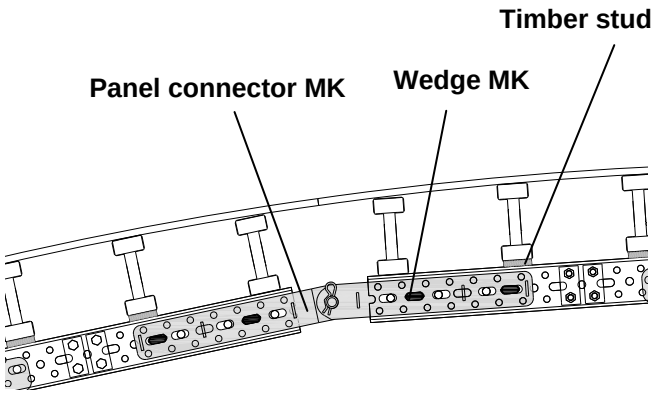
The ARTICULATED ADJUSTABLE CONNECTOR MK connects 2 different WALERS MK-120 inside 1 PANEL.

4.8.1 Inner solution



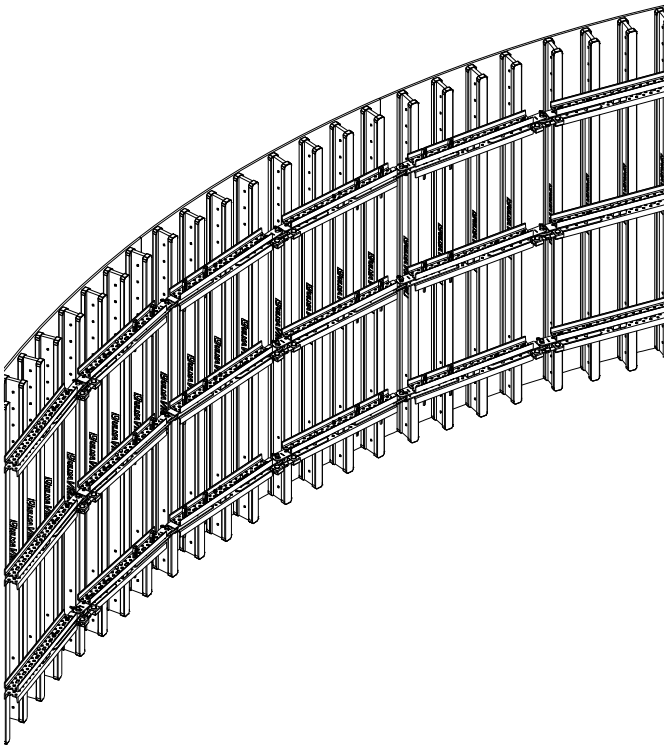
General view of an inner circular formwork.

Where necessary, TIMBER STUDS are placed between the BEAM VM20 and WALER MK-120. This way, the radius is obtained easily.

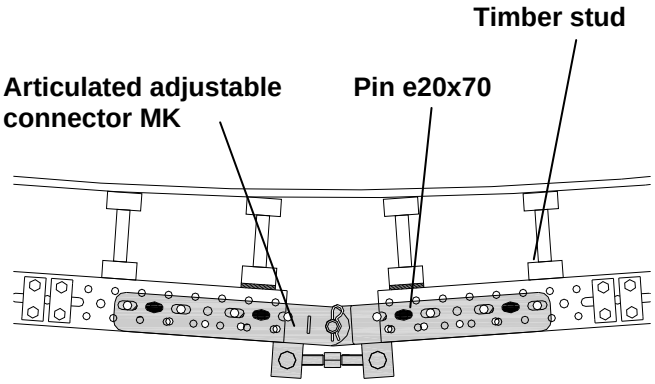


The ARTICULATED CONNECTOR MK connects 2 different PANELS.

4.8.2 Outer solution

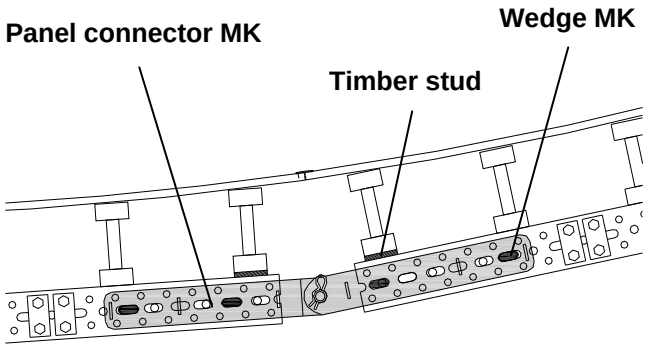


General view an outer circular formwork.



The ARTICULATED ADJUSTABLE CONNECTOR MK connects 2 different WALERS MK-120 inside 1 PANEL.

Where necessary, TIMBER STUDS are placed between the BEAM VM20 and WALER MK-120. This way, the radius is obtained easily.



The ARTICULATED CONNECTOR MK connects 2 different PANELS.

4.9. LIFT SHAFTS OR PIERS

Lift shafts and piers are solved in a similar way.

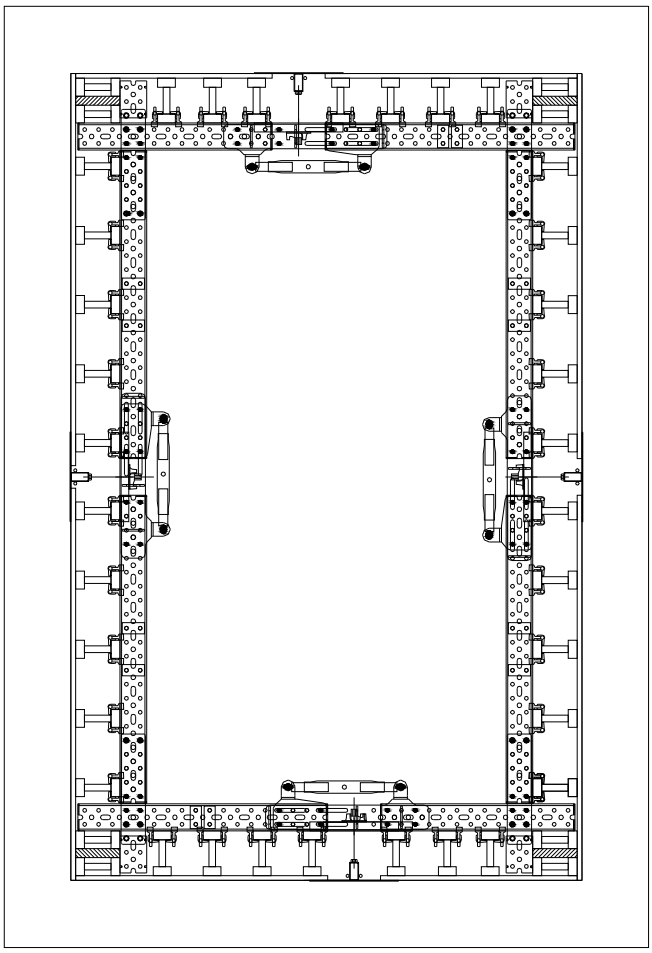
4.9.1 Solution of the inner part

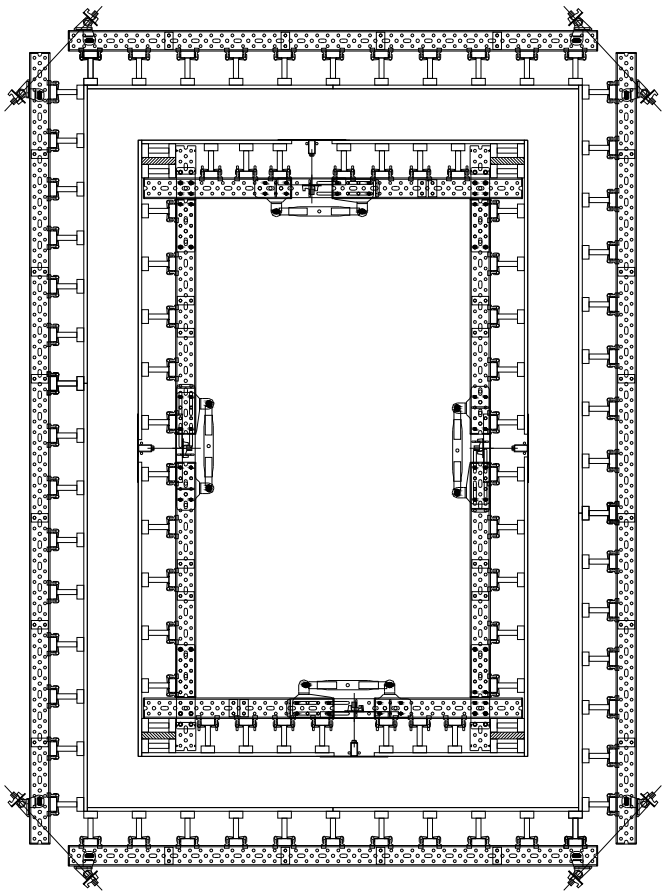
The inner part is solved by means of 4 CORNER PANELS and 4 COMPENSATION PLATES, because they are no fair-faced walls. PANELS are connected to each other by means of ADJUS. COMPENSATION CONNECTORS MK, ADJUS. COMPENSATION HEADS MK and PUSH-PULL PROPS.

4.9.2 Solution of the outer part

Whenever it is possible, the outer part will be solved with one PANEL on each side. In case it were not possible, the number of PANELS used to solve it will be as low as possible.

The four straight PANELS will be connected to each other by means of OUTSIDE CONRNER HEADS MK, TIE RODS and PLATE NUTS 15.





4.10. PILASTERS

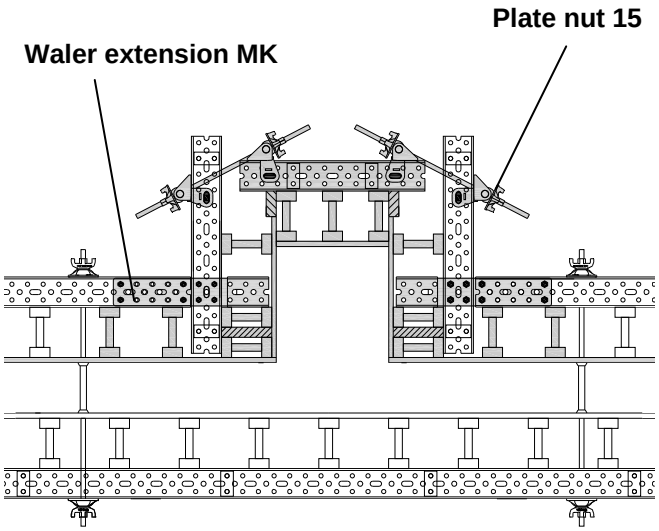
The side of the wall with no bulkhead will be solved by means of any PANEL (differing from the modular formwork ORMA). In other words, when solving one side of the wall, it does not matter at all what happens on the other side.

The inner corner can be solver in 2 different ways:

- By means of the WALER EXTENSION MK.
- By means of the CORNER CONNECTOR MK.

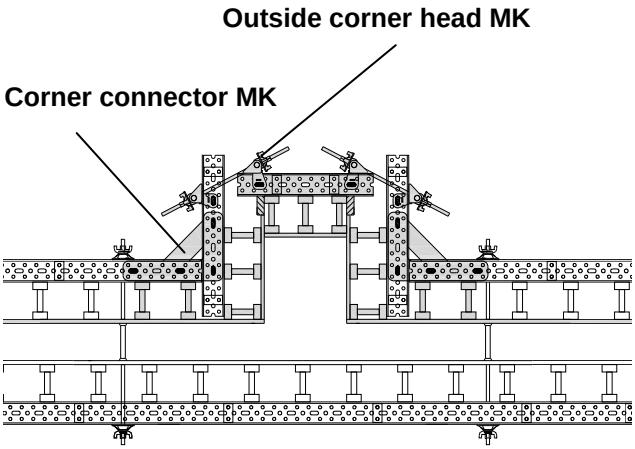
4.10.1 Solution with the WALER EXTENSION MK

In this case, the connection will be carried out by means of 8 BOLTS M16, what makes it possible that in one of the sides can be placed PROFILES MK instead of WALERS (i.e., it allows shorter lengths than 1,125). If necessary, a SPACER TUBE MK-120/52 will be placed.



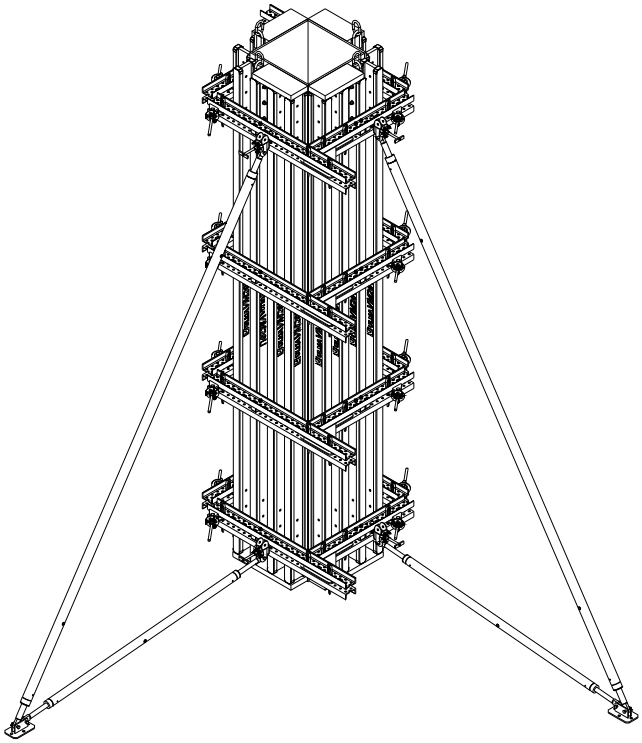
4.10.2 Solution with the CORNER CONNECTOR MK

In this case, if it is wanted to solve one side with a length shorter than 1,125 m, a WALER will have to be formed by means of PROFILES MK-120 and SPACER TUBES MK-120/52.



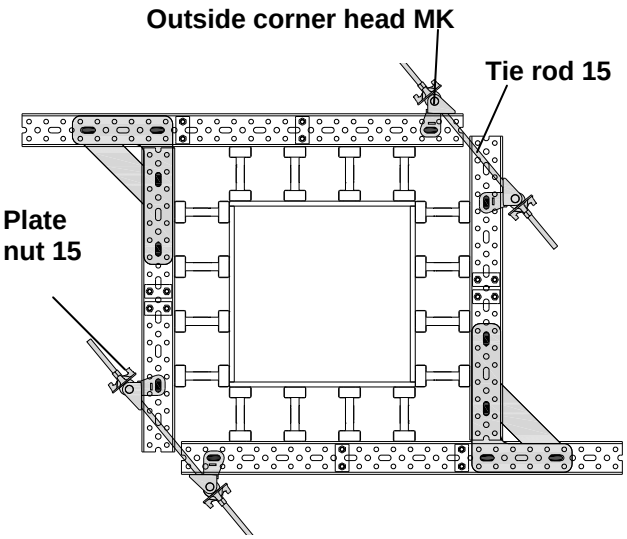
4.11. COLUMN SOLUTION

ENKOFORM VMK also allows solving formwork columns.



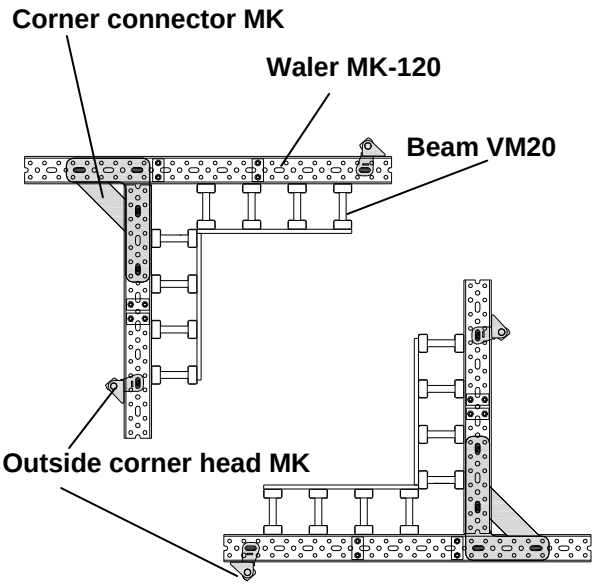
General view of the formwork column.

The column formwork consists of two column PANELS joined to each other by means of the OUTSIDE CORNER HEAD MK, WEDGES MK, TIE RODS 15 and PLATE NUTS 15.



Top view of a column by means of the formwork ENKOFORM VMK.

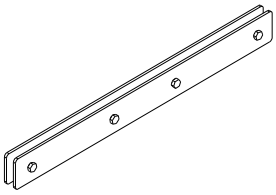
On the other hand, column PANELS are formed by MK-120 WALERS, VM 20 BEAMS, RVM20 CLAMPS, E V-100 LIFTING BRACKETS, CORNER CONNECTORS, BOARDS and planks.



The 2 COLUMN PANELS that form the column formwork.

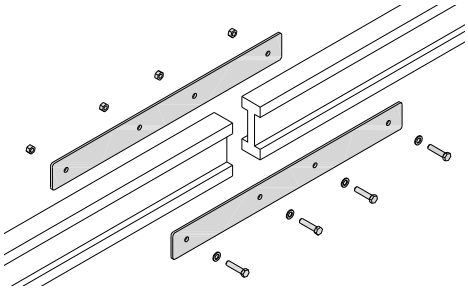
4.12. BEAM VM20 CONNECTION PLATE

The BEAM VM20 CONNECTION PLATE makes possible to connect two VM20 BEAMS lengthways.

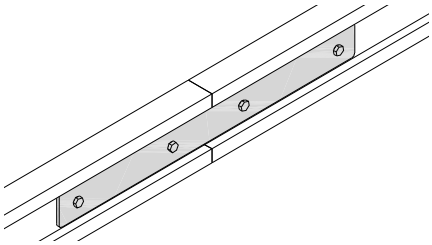


BEAM VM20 CONNECTION PLATE.

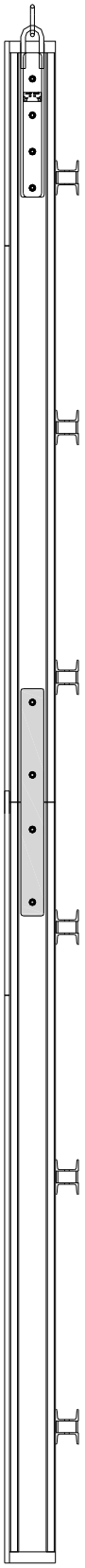
The joint is carried out by means of 4 BOLTS M16, using the holes of the BEAMS VM20.



Assembly of the BEAM VM20 CONNECTION PLATE.



Two VM20 BEAMS joined with the BEAM VM20 CONNECTION PLATE.

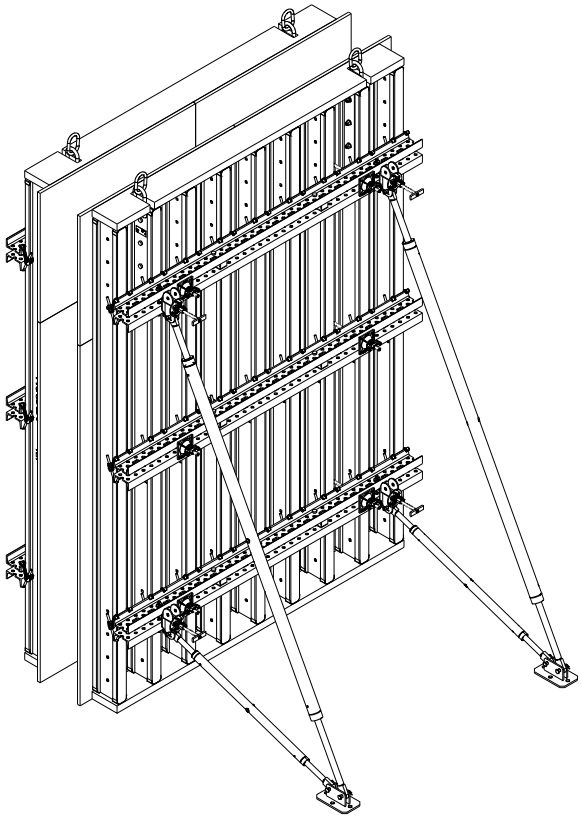


Two VM20 BEAMS joined by means of the BEAM VM20 CONNECTION PLATE.

4.13. PANEL STABILIZATION

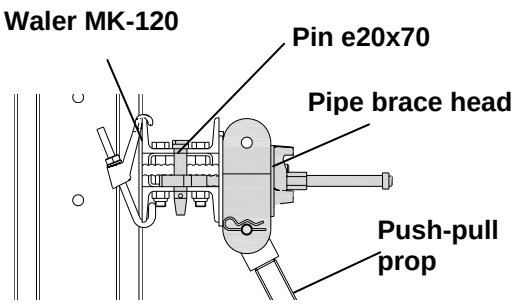
The use of PUSH-PULL PROPS to stabilize the PANELS provides:

- Protection of the formwork from possible wind strengths.
- An easier placement and position of the formwork.

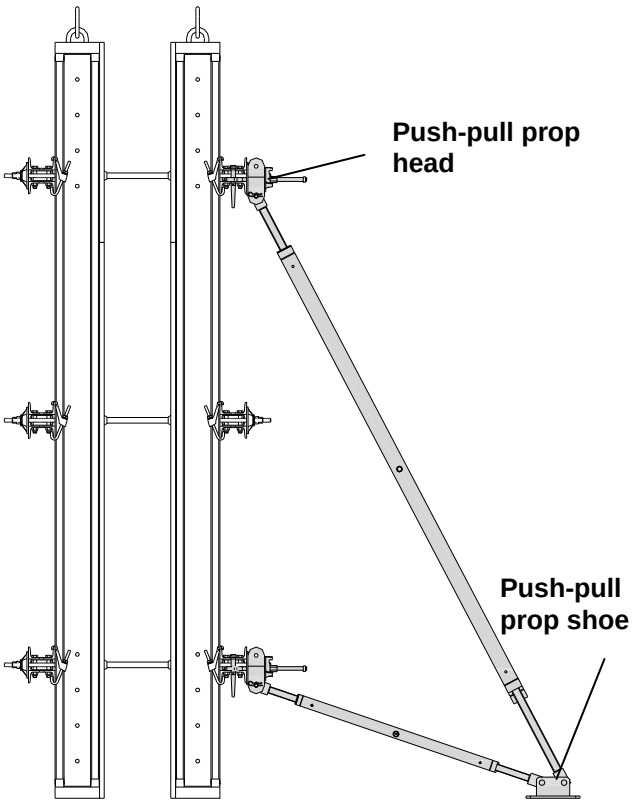


General view of PANELS with PIPE.

PUSH-PULL PROPS are joined to the MK-120 WALERS with HEAD PUSH-PULL PROPS. Just one PUSH-PULL PROPS could be placed to each HEAD PUSH-PULL PROP.

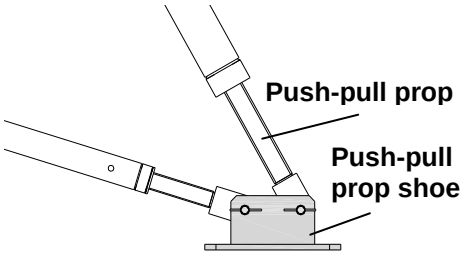


The PUSH-PULL PROPS HEAD is joined to MK-120 WALERS with one E20x190 PIN (each pin will carry at the same time a COTTER PIN R 5) or with no PIN at all.



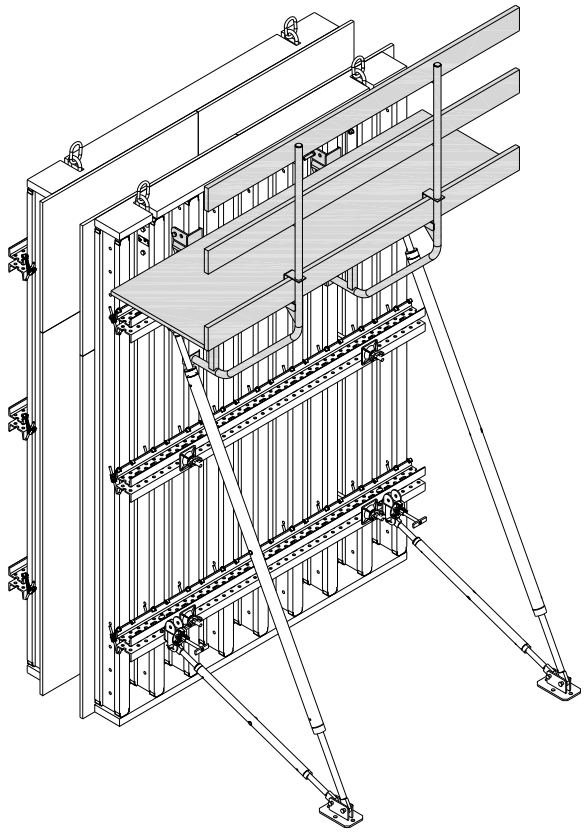
Panel with PUSH-PULL PROPS in MK-120 WALERS.

PUSH-PULL PROPS are joined to the ground by means of the PUSH-PULL PROPS SHOE, which will be anchored to the ground. Each PUSH-PULL PROP SHOES will have a maximum of 2 PUSH-PULL PROPS.



Detail of the joint of PUSH-PULL PROPS to the PUSH-PULL PROP SHOE.

4.14. WALKWAY BRACKET E V-100



General view of PANELS with TIE RODS, PUSH-PULL PROPS and E V-100 WALKWAY BRACKETS.

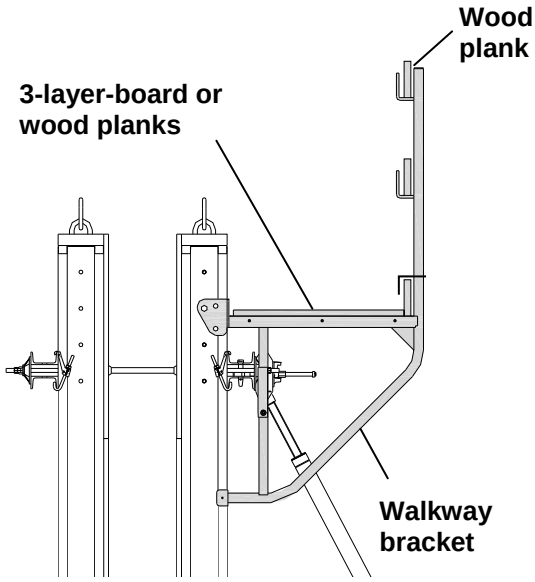
E V-100 WALKWAY BRACKETS allow forming working platforms to make possible the concreting. Some planks will be placed on walkway brackets, forming the working surface. Other planks will act as handrails.

The WALKWAY BRACKET E V-100 can be placed in:

- BEAM VM20 (vertical position):
- WALER MK-120 (horizontal position):

4.14.1 Walkway bracket in beam VM 20:

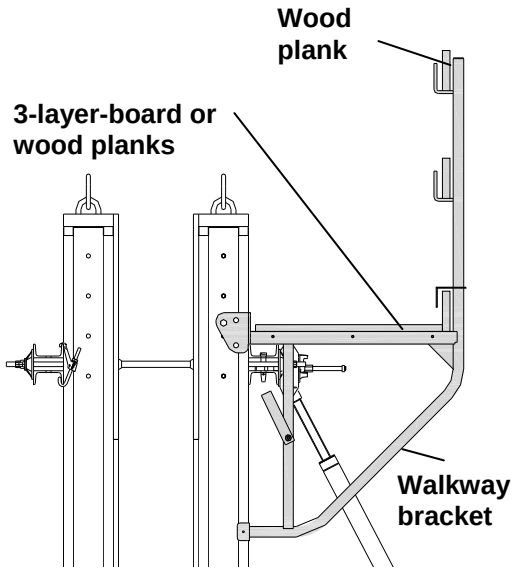
The WALKWAY BRACKET E V-100 will be placed in one of the holes used to place the BEAM VM 20 CONNECTOR. It will be fixed by means of a screw.



WALKWAY BRACKET E V-100 placed vertically in BEAM VM20.

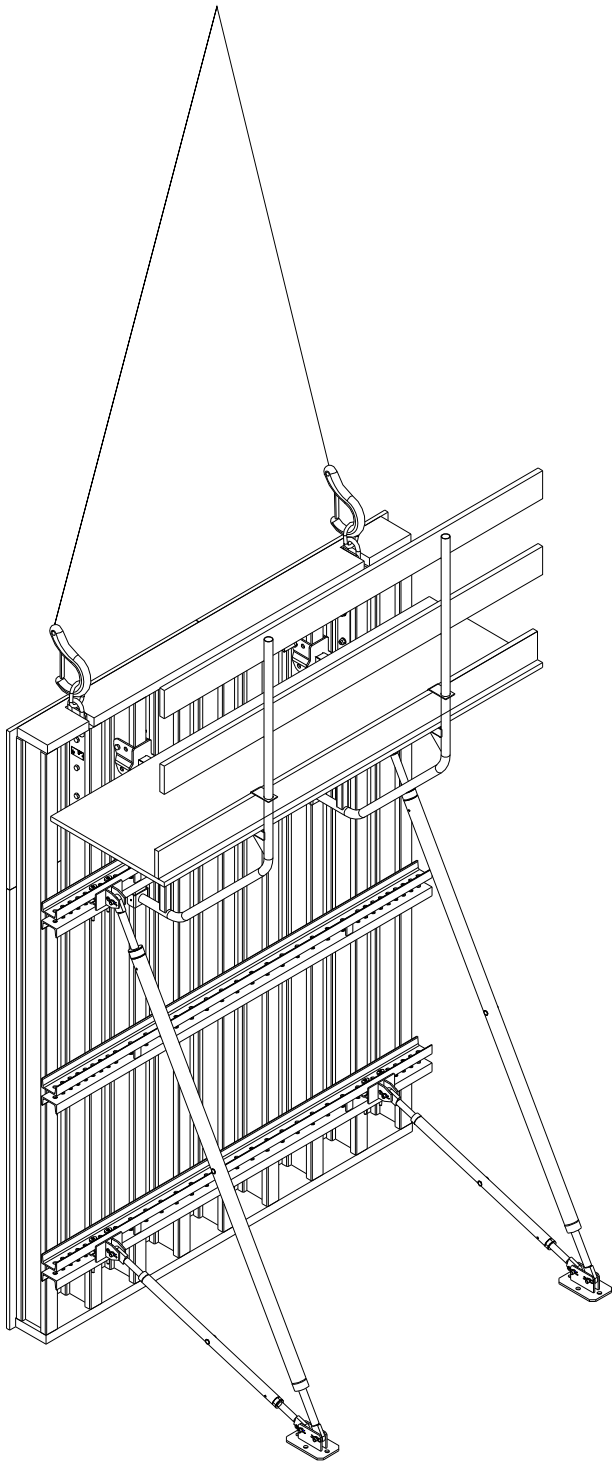
4.14.2 Walkway bracket in waler MK-120:

The WALKWAY BRACKET will lie on the wings of the UPN.



WALKWAY BRACKET placed on a WALER MK-120 in horizontal position.

4.15. SHIFTING OF PANEL



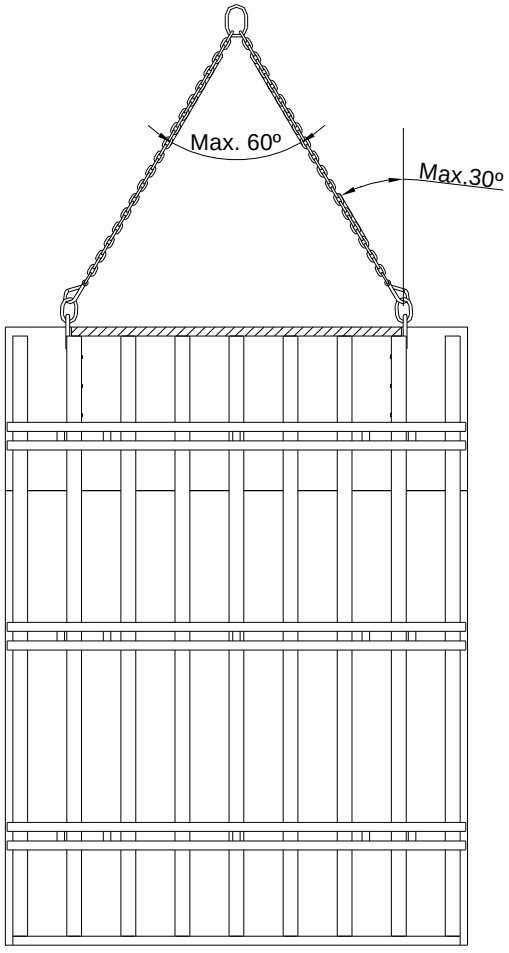
PANEL shifting with PUSH-PULL PROPS and WALKWAY BRACKETS.

Each PANEL will have 2 E V-100 LIFTING BRACKETS; i.e., the E V-100 LIFTING BRACKETS are part of the PANEL.

The LIFTING BRACKET E V-100 is fixed to the VM 20 BEAM with 4 M16 screws.

The maximum working load for each LIFTING BRACKET E V-100 is 1300 kg (13 kN). This limit could be lower depending on the configuration of the PANEL.

The maximum angle between the 2 chains of the LIFTING BRACKET E V-100 is 60º.



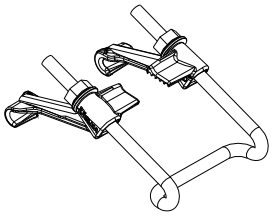
The maximum angle between the chains of the E V-100 LIFTING BRACKETS is 60º.

4.16. WALER-VM20 BEAM CLAMP TYPES

There are 2 CLAMPS that make possible to fix the WALER MK-120 to the BEAM VM20:

- WALER-VM20 CLAMP 2T
- WALER-VM20 ANGULAR CLAMP

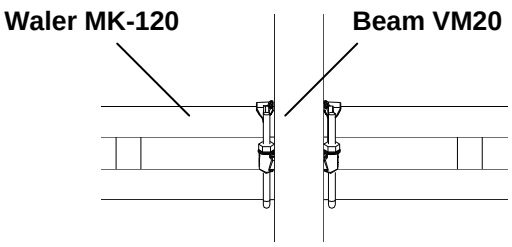
4.16.1 WALER-VM20 CLAMP 2T



General view of the WALER-VM20 CLAMP 2T.

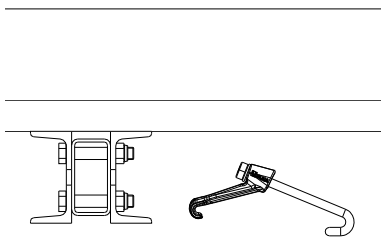
The features of this component are:

- The joint between the BEAM VM20 and the WALER MK-120 makes 90º.
- Each joint point between the WALER and BEAM VM20 will be fixed by means of **one** WALER-VM20 CLAMP 2T.
- It can be assembled in any point of the WALER and BEAM VM20, with no need of being brought in from an end of the VM20 BEAMS.
- **Two nuts** have to be tightened to tie the joint up.
- The nuts are captive.
- The assembly of the PANEL can be carried out on the ground.

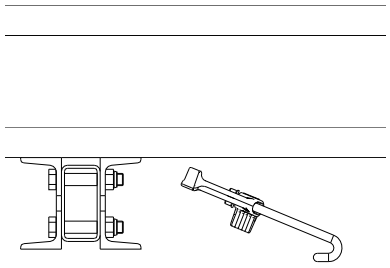


Steps for assembling WALER-VM20 CLAMPS 2T:

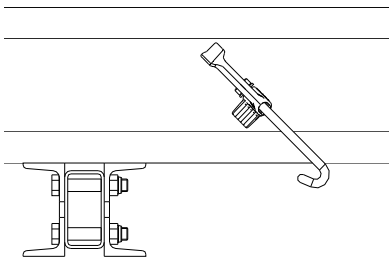
1.- The BEAMS VM20 are placed on the MK-120 WALERS. The WALER-VM20 CLAMP has to be placed under the BEAM VM20 to carry out the joint.



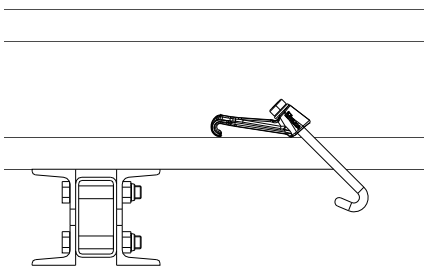
2.- The arms of the WALER-VM20 CLAMP have to be turned outwards.



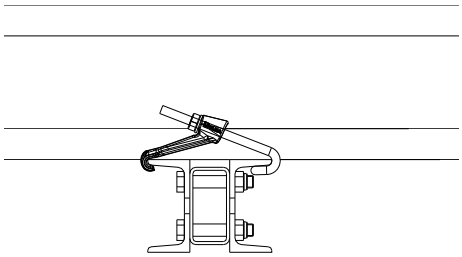
3.- The WALER-VM20 CLAMP is lift up.



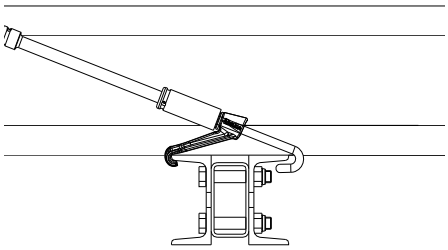
4.- The arms of the WALER-VM20 CLAMP are turned inwards (it will remain in this position to make the joint).



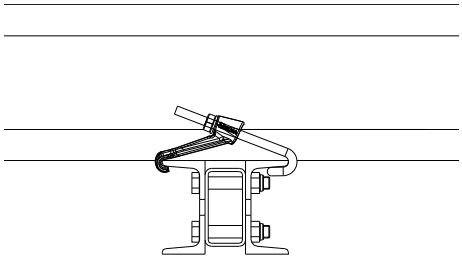
5.- The arms are inserted in the section of the WALER MK-120.

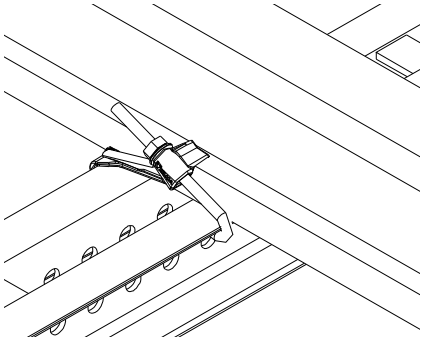


6.- The SCREWER will be used to tie up the nuts electrically.



7.- The WALER-VM20 CLAMP 2T is properly tied up.

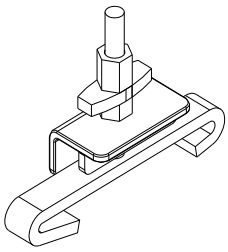




General view of the assembly of the WALER-VM20 CLAMP 2T.

The SCREWER KEY URVM20 20 can be used to tighten the screw of the CLAMP RVM20 2T electrically.
The screwdriver should have a ½" head.

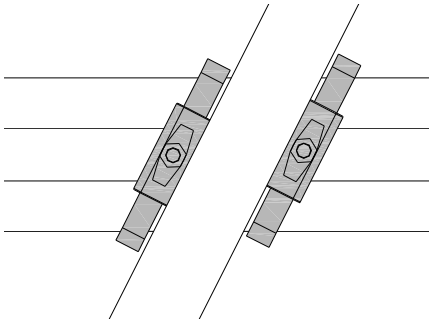
4.16.2 WALER-VM20 ANGULAR CLAMP



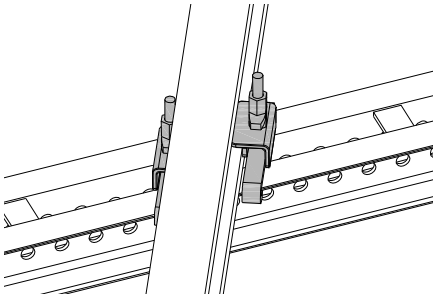
General view of the WALER-VM20 ANGULAR CLAMP.

The features of this component are:

- The angle of the joint between the BEAM VM20 and the WALER MK-120 is between 74º and 106º.
- Each joint point between the WALER and the BEAM VM20 needs **two** WALER-VM20 ANGULAR CLAMPS.
- **It has to be introduced from the ends of the WALERS MK-120.**
- **A nut** has to be tightened to tie up the component. (But 2 components in each joint mean 2 nuts to tie up).
- The nut is captive.
- The assembly can be carried out on the floor. (The nuts are tied up from above).
- **The LIFTING BRACKET E V-100 CANNOT be placed in the BEAM VM20 that has already been fixed to the WALER by means of this joint.**



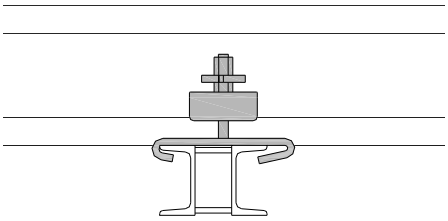
Top view of the assembly by means of two WALER-VM20 ANGULAR CLAMPS. The angle between the WALER MK-120 and the BEAM VM20 will be between 74º-106º.



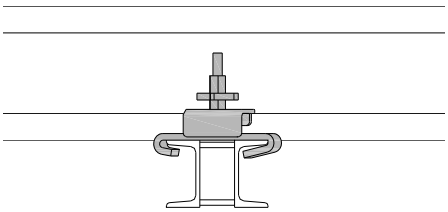
General view of the assembly of the WALER-VM20 ANGULAR CLAMP.

Steps for assembling WALER-VM20 ANGULAR CLAMPS:

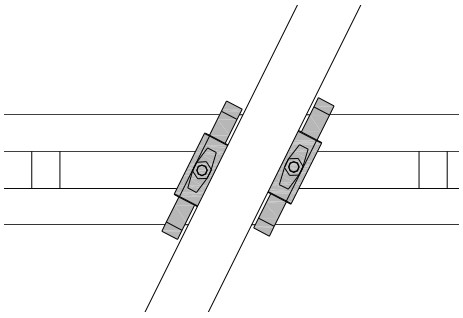
1.- Introduce the CLAMP from one end of the WALER.



5.- Turn the component until the desired angle. (The allowed range is geometrically between 74º and 106º), and tighten the nut.



6.- Each joint will have 2 WALER-VM20 ANGULAR CLAMPS. The top view would be:

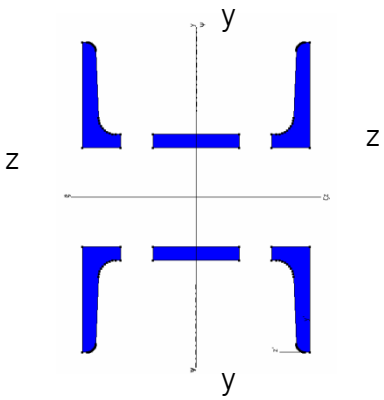


5. FEATURES

5.1. FEATURES OF THE MAIN COMPONENTS

5.1.1 WALER MK-120

The properties of the WALER MK-120 are:



$m = 27,5$	kg/m	mass/m
$A = 27\ 10^{-4}$	m^2	area of the net section
$Av_{zz} = 12,32\ 10^{-4}$	m^2	shear area
$I_{yy} = 678\ 10^{-8}$	m^4	moment of inertia
$W_{elyy} = 113\ 10^{-6}$	m^3	section modulus

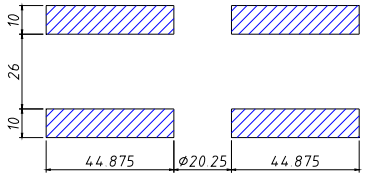
$f_y = 275$ MPa Yield strength

Technical features of MK-120 WALERS are (for working loads in SLS):

V_{Rdzz} = 118,5	kN	(Considering that N and M are 0)	Maximum shear force
M_{Rdyy} = 21,3	[kN m]	(Considering that N and V are 0)	Maximum bending moment in axis y-y

5.1.2 WALER CONNECTOR MK

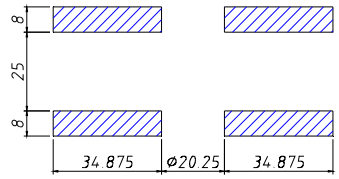
The properties of the WALER CONNECTOR MK are:



$A = 17{,}95\ 10^{-4}$	m^2	area of the net section
$A_v = 33{,}99\ 10^{-4}$	m^2	shear area
$I = 220\ 10^{-8}$	m^4	moment of inertia
$W_{pl} = 58\ 10^{-6}$	m^3	section modulus
$f_y = 670$	MPa	Yield strength

5.1.3 PANEL CONNECTOR MK

The properties of the PANEL CONNECTOR MK are:



$A = 11{,}16\ 10^{-4}$	m^2	area of the net section
$A_v = 23{,}95\ 10^{-4}$	m^2	shear area
$I = 96{,}1\ 10^{-8}$	m^4	moment of inertia
$W_{pl} = 30{,}7\ 10^{-6}$	m^3	section modulus
$f_y = 420$	MPa	Yield strength

5.1.4 BEAM VM20

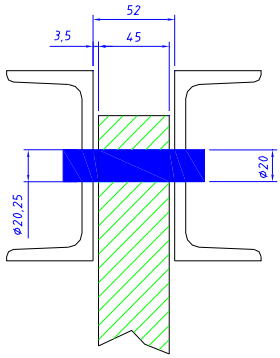
The technical properties of the BEAM VM20 are (in SLS):

$M_{ad} = 5$	kNm	Maximum bending moment
$Q_{ad} = 11$	kN	Maximum shear force
$EI = 450$	kN m^2]	Rigidity (EI)

5.1.5 PIN E20x70 + PUSH-PULL PROP E

Working load of the PIN E20x70 in the WALER MK-120 with the PUSH-PULL PROP E:

Name	Working Load (S.L.S.)
PIN E20x70	90 kN



5.1.6 BOARD

Taking into account the wide range of BOARDS in the market, it has been written that includes all the mechanical properties of different types of Boards. Please use this document for further information. The program CALCUMAX can be used to calculate BOARDS.

5.1.7 LIFTING BRACKET E V-100

The fact that the LIFTING BRACKET E V-100 has a 13 kN working load, does not mean that PANELS of 26 kN (2 brackets/PANEL) can be raised:

The 13 kN working load is the maximum working load of the LIFTING BRACKET E V-100, but the geometry of this PANEL can limit this value, dropping it until 5.5 kN. The reason of this dropping is that when calculating the lifting of the PANEL, apart from the LIFTING BRACKET E V-100, it has to be taken into account how many WALER VM20 CLAMPS has each BEAM M20 with the E V-100 LIFTING BRACKETS.

Each CLAMP RVM20 has a 2.75 kN shear working load.

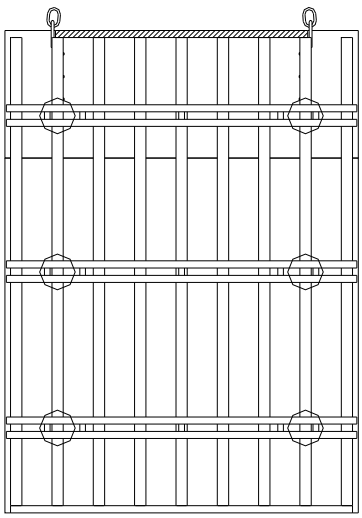
In PANELS with fewer than 5 rows of MK-120 WALERS (i.e., fewer than 5 WALER-VM20 CLAMPS per BEAM VM20 with the LIFTING BRACKET E V-100), the working load will be delimited by the number of MK-120 WALERS it has (The number of WALER-VM20 CLAMPS).

From 5 rows of MK-120 WALERS on, the working load of the LIFTING BRACKET E V-100 will be 13 kN, regardless of the number of WALERS it has.

Number of WALER rows	Number of WALER-VM20 CLAMPS per BEAM VM 20	Working load of each LIFTING BRACKET [kN]
2	2	5,5
3	3	8,25
4	4	11
≥5	= row of WALERS	13

Working loads of the E V-100 LIFTING BRACKETS.

Example: in a 2.5x3.4 m PANEL (width x height) there will be 3 horizontal MK-120 WALERS, so each BEAM VM 20 with the LIFTING BRACKET E V-100 will be tied to the 3 WALERS; by means of 3 WALER-VM20 CLAMPS. Therefore, **the working load of each bracket will be 8.25 kN** (3 x 2.75kN).



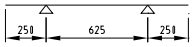
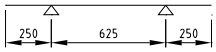
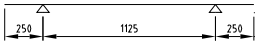
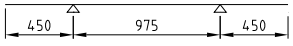
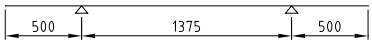
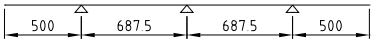
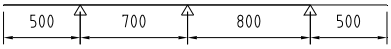
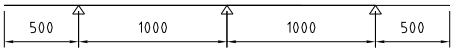
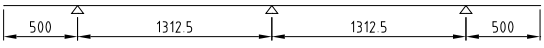
A 2.5x3.4 m PANEL with 6 WALER-VM20 CLAMPS between the MK-120 WALERS and VM 20 BEAMS. Each LIFTING BRACKET E V-100 will have a 3x2.75 kN working load.

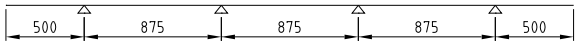
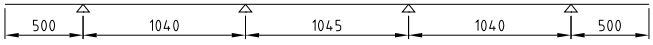
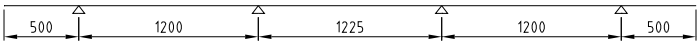
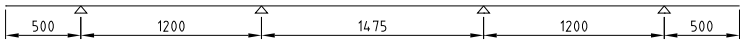
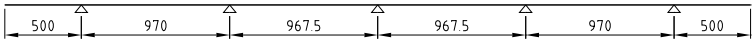
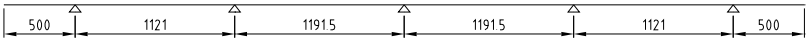
5.2. TABLES

5.2.1 WALER MK-120

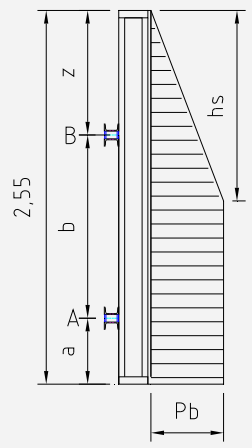
When placing the PANELS, TIE RODS are used to join a PANEL with the one in front of it. The maximum working load of the TIE RODS is 90 kN (tension axis).

The suggested distribution of TIE RODS 15 in standard PANELS is shown in the next table:

MK-120 waler type	Gap between TIE RODS 15 [mm]	Maximum deflection in span[mm]	Maximum deflection in cantilever. [mm]	Max. working load in the WALER [kN/m]	Working load in the TIE ROD 15 [kN]
1.125		**0.05**	**0.04**	**160**	**90**
1.375		**0.40**	**-0.12**	**131**	**90**
1.625		**0.20**	**1.05**	**110.8**	**90**
1.875		**-0.04**	**0.63**	**96**	**90**
2.375		**-0.17**	**0.84**	**75.8**	**90**
2.375		**-0.05**	**0.87**	**87.3**	**90**
2.625		**-0.05**	**0.85**	**87**	**90**
3.125		**0.12**	**0.65**	**83.7**	**90**
3.625		**0.45**	**0.25**	**79.3**	**90**

MK-120 waler type	Gap between TIE RODS 15 [mm]	Maximum deflection in span[mm]	Maximum deflection in cantilever. [mm]	Max. working load in the WALER [kN/m]	Working load in the TIE ROD 15 [kN]
3.625		**0.23**	**0.91**	**88.1**	**90**
4.125		**0.23**	**0.74**	**84.9**	**90**
4.625		**0.30**	**0.44**	**74.4**	**90**
4.875		**0.79**	**0.55**	**65.9**	**90**
4.875		**0.20**	**0.80**	**86**	**90**
5.625		**0.30**	**0.56**	**73.5**	**90**

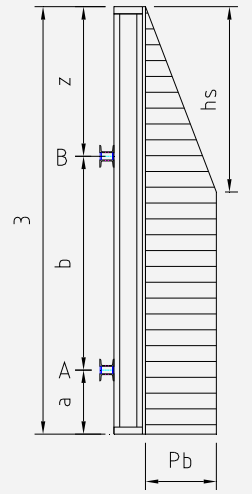
5.2.2 VM20 BEAMS



h = 2.55[m]

a [m]	b [m]	z [m]
0.45	1.25	0.85

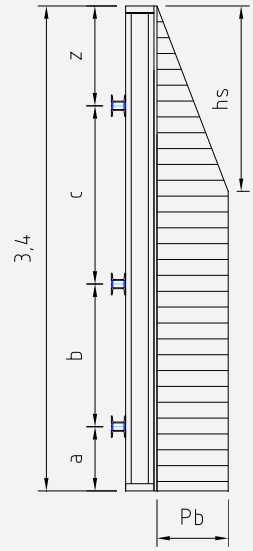
Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	575	440	390	375	-	-
Maximum deflection in span [mm]	0.5	0.5	0.4	0.3	-	-
Maximum deflection in cantilever [mm]	-0.3	-0.4	-0.3	0.2	-	-
Load in WALER B [kN/m]	26.02	27.2	26.82	26.11	-	-
Load in WALER A [kN/m]	32.44	42.79	50.69	54.91	-	-



h = 3[m]

a [m]	b [m]	z [m]
0.45	1.50	1.05

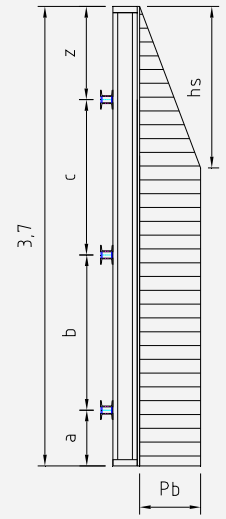
Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	465	375	310	280	270	-
Maximum deflection in span [mm]	0.9	1.1	1	0.9	0.8	-
Maximum deflection in cantilever [mm]	-0.5	-0.8	-0.9	-0.8	-0.6	-
Load in WALER B [kN/m]	37.20	40.99	42.22	42	41.37	-
Load in WALER A [kN/m]	34.80	47.01	57.77	66	70.63	-



h = 3.4[m]

a [m]	b [m]	c [m]	z [m]
0.45	1	1	0.95

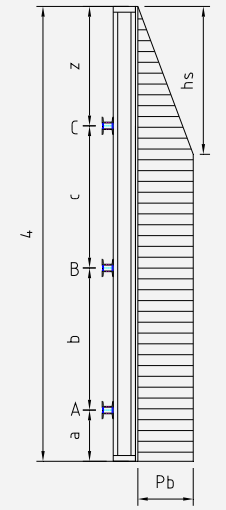
Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	545	435	410	360	315	305
Maximum deflection in span [mm]	0.5	0.4	0.4	0.3	0.3	0.3
Maximum deflection in cantilever [mm]	-0.6	-0.6	-0.5	± 0.4	± 0.4	0.6
Load in WALER C [kN/m]	20.35	20.92	20.76	20.58	20.63	20.82
Load in WALER B [kN/m]	35.84	45.56	51.66	53.92	53.43	52.1
Load in WALER A [kN/m]	27.82	37.49	47.61	57.53	65.94	71.08



h = 3.7[m]

a [m]	b [m]	c [m]	z [m]
0.45	1.25	1.25	0.75

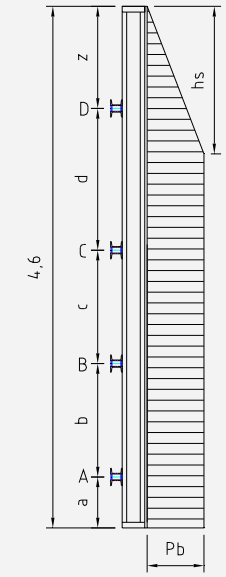
Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	530	415	335	300	260	240
Maximum deflection in span [mm]	0.4	0.3	0.3	0.4	0.4	0.3
Maximum deflection in cantilever [mm]	-0.3	-0.3	-0.2	-0.1	-0.1	±0.1
Load in WALER C [kN/m]	21.30	21.81	21.34	20.87	20.70	20.83
Load in WALER B [kN/m]	40.68	52.60	61.16	65.8	67.08	66.30
Load in WALER A [kN/m]	31.02	41.60	52.48	63.33	73.23	80.87



h = 4[m]

a [m]	b [m]	c [m]	z [m]
0.45	1.25	1.25	1.05

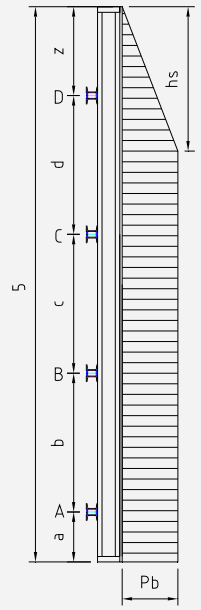
Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	565	420	335	285	255	230
Maximum deflection in span [mm]	0.3	0.3	0.3	0.4	0.4	0.4
Maximum deflection in cantilever [mm]	1.8	1.1	0.9	0.8	0.8	0.7
Load in WALER C [kN/m]	33	35.1	35.22	34.70	34.27	34.17
Load in WALER B [kN/m]	37.43	51.05	62.21	69.79	73.53	74.13
Load in WALER A [kN/m]	31.57	41.9	52.57	63.51	74.20	83.69



h = 4.6[m]

a [m]	b [m]	c [m]	d [m]	z [m]
0.45	1	1	1.25	0.9

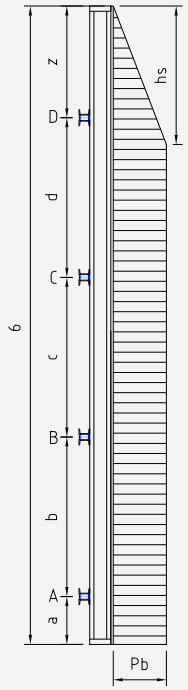
Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	570	435	380	345	295	255
Maximum deflection in span [mm]	0.4	0.4	0.3	0.3	0.2	0.2
Maximum deflection in cantilever [mm]	0.3	0.3	0.3	0.3	0.3	0.3
Load in WALER D [kN/m]	27.40	28.78	28.81	28.55	28.47	28.51
Load in WALER C [kN/m]	35.58	47.15	55.39	59.68	60.75	60.35
Load in WALER B [kN/m]	27.58	36.83	46.87	57.22	66.47	72.74
Load in WALER A [kN/m]	29.44	39.24	48.92	58.55	68.3	78.39



h = 5[m]

a [m]	b [m]	c [m]	d [m]	z [m]
0.45	1.25	1.25	1.25	0.8

Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	540	420	335	275	235	210
Maximum deflection in span [mm]	0.4	0.3	0.3	0.3	0.3	0.3
Maximum deflection in cantilever [mm]	-0.2	-0.3	-0.2	-0.1	-0.1	-0.1
Load in WALER D [kN/m]	23.26	24	23.76	23.34	23.19	23.29
Load in WALER C [kN/m]	39.15	50.95	59.37	63.89	65.15	64.67
Load in WALER B [kN/m]	38.13	51.09	64.63	78.18	90.55	100.1
Load in WALER A [kN/m]	31.44	41.88	52.24	62.58	73.11	83.90



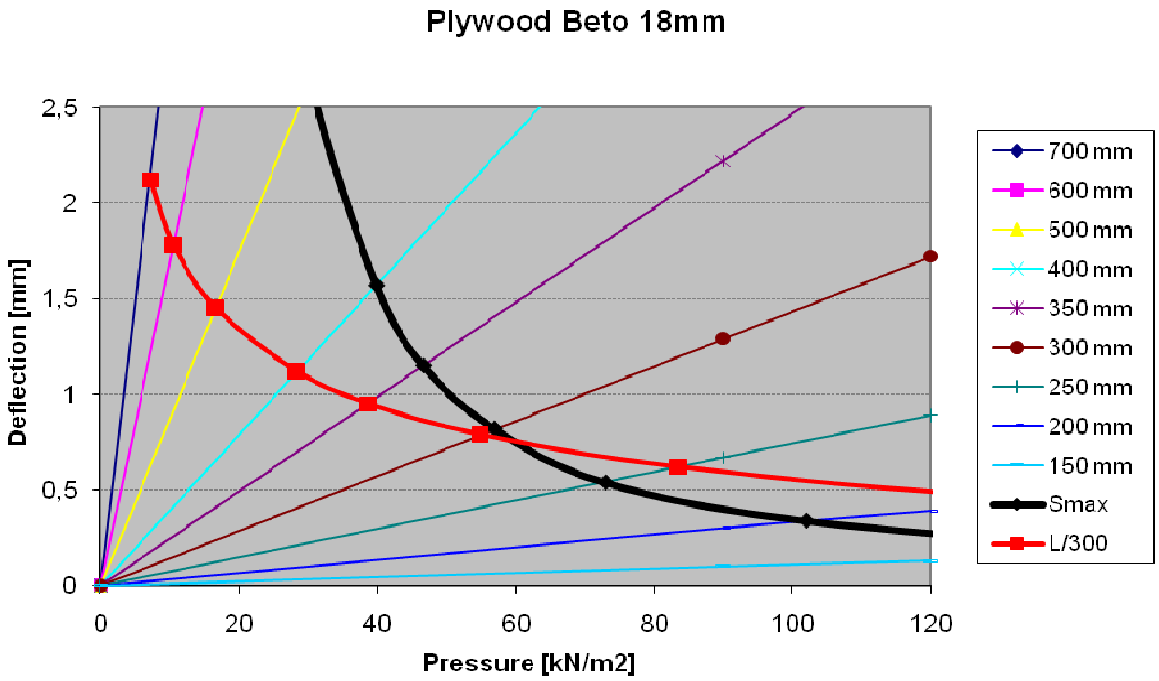
h = 6[m]

a [m]	b [m]	c [m]	d [m]	z [m]
0.45	1.50	1.50	1.50	1.05

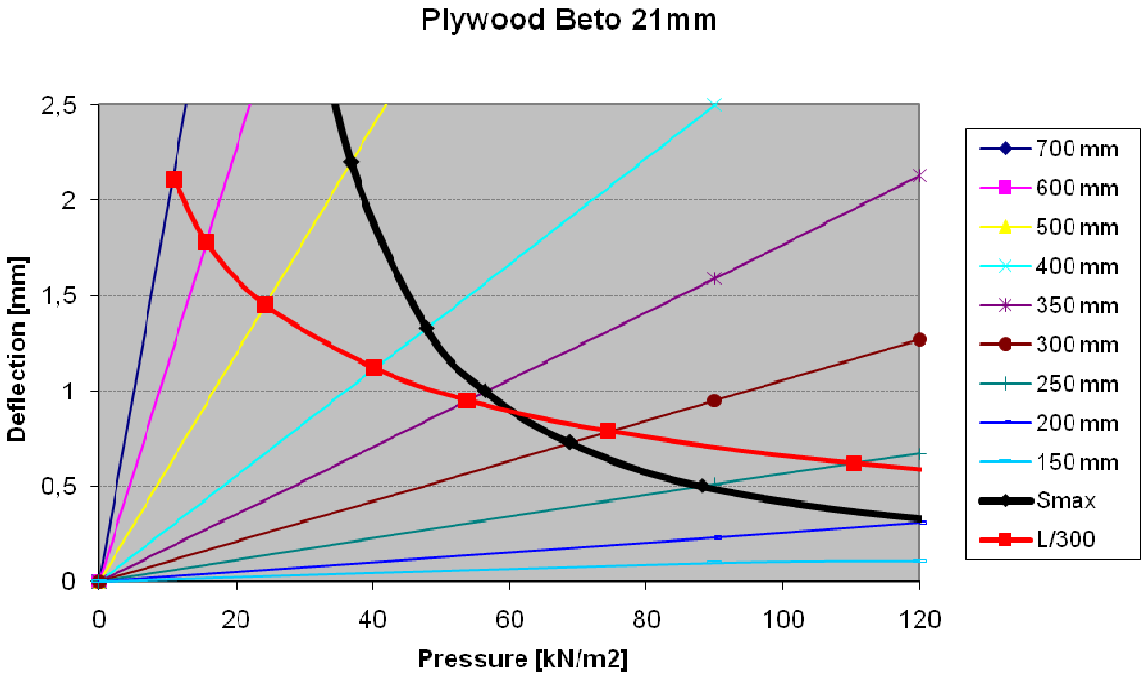
Concrete pressure [kN/m^2]	30	40	50	60	70	80
Beam spacing [mm]	445	335	265	220	190	165
Maximum deflection in span [mm]	0.7	0.7	0.7	0.6	0.6	0.6
Maximum deflection in cantilever [mm]	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3
Load in WALER D [kN/m]	35.46	38.47	39.28	25.36	38.47	38.18
Load in WALER C [kN/m]	45.15	61.19	75.05	85.54	92.05	94.96
Load in WALER B [kN/m]	47.55	63.13	79.21	95.86	112.7	94.97
Load in WALER A [kN/m]	33.84	45.16	56.41	67.59	78.68	89.88

5.2.3 BETOFILM BOARDS

4.2.3.1 *Plywood Betofilm (18mm)*



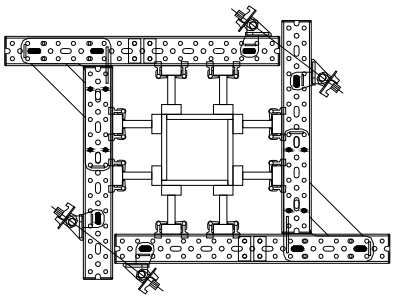
4.2.3.2 *Plywood Betofilm (21mm)*

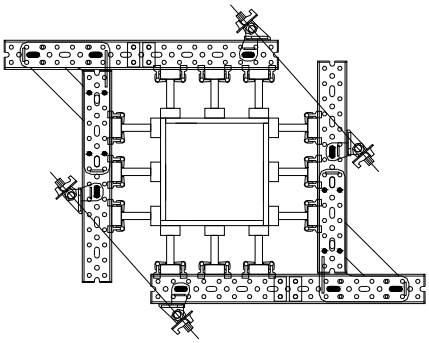


5.2.4 COLUMNS

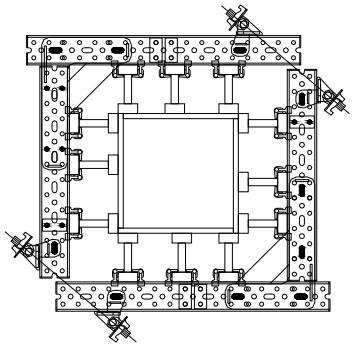
4.2.4.1 ***Up to 70x70 cm***

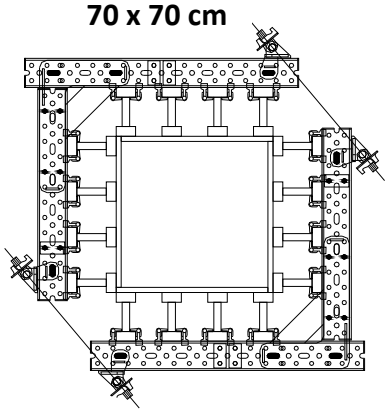
From 20 x 20 cm **to** **52 x 52 cm**





From 50 x 50 cm **to** **70 x 70 cm**



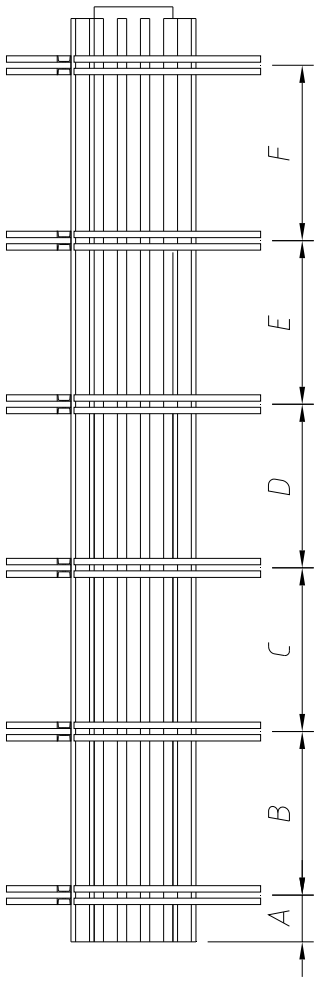


Components pro waler row:

	Dimensions of the column [cm]					
	20/20	30/30	40/40	50/50	60/60	70/70
Profile MK-120 / 0,875	4	4	4	4	4	4
Spacer tube MK-120 / 52	2	2	2	2	2	2
Waler MK-120 / 1,125	2	2	2	2	2	2
Corner connector MK	2	2	2	2	2	2
Wedge	8	8	8	8	8	8
Bolts M16x90+Nut M16+Washer	12	12	12	12	12	12
Waler-VM20 Clamp 2T	8	8	12	16	16	20
Outside corner head MK	4	4	4	4	4	4
Plate nut 15	4	4	4	4	4	4
Tie rod 1m	2	2	2	2	2	2

80 kN/m²

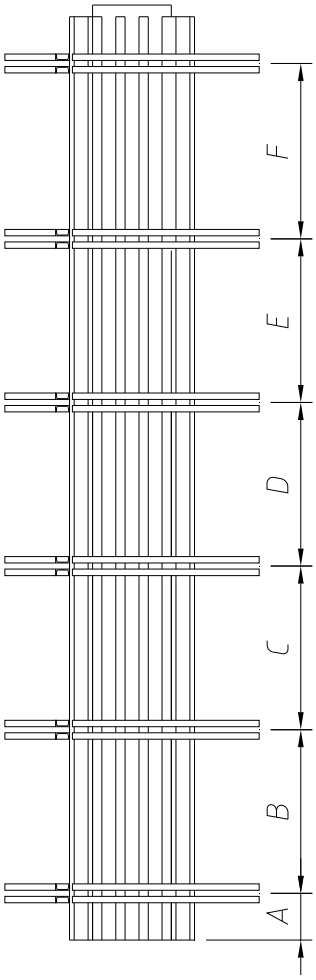
Column dimensions [cm]		20/20	30/30	40/40	50/50	60/60	70/70
Number of beams VM20 on each side		2	2	3	4	4	5



Column height [m]		Gap between WALERS [m]					
6	E			1,35	1,35	1,35	1,35
	D			1,10	1,10	1,10	1,10
	C			1,05	1,05	1,05	1,05
	B			1,00	1,00	1,00	1,00
	A			0,40	0,40	0,40	0,40
5	D	1,40	1,40	1,40	1,40	1,40	1,40
	C	1,10	1,10	1,10	1,10	1,10	1,10
	B	1,00	1,00	1,00	1,00	1,00	1,00
	A	0,40	0,40	0,40	0,40	0,40	0,40
4,6	D	1,25	1,25	1,25	1,25	1,25	1,25
	C	1,00	1,00	1,00	1,00	1,00	1,00
	B	0,90	0,90	0,90	0,90	0,90	0,90
	A	0,40	0,40	0,40	0,40	0,40	0,40
4	C	1,40	1,40	1,40	1,40	1,40	1,40
	B	1,10	1,10	1,10	1,10	1,10	1,10
	A	0,40	0,40	0,40	0,40	0,40	0,40
3,7	C	1,15	1,15	1,15	1,15	1,15	1,15
	B	0,90	0,90	0,90	0,90	0,90	0,90
	A	0,40	0,40	0,40	0,40	0,40	0,40
3,4	B	1,65	1,65	1,65	1,65	1,65	1,65
	A	0,40	0,40	0,40	0,40	0,40	0,40
3	B	1,40	1,40	1,40	1,40	1,40	1,40
	A	0,40	0,40	0,40	0,40	0,40	0,40

90 kN/m² y 100 kN/m²

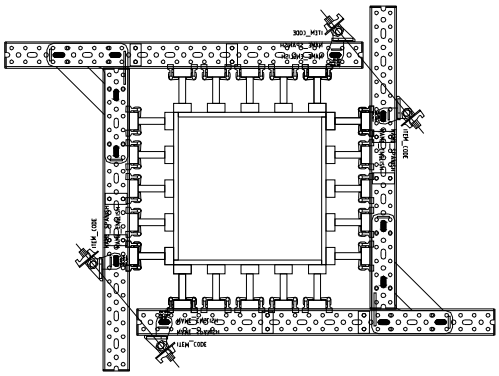
Column dimensions [cm]		20/20	30/30	40/40	50/50	60/60	70/70
Number of beams VM20 on each side		2	2	3	4	4	5

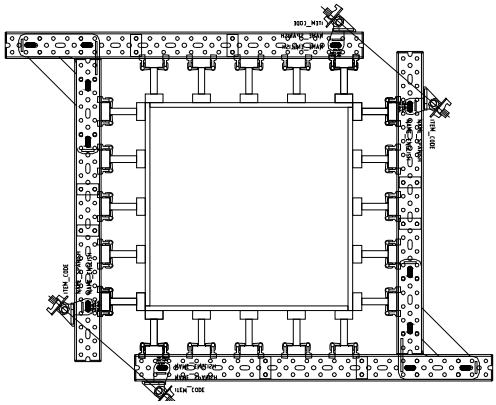


Column height [m]		Gap between WALERS [m]					
6	E			1,35	1,35	1,35	1,35
	D			1,10	1,10	1,10	1,10
	C			1,05	1,05	1,05	1,05
	B			1,00	1,00	1,00	1,00
	A			0,40	0,40	0,40	0,40
5	D	1,40	1,40	1,40	1,40	1,40	1,40
	C	1,10	1,10	1,10	1,10	1,10	1,10
	B	1,00	1,00	1,00	1,00	1,00	1,00
	A	0,40	0,40	0,40	0,40	0,40	0,40
4,6	D	1,25	1,25	1,25	1,25	1,25	1,25
	C	1,00	1,00	1,00	1,00	1,00	1,00
	B	0,90	0,90	0,90	0,90	0,90	0,90
	A	0,40	0,40	0,40	0,40	0,40	0,40
4	C	1,40	1,40	1,40	1,40	1,40	1,40
	B	1,10	1,10	1,10	1,10	1,10	1,10
	A	0,40	0,40	0,40	0,40	0,40	0,40
3,7	C	1,25	1,25	1,25	1,25	1,25	1,25
	B	1,00	1,00	1,00	1,00	1,00	1,00
	A	0,40	0,40	0,40	0,40	0,40	0,40
3,4	C	1,15	1,15	1,15	1,15	1,15	1,15
	B	0,90	0,90	0,90	0,90	0,90	0,90
	A	0,40	0,40	0,40	0,40	0,40	0,40
3	B	1,40	1,40	1,40	1,40	1,40	1,40
	A	0,40	0,40	0,40	0,40	0,40	0,40

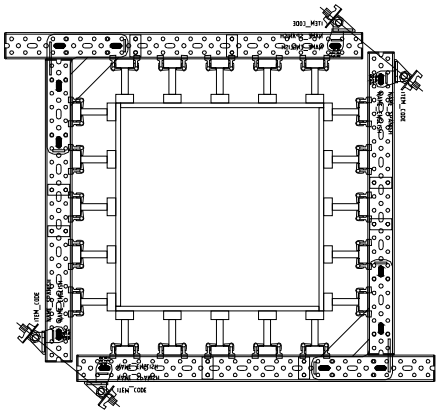
4.2.4.2 ***Up to 120x120 cm***

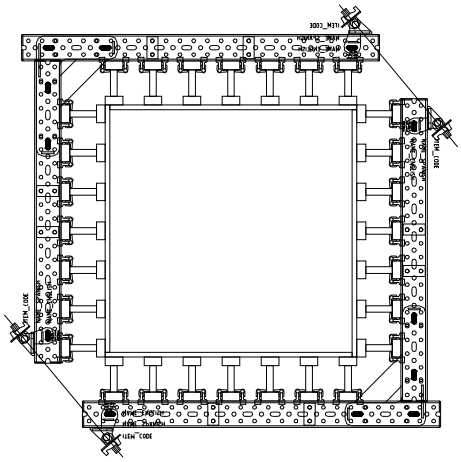
From 65 x 65 cm **to** **92 x 92 cm**





From 90 x 90 cm **to** **120 x 120 cm****





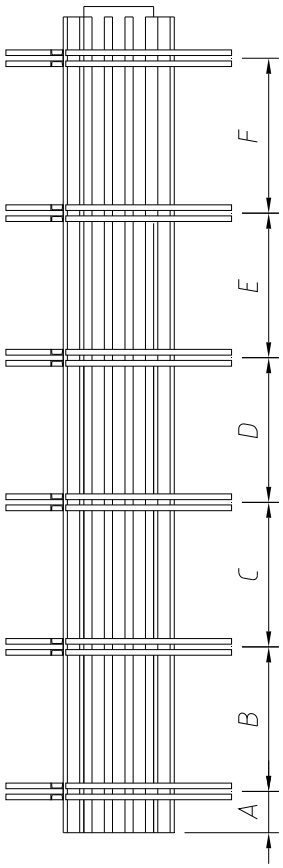
Components pro waler row:

	Dimensions of the column [cm]					
	70/70	**80/80**	**90/90**	**100/100**	**110/110**	**120/120****
Waler MK-120 / 1,625	2	2	2	2	2	4
Waler MK-120 / 1,375	2	2	2	2	2	0
Corner connector MK	2	2	2	2	2	2
Wedge	12	12	12	12	12	12
Waler-VM20 Clamp	8	8	12	16	20	22
Waler-VM20 angular clamp	-	-	-	-	-	2
Outside corner head MK	4	4	4	4	4	4
Plate nut 15	4	4	4	4	4	4
Tie rod 1m	2	2	2	2	2	2

***In the case of 120x120 columns, 4 WALERS MK/1.625 will be used pro row.*

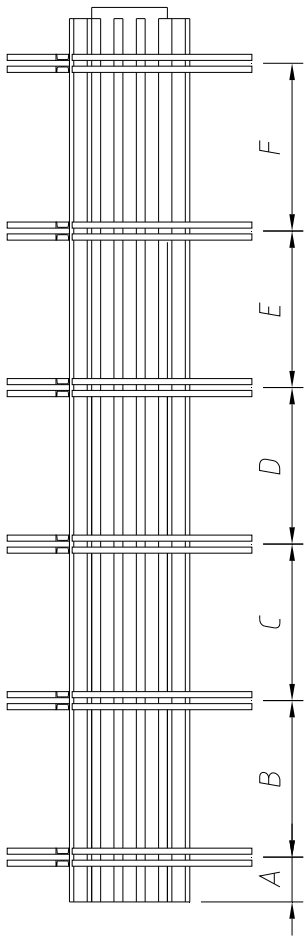
80 kN/m²

Column dimensions [cm]		70/70	80/80	90/90	100/100	110/110	120/120
Number of beams on each side		5	5	5	6	7	
Column height [m]	Gap between WALERS [m]						
6	F				1,10	1,10	1,15
	E	1,35	1,35	1,35	1,00	1,00	1,00
	D	1,10	1,10	1,10	0,90	0,90	0,90
	C	1,05	1,05	1,05	0,90	0,90	0,85
	B	1,00	1,00	1,00	0,85	0,85	0,85
	A	0,40	0,40	0,40	0,30	0,30	0,30
5	E				1,20	1,20	1,15
	D	1,35	1,40	1,40	1,00	1,00	0,95
	C	1,10	1,10	1,10	0,90	0,90	0,85
	B	1,05	1,00	0,95	0,85	0,85	0,80
	A	0,40	0,40	0,40	0,35	0,35	0,35
4,6	D	1,25	1,25	1,25	1,25	1,25	1,30
	C	1,00	1,00	1,00	1,05	1,05	1,00
	B	0,90	0,90	0,90	0,90	0,90	0,90
	A	0,40	0,40	0,40	0,35	0,35	0,35
4	D				1,10	1,10	1,10
	C	1,40	1,40	1,40	0,90	0,90	0,90
	B	1,10	1,10	1,10	0,80	0,80	0,80
	A	0,40	0,40	0,40	0,35	0,35	0,35
3,7	C	1,25	1,30	1,30	1,30	1,30	1,30
	B	1,00	1,00	1,00	1,00	1,00	1,00
	A	0,40	0,40	0,40	0,35	0,35	0,35
3,4	C		1,15	1,15	1,20	1,20	1,15
	B	1,60	0,90	1,10	0,95	0,95	0,95
	A	0,40	0,40	0,40	0,35	0,35	0,35
3	C				1,05	1,05	1,05
	B	1,40	1,40	1,40	0,80	0,80	0,80
	A	0,40	0,40	0,40	0,30	0,30	0,30



90 kN/m²

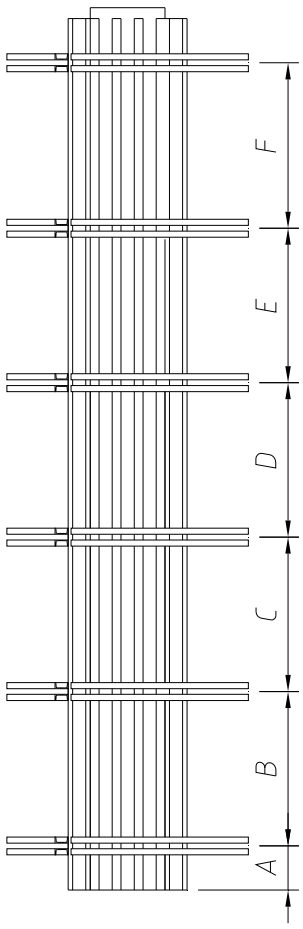
Column dimensions [cm]		70/70	80/80	90/90	100/100	110/110	120/120
Number of beams VM20 on each side		5	5	5	6	6	6



Column height [m]		Gap between WALERS [m]					
6	F			1,20	1,10	1,10	1,15
	E	1,35	1,35	0,95	1,00	1,00	1,00
	D	1,10	1,10	0,85	0,90	0,90	0,90
	C	1,05	1,05	0,85	0,90	0,90	0,85
	B	1,00	1,00	0,85	0,85	0,85	0,85
	A	0,40	0,40	0,30	0,30	0,30	0,30
5	E				1,20	1,20	1,20
	D	1,40	1,40	1,40	1,00	1,00	0,95
	C	1,10	1,10	1,10	0,90	0,85	0,85
	B	1,00	1,00	0,95	0,85	0,80	0,80
	A	0,40	0,40	0,40	0,35	0,30	0,30
4,6	D	1,25	1,25	1,25	1,35	1,25	1,30
	C	1,00	1,00	1,00	1,05	1,05	1,05
	B	0,90	0,90	0,90	0,85	0,90	0,90
	A	0,40	0,40	0,40	0,35	0,35	0,35
4	D				1,15	1,10	1,10
	C	1,40	1,40	1,40	0,95	0,90	0,90
	B	1,10	1,10	1,10	0,80	0,80	0,80
	A	0,40	0,40	0,40	0,35	0,35	0,30
3,7	C	1,30	1,30	1,30	1,30	1,30	1,30
	B	1,00	1,00	1,00	1,00	1,00	1,00
	A	0,40	0,40	0,40	0,35	0,35	0,35
3,4	C	1,20	1,20	1,20	1,15	1,15	1,15
	B	0,90	0,90	1,10	0,95	0,95	0,95
	A	0,40	0,40	0,40	0,35	0,35	0,35
3	C				1,05	1,05	1,05
	B	1,40	1,40	1,40	0,80	0,80	0,80
	A	0,40	0,40	0,40	0,30	0,30	0,30

100 kN/m²

Column dimension [cm]		70/70	80/80	90/90	100/100	110/110	120/120
Number of beams VM20 on each side		5	5	5	6	7	7
Column height [m]	Gap between WALERS [m]						
6	F		1,15	1,15	1,10	1,15	1,15
	E	1,35	1,00	1,00	1,00	1,00	1,00
	D	1,10	0,90	0,90	0,90	0,90	0,90
	C	1,05	0,85	0,85	0,85	0,85	0,85
	B	1,00	0,85	0,85	0,85	0,85	0,85
	A	0,40	0,35	0,35	0,35	0,30	0,30
5	E				1,20	1,20	1,20
	D	1,35	1,40	1,40	1,00	0,95	0,95
	C	1,15	1,10	1,10	0,90	0,85	0,85
	B	1,00	1,00	0,95	0,80	0,80	0,80
	A	0,40	0,40	0,40	0,35	0,30	0,30
4,6	D	1,30	1,25	1,25	1,30	1,30	1,30
	C	1,00	1,00	1,05	1,05	1,05	1,05
	B	0,90	0,90	0,90	0,90	0,90	0,90
	A	0,35	0,40	0,35	0,35	0,35	0,35
4	D				1,15	1,10	1,10
	C	1,40	1,40	1,40	0,95	0,90	0,90
	B	1,10	1,10	1,10	0,80	0,80	0,80
	A	0,40	0,40	0,40	0,30	0,30	0,30
3,7	C	1,25	1,30	1,30	1,30	1,30	1,30
	B	1,00	1,00	1,00	1,00	1,00	1,00
	A	0,40	0,40	0,40	0,35	0,35	0,35
3,4	C	1,15	1,15	1,20	1,15	1,15	1,15
	B	0,95	0,95	0,95	0,95	0,95	0,95
	A	0,35	0,35	0,35	0,35	0,35	0,35
3	C				1,05	1,05	1,05
	B	1,40	1,45	1,40	0,80	0,80	0,80
	A	0,45	0,40	0,45	0,30	0,30	0,30

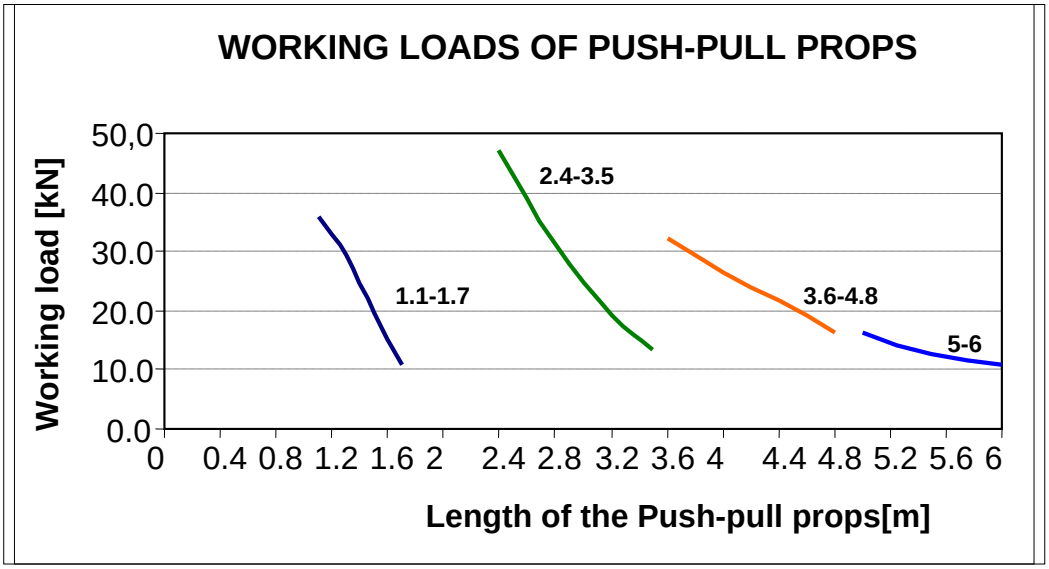


5.2.5 PUSH-PULL PROPS

The working loads of the PUSH-PULL PROPS will be represented depending on the extension.

WORKING LOAD OF PUSH-PULL PROPS							
PUSH-PULL PROP 1.1-1.7		PUSH-PULL PROP 2.4-3.5		PUSH-PULL PROP 3.6-4.8		PUSH-PULL PROP 5-6	
L [m]	Working load [kN]	L [m]	Working load [kN]	L [m]	Working load [kN]	L [m]	Working load [kN]
1.1	35.8	2.4	47.0	3.6	32.3	5	16.3
1.3	29.4	2.8	31.4	4	26.5	5.25	14.2
1.5	19.6	3.2	19.1	4.4	21.6	5.5	12.7
1.7	10.8	3.5	13.4	4.8	16.2	5.75	11.8
						6	10.8

The same values in a diagram:



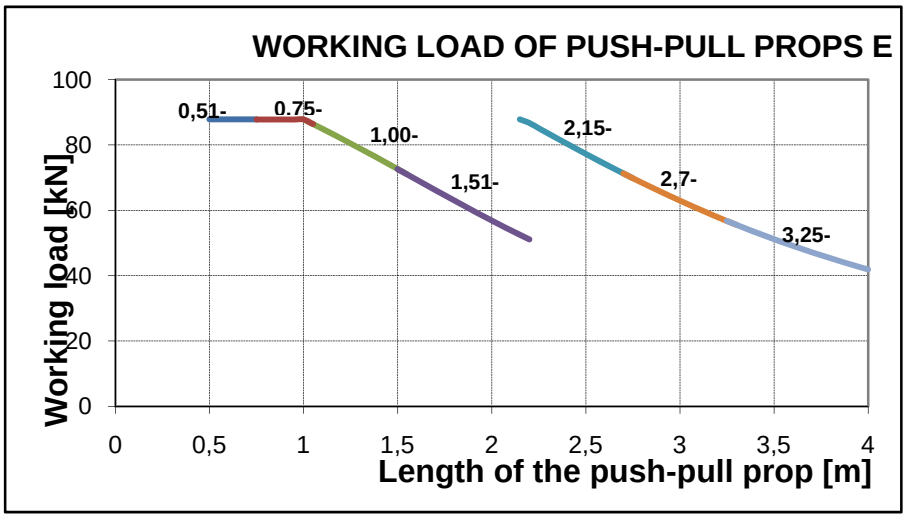
5.3. PUSH-PULL PROPS E

Table and diagram of working loads in PUSH-PULL PROPS E:

WORKING LOADS OF PUSH-PULL PROPS E

PUSH-PULL PROP E 0.51-0.75		PUSH-PULL PROP E 0.75-1.05		PUSH-PULL PROP E 1.00-1.55		PUSH-PULL PROP E 1.51-2.20	
L [m]	Working load [kN]	L [m]	Working load [kN]	L [m]	Working load [kN]	L [m]	Working load [kN]
0.50	90	0.75	90	1.00	87.8	1.50	72.6
0.55	90	0.80	90	1.05	86.3	1.55	71.0
0.60	90	0.85	90	1.10	84.9	1.60	69.4
0.65	90	0.90	90	1.15	83.4	1.65	67.8
0.70	90	0.95	89.2	1.20	81.9	1.70	66.2
0.75	90	1.00	87.8	1.25	80.4	1.75	64.6
		1.05	86.3	1.30	78.9	1.80	63.0
				1.35	77.3	1.85	61.4
				1.40	75.7	1.90	59.9
				1.45	74.2	1.95	58.3
				1.50	72.6	2.00	56.8
				1.55	71.0	2.05	55.3
						2.10	53.9
						2.15	52.4
						2.20	51.0

PUSH-PULL PROP E 2.15-2.75		PUSH-PULL PROP E 2.70-3.30		PUSH-PULL PROP E 3.25-4	
L [m]	Working load [kN]	L [m]	Working load [kN]	L [m]	Working load [kN]
2.15	87.8	2.70	71.2	3,25	56,70
2.20	86.6	2.75	69.8	3,30	55,54
2.25	85.0	2.80	68.3	3,35	54,40
2.30	83.5	2.85	66.9	3,40	53,29
2.35	81.9	2.90	65.6	3,45	52,21
2.40	80.3	2.95	64.2	3,50	51,15
2.45	78.7	3.00	62.9	3,55	50,12
2.50	77.2	3.05	61.6	3,60	49,11
2.55	75.7	3.10	60.3	3,65	48,13
2.60	74.2	3.15	59.1	3,70	47,17
2.65	72.7	3.20	57.8	3,75	46,23
2.70	71.2	3.25	56.7	3,80	45,32
2.75	69.8	3.30	55.5	3,85	44,43
				3,90	43,56
				3,95	42,72
				4,00	41,90



6. TERMS AND CONDITIONS OF USE

6.1. SAFE OPERATING GUIDELINES

6.1.1 General guidelines

- It is recommended to strictly follow the instructions of the project plan, the health and safety plan, as well as any further technical and/or safety rules which might apply to the project.
- Works are carried out by qualified personnel only, and under the supervision of a competent person.
- Instructions of use for the employed equipment must be followed. Consult operating manuals of the manufacturer or distributor.
- Only statutory auxiliary means and the corresponding protection equipment, preferably collective protection equipment are employed.
- Personal protective equipment (PPE) should comprise at least safety helmet, safety footwear, protective gloves and tool holder belt. Whenever necessary use further PPE, such as reflective jackets, anti-fall harness with lifeline, goggles, breathing masks, earmuffs, etc.
- Avoid heavy impacts on working platform or board. It is strictly forbidden to jump on platforms or board, to abruptly unload material or letting it fall from height onto the platforms.
- If the building site is located nearby high voltage power lines, it is recommended to work without power supply. If this is not possible, the appropriate measures according to the respective reference standard should be taken.
- Under adverse weather conditions, works on the building site should stop.
- Under heavy wind conditions, remove materials and other objects from the platforms, and check the stability of all ties, meshes, platform anchorages, etc. before and afterwards.
- Before starting the stripping/dismantling procedure, check that all structural components (e.g. ties) are in place. If not, revise the assembly before proceeding with stripping/dismantling.
- Furthermore, check that no loose material remains on the structure, e.g. on working platforms, in danger of falling from it, and striking persons below.
- The following measures must be taken to restrict access to the structure during erection and dismantling or whenever the structure is not in correct working conditions (e.g. missing collective protection): signposting, fencing, closing or demarcation with straps, barriers or meshes of the working area and third-party passageways.
- Employees and any third party accessing a structure without collective protection yet in place, must wear all indicated PPE to prevent falls from height or to be protected from falling objects.
- The purchaser or lessee of the structure shall instruct its employees on all necessary guidelines for the safe operating of the structure.
- Any alterations of the structure must be executed under the supervision of a competent person and must comply with instructions in the operating manuals of the manufacturer or distributor.
- The purchaser or lessee shall conduct periodic checks of the assembly to verify the correct installation of critical structural elements and to identify the potential withdrawal of parts or the alteration of the structure as such by employees or a third party.

6.1.2 Guidelines for formwork

4.1.2.1 *Formwork*

- Place some sort of support to store or move the formwork panels which prevent their damage and ease the building site order, the panel cleaning and the transport to their area of operation.
- Ensure the fastening of plate nuts, and the correct positioning and anchorage of push-pull props to the ground.
- Special attention should be paid to the fastening of the wedges of the clamps, holding together the panel joints to prevent concrete laitance.
- Ensure the correct anchorage of the previous formwork set, before placing the next.
- Do not leave any part half-assembled or half-dismantled.
- It is forbidden to climb on formwork except in extraordinary cases duly studied and with appropriate protection systems in place.
- Before concrete pouring, make sure the formwork surfaces are clean.
- Clean panels after each use. Wire brushes are not suitable for cleaning as they are damaging the phenolic film of the plywood.
- It is important to state that the phenolic coating rarely suffers from the chemical and abrasive action of the concrete. But where it is already damaged, e.g. at holes and deteriorated areas, it must be thoroughly sealed to prevent any further damage to the plywood.
- Any cut edge of the plywood should be sealed as soon as possible, because cut edges soak up water from the concrete and swell, thus increasing in thickness.
- In general, it is not recommended to use nails or screws on the plywood.
- For storage, the panels should be stacked one on top of the other, placing wood runners between them. Use some sort of support to separate them from the ground, and provide shelter. Prolonged sun and rain exposure damages the panels.

4.1.2.2 *Release agent*

- Release agent helps separating the formwork from the concrete, and thus increases the number of uses and the life span of the panel in general.
- It plays an important role for the quality of the concrete finishing because it prevents holes from air bubbles on the concrete surface and provides a uniform colour.
- Apply the release agent uniformly and in thin layers onto the panel, bearing in mind at all times the instructions for correct use.
- Thoroughly clean the panel surface before applying the release agent on it.
- Clean the metal frame and the panel off the release agent after every 4 to 5 uses.

4.1.2.3 *Concrete placement and compaction*

- Comply with the maximum pressures according to the instructions of the respective formwork system.
- Continuously check the state of the formwork during concrete casting. Stop further casting in case of any incident.
- Place the concrete in uniform layers of 30 to 45 cm.
- For vertical concrete placement, cast the concrete from the least height above the formwork possible. Do never exceed 2 m height unless a pipe or tube or any similar accessory is used to channel the concrete. Deposit the concrete as near as possible to the formwork base, centring

on one point without casting directly against the formwork.

- When casting with bucket, take special care of not hitting the formwork, and of complying with the maximum load-bearing capacity of the crane.
- Avoid concrete splashes on the plywood as these will reflect on the finished surface.
- Use the appropriate method for concrete consolidation and compaction depending on the concrete consistency and its workability.
- The preferred consolidation and compaction method for wet cast-in-place concrete are poker vibrators. Use external vibrators only when the concrete cannot be accessed with poker vibrators and for parts moulded already in the workshop. External vibration requires a specific analysis.
- Completely immerse the poker 10 to 15 cm into the concrete, and put it into each area of concrete, only once. When concrete is poured in layers, place the vibrator into the previous layer to meld the two layers together.
- Never allow the vibrator to touch the formwork to prevent exceeding the considered loads.
- Immerse vertically or slightly inclined and quickly, but withdraw slowly.

4.1.2.4 ***Concrete curing and formwork stripping***

- Check that curing is sufficiently advanced for stripping without causing spalling at the concrete surface which destroys the finishing and can affect the strength and durability of the concrete.
- Increase the curing time of the concrete when facing fast drying and shrinkage due to evaporation from wind or low temperatures.
- The time span between casting and stripping shall be the same for all parts of the concrete structure. This is justified when a high finishing quality is aimed for because the tone of the concrete surface depends on how long the concrete surface is isolated from the outside.
- Ensure the absence of unauthorised people in the vicinity where stripping takes place.

1. Once stripping is finished, place the formwork on a sort of support and proceed with its cleaning and dismantling, if it is not going to be used for further casts.

4.1.2.5 ***LIFTING BRACKET E V-100***

- The LIFTING BRACKET E V-100 should be used in a way it does not put in danger the integrity of people.
- The LIFTING BRACKET E V-100 cannot be used in applications not described in the User's Guide.
- The LIFTING BRACKET E V-100 must be used only to lift panels of the system ENKOFORM V-100. It will never be used in other applications or with other formwork systems.
- The LIFTING BRACKET E V-100 can only be used to raise PANELS of the system ENKOFORM V-100 of ULMA. It will never be used for other applications or other formwork systems.
- In case the LIFTING BRACKET E V-100 does not work properly, it will have to be taken back immediately to be repaired.
- The LIFTING BRACKET E V-100 must not suffer strong knocks and excessive crushing during its handling, storage, transport and, mainly, when shifting the PANEL from these BRACKETS.
- The LIFTING BRACKET E V-100 will remain in a place protected from the atmospheric and aggressive agents to avoid its deterioration.
- In case anyone who manipulates the LIFTING BRACKET E V-100 notices any deterioration in it, he/she will immediately take it back to have it repaired.

2. Make sure that the used wire rope slings to raise the PANELS are placed in a symmetric way. Make a previous study of the area where the E V-100 LIFTING BRACKETS should be placed (this will be done by the application engineers).
- Check visually the state of the LIFTING BRACKET E V-100 before any use, discarding it if any problem.
- In long term jobsites the components will be revised periodically (every six months) by qualified personnel.
- NEVER STAY UNDER THE LIFTED LOAD.
- PANELS will be raised slowly, avoiding sudden movements.
- When raising the PANEL do not stay near it. Lift it some centimetres and check the correct placement of the slings.
- If the lifting brackets are not working properly, the PANEL will be placed on the ground and all the mistakes will be corrected.
- If the load has to be guided, cords and other auxiliary means will be used. These means will be placed in the PANEL in advance.
- Never guide the load with the hand.
- If the crane operator does not have visual control of the whole course, the displacement labours of the PANELS will be guided by someone qualified to do it.
- Gloves and safety boots with metallic toecap will always be used for hand and feet protection when placing E V-100 LIFTING BRACKETS and raising PANELS. A helmet will always be used to protect the head.

6.2. TRANSPORT, HANDLING AND STORAGE

6.2.1 General guidelines

- Get informed about hazards on the building site and preventive measures to avoid those.
- Obey the instructions of the person-in-charge at the workplace.
- Ensure adequate communication between the employees working together.
- Use work equipment only when authorised, trained and provided with all required information to conduct it.
- Maintain minimum distances to mobile work equipment (forklifts, lorries, cranes, other construction machinery) and to areas with the risk of falling objects.
- Do not stand, walk, or work under suspended loads, nor under the trajectory or in the vicinity of these loads.
- Avoid the parts suffering blows and crushing during transport, handling and storage.
- The material is packed for transport in appropriate containers such as wood or steel pallets, boxes, or strapped in bundles with stable base.
- Strap the bundles sufficiently stable to prevent them from moving and getting damaged. If necessary, protect the items with some sort of buffer.
- Cut the metal strap, standing on the side, using gloves and goggles to prevent getting cut by the bouncing strap or caught in the strap.

6.2.2 Transport

- Ensure the stable loading of the material, complying with the instructions of the driver (equilibrated distribution on the lorry bed, fastening of auxiliary items, etc.).

- Keep your distance when opening the containers after transport to prevent injuries from falling objects.

6.2.3 Handling

4.2.3.1 *Manual handling of loads*

- Some ergonomic principles to be followed are listed below:
- Do not make any sudden jerky movements.
- Before lifting the load, examine it to detect any sharp corners, dirt, etc. and decide according to its shape, weight and volume for the best way to get a secure grip of the load.
- Lift, separating the feet at shoulder distance, duck, bending the knees, never the back.

3. Do not attempt to lift alone, any load that is too heavy, too large, or awkward. Use a mechanical lifting device or get a helping hand from co-workers.

4.2.3.2 *Mechanical handling of loads*

- Only statutory mechanical lifting devices, appropriate for the operation are allowed for use.
- Check the condition of the lifting gear such as slings or cables before each use and report any defects.
- Place lifting accessories and step back to a secure distance from the load and other materials which could get affected.
- Comply with all instructions given by the team chef who is specifically trained for this.
- Cause no sudden acceleration or deceleration of the moving load.
- When conducting difficult or dangerous lifting operations, or in the case that the crane operator has no obstruction free visual control of the entire trajectory of the load, the crane operations are directed by a banksman who is in constant communication with the crane operator by means of a previously agreed sign code.
- If necessary, use tag lines to control the load from distance. Keep hands clear of suspended load if hands could get caught between the load and another object. Swinging and/or unforeseen movements with the load can cause serious accidents.

6.2.4 Storage

- Proper storage of the parts is fundamental to keep them in good working condition.
- Wherever possible, store the material in a place protected from atmospheric impact to avoid wear.
- It is recommended to place parts of the same type and dimensions in its respective container (boxes, steel pallets, etc.).
- Ensure the stability of any piles, bearing in mind the following aspects:

4. Load-bearing capacity of the ground
5. Varying ground levels
6. Levelling of the packages
7. Package or container support
8. Package stability
9. State of the strap
10. State and capacity of the containers used
11. Do not stack full containers on top of empty or half-empty containers
12. External conditions (wind, risk of another object hitting the pile, etc.)

6.3. INSPECTION AND MAINTENANCE

6.3.1 General guidelines

- ULMA is responsible for the delivery of the products, for sale or rent, in good working condition.
- From the moment of delivery, the responsibility for correct use, inspection and product maintenance passes on to the purchaser or lessee. All damaged and broken parts, parts with missing components, i.e. all parts in no proper working condition must be removed from service.
- For use, inspection and maintenance of the product, special attention should be paid to the following points:

13. Items aimed to ensure people´s safety
14. Items made of aluminium, as they are more vulnerable to damages of the welded joints and deformation

6.3.2 Inspection instructions of lifting appliances with CE marking of ULMA Construcción

Before each use, the condition of the lifting appliance must be checked, confirming the good working condition of the following parts:

SYSTEM PART	SPECIFICATION
Outer plate	Welded joints without fissures or cracks
Ring	Without deflection nor excessive wear
Hexagonal bolt, nut and washer	No missing components Appropriate tightening of the parts Without deflection
ID plate	Existing and readable

In case that the lifting appliance does not fulfil all defined requirements, it must be removed from service.

For more information, consult ULMA Construcción.

6.3.3 Inspection instructions with CE marking of equipment marketed by ULMA Construcción

Equipment with CE marking marketed by ULMA Constucción is checked following the instructions stipulated in the User´s Guide of the respective product.

7. Legal references

- Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.
- Council Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace.
- Council Directive 89/656/EEC of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace.
- Council Directive 90/269/EEC of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.
- Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites.
- Council Directive 92/58/EEC of 24 June 1992 on the minimum requirements for the provision of safety and/or health signs at work.
- Council Directive 89/655/EEC - Council Directive 95/63/EEC - Directive 2001/45/EC of the European Parliament and of the Council of 27 June 2001 amending Council Directive 89/655/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work.
- Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration).
- Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise).
- Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast).

Standards:

- EN 13374: _Temporary edge protection systems. Product specifications, test methods.

8. APPENDIX

8.1. AGREEMENT STATEMENT OF THE LIFTING BRACKET E V-100

AGREEMENT STATEMENT
According to Directive 98/37/CE concerning machines

Hereby ULMA C y E, S. Coop., located in Paseo Otadui 3, 20560 Oñati, declares that the product whose code and name are mentioned below complies with the design and manufacturing aspects concerning people's safety required by the corresponding European directive, being this the valid statement until the product suffers any modification.

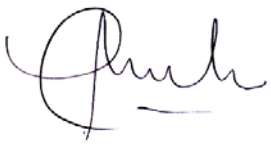
Code: 1960220
Name: LIFTING BRACKET E V-100

Oñati, 11th May 2006

Signed

Ander Ollo, R&D Manager
Responsible for compile the technical file
Garibai n. 9, 20560 Oñati

Signed



Carmelo Bilbao , General Manager

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