USER GUIDE

CANTILEVER CARRIAGE

CVS 200 / 5

IMPORTANT:

All health and safety regulations established by the relevant professional or governmental authorities in each country must be followed when using ULMA products.

The images in this document are depictions of site-specific situations or stages of assembly and therefore for safety purposes are not to be considered comprehensive, nor shall they be used as a guide.

All instructions regarding safety and operation contained in this guide, including the data on stress and loads, must be followed. Any change or unique assembly necessitates a special calculation or solution.

The weights of the basic constituent components included in this document are approximate.

ULMA equipment is designed to work only with ULMA accessories and components. Combining our equipment with other manufacturers' products without first making all necessary inspections can be extremely dangerous.

The company reserves the right to make any changes deemed necessary for the technical development of the product.

"ORIGINAL DOCUMENT" PRODUCED AND APPROVED BY ULMA CONSTRUCTION

TABLE OF CONTENTS

1. PRODUCT DESCRIPTION

The cantilever carriage is a mobile steel structure designed for the construction of bridge segments using the balanced cantilever method.

The building process begins at the piers; first, the pier segment (called pier segment 0) is built on top of the pier, and then successive segments are attached, moving outward across the span.

Construction must proceed symmetrically from each pier 0, so that the assembly doesn't subject the pier to excessive moments, which could cause it to fail.

The main characteristics of the system are detailed below:

- Appropriate for spanning distances between piers up to 200 m. Ideal for easily spanning riverbeds, road intersections, sites where railways and motorways converge, etc.
- Advisable when pier height is greater than 50 m.
- Work is concentrated in a reduced area on the bridge deck, so construction does not interfere with traffic.
- Allows for varied span distances.
- Allows for varied deck thickness.
- The advance is propelled by hydraulic cylinders; movement is regular and repetitive.

Bridge construction with cantilever carriage is carried out in two phases: **pouring** and **advance**.

POURING PHASE

In this phase the carriage must be prepared so as to support the load of the concrete that will be poured into the formwork.

The force exerted by the concrete tends cause the main carriage structure to rotate about its foremost point of support. To counteract this tendency and ensure adequate balance, the rearmost section must be anchored firmly to the deck segment already constructed. The formwork extends out from the front of the carriage and is anchored to the concrete in the rear.

Once the pour is finished and the concrete has set, the second phase begins: the advance.

ADVANCE PHASE

In this phase the load transferred from the formwork to the carriage is solely the force of its own weight.

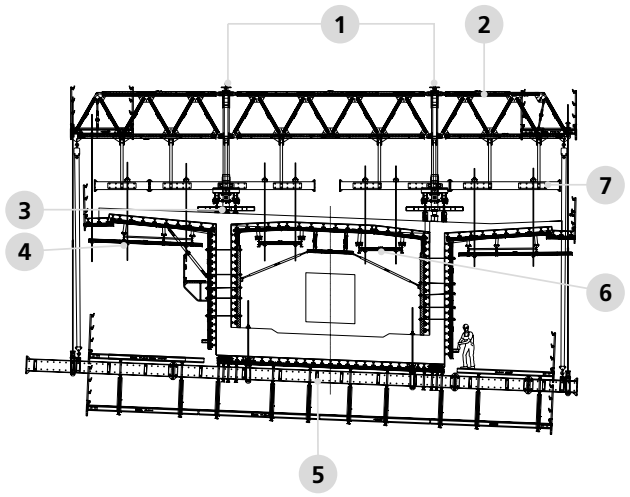
First, the advancing rails are removed from the finished segment; the main carriage structure remains anchored to the deck. The rails are anchored in their new position. Now the rods anchoring both the carriage structure and the formwork to the concrete can be freed. The main structure rests on rollers fitted onto the rails; the carriage moves into position by hydraulic advance.

All necessary steps in carriage movement are detailed in the corresponding section on kinematics.

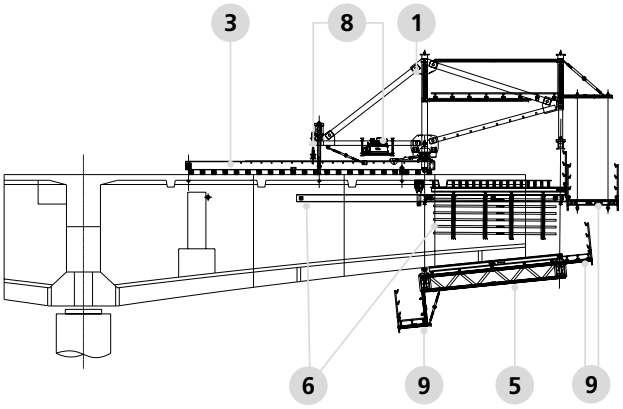
1.1. CANTILEVER CARRIAGE COMPONENT DESCRIPTION

In all Cantilever Carriage CVS structures, the following assemblies are defined:

- Advancing rails and main truss.
- Transversal bracing and horizontal bracing.
- Hanging support.
- Wing slab structure, bottom slab structure, and top slab structure + interior formwork.
- Hydraulics and accessories, and working platforms.



TRANSVERSAL SECTION OF CANTILEVER CARRIAGE

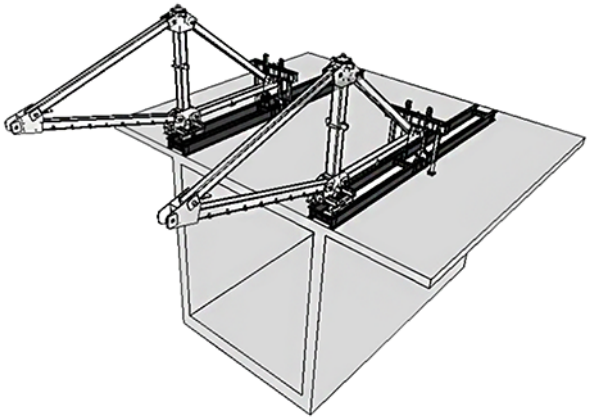


LONGITUDINAL SECTION OF CANTILEVER CARRIAGE

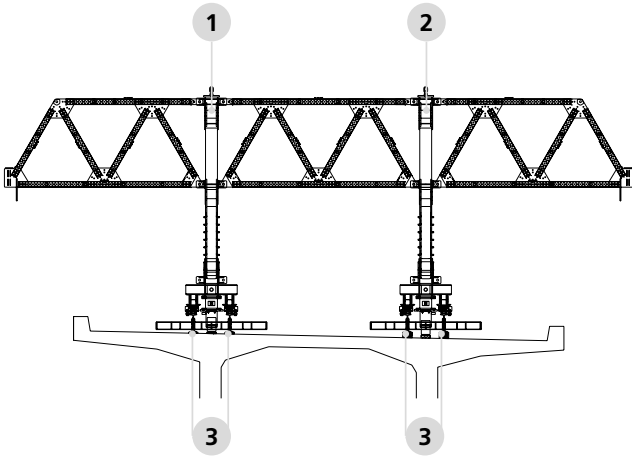
1. *Main truss*
2. *Transversal bracing*
3. *Advancing rails*
4. Wing slab *structure*
5. *Bottom slab structure*
6. *Top slab structure + interior formwork*
7. *Hanging support*
8. *Hydraulic system*
9. *Working platform*

1.1.1 Advancing rails

The advancing rails serve to guide the carriage during movement as well as transmit the loads from the main truss to the previously finished segment. They must be anchored firmly to the previous segment so as to prevent the assembly from tipping during the advance.

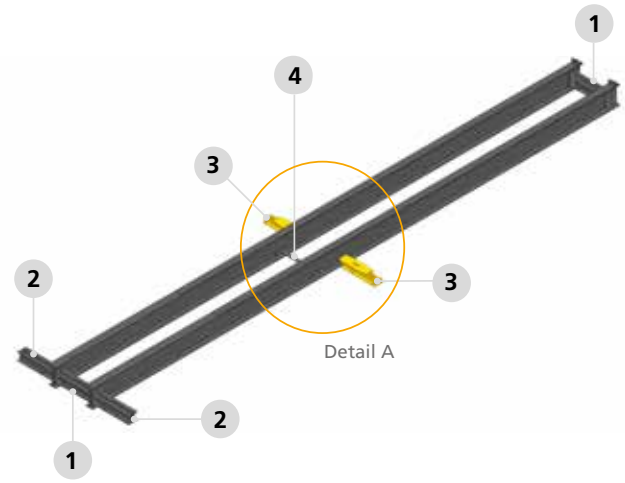


The cantilever carriage consists of two main structures, each of which rests on a double rail.



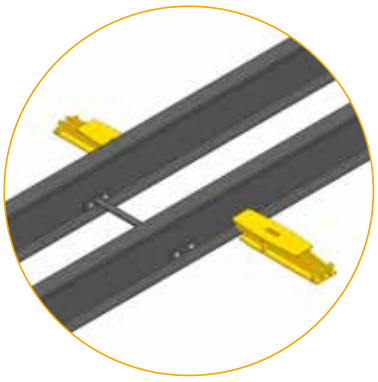
1. *Main structure 1*
2. *Main structure 2*
3. *Advancing rails*

The advancing rail assembly is made of two profiles IPN joined at both front and rear by a component called Rail Union Element.



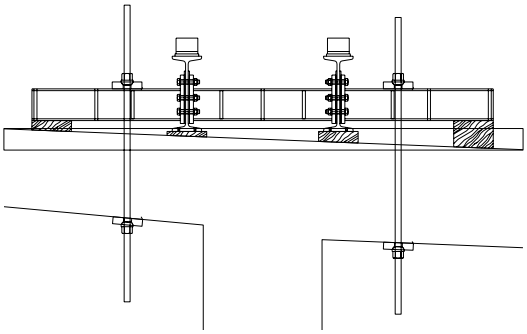
1 *Rail union element*
2 *Rail outer anchor*
3 *Intermediate anchorage AR*
4 *Advancing rail spacer*

To maintain the distance between the two IPN profiles in their intermediate zone, the element Advancing Rail Spacer is used.

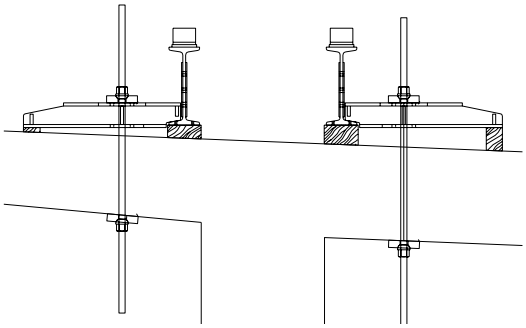


DETAIL A

The advancing rails are fixed to the concrete using tie rods. In the rear part the tie rods are placed in the Rail outer Anchors and in the central zone in the Intermediate Anchorage AR.

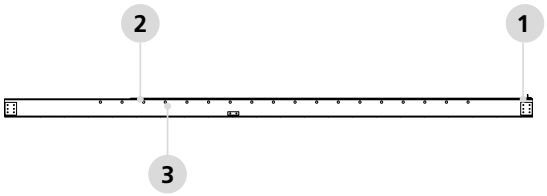


REAR PART



INTERMEDIATE ZONE

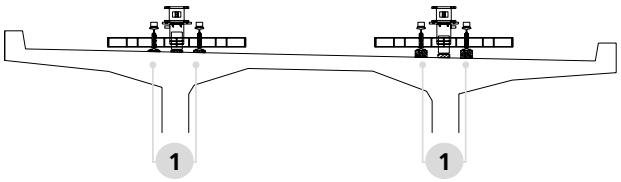
Advancing rail profiles have a plate welded to the upper flange, where the carriage rollers are placed when necessary for movement. An angular profile at one end serves as a stopper; it prevents the carriage from advancing past the point where it is fixed.



1 *Angular profile serves as a stopper*
2 *Roller support plate*
3 *Orifices for pins that fasten the pushing components*

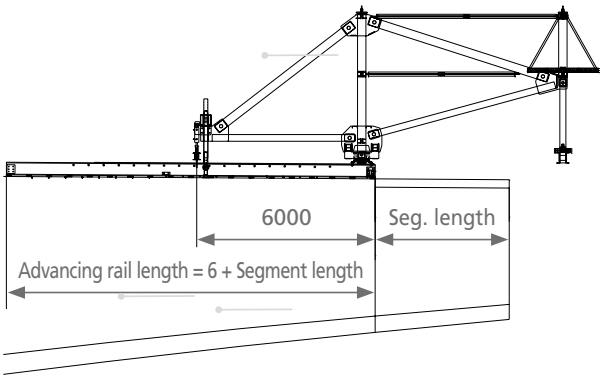
The rail centreline orifices are fastened with pins to the components that will push the rails when they need to be moved; this will be explained in more detail when the hydraulics is described.

To facilitate movement, it is recommended that wooden boards are placed between the advancing rails and the segment already poured. The same boards are used to level the two main carriage structures when the bridge segment is canted.



1 *Wooden boards placed between the advancing rails and the concrete*

The total length of the advancing rails depends on the length of the segment to be poured:

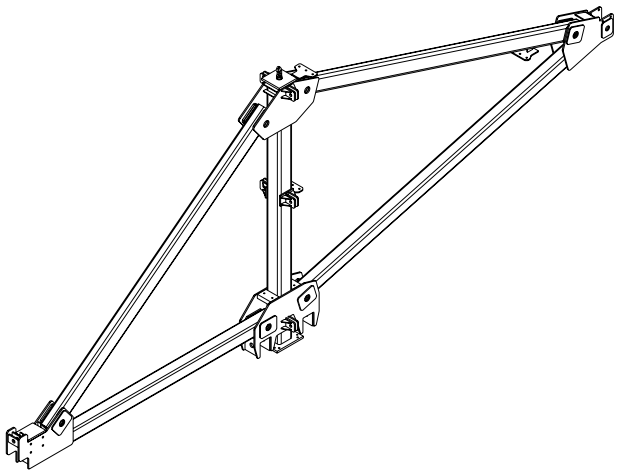


In this document a carriage **CVS 200/5** is shown; the maximum segment length is 5 m, so the rails are 11 m length.

ITEM NO.	ITEM NAME	MÁX. SEGMENT LENGTH POSSIBLE	RAIL LENGTH (m)
3200406	Advancing rail (5 m segment)	5	11

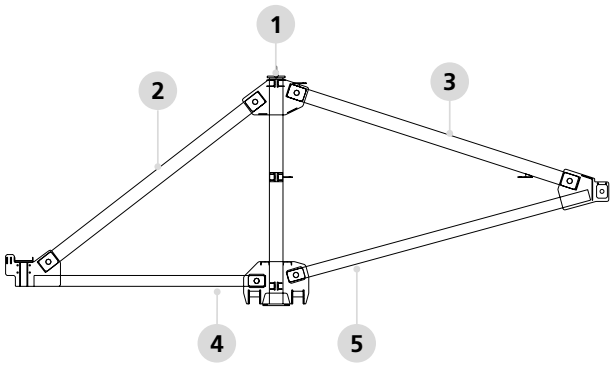
1.1.2 Main Truss

A tubular structure fastened with pins that receives the load exerted by all elements suspended during the pouring and advance phases and transfers it to the supports and anchor points in the previous segment.



To ensure proper load transfer the truss must always be placed precisely above the sidewall.

The illustration below shows the five components that form the main truss.



1 *Central post C5*

2 Rear *diagonal C2*

3 *Upper front diagonal C1*

4 *Lower rear ledger C4*

5 *Lower front diagonal C3*

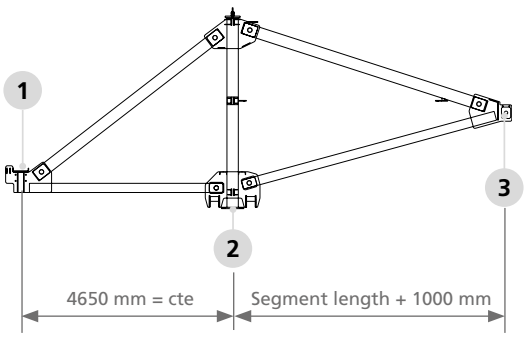
Depending on the load-bearing capacity and length of the segment, different elements will be used to form the main truss. In this document elements used in a carriage CVS 200/5 are shown.

- 200: Maximum possible weight of the longest possible segment. Weight given in metric tons.
- L: Maximum segment length, given in meters.

The union of the elements that form the main truss is done with Ø 95 bolts.

For the system to function properly the lower rear ledger must always be in a horizontal position, during both pouring and advance phases.

The distance between anchor and support for the main structure must always be constant, regardless of the segment length to be poured. What varies according to segment length is the distance between the hanging point and the structure support. In the case studied (CVS 200/5), this distance is 6 m.

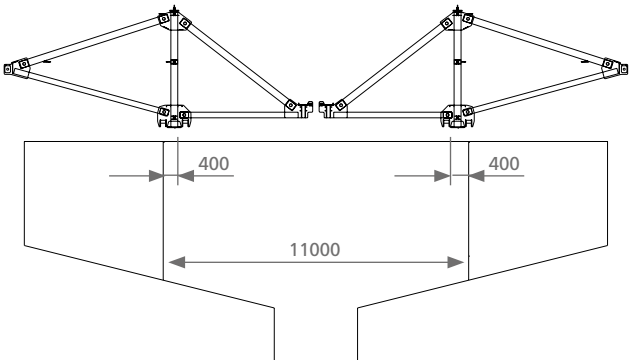


1 *Anchor point*

2 *Support point*

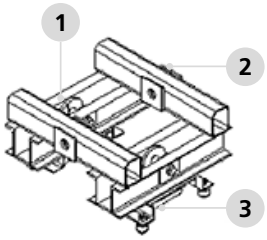
3 *Hanging point*

It is recommended that the support point be placed approximately 400 mm from the end of the previously completed segment. This measurement, along with the necessary distance between the structure support and the anchors, implies that the minimum width of pier segment 0 (from a longitudinal perspective) is 11 m, so that two carriages can be placed side by side and pour symmetrically in both directions.

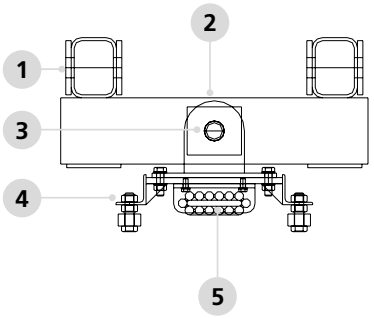


1.1.3 Roller system - front support

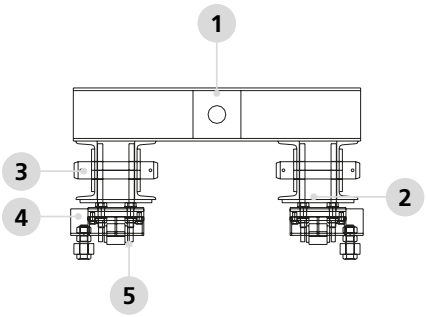
During carriage advance, the main structure will be supported by an assembly composed of:



1. *Roller connector*
2. *Front rolling set*
3. *40 t roller*

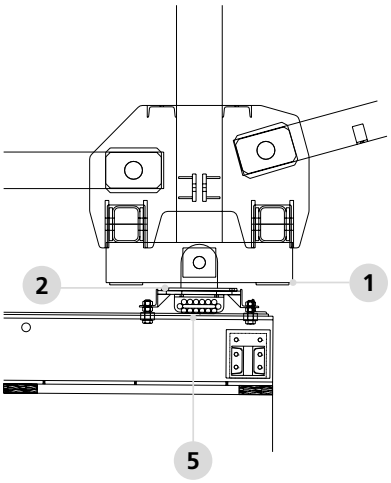


LONGITUDINAL VIEW



FRONT VIEW

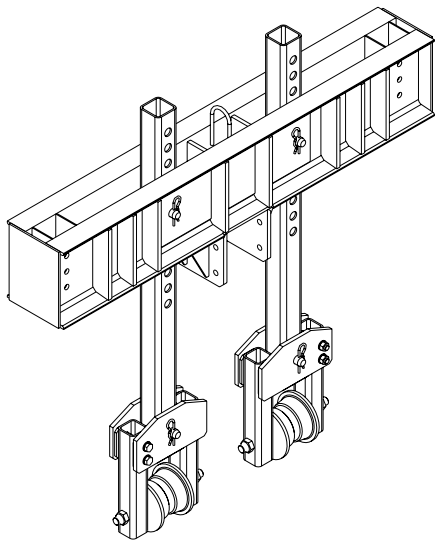
The roller connector is attached with pins to the front rolling set; this implies that it can turn and adapt to the longitudinal slope of the bridge.



1. *Front rolling set*
2. *Roller connector*
3. *Pin Ø 65 x 260*
4. *40 t roller adaptor*
5. *40 t roller*

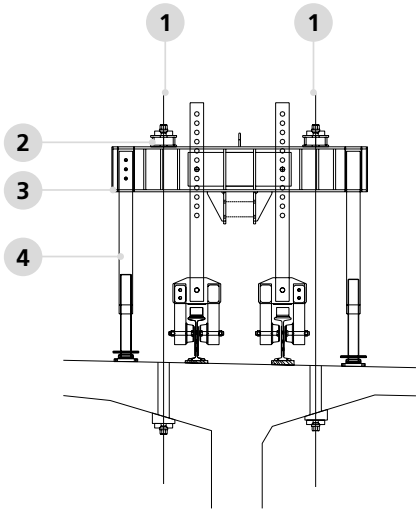
1.1.4 Roller system - rear support

The support and advance of the rear part of the carriage is made possible by an assembly known as the rear gantry. It is bolted to the lower ledger.



As with the rest of the system, there are two distinct phases of use: pouring and advance.

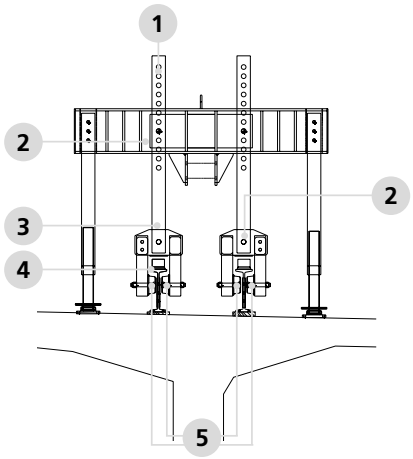
During the **pouring** phase, the anchor rods at the rear of the main structure are fastened to the rear prestressing profile. The profile has two lateral screw jacks placed against the concrete of the previously completed segment, which allow the rear anchor rods to be prestressed.



REAR GANTRY / POURING

1. *Rear anchor rods*
2. *Tie rod support for curve*
3. *Rear prestressing profile for curve*
4. *Prestressing screw jack 85 t*

During the **advance** the anchor rods are removed. The rear part will tend to rise until the rollers come into contact with the advancing rails. There are two rollers for each IPN, which make movement possible.



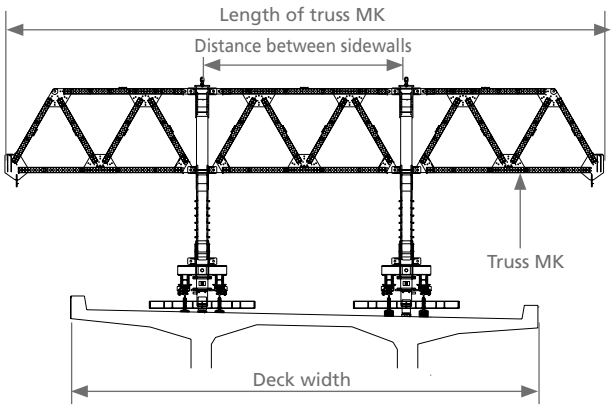
REAR GANTRY / ADVANCE

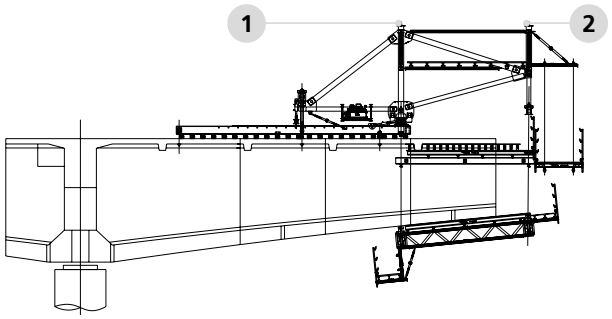
1. *Tube 120 x 120 x 8 / 1765*
2. *Pin Ø 40 x 190*
3. *Rear rolling set*
4. *Tube 100 x 100 x 8 / 540*
5. *Rear roller*

These rollers are joined to the rear rolling set, which in turn is fastened with pins to a tube bolted to the prestressing profile. These tubes have various orifices which allow their height to be adjusted, so that they can adapt as necessary to the longitudinal slope of the bridge.

1.1.5 Transversal bracing

The primary function is to form a brace between the two main trusses. The transversal bracing is formed with two trusses MK; one at the front end of the carriage and another in the mid-zone. Deck width and the distance between sidewalls determine the length and design of the bracing.

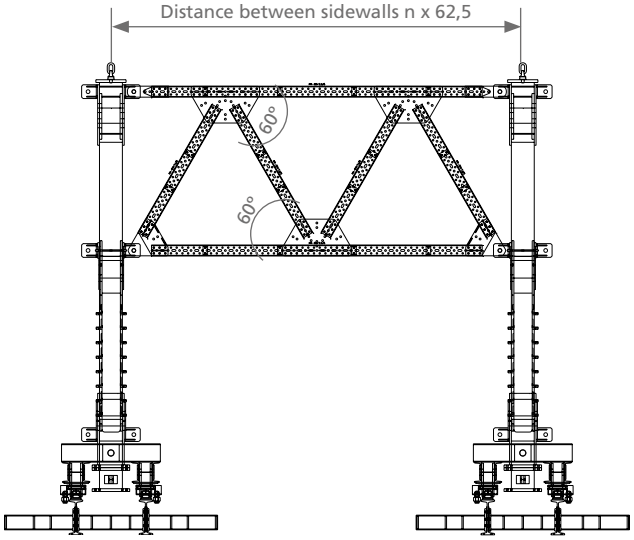


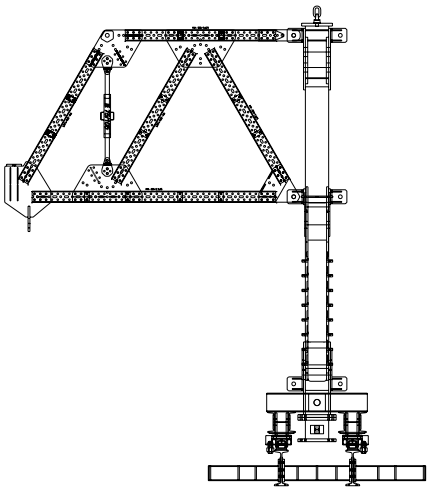


1 *Rear truss MK*

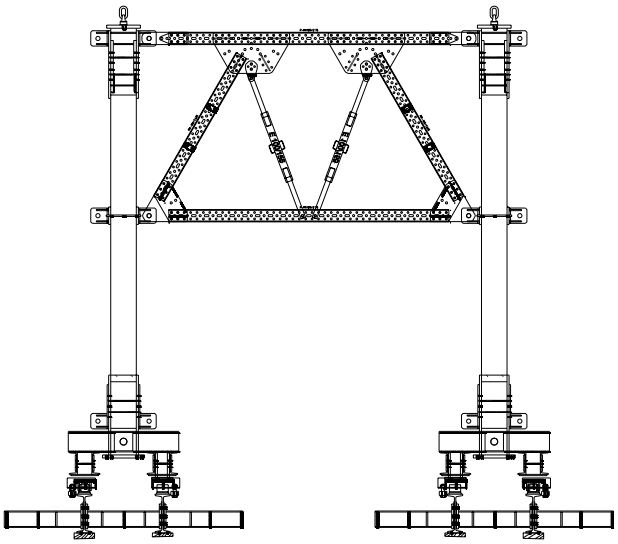
2 *Front truss MK*

The trusses MK are generally formed by walers MK and connectors. The design of the connectors is such that the walers can only be attached at a 60° angle from the horizontal. This is why in some cases it is not possible to use walers to adjust the length of the truss, and push-pull props must be used instead.



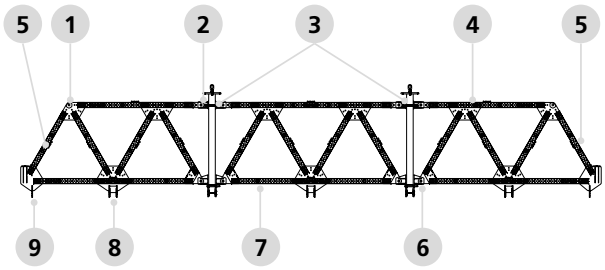


TRUSS FLANGE ADJUSTMENT WITH PUSH-PULL PROPS



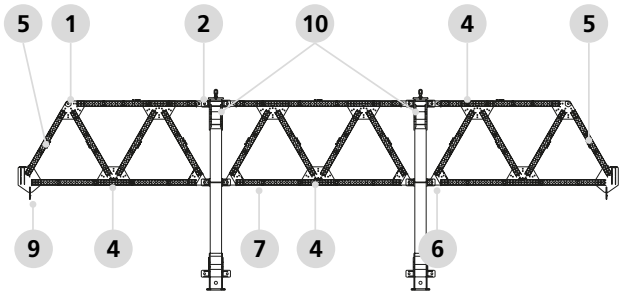
TRUSS CENTRE ADJUSTMENT WITH PUSH-PULL PROPS

The front and rear trusses must be differentiated; they are not identical. For the front truss, the centre and corners are fastened with pins to the Transversal Bracing Post. The nodes 180 MK of the bottom chord are specifically designed to be used in cantilever carriages. They are used to hang the Hanging Support Post 1.75 which are shown in detail further below.



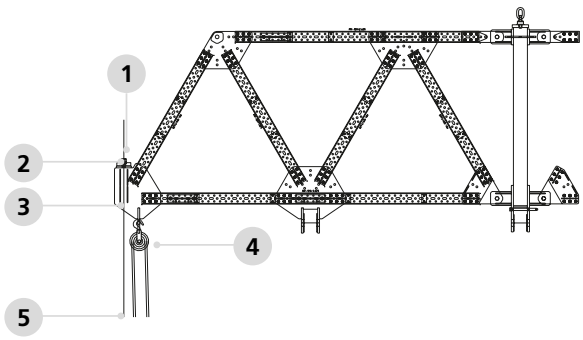
This truss supports loads from the front drop trusses during both advance and pouring stages.

For the rear truss, the centre and corners are attached with pins to the Central Post of the main truss. In this case the nodes 180 MK of the top and bottom chords are identical, and no formwork is hung from them. This truss supports the load exerted by the formwork during advance only.



1. *Node 120 MK*
2. *Axial node M Ø 40*
3. *Transversal bracing post*
4. *Node 180 MK*
5. *Corner truss area*
6. *Node 60 M MK*
7. Central truss area
8. Hanging *node 180 MK*
9. *Hanging node 60 MK*
10. *Central post*

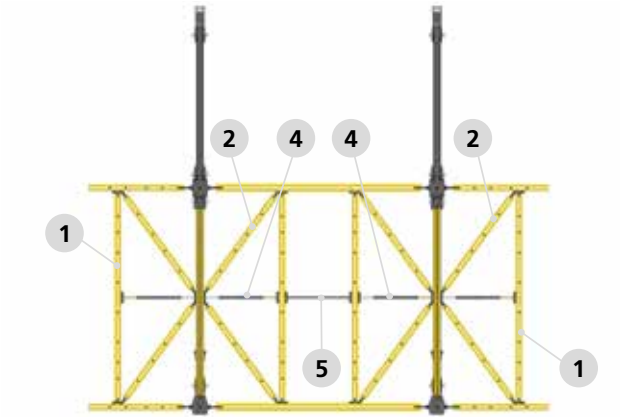
On both the front and rear trusses the joint called Hanging Node 60 MK is attached to the corners of the flanges. Used to join the two walers that form the truss, but also to fasten the tie rod DW 26.5 and the pulley block used to stabilise the bottom slab structure during advance.



1. *Domed nut DW 26.5*
2. *Domed plate DW 26.5*
3. *Hanging node 60 MK*
4. *Pulley block*
5. *Tie rod DW 26.5*

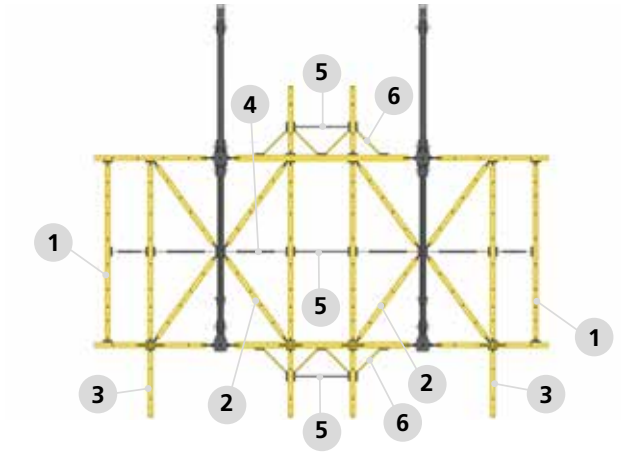
1.1.6 Horizontal bracing

Used to brace the MK trusses on the horizontal plane. Secures the points on the trusses that receive a vertical load. The upper chord and lower chord of the trusses shall be braced using MK-120 walers, MK horizontal and diagonal braces and E push-pull props.



PLAN VIEW OF THE HORIZONTAL BRACING OF THE UPPER CHORD

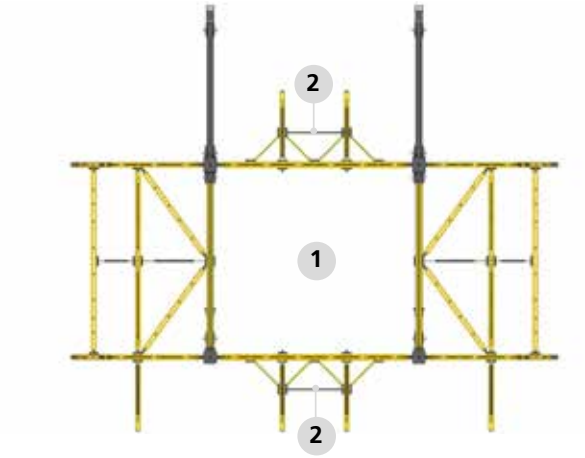
1. *Waler MK-120/5.625*
2. *Waler MK-120/3.125*
3. *Waler MK-120/2.125*
4. *Push-pull prop E 1.51-2.2*
5. *Horizontal brace MK*
6. *Diagonal brace MK*



PLAN VIEW OF THE HORIZONTAL BRACING OF THE LOWER CHORD

Apart from the bracing joining the two transverse trusses, two auxiliary trusses shall be included. Their function is stiffening the central trusses during the assembly phase.

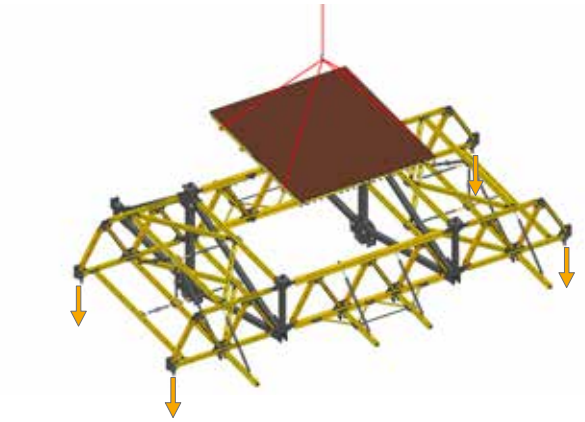
The horizontal bracing of the central area located between the two main trusses is generally not assembled yet during this phase. This gap is left in order for the upper slab formwork to be able to pass through it.



1 *Central area without horizontal bracing*

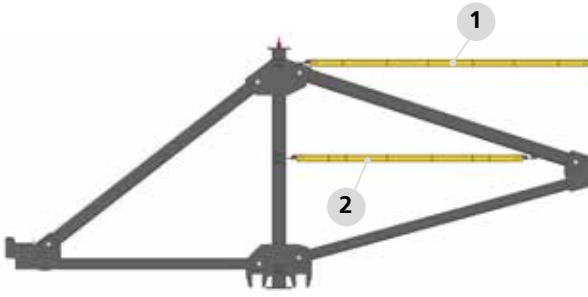
2 *Auxiliary truss*

Since at this time the transverse bracing trusses are already bearing the weight of the lower slab structure, it is necessary to reinforce the central transverse bracing areas in order to prevent potential instability caused by their lateral buckling.



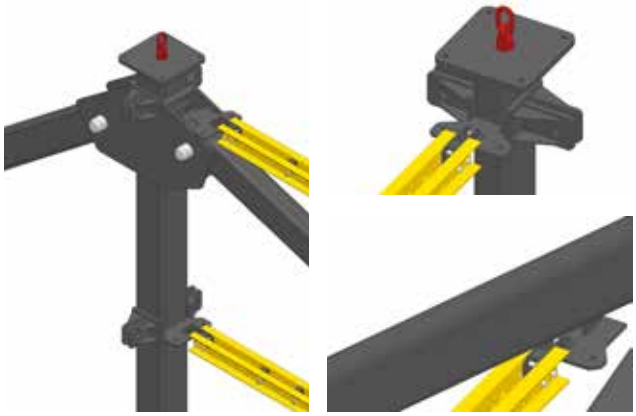
The walers of the front auxiliary truss shall also be used to hang the upper platform from it.

The CVS Horizontal Bracing Joint shall be used to fix the MK-120 walers to the main structure.



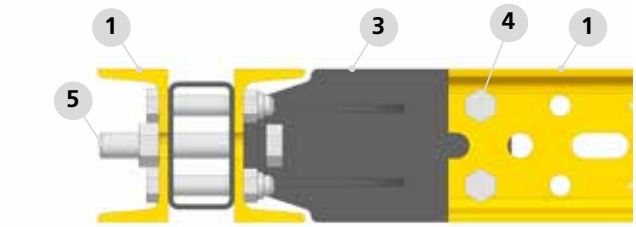
1 *Upper chord horizontal bracing (Waler MK-120/5.125)*

2 *Lower chord horizontal bracing (Waler MK-120/4.125)*

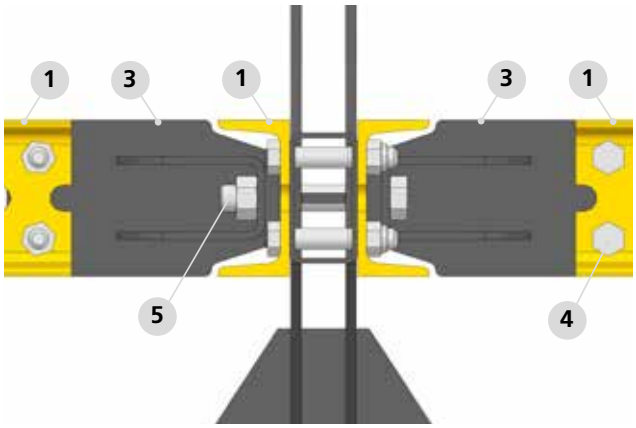


The connector shall be placed on the central post, upper diagonal or transversal bracing post using a M20x50 bolt.

The MK Truss HB Connector shall be used to join the MK-120 walers to the transverse trusses.



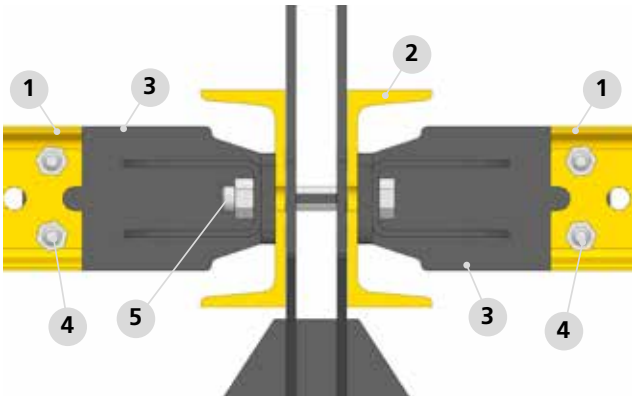
SIMPLE JOINT
TRANSVERSE TRUSS WALER MK-120



DOUBLE JOINT
TRANSVERSE TRUSS WALER MK-120

1. *Waler MK-120*
2. Waler *MK-180*
3. *MK truss HB connector*
4. Bolt *M16x90* + *Nut M16*
5. Bolt *M20x130* + *Nut M20*

This connector can be fixed both to walers MK-120 and to walers MK-180.

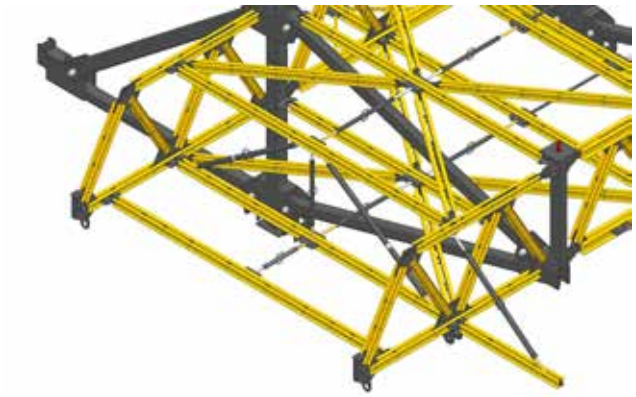


DOUBLE JOINT
TRANSVERSE TRUSS WALER MK-180

The walers that tie the two transverse trusses shall be joined at their midpoints with E push-pull props or MK horizontal braces.

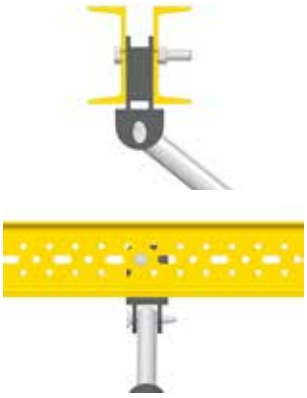
The walers that are placed diagonally shall be fixed to the MK Truss HB Connector on one end and to the MK Secondary Axis U on the other. In both cases this connection is made using the HB Diagonal Waler Joint and E20x70 pin.

On the flanges, the walers that make up the upper chord and lower chord bracing are joined using E push-pull props.



The auxiliary truss walers are supported by E push-pull props. One of the screw jacks is fixed to the end of the waler and the other is fixed to the Right Angle Head MK180-120, placed on the upper chord waler.

This head is suitable for use with walers MK-120 and MK-180.

MK-120	MK-180
	

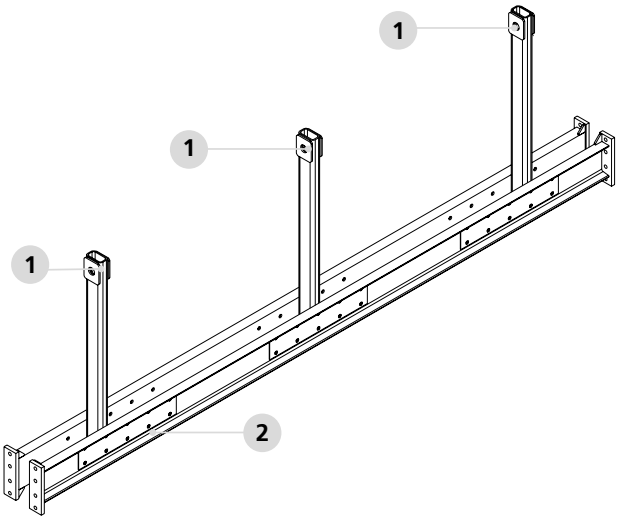
1.1.7 Hanging support

An assembly composed of a number of Hanging Support Posts 1.75 and UPN profiles.

The number of Hanging Support Posts 1.75 depends on the width of the bridge and also the length of the UPN profiles.

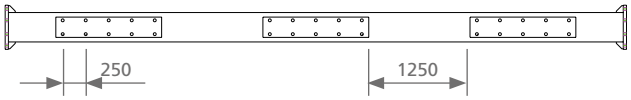
A range of different lengths of UPN profiles has been defined; all of them with end-plates. It is possible to join them using bolts to get different lengths.

Each profile has several lines of holes to have the option of placing the posts in different positions. The hole spacing is a multiple of 250 mm.

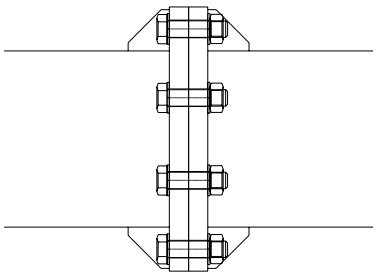


1 *Hanging support post 1.75*

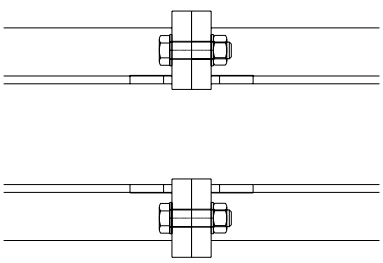
2 *Profile UPN*



M30 bolts will be used to do the longitudinal joint between profiles.

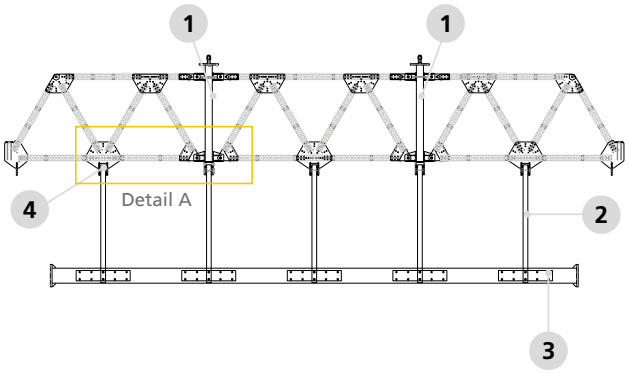


FRONT VIEW

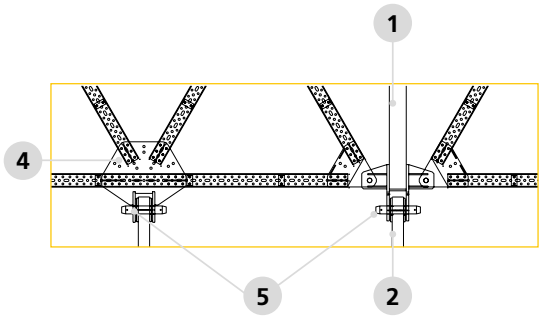


TOP VIEW

The Hanging Support Post 1.75 hang from the front truss on either Hanging Node 180 MK or Transversal Bracing Post, and in either case are joined with Pins Ø 70 x 297.



FRONT TRUSS



DETAIL A

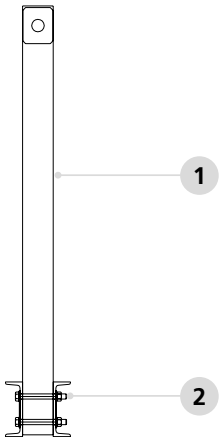
1 *Transversal bracing post*

2 *Hanging support post. 1.75*

3 *Double profile UPN*

4 *Hanging node 180 MK*

5 *Pin Ø 70 x 297*



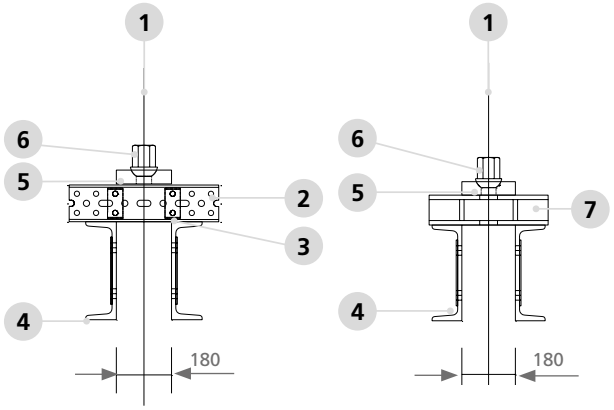
1 *Hanging support post 1.75*

2 *Profile UPN*

The separation between the two profiles UPN is 180 mm. The beam hanger plates and nuts are not fastened directly to the profiles UPN, but rather to an intermediary component. The component used is determined by the load to be borne by the beams.

For loads less than 175 kN (SLS), two profiles MK-120/0.5 with separators near the support points will be sufficient.

This solution is normally used with the rods that hold the wing and top slab structures.

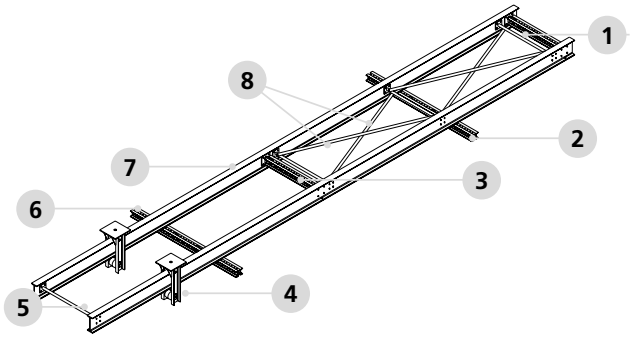


1. *Tie rod DW*
2. *Waler MK-120/0.5*
3. *Spacer*
4. *Profile UPN*
5. *Domed plate*
6. *Domed nut*
7. *Tie rod support for curve DW 36*

If the load is greater than 175 kN (SLS) the Tie rod support for curve must be used. In this part of the carriage will be used with rods DW 36 (bottom slab structure) and its load bearing capacity is 560 kN (SLS).

1.1.8 Top slab structure

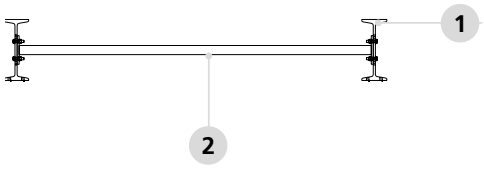
Support structure for the top slab formwork. Composed of longitudinal profiles, walers, bracing tubes, and rollers.



1. *Rod waler*
2. *Auxiliary rod waler in pier segment 0*
3. *Rod waler*
4. *Formwork hanging roller*
5. *Tie tube*
6. *Auxiliary rod waler in pier segment 0*
7. *IPN 320/11900 (Segment 5 m)*
8. *Bracing tubes*

The thickness and spacing between profiles IPN depends upon top slab thickness, length of the segment, and geometry of the interior cavity.

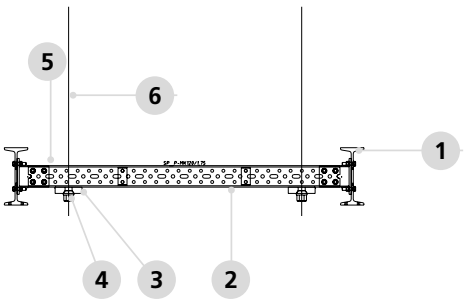
Walers and joining tubes are used to fasten the profiles together. The joining tubes are Ø 48 so that they can be fastened to Ø 48 cross bracing. Fastened directly to the profile centrelines.



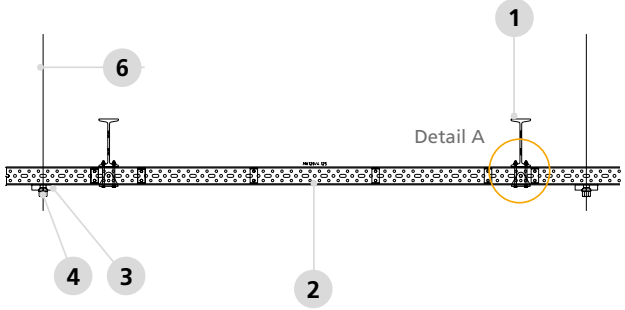
1. *Profile IPN*
2. *Tie tube*

The rods that support the weight of the structure and concrete are fastened to the walers.

There are two ways to join them to the longitudinal profiles. One method is to bolt the walers to the profile web, for which the connector called Horizontal Joint IPN-MK is necessary.

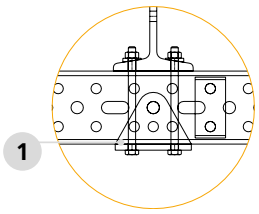


The second method is to pass the waler MK-120 underneath the longitudinal profiles IPN. The joint between the profile IPN and waler is made with IPN Profile Tying Clamp.



1. *IPN 320/11900 (Segment 5 m)*
2. *Waler MK-120*
3. *Domed plate*
4. *Domed nut*
5. *Horizontal joint IPN-MK*
6. *Tie rod DW*

The IPN Profile Tying Clamp has orifices for bolts of M16 and M20; it can be bolted to walers MK using either gauge.

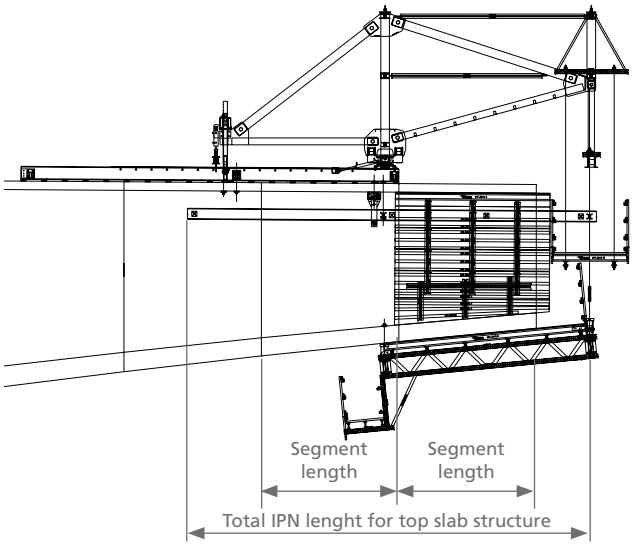


DETAIL A

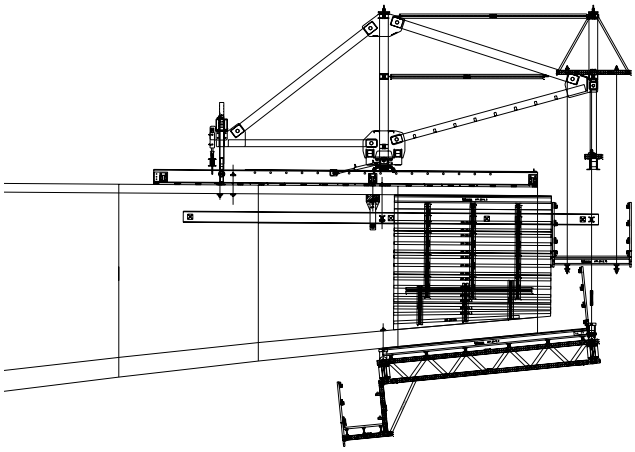
1. *IPN Profile tying clamp*

The length of the profiles IPN for the top slab structure depends upon the length of the segments to be poured. These profiles support the interior formwork, which is moved at the end of the advance sequence after the rebar has been placed in the segment, which is why they are slightly more than twice the length of the segment. The various phases of movement are shown in detail below:

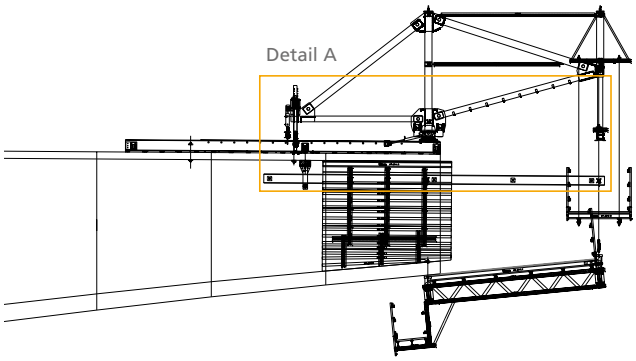
1. **Pouring position:** the interior formwork support structure is braced by four rods; two fixed in the front waler and two in the rear waler.

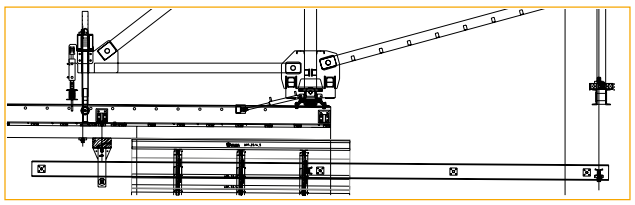


2. **Movimiento de los carriles de avance:** Se retiran las barras que fijan los carriles de avance y se mueven a la posición de hormigonado siguiente. Se fijan en esta nueva posición.



3. **Moving the carriage:** the anchor rods for the main structure, as well as the rear rods of both the top and bottom slab structures, are removed. The carriage is advanced. Now the profiles IPN are hung by their front ends from the rods supported by the profiles UPN that form the hanging support, and their rear end rests on the rollers fixed by rods to the previously poured segment.



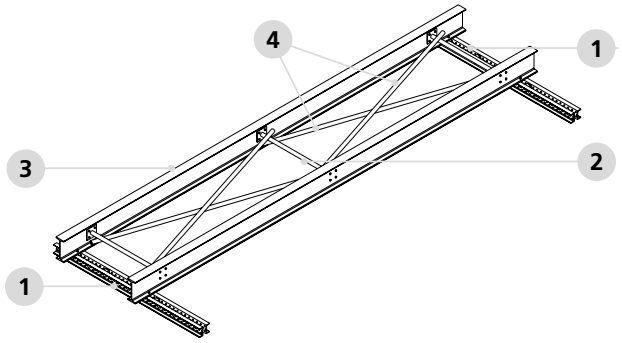


DETAIL A

4. **Interior formwork advance:** after placing the rebar in the segment to be poured, the interior formwork is moved and placed in its new position. Interior formwork slides along the profiles IPN. The rear part of the top slab structure is anchored again, and the rollers are placed in their new position. At this point the assembly is once again as it was in the starting position.

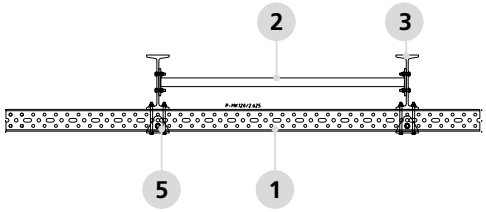
1.1.9 Wing slab structure

The support structure for exterior formwork. Composed of longitudinal profiles, walers, and bracing tubes.



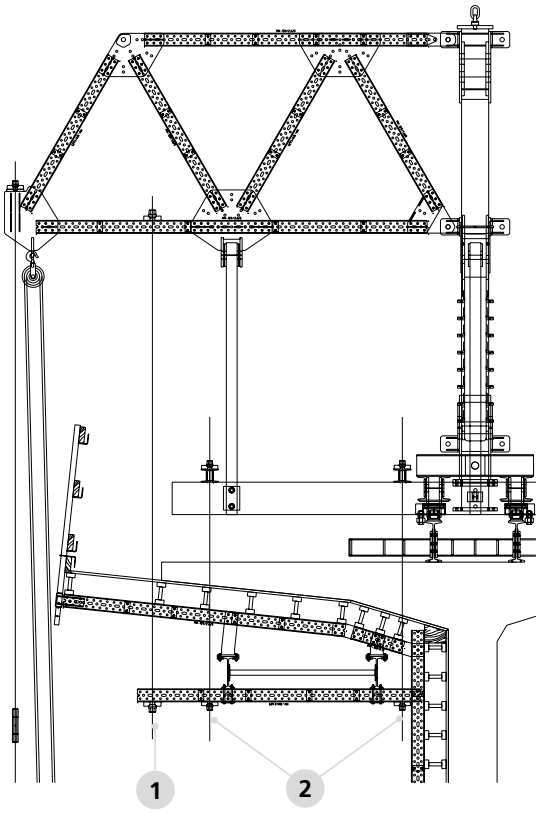
The thickness and spacing between profiles IPN depends upon the thickness and geometry of the wing slab, as well as the segment length.

In this case the walers that will receive the anchor rods are placed below the profiles IPN. To achieve this, IPN Profile Tying Clamps are used.



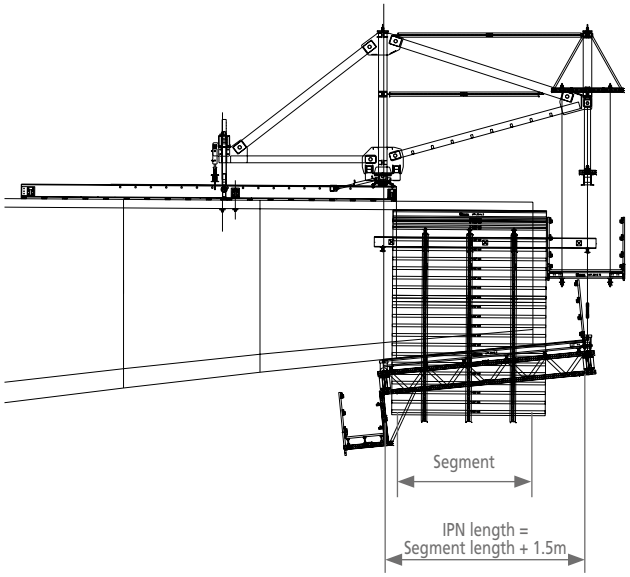
1. *Rod waler*
2. *Tie tube*
3. *IPN 300/6500 (Segment 5 m)*
4. *Bracing tubes*
5. *IPN profile tying clamp*

Two rods are placed between two profiles IPN, which are used to hold the structure during the pour. It is necessary to place another rod completely outside the bridge deck to facilitate advance and possibly reversal of the structure. This is why the waler should be placed underneath the profiles IPN.



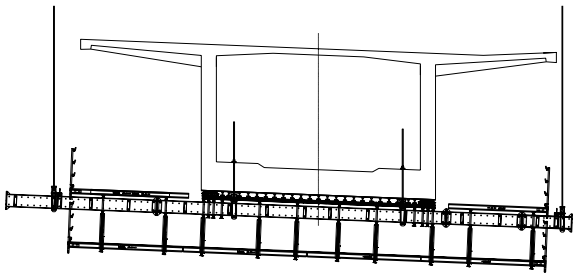
1. *Rod for advance along rear truss, or for possible carriage retreat*
2. *Pouring rods*

In this case the exterior formwork advances with the carriage; it is not necessary to wait until placing the rebar as with the top slab. This means that the profiles IPN needn't be as long; their length depends only upon the segment length. In the case studied, segments of 5 m, the profile length is 6.5 m.

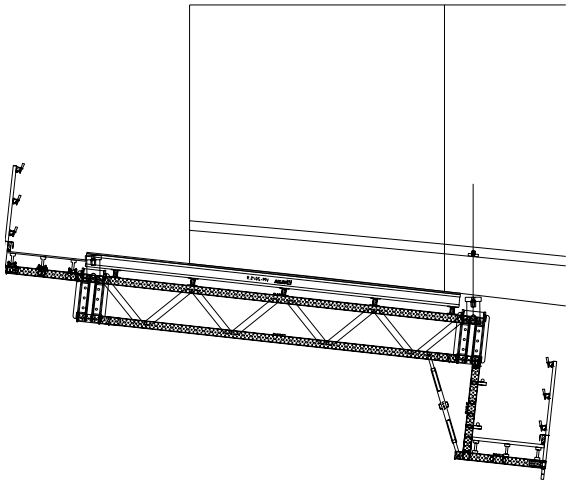


1.1.10 EBottom slab structure

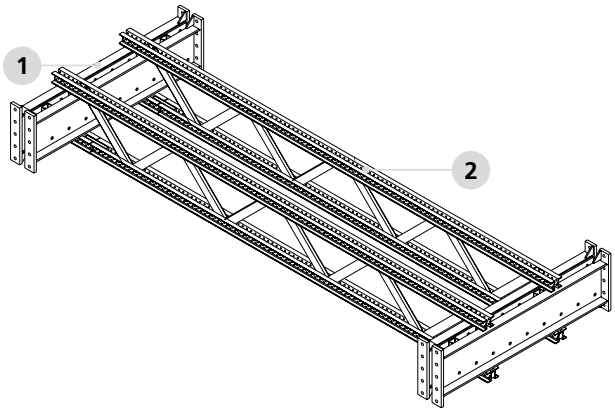
The structure that supports the weight of the sidewall and flooring concrete, which is approximately 75% of the total segment weight. Composed of two transversal profiles and longitudinal trusses MK, on which the formwork is installed.



FRONT VIEW



LONGITUDINAL VIEW

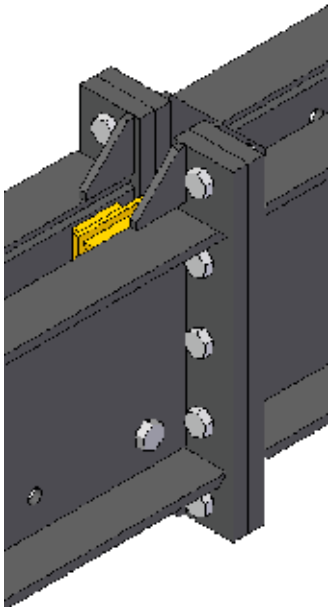


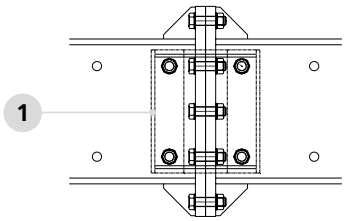
1 *Transversal beam / DUPN 500*

2 *Longitudinal MK Truss*

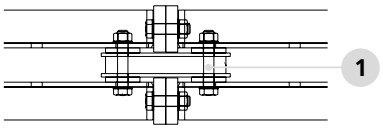
Each transversal beam is formed by two UPN 500 profiles. A range of different lengths of profiles has been defined; it is possible to join them using bolts to get different lengths.

The joint between profiles is done with end-plates and the DUPN 500 Longitudinal Connector.





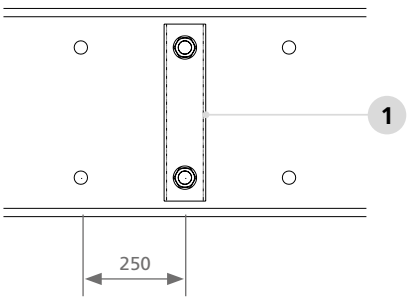
FRONT VIEW



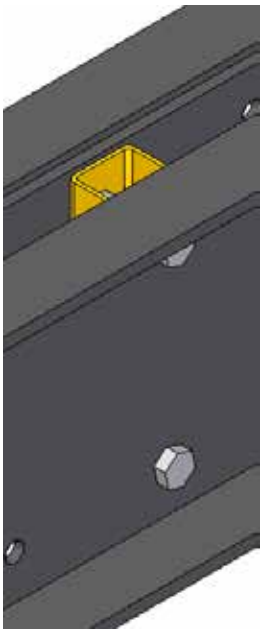
TOP VIEW

1 *DUPN 500 longitudinal connector*

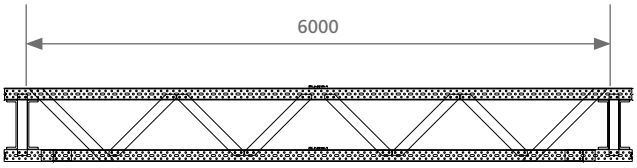
UPN 500 profiles have holes every 250 mm, it makes possible to place the Spacer Tube DUPN 500 in the most suitable point in each project. This element is used to keep a distance of 100 mm between the web of the two profiles.



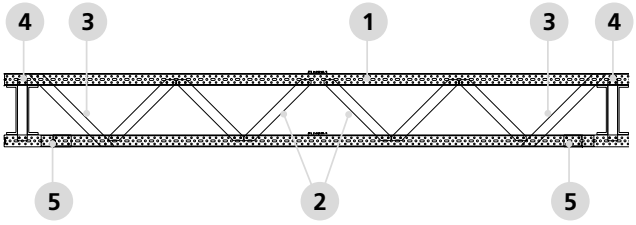
1 *Spacer tube DUPN 500*



The length of MK trusses depends on the length of the segment.



Trusses are formed by MK-120 walers and diagonals. There are two different kind of diagonals; some are place at the end of the trusses and other in the central area. Trusses are not bolted to the transversal beams.

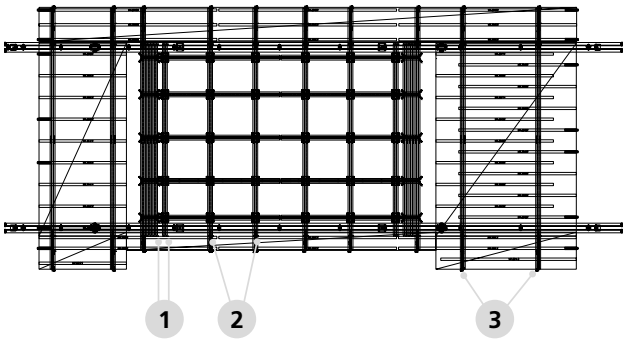


1. *MK waler*
2. *Truss diagonal 625-DUPN 500*
3. *Truss diagonal 687-DUPN 500*
4. *Vertical tube 625 DUPN 500*
5. *MK truss bottom joint*

To do the assembly easier the bottom chord of the truss is shorter; to fix the MK waler and the vertical tube the element MK truss bottom joint is used.

The spacing between trusses depends on the thickness of the slab where they are placed; consequently, the spacing will be smaller directly beneath the sidewall and increase in the centre. The corner trusses are used for working platforms, so the load they must bear will be only that exerted by the employees working there. In some cases these trusses can be substituted by walers MK-180.

The top view of the bottom slab structure is shown in the diagram below. Notice that the spacing between trusses is small below the sidewalls and increases toward the centre.



BOTTOM SLAB STRUCTURE

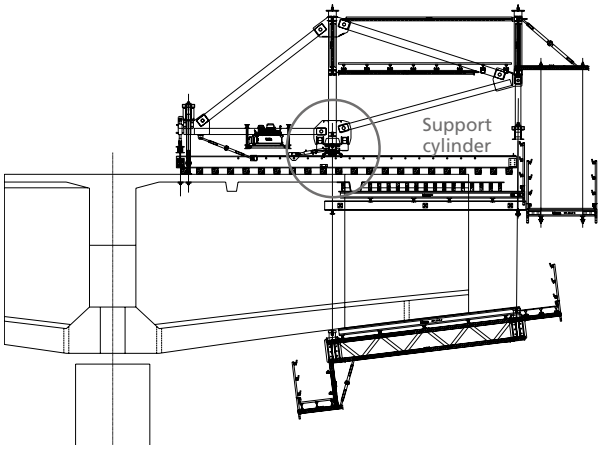
1. *Sidewall trusses*
2. *Central trusses*
3. *Trusses for platforms*

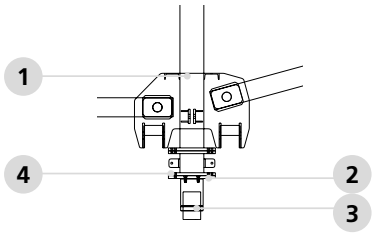
1.1.11 Hydraulics and accesories

The hydraulics of each carriage consists of 6 cylinders (in equal pairs), hydraulic equipment, a hollow cylinder, a manual pump, and the hoses necessary for connections.

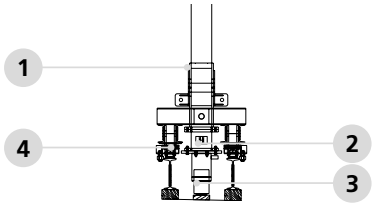
- **Hydraulic support cylinder / Cylinder CRI-200/160-GS-TA**

Two units per carriage are needed: one for each main structure. They are used to transmit the load exerted by the main structure to the previously poured segment. Placed beneath the Central Post.





LONGITUDINAL VIEW



FRONT VIEW

1. *Central post*
2. Adv Cyl connector
3. *Hydraulic support*
4. *Joint plate Hyd Cyl 200 t CVS*

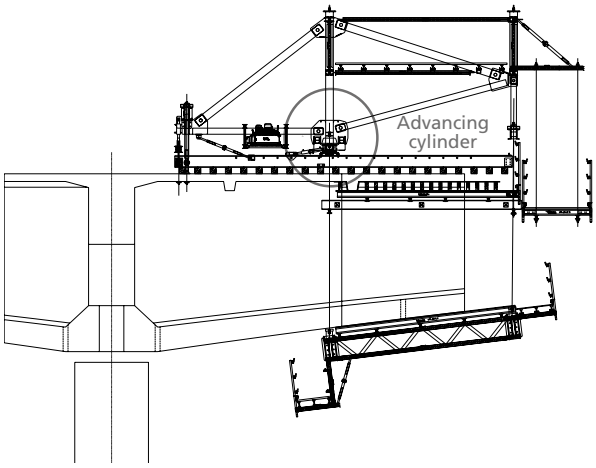
These are dual-action cylinders with a load-bearing capacity of 200 t and 160 mm of travel and a locknut. The locknut provides mechanical load restraint, thus creating a safer working environment.

CYLINDER CHARACTERISTICS
DOUBLE ACTING
MAXIMUM STROKE: 160 mm
HIGH PRESSURE

With an adjustable element that adapts to the contact surface. Generally a customised piece of wood or metal is placed between the concrete and cylinder.

- **Hydraulic advancing cylinder / Hyd Cyl CRI-10/500-UL**

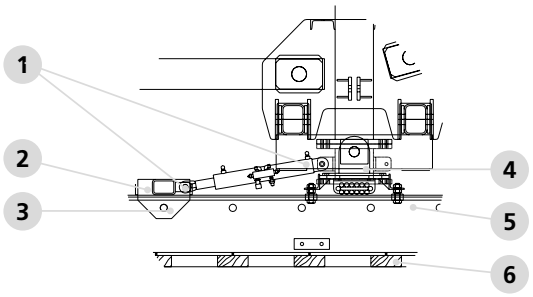
In this case as well, two units per carriage are needed: one for each main structure. As the name indicates, it is used during carriage movement, first to move the advancing rails and later to move the carriage along with all of its structures and formwork.



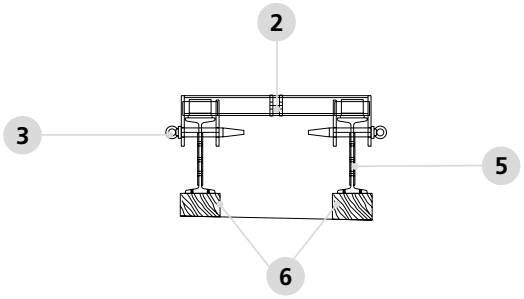
This double acting cylinder has a push capacity of 10 t. It has a load holding valve to control the speed of the carriage when the bridge has high longitudinal slope.

ITEM NO.	1992115
ITEM NAME	HYD CYL CRI-10/500-UL
PUSH CAPACITY (t)	10.5
PULL CAPACITY (t)	5.4
STROKE (mm)	500
PRESSURE	LOW

The element that is used to pull the rails is the 10 t Adv Cyl-Rail Connector; in the other end is placed the 10 t Advancing Cylinder Connector. The cylinder is fixed at both ends using the Pin Ø 34 x 95.



LONGITUDINAL VIEW

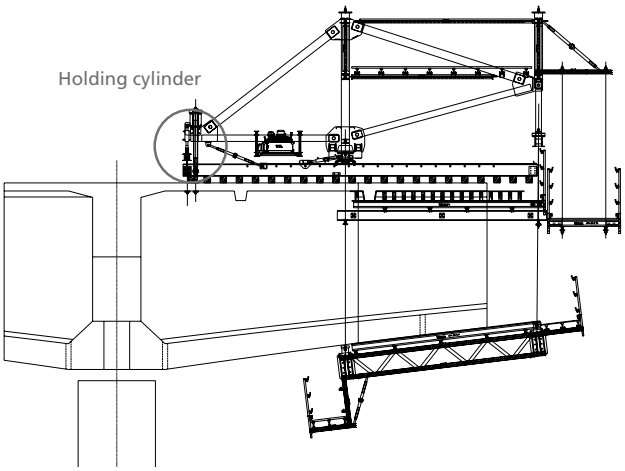


FRONT VIEW

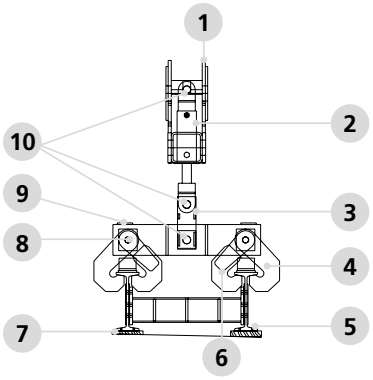
1. *Pin Ø 34 x 95*
2. 10 t *Adv Cyl-Rail connector*
3. *Pin Ø 45 x 250 with eyebolt*
4. 10 t *Adv Cyl-Rail connector*
5. *Advancing rail*
6. *Wooden blocks to level the profiles*

- **Hydraulic holding cylinder / Hyd Cyl CRI-25/200 UL**

As in the previous cases, two are needed per carriage; one for each of the main structures. Used to level the assembly.

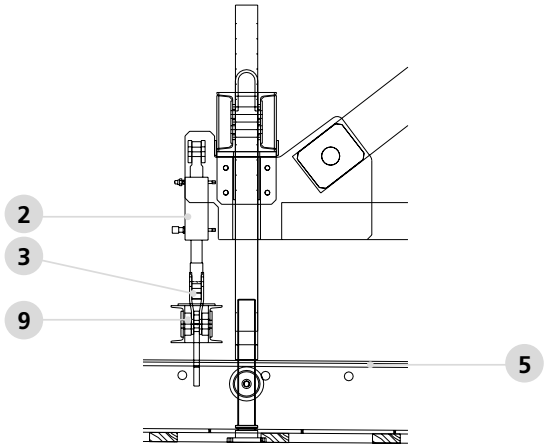


Fastened on one end with a pin to the rear part of the main truss, and on the other to a Holding Cylinder Connector. This component is in turn fastened to a profile upon which the clamps are hung. The clamps press against the advancing rails set in concrete and prevent the carriage from tipping when it isn't held in place by rods.



FRONT VIEW

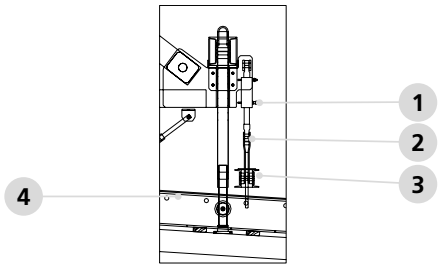
The length of the Holding Cylinder Connector depends upon the longitudinal slope of the bridge; if the slope is very pronounced, the component might not be necessary when the carriage advances down the slope. In this case the Holding Cylinder is fastened with a pin directly to the Clamps UPN Profile.



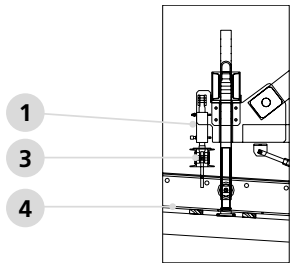
LONGITUDINAL VIEW OF BRIDGE WITHOUT SLOPE

1. *Main truss*
2. *Hyd Cyl CRI-25/200-UL*
3. *Holding cylinder connector*
4. Rear pincer
5. *Advancing rail*
6. *Rear clamp*
7. *Wooden shoe*
8. *Pin Ø 40 x 190*
9. Clamp *UPN profile*
10. *Pin Ø 50 x 160*

Uphill advance



Downhill advance



LONGITUDINAL VIEW OF BRIDGE WITHOUT SLOPE

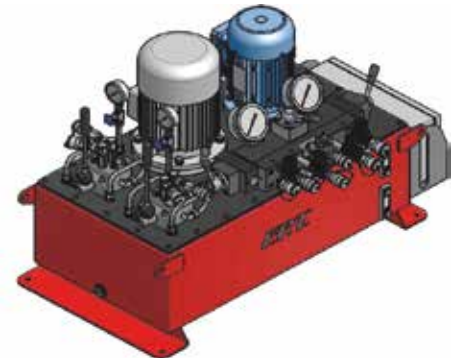
1. *Hyd Cyl CRI-25/200-UL*
2. *Holding cylinder connector*
3. Clamps *UPN profile*
4. *Advancing rail*

The characteristics of the holding cylinder are shown in the table below:

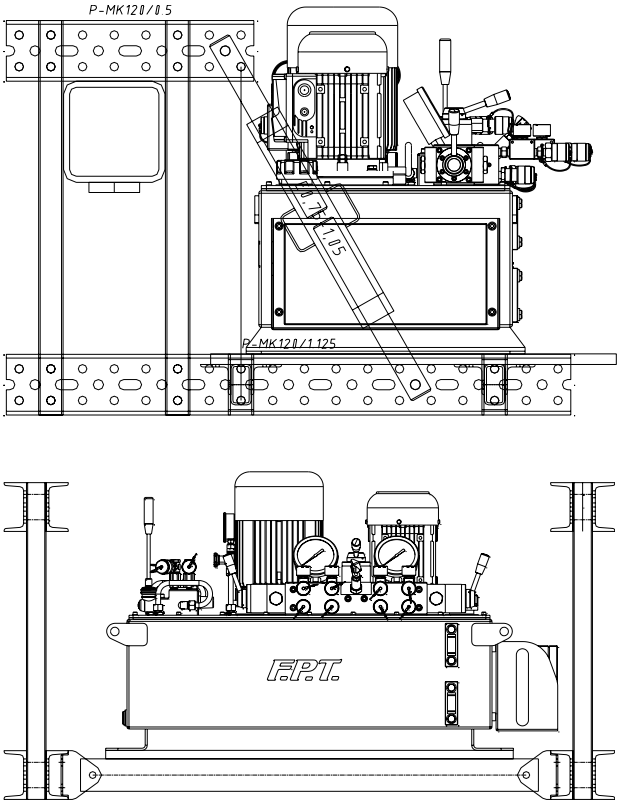
ITEM NO.	1992110
ITEM NAME	HYD CYL CRI-25/200-UL
PUSH CAPACITY (t)	22,3
PULL CAPACITY (t)	24,7
STROKE (mm)	200
PRESSURE	LOW

- **Power unit**

Hydraulic equipment, is a system composed of two electric motors and two pumps. The smaller motor powers the pump that feeds the support and holding cylinders. The bigger motor powers the pump that feeds the advancing cylinders.

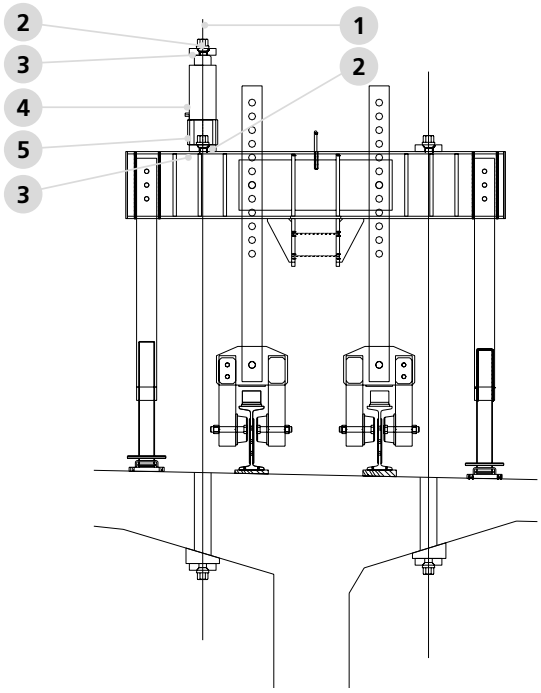


So that the hydraulic unit can move together with the carriage a platform is mounted in the rear ledger of the main truss.

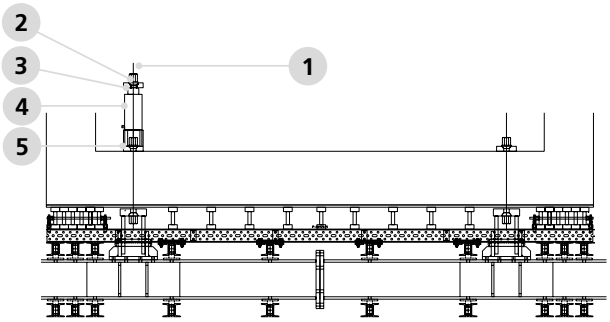


- **Hollow cylinder and manual pump**

Used to tense the anchor rods from the rear part of the main truss, as well as the central rear rods of the bottom slab structure.



PRESTRESSED RODS IN THE REAR
OF THE MAIN TRUSS



PRESTRESSED RODS IN THE REAR CENTRE
OF THE BOTTOM SLAB STRUCTURE

1. *Tie rod DW*
2. *Domed nut*
3. *Domed plate*
4. *High-pressure hollow cylinder SE 60 t*
5. *Hollow jack spacer 70 t*

The characteristics of the hydraulic cylinder are as follows:

ITEM NO.	3200506
ITEM NAME	HYDRAULIC HOLLOW JACK SE 60 t
CAPACITY (t)	60
PRESSURE	HIGH

The manual pump to be used is as follows:

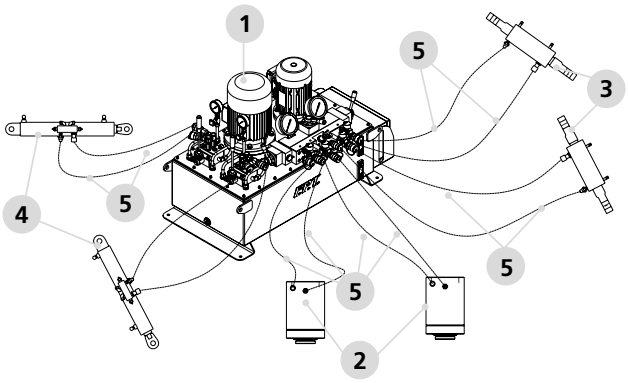
ITEM NO.	3200507
ITEM NAME	HIGH-PRESSURE MANUAL PUMP
PRESSURE	HIGH

The loads to be borne by the prestressed rods will be individually determined for each project.

HIGH-PRESSURE MANUAL PUMP

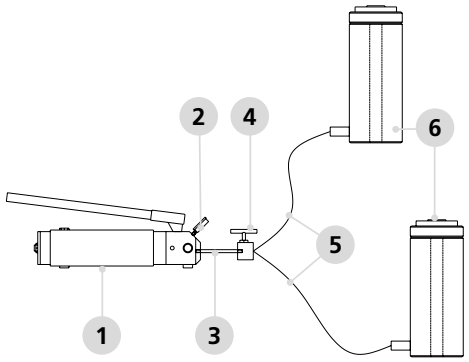
- **Hydraulic hoses**

Used to connect the hydraulic unit with the cylinders, and the manual pump with the hollow cylinder. Although advancing cylinders are designed to use with low pressure all the hoses of the hydraulic circuit will be high pressure hoses. The diagram below illustrates the hydraulic system layout.



1. *Power unit*
2. *Cylinder CRI-200/160-GS-TA*
3. *Hyd. Cyl. CRI-25/200-UL*
4. *Hyd. Cyl. CRI-10/500-UL*
5. *Hyd. Hose WP 700 DN6-TFGG-10*

The manual pump is used with high-pressure hoses.



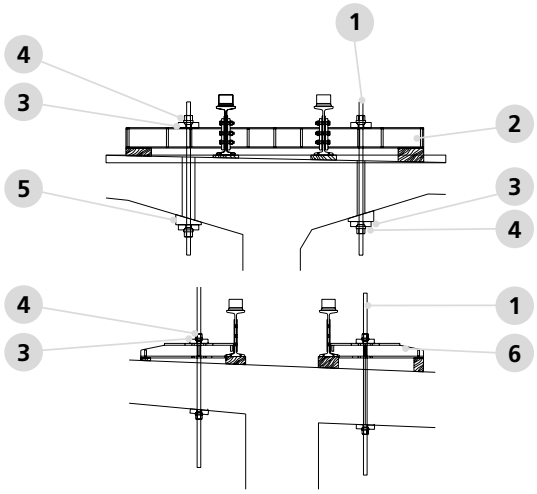
1. *High pressure handpump*
2. *Pressure gauge 01MD100G/700*
3. *Large fifting 3/8"NPT-3/8"NPT*
4. *Manifold 01VM5A/2*
5. *Hose Hid WP 700 DN6 TFG-3*
6. *Hydraulic hollow jack SE 60 t*

1.1.12 Rods

Different types of rods are used to fasten the advancing rails, the main truss, the secondary structures, and the formwork.

- **Anchor rods for advancing rails**

The rods used to hold the advancing rails in place; employed during movement of the main truss. Though they can vary from one project to another, generally rods DW 26.5 are used.

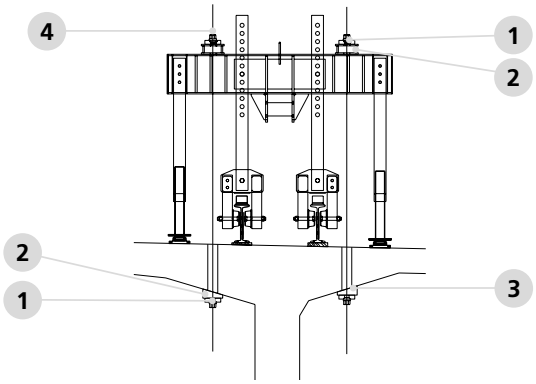


1. *Tie rod DW 26.5*
2. *Rail outer anchor*
3. *Domed plate DW 26.5*
4. *Domed nut DW 26.5*
5. *Shoe adjusted to the inclination present*
6. *Intermediate Anchorage AR*

When constructing segments it is necessary to leave the required orifices open so that these rods can later be inserted. These rods are not prestressed.

- **Anchor rods for main truss**

Hold the main truss in place during pouring and movement of the advancing rails. Normally rods DW 32 are used.

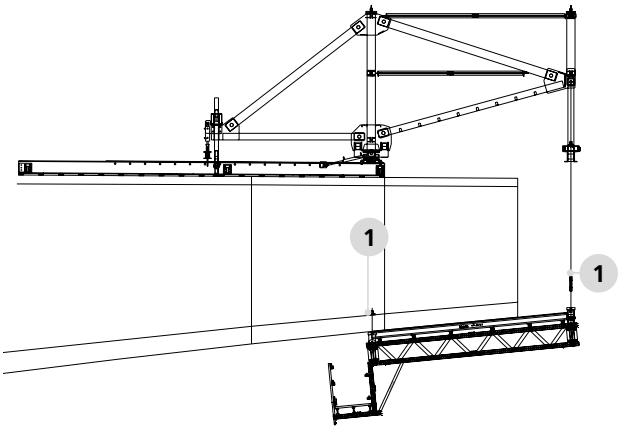


1. *Domed nut DW 32*
2. *Domed plate DW 32*
3. *Shoe adjusted to the inclination present*
4. *Tie rod DW 32*

In this case it is also necessary to leave adequate orifices during segment pouring. These rods are prestressed, and in each project the prestress load must be defined.

- **Rods for the bottom slab structure**

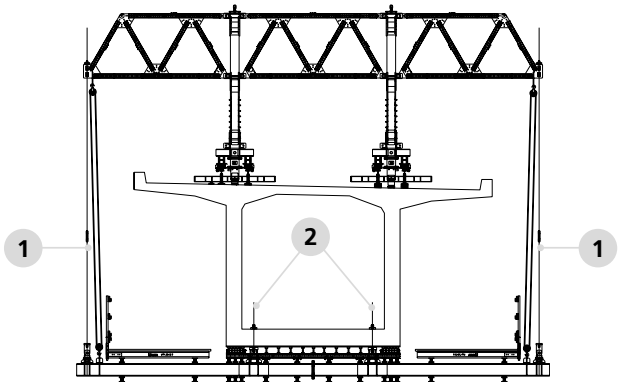
In this case rods for advance are differentiated from rods for pouring. During pouring the bottom slab structure is fixed at four points; two rods DW 36 in the front and two in the rear. The rear rods are fixed directly in the concrete of the previously poured segment. They are prestressed. The rods DW 36 at the front are fastened to the hanging support.



POURING PHASE

1 *Tie rod DW 36*

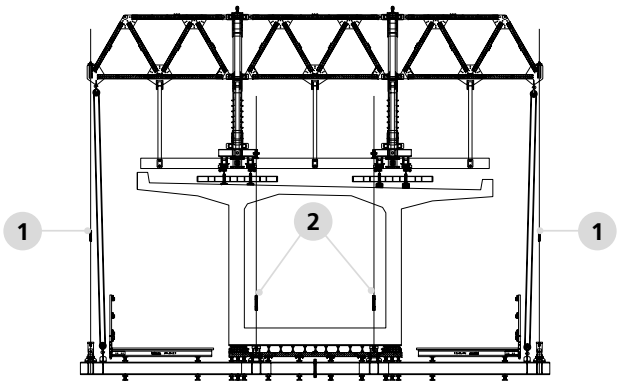
On the other hand, during the advance, rods DW 26.5 are used, and the bottom slab structure advances suspended from four exterior points.



ADVANCING PHASE - REAR AREA

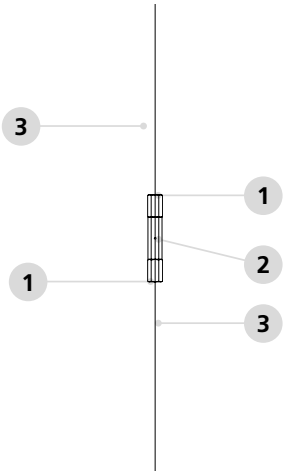
1 *Tie rod DW 26.5*
2 *Tie rod DW 36*

If the length of the rods is longer than 6 m, nuts and round couplers are used to join the rods together.



ADVANCING PHASE - FRONT AREA

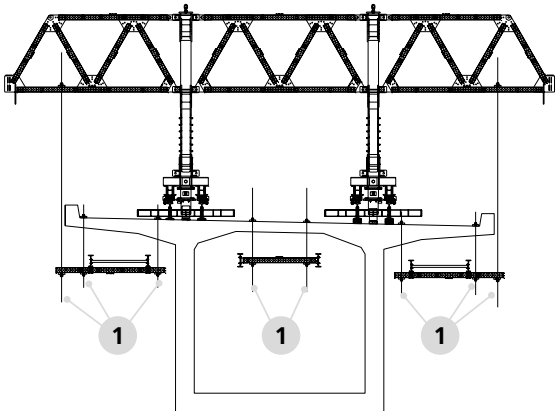
1 *Tie rod DW 26.5*
2 *Tie rod DW 36*



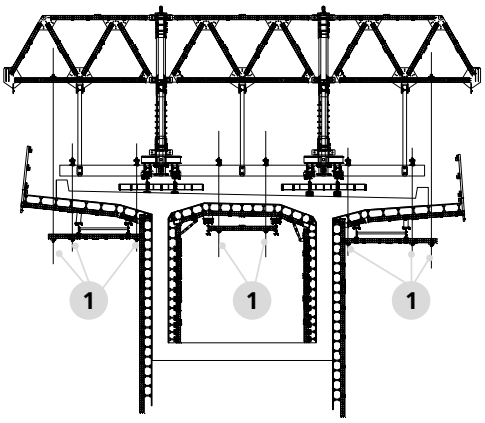
1 *Nut DW 26.5*
2 *Round coupler DW 26.5 Ø 50 x 150*
3 *Tie rod DW 26.5*

- **Rods for top slab structure and wing slab structure**

In this case rods DW 26.5 are used for both the advancing and the pouring. The rods in the rear are fixed in the concrete of the previously poured segment, and the front rods are fastened to the hanging support. None of these rods are prestressed.



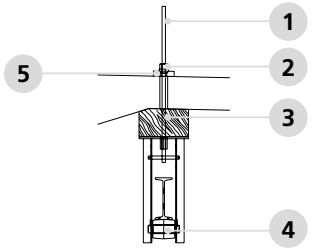
REAR AREA



FRONT AREA

1 *Tie rod DW 26.5*

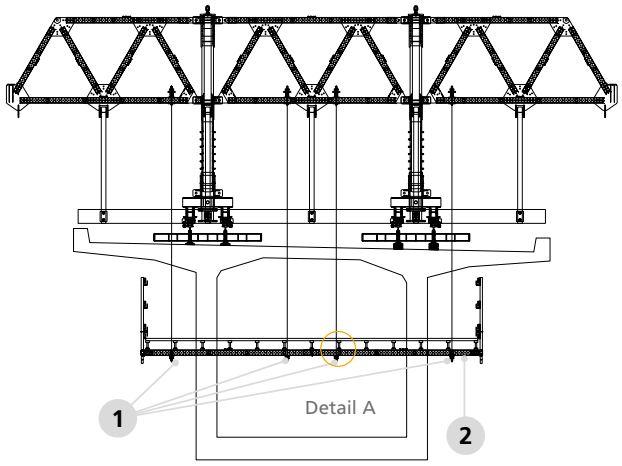
Rods DW 26.5 are also used in the top slab structure to support the Formwork Hanger Rollers.



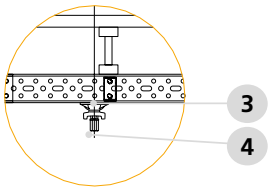
1 *Tie rod DW 26.5*
2 *Domed nut DW 26.5*
3 *Wooden shoe*
4 *Formwork hanging roller*
5 *Domed plate DW 26.5*

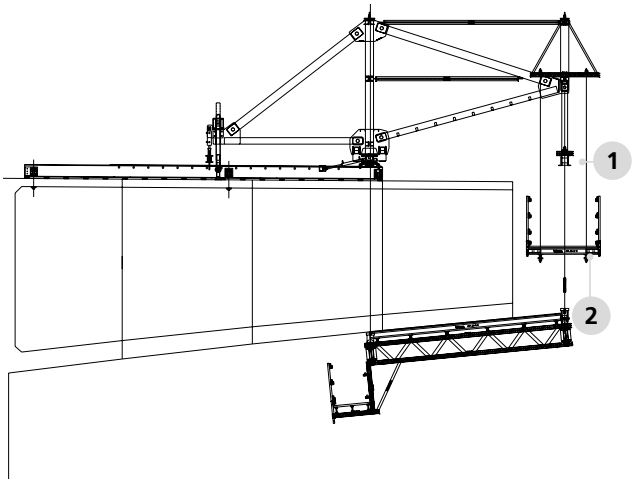
- **Rods DW 15 for upper platform and sidewall formwork**

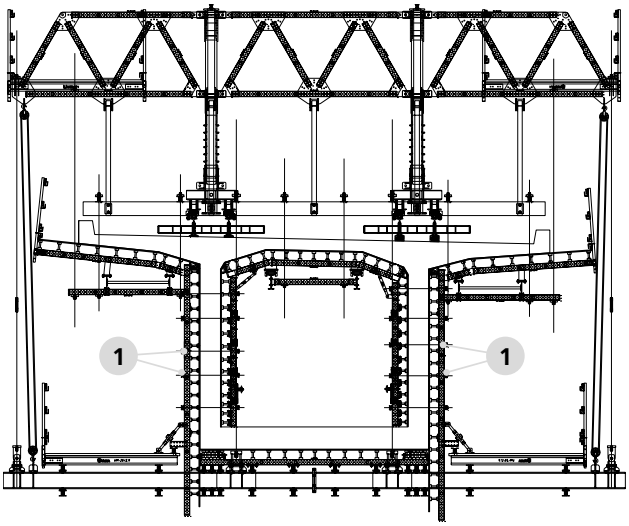
Rods DW 15 are used to hang the upper platform from the front truss, and to equilibrate the pressure from the sidewalls.



DETAIL A







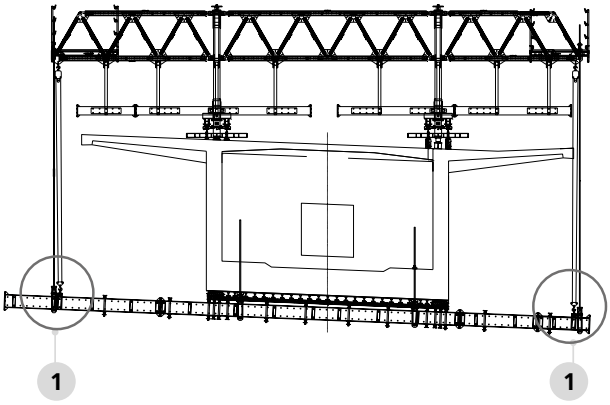
1 *Tie rod DW 15*
2 *Upper plataform*
3 *Plate washer nut 15*
4 *Hexagonal nut 15*

1.1.13 Cardan joints

Advancing cardan joints must be differentiated from pouring cardan joints.

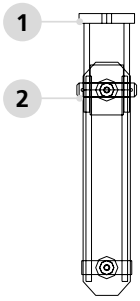
- **Advancing cardan joints**

Four are placed in the bottom slab structure; two in each transversal profile. Used in the advancing phase, they support the weight of the bottom slab structure.

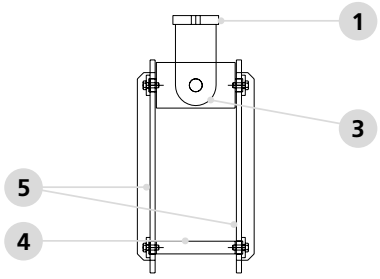


1 *Cardan joint DW 26.5 / Advance*

The piece's design allows it two swivel on both longitudinal and transversal axes; used with rods DW 26.5.



TRANSVERSAL VIEW

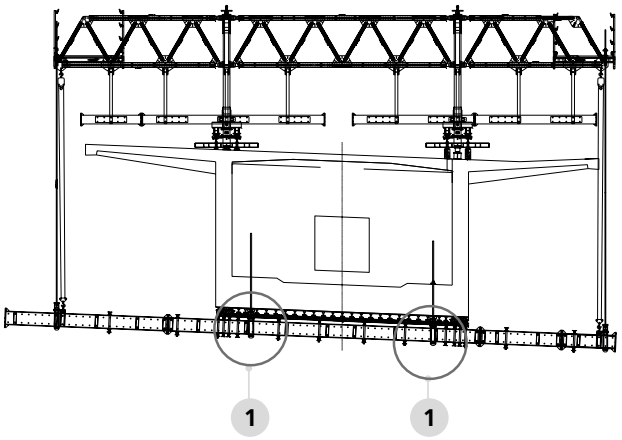


LONGITUDINAL VIEW

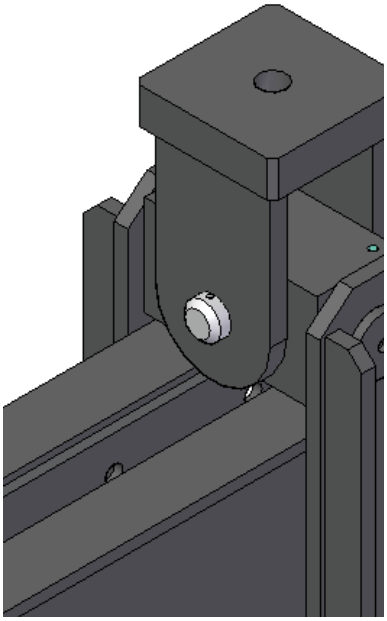
1 *Advancing cardan DW 26 300 kN*
2 *Pin Ø 50 x 175 215 Cardan DW 26*
3 *Cardan DW 26.5 DUPN 500 Upper part*
4 *Cardan DW 26.5 DUPN 500 Lower part*
5 *Cardan DW 26.5 DUPN 500 Lateral plate*

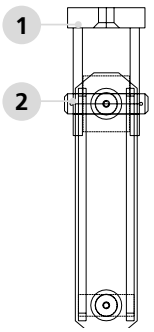
- **Cardan joint pouring**

Four joints are used for this application as well; two placed on each transversal profile. They support the load exerted by the concrete, and are commonly placed in areas close to the sidewalls. Used with rods DW 36.

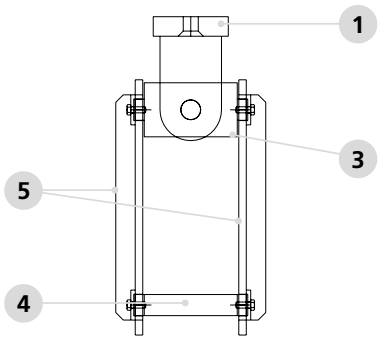


1 *Cardan joint DW 36 / Pouring*





TRANSVERSAL VIEW

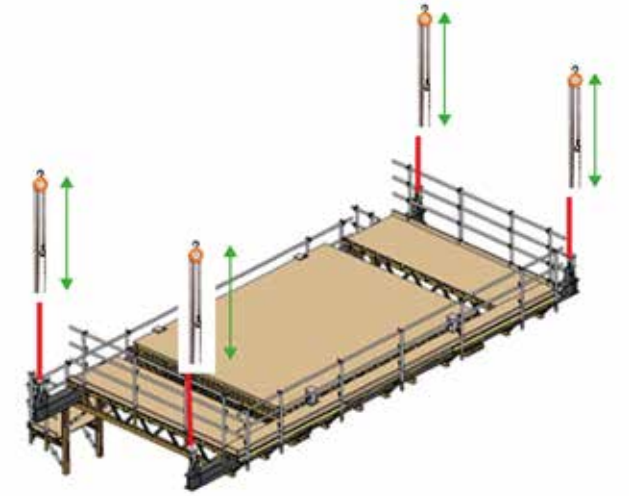


LONGITUDINAL VIEW

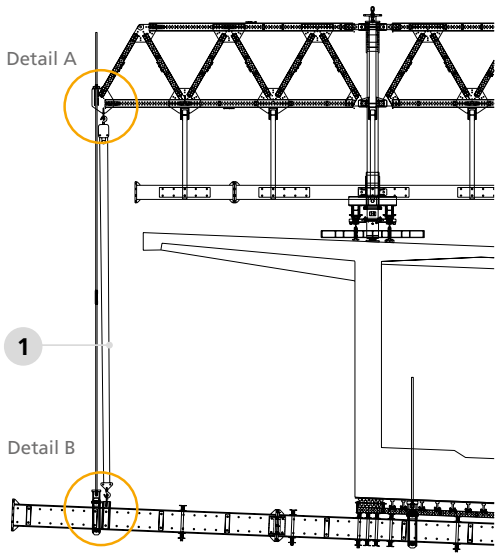
1. *Pouring cardan H DW 26.5 500 kN*
2. *Pin Ø 65 x 225 315 Cardan DW 36*
3. *Cardan DW 36 / DUPN 500 upper part*
4. *Cardan DW 36 / DUPN 500 lower part*
5. *Cardan DW 36 / DUPN 500 lateral plate*

1.1.14 Pulley blocks

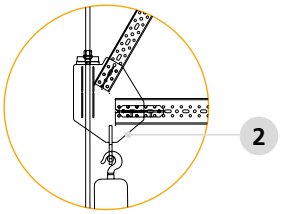
Four per carriage are installed, and they are used to level the bottom slab structure. There are two different models; depending on the weight of the bottom slab structure one model or the other is used.



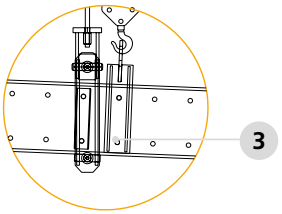
On the upper part they are fastened in the corners of the trusses with Hanging Nodes 60 MK, and on the lower part with Pulley-DUPN 500 Connector. These pieces are attached to the transversal profiles with bolts M30.



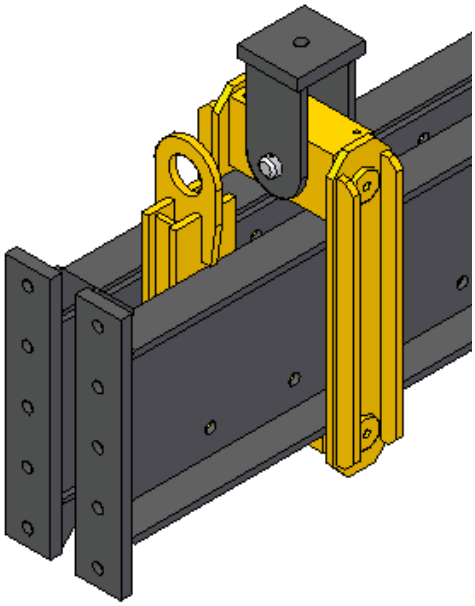
DETAIL A



DETAIL B



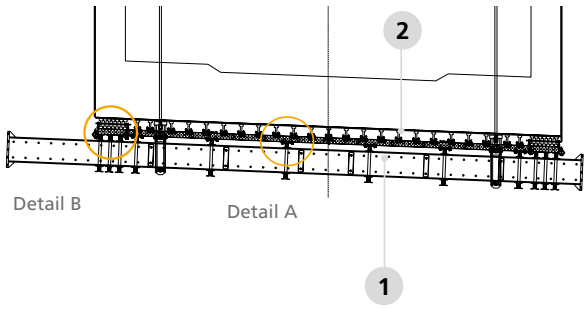
1. *Pulley block*
2. *Hanging node 60 MK*
3. *Pulley-DUPN 500 connector*



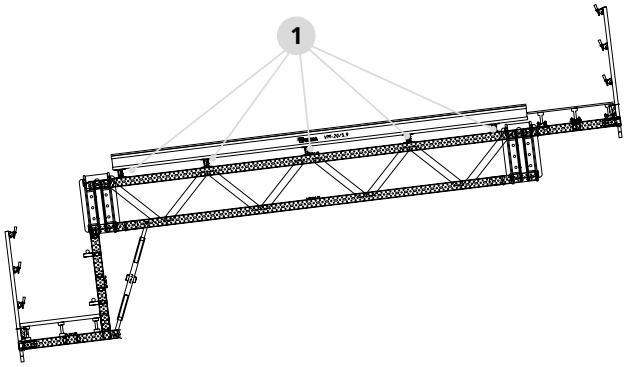
1.1.15 Formwork

- **Bottom formwork**

Generally composed of walers MK-120 and wooden beams.



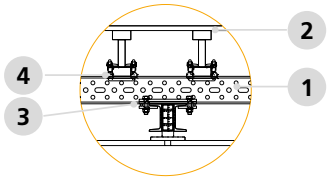
Depending on the length of the segment, more or fewer waler lines will be needed.



SEGMENT 5 m

In the central area the spacing between trusses MK allows for the use of Plate Clamps DU-DU to fasten the bottom formwork walers.

DETAIL A

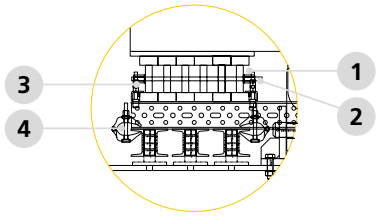


CENTRAL AREA OF THE BOTTOM FORMWORK

1. *Waler MK-120*
2. *Wooden beam*
3. *Plate clamp DU-DU*
4. *Waler-VM20 clamp 2T*

In the areas near the sidewalls the bottom slab structure trusses are extremely close together; there is not sufficient space for Plate Clamps DU-DU. Joint Clamps 16/70 are used to fix the bottom walers in place. The timber beams are also placed quite close together; they are joined together with threaded rods and nuts, and joined to the bottom waler using Angle Clamps RVM20.

DETAIL B



SIDEWALL - BOTTOM AREA

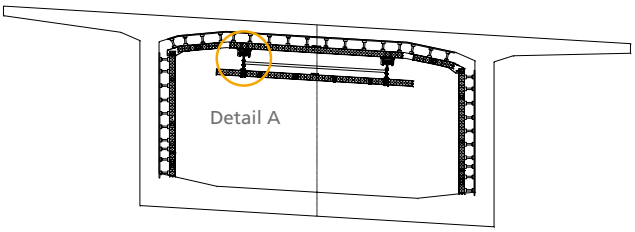
1. *Hexagonal nut 15*
2. *Threaded rod 15/0.6*
3. *Waler-VM20 angular clamp*
4. *Joint clamp 16/70*

- **Interior formwork**

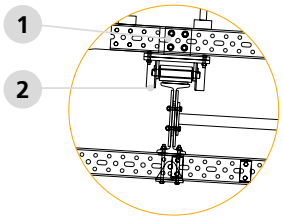
As with bottom formwork, this is generally formed by walers MK-120 and timber beams.

The interior formwork is supported by the profiles IPN of the top slab structure using Internal Formwork Wheels. Two components can be used to fix these wheels to the inner formwork.

1. **Internal profile connector:** It shall be used when the upper waler of the inner formwork is horizontal or at a very small angle to the horizontal. This part is screwed to the upper waler using four M16x90 bolts.



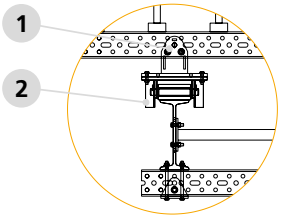
DETAIL A



1. *Internal profile connector*
2. *Internal formwork wheel*

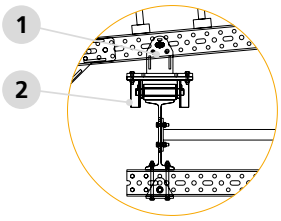
2. **IF Wheel Connector:** It can be used when the upper waler of the inner formwork is horizontal or at a very small angle to the horizontal. It is screwed using two M16x90 bolts on the lower row of holes of the waler.

DETAIL A



Its design also allows fixing it to the waler using an E20x70 pin. In general, this option shall be chosen when the waler is inclined.

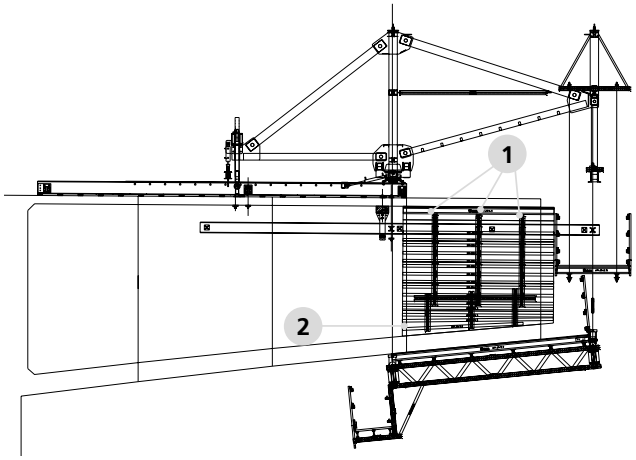
DETAIL A



1 *IF wheel connector*

2 *Internal formwork wheel*

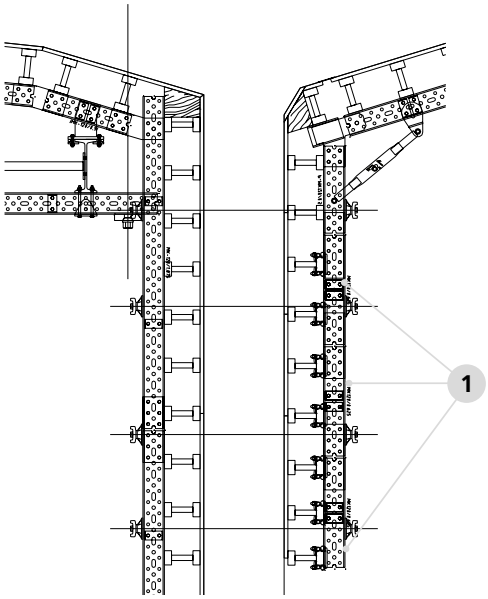
The number of waler rows will depend on the length of the segment. Normally, it will be necessary to adjust the lower part of the inner formwork on site.



1 *Waler row*

2 *Lower part*

In bridges with a variable cross-sectional height, the sidewall waler MK-120 will not span the whole distance. The usual procedure is to design it by joining short walers in order to be able to remove them as the cross-sectional height decreases.

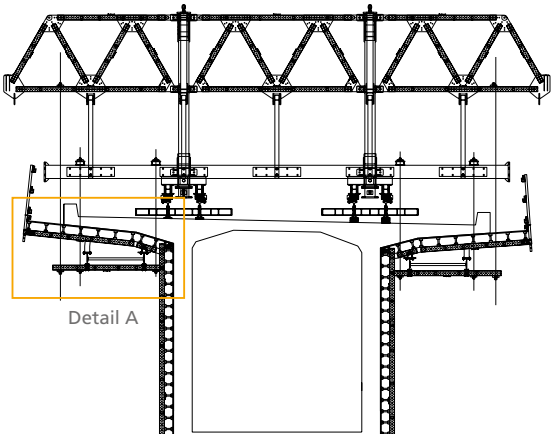


1 *Profile MK-120/0.625*

- **Outer formwork**

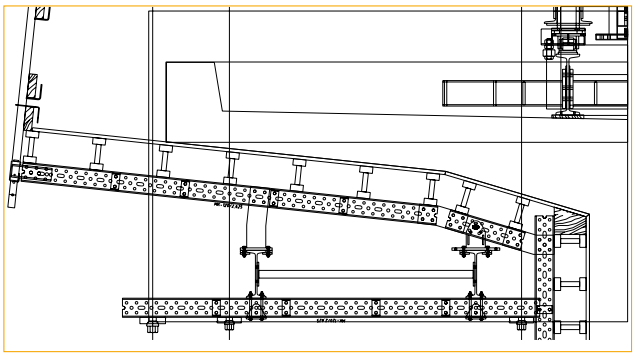
Normally, it shall also be made of walers MK-120 and wooden beams. It is usually joined to the wing slab structure using the IF wheel connector with clamps and special parts

.



The IF wheel connector with clamps shall be placed on the inner profile of the wing slab structure. 4 clamps are added to the part that is used with the inner formwork (IF wheel connector) to secure the IPN profile.

DETAIL A

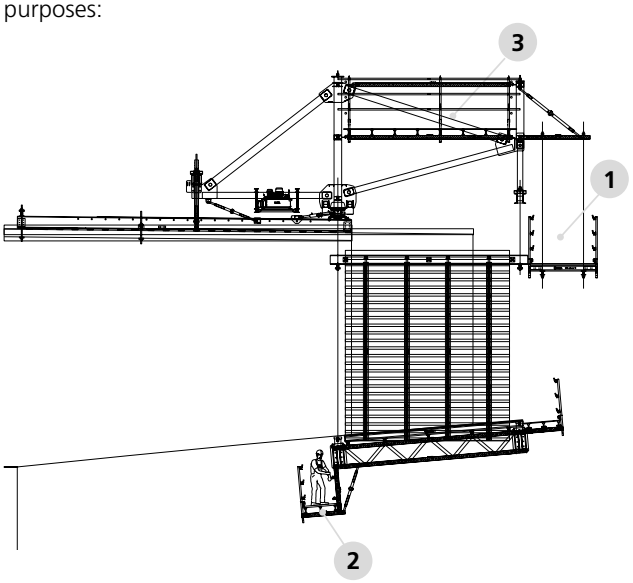


A special part shall be used to secure the outer profile of the flange support structure. In general, a specific part is designed for each project, since its geometry depends on the width and inclination of the bridge flange.

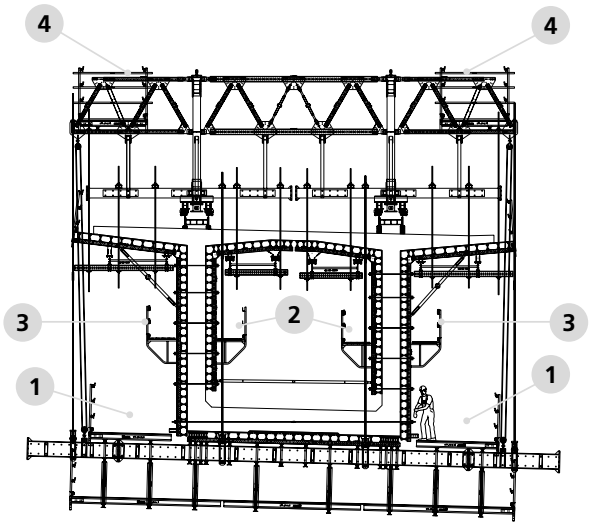
Obviously the number of waler lines for the exterior formwork will be the same as that for the interior formwork. They are attached head to head using rods DW 15.

1.1.16 Working platforms

The system is made of different platforms with different purposes:



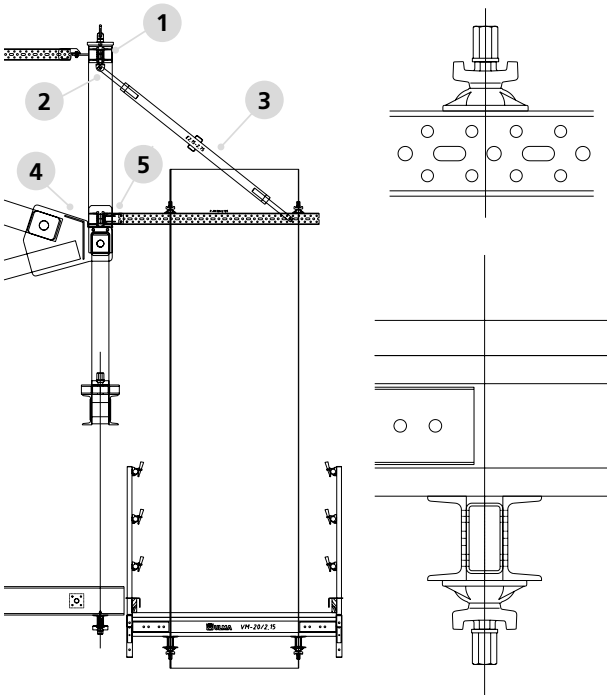
1. *Upper platform*
2. *Lower platform*
3. *Horizontal bracing platform*



1. *Bottom slab structure platform*
2. *Sidewall formwork platform (Interior)*
3. *Sidewall formwork platform (Exterior)*
4. *Horizontal bracing platform*

- **Upper platform**

Hangs from the front truss; used during segment tensioning to support the cylinder and workers.

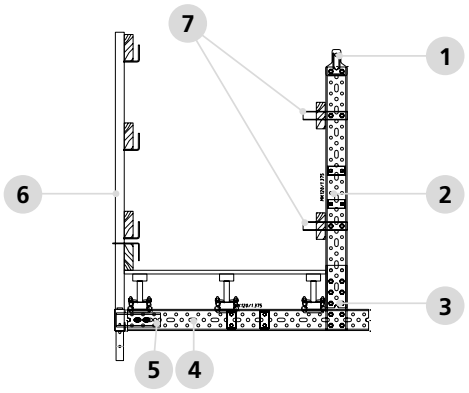


The tie rods that bear the weight of the platform shall be fixed with a nut and locknut on both their ends.

1. *Front truss upper chord*
2. *Right angle head MK180-120*
3. *Push-pull prop E*
4. *Front truss lower chord*
5. *MK truss HB connector*

• Lower platform

Used to place the central rods of the bottom slab structure. Fastened to the bottom chord of the bottom slab structure trusses using Axial Node M D20 MK.



1. *Axial node M Ø 20 MK*
2. *Waler MK-120/1.375*
3. *Orthogonal joint*
4. *Waler MK-120/1.375*
5. *Handrail socket Ø 50*
6. *Handrail post 1.5 wood*
7. *Handrail head MK*

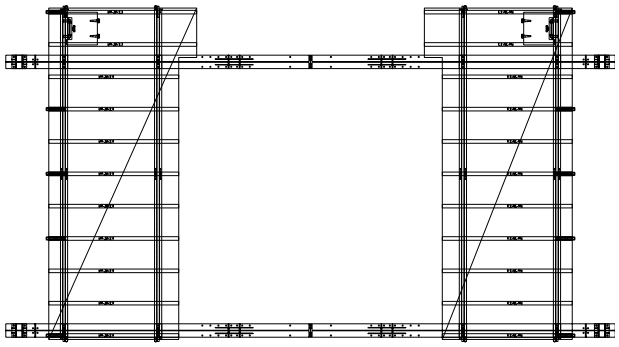
• Horizontal bracing platform

It is assembled on the walers used in the horizontal bracing of the lower chord.

It allows adjusting the length of the tie rods that bear the weight of the bottom slab structure in the advancing phase.

• Bottom slab structure platform

The two outermost trusses on each side of the bottom slab structure are used to make working platforms.

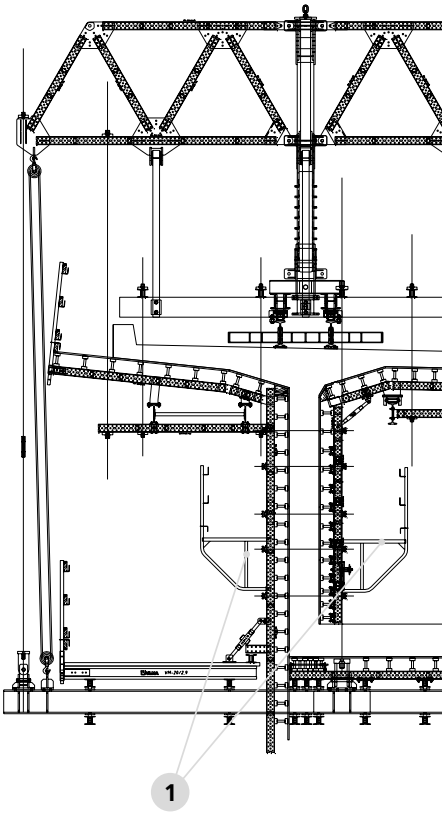


BOTTOM SLAB ESTRUCTURE PLATFORM
(Top view)

Used to place the rods DW 15 of the sidewall formwork. They also allow access to the pulley blocks on the lower section.

• Sidewall formwork platform

When building tall segments, brackets are mounted on the sidewalls to make working platforms. Brackets can be placed on either the interior or exterior. Used to place the rods DW 15 of the sidewall formwork.



1. *Selling MK bracket*

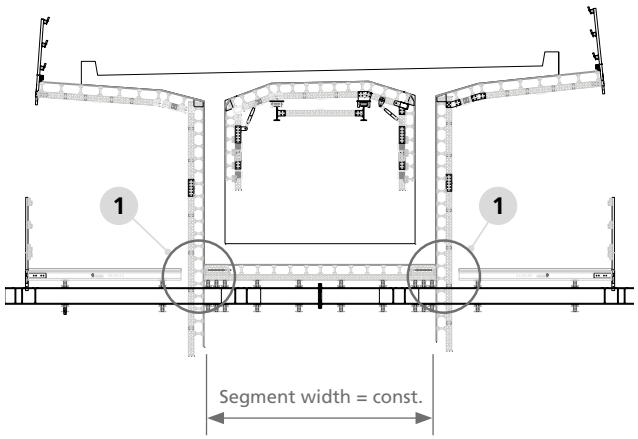
2. SOLUTIONS

2.1 STRAIGHT/INCLINED SIDEWALL

Bridge cross-sections can be defined according to their sidewalls, which can be either straight or inclined.

2.1.1 Cross-sections with straight sidewalls

In principle these bridges are easier to build than those with inclined sidewalls. The sidewall formwork only bears the pressure of the concrete, and not its weight. In these cases the width of the bottom part of the segment is constant. When the height of the segment is varied a space must be left in the bottom slab structure so that the exterior formwork can slip through it as necessary to make a shorter sidewall.

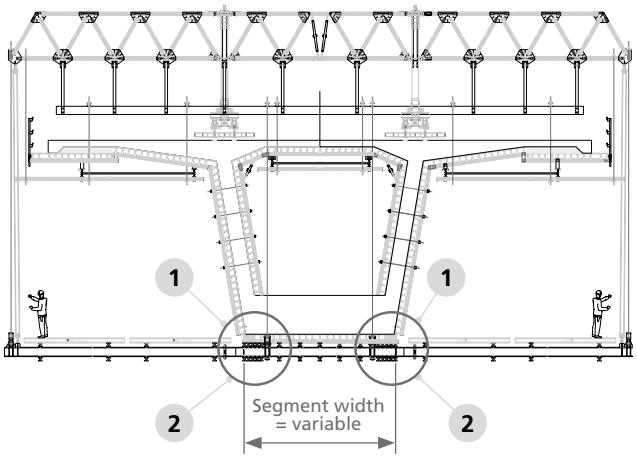


1 *Space for sidewall*

2.1.2 Cross-sections with inclined sidewalls

In this case, even if the inclination is very slight, the sidewall formwork must support both the weight and pressure of the concrete. If the segment is of varied height, the width of the bottom part of the segment increases as the height decreases. No space is left in the bottom slab structure to allow the exterior formwork to pass. It would be extremely complex to do this, as the space would have to change positions according to the variations in height. To solve this problem the exterior formwork is designed with short walers MK-120, which are dismantled as necessary to accommodate the diminishing height.

As the sidewall takes up more space, this type of cross-section requires more trusses MK-120 underneath the sidewall.

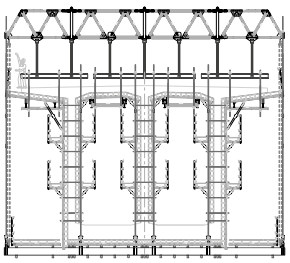


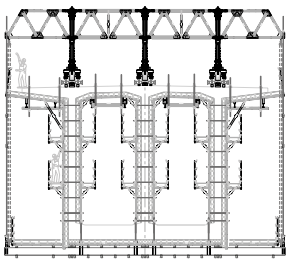
1 *Walers MK-120 short, detachable*

2 *More trusses than in segment with straight sidewalls*

2.2 CROSS-SECTIONS WITH MORE THAN TWO SIDEWALLS

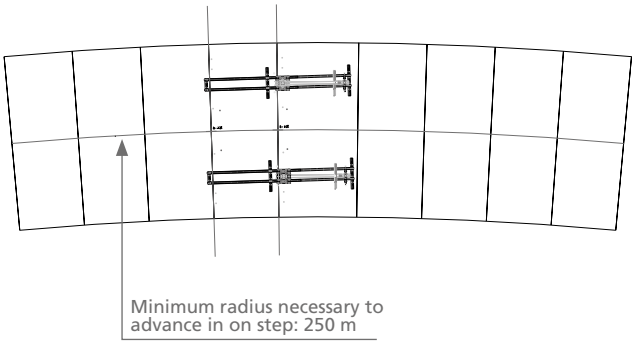
It is possible to encounter wide segments with more than two sidewalls. In these cases a main carriage structure is generally placed on top of each sidewall.





2.3 CURVED BRIDGES

The current design of the cantilever carriage allows for the construction of curved bridges. For the advance to be accomplished in a single phase, the curve must have a minimum radius of 250 m. If the radius is smaller, the advance must be done in more than one phase, which means that more anchoring orifices must be left when pouring the segment.

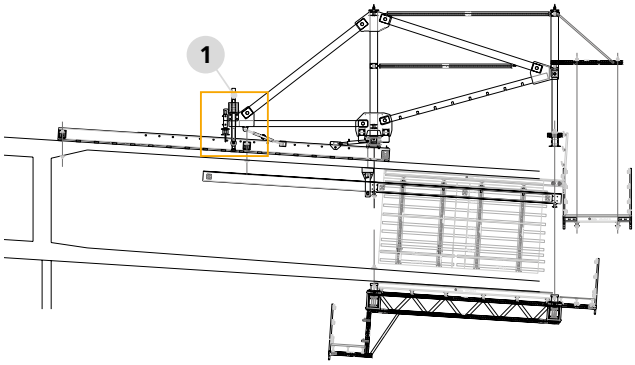


CANTILEVER CARRIAGE FOR CURVED BRIDGE

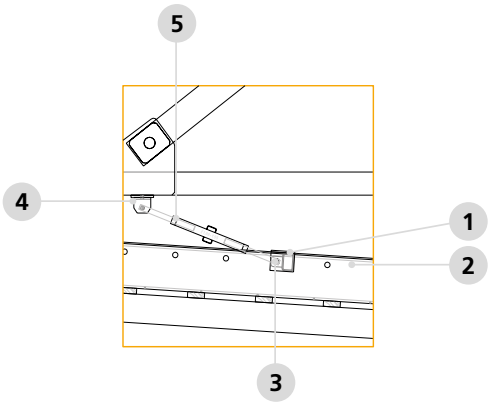
2.4 HOLDING SYSTEM

When constructing a bridge with pronounced longitudinal slope it is absolutely necessary to secure the carriage at all times. During the advance of the main truss there is a moment in which it is necessary to remove the component that joins the cylinder with the rails. The piece must be moved forward and fastened with a pin in the next rail orifice. At this moment the carriage is free, which is why a holding system that prevents the carriage from moving unrestrained, must be used.

The holding system is composed of a Joint Rail-Holding PP Prop, a Push-Pull Prop E, and a Joint Main Truss-PP Prop. Assembly is illustrated in the diagram below.



1 *Holding system*



1 *Joint rall-holding PP prop*
2 *Advancing rail*
3 *Pin Ø 45 x 250 with eyebolt*
4 *Joint main truss-PP prop*
5 *Push-pull prop E 1-1.55*

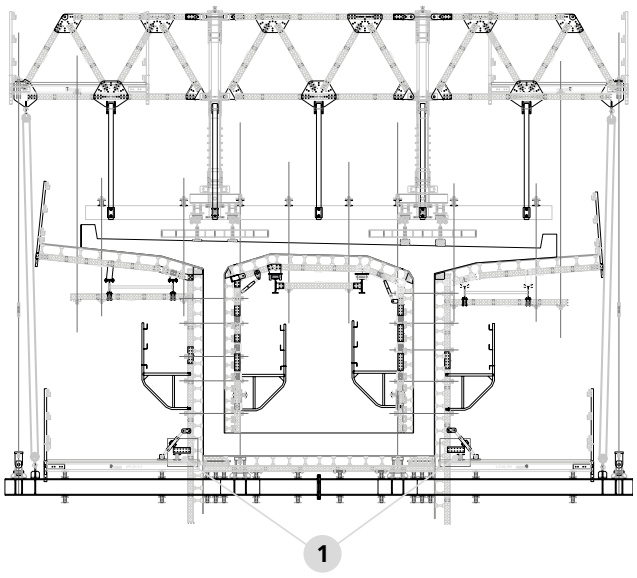
HOLDING SYSTEM FOR BRIDGES WITH PRONOUNCED SLOPE

2.5 BACKWARD MOTION

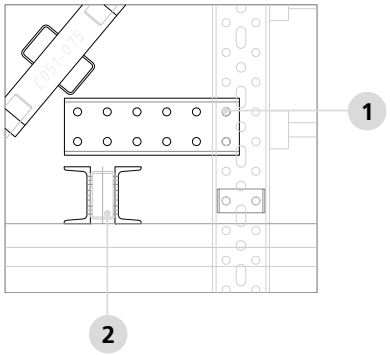
In the construction of many bridges, due generally to the terrain, it is impossible to lower the carriage immediately after pouring the final segment in the centre of the span. In these cases it is necessary to move the carriage backward to the pier, where it can be dismantled.

The orifices used for advance are also used for backward motion. The interior formwork and top slab structure are normally dismantled in the centre of the span, leaving a window through which material can be removed.

The bottom slab structure is secured while it is moved by the four exterior rods installed outside the bridge deck. However, it is necessary to install more support points to move the wing slab structure backwards. Concrete interferes with two of the three front rods, so that other supports points on the bottom part must be devised.



1 *Support point for backward motion*



1 *Orthogonal joint MK*

2 *Waler MK-120/1.125*

SETUP OF SUPPORT POINT FOR BACKWARD MOTION

3. ASSEMBLY, USE AND DISMANTLING

3.1 TECHNICAL ASSEMBLY INSTRUCTIONS

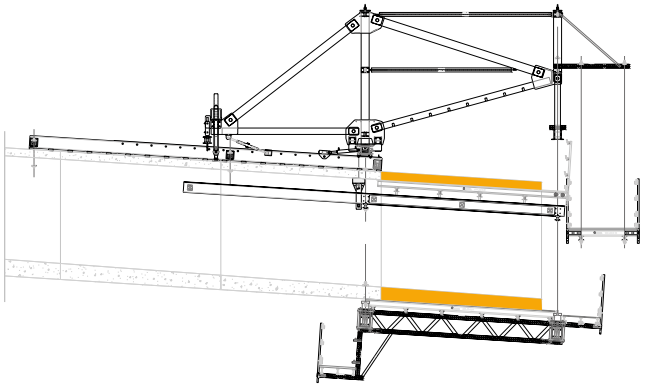
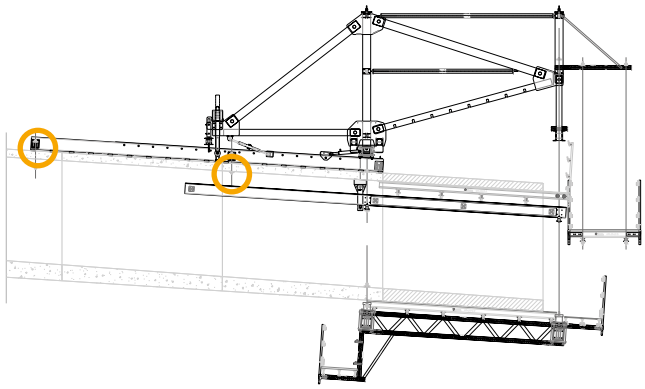
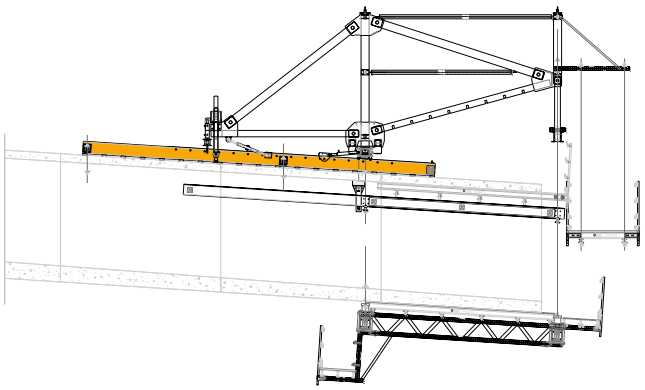
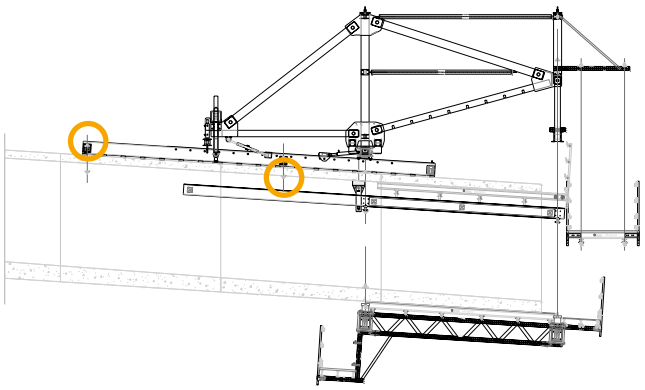
- **ITM CVS01-03** "Assembly of Carriage CVS on pier segment 0 with asymmetric advance".
- **ITM CVS02-03** "Assembly of Carriage CVS on pier segment 0 with symmetric advance".
- **ITM-CVS04-00** "Bottom slab structure + wing slab structure + external formwork lifting with two cranes".
- **ITM-CVS05-00** "Bottom slab structure + wing slab structure supported by shoring + external formwork lifting with two cranes".
- **ITM-CVS07-00** "Bottom slab structure + wing slab structure + external formwork lifting with pulley blocks or tensioning cables".
- **ITM-CVS08-00** "Bottom slab structure + wing slab structure supported by shoring + external formwork lifting with pulley blocks or tensioning cables".
- **ITM-CVS09-00** "Dismantling of Cantilever Carriage".

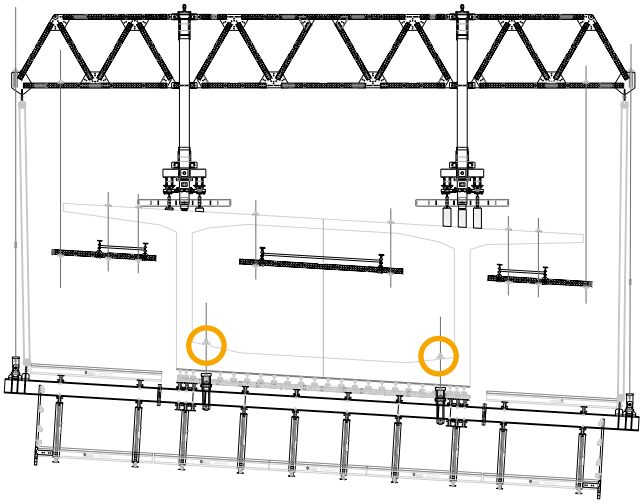
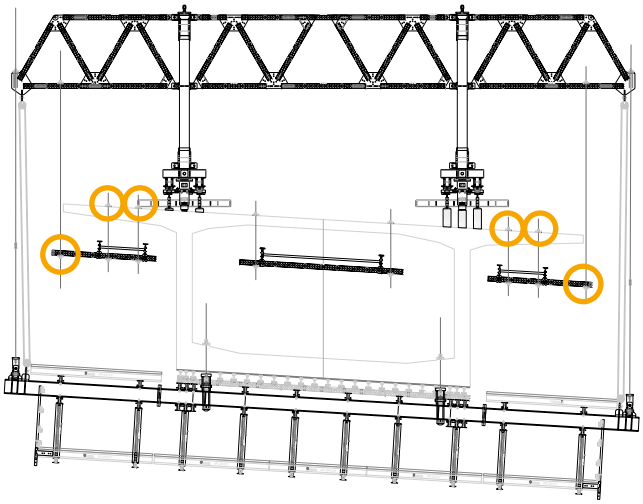
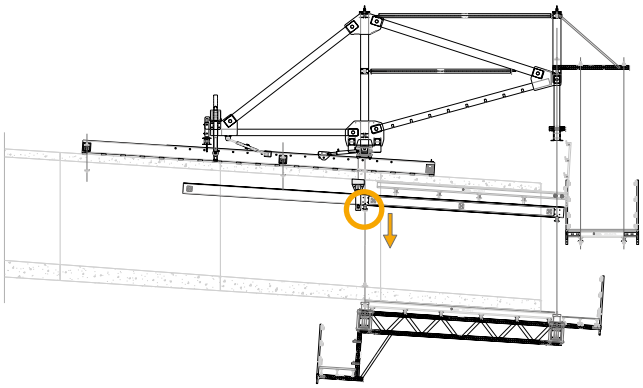
3.2 VIDEO ANIMATIONS

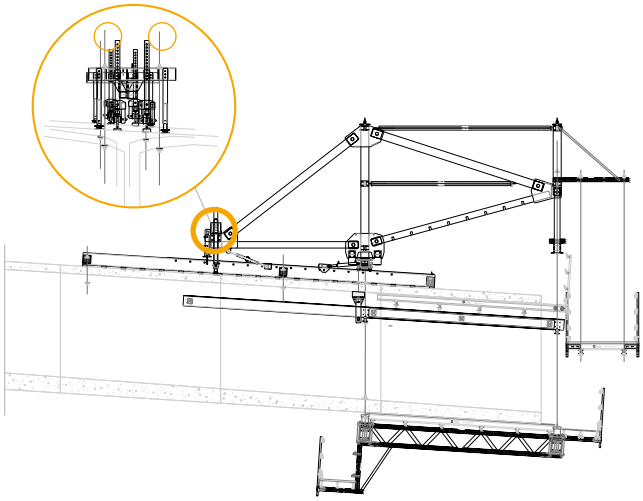
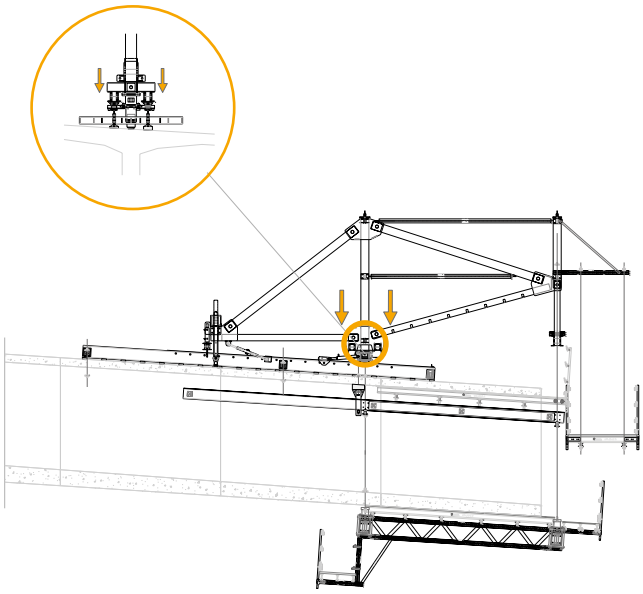
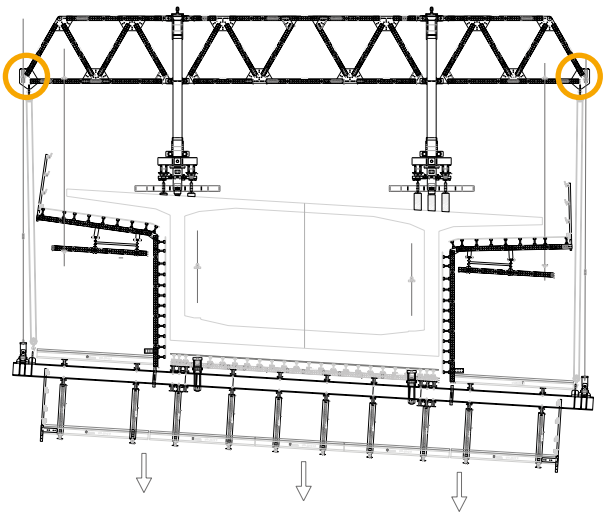
Animations available on the ULMA Construction website.

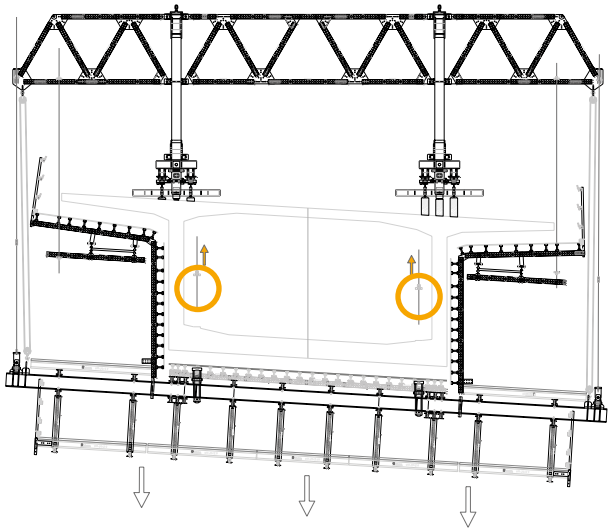
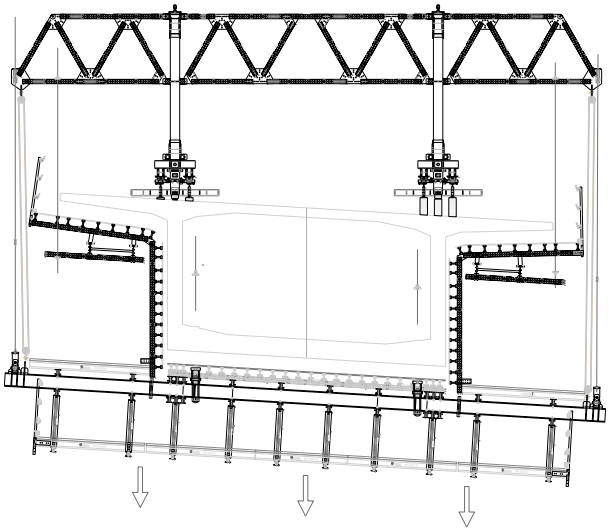
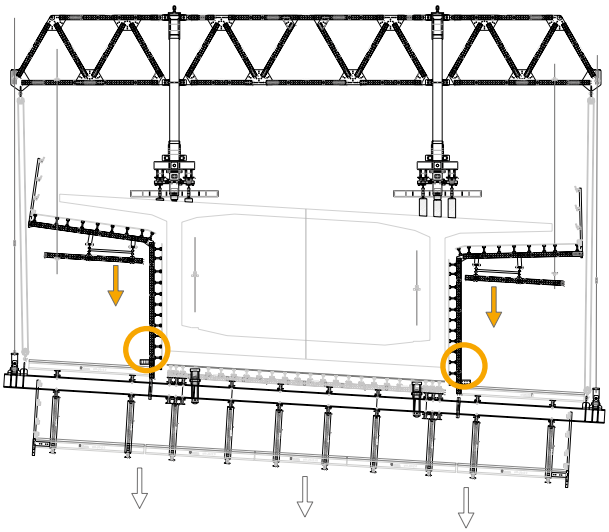
3.3 ADVANCING PROCEDURE – WORK PHASES

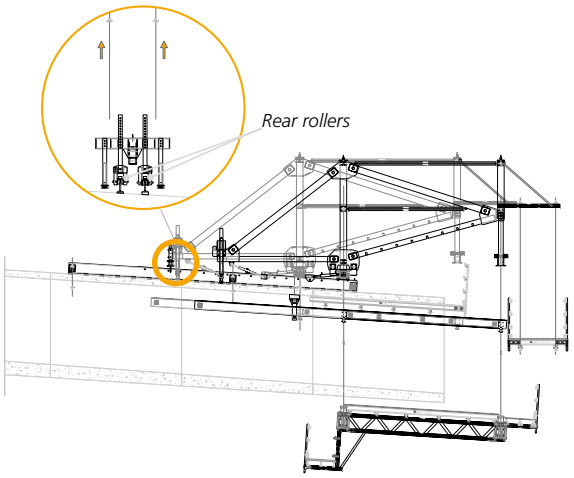
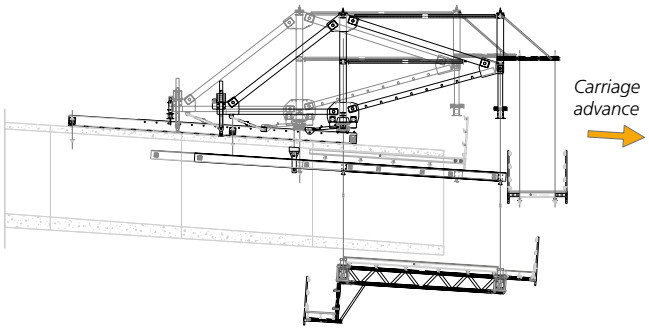
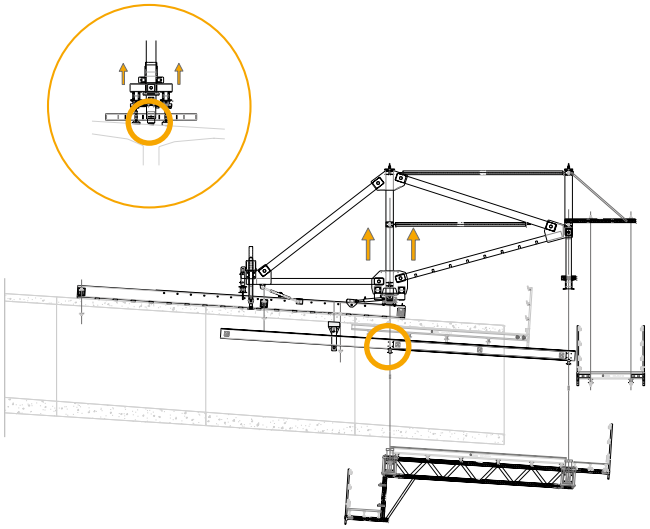
In this section the steps to follow, from pouring a segment through placing the carriage in the correct position to make the next pour, are enumerated:

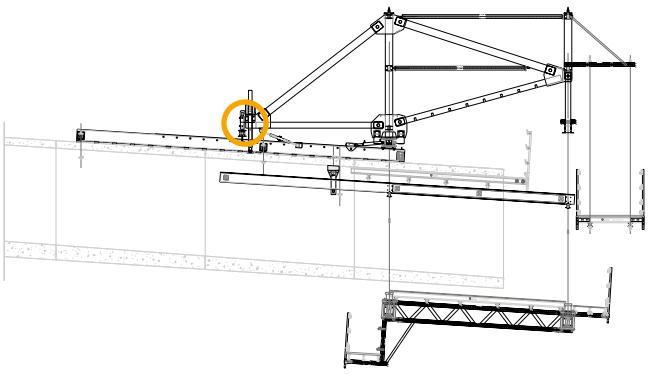
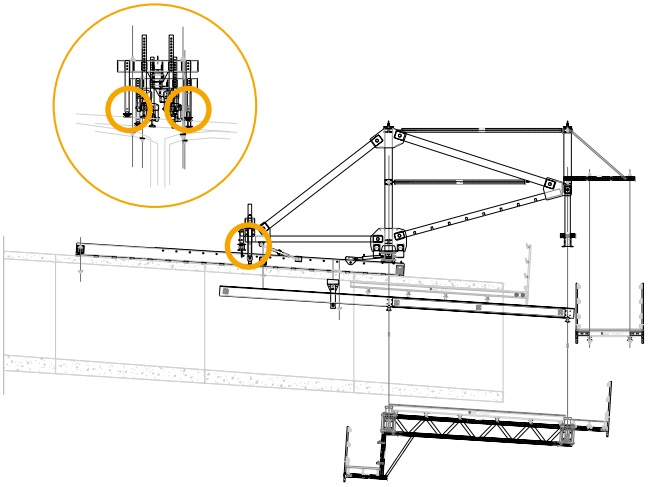
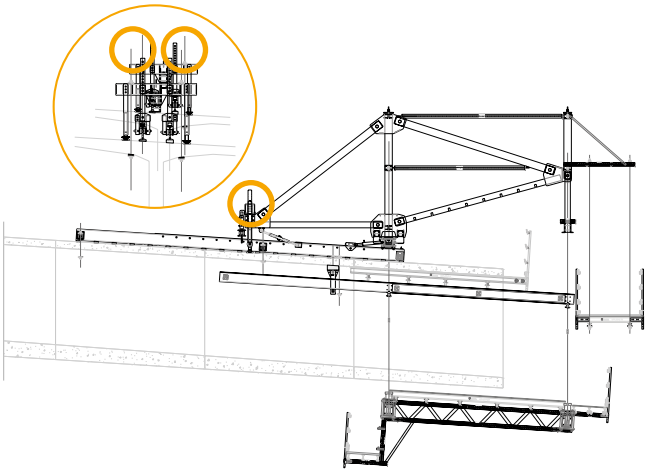
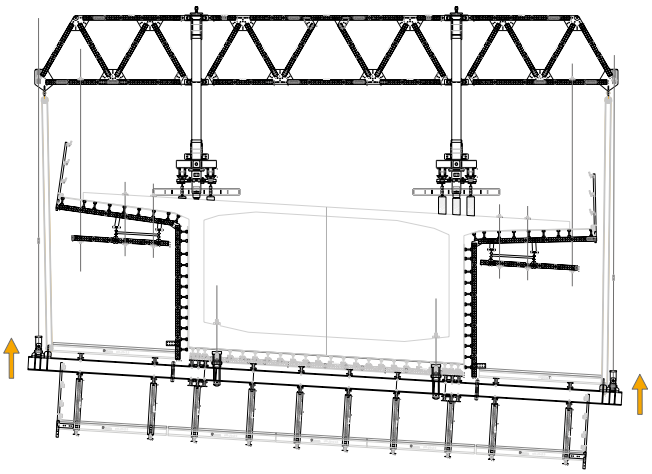
STEP	DESCRIPTION	IMAGE
1	Pour the segment.	
2	Remove anchor rods for rails	
3	Advance the rails.	
4	Position the rails.	
5	Anchor the rails.	

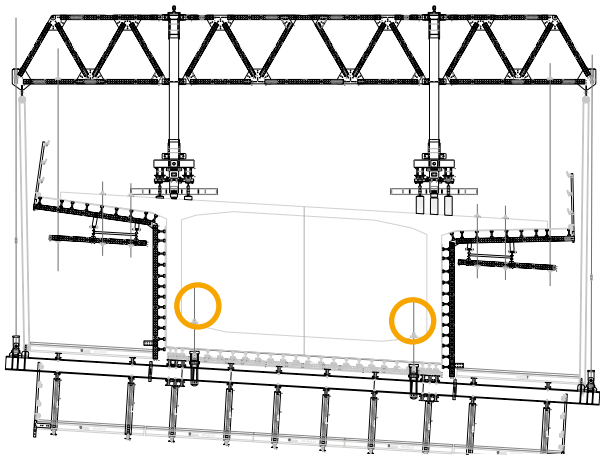
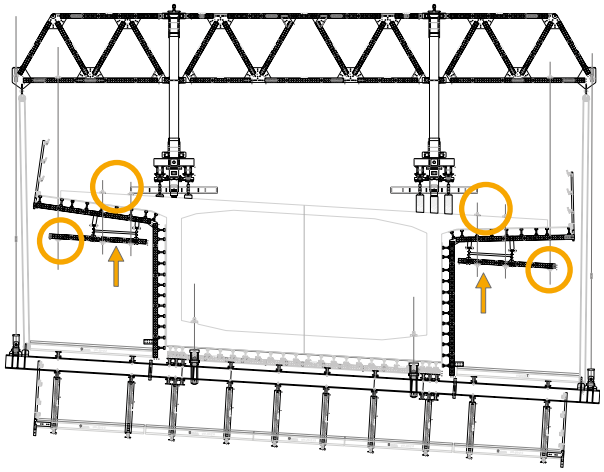
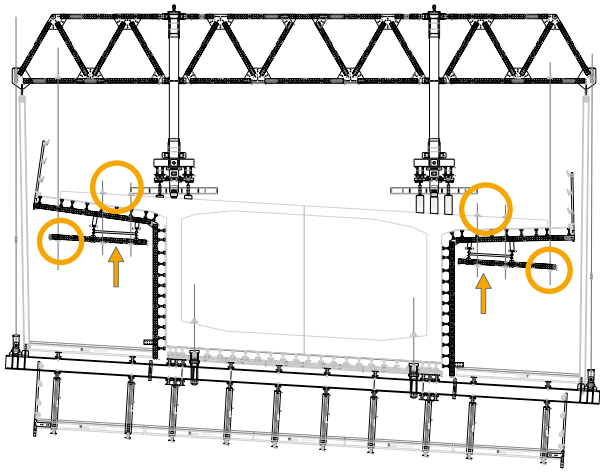
STEP	DESCRIPTION	IMAGE
6	Remove stop-ends from the exterior formwork.	
7	Remove front bulkhead panels.	
8	Remove joining rods between sidewall formwork sections, and strip the shuttering.	
9	Allow the concrete to set until it reaches the desired resistance.	
10	Prestress the segment.	
11	Remove the tension from the rear anchor rods of the bottom slab. Do not remove the rods yet.	
12	Loosen the exterior formwork suspension rods.	
13	Remove the tension from the rear rods in the interior formwork of the top slab until the profile IPN rests on the interior wheel.	

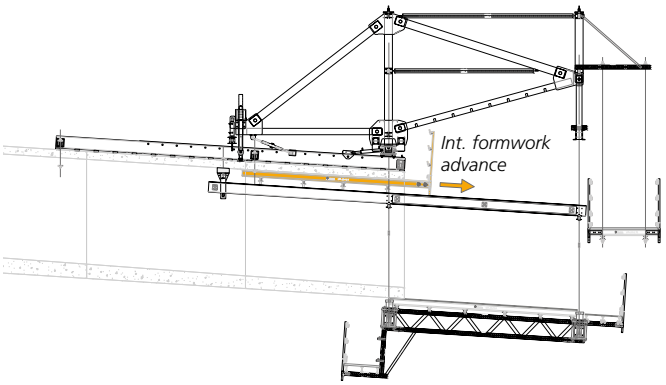
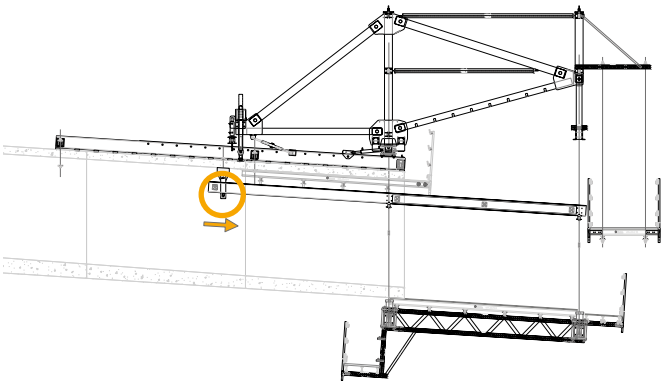
STEP	DESCRIPTION	IMAGE
14	Remove the stress from the rear carriage support retaining rods. The rods continue retaining the carriage.	
15	Lower the cantilever carriage by lowering the principal hydraulic support cylinder.	
16	Before lowering the bottom formwork, leave a margin of play in the upper nuts of the outer suspension rods so that the bottom formwork can remain suspended on them once the lowering has been accomplished with the pulley blocks.	

STEP	DESCRIPTION	IMAGE
17	Completely remove the rear formwork anchor rods (using hollow jacks) and suspend them with pulley blocks.	
18	Lower the bottom formwork with pulley blocks until it rests on the lateral rods.	
19	Lower the exterior formwork until it rests on the bottom formwork.	

STEP	DESCRIPTION	IMAGE
20	Completely remove the rear carriage anchors with the aid of hollow jacks. The rear of the system is supported by the advance wheels, which rest against the lower part of the upper flange of the advancing profile, so as to prevent the carriage from tipping.	
21	Fasten the interior formwork to the concrete so as to avoid it from moving along with the carriage.	
22	Advance the carriage using the hydraulic system. The carriage must be held at all times by either the advancing cylinder or the holding system so as to prevent uncontrolled advance along the longitudinal slope, if any is present.	
23	During carriage advance the interior formwork will not advance along with the rest of the carriage. Instead it will roll along the interior profile IPN.	
24	Position the carriage.	
25	Principal support cylinder bears the load of the carriage until it is left in working position.	

STEP	DESCRIPTION	IMAGE
26	Level the carriage horizontally with the rear holding cylinder.	
27	Put the rear prestressing screw jacks in contact with the concrete.	
28	Place the rear carriage anchors and prestress them with hollow jacks.	
29	Adjust bottom slab height with the pulley blocks until it locks into the concrete of the previous segment.	

STEP	DESCRIPTION	IMAGE
30	Prestress the rear anchor rods of the bottom formwork with hollow jacks.	
31	Position the exterior formwork.	
32	Adjust, tighten, and load the wing slab structure suspension rods.	
33	Install rebar for the bottom slab and sidewalls.	

STEP	DESCRIPTION	IMAGE
34	Advance the interior formwork into pouring position using the roller system between the formwork and profile IPN and winches. In situations with a downward slope, retain the formwork with winches attached at the rear.	
35	Anchor the rear part of the interior formwork to the concrete.	
36	Advance the interior wheel along the profile until it reaches the anchoring position.	
37	Assemble the tie rods between formwork and sidewalls.	
38	Install the rebar for the top and wing slabs.	
39	Install the front bulkhead panels.	
40	Install the lateral stop-ends with overlapping adjustments against the finished concrete.	
41	Pour the segment.	

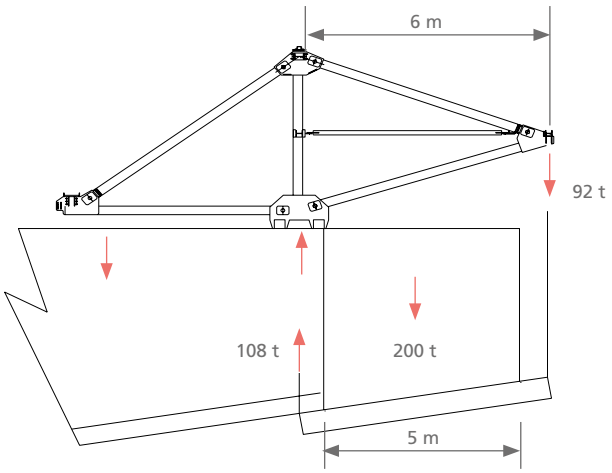
4. SYSTEM LIMITS

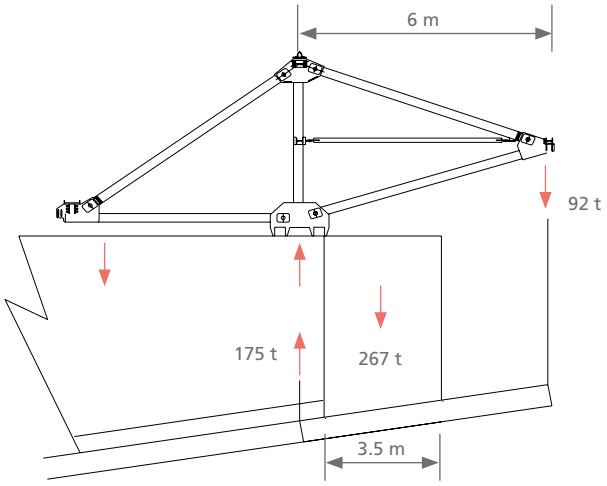
In this section the maximum possible segment weight for carriage CVS 200/5 is shown:

SEGMENT LENGTH	MAX. POSSIBLE SEGMENT CVS 200/5
5 m	200 t
4.5 m	218 t
4 m	240 t
3.5 m	267 t
3 m	300 t

It should be noted that if the actual segment length is less than that for which the main structure was designed, the maximum possible weight of the segment increases. This is because although the segment weighs more it doesn't increase the load borne at the front end of the main structure.

As an example, the values of loads borne and structural reactions for different main structures paired with a CVS 200/5 are shown. The load borne corresponds solely to the concrete.

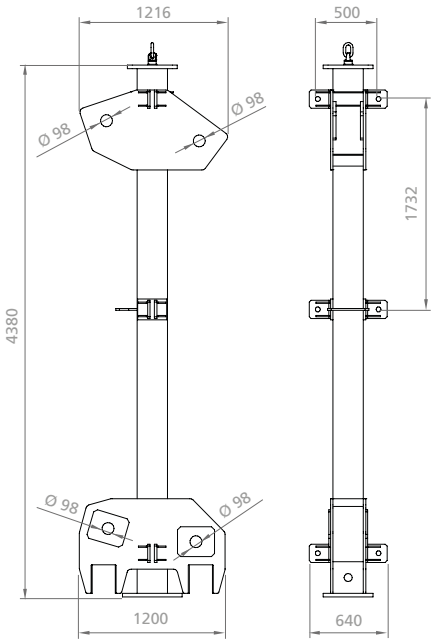




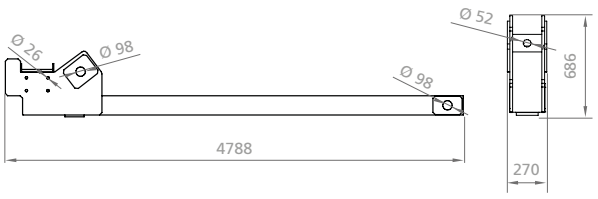
With the same design, the main structure could be used to construct longer and heavier segments; such cases always require a detailed study and customised modifications.

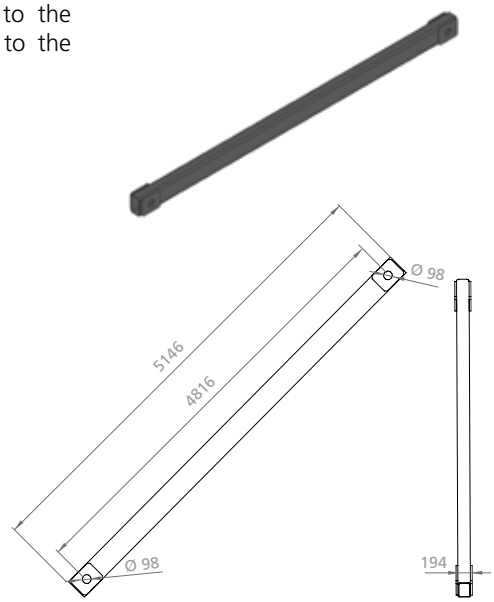
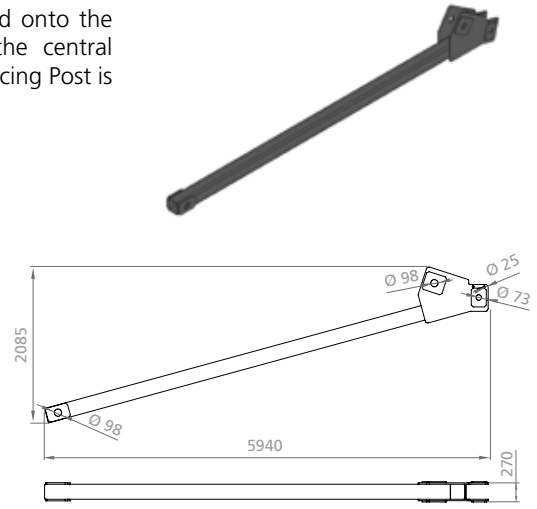
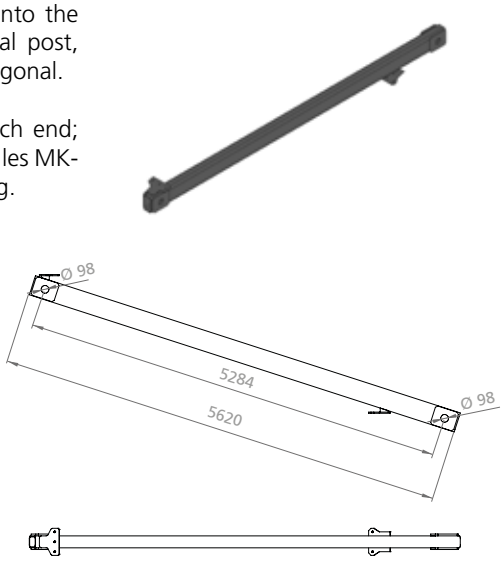
5. COMPONENTES Y ACCESORIOS

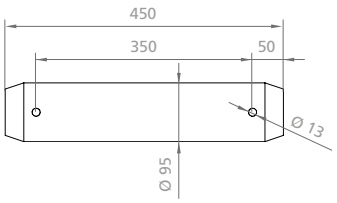
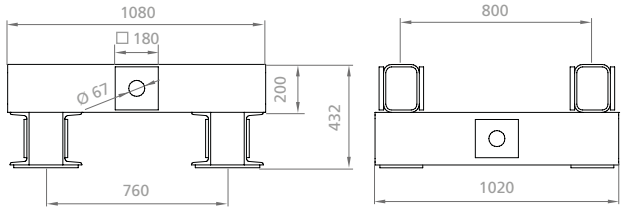
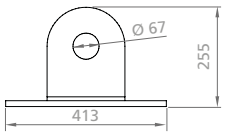
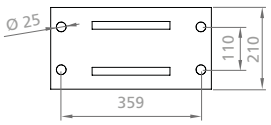
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
MAIN TRUSS				
3200290	1034	CENTRAL POST CVS200 C5	This is placed just above the side walls. It must be in the fully upright position during the concrete pouring phase.	

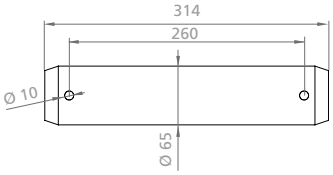
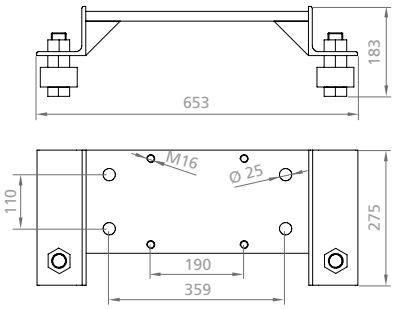
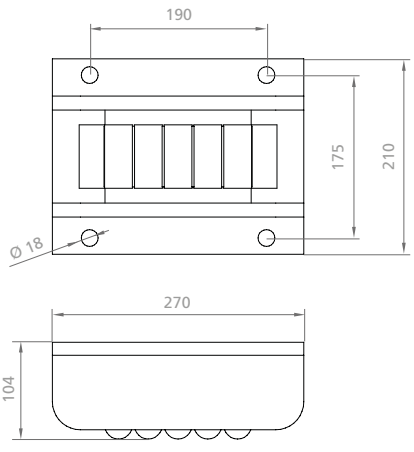


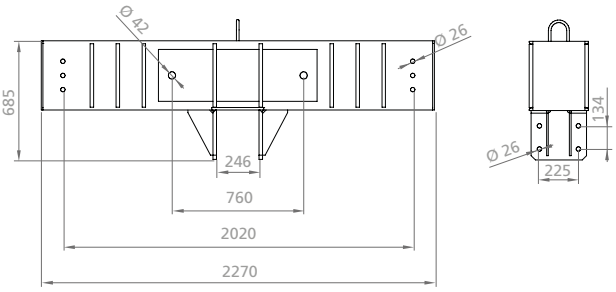
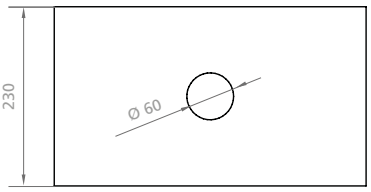
3200300	524	REAR LOWER LEDGER CVS200 C4	This is pinned onto the bottom rear area of the central post. It must be in the horizontal position during the concrete pouring phase.	

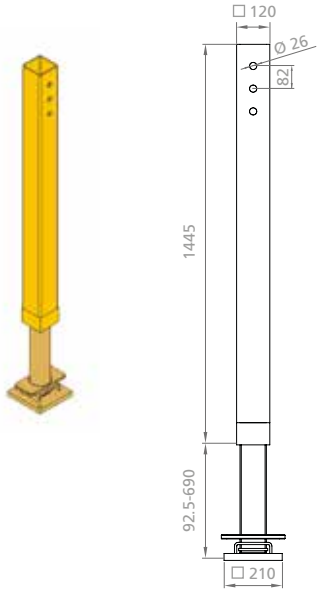
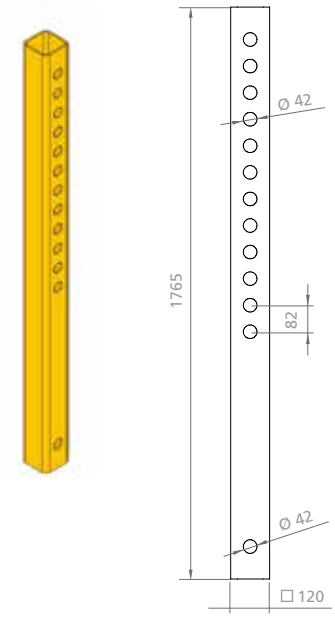
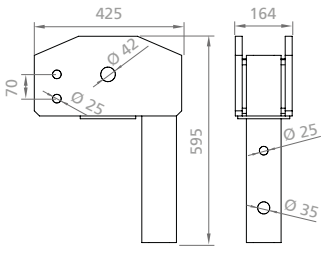


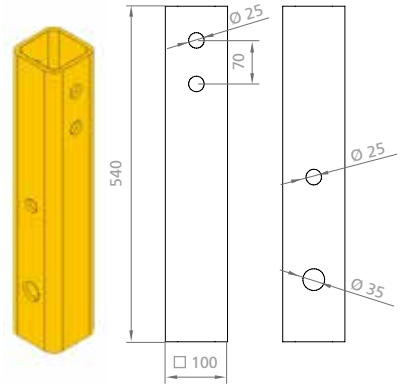
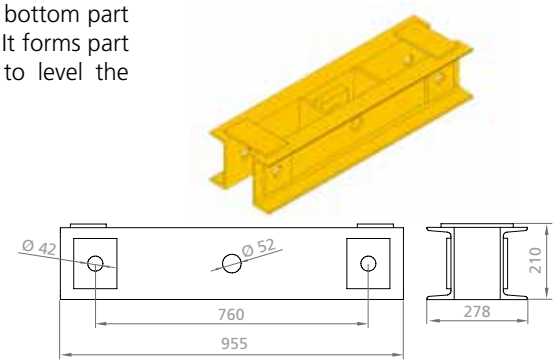
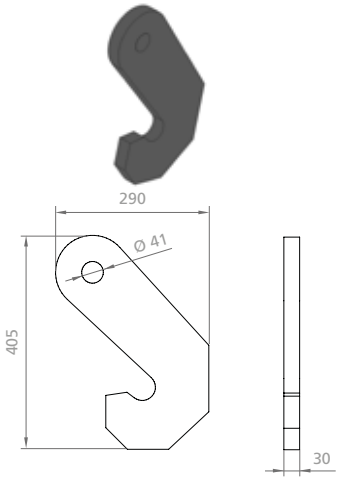
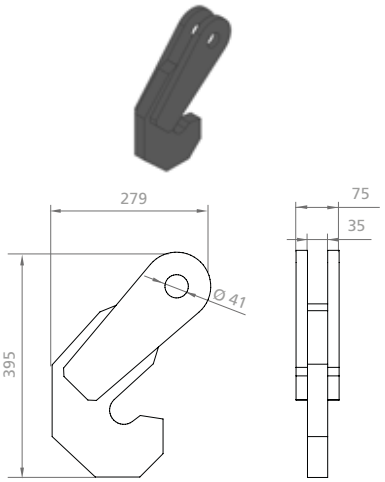
ITEM NO	WEIGHT/ Kg	DENOMINACIÓN	DESCRIPTION	IMAGE
MAIN TRUSS				
3200295	387	REAR DIAGONAL CVS200 C2	One of its ends is pinned to the central post and the other to the rear lower ledger.	
3200335	612	LOWER DIAGONAL CVS200 50 C3	One of its ends is pinned onto the bottom front area of the central post. The Transversal Bracing Post is placed at the other end.	
3200340	431	UPPER DIAGONAL CVS200 50 C1	One of its ends is pinned onto the top front area of the central post, the other onto the lower diagonal. A flat-plate is welded to each end; these are used to fix the profiles MK-120 of the horizontal bracing.	

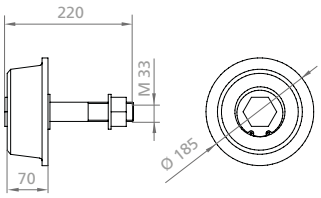
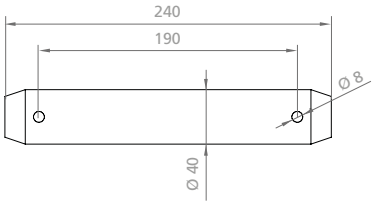
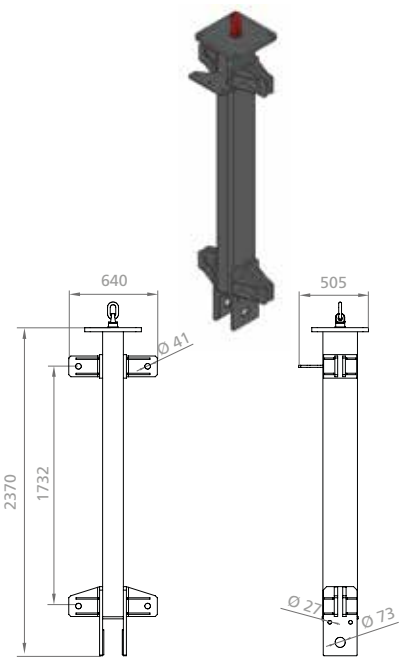
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
MAIN TRUSS				
3200440 0250002	24.2 0.08	PIN D95x35 WING PIN D10x125	This is the pin used to join the different items that form the main truss.	 
ROLLING-FRONT SUPPORT				
3200028	283	FRONT ROLLING SET	This is pinned onto the bottom part of the central post.	 
3200035	20.1	ROLLER CONNECTOR	These are pinned to the front rolling set. They allow the main truss to be adapted to the longitudinal slope of the bridge.	  

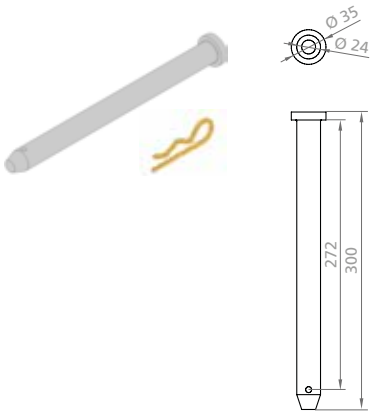
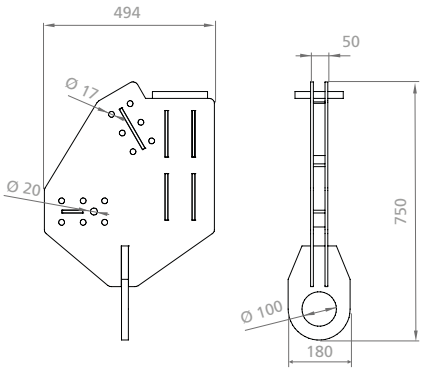
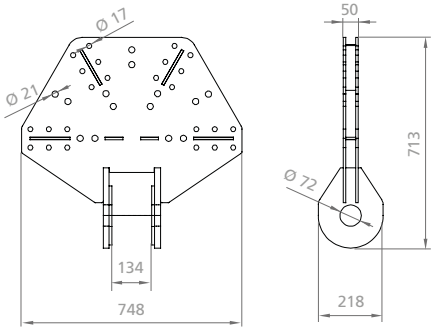
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
ROLLING-FRONT SUPPORT				
3200034 9022702	8 0.04	PIN D65x260 WING PIN 8x90 DIN94	These are the pins that are used to join the front rolling set to the central post. They are also used to fix the roller connector to the front rolling set.	 
3200530	21.8	40TN ROLLER ADAPTER	This is placed between the roller connector and 40 t roller. They have built-in rollers that serve as a guide and ensure the rollers are supported on the advancing rails at all times.	 
1990657	30.8	40TN ROLLER	In the carriage's advance phase, the main truss is moved supported on these items.	 

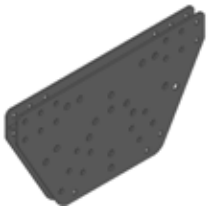
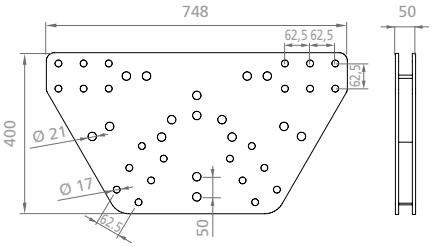
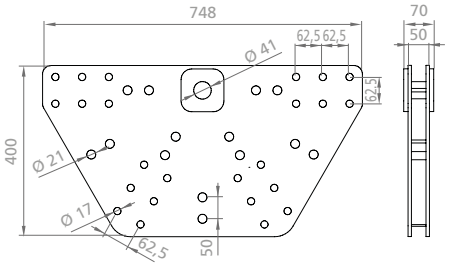
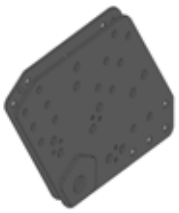
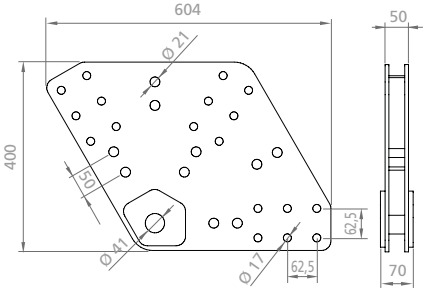
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
ROLLING-FRONT SUPPORT				
0241635 0241601	0.08 0.01	BOLT M16x35 DIN-933-8.8 WASHER A16 DIN-125	These are used to fix the rollers to the roller adapter.	
0242480 0242401 0242400	0.38 0.03 0.11	BOLT M24x80 DIN-931-8.8 WASHER A24 DIN-125 NUT M24 DIN-934-8.8	This is the bolt that is used to join the roller connector and the roller adapter together.	
ROLLING - REAR SUPPORT				
3200610	582	REAR PRESTRESSING PROFILE FOR CURVE	This is bolted to the rear part of the rear lower ledger. This is the item which the rods that avoid the carriage overturning during the concrete pouring phase are supported on.	 
3200618	30.4	DW36 TIE ROD SUPPORT FOR CURVE	These are placed on the prestressing profile so that the plates of the rods have adequate support.	  

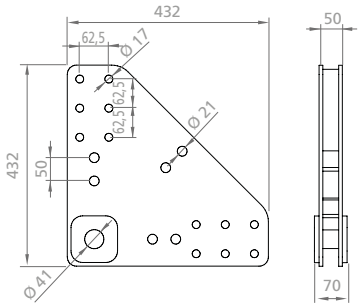
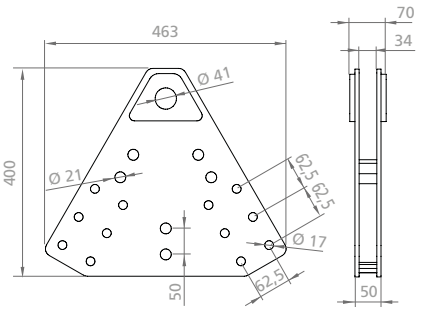
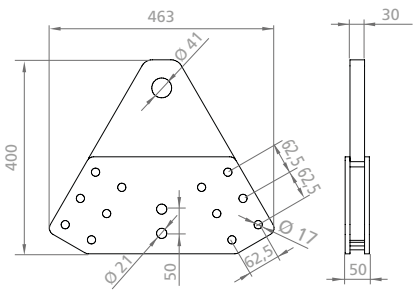
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
ROLLING - REAR SUPPORT				
3200010	87	PRESTRESSING SCREW JACK 85TN	These are screwed into the ends of the prestressing profile. They will stop against the concrete of the previous segment when rear rods are prestressed.	
3200020	44.3	TUBE 120x120x8/1765	These are pinned to the prestressing profile. There are various holes in the upper part to enable adjusting the height to the required dimension.	
3200021	46.1	REAR ROLLING SET	This is pinned onto the bottom part of the Tube 120 x 120 x 8/1765. They are fixed onto the rear roll ers that enable the movement of the carriage in the advance phase.	 

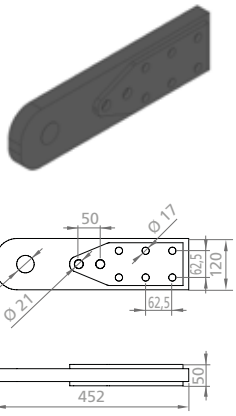
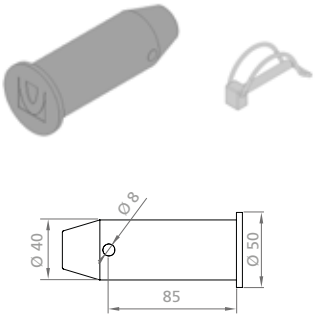
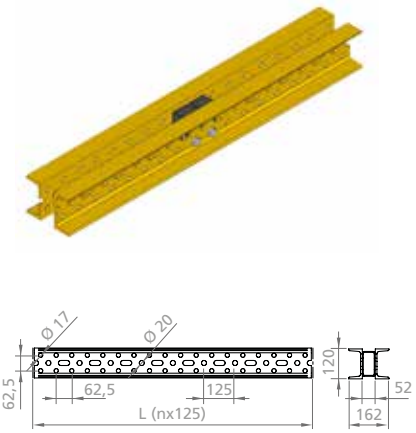
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
ROLLING - REAR SUPPORT				
3200027	11.3	TUBE 100x100x8/540	This is screwed to the rear rolling element. It is assembled after placing the main trusses over the advancing rails.	
3200039	69	CLAMPS UPN PROFILE	This is pinned onto the bottom part of the holding cylinder. It forms part of the assembly used to level the main truss.	
3200047	14.2	REAR PINCER	This is pinned onto the clamps UPN profile. Along with the Rear Clamp, this forms part of the assembly which strips from the advancing rails when levelling the main truss.	
3200048	20.3	REAR CLAMP	This is pinned onto the clamps UPN profile. Along with the Rear Pincer, this forms part of the assembly which strips from the advancing rails when levelling the main truss.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
ROLLING - REAR SUPPORT				
3200104	11.1	RODILLO TRASERO IPN380	This avoids the carriage overturning during the advancing phase; they are supported on the interior area of the flanges of the advancing rails.	 
3200105 9023102	2.3 0.04	PIN D40x190 SAFETY PIN D7x50	This is used to fix the Rear Pincer and the Rear Clamp to the Clamps UPN Profile.	 
0242420 0242400 0242401	0.83 0.11 0.03	BOLT M24x200 DIN931-8.8 NUT M24 DIN-934-8.8 WASHER A24 DIN-125	These are the bolts used to fix the Prestressing Screw Jacks to the Prestressing Profile and the Tubes 100 x 100 x 8/540 to the Rear Rolling Set.	
TRANSVERSAL BRACING				
3200106	237	TRANSVERSAL BRACING POST	These are pinned onto the front part of the lower diagonal. These are part of the transversal bracing front truss. The Hanging Support Post 1.75 is fixed onto its bottom part.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TRANSVERSAL BRACING				
3200133 0250000	1.1 0.03	ASSEMBLY PIN C24x272 COTTER PIN R/5	These are used to join the Transversal Bracing Post to the Lower Diagonal. They avoid the post turning during the assembly phase.	
1990362	37	HANGING NODE 60MK	These are placed in the bottom corner of the transversal bracing trusses. The differential pulleys are fixed to the bottom ring; the rods used for moving the carriage forward are fixed to the top horizontal plate.	 
1990481	55	HANGING NODE 180MK	These are screwed into the walers of the lower boom of the front truss. The Support Post Susp 1.75 hangs from the interior rings.	 

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TRANSVERSAL BRACING				
1990485	30.6	NODE 180MK	These are used in the formation of the transversal bracing trusses. 4 walers are joined together, forming angles of 60 degrees between them.	 
1990480	31.8	NODE 180 D40 MK	These are used in the formation of the transversal bracing trusses. 4 walers are joined together, forming angles of 60º between them. The central hole differentiates it from the Node 180 MK. This hole is not used for cantilever carriages, but in other cases it enables an axial node to be joined with Ø 40 pins.	 
1990420	24	NODE 120 MK	These are used in the formation of the transversal bracing trusses. They allow 3 walers to be joined together at 60º. The Ø 21 holes are used to join secondary items, mainly E push-pull props. The Ø 41 hole can be used to fix an axial node, but is not used in the cantilever carriage system.	 

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TRANSVERSAL BRACING				
1990390	18.8	NODE 90 MK	This joins two walers, forming angles of 90º. It can also be joined with an articulated joint, by means of another male item. This joint is made using a Ø 40 pin.	 
1990360	16	NODE 60 F MK	Two walers are joined at 60º. The joints are made using 6 M16 bolts in the Ø 17 holes.	 
1990361	21.3	NODE 60 M MK	Two walers are joined at 60º degrees. The joints are made using 6 M16 bolts in the Ø 17 holes. They are fixed by means of a Ø 40 pin to the Transversal Bracing Post or to the Central Post CVS 200 C5.	 

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TRANSVERSAL BRACING				
1990300	15	AXIAL NODE M D40 MK	They allow a waler to be joined to the Transversal Bracing Post or to the Central Post CVS 200 C5 with an articulated joint. The joint is made by means of a Ø 40 Pin.	
1980120 3200602 9023102	1.1 1.1 0.04	PIN D40x85 PIN D40x95 SAFETY PIN EN D7x50	These are used with the cantilever carriages to fix the Axial Node and the Node 60 M MK to the Transversal Bracing Post and the Central Post CVS 200 C5. The 95 mm length pins are used on the bottom part of the Transversal Bracing Post, where the lugs are of greater thickness.	
1990209 1990211 1990213 1990215 1990217 1990219 1990221 1990223 1990225 1990227 1990229 1990231 1990233 1990235 1990237 1990239 1990241 1990243 1990245 1990247	29.4 35.5 41.9 47.9 54 60 68 75 81 87 93 101 107 113 120 126 132 140 146 152	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-120/2,875 WALER MK-120/3,125 WALER MK-120/3,375 WALER MK-120/3,625 WALER MK-120/3,875 WALER MK-120/4,125 WALER MK-120/4,375 WALER MK-120/4,625 WALER MK-120/4,875 WALER MK-120/5,125 WALER MK-120/5,375 WALER MK-120/5,625 WALER MK-120/5,875	The Waler MK-120 is formed by two face-to-face UPN-120 profiles. The main feature of the profile is its double row of holes that are used for the different connections required. The external row consists of Ø 17 holes, separated by 62.5 mm in both directions. On the central row, Ø 20 holes are alternated with 45.5 mm width slots. The gap between the waler holes is 62.5 mm for the exterior row and 125 mm for the central row. All the walers begin with a Ø 20 hole at both ends of the central row.	

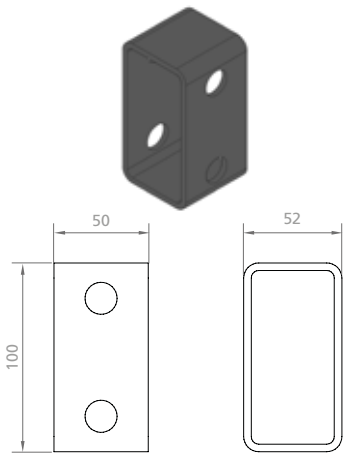
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

TRANSVERSAL BRACING

1990200 0.46 SPACER TUBE MK-120/52

This is the item that separates the profiles formed by the MK Walers.

With Walers, it is used as a spare part, as they already have this item built-in.

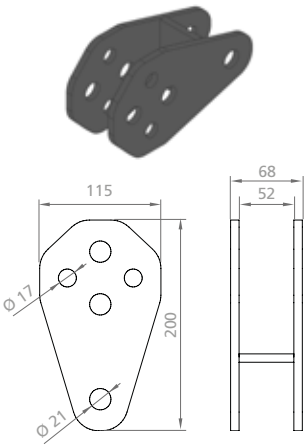


1990403 2.3 JOINT PUSH-PULL PROP E-NODE MK

This is for joining push-pull props E to any node.

Two E20 x 70 pins are used for the connection to the node, whereas only one is used for the push-pull prop, permitting an articulated joint.

Two M16 bolts can be used to connect it to the node.



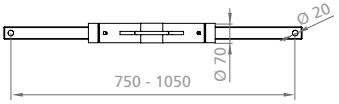
1960100 14.1 PUSH PULL PROP E 0.75-1.05
1960110 18.8 PUSH PULL PROP E 1-1.55
1960115 24.1 PUSH PULL PROP E 1.51-2.2
1960130 33.2 PUSH PULL PROP E 2.15-2.75

These are used in the formation of the transversal bracing trusses. They replace the walers when the angle needed is not 60°.

The joint between elements is made by means of 2 E20 x 70 Pins (1 to each side).

The range of push-pull props used in this application is as shown in the table below:

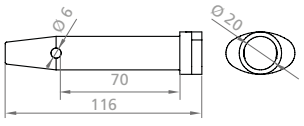
Item No	min L	max L	D
1960100	750	1050	70
1960110	1000	1550	70
1960115	1510	2200	70
1960130	2150	2750	90

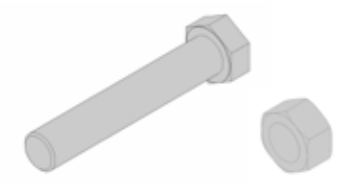
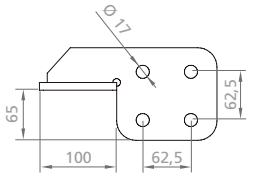
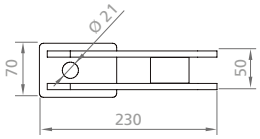
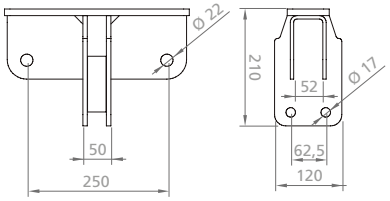
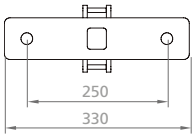
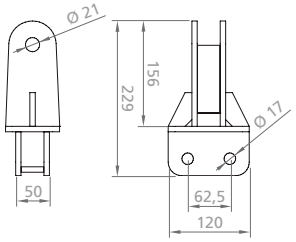


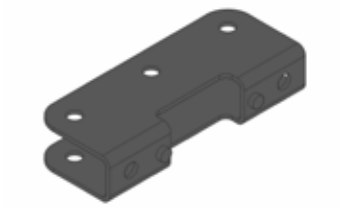
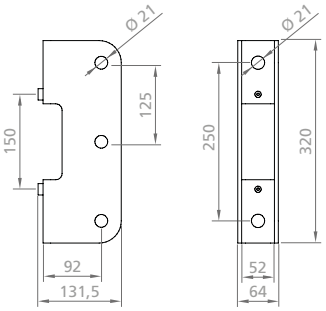
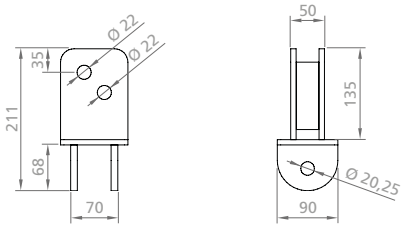
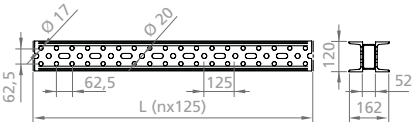
0252070 0.29 PIN E20x70
0250000 0.03 COTTER PIN R/5

This is the pin that fixes the push-pull props to the Joint Push-Pull Prop E-Node MK or directly to the walers.

Each pin has an R/5 mm cotter pin.



ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TRANSVERSAL BRACING				
0241690 0241600	0.17 0.03	BOLT M16x90 DIN-931-8.8 NUT M16 DIN-934-8.8	Used to join walers and nodes together.	
HORIZONTAL BRACING				
3200710	3	CVS HORIZONTAL BRACING JOINT	It is fixed using M20x50 bolts and it is used for horizontally bracing components of the main truss or the Transversal Bracing Post using walers.	  
3200725	8.5	MK TRUSS HB CONNECTOR	It is fixed to the walers of the transverse bracing trusses, on the upper and lower chord. Its design allows assembling three walers on it. The central one is directly screwed onto the connector, and the diagonal ones are fastened with the HB Diagonal Waler Joint.	  
3200720	3.6	HB DIAGONAL WALER JOINT	It is placed at both ends of the diagonally placed walers of the horizontal bracing. It is fixed using an E20x70 pin to the MK Truss HB Connector or to the U Secondary Axis MK/3.	 

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HORIZONTAL BRACING				
1990521	3.6	U SECONDARY AXIS MK/3	It is screwed to the walers and they are used for fixing the horizontal bracing components to them (diagonal walers, MK horizontal braces, MK diagonal braces and E push-pull props).	 
3200715	3.3	RIGHT ANGLE HEAD MK180-120	It is screwed onto the upper chord of the transverse bracing. It is valid for MK-120 and MK-180 walers. The push-pull props that are used for supporting the walers of the horizontal bracing auxiliary truss shall be fixed to it.	 
1990217	54	MK-120/2,125 WALER	These are the walers used in the horizontal bracing.	 
1990225	81	MK-120/3,125 WALER		
1990233	107	MK-120/4,125 WALER		
1990241	132	MK-120/5,125 WALER		
1990245	146	MK-120/5,625 WALER		

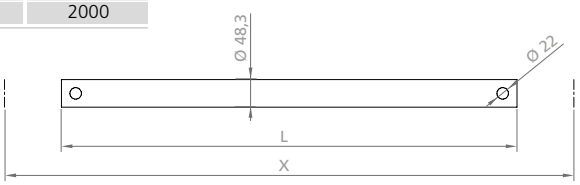
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

HORIZONTAL BRACING

1990605	1.9	MK 0.75/550 HORIZONTAL BRACE
1990608	2.7	MK 1/800 HORIZONTAL BRACE
1990613	4.5	MK 1.5/1300 HORIZONTAL BRACE
1990618	6.2	MK 2/1800 HORIZONTAL BRACE

They are used in the horizontal bracing, fixing them to the U Secondary Axis MK/3 connectors using E20x70 pins.

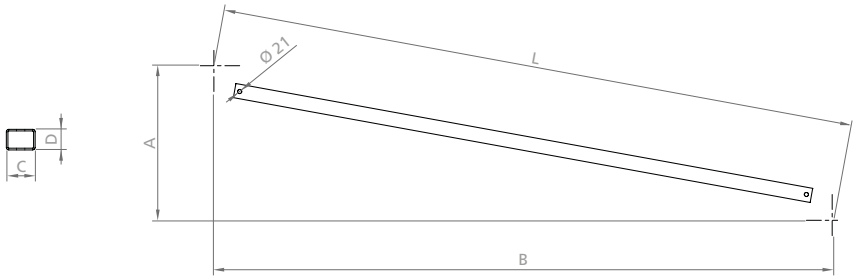
Item No	L	X
1990605	550	750
1990608	800	1000
1990613	1300	1500
1990618	1800	2000



1990611	6.1	MK 1x1/1100 DIAGONAL BRACE
1990612	7.2	MK 1x1.25/1300 DIAGONAL BRACE
1990615	8.3	MK 1x1.5/1508 DIAGONAL BRACE

They are used in the making of the auxiliary horizontal bracing truss.

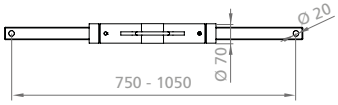
Item No	L	A	B	C	D
1990611	1110	1000	1000	50	50
1990612	1300	1000	1250	50	70
1990615	1508	1000	1500	50	50



1960100	14.1	E 0.75-1.05 PUSH-PULL PROP
1960110	18.8	E 1-1.55 PUSH-PULL PROP
1960115	24.1	E 1.51-2.2 PUSH-PULL PROP
1960130	33.4	E 2.15-2.75 PUSH-PULL PROP
1960125	38.1	E 2.7-3.3 PUSH-PULL PROP

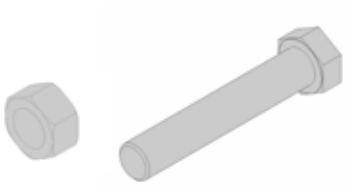
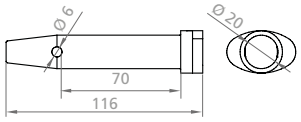
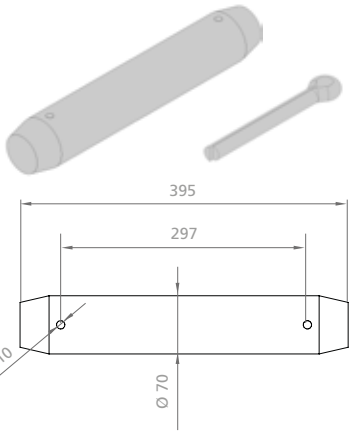
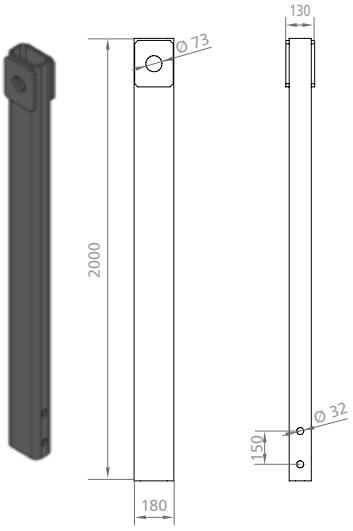
They are used for horizontal bracing in cases where the required dimension cannot be obtained with MK horizontal braces or MK diagonal braces.

Item No	min L	max L	D
1960100	750	1050	70
1960110	1000	1550	70
1960115	1510	2200	70
1960130	2150	2750	90
1960125	2700	3300	90



0242050	0.18	M20X50 DIN-933-8.8 BOLT
0242010	0.3	M20x100 DIN-931-8.8 BOLT
0242013	0.4	M20x130 DIN-931-8.8 BOLT
0242000	0.06	M20 DIN-934-8.8 NUT

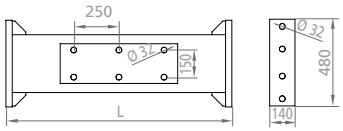
They are used for fixing the different connectors and heads to the walers.

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HORIZONTAL BRACING				
0241690 0241600	0.17 0.03	M16x90 DIN-931-8.8 BOLT M16 DIN-934-8.8 NUT	They are used for screwing the MK walers to the different connectors used in horizontal bracing.	
0252070 0250000	0.29 0.03	E20x70 PIN R/5 COTTER PIN	It allows fixing walers, MK horizontal braces, MK diagonal braces and push-pull props to the corresponding connectors.	 
HANGING SUPPORT				
3200134 9022702	11.4 0.04	PIN D70x297 WING PIN 8x90 DIN94	These are used to pin the Hanging Support Post 1.75 to the Transversal Bracing Post or to the Node 180 Hinge MK.	
3200563	96	HANGING SUPPORT POST 1.75	These hang from the front truss of the transversal bracing. The hanging system profiles are bolted to the bottom part.	

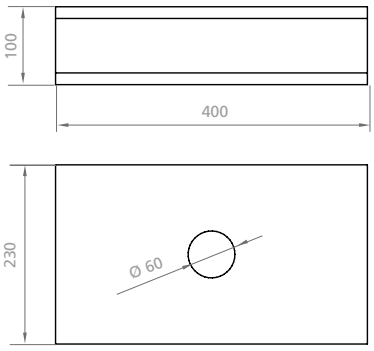
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

HANGING SUPPORT

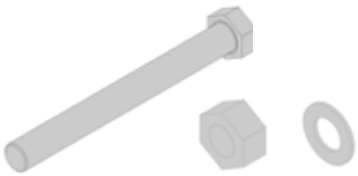
3200695	111	HANGING SYSTEM PROFILE UPN-320/1250	These are UPN-320 profiles that are screwed in pairs onto the bottom part of the Hanging Support Post 1.75. They have several lines of holes in the web separated by 250 mm. They allow profiles to be screwed in different points, enabling them to be reused. There are various lengths of profiles and they all have end-plate joints at each end to enable two profiles to be joined together longitudinally.
3200630	173	HANGING SYSTEM PROFILE UPN-320/2250	
3200648	313	HANGING SYSTEM PROFILE UPN-320/4500	
3200649	453	HANGING SYSTEM PROFILE UPN-320/6750	
3200625	734	HANGING SYSTEM PROFILE UPN-320/11250	

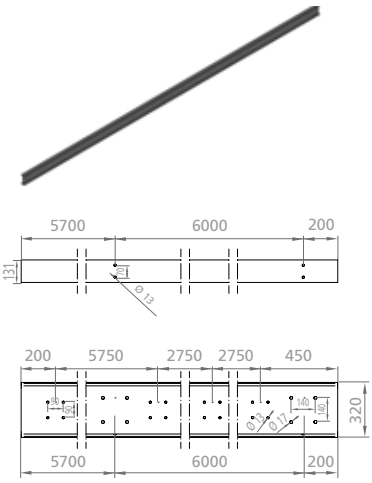
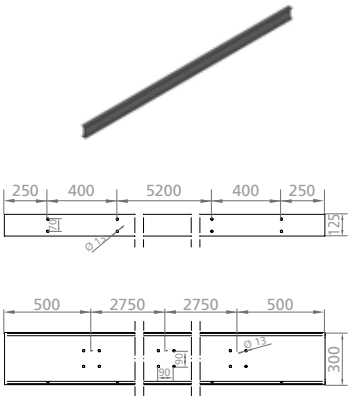
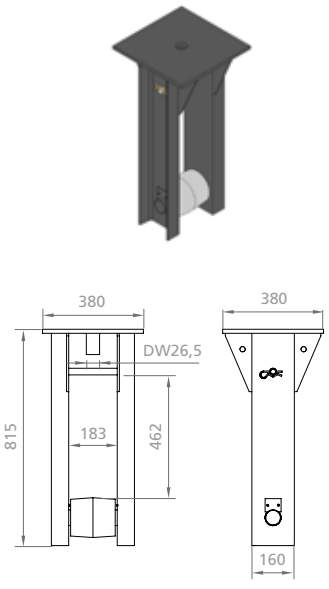


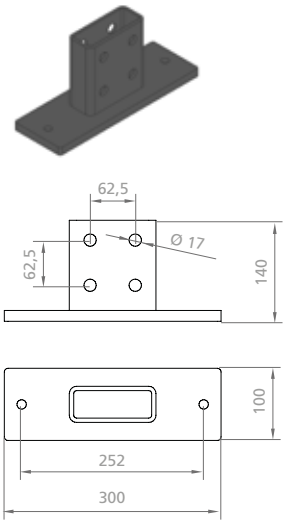
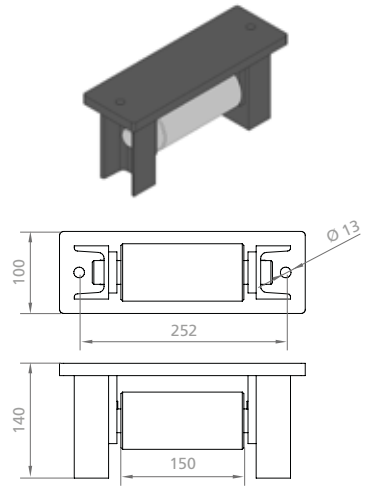
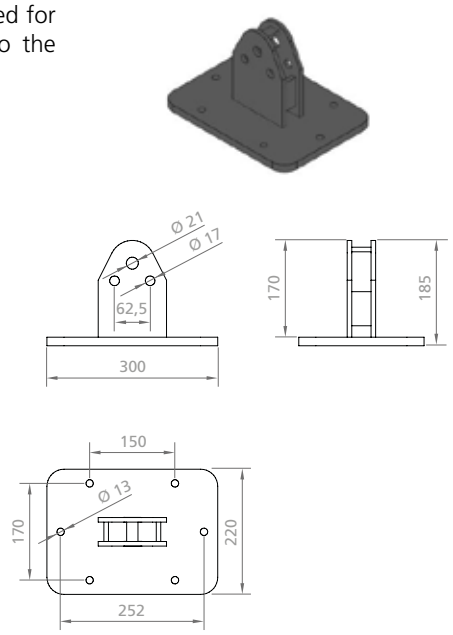
3200618	22.4	DW36 TIE ROD SUPPORT FOR CURVE	These are placed on the hanging system profiles so that the rod plates have adequate support.



0243028	1.7	BOLT M30x280 DIN-931-10.9	M30 x 280 bolts are used to fix the hanging system profiles to the Hanging Support Posts. M30 x 110 bolts are used to join different profiles together longitudinally.
0243021	0.82	BOLT M30x110 DIN-931-10.9	
0243008	0.22	NUT M30 DIN-934-10.9	
0243001	0.05	WASHER A30 DIN-125	



ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TOP SLAB STRUCTURE / WING SLAB STRUCTURE				
3200470	724	IPN-320/11900 (SEGMENT 5M)	Joining two together forms the structure that serves as a support for the interior formwork. More than two profiles may be needed if the section of the bridge to be built is very wide. The Ø 17 holes in the web are used to fix Horizontal Joints IPN-MK. The Ø 13 holes are used to tie the Ø 48 tubes that maintain spacing between profiles and brace the assembly. The Ø 13 holes in the flange are for fixing the IPN Profile Tying Clamp	
3200450	351	IPN-300/6500 (SEGMENT 5M)	This is used to form the wing slab structure. Two profiles are normally sufficient but, depending on the width of the flange, it is possible that a third profile may be needed occasionally. The Ø 13 holes in the web are used for tying the special parts with Ø 48 tubes that maintain spacing between the profiles. The Ø 13 holes in the flange are for fixing the IPN Profile Tying Clamp	
3200175	74	FORMWORK HANGING ROLLER	These are fixed into the previously concreted segment with DW rods. They are used to provide a second support for the profiles that form the top slab structure during the advancing stage.	

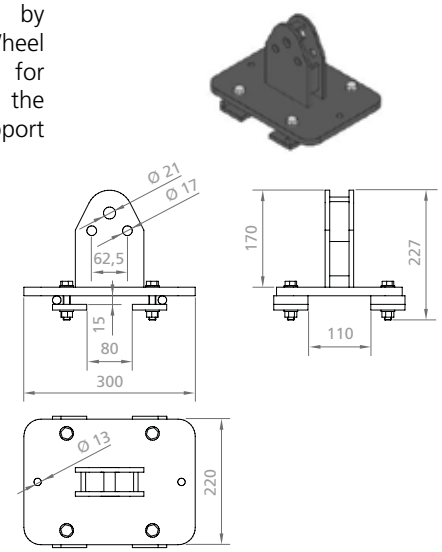
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TOP SLAB STRUCTURE / WING SLAB STRUCTURE				
3200216	5,2	INTERNAL PROFILE CONNECTOR	This enables joining the wheels to the interior formwork walers.	
3200220	10.5	INTERNAL FORMWORK WHEEL	These are screwed to the Internal Profile Connector. They enable the interior formwork to roll over the IPN profiles of the bottom slab structure.	
3200708	10	IF WHEEL CONNECTOR	As the name suggests, it is used for joining the inner formwork to the wheels that allow it to move.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

TOP SLAB STRUCTURE / WING SLAB STRUCTURE

3200700 11.8 IF WHEEL CONNECTOR w/ CLAMP

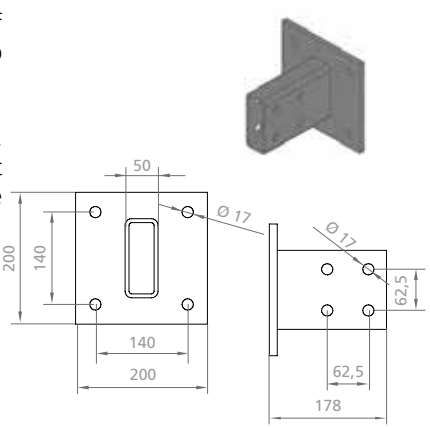
This component is obtained by adding 4 clamps to the IF Wheel Connector, and it is used for fixing the outer formwork to the IPN profiles of the flange support structure.



3200485 6 HORIZONTAL JOINT IPN-MK

These are screwed into the web of the IPN profiles that form the top slab structure.

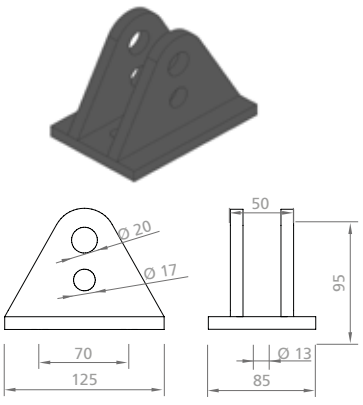
They are used so that MK walers, where the DW rods that support the structure are to be fixed, can be placed on them.



3200467 1.8 IPN PROFILE TYING CLAMP

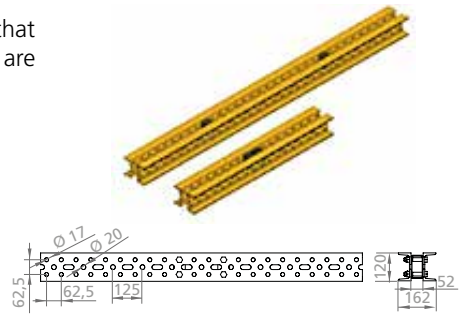
These are used to fix MK-120 walers to the IPN profiles of the top slab structure. They are used when the waler is placed under the IPN profiles, and don't go to the web as in the previous case.

The Ø 13 holes in the base are to join the clamp to the profile. The Ø 20 or Ø 17 holes are used to join the waler to the clamp.



1990211	35.5	WALER MK-120/1,375
1990213	41.9	WALER MK-120/1,625
1990215	47.9	WALER MK-120/1,875
1990217	54	WALER MK-120/2,125
1990219	60	WALER MK-120/2,375
1990221	68	WALER MK-120/2,625
1990223	75	WALER MK-120/2,875
1990225	81	WALER MK-120/3,125
1990227	87	WALER MK-120/3,375
1990231	101	WALER MK-120/3,875
1990233	107	WALER MK-120/4,125

In this case, the DW rods that support the top slab structure are fixed to them.



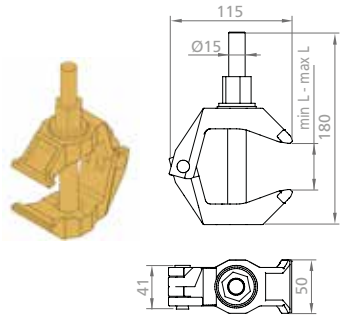
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

TOP SLAB STRUCTURE / WING SLAB STRUCTURE

0260006 1.8 JOINT CLAMP 16/70

This is used to fix MK-120 walers to the IPN-320 profiles of the top slab structure, in those points where there are no holes to place a Horizontal Joint IPN-MK or an IPN Profile Tying Clamp.

Item No	min L	max L
0260006	16	70

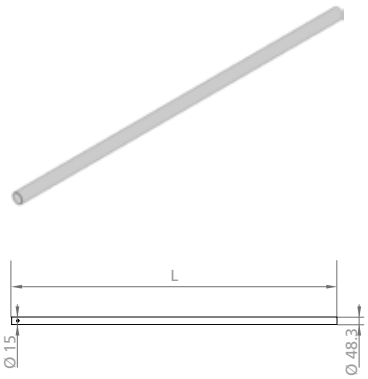


2125290 5.5 TUBE 48/1.6
2125291 7 TUBE 48/2.1
2125647 8.7 TUBE 48/2.6
2125249 11.4 TUBE 48/3.1
2125648 12.1 TUBE 48/3.6
2125250 14.6 TUBE 48/4.1

These are Ø 48 tubes that have various applications.

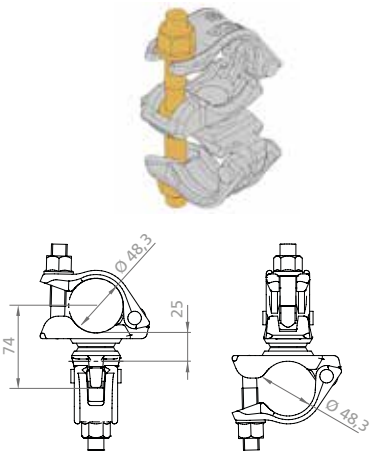
In this case, they are used to brace the profiles that form the top slab structure to stiffen the system.

Item No	L
2125288	500
2125289	1100
2125290	1600
2125291	2100
2125249	3100
2125250	4100
2125251	5000



2125147 1.3 SWIVEL COUPLER 48/48

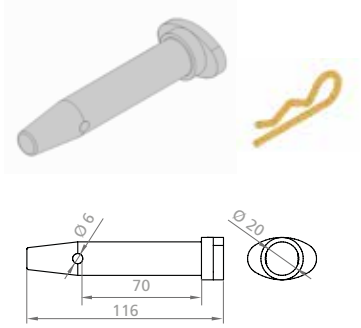
They allow two Ø 48 tubes to be joined at an angle other than 90 degrees, allowing cross bracing, for example.



0252070 0.29 PIN E20x70
0250000 0.03 COTTER PIN R/5

This is used to fix the IPN Profile Tying Clamp to Waler MK-120s.

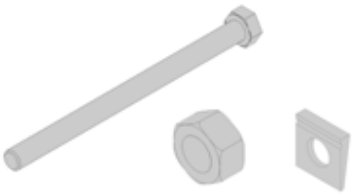
Each pin has an cotter pin R/5.



ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

TOP SLAB STRUCTURE / WING SLAB STRUCTURE

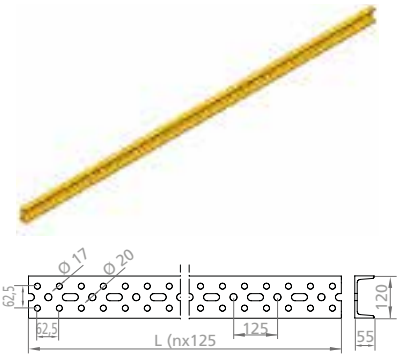
0241217	0.12	BOLT M12x170 DIN-933-0.0	The M12 x 170 bolt is used to fix the Tie Clamp to the IPN profiles of the top slab structure. The M12 x 50 bolt is used to screw the special parts that maintain the spacing between the IPNs to the web of the profiles. They are also used to join together the Internal Formwork Wheel and the Internal Profile Connector.
0241250	0.06	BOLT M12x50 DIN-933-5.6	
0241200	0.02	NUT M12 DIN-934-5.6	
0241203	0.02	WASHER AI12 DIN-435	



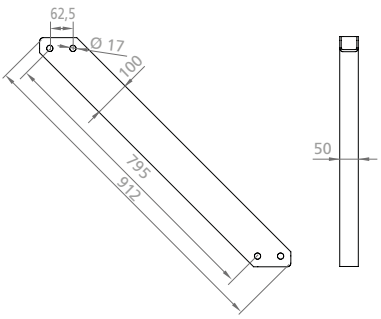
0241690	0.17	BOLT M16x90 DIN-931-8.8	The M16 x 90 bolt is used to fix the IPN Profile Tying Clamp to Waler MK-120s. The M16 x 50 bolt is used to place the Horizontal Joint IPN-MK on the web of the profiles of the top slab structure.
0241650	0.11	BOLT M16x50 DIN-933-8.8	
0241600	0.03	NUT M16 DIN-934-8.8	

BOTTOM SLAB STRUCTURE

1990143	67	PROFILE MK-120/5,375	These are MK-120 profiles that are used to form the upper and bottom booms of the MK trusses of the bottom slab structure.
1990147	73	PROFILE MK-120/5,875	
1990151	79	PROFILE MK-120/6,375	
1990155	85	PROFILE MK-120/6,875	
1990159	91	PROFILE MK-120/7,375	



3200586	7.3	TRUSS DIAGONAL 625-DUPN 500	These are the central diagonals of the MK trusses of the bottom slab structure.

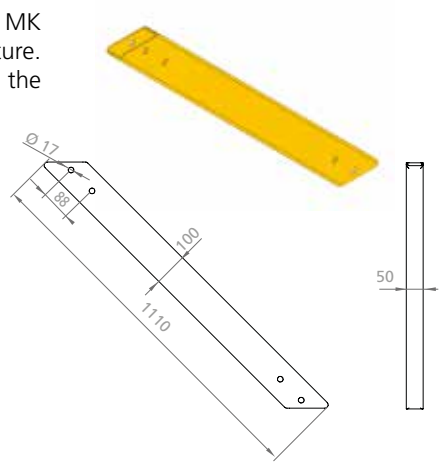


ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

BOTTOM SLAB STRUCTURE

3200650 8.8 TRUSS DIAGONAL 687-DUPN 500

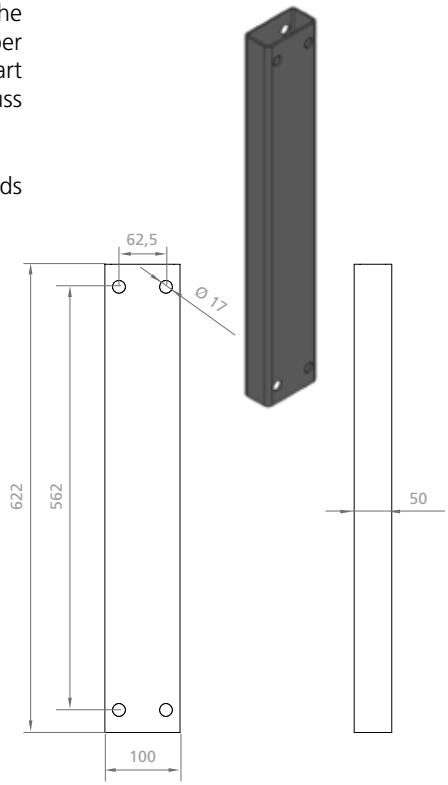
This is used to assemble the MK trusses of the bottom slab structure. They are always placed in the corners of the trusses.



3200587 5.3 VERTICAL TUBE 625-DUPN 500

These are part of the MK trusses of the bottom slab structure. The upper part is screwed into the upper boom of the truss, the bottom part into the item known as MK Truss Bottom Joint.

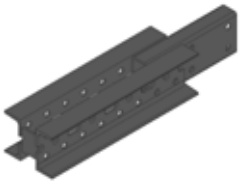
They are always placed at the ends of the MK trusses.

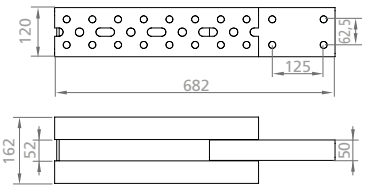


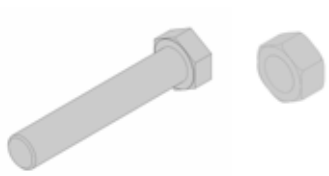
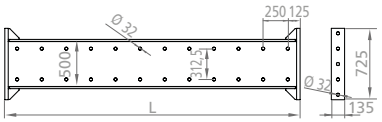
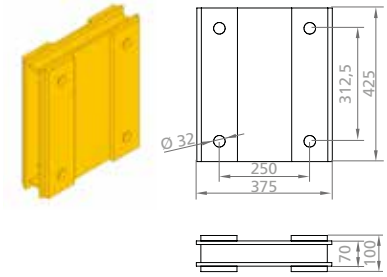
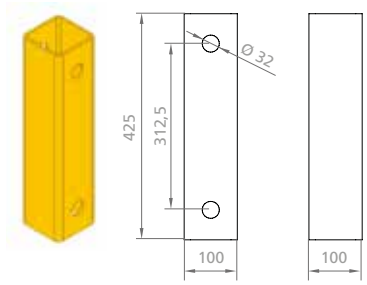
3200455 16.8 MK TRUSS BOTTOM JOINT

This is the part that is mounted on the ends of the lower boom of the MK trusses.

It is usually mounted after the upper boom of the trusses has been positioned supported on the transversal beams.





ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
BOTTOM SLAB STRUCTURE				
0241690 0241600	0.17 0.03	BOLT M16x90 DIN-931-8.8 NUT M16 DIN-934-8.8	These are the bolts used to join the different items that form the MK trusses.	
3200685 3200640 3200673 3200676 3200679 3200680	220 263 306 564 821 1036	PROFILE UPN 500/2000 PROFILE UPN 500/2500 PROFILE UPN 500/3000 PROFILE UPN 500/6000 PROFILE UPN 500/9000 PROFILE UPN 500/11500	These are UPN 500 welded profiles. They are used to form the transversal beams which support the MK trusses of the bottom slab structure. There are various lengths and they have an end-plate joint at each end to enable two profiles to be joined longitudinally. The profile web holes are to enable the DUPN 500 Spacer to be bolted between the two UPN 500 profiles that form each transversal beam.	 
3200635	46.5	DUPN-500 LONGITUDINAL CONNECTOR	This is placed between two UPN 500 profiles when they are to be joined longitudinally with another two.	
3200647	7	SPACER TUBE DUPN-500	These are placed between the two UPN 500s that form the transversal beam of the bottom slab structure. Their function is to maintain a spacing of 100 mm between the two UPN 500 profiles that form the assembly.	
0243017 0243021 0243008 0243001	1.4 0.82 0.22 0.05	BOLT M30x170 DIN-931-8.8 BOLT M30X110 DIN-931-10.9 NUT M30 DIN-934-10.9 WASHER A 30 DIN-125	The M30 x 170 bolts are used to fix the Longitudinal Connector and the Spacer between the two UPN 500 profiles. The M30 x 110 bolts are used to longitudinally join two UPN 500 profiles.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

HYDRAULICS AND ACCESSORIES

1992120 300 (with oil) GRUPO HIDRÁULICO CVS FPT5

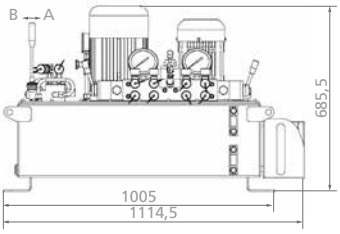
This pumps oil to the hydraulic cylinders.

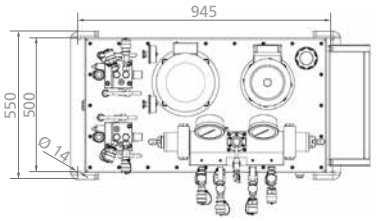
It controls three different models of hydraulic cylinders. The circuit consists of two cylinders of each model: six cylinders in total.

All the cylinders are double acting so the group has six oil outputs and six inputs.

The oil output spigots of the group are female and the input spigots are male.

As in the circuit, there are high and low pressure cylinders, the unit has two pumps and two motors.

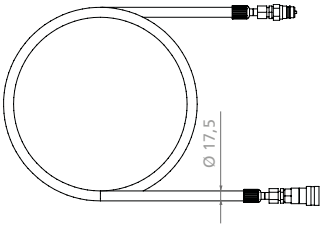




I872564 2.5 HOSE HID WP 700 DN6-TFGG-10

These are high pressure hoses of 10m in length.

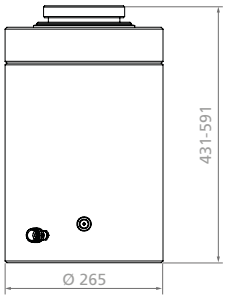
At one end there is a female spigot and at the other, a male.

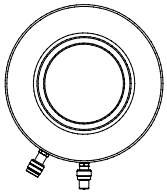


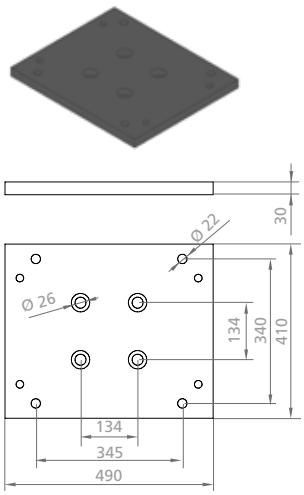
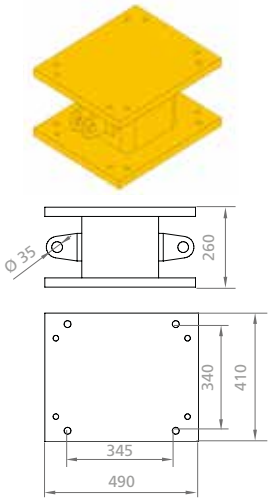
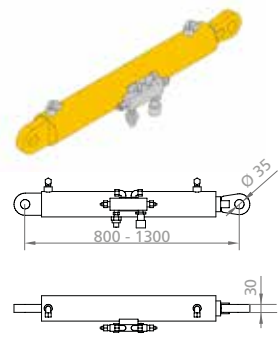
1992105 160 (with oil) HYD. CYL. CRI-200/160-GS-TA

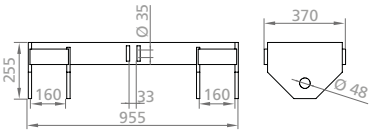
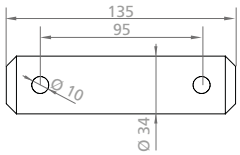
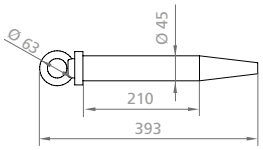
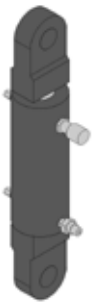
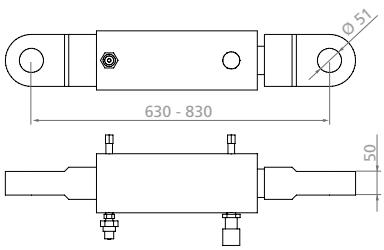
These are the cylinders that are used for transmitting the load to the previous segment during concrete pouring. They are fixed to the bottom part of the main truss post by means of four bolts.

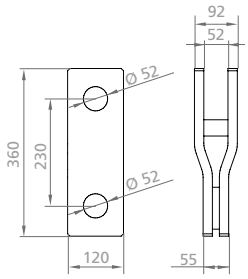
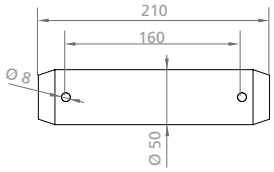
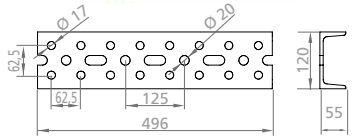
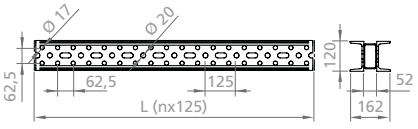
They are double acting cylinders that work at high pressure.

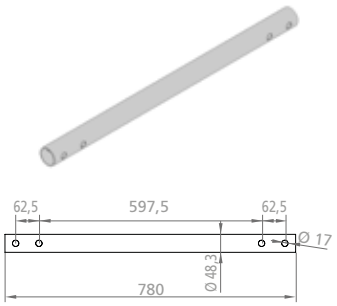
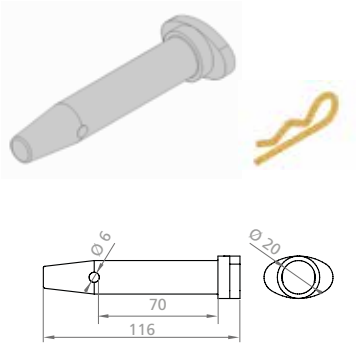
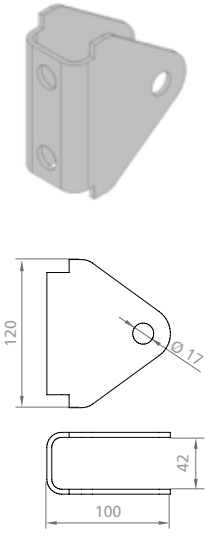


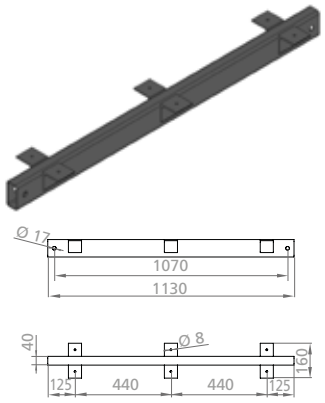
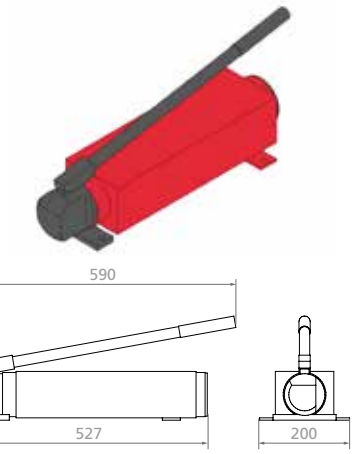
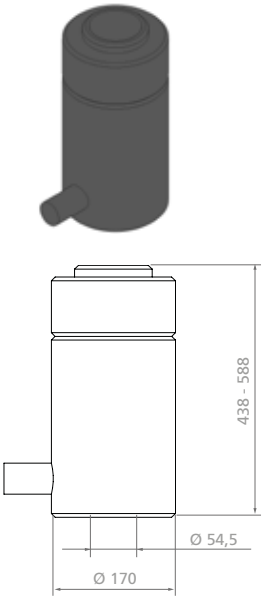


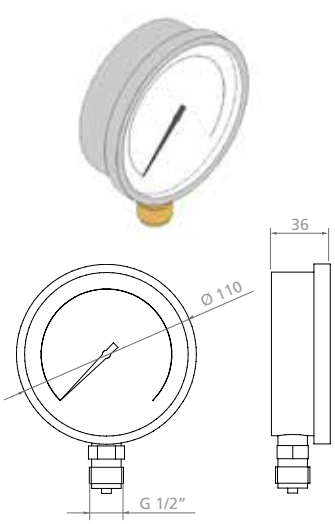
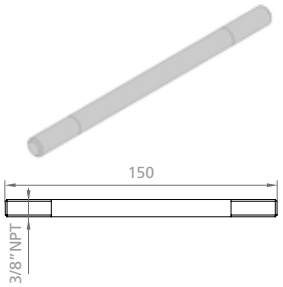
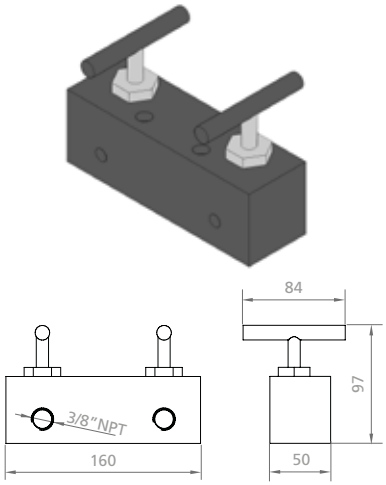
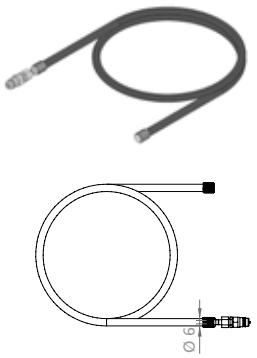
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HYDRAULICS AND ACCESSORIES				
3200540	46	JOINT PLATE HYD CYL 200TN-CVS	This is used to join the Cylinder CRI-200/160-GS-TA and the 10Tn Adv Cyl Connector.	
9371467	0.27	BOLT. M24x50 DIN 7991 8.8 CINC	This is used to join the Cylinder CRI-200/160-GS-TA and the Joint Plate. A countersunk screw is used to ensure that the 10 t Adv Cyl Connector is correctly supported on the Joint Plate.	
3200542	116	10TN ADV CYL CONNECTOR	This is screwed onto the bottom part of the Central Post. One of the ends of the advancing cylinder is fixed at its lugs.	
0242090 0242000 0242001	0.28 0.06 0.02	BOLT M20x90 DIN-931-8.8 NUT M20 DIN-934-8.8 WASHER A20 DIN-125	These are the bolts used to join the Adv Cyl Connector to the Central Post and the Joint Plate to Adv Cyl Connector.	
1992115	45 (with oil)	HYD CYL CRI-10/500-UL	These are used for moving the carriage forwards. One of the ends is fixed by means of a connector to the advancing rails, the other to the 10 t Adv Cyl Connector. They are double acting cylinders that work at low pressure. They have an inbuilt counterbalance valve to control movement in bridges with a high longitudinal slope.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HYDRAULICS AND ACCESSORIES				
3200541	67	10TN ADV CYL-RAIL CONNECTOR	They are pinned onto the rails to be used in the advancing phase. The other end of the advancing cylinders is fixed onto the central lugs.	 
3200543 0250002	0.9 0.08	PIN D34x95 WING PIN D10x125	This is the pin used to secure the Cylinder CRI-10/500-UL. Each pin has two cotter pins.	 
3200368	3.3	PIN W/EYEBOLT D45x250	This is used to fix the 10 t Adv Cyl-Rail Connector to the advancing rails.	 
1992110	70 (with oil)	HYD. CYL CRI-25/200-UL	These are placed on the rear of the main truss and are used to level the structure. They are double acting cylinders that work at high pressure.	 

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HYDRAULICS AND ACCESSORIES				
3200494	13	HOLDING CYLINDER CONNECTOR	This is the part used for the joint between the Clamps UPN Profile and the Cylinder CRI-25/200-UL.	 
3200051 9023102	3 0.04	PIN D50x160 SAFETY PIN D7x50	This is used to fix the Cylinder CRI-25/200-UL and the Holding Cylinder Connector Each pin has two cotter pins.	 
1990104	6	PROFILE MK-120/0,5	In this case, this is used to make the platform where the hydraulic unit is supported during forward travel.	 
1990209	29.3	WALER MK-120/1,25	In this case, this is used to make the platform where the hydraulic unit is supported during forward travel.	 

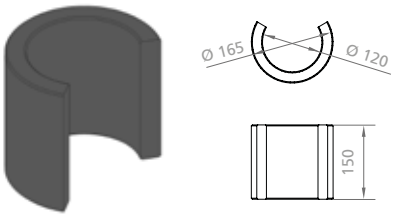
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HYDRAULICS AND ACCESSORIES				
3200688	2.6	HYD GROUP PLAT VERTICAL TUBE	These are Ø 48 tubes that are used for assembling the platform for the hydraulic power unit.	
1960100	14.1	PUSH PULL PROP E 0,75-1,05	This is used for making the platform for the hydraulic power unit.	
0252070 0250000	0.29 0.03	PIN E20x70 COTTER PIN R/3	These are used for fixing push-pull props to the platform walers.	
3101030	0.6	TUBE HEAD W/SLOT	These are screwed into the platform walers to enable the horizontal tubes that will support the hydraulic power unit to be fixed afterwards.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HYDRAULICS AND ACCESSORIES				
3200691	9.2	HYD GROUP HORIZONTAL SUPPORT	These are screwed into the heads laid on the walers. A board to support the hydraulic power unit can be placed over these parts.	
0241612 0241690 0241600	0.34 0.17 0.03	BOLT M16x120 DIN-931-8.8 BOLT M16x90 DIN-931-8.8 NUT M16 DIN-934-8.8	The M16 x 120 bolts are used to fix the heads to the walers. The M16 x 90 bolts are used to fix the horizontal supports to the heads.	
HYDRAULICS FOR TIE RODS PRESTRESSING				
3200507	4.5	HIGH PRESSURE HANDPUMP	Single acting handpump. These are used to supply oil to the hollow cylinders at high pressure.	
3200506	37	HYDRAULIC HOLLOW JACK SE 60TN	These are used to prestress some of the system's rods. They are single acting hollow cylinders with spring return.	

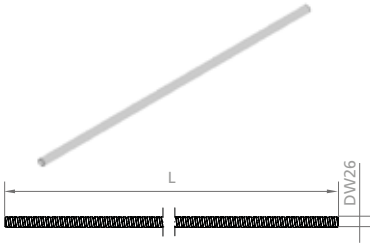
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HYDRAULICS FOR TIE RODS PRESTRESSING				
1992126	1	PRESSURE GAUGE 01MD100G/700	This indicates oil pressure in the circuit. It has a measurement range of 0-700 bar.	
1992129	0.2	LARGE FIFTING 3/8"NPT-3/8"NPT	Connecting element between handpump and manifold.	
1992128	3.5	MANIFOLD 01VM5A/2	Valve with one input and two outputs. Divides the flow coming from the pump to enable the activation of two cylinders at the same time.	
1992125	1.2	HOSE HID WP 700 DN6-TFG-3	High pressure hoses of 3 m in length. These transmit the oil from the manifold to the hollow cylinders. They are called TFG because the connection at one end is type 3/8" NPT and at the other, type GR-6M.	

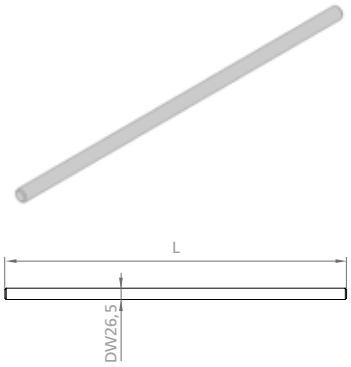
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

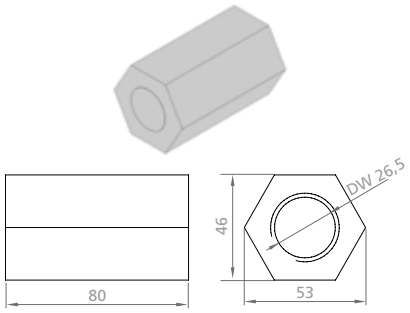
HYDRAULICS FOR TIE RODS PRESTRESSING

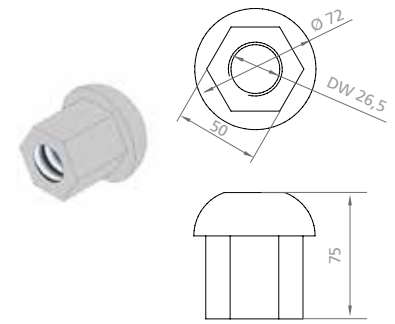
0263102	7.9	HOLLOW JACK SPACER 70TN	This is used together with the hollow cylinder for prestressing rods. It is a tube which is cut to enable the handling of the nut that goes into it.	

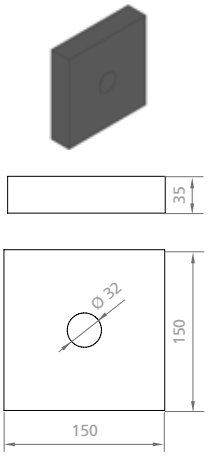
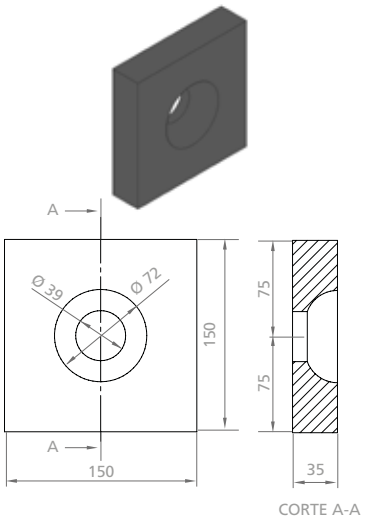
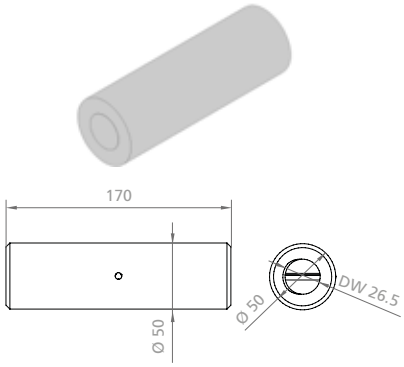
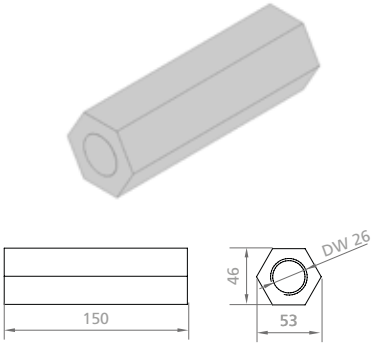
TIE RODS, NUTS AND BASE PLATES

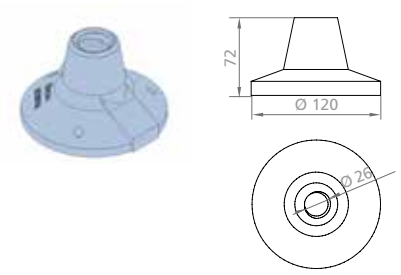
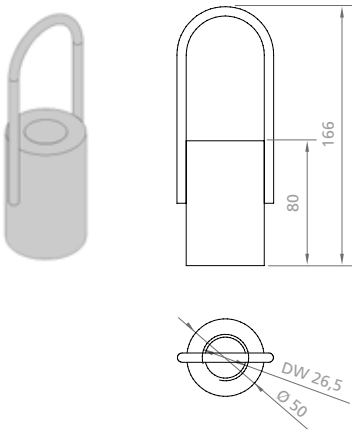
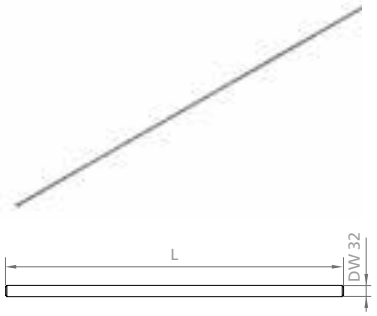
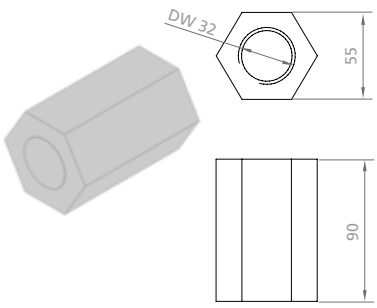
1907131 0231600	5.4 26.9	BARRA ROSCADA 26/1,15 BARRA ROSCADA 26,5/6	The shortest rods are used for fixing the Formwork Hanging Roller and the advancing rails. The longest rods are used to support the bottom slab structure during forward movement.	

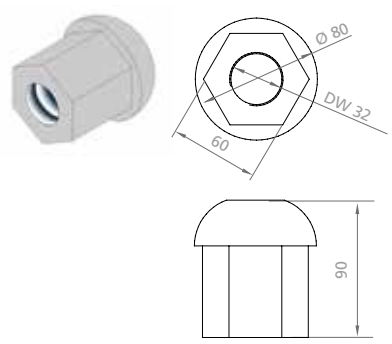
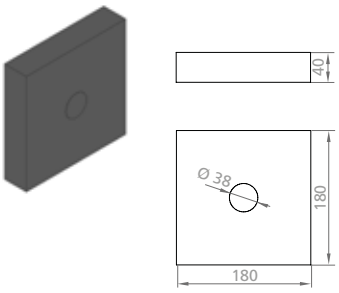
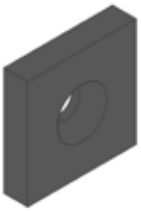
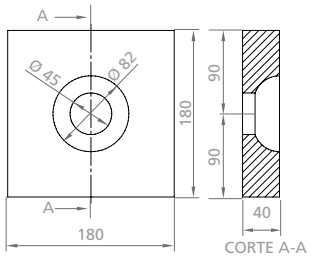
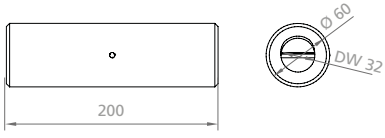
0231080 0231100 0231120 0231150 0231200 0231250 0231300 0231320 0231350 0231380 0231400 0231410 0231450 0231470 0231500 0231550	3.58 4.48 5.38 6.72 8.96 11.2 13.44 14.34 15.68 17.02 17.92 18.37 20.2 21.06 22.4 24.64	TIE ROD DW26,5/0,8 TIE ROD DW26,5/1 TIE ROD DW26,5/1,2 TIE ROD DW26,5/1,5 TIE ROD DW26,5/2 TIE ROD DW26,5/2,5 TIE ROD DW26,5/3 TIE ROD DW26,5/3,2 TIE ROD DW26,5/3,5 TIE ROD DW26,5/3,8 TIE ROD DW26,5/4 TIE ROD DW26,5/4,1 TIE ROD DW26,5/4,5 TIE ROD DW26,5/4,7 TIE ROD DW26,5/5 TIE ROD DW26,5/5,5	The shortest rods are used for fixing the Formwork Hanging Roller and the advancing rails. The longest rods are used to support the bottom slab structure during forward movement. Las barras más largas sirven para sostener la estructura losa inferior durante el avance.	

0231000	0.7	HEXAGONAL NUT DW26,5	These are used to attach the DW 26.5 rods that support the bottom slab structure during forward travel.	

0231002	0.6	DOMED NUT DW26,5	These are used for fixing DW26.5 rods.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TIE RODS, NUTS AND BASE PLATES				
0231001	4.9	BASE PLATE DW26,5	These are used to support the DW 26.5 Nuts.	
0231003	4.7	DOMED PLATE DW26,5	These are used to support the Domed Nuts DW 26.5.	 CORTE A-A
0231004	1.5	ROUND COUPLER DW26,5 D50x170	This is used to join two DW 26.5 rods together.	
1907133	1.4	HEXAGONAL COUPLER DW26,5	This is used to join two DW 26.5 rods together.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TIE RODS, NUTS AND BASE PLATES				
0238036	1.4	FIX ANCHOR DW26	These are used when anchorage rods need to be fixed onto a solid area.	
3200496	1.1	NUT WITH RING DW26	These are used to enable the recovery of anchorage rods when they are inaccessible.	
0232100	6.53	TIE ROD DW32/1	These are the rods that prevent the carriage from tipping over during concrete pouring. They are usually prestressed and fixed to the Rear Prestressing Profile For Curve.	
0232120	7.84	TIE ROD DW32/1,2		
0232130	8.49	TIE ROD DW32/1,3		
0232150	9.8	TIE ROD DW32/1,5		
0232180	11.75	TIE ROD DW32/1,8		
0232200	13.06	TIE ROD DW32/2		
0232250	16.33	TIE ROD DW32/2,5		
0232350	22.86	TIE ROD DW32/3,5		
0232400	26.12	TIE ROD DW32/4		
0232450	29.39	TIE ROD DW32/4,5		
0232500	32.65	TIE ROD DW32/5		
0232600	39.2	TIE ROD DW32/6		
0232000	1.2	HEXAGONAL NUT DW32	These are used for fixing DW 32 rods.	

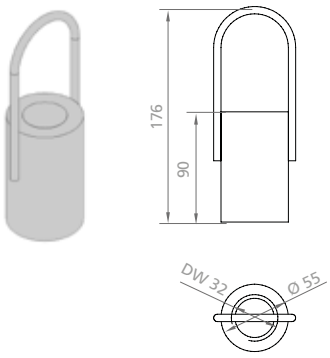
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TIE RODS, NUTS AND BASE PLATES				
0232002	1.1	DOMED NUT DW32	These are used for fixing DW 32 rods.	
0232001	8	BASE PLATE DW32	These are used to support DW 32 nuts.	
0232003	7.4	DOMED PLATE DW32	These are used to support the Domed Nuts DW 32.	 
0232004	3.2	ROUND COUPLER DW32 D60x200	These are used to join two DW 32 rods together.	 

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

TIE RODS, NUTS AND BASE PLATES

3200497 1.3 NUT WITH RING DW32

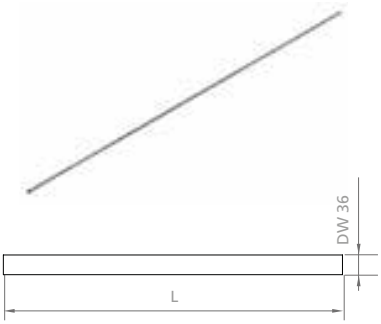
These are used to enable the recovery of anchorage rods when they are inaccessible.



0233100 8.3 TIE ROD DW36/1
0233120 9.92 TIE ROD DW36/1,2
0233125 10.34 TIE ROD DW36/1,25
0233150 12.5 TIE ROD DW36/1,5
0233200 16.54 TIE ROD DW36/2
0233300 24.81 TIE ROD DW36/3
0233400 33.08 TIE ROD DW36/4
0233450 37.2 TIE ROD DW36/4,5
0233500 41.35 TIE ROD DW36/5
0233600 49.6 TIE ROD DW36/6

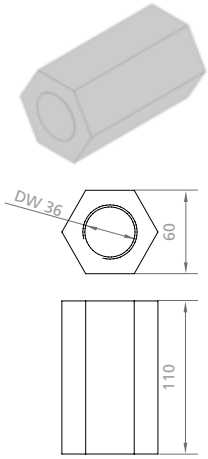
These are used to support the bottom slab structure during concrete pouring.

The shortest rods used in the rear part are prestressed.



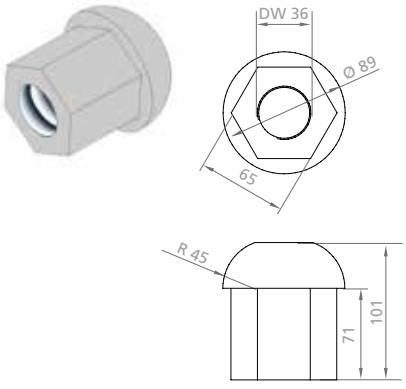
0233000 1.6 HEXAGONAL NUT DW36

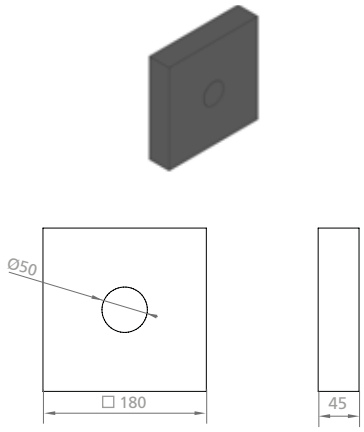
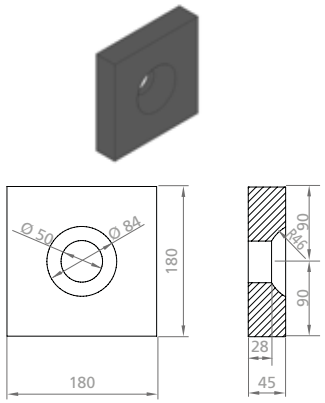
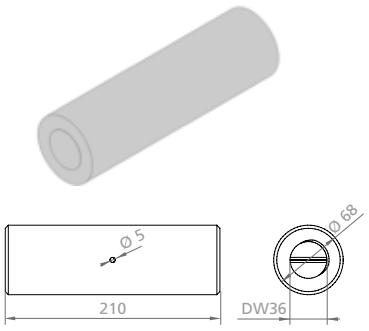
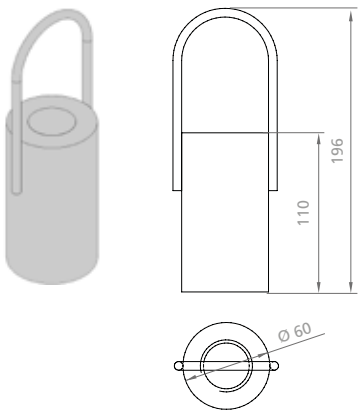
These are used for fixing DW 36 rods.



0233002 1.5 DOMED NUT DW36

These are used for fixing DW 36 rods.



ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
TIE RODS, NUTS AND BASE PLATES				
0233001	10.8	BASE PLATE DW36 (180x180x45)	These are used to support the hexagonal nut DW 36.	
0233003	11	DOMED PLATE DW36 (180x180x45)	These are used to support DW 36 Domed Nuts.	
0233004	4.2	ROUND COUPLER DW36 D68x210	These are used to join two DW 36 rods together.	
3200498	1.8	NUT WITH RING DW36	These are used to enable the recovery of anchorage rods when they are inaccessible.	

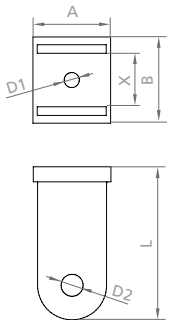
ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

CARDANS AND PULLEY BLOCKS

3200205 24 ADVANCING CARDAN DW26/300kN
3200210 60 POURING CARDAN DW36/500kN

These are parts that embrace the top plate of the cardan.

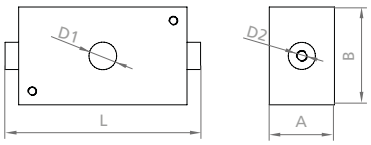
Item No	B1	BA	H	S	D1	D2
3200205	200	180	355	124	51	35
3200210	250	250	412	154	66	50



3200663 51 CARDAN DW26,5/DUPN500 UPPER PART
3200657 63 CARDAN DW36/DUPN500 UPPER PART

These form part of the cardan; they are placed at the top part of the transversal beam.

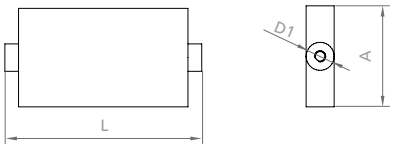
Item No	B	H	S	D1	D2
3200663	360	180	120	51	50
3200657	370	180	150	66	70



3200662 22.5 CARDAN DW26/DUPN500 LOWER PART
3200656 32.3 CARDAN DW36/DUPN500 LOWER PART

These form part of the cardan; they support the transversal beam.

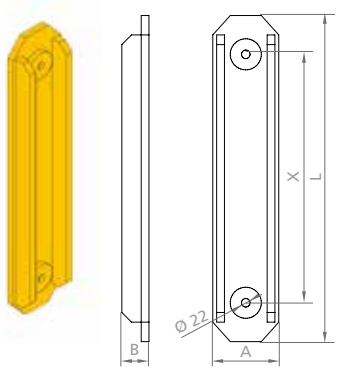
Item No	B	H	D
3200662	360	180	50
3200656	370	180	70



3200666 33,4 PLACA LAT CARDAN DW26/DUPN500
3200660 51 PLACA LAT CARDAN DW36/DUPN500

Se usan para unir entre sí la placa superior e inferior del cardan.

Código	H1	H2	B1	B2	D
3200666	640	840	170	70	22
3200660	650	850	200	90	22

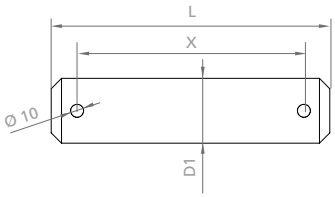


ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

CARDANS Y POLEAS DIFERENCIALES

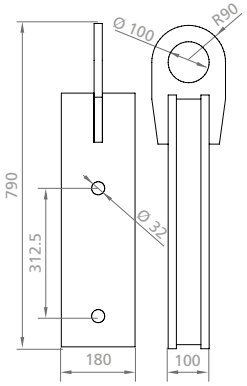
3200204	3.2	PIN D50x175/215 CARDAN DW26	These are used to join the cardan and the top plate of the cardan. Each pin has two cotter pins.
3200474	6.8	PIN D65x225/270 CARDAN DW36	
9851814	0.05	WING PIN D10x80 DIN94	

Item No	D1	D2	L1	L2
3200204	50	10	175	215
3200474	65	10	225	270

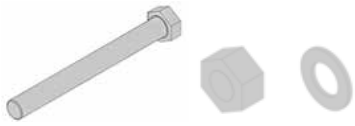


0242022	0.02	BOLT M20x50 DIN933 10.9	These are used to fix the side plates of the cardan to the top and bottom plates of the cardan.

3200646	48.4	PULLEY-DUPN500 CONNECTOR	These are screwed into the opening of the UPN 500 profiles that form the transversal beam. The bottom hook of the differential pulley is fixed to its ring.



0243017	1.4	BOLT M30x170 DIN-931-8.8	These are used for bolting the Pulley-DUPN 500 Connector to the UPN 500 profiles that form the transversal beam.
0243008	0.22	NUT M30 DIN-934-10.9	
0243001	0.05	WASHER A30 DIN-125	



ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

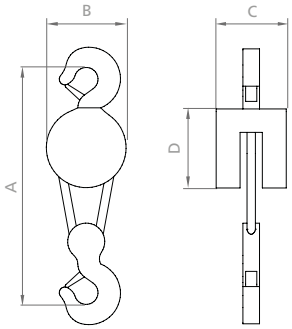
CARDANS AND PULLEY BLOCKS

3200495 78 PULLEY BLOCK 8TN/10m
3200690 235 PULLEY BLOCK 15TN/10m

These are used to adjust the height of the bottom slab structure.

One of the hooks is fixed onto the MK truss of the transversal bracing, the other onto the Pulley-DUPN 500 Connector.

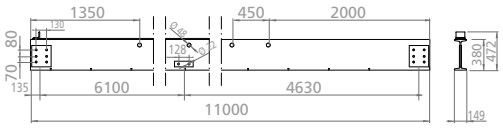
Item No	A	B	C	D
3200495	800	400	176	226
3200690	1020	410	215	226



ADVANCING RAILS

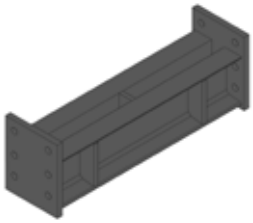
3200406 1030 ADVANCING RAIL 5M SEGMENT

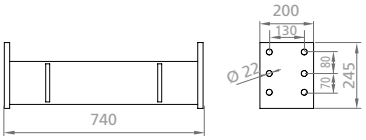
These guide the carriage during the movement phase. They should be anchored to the previous segment to prevent the assembly overturning during forward movement.

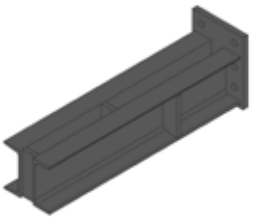
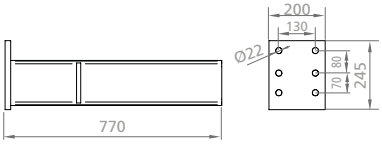
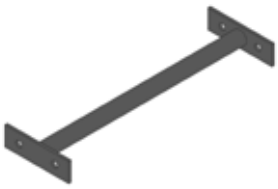
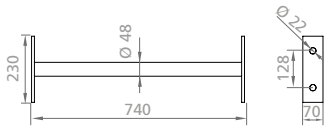
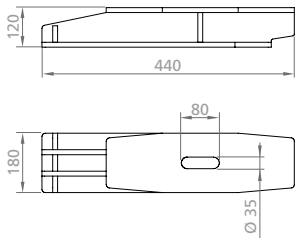


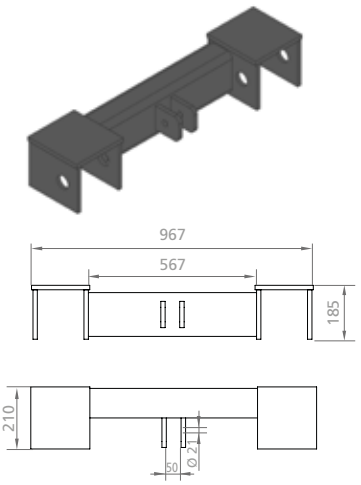
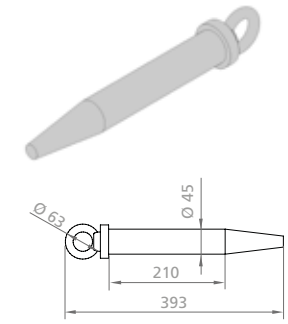
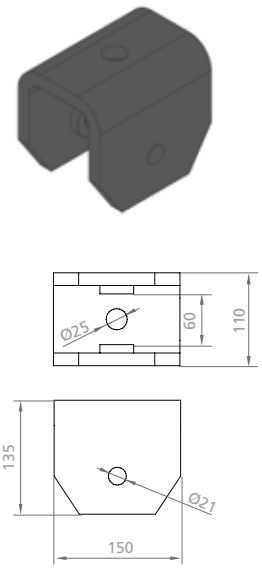
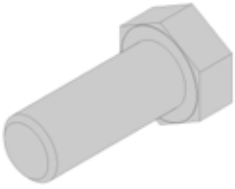
3200128 45.5 RAIL UNION ELEMENT

These are bolted to the front and rear parts of the advancing rails They are used to maintain spacing between the two profiles.





ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
ADVANCING RAILS				
3200364	39.2	RAIL OUTER ANCHOR	These are bolted to the rear parts of the advancing rails, towards the exterior. They are used to fix the anchorage rods there to avoid the structure overturning during forward movement.	 
3200670	4.8	ADVANCING RAIL SPACER	These are bolted to the central part of the advancing rails. They are used to maintain distances between the two profiles.	 
0242090 0242000 0242001	0.28 0.06 0.02	BOLT M20x90 DIN-931-8.8 NUT M20 DIN-934-8.8 WASHER A20 DIN-125	These are the bolts used to fix the different items that are placed on the web of the advancing profiles.	
3200730	42.4	INTERMEDIATE ANCHORAGE AR	These are placed in the middle area of the set of advancing rails. They are clamped to the bottom flange of the profiles and are used to fix the anchorage rods to them.	 

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE
HOLDING SYSTEM				
3200575	47.6	JOINT RAIL-HOLDING PP PROP	This is pinned onto the advancing rails. On end of the push-pull prop is fixed to the central lugs to hold the structure if the longitudinal slope of the bridge is very pronounced.	
3200368	3.3	PIN W/EYEBOLT D45x250	In this case, it is used to fix the Joint Rail-Holding PP Prop to the web of the advancing profiles.	
3200525	5.5	JOINT MAIN TRUSS-PP PROP	This is bolted onto the rear part of the Rear Lower Ledger. The other end of the push-pull prop that holds the structure is fixed to this if the longitudinal slope of the bridge is very pronounced.	
9370409	0.35	BOLT M24x60 DIN933 10.9C	This is used to fix the Joint Main Truss-PP Prop to the rear lower ledger.	

ITEM NO	WEIGHT/ Kg	NAME	DESCRIPTION	IMAGE

HOLDING SYSTEM

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

These are used to hold the structure during forward movement if the longitudinal slope of the bridge is very pronounced.

Item No	min. L	max. L	D
1960100	750	1050	70
1960110	1000	1550	70
1960115	1510	2200	70

9370408 0.41 BOLT M20x140 DIN933 10.9C
0242000 0.06 NUT M20 DIN-934-8.8
0242001 0.02 WASHER A20 DIN-125

These are used for fixing holding push-pull props.

6. TERMS AND CONDITIONS OF USE

6.1. SAFE OPERATING GUIDELINES

6.1.1 General guidelines

- All guidelines in the Project Plan and Health and Safety Plan, as well as any other applicable technical and/or safety requirements must be strictly followed at all times.
- Labour must be performed only by qualified personnel under the instruction of a competent supervisor.
- The instructions for use of all equipment employed on the worksite must be followed; consult the user guides provided by the equipment manufacturer or distributor.
- Work must only be carried out using approved auxiliary means and the corresponding protective equipment, preferably collective protection.
- Personal protective equipment (PPE) should include, at minimum, a safety helmet, protective footwear, protective gloves, and a tool belt. Whenever necessary additional PPE must be used.
- Avoid heavy impact on working platforms or bridge deck. Jumping, unloading material roughly, etc. is strictly prohibited.
- If work is performed near high-tension lines, an effort must be made to work without electrical power. If this is impossible, all measures outlined in the relevant governmental regulations must be taken.
- Under adverse weather conditions all work with material must be postponed.
- In heavy winds all loads and objects on working platforms must be removed; all ties, meshes, platform braces, etc. must be checked for stability both before and after the inclement weather.
- Before starting the stripping and dismantling procedure, check that all structural components (ties, etc.) are in place, and if not, make all necessary adjustments before proceeding.
- Furthermore, before starting the procedure, check the structure (e.g. the working platforms) to ensure that there is no loose material at risk of falling.
- All necessary measures (signage, fencing, etc.) must be taken to prevent access of both personnel and third parties while the structure and its surroundings are not in proper working condition (e.g. when the assembly is unfinished, collective protection is not present, access is restricted to authorised personnel, or access by third parties is prohibited during assembly and dismantling).
- Any personnel or third parties accessing a structure where collective protection is not present must wear all PPE necessary to prevent the risk of falls.
- The purchaser or lessee of the structure must inform its employees of all regulations and guidelines necessary to ensure safety.
- Any possible modifications to the structure must be made under the instruction of a competent supervisor, and in all cases must comply with the guidelines provided in the manufacturers or distributors operating manual.
- The purchaser or lessee must conduct periodic checks of the structure to verify the physical state of all key structural elements and ascertain whether any parts of the structure have been removed or altered either by personnel or a third party.

6.1.2 Complementary structural elements

- **Structure assembly**

- The assembly area must be enclosed with fencing such that only personnel directly involved in the assembly process may enter.
- The proper tightness of bolts and nuts joining different components, as well as the correct positioning and tightness of the push-pull props, must always be verified.
- The proper tightness of all rods, nuts, coupling nuts, plate for conical nut, and any other components fastened to the floor must also be verified.
- No new assembly is to be put in place until verifying that the previously installed assembly is correctly fastened.
- No parts are to be left in a partially assembled state.
- Sufficient slab strength to bear actual loads under actual working conditions must always be verified, and in those instances where the slab will be subject to severe climatic conditions all necessary precautionary measures must be taken (surface cleaning, concrete footings, etc.).
- In instances where heavy loads are to be borne, the contractor must ensure that a proper geotechnical study is performed and that all foundations necessary to ensure safe working and operating conditions are put in place.
- In cases where specialised foundations are necessary, a separate project must be undertaken specifically for foundation work, complete with plans and calculation annexes.
- The stability of the structure will be ensured by fastening all ties and joints according to project plans and/or configuration type.
- If any product is spilled on the working platforms it must be cleaned immediately.
- No material is to be stored on the working platforms other than that which is strictly necessary for the work currently at hand.

- **Dismantling the structures**

- The falsework must always be inspected for any missing structural elements and/or ties before dismantling.
- If the dismantling process is to be performed by crane it must first be ensured that there are no loose components at

the top of the shoring tower.

• It must be ensured that no personnel remain either directly underneath or near the dismantling area.

• Special care must be taken to guarantee the stability of the structure during the dismantling process.

• No material is to be stored on the working platforms during dismantling; it is to be lowered to the ground when

dismantling begins.

6.1.3 Complementary formwork elements

• Formwork

- Framing that supports the formwork panels will be installed, so as to avoid panel deterioration and create orderly, clean, and proper panel distribution.
- Proper nut and tie-plate tightness, correct push-pull prop positioning and adjustment, as well as adequate anchoring of the base to the ground, must all be verified.
- No new assembly is to be put in place until verifying that the previously installed assembly is correctly fastened.
- No parts are to be left in a partially assembled state.
- It is forbidden to climb on formwork except in extraordinary circumstances, and then only when the situation has been duly studied and appropriate protection systems have been put in place.
- Before pouring concrete all formwork surfaces must checked, and if necessary, cleaned.
- Clean panels after every use. Wire brushes are not suitable for cleaning as they risk damaging the phenolic film of the plywood.
- It is important to understand that the phenolic film of the plywood panels hardly suffers any damage from the abrasive and chemical action of the concrete, but special care must be taken of orifice seals and any deteriorated areas.
- Whenever plywood panels are trimmed, the cut must be sealed as soon as possible, because any water that penetrates into the panel can cause the layers to swell and increase in thickness.
- In general, the use of nails and bolts is not recommended.
- For storage purposes, panels should be stacked on supports, separated from one another with wooden spacers, and protected from the elements. Prolonged exposure to sun or rain can damage the panels.

• Release Agent

- Release agents are necessary to prevent the concrete from adhering to the formwork; their use will drastically increase the working life of the panels.
- Release agents play an important role in the creation of a high-quality concrete finish free from both surface cavities and irregular colouring.
- Application must always be in thin uniform layers, and in compliance with the regulations governing proper use.
- Panel surfaces must be scrupulously cleaned before applying release agent.
- It is recommended that the metal panel frame be cleaned and fresh release agent applied after every fourth or fifth use.

• Pouring

- Do not exceed the maximum hydrostatic pressures of the formwork system as outlined in the instructions and calculations.
- The formwork must be closely monitored during pouring, and in the event of any incidents, pouring must be immediately stopped.
- Pouring must be performed in uniform layers between 30-45 cm thick.
- It is recommended that the concrete be poured from the lowest height possible, and never from more than 2m without the use of an appropriate accessory, such as a tube or trough. Pour the concrete at a single point as near as possible to the formwork base, without pouring directly against it.
- If the concrete is poured from a bucket, special care must be taken to avoid collision with the formwork and to remain within the load limits of the crane.
- Splashing the concrete against the panels should be avoided, as this will create discoloured spots on the finished surface.
- An appropriate compaction or vibration system must be used so that the concrete settles properly.
- The preferred means of compaction for concrete cast on-site is an internal vibrator. Use external vibrators only when the concrete cannot be accessed with internal vibrators, or for pieces cast in the workshop. In such cases, a specific analysis must be made to define the best method of external vibration.
- The internal vibrator must penetrate into the concrete between 10-15 cm.
- The internal vibrator must not come into contact with the formwork surface, so as not to exceed the stipulated load limits.
- The vibrator must be inserted quickly, and remain still, in a vertical or slightly inclined position.
- When finished, the vibrator must be withdrawn slowly.

• Curing the concrete and stripping the formwork

- Before stripping, concrete must be sufficiently cured to prevent surface spalling, which destroys the finish and

compromises both strength and durability.

- Curing time should be increased in low temperatures or windy conditions, either of which can cause rapid surface drying.

- The time between pouring and stripping must remain uniform for all parts of the project. This is necessary for a high-quality finish because the final tone of the concrete surface depends on how long it is isolated from the outside air.

- Ensure that no people are in the vicinity while stripping takes place. Once stripping is complete, store the formwork on frames for cleaning and dismantling if it is not going to be used for further pours.

6.2. TRANSPORT, HANDLING AND STORAGE

6.2.1 General guidelines

- Study potential hazards and adequate preventative measures specific to the worksite.

- Follow the instructions of the project foreman.

- Ensure that adequate communication between employees is maintained.

- Use work equipment only when all proper authorisation, training, and information have been obtained.

- Maintain a minimum safety distance from mobile work equipment (forklifts, lorries, cranes, etc.), and from areas with risk of falling objects.

- Under no circumstances is anyone to remain either underneath or in the path of elevated loads.

- Prevent all parts from suffering blows or being crushed during transport, handling, and storage.

- The material must be packed for transport in appropriate containers such as pallets or boxes, or strapped securely to skids, or packed using any other system that will ensure stability and prevent damage.

- Strap the load down with sufficient strength to prevent it from shifting, but not so much as to deform the material; if necessary, protect the load with padding.

- When cutting the strapping, stand to one side and use both gloves and safety goggles so as to avoid the risk of being trapped by the load or injured by the strap.

6.2.2 Transport

- Ensure that the load is stable, and comply with driver instructions regarding uniform load distribution, fastening with auxiliary aids, etc.

- When opening containers or boxes used in transport always stand clear of the possible trajectory of any falling objects.

6.2.3 Handling

- **Manual handling of loads**

Some basic ergonomic principles to be followed are listed below:

- Do not make abrupt movements.

- Before lifting any load, examine it carefully for any sharp corners, dirt, etc. and decide, based on the shape, weight, and volume of the load, the best place to hold it.

- To lift the load, first stand with your feet shoulder-width apart and bend at the knees - never at the back.

- Do not attempt to lift heavy or unwieldy loads without the aid of either mechanical means or other worker(s).

- **Mechanical handling of loads**

- Only mechanical lifting devices that meet regulatory standards and are appropriate for the task at hand may be used.

- Check the condition of lifting gear such as slings, cables, and other ties, before each use.

- Once the lifting accessories are in place, but before lifting begins, step back to a safe distance from the load and any other objects that could be affected during the lifting process.

- Comply with all instructions provided by the team supervisor, who is specifically trained for such operations.

- Move the load carefully, avoiding any brusque movements.

- In complex or dangerous lifting operations, or when the crane operator cannot see the entire transport path, movement must be directed by a signalman who communicates with the crane operator by means of a previously defined code.

- When necessary to guide the load use equipment, such as a rope, that allows it to be guided from a distance. The load must never be guided by hand if there is any risk that the hand could be caught between the load and another object. Any swinging and/or unforeseen movement of the load has the potential to cause a serious accident.

6.2.4 Storage

- Proper storage is fundamental to ensuring that equipment remains in good working condition.

- Wherever possible, material is to be stored in a place protected from the elements and any other possible causes of deterioration.

- It is recommended that parts of the same type and size be stored in containers - such as metal baskets, boxes, or pallets - dedicated specifically for them.

- Always ensure the stability of any stacked or piled goods, bearing in mind the following:
  - Load-bearing capacity of the surface on which they rest.
  - Any slopes or unevenness in the surface.
  - Levelling the packages.
  - Package or container support.
  - Package stability.
  - Condition of strapping.
  - State and capacity of the containers used.
  - Do not stack full containers on top of empty or partially-empty containers.
  - External conditions such as wind, risk of collision from other objects, etc.

6.3. INSPECTION AND MAINTENANCE

6.3.1 General guidelines

- ULMA is responsible for delivering products, whether sold or rented, in good working condition.

- From the moment of delivery, the responsibility for correct use, inspection, and maintenance of all material is solely that of the purchaser or lessee. All material damaged, broken, incomplete, or otherwise out of working condition, must be removed from service.

- During the use, inspection, and maintenance of material, special care should be taken in the following areas:
  - All components that influence human safety.
  - All aluminium components, if any, as they are both more prone to deformation and more vulnerable than other materials at welded joints.

6.3.2 Inspection instructions for ULMA Construction components with CE marking

Before each use, check the condition of all components with CE marking. If they do not meet the specified requirements, they must be removed from service.

For more information consult ULMA Construction.

6.3.3 Inspection instructions for equipment marketed by ULMA Construction with CE marking

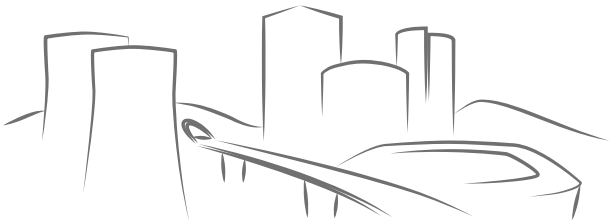
Equipment marketed by ULMA Construction with CE marking must be inspected according to the instructions found in the User Guide for that equipment.

7. LEGAL REFERENCES

- Council Directive 89/391/CEE of 12 June 1989, regarding the application of measures to improve the health and safety of workers while at work.
- Council Directive 89/654/CEE of 30 November 1989, regarding minimum health and safety standards in the workplace.
- Council Directive 89/656/CEE of 30 November 1989, regarding minimum health and safety standards for the use of personal protective equipment at the workplace.
- Council Directive 90/269/CEE of 29 May 1990, regarding minimum health and safety standards for manually handling loads when risk - especially risk of back injury - is present.
- Council Directive 92/57/CEE of 24 June 1992, regarding minimum health and safety standards applicable to temporary or mobile construction sites.
- Council Directive 92/58/CEE of 24 June 1992, regarding minimum standards for health and safety signage in the workplace.
- Directive 89/655/CEE - Directive 95/63/CE - Directive 2001/45/CE of both the European Parliament and Council, of 27 June 2001, which amend Council Directive 89/655/CEE, regarding minimum health and safety standards for the use of equipment on the worksite.
- Directive 2002/44/CE of both the European Parliament and Council, of 25 June 2002, regarding minimum health and safety standards for worker exposure to risks caused by physical agents (vibrations).
- Directive 2003/10/CE of the European Parliament and Council, of 6 February 2003, regarding minimum health and safety standards for worker exposure to risks caused by physical agents (noise).
- Directive 2006/42/CE of the European Parliament and Council, of 17 May 2006, regarding machines, which amends Directive 95/16/CE (consolidated).

Standars:

- EN 12812. Shoring. Performance and general design requirements.
- EN 12811-1 Equipment for temporary jobs on the worksite. Part 1: Scaffolding. Performance and general design requirements.
- EN 12811-2_Equipment for temporary jobs on the worksite. Part 2: Information on materials.
- EN 12811-3_Equipment for temporary jobs on the worksite. Part 3: Load test.
- EN 13374_ Provisional edge protection systems. Product specifications and test methods.
- EN 74-1_Couplings, spigot pins, and base plates for scaffolding and shoring. Part 1: Pipe fittings. Test requirements and processes.
- EN 74-2_Couplings, spigot pins, and base plates for scaffolding and shoring. Part 2: Specialised couplings. Test requirements and methods.
- EN 74-3_Couplings, spigot pins, and base plates for use in scaffolding and various jobs. Part 3: spigot pins and flat base plates. Test requirements and methods.



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