STRUKTURAS

Movable Scaffolding System MSS

Contents

1 General

General

The Strukturas MSS system is a modern movable scaffolding system used for cast-in-place bridges and viaducts decks.

Engineer Tore Gjolme, who founded Strukturas in 1991, developed the MSS concept while working as an engineer for Olav Opedal AS, a company in the AKER group that specialises in mechanical engineering. The first MSS developed in this way was used by the company in Norway in 1971.

The idea of movable scaffolding arose after the use of prestressed technology became generalised and Strukturas has contributed greatly to its development over the last 30 years.

The Strukturas MSS comes in underslung and overhead versions, which can be self-launching or not.

Underslung MSS

Overhead MSS

2 Underslung MSS system

Underslung MSS Deck box section

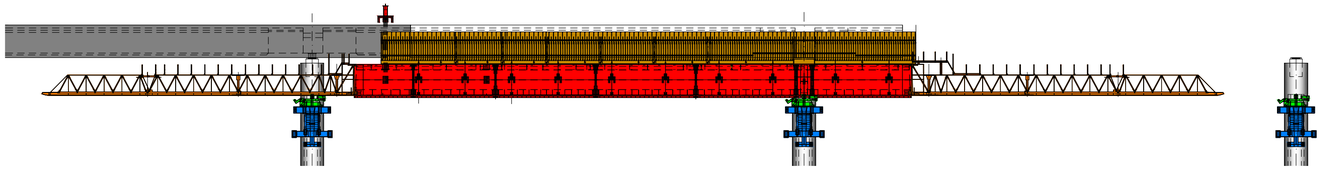
The Underslung MSS solution is currently used in the construction of the decks on road and railway bridges and viaducts, with spans normally varying between 20 m and 70 m.

Concreting each box section span using Underslung MSS can be done in one or more stages, depending on the deck design.

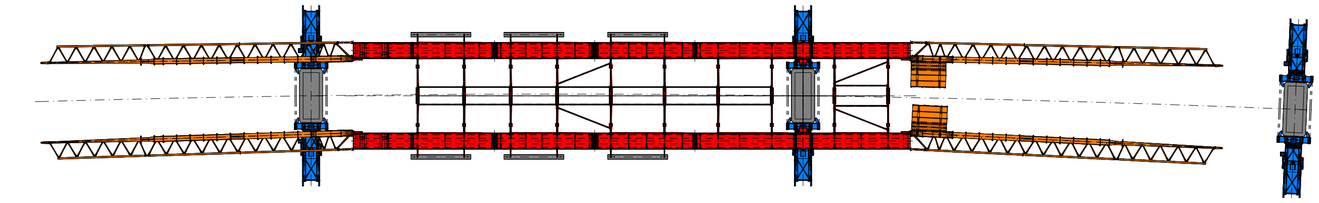
The versatility of the Underslung MSS solution makes it possible to be used on decks with a variable plan view radius and up to minimum of 250 m to 300 m.

The search for simple yet effective solutions has guided the work done by Strukturas over its many years in existence.

Longitudinal view



Plan view



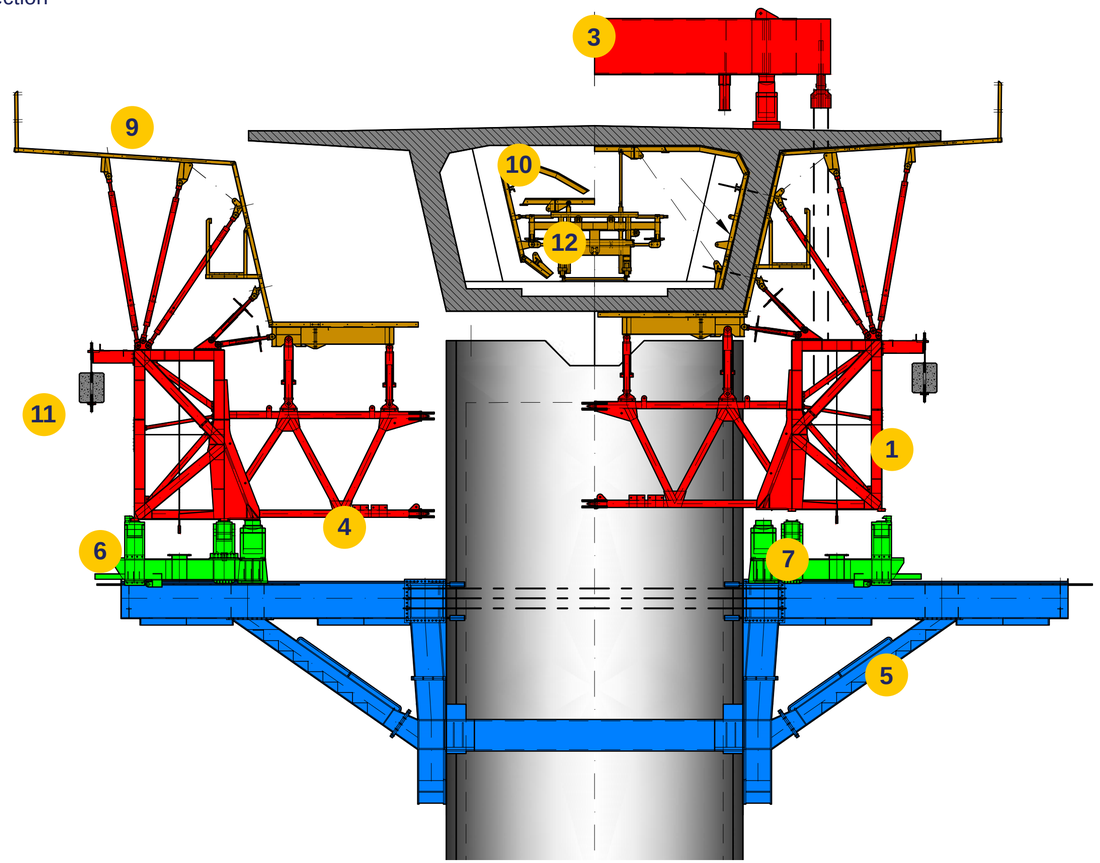
Main components

Each underslung MSS normally consists of: a resistant steel structure, supporting brackets, suspension gallows, a set of working platforms and ladders, internal and external formwork, high resistance threaded bars, bolts, pin bolts and hydraulic systems that allow the MSS to be launched and formwork to be opened and closed, as well as making the necessary geometric adjustments.

The MSS noses are hinged in relation to the main girders, making it possible to adjust to relatively small, fixed or variable plan view

curvature radius.

Cross section



Main components:

1. Main girder
2. Nose (not shown)
3. Suspension gallows
4. Transverse beams
5. Supporting brackets
6. Launching wagons
7. Main jacks
8. Platforms and ladders (not shown)
9. External formwork
10. Internal formwork
11. Counterweights
12. Transport trolley

Underslung MSS Deck TT section

The Underslung MSS is also used to concrete deck TT sections, in which case concreting spans of around 45 m in length is commonplace.

When using this type of solution, the internal formwork is transported together with the main MSS structure and this is opened and closed by a specific hydraulic system.

To allow the MSS two halves to pass through the columns, minimising their transverse side shift and consequently the length of the supporting brackets, the transverse beams of the MSS joining the main girders are foldable.

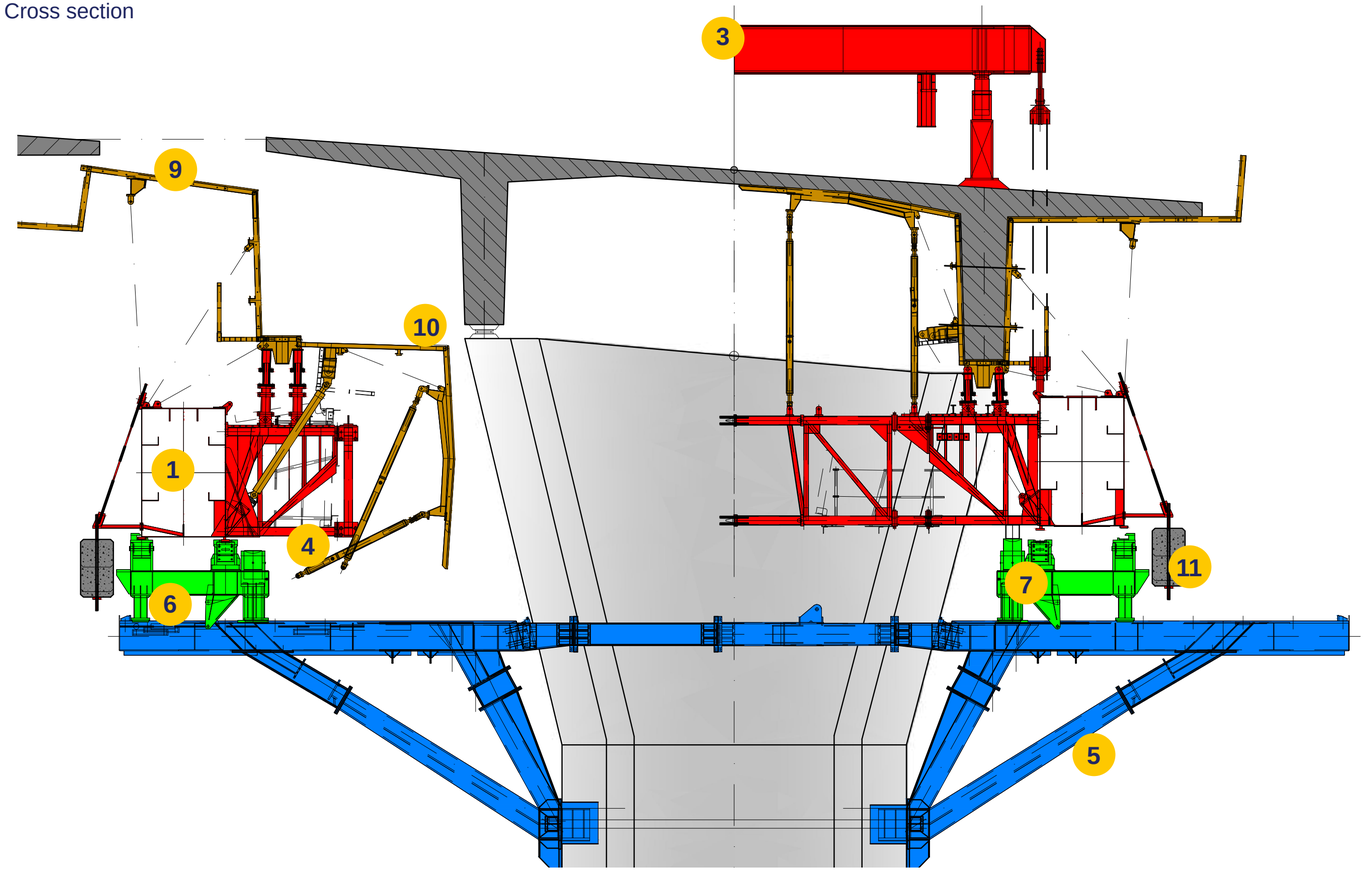
The underslung MSS can be easily adapted to different deck sections and different span lengths, as well as to variable curvature radius, both vertical and horizontal.

Main components

The main components of the underslung MSS solution adapted for double T sections are identical to the solution used for deck box sections, except in terms of the internal formwork, which is launched from one span to the next along with the MSS main structure.

The transverse beams in this kind of MSS are normally equipped with a hinge so that they can partially rotate, making it easier to pass through the columns, which is not the common solution used in deck box sections.

Cross section



Main components:

1. Main girder
2. Nose (not shown)
3. Suspension gallows
4. Transverse beams
5. Supporting brackets
6. Launching wagons
7. Main jacks
8. Platforms and ladders (not shown)
9. External formwork
10. Internal formwork
11. Counterweights

Launching device

Launching wagon

The underslung MSS is equipped with three pairs of launching wagons with hydraulic jacks and teflon plates, designed to carry out the opening and closing of the two MSS halves and for its longitudinal movement.

Apart from the current solution using Teflon plates in the launching wagons, Strukturas also has solutions using express rollers or wheels to reduce friction during MSS launching whenever this is necessary to ensure the stability of the columns.

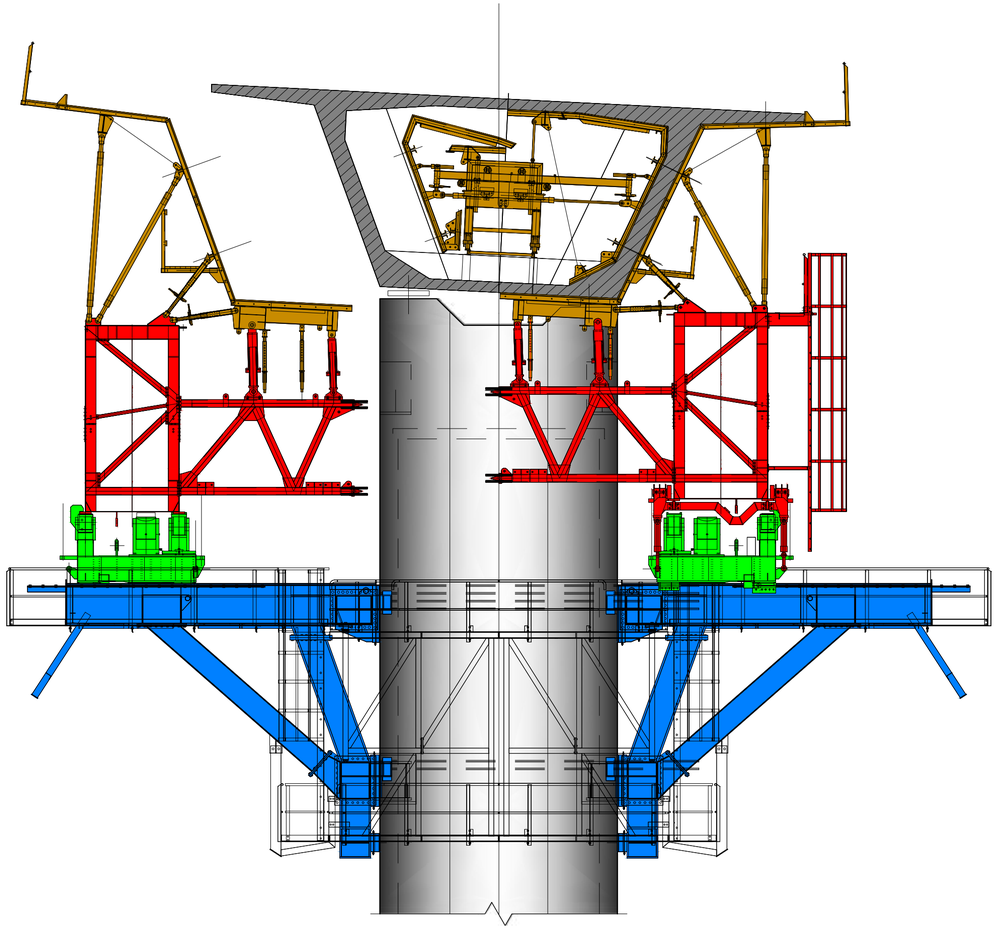
Underslung self-launching MSS

In the current versions of underslung MSS, mobile cranes are used to relocate the supporting brackets on the columns in the different spans.

With the MSS self-launching version, cranes are not needed for relocating the supporting brackets because the MSS is equipped with a specific device for carrying out this operation.

The supporting brackets are suspended from a transport bogie, which moves them along the main girders and the noses with the aid of electric winches included in the system.

Cross section



Underslung self-launching MSS

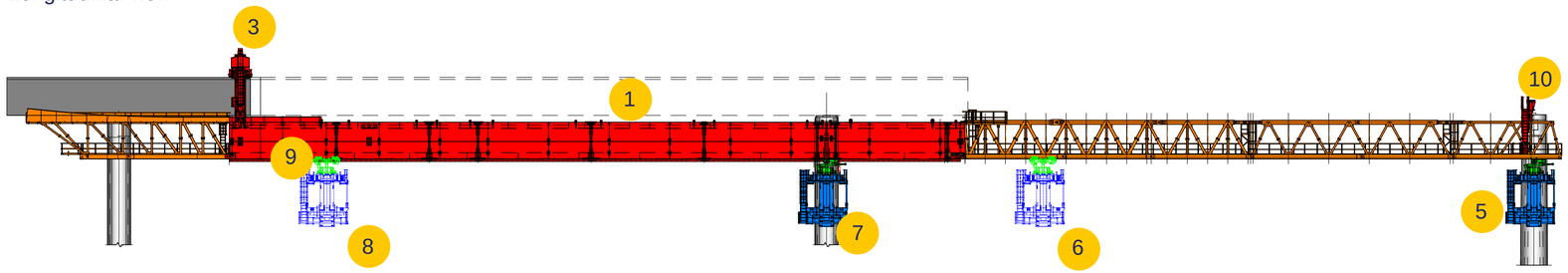
The front nose is long enough to rest on the next column, while the back nose is short.

During relocation of the supporting brackets, the main girders rest on the front column through a temporary support, making it possible for rebar assembly work to continue while the supporting brackets are being relocated.

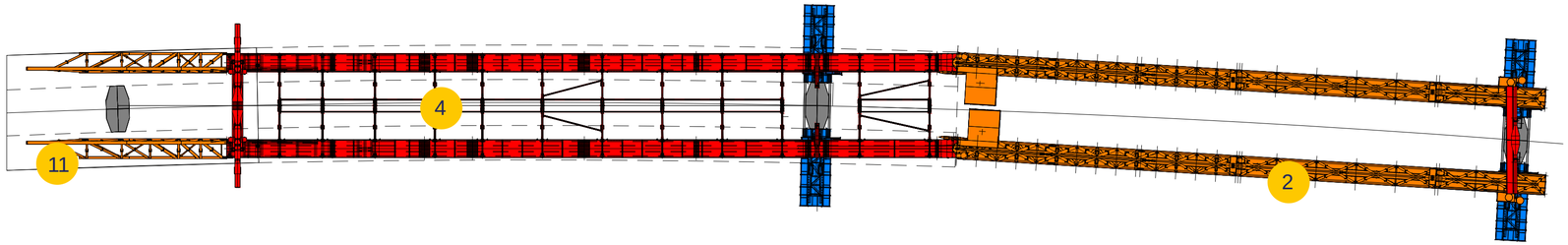
Main components:

1. Main girder
2. Front nose
3. Rear launching support
4. Transverse beams
5. Supporting bracket 1 installed
6. Supporting bracket 1 during transport stage
7. Supporting bracket 2 installed
8. Supporting bracket 2 during transport stage
9. Transport bogie (only 1 unit per main girder)
10. Front nose temporary support
11. Rear nose

Longitudinal view



Plan view



Underslung self-launching MSS is equipped with only two pairs of supporting brackets, instead of the three pairs used in current versions. The rear launching support makes it possible to keep the MSS rear suspended during concreting and launching until the centre of gravity (COG) is positioned in front of the front column, ensuring the safety of the launching.

Underslung self-launching MSS

The underslung self-launching MSS solution is particularly suitable for the construction of decks located over water or when the columns are very high, making it difficult, if not impossible, to use mobile cranes positioned at ground level.

Because the supporting brackets are moved suspended from the main girders and the front noses, this MSS solution is harder to use when the plan radius of curvature is small because it requires the introduction of an angle between the main girders and the front noses, making it difficult for the transport bogie to pass.

Main support:

Underslung MSS normally transmits its front reactions to the columns through the supporting brackets.

The supporting brackets are equipped with a steel corbel on their lower extremities, which goes into a blockout left in the columns. To ensure the stability of the pair of brackets, these are connected to each other by prestressed threaded bars, pushing them against the column.

Whenever blockouts cannot be left in the columns, alternative solutions working by friction are used, suspending the brackets from the column or transmitting the reactions to the foundations through struts.

The rear reactions are transmitted to the tip of the deck concreted in the previous stage, through a suspension gallows.

Supporting brackets supported on struts transmitting the reactions to the foundations

Supporting brackets supported on the column and blockout visible in the front column

Supporting brackets suspended from the column

Supporting brackets suspended from the arch

3 Overhead MSS system

Overhead MSS

Overhead MSS is another movable scaffolding system solution that is also suitable for concreting box or double T deck sections.

Both MSS solutions are similar, but one solution can have advantage over the other in some situations where local conditions are more favourable to one or the other.

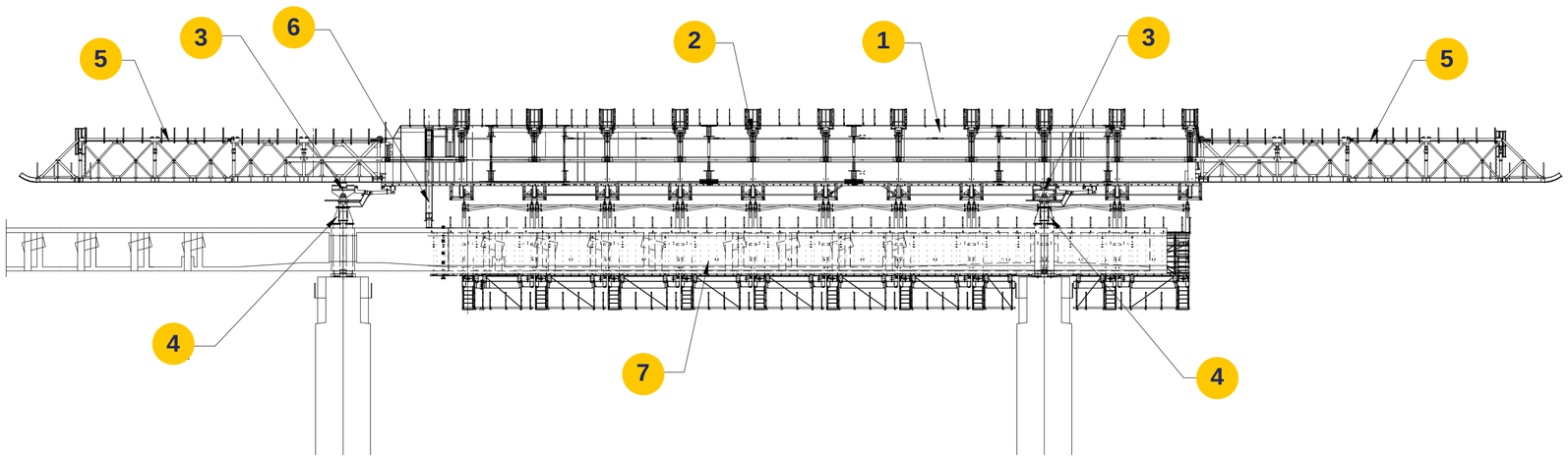
Main components:

1. Main I-beams
2. Transverse beams
3. Launching wagon
4. Main support
5. Noses
6. Rear support
7. External formwork

Overhead MSS normally has the advantage of being able to be assembled and dismantled behind the abutments, at an elevation close to ground level.

The overhead MSS solution is normally equipped with a rebar cage transport system that includes electric winches and rails.

Longitudinal view



Main components

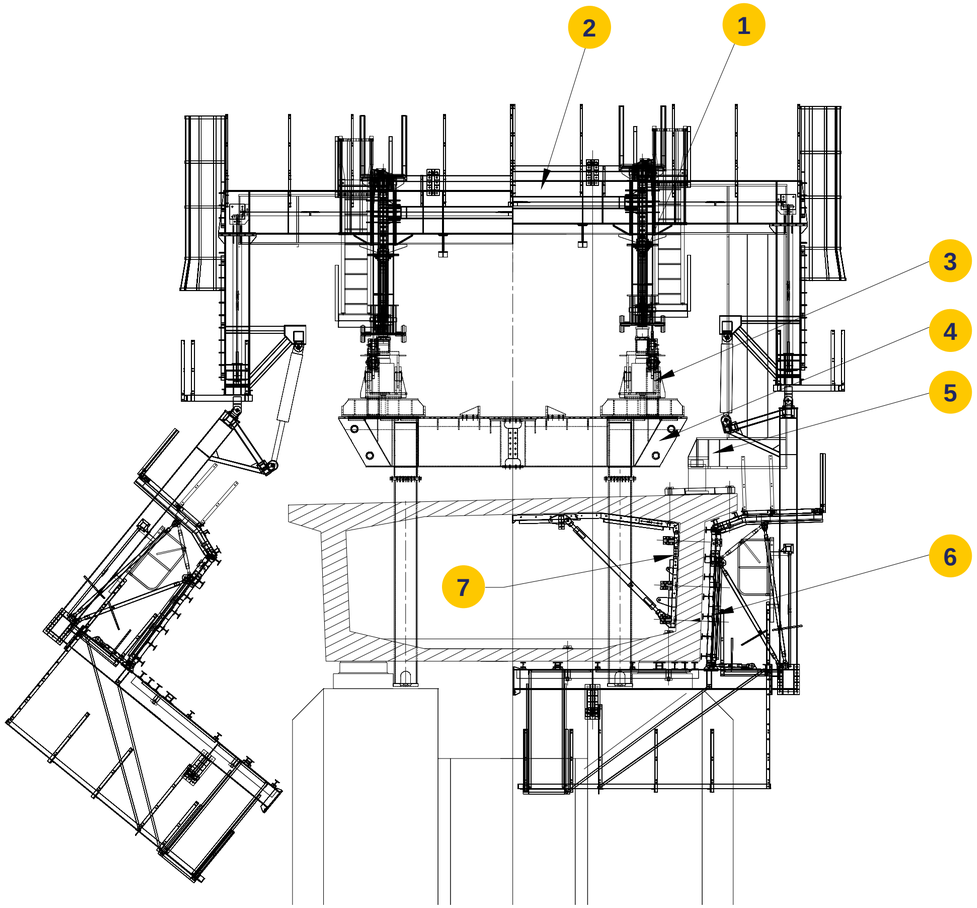
Overhead MSS typically consists of a

resistant structure supported by the columns, from where the formwork is suspended.

The resistant structure normally includes two main I-beams, a set of transverse beams and the noses and supports.

When the solution is used for concreting box section decks, the internal formwork is identical to the internal formwork used in underslung MSS.

Cross section



Main components:

1. Main I-beams
2. Transverse beams
3. Launching wagons
4. Main support
5. Rear support
6. External formwork
7. Internal formwork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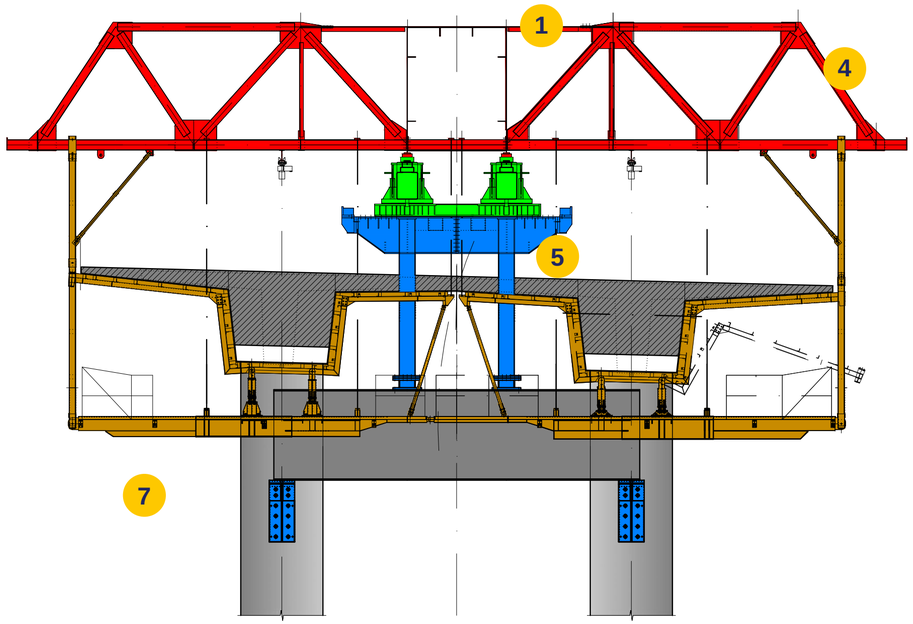
Overhead MSS

The main structure in overhead movable scaffolding may sometimes be made up of a single main girder aligned with the deck axis, instead of having a pair of main I-beams.

In this case, overhead MSS only includes two noses, one front and one rear.

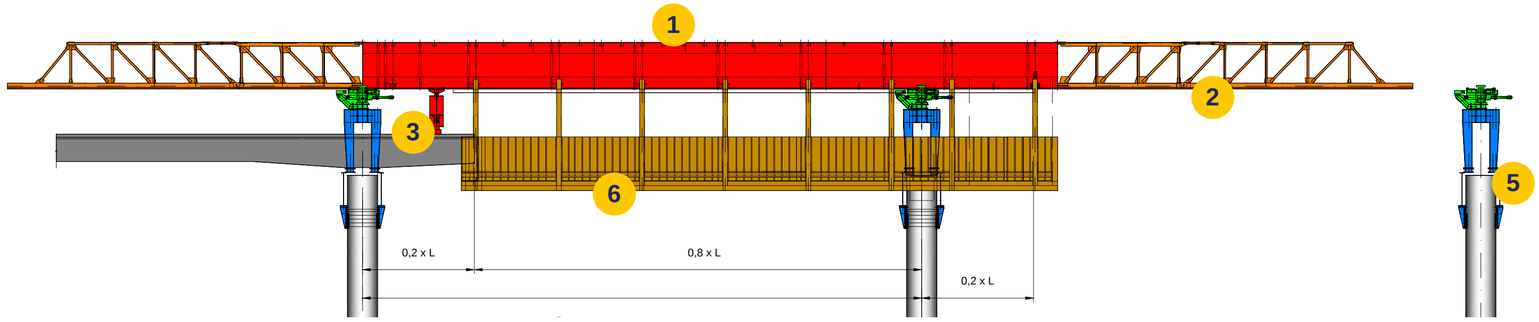
Cross section



Main components:

1. Main girder
2. Nose
3. Rear support
4. Transverse beams
5. Main support
6. External formwork
7. Bottom formwork

Longitudinal view



Self-launching overhead MSS

The overhead MSS system can also be supplied in the self-launching version, which means that the actual MSS can relocate its supports on the columns of the next span without the need to use a crane

Main support:

The MSS main supports are designed in each case to adjust to the geometry of the columns in each project and the way the reactions should be transmitted to the concrete.

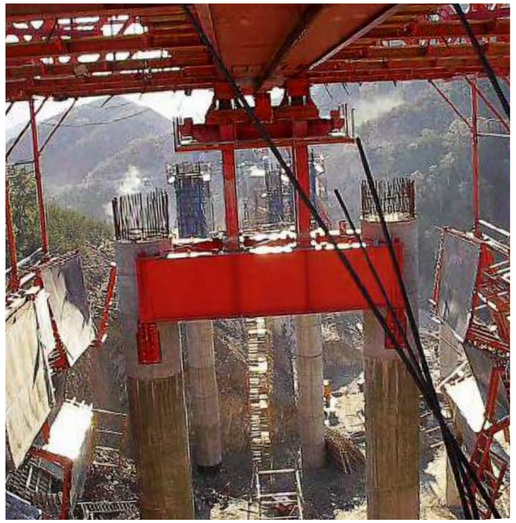
Strukturas has extensive experience in designing different support configurations for overhead MSS.

The most common support solution consists of assembling support legs directly on the column, in which case the legs are connected to the concrete using embedded anchors.

Other solutions less frequently used have profiles passing through the column walls, collar friction or even precast concrete legs which become lost inside the deck structure.

Profiles passing through the column

Concrete legs support



Crossbeam supported on short brackets operating through friction

Direct support on the column

Crossbeam supported on the columns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4 Formwork

Internal formwork in casting position

Use of the transport trolley to relocate the rails on the next span

Formwork panel during the transport stage

Formwork in the relocation stage on the next span

Internal formwork box section deck

The internal formwork in Strukturas MSS is the same both for overhead MSS and underslung MSS

Main advantages:

- The formwork panels are transported from one span to the next using a motorised transport trolley on rails
- Smaller number of formwork panels as they are built in lengths of around 5 m to 7 m
- Less manpower
- As soon as the first panel from the front is relocated on the next span, the assembly of the top slab reinforcements can begin, with both tasks being carried out simultaneously after this

Important:

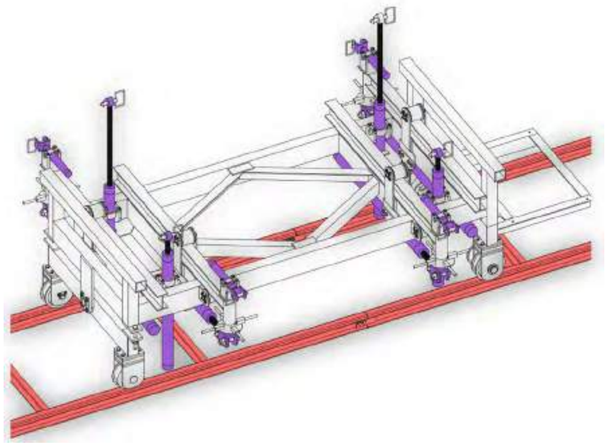
In order to use the Strukturas internal formwork system, it is necessary:

- That the free opening in the deck diaphragms during the construction stage is big enough to allow for the passage of the folded formwork panels supported on the transport trolley;
- That the section geometry is constant; however, it can rotate transversally along the deck axle.

Internal formwork transport trolley

The internal formwork transport trolley developed by Strukturas is a simple solution that not only allows the panels to be transported effectively to the next span, but also assembles them in their final position, without the need to use cranes.

The transport trolley is equipped with motors and hydraulic jacks that allow it to carry out the different tasks it was designed for.



Transport trolley 3D model

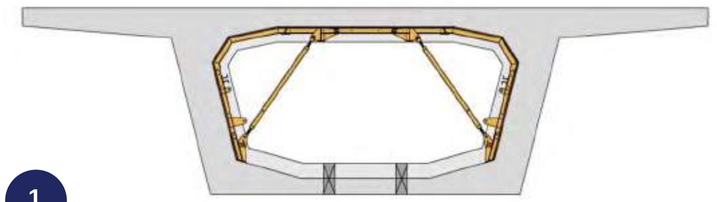
Hydraulic operated transport trolley

Formwork panel transport

Column section deck diaphragm

Internal formwork transport kinematics:

1. Formwork in the casting position
2. Relocating the rails for transport
3. Positioning the transport trolley under the formwork panel
4. Connecting the formwork panel to the transport trolley using hydraulics
5. Formwork struts dismantling
6. Folding the formwork panel to be transported, activating the hydraulic jacks of the transport trolley and transporting it to the next span



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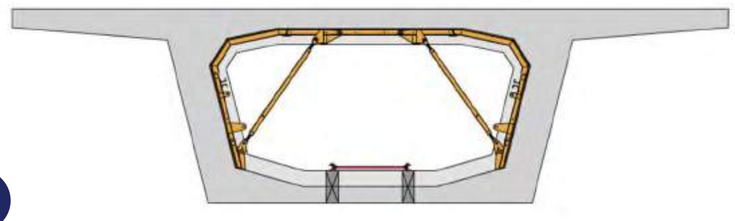

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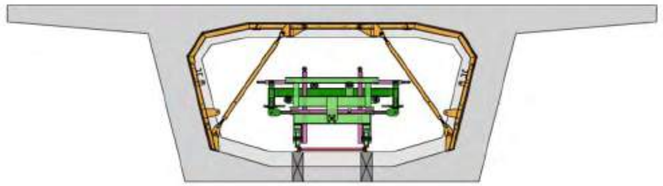

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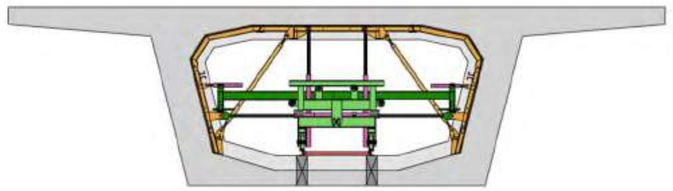

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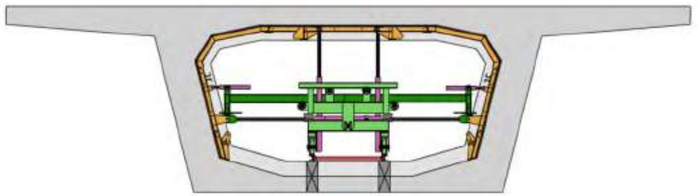

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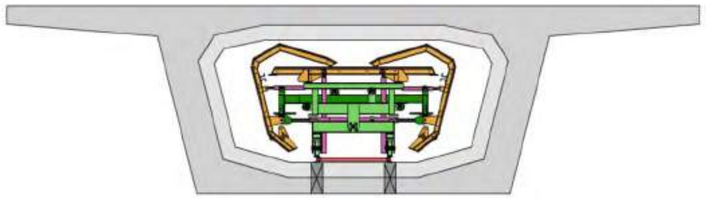
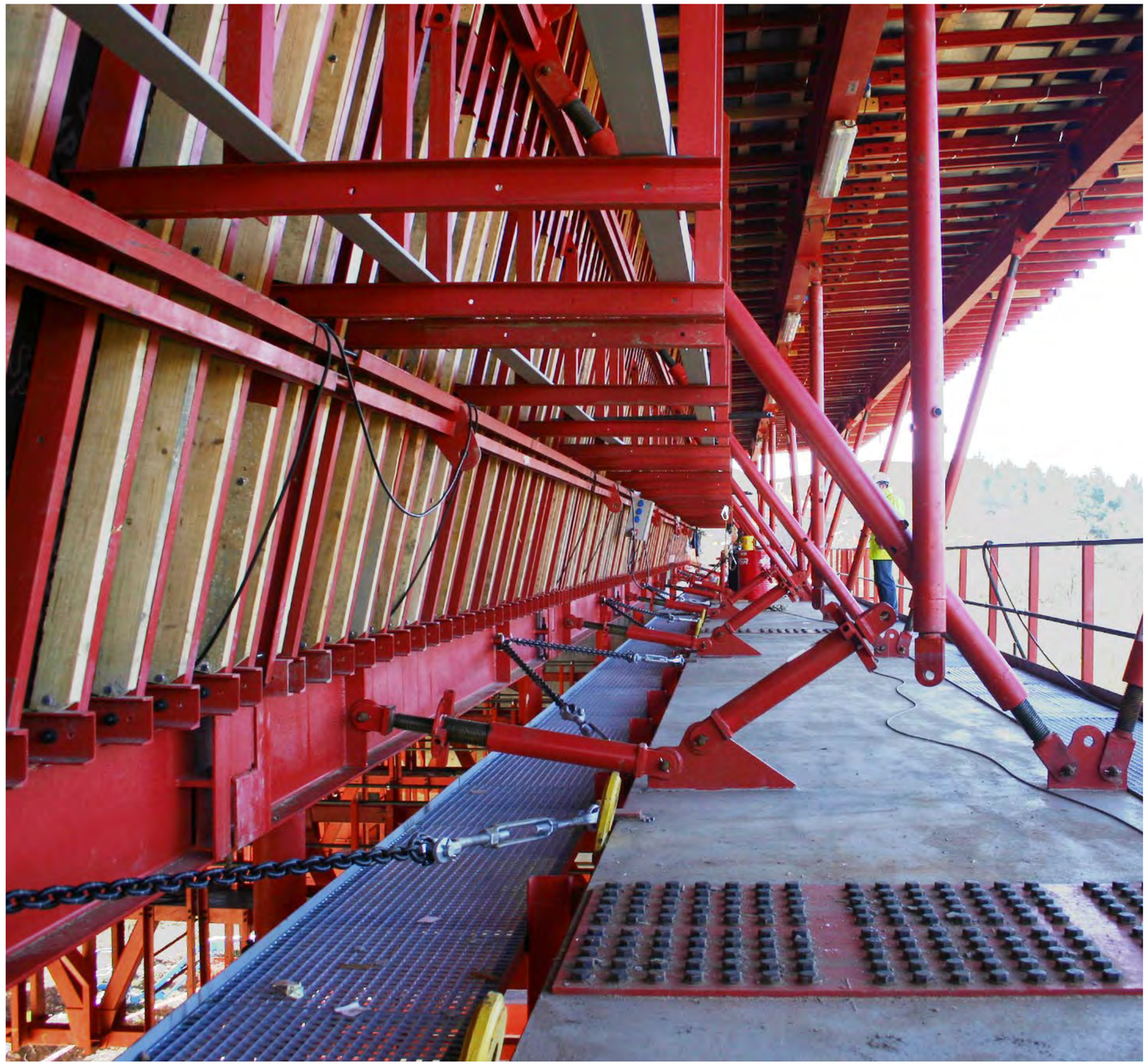


6

External fromwork and Cambering adjustment system

The panels in the external bottom formwork are made from a steel structure including U-profiles spaced in accordance with the capacity of the 21 mm plywood. Normally, the U-profiles are perforated to allow a wooden slat to be assembled next to them and thus facilitate the attachment of the plywood.

A set of adjustable screw jacks connecting the formwork to the transverse beams forms the cambering adjustment system, allowing the formwork to be adjusted to the deck transverse slope and compensating for the MSS deformations.



The web and wing external formwork is connected to the bottom formwork by bolts; it is also supported by adjustable struts that help keep the formwork steady and carry out the necessary adjustments.

The external formwork is connected to the internal formwork by threaded rods, keeping this stable while the deck is being concreted.

Internal formwork in the closed position

Internal formwork in the open position

Internal formwork in the open position

Internal formwork TT section deck

The MSS internal formwork for TT-section decks is a foldable formwork connected to the bottom formwork by bolts, allowing it to be transported from one span to the next along with the MSS.

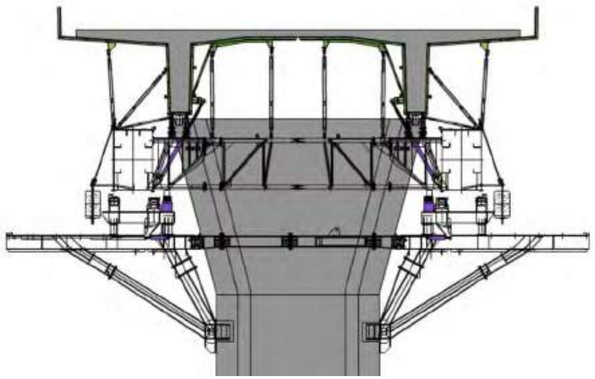
In order to fold the underslung MSS internal formwork, the transverse beams are also folded, making it possible for the entire assembly to pass through the columns.

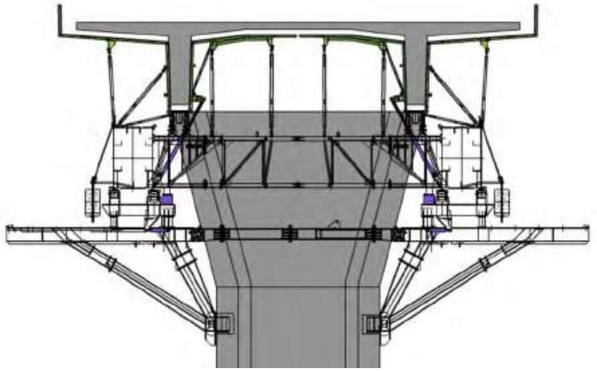
A similar internal formwork solution is used at the overhead MSS.

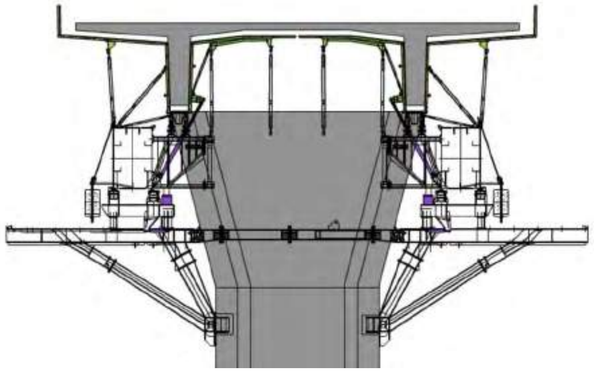
Internal formwork folding kinematics:

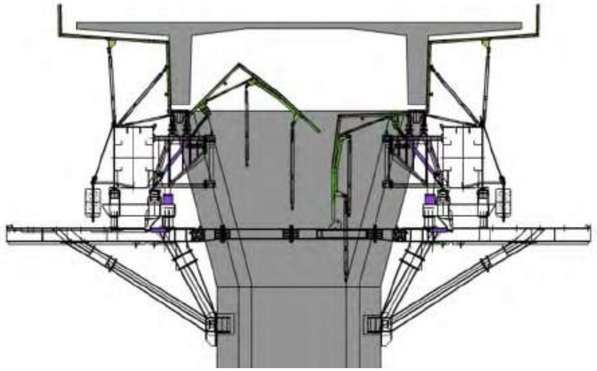
1. Formwork in the casting position
2. Lower the MSS using the four main jacks
3. Folding the transverse beams
4. Folding all the internal formwork at once or panel by panel using the hydraulic system
5. Opening the two halves of the MSS up to the end of the supporting brackets to allow for longitudinal launching without colliding with the columns

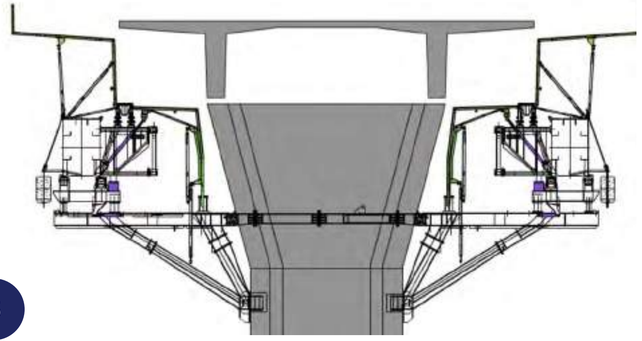
The internal formwork is closed by reversing the opening sequence.











5 Rebar transport and assembling

Rebar transport and assembling

The use of electric winches on overhead MSS makes it possible to transport pre-assembled rebar cages, reducing crane usage time.

The current pre-assembled rebar cage transport solution for underslung MSS normally uses cranes.

Overhead MSS

Underslung MSS

Rebar transport devices

Strukturas offers solutions for pre-assembled rebar transport from simple panels to the transport of the rebar cage full span.

A tailor-made solution can be designed for each project.

Raising the pre-assembled rebar cage from the ground

Overhead MSS – transporting the rebar cage using winches

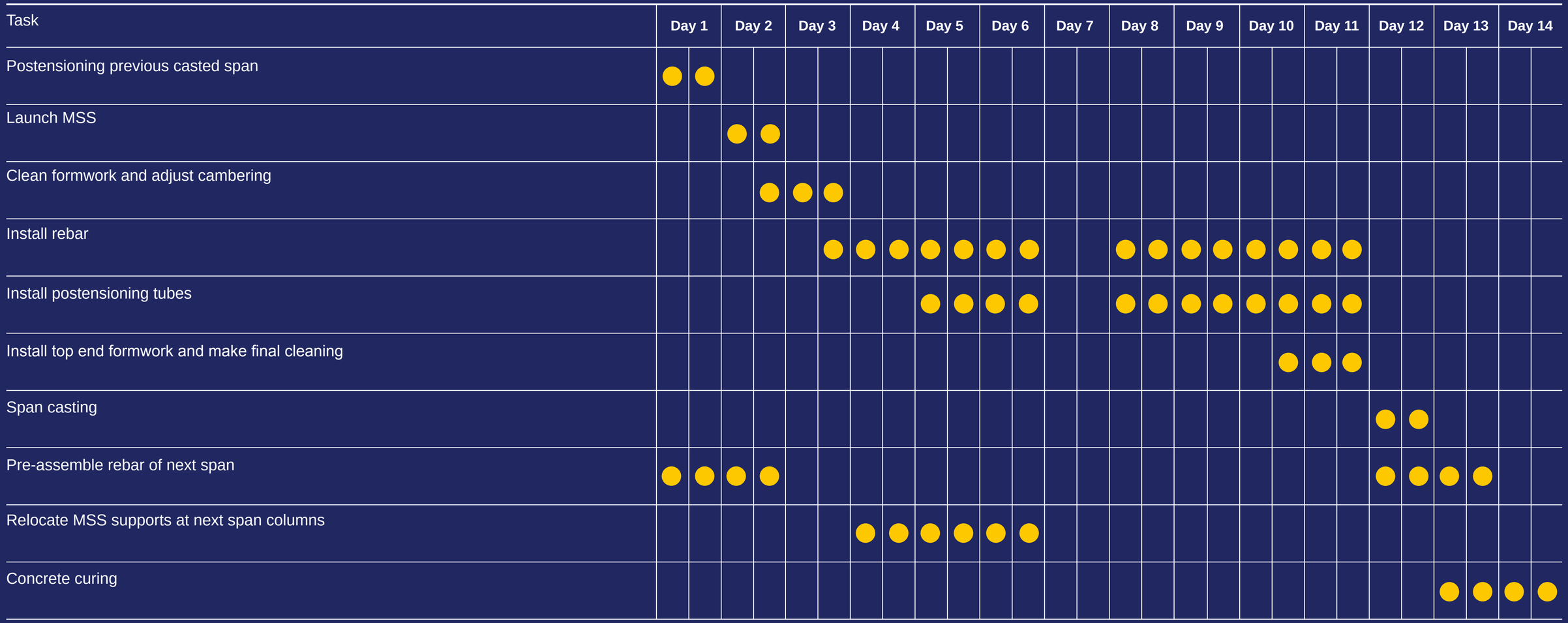
Underslung MSS – transporting the rebar panels using a transport trolley

Underslung MSS – transporting the full span rebar cage

6 Typical cycle

Typical cycle

The formwork solutions specifically developed by Strukturas for its MSS make it possible to optimise the relocation of MSS to the next span, leading to the execution of optimal cycles. Currently, the cycle duration varies between one and two weeks, depending on the complexity and size of the deck.



7 Project gallery

MSS launching– Salamanca, Spain

Underslung MSS used at bridge deck demolition– Werntal, Germany

Underslung MSS – Füllbachtal, Germany

Overhead MSS – Wisla River, Poland

MSS assembling at first span – Randselva, Norway

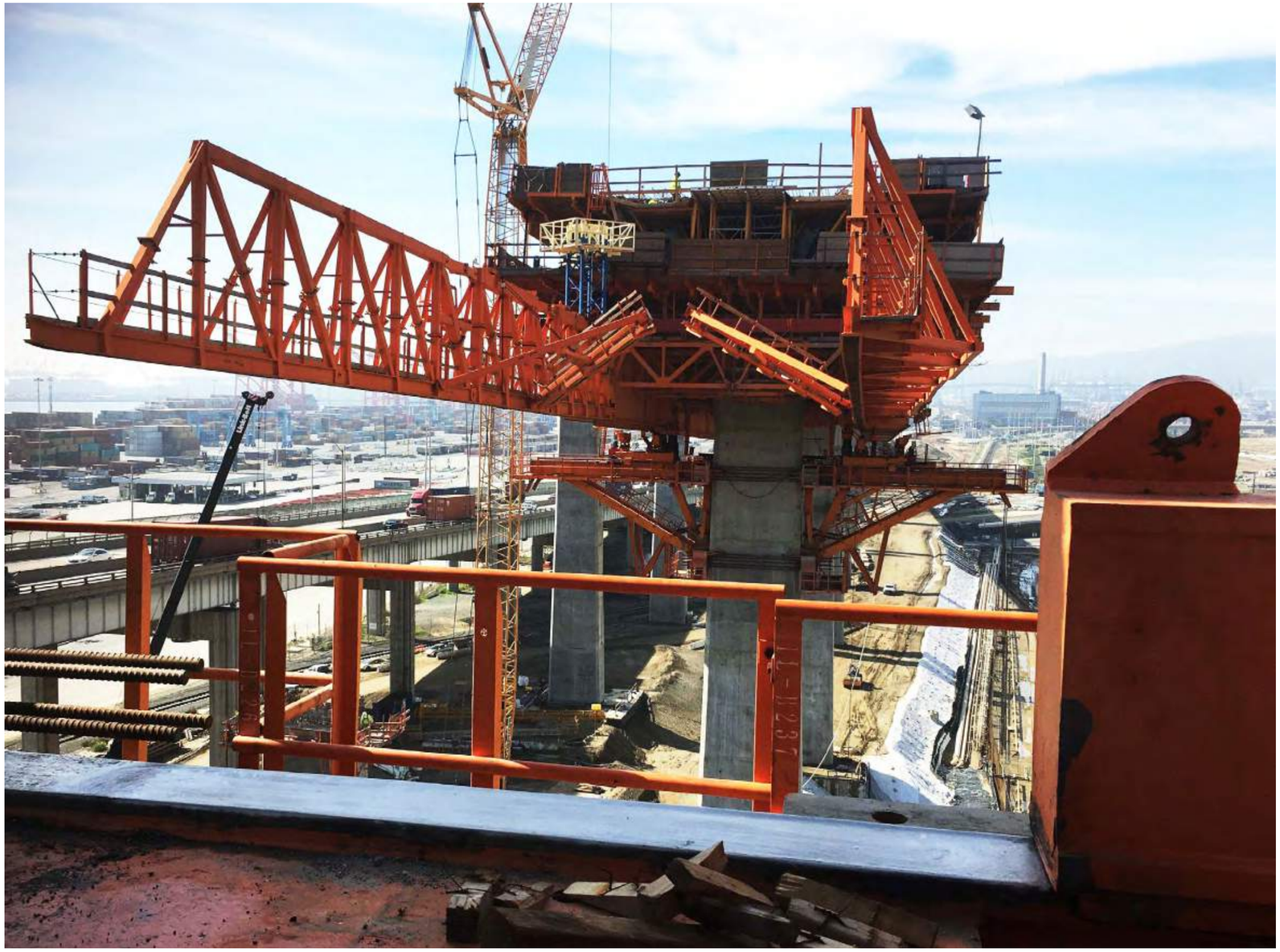
Temporary support close to abutment – Randselva, Norway

MSS supporting bracket assembling – Randselva, Norway

MSS dismantling – Randselva, Norwazy

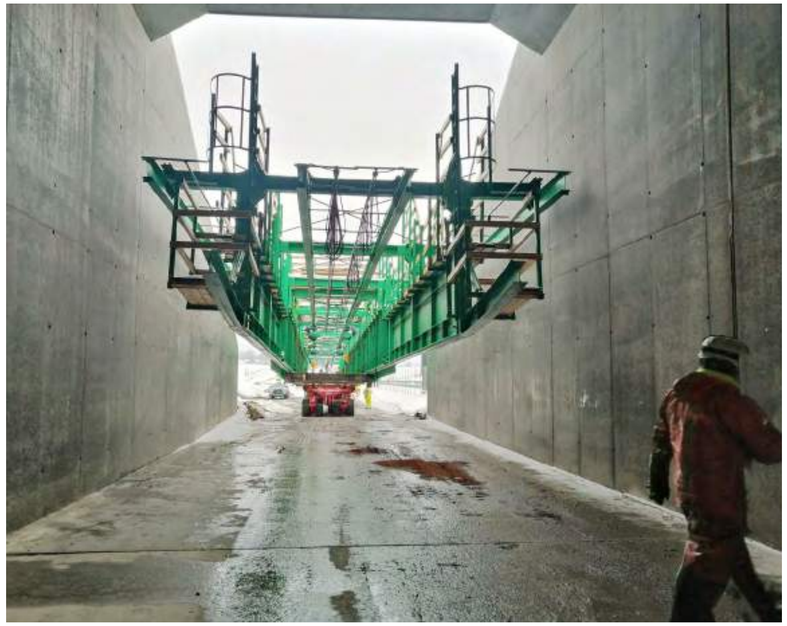
Underslung MSS with steel formwork and launching wagons with wheels – Industrial Ring Road, Thailand

Underslung MSS– Marmara, Turkey

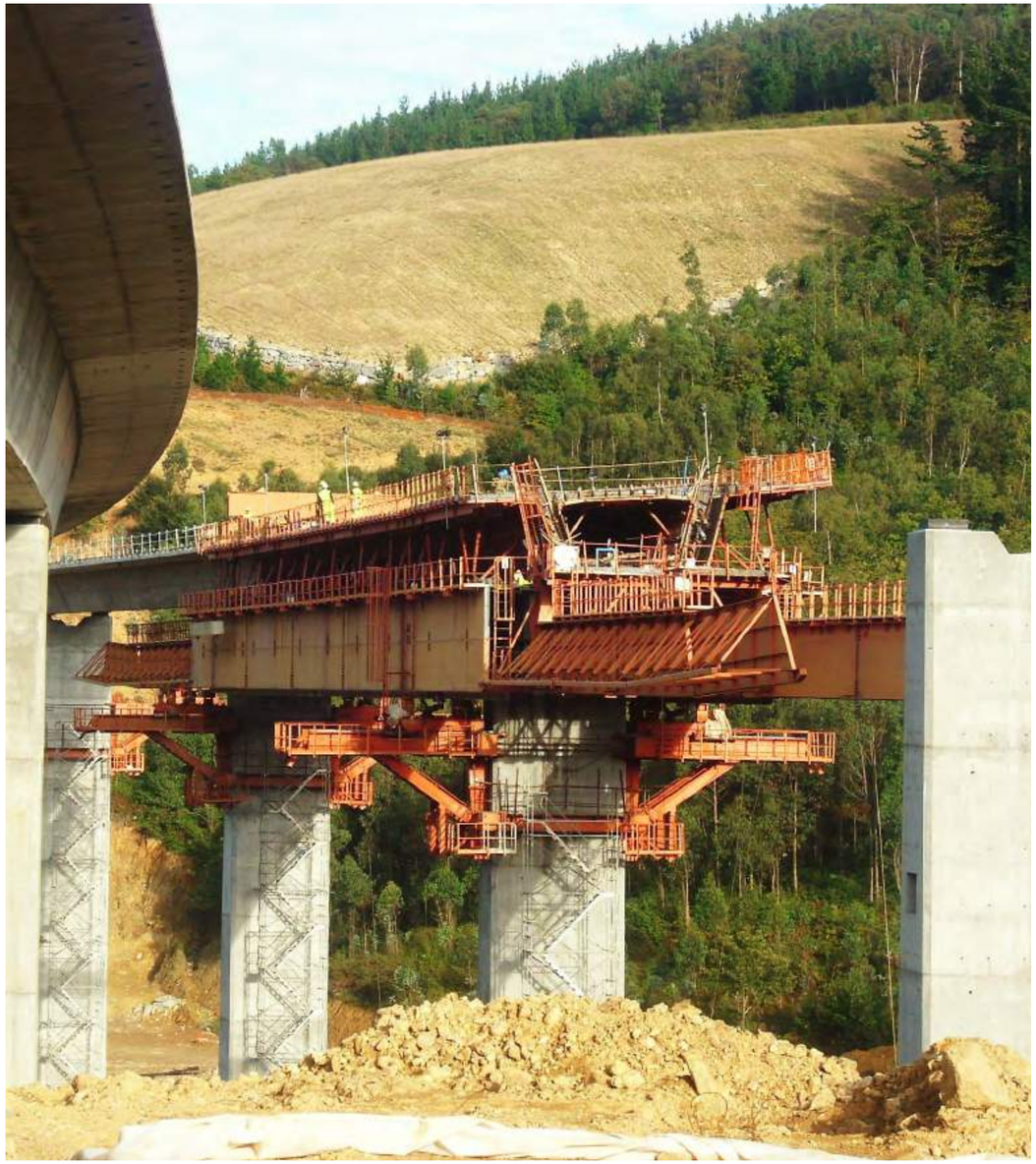


Underslung MSS – Long Beach, USA

Overhead MSS front support – Bystrica, Slovakia



Overhead MSS relocation – Eidsvoll, Norway



Underslung MSS – Cabirtas, Spain

Underslung MSS – Cabirtas, Spain

Underslung MSS – Muge, Portugal

Underslung MSS – Muge, Portugal

8 Safety and quality

Safety and quality

Our more than 30 years of experience in designing and supplying bridge-building equipment are leveraged by norms to uphold the high quality, simplicity and user safety of the resulting solutions.

A proper set of work platforms and ladders provides operators with safe access in carrying out all everyday tasks during span construction cycle.

The MSS steel structure is produced in CE-certified steel workshops. Special components such as hydraulic systems, threaded bars and express rollers are manufactured by the world’s best suppliers.

8 Services

Our services includes

01 Quotes during tender stage

02 Design, fabrication, delivery and technical assistance

03 Redesign of existing equipment

04 Assembly, operation and dismantling

Equipment assembling, operation and dismantling

A professional team at your service.

Strukturas has teams specialising in planning, assembly, operation and dismantling of its MSS, allowing it to offer its clients turnkey solutions.

By using our teams we are able to reduce costs for the client, given that this minimises the use of auxiliary support equipment, such as cranes, forklifts, platforms, trucks, support towers, etc.

STRUKTURAS
WE MAKE IT SIMPLE !

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