UNDERSLUNG MOVABLE SCAFFOLDING SYSTEM FOR THE NECKAR BRIDGE ON A6 MOTORWAY, GERMANY

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Figure 1: Aerial view of the construction site

INTRODUCTION

This article showcases one of BERD's reference project where a MSS Movable Scaffolding System was used for the construction of the remarkable A6 Neckar Bridge. It is located on the A6 motorway in Heilbronn, Germany and has two parallel decks with a typical TT cross section. Each 21m wide deck has 22 spans, with a typical span of 38 m, resulting in a total building length of 1644 m.

For the construction of these twin viaducts, we redesigned and refurbished a self-launched gantry M38-I with Organic Prestressing System (OPS). The equipment was prepared for industrialised cycles and to comply with the bridge's design specifications. We also implemented protective measures to ensure safe operation.

M38-I MOVABLE SCAFFOLDING SYSTEM (MSS)

The M38-I is an underslung self-launched Movable Scaffolding System, conceived for span-by-span construction of cast-in-situ concrete bridges with decks with a span length of up to 38 m. Its moving part has a total length of 93 m and a weight of about 450 tonnes (including all metallic structure, formwork, hydraulic equipment and other components).

The main M38-I load carrying structure comprises three steel truss girders (two lateral and one central in the middle). Each girder is equipped with a set of prestressing cables which are during the concrete pouring stage actively controlled by an Organic Prestressing System (OPS).

Figure 2: Underslung movable scaffolding system M38-I

ORGANIC PRESTRESSING SYSTEM (OPS)

The OPS, worldwide patented and used exclusively by BERD, is a deflection control system that helps ensure lighter, safer and more functional operation.

It also includes several safety systems, such as redundant components, monitoring systems and alarm warning.

The OPS is an adaptive prestressing system in which the forces applied are automatically adjusted to the acting load, reducing strains and minimising stresses to compensate for the deflection.

During the launching stage, the cables are not active, and the structure behaves as a simple truss structure.

Main Girders

The Main Girders are the most important structural element of the MSS. They support the transverse structures that carry the load from the formwork.

During the concrete pouring stage, in which maximum vertical loading occurs, the MSS is supported in 2 different sections: in the front tower and in the rear deck frame.

Figure 3: The deck construction

The front support section is nearly the same for all the spans (it varies slightly due to the plan curvature radius).

Each of the Main Girders is composed of the front nose, the main body (where the transverse structures are assembled) and the rear nose.

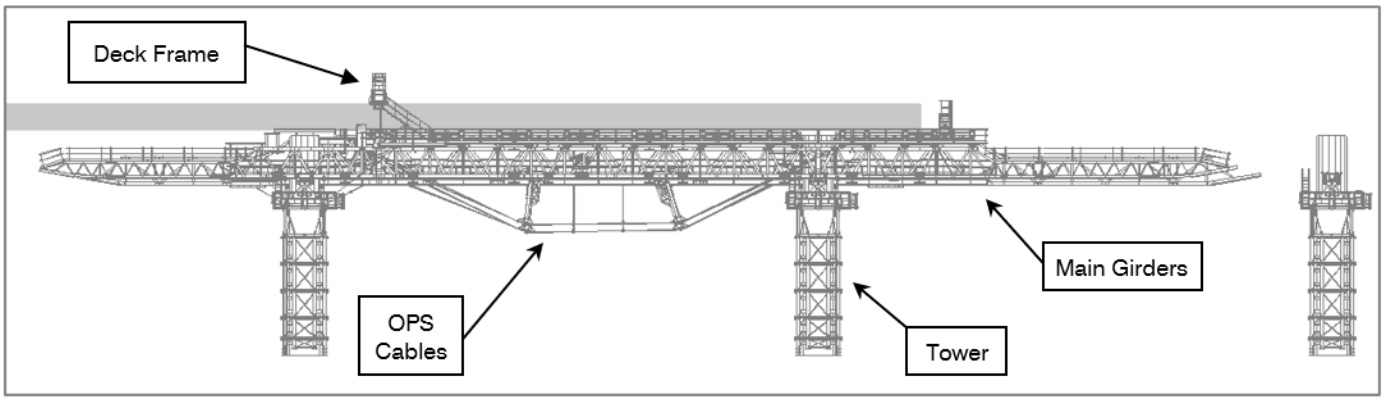
Transverse Structures

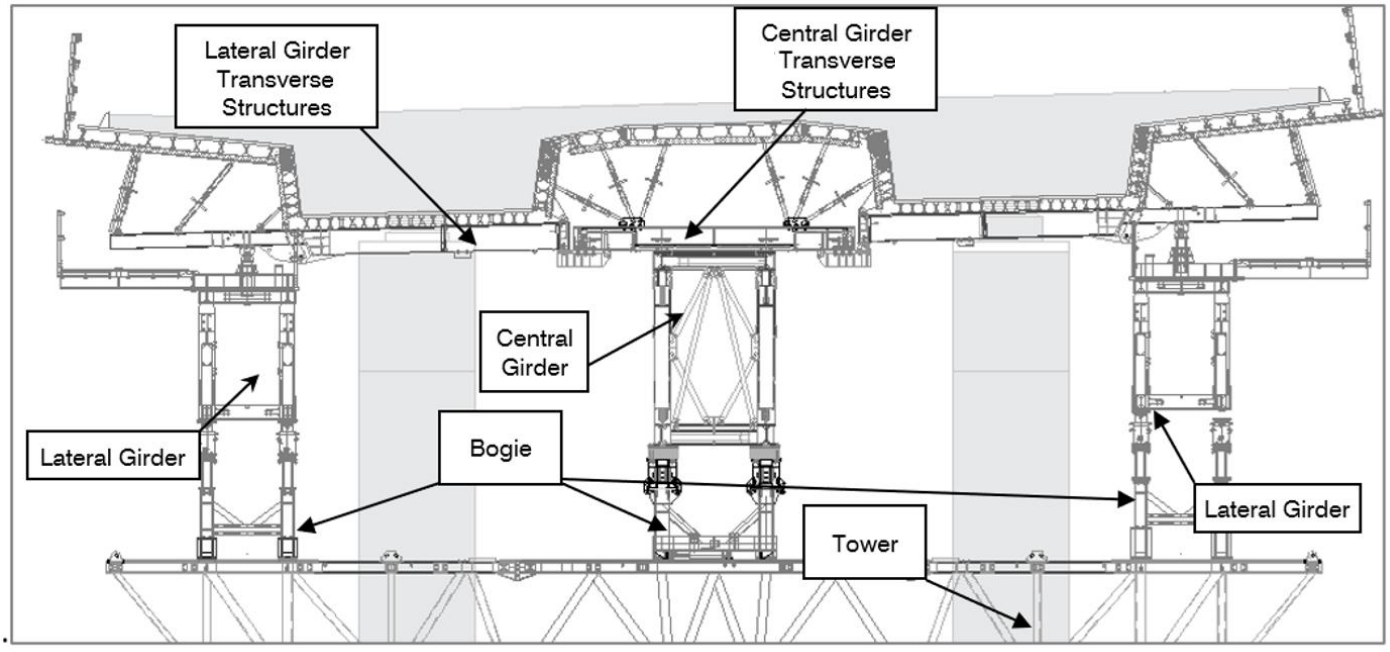
The transverse structures support all the MSS formwork. They are located on the central and lateral girders. They are composed of eight interlinked panels that give support to the formwork.

The ones on the lateral girders are supplied with a rotation mechanism (with hydraulic cylinders) in order to allow MSS launching with minor transverse movements of the lateral girders.

They are equipped with spindles on their interface with the lateral girders which allows the transverse structures to be levelled in altimetry to promote the transverse slope of the bridge deck.

During the concreting stage, they are supported on the three girders. During the launching stage, they are separated and each girder transports its own transverse structure.





Figures 4 and 5: Description of the M38-I

Figure 6: The MSS operating under the deck

Bogies

Bogies are the components that form the interface between the main girders and the towers. They give support during both the launching and concreting stages.

During the launching stage, they support the weight of the main girders using the roller devices. These rollers have a low friction factor to promote the longitudinal movement on each main girder.

At the concreting stage, the front support of the girders is made on the bogies. There are 6 sets of bogies for the lateral girders and 3 for the central girder.

Towers

The towers give support to the whole MSS during the launching and concreting stages.

They are equipped with transverse sliding rails that allow the main girders to be adjusted transversely during concreting and launching using hydraulic cylinders.

The top level of the towers is a full working platform equipped with safety handrails.

The MSS disposes of 3 sets of towers. Special anchorages on top of the pile cap need to be previously installed before each assembly.

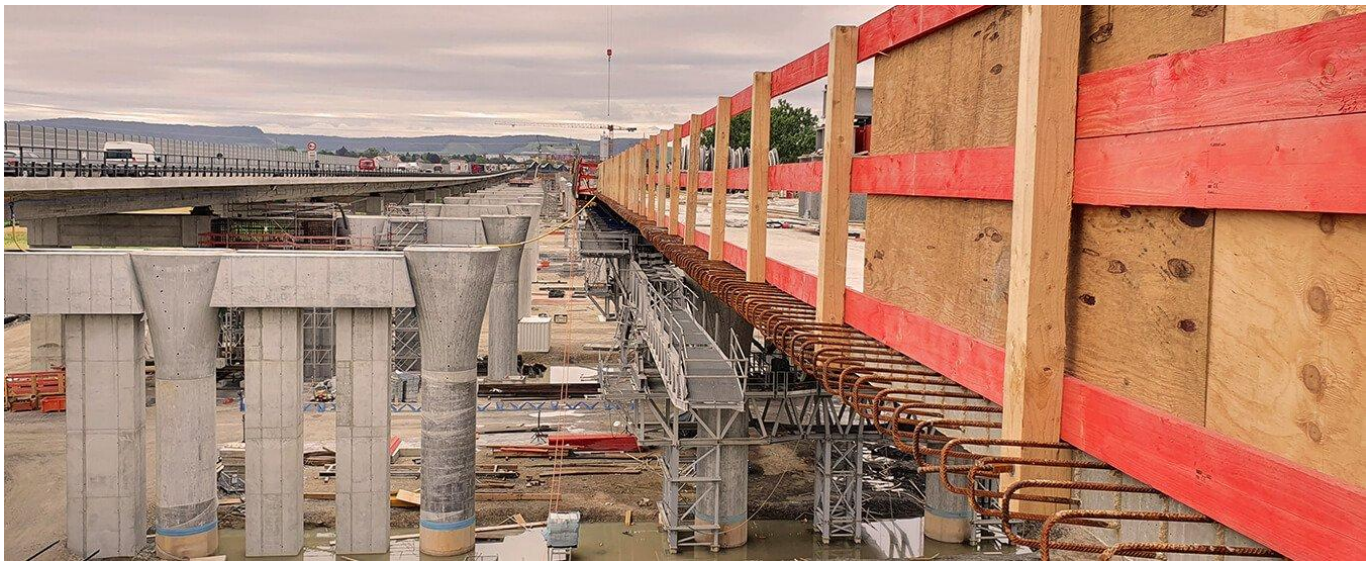


Figure 7: View of the MSS from the side of the bridge

For horizontal load transmission, special spindles on the top level of the tower need to be leaned against the pier.

All the bracing systems of the MSS are assembled directly to the towers.

Bracing System

The bracing system guarantees the stabilisation of the main girders for horizontal loads (longitudinal and transverse ones). It is a blocking measure that shall be used when the MSS is in operation.

These elements are also especially important in the case of high-speed winds or storms.

Formwork

The formwork is generally composed of plywood panels, timber and steel beams, spindles and other accessories. For this particular project wood boards were used as a surface and visual finishing requirement of the client.

The formwork is placed directly on top of the transverse structures. For the cross-beam concreting, we developed a specific solution.

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MAIN CHALLENGES

For the construction of the bridge, we had to face several challenges:

- For the assembly of the MSS we had a limited space;
- The MSS was disassembled under the built deck;
- The deck was very heavy;
- The bridge crosses a crucial road open to traffic; the operation had to be absolutely safe;
- The work cycle was demanding;
- The first span was built over the existing road, which meant a limited time for the operations during overnight road closure.

Apart from that, the project required a turnkey solution and operation, and also a technical solution that ensures a high construction quality and control of deck deformations.

CONCLUSION

The underslung movable scaffolding system we used for the construction of the A6 Neckar Bridge ensured fast construction with cycles of nine days. It also enabled a highly industrialised construction process and ensured high construction quality and deformation control.

During all the construction, high safety levels were observed, taking into account that the first spans were built over a road open to traffic.

Figure 8: The MSS ensured fast construction within cycles of nine days