

INCREMENTAL LAUNCHING OF BRIDGE OVER THE SAVA RIVER AT SREMSKA RACA



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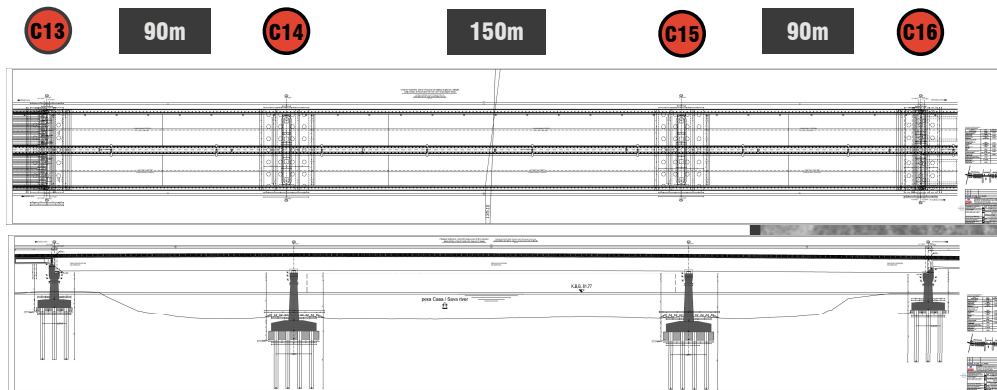


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Bridge Design

Main Steel Bridge is a continuous girder
Total length: $L=90.0+150.0+90.0=330\text{m}$
Cross Section: 2 twin steel box beams
Width: $B=14.75+1.50+14.75=31.0\text{m}$
Weight: 5500t

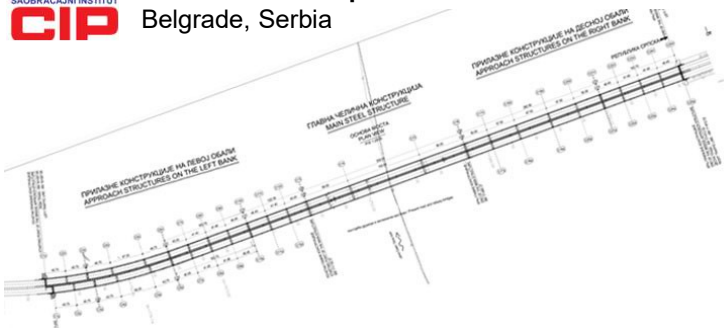
Single-cell box structure of the trapezoidal cross-section
Constant depth of 5000mm
Inclined webs are at a distance of 8377mm (level of the upper flange) and at 6707mm (level of the bottom flange).



Designer



Institute of Transport CIP
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Left Approach Structure 541m

MAIN STEEL STRUCTURE 330m

Right Approach Structure 450m

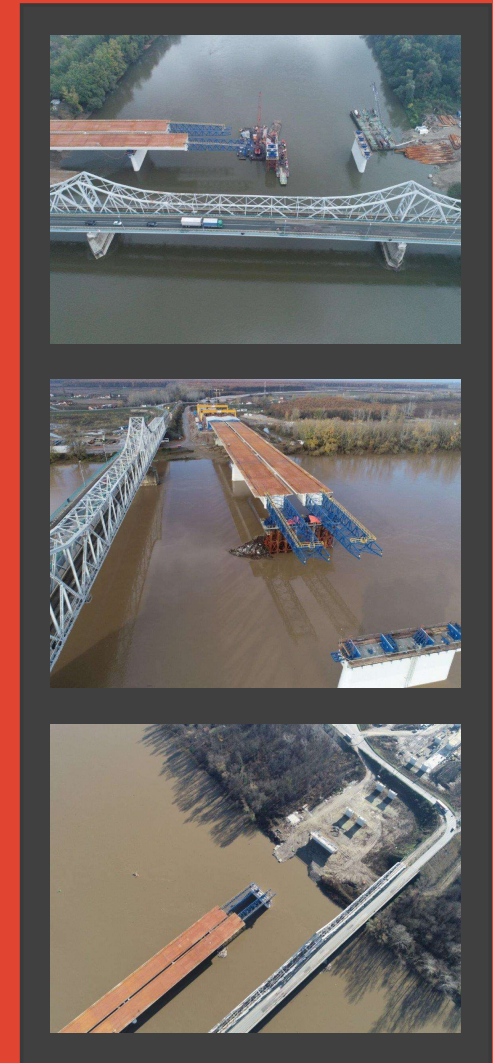
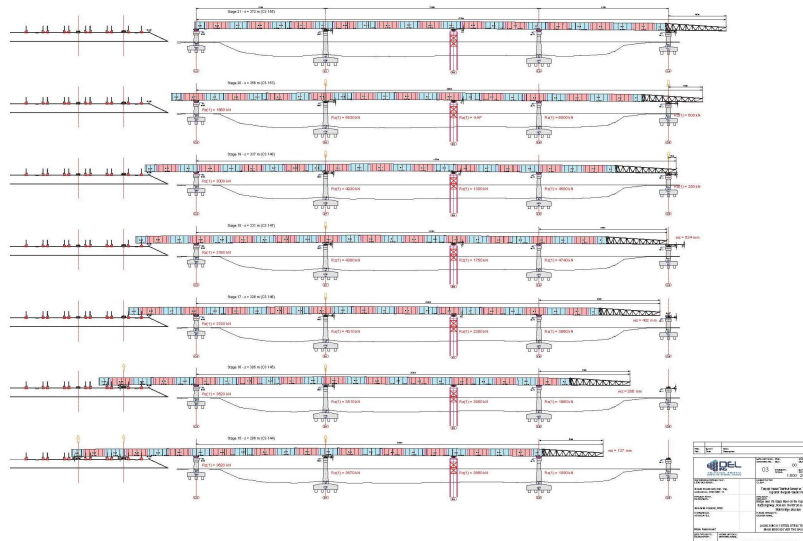
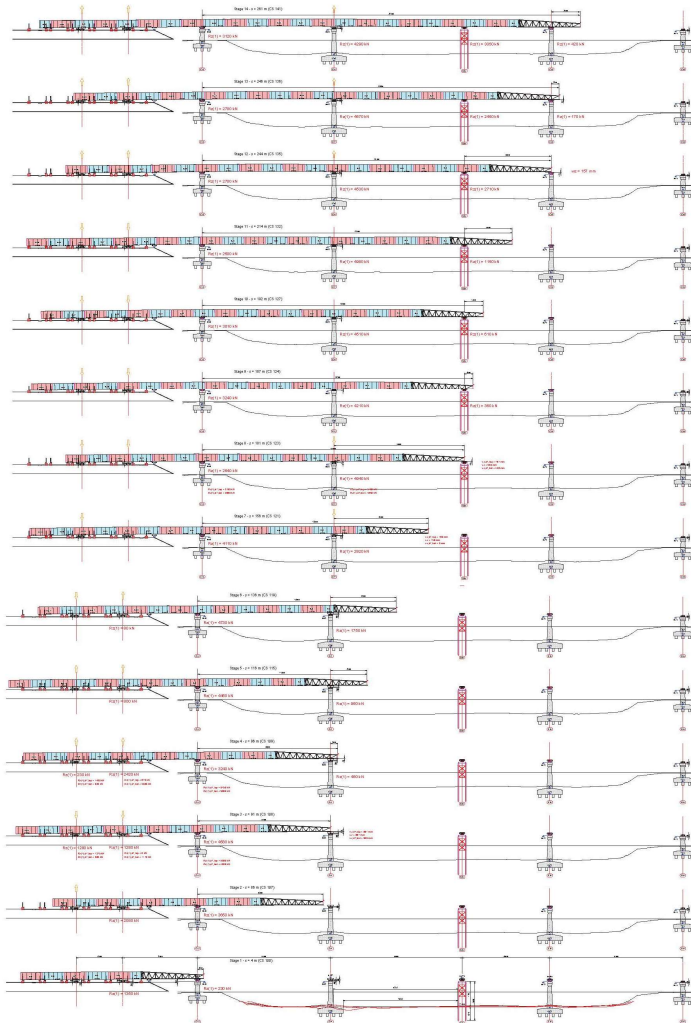
TOTAL Bridge Length 1321m



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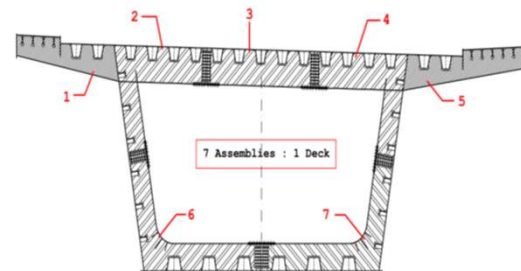
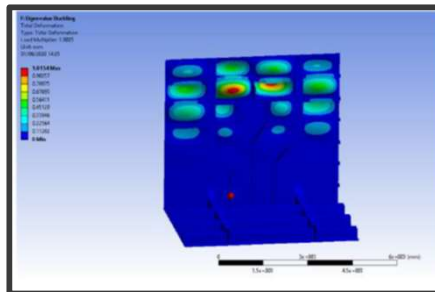
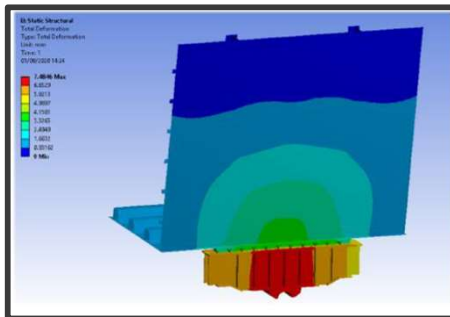
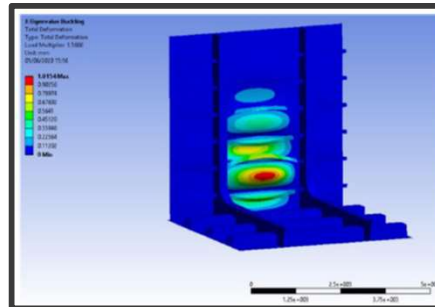
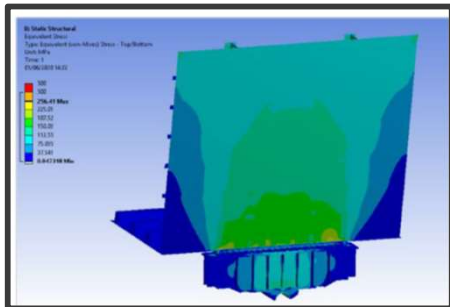
Incremental Launching Method - ILM

- Incremental launching was carried out in 13 stages for both steel bridge structures in the average period of 2 weeks.
- Applying an incremental launching method (ILM) with temporary steel pier in the river and hydraulic systems, the assembled successive sections of 2x15m long steel segments were launched in their final position.
- 21 construction stages were analyzed in the design to determine the most loaded cases of bridge sections.
- To solve the problem of the bridge geometry of vertical curvature and pre-chamber, vertically adjustable supports were provided temporary supports T1-1 and TS-2 and permanent pier C14.



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Launching Design



Incremental Launching Design



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Bridge steel structure has been analysed for all launching phases for ULS load combination using permanent and transient situations. Highest **support reactions** with **different web thickness** have been taken into account to calculate **reduced resistance of the webs** of the box cross section according to **EN 1993-1-5**.

Following loads have been used in calculation:

- Structure self-weight
- Construction loads acc. EN 1991-1-6 Table 4.1
- Snow loads
- Uneven settlement
- Wind Actions acc. EN 1991-1-4:2005+A1:2010
- Thermal Actions acc. EN 1995-1-5
- Seismic Action

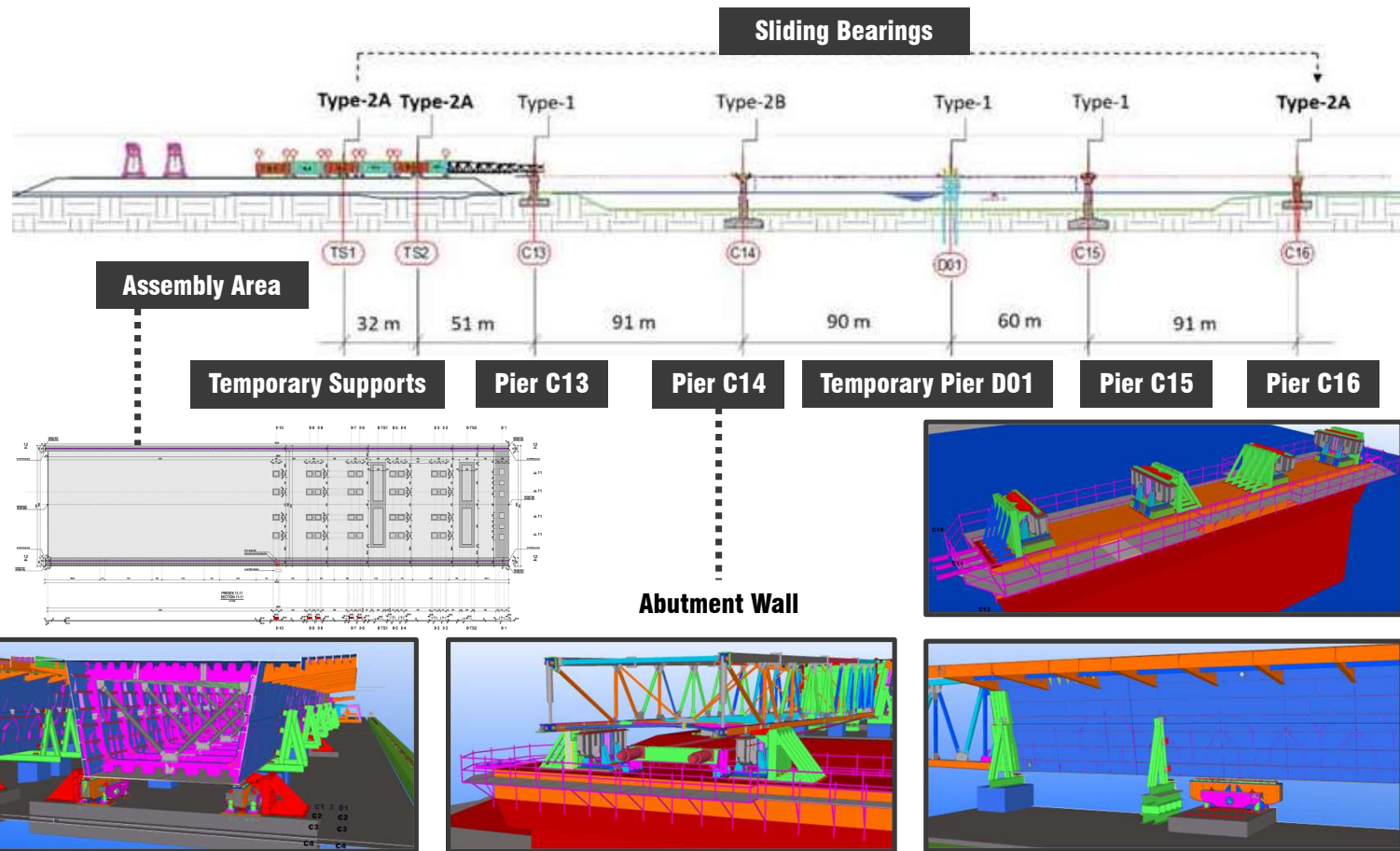
As a result, additional vertical stiffeners were added on the webs of critical blocks

Maximum, allowable temperature difference between top and bottom plates at launching is $\Delta t = 20^\circ\text{C}$

Maximum cantilever of bridge structure with nose approx. 90m

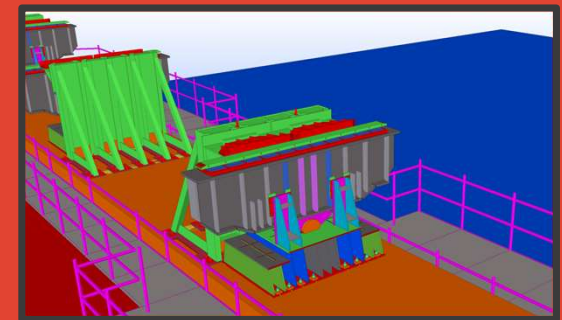
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Temporary Structures - General



The temporary structures were used for launching:

- Temporary supports on assembly area
- Temporary pier D01
- Nose truss
- Fixed sliding bearings
- Vertically adjustable sliding bearings
- Guiding devices
- Abutment wall – pulling device
- Breaking system
- Pulling lugs
- Red box structure
- Hydraulic jacks
- Steel strands



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Assembly and Launching Yard

Assembly yard with gantry cranes and temporary supports were constructed on temporary embankment.

Sliding Bearings and Concrete Supports

Welding Facility

Temporary Pier

Painting Facility

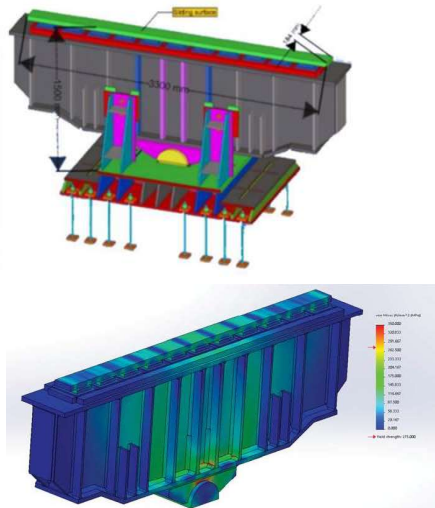
Gantries 40+40 tons



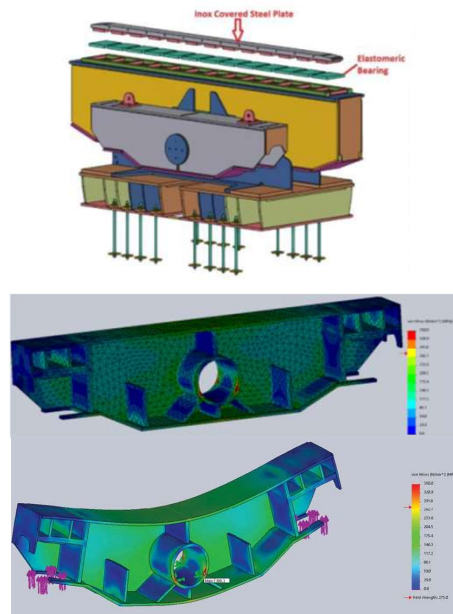
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Sliding Bearings and Guiding Devices

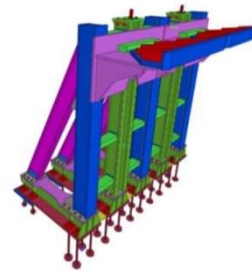
Fixed Bearings Type



Bearings Adjustable in Vertical Direction



Guiding Devices



Sliding Bearings with inox plates on the top and elastomeric pads and guiding devices were installed on:

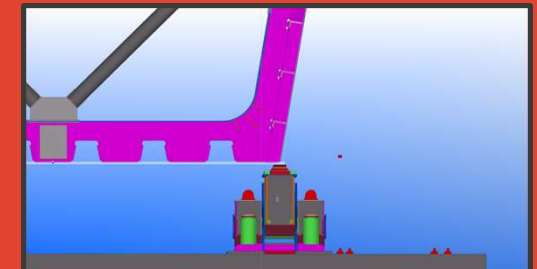
- supports in axis TS1&TS2
- top of piers S13-S14-S15-S16
- temporary pier D01

Two types of (launching) Sliding Bearings:

1. Fixed Bearings: on C14, C15, temporary pier D01 and C16
2. Bearings Adjustable in Vertical Direction: placed over the precast yards in axis TS1 & TS2

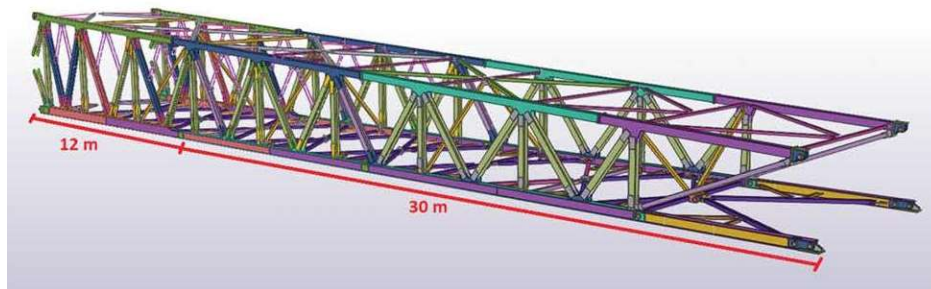
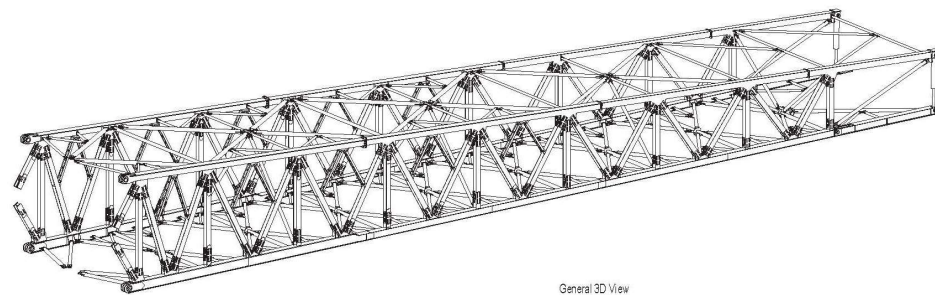
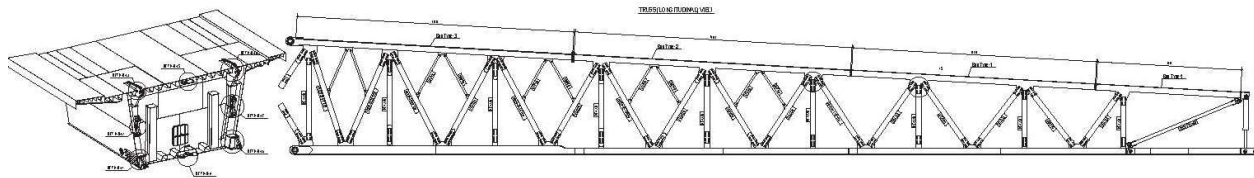
Sliding Contact Pads:

- Elastomeric bearing with PTFE (Teflon) plate on the lower side



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Launching Nose



Launching nose steel structure was a temporary structure, with 42m length and 60 tons weight.

It was assembled in front of the first segment, to be able to reach forthcoming pier before bridge structure.

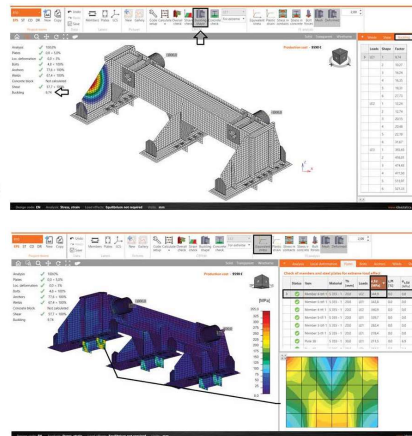
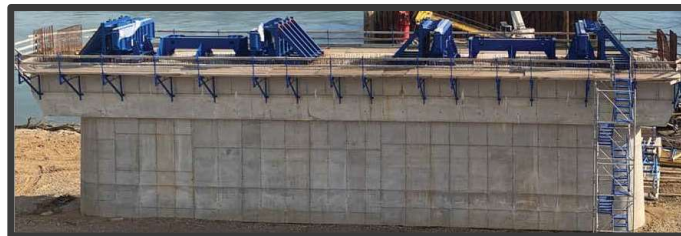
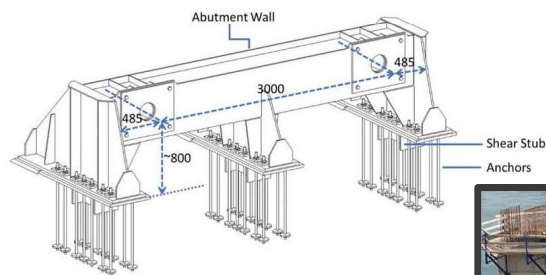
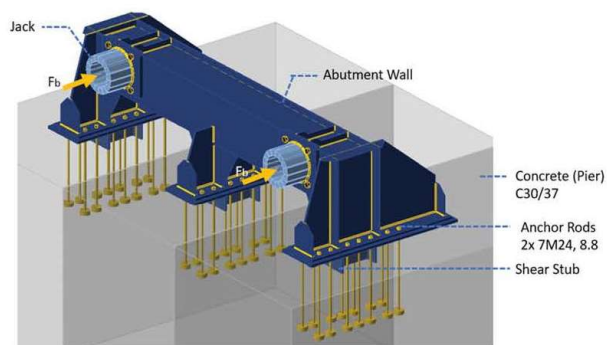
The vertically acting cylinders were placed in front of the nose, which pushed the nose upwards when reaching the next pier.



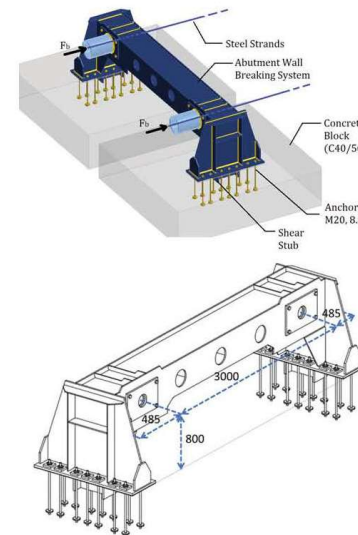
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Pulling Equipment

Abutment Wall



Breaking System



The launching system contained pulling steel strands that launch (pull) the main bridge structure. There was one abutment wall for each bridge structure (left & right) on the top of the C13 pier.

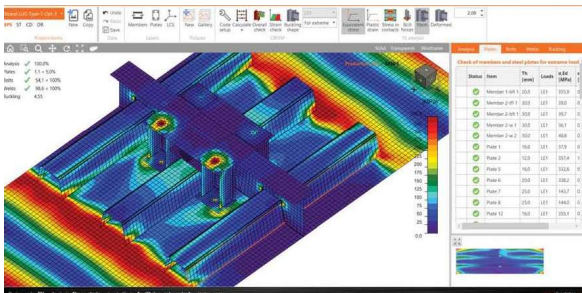
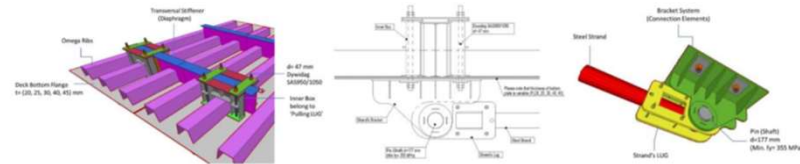
The **moving of assembled bridge structures** in incremental process was operated by **2 hydraulic strand jacks capacity of 200 tons**.

An additional **braking system** consisting of **2 hydraulic strand jacks capacity of 70 tons** was used for breaking in the event of the structures stopping during the launching.

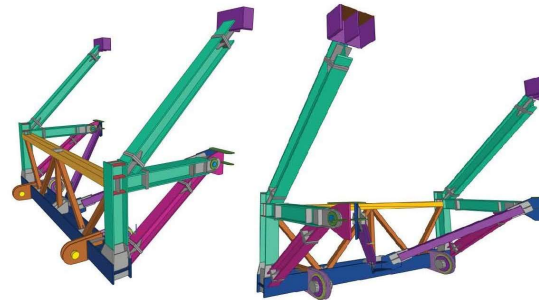


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Strand Lugs



Red Box



Strand Lugs

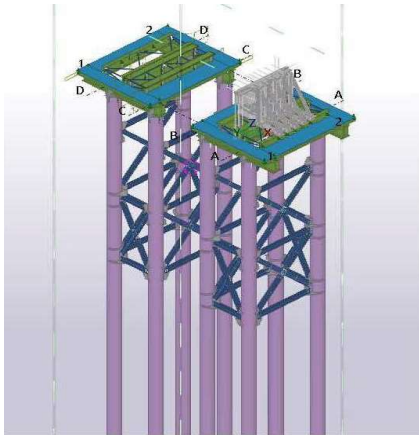
The **pulling lug** is a temporary structure that was used repeatedly to pull and slide the bridge decks over the launching bearings. The **braking lug** was used as braking device during launching and after launching.

Red Box

Red box temporary structure, having been installed to the end of the bridge deck was used for pulling the bridge structure over the sliding bearings in the last phases of launching.

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Temporary Pier D01



- The temporary piers were constructed for each bridge structure (left & right).
- Each temporary pier consisted of 2 groups 4 steel piles: Ø814x12 pipes S355JH

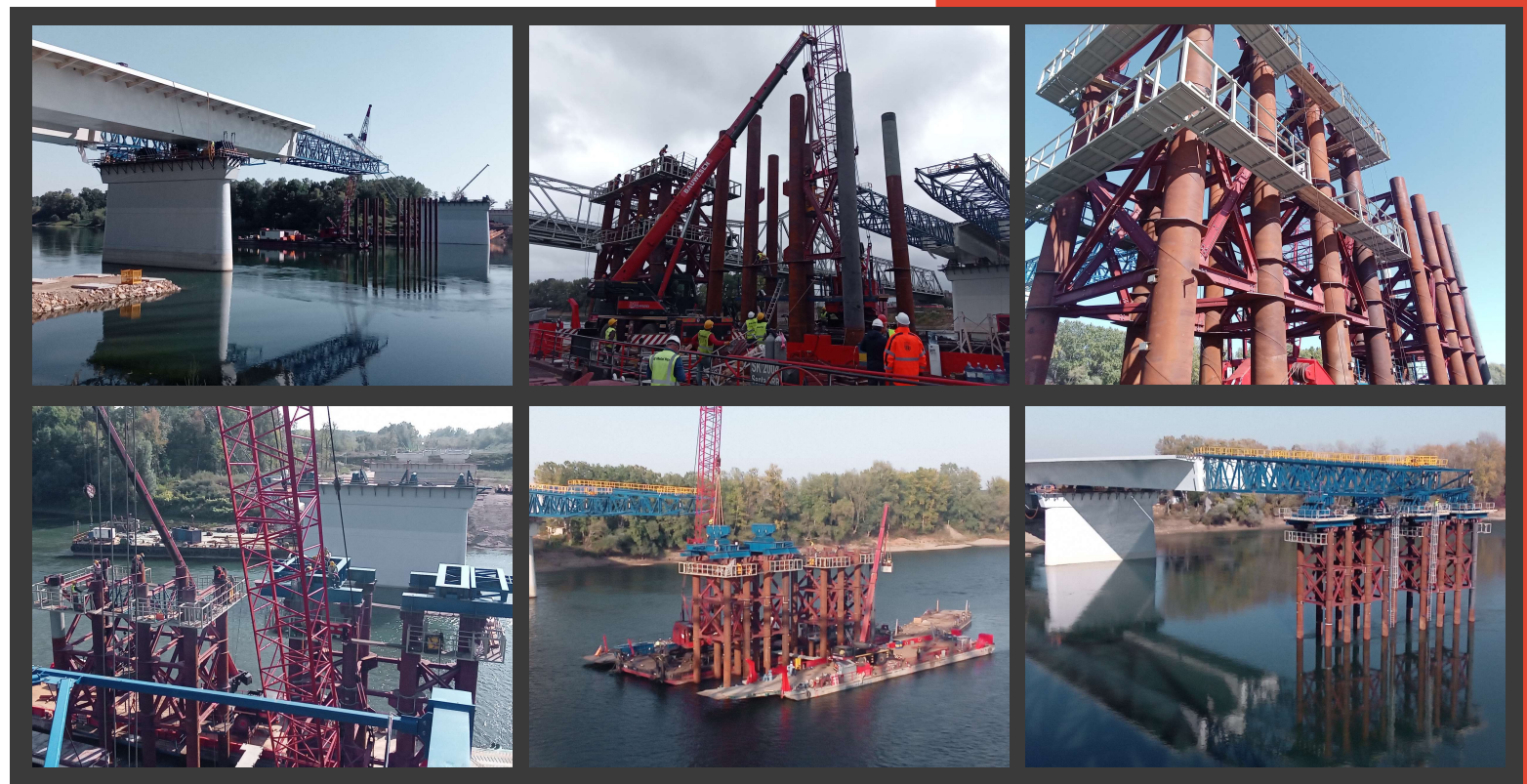
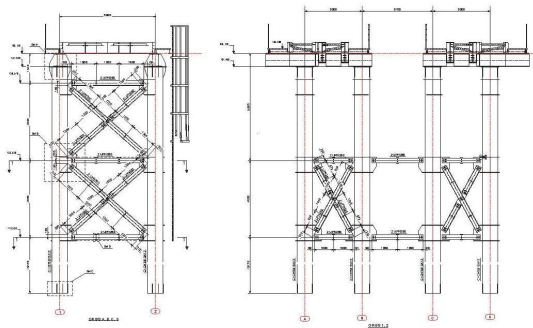
Distances between the piles
(center to center):

- 5.0m in longitudinal direction
- 6.0m in transversal direction

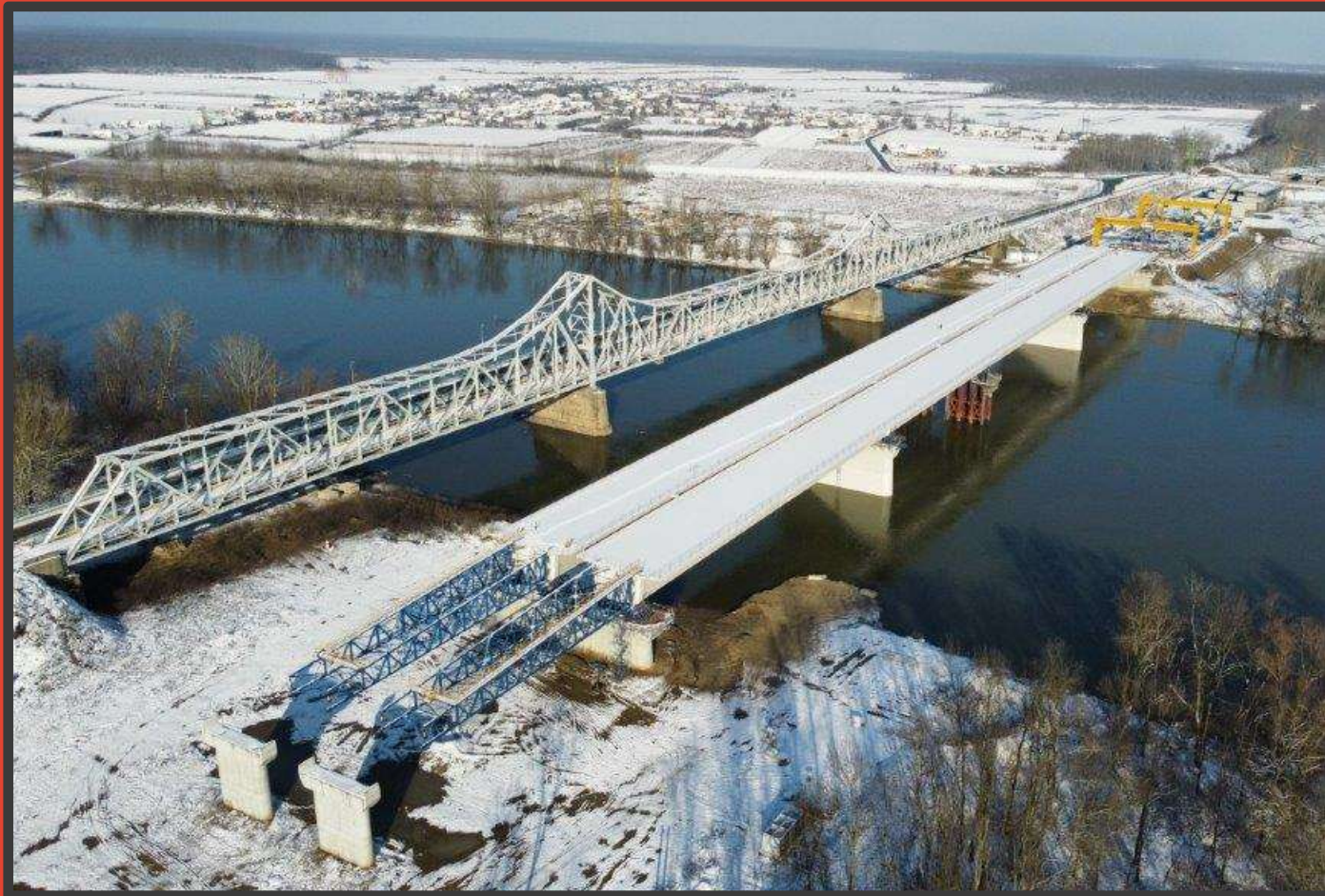
X bracings: vertical and horizontal

Top of the piles:

- Sliding bearings
- Guiding devices
- Working platform



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THANKS FOR YOUR ATTENTION