Transporte e instalación del puente nuevo Verbindingsbrug. Zeebgrugge – Bélgica.

Transport and installation of a new Verbindingsbrug Bridge. Zeebgrugge – Belgium.

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RESUMEN

Zeebrugge es uno de los puentes giratorios más grandes de Europa con una plataforma móvil de 130 m. El alcance de Sarens incluyó cuatro fases: gateo en el taller de fabricación de la plataforma móvil para instalar bajo ella su corona de giro, pesaje de la plataforma móvil, transporte de la plataforma móvil desde el taller hasta Zeebrugge, e instalación del puente. Para navegar 3 Kms a lo largo del estrecho Canal de Ringvaart, las barcazas fueron lastradas para pasar con 100 mm de holgura por debajo de los puentes. Después, las barcazas navegaron hasta Kluizendok y el puente fue transferido a una barcaza mayor con SPMT para navegar hasta la posición final. Por último, en 48 h de corte del Canal, se instaló el puente.

ABSTRACT

Zeebrugge is one of the largest rotating bridge in Europe with a mobile deck of 130 meters. Sarens' scope included four phases: jacking the mobile deck to install the carrousel crown below it at the fabrication workshop, weighing of the mobile deck at the same place, transport the mobile deck from the fabrication workshop to Zeebrugge, and bridge installation. To sail along the 3km-long narrow on the Ringvaart Canal, Sarens' Twin barges were ballasted to get 100mm clearance under the Canal bridges. Then the twin barges sailed to Kluizendok and the bridge was transferred to a bigger Sarens barge with SPMTs for sailing till final place. Finally during a 48h closure of the ship traffic the bridge was installed.

PALABRAS CLAVE: Construcción de estructuras, puente giratorio, equipos de transporte, barcazas.
KEYWORDS: Construction of structures, rotating bridge, SPMTs, barges.

1. Introduction

Sarens received the order in 2020 to transport and install on that time the largest rotating bridge in Europe for our client Victor Buyck Steel Construction, a well-know and trusted partner from many years ago.

With a total length of 400 m, the bridge has 5 fix concrete spans and on middle steel mobile one, allowing ships up to 55 m wide to pass through. This is tailored to the Pierre Vandamme Lock and the planned new sea lock.

The total cost of the project amounts to an invest of 35 million euros by the Zeebrugge port authority.

This new bridge over the Verbindingsdok connects the Verschaveweg and Koffieweg, with two traffic lines and a separated footpath and bicycle path with double direction, creates an additional North-South access road in the port for road traffic in the port: the trucks, the employees, but also 500 tons heavy mobile cranes and other convoys, from the 300 established port companies.

The middle steel bridge mobile deck has the following dimensions 130 m length 22 m width and 4,5m depth. The bridge consisting of heavy welded main girders, coupled with cross beams and an orthotropic road surface, was carefully assembled by Victor Buyck in a period of approximately one year.

The biggest challenge we faced was that our client had never built a bridge as large as this at their workshops in Ghent (at Eeklo and Wondelgem) which have a ro-ro quay in their yard. This meant to get the bridge in our Sarnes barges and then transporting it along a small and shallow canal with many low bridges in the way.

During the bridge construction in September 2021, Sarens had to assist in driving-in and placing the rotating crown under the mobile deck which is the high-tech propulsion drive used to open the mobile bridge part in its operational state. This carrousel has been designed to withstand more than 650.000 turnings during the next 100 years.

A few weeks later, the entire mobile deck and rotating were weighed.

In January 2022, the more impressive part of the project began: the mobile deck was transported and installed on its final position at Zeebrugge during a 12-hour complete closure of the canal and the required police escorts due to the big dimensions of the bridge.

2. Summary of Sarens' works

Sarens' scope included three phases:

- Jacking the mobile deck to install the carrousel crown below it at the fabrication workshop in Bumar (Ghent) where the bridge was completely assembled (see figure 4). To mount the carrousel, 4 sets of 2x450t jacking towers raised the 2.200 Tons mobile deck 2,5m to position the rotating using 10 Self Propelled Modular Trailers (SPMTs).
- Weighing of the mobile deck and carrousel in the workshops, using 8x500t cells and the corresponding jacks, to know the exact weight and center of gravity of the entire structure.

Figure 1: Sarens twin barges Karel-Victor transport 2.200 tons mobile deck from Bumas to Kluizendok.

- Transport of the mobile deck with its carrousel from Ghent to Zeebrugge (see figures 1, 2, 3, 6 and 7). Using Sarens' standard "North Sea" large barges was not possible as they are not able to reach the ro-ro client's yard at Ghent. This is the reason why we had to load the mobile deck first in our on special Sarens twin barges Karel & Victor (with dimensions 61,5x11,4x4,5 meters each) in order that the height of the mobile deck could pass underneath the bridges over the Ringvaart Canal. So 66 SPMTs supported in 2

transversal sections of the bridge drove the mobile deck on these twin barges during a 12-hour closure of the canal, as the 130m-long mobile deck covered the entire canal (see figure 6). This was a feat in itself as the barges strength and stability were calculated to the limit. Once the mobile deck and carrousel were complete onboard, they were secured and fastened to the barges using chains special designed bracings. To cover the 3km-long narrow and low height on the Ringvaart Canal, Karel & Victor were ballasted to a draft of 4.200 mm meaning a minimum of only 300 mm freeboard, to get no more than 150 mm clearance under the Canal bridges (see figure 3). Due to the fact that the mobile deck was wider and longer than the barges, the tug pushers were couple directly to the bridge instead of to the barge (see figures 1, 2 and 3). After sailing down the Ringvaart Canal under complete closure, the twin barges sailed to Ghent harbor and were moored again. At the Kluizendok in Ghent, 300ft Barge Louis (with dimensions 101,1x33x7,6 meters) was prepared to transfer the bridge deck from Karel & Victor to this larger barge (see figures from 7 to 15). Using the SPMTs always positioned in the same 2 transversal bridge sections, we moved the bridge from the Karel and Victor to the Louis barge. Then barge Louis was prepared for departure and, a few days later, travelled from Ghent to Zeebrugge via the North Sea. Karel and Victor also left empty for Zeebrugge so that each barge could carry half of the bridge (see figures from 8 to 15).

Figure 2: Mobile deck approaching to the lowest canal bridge that had to be crossed.

- Installation of the bridge on its place connecting the lower half of the carrousel crown to the concrete foundation (see figures 8 to 15). Half of the bridge was transferred from Louis to Karel & Victor barges driving the SPMTs of one bridge section from the big barge to the twin ones. This allowed to move each set of SPMTs on the deck barges in order to separate and make enough room between them for the concrete foundation (pier) were the crown had to be supported. During a 48h closure of the ship traffic, both Louis and Karel & Victor barges carrying the bridge sailed into position in a catamaran configuration, aided by three push boats. They were then secured with winch cables and positioned to within 1 cm above the carrousel crown. To complete all operations, we ballasted both barges in such a way so that the bridge could be lowered onto its final supports. After our client made all the bolting connections, our barges could be removed and returned to the port of Ghent.

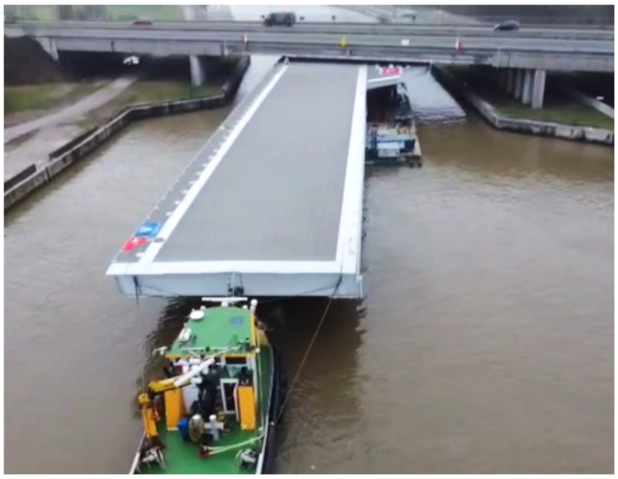

Figure 3: Mobile deck passing below the lowest canal bridge with less 150 mm gap.

3. Conclusions

During the weekend of 22 January 2022, the new Verbindingsbrug in Zeebrugge was floated in, lowered, connected and fully opened for the first time.

Besides all these technical challenges, Saren's finished these operations successfully on time with the entire satisfaction of our client.

Figure 4: 130m mobile deck completed at Wondelgem fabrication workshop in Ghent during the 2,5m jacking with 4 climbing towers of 2x450 tons to attache the carrousel crown below it.

Figure 5: Mobile deck and carrousel supported on SPMTs driving out the fabrication workshop.

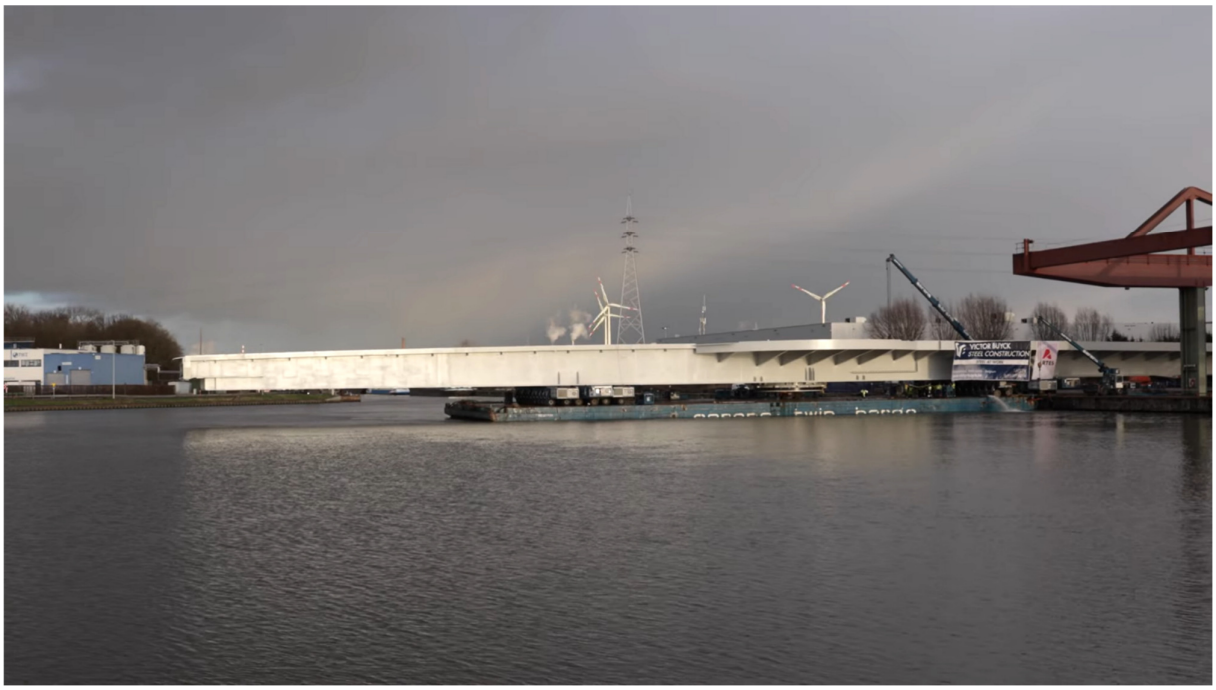

Figure 6: Mobile deck and carrousel at the end of the load out on Karel-Victor twin barges at the yard of client fabrication workshop in Wondelgem.

Figure 7: Mobile deck and carrousel on Louis 300ft barge after transferring it from Karel and Victor twin barges, starting its sail to the final position at Zeebrugge.

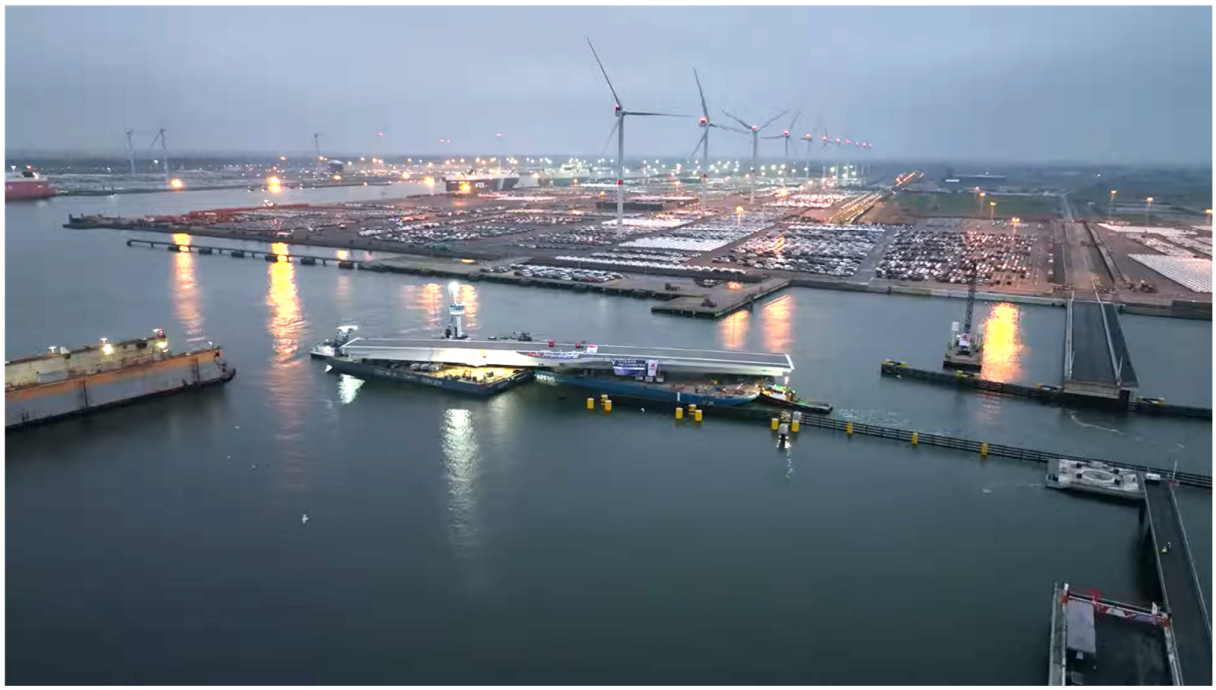

Figure 8: Side view of the mobile deck and carrousel on Louis and Karel -Victor barges on a catamaran configuration getting close to the final bridge position.

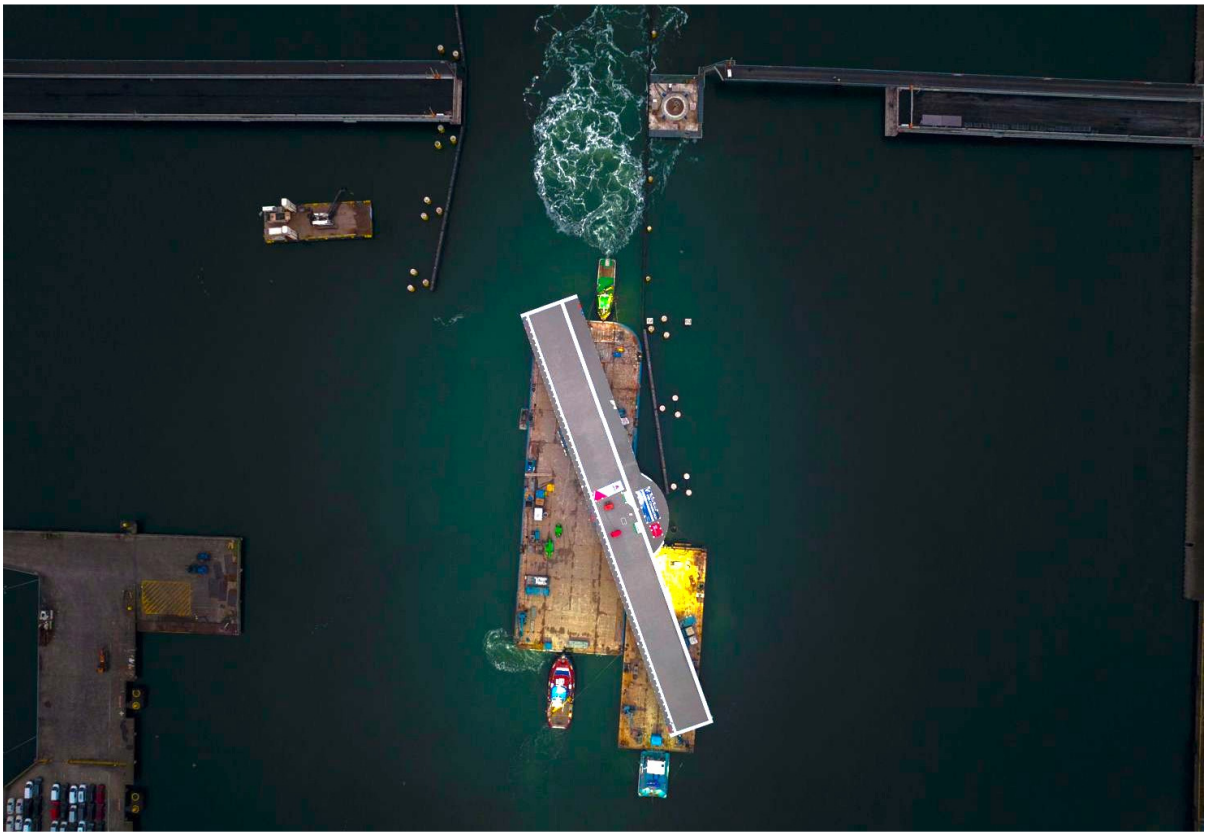

Figure 8: Top view of the mobile deck and carrousel on Louis and Karel -Victor barges on a catamaran configuration getting close to the final bridge position.

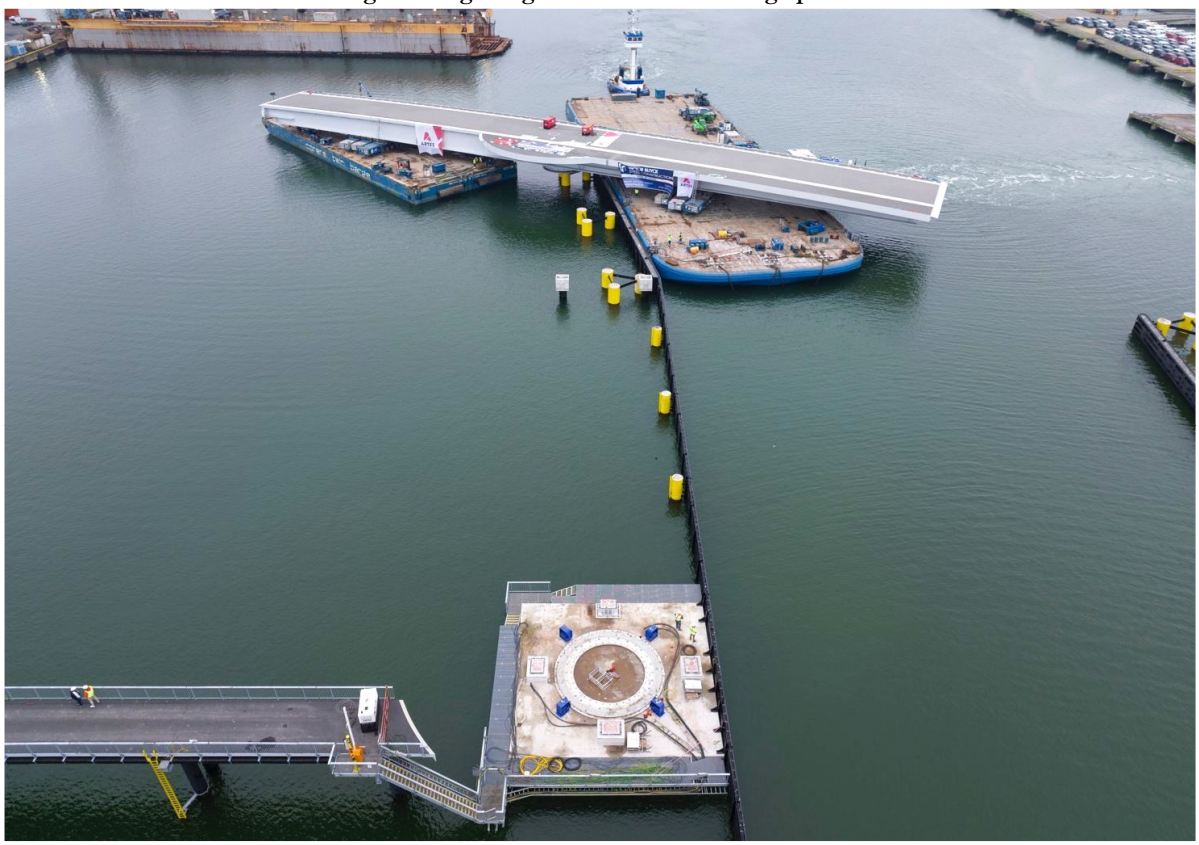

Figure 10: Side view of the mobile deck and carrousel on Louis and Karel -Victor barges on a catamaran configuration. Barges separation to go through the canal defenses for reaching the final bridge position.

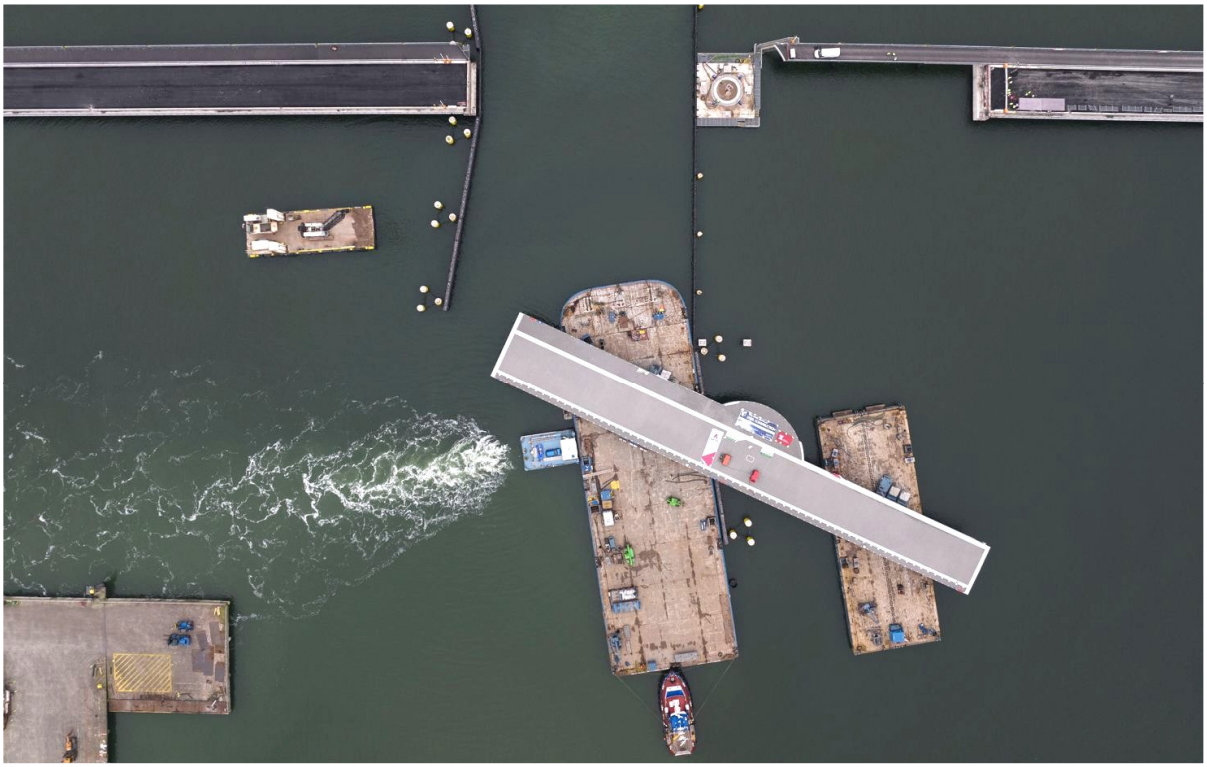

Figure 11: Top view of the mobile deck and carrousel on Louis and Karel -Victor barges on a catamaran configuration. Barges separation to go through the canal defenses for reaching the final bridge position.

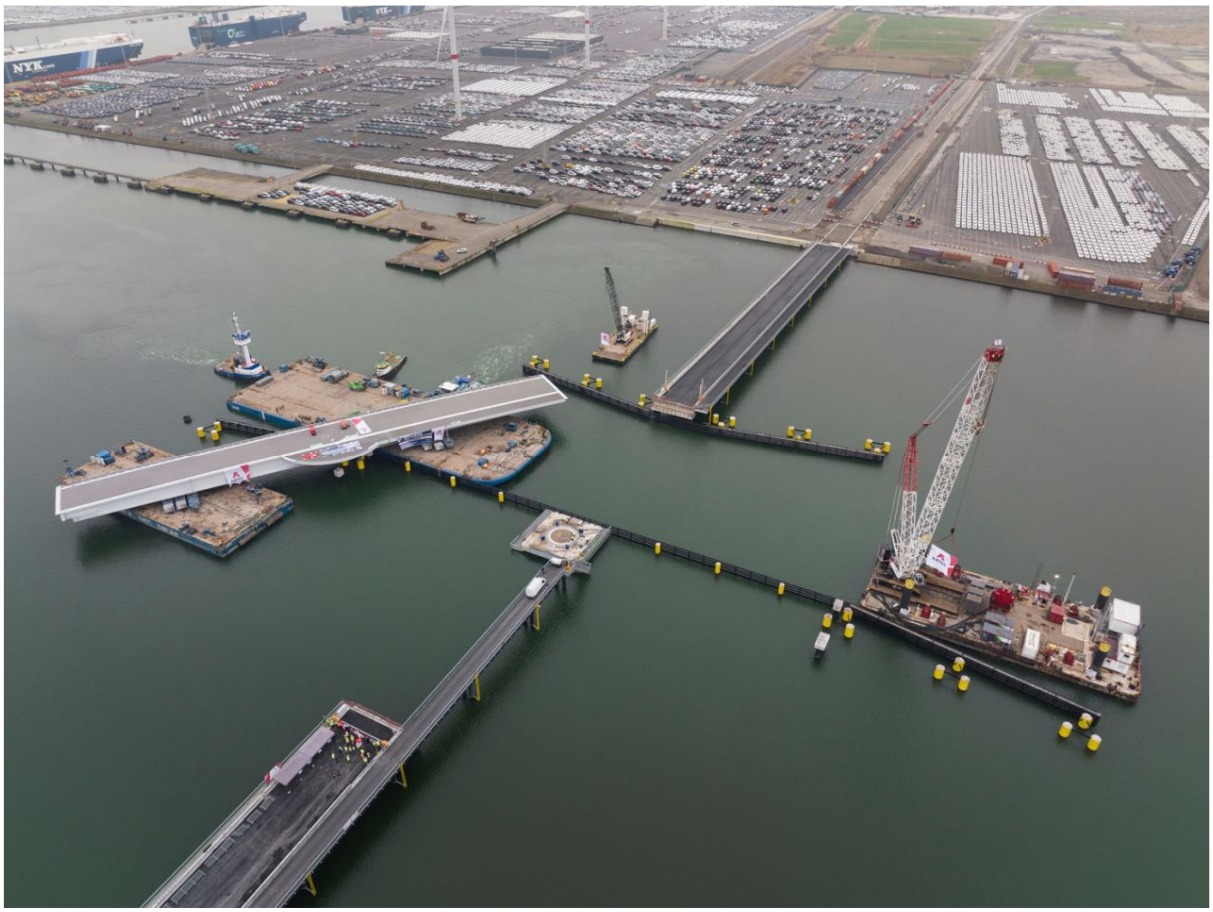

Figure 12: Side view of the following installation phases.

Figure 13: Top view of the following installation phases.

Figure 14: Detail of the final concrete foundation in between Louis and Karel-Victor barges right before reaching the final bridge position.

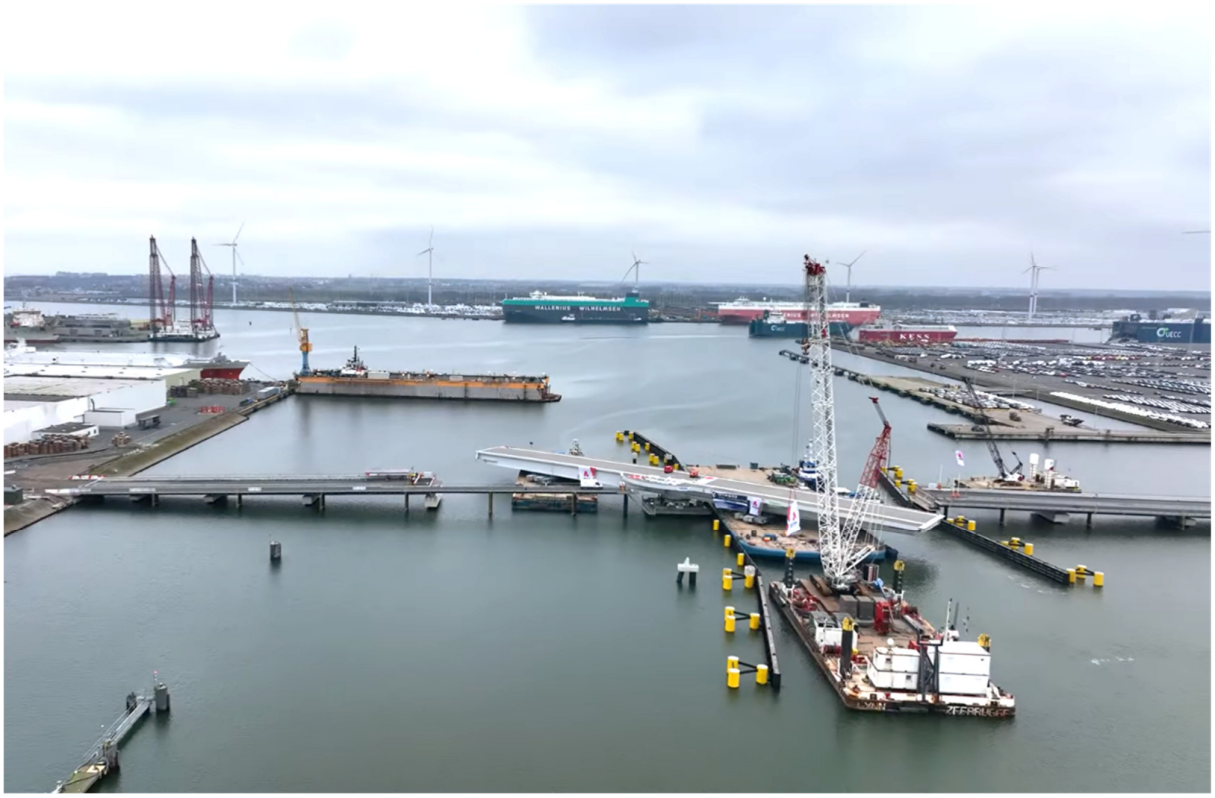

Figure 15: Side view of the mobile deck and carrousel right over the final concrete foundation.