Installation of a 1.700t pylon for the New Wear crossing bridge at Sunderland – UK.

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ABSTRACT

The New Wear Crossing bridge was open in 2018. It spans the River Wear with 300m length. Its centrepiece is a soaring 105m-high pylon. SARENS was contacted for the transport and installation of the composite 1.700 tons A-frame pylon, which was fabricated in Ghent, Belgium. When the pylon was sailed successfully to its final destination, the SARENS team carefully lifted and positioned it to its full height.

KEYWORDS: Barges, Self Propelled Modular Trailers, cranes, tilting, jacking systems, Strand Jacks.

1. Introduction:

The New Wear Crossing bridge, a project of the city of Sunderland in the UK, was open in 2018. The bridge spans the River Wear from Castletown to Pallion with 300m length. Its centrepiece is a soaring 105m-high pylon. With dual 2-lane carriageways for vehicles and dedicated cycle and pedestrian routes, the New Wear Crossing will enhance public transport as well as significantly improve transport links to the city center and Port of Sunderland from the A19 and A1.

SARENS was contacted for the installation of the 1.700 tons (more than 1.000 steel tons and concrete) A-frame pylon for the Sunderland bridge, which was fabricated at our client VICTOR BUYCK steel shop in Belgium. The main dimensions of the pylon are 105m height and 30 m width.

2. SARENS' scope:

SARENS´ scope included:

- Load out of the pylon at VICTOR BUYCK facilities by means of 52 SPMTs (Self Propelled Modular Trailers) axel lines on one of our twin barge (December´16, see Figure 1). The first challenge was slowly manoeuvring the pylon out of the fabrication yard. The pylon had to be jacked down onto one of our Sarens' twin barges, "Jozef-Rosa" and "Karel-Victor", using a combination of Sarens' PJ250 jacking system. During the two-day loading process, the barges were moored with a variety of hydraulic winches. This was a slow process because the ballast of the barges had to be carefully adjusted throughout the operation.

- Once the pylon was secured, the team had to maneuver it along the canals. River transport of the pylon on this barge till Ghent harbor. The transport of the pylon was challenging as SARENS had to manoeuvre along tight canals and under a series of low bridges while bearing the pylon on a barge SARENS operators had only about 30 cms of margin on all sides of the pylon to pass under several bridges (see Figure 2 at next page).

- Water transfer of the pylon from the twin barge to one of our sea-going barges, by means of SPMTs. In the Port of Ghent, the pylon was then transferred to Sarens' larger sea-faring barge, "Louis" (see Figure 3 at page 4). For this, the twin barges were first driven apart with SPMTs and once they were adequately separated, the barge Louis was inserted between them. The pylon was transferred using SPMTs and ballasting the barges. Once on board "Louis", the pylon was rotated by 90° and set down on its sea-fastening supports. Then, two weeks of preparation followed before the barge was ready for its two-day sea journey to Sunderland.

Figure 1: General view of the loadout at Ghent.

- Sea transport of the pylon along the English Channel until Greenwells Quay at the Port of Sunderland (arriving 7th Jan´17, see Figure 4 at next page).
- Transport of the pylon through the River Wear till the final bridge site (see Figure 5 at page 5).
- Turning 90º around the vertical axis of the pylon by means of SPMTs (see Figure 6 at page 5).
- Connect the legs of the pylon with the giant concrete tusks that are fixed into the riverbed inside the cofferdam.
- Tilting up the pylon till its final vertical position, by means of strand jacks and auxiliary steel structures like a back mast of 50m height (11th & 12th Februray´17). The pylon will be raised using a mix of tried and tested lifting methods and technologies.

Figure 2: Pylon passing under canal bridge.

Figure 3: Pylon from river to sea barges.

Figure 4: Sailing from Ghent to UK.

Figure 5: Pylon arriving to site close to main pier.

Figure 6 : Pylon turned 90º ready for tilting.

3 Tilting up the pylon:

The operation had to start and finish during daylight, to allow the full site team to carry out important checks and tasks in the natural light. This means that as the operation will not continue through the night, it was slowed down to ensure completion occurs at the optimum, preferred time, during the following day.

There are several key components / equipments that are being used to raise the pylon into position, which will be visible throughout the operation (see Figure 7 at next page):

- Giant hinges: they have been used to attach each leg of the pylon to the tusks that are built into the riverbed foundations to support the pylon. The hinges are fixed together to hold the pylon in place and will enable the pylon to be rotated into a vertical position.
- The backmast: a 50-metre high crane boom has been temporarily fixed to the pylon for the raising operation. It is being used to create an angle between the cables and the top of the pylon, which will allow the pylon to be pulled upwards. The crane boom has been taken from SARENS' SGC-120 super crane, which is one of the largest cranes in the world, with a lifting capacity of 3.200 tonnes.
- The cables: used to pull the pylon into position – also known as strand bundles – are connected to a spreader beam, which in turn is connected to the top of the pylon. They pass through four hydraulic SJs, anchored 30m into the ground on the south side of the river. The strand bundles are drawn through the jacks in order to pull the pylon into a vertical position.
- Tie back: similarly to the point above, there are two Strand Jacks (SJs) located on the other side of the river (North side) that act as a counter-balance to those on the south side, to ensure a steady operation.

The tilting up process can be summarized as follows:

- Planning for the raising operation began two years ago, with the process calculated to the nearest millimetre. During the lifting process, the pylon will be continuously monitored in line with expectations for each phase of activity.
- The SJs, initially with the backmast, will be used to raise the pylon – up through most of the lift – until the pylon reaches an angle of about 70 degrees, which will be three quarters of the way through the operation.
- At this point, the backmast will automatically disconnect from the cables, and the SJs will continue to draw the strand bundles through, pulling the pylon up for the remaining 20-degree rotation to its final vertical position.
- As the pylon approaches its final position, the backmast will be retracted to stand vertically alongside the pylon and the tie back strand bundles will be tensioned to ensure the pylon is supported from both sides until it is fully secured (see Figure 9 at end page).
- Once the raising is complete, the backmast will gradually be removed and lowered to the ground and work will begin to secure the pylon permanently to

Figure 7: Pylon in the middle of the tilting.

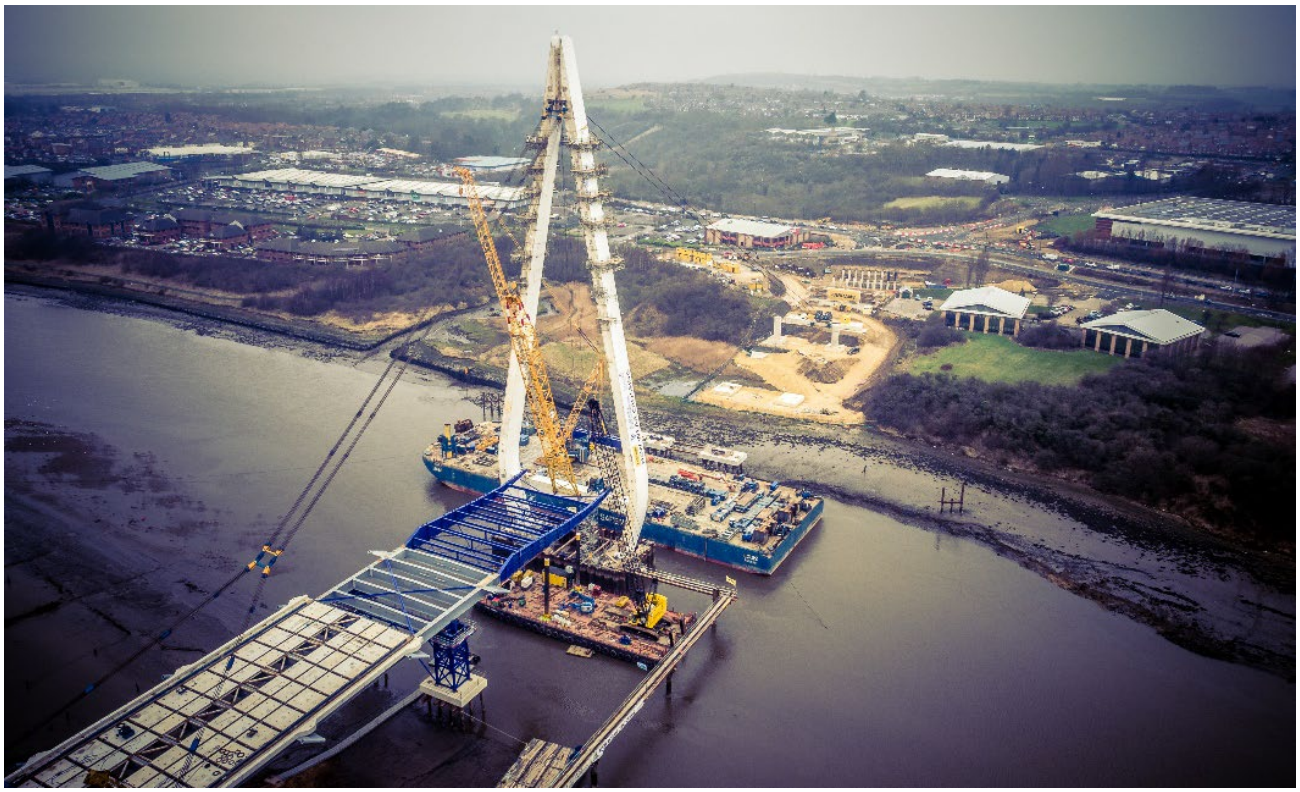

Figure 8: Pylon right after ending the tilting.

the tusks. It took three weeks of intensive work to ensure the pylon is fixed in place (see Figure 8 at previous page).

- Each leg of the pylon will be fixed to one of the tusks with 20 bolts, with each bolt measuring 6m long by 65mm in diameter. A total of 40 bolts will secure the pylon in position.
- After the bolts are fitted, tensioned and the gaps grouted, the base of each leg of the pylon will be filled with reinforced concrete.
- When all of that is complete, the rigging and cables used for the raising will be released. The pylon will then become free-standing until the bridge deck is launched into place in the spring and the cable stays connecting the bridge deck to the pylon are positioned and secured over the summer.
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4 Conclusions:

Transporting and tilting up the pylon was a technically challenging feat of engineering, ingenuity, and teamwork. Sarens engineers and field professionals handled it with coordination and expertise.

All these manoeuvres described above, besides the fact of their technical challenge, had to be perform following a very precise and detailed planning.

All these manoeuvers were performed from December 2016 till February 2017, to the entire client´s satisfaction and without any incident.

Figure 9: General night view of the new bridge once completed all the construction jobs.

Acknowledgments

This operation was performed on behalf of joint venture client VICTOR BUYCK STEEL CONSTRUCTION. SARENS wants to thank the trust and confidence showed by these companies for awarding this job to us.

SARENS is pleased to have been part of such an ambitious project, and would like to congratulate everyone who helped make it a success from the safety point of view till fulfilling the tied schedule, passing by a very complicated technical operations.

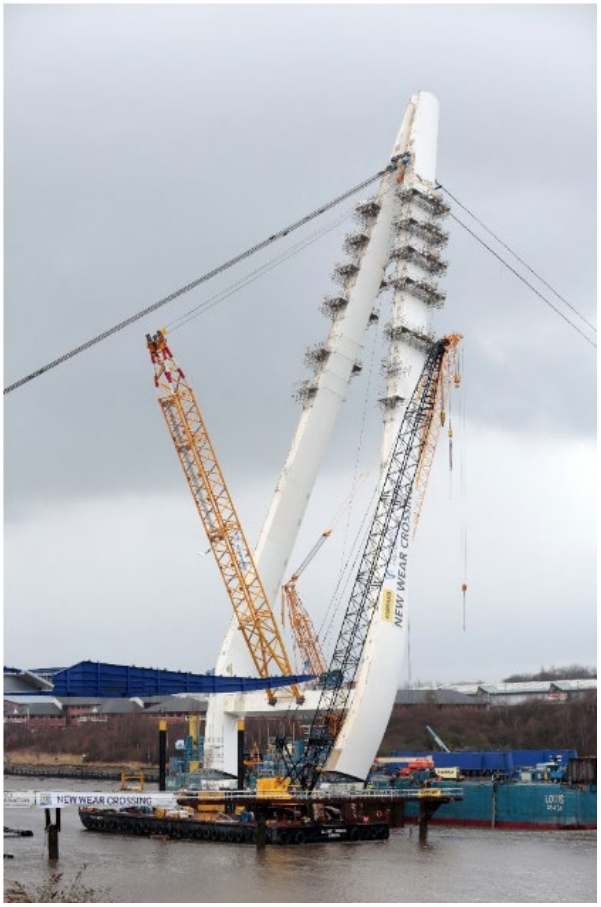

Figure 9 : Pylon almost reaching the end of the tilting.