

Lifting 56 steel deck segments for widening the Rande Bridge, Vigo - Spain.

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ABSTRACT

SARENS has taken part in the expansion of Rande Bridge to lift 56 new steel segments up to 105 t/each. Rande Bridge cable-stayed spans the Vigo's Stuary with 700 metres long. A first time in the world widening project of a big cable-stayed bridge, without interrupt traffic on the existing bridge. As part of the expansion, two new external decks span both sides of the existing bridge. SARENS faced the challenge of lifting two segments of the same bridge's cross section on the same day, with two different barge transports.

KEYWORDS: Strand Jacks (SJs), lifting, steel deck segments.

1. Introduction

SARENS has taken part in the expansion of Rande Bridge, near Vigo (Spain). SARENS' team worked to lift 56 new steel segments, each weighing up to 105 tons, for widening the bridge.

Rande Bridge cable-stayed spans the Vigo's Stuary, linking Redondela to Moaña. It is considered a defining icon of Vigo, rising 40 metres and stretching 700 metres long.

It opened to traffic in 1981, but by 2006 its average daily load reached 47.000 vehicles, resulting in frequent congestion. A widening project was presented as a solution: it would increase the bridge's capacity from four lanes up to six, without the need to construct a completely new bridge or even interrupt traffic on the existing bridge. This has been the first time in the world that a big stay cable bridge like this has been widening without any traffic cut on the existing bridge lines.

As part of the expansion, two new external decks span both sides of the existing bridge (see Figures 1 & 2 of next page).

Each external deck has 28 new steel segments with the following main dimensions: 21m length and an inverted triangular section 12m wide and 2,3m constant height.



Figure 1: Top view of the bridge from one of the piers before the widening.



To perform all these liftings and install the new segments, SARENS operators used 16 SJs 105t with coiler and 3 computer control systems. These SJs were divided in 8 sets with 2 SJs each. On each of the two main piers of the bridge, four sets of SJs were assemble.

SARENS mobilized half of these equipments within a very short time span in order to set up four working lift areas around one pier as soon as possible.. The team spent three days transporting equipment from SARENS headquarters at Brussels by truck, and another month setting everything up.

Each set of SJs were installed on the lifting gantries supplied by our client (see Figures 3 and 4 in the next page). The front lifting gantry was a transversal single steel frame which was holding and moving along the lower flange of the main bridge deck. And the rear lifting gantry was in fact composed by two independent gantries supported of the previous segments already lifted.

The connection between the SJs and the segments to be lifted was achieved by means of an equalizer beam (see Figures 3 and 4 in the next page). The front SJ was connected to a longitudinal equalizer beam installed in the middle of the segment and parallel to the main bridge deck. The rear SJ was connected to a transversal equalizer beam installed also in the middle of the segment and perpendicular to the main bridge deck.

Both equalizer beams had some hydraulic jacks to compensate the transversal inclination of the segment in order to adjust it and march with the required geometry.



Figure 3: General view of the front lifting gantry, transversal to the bridge section and with the lifting beam longitudinal to the segment.

3. Description of the SJs sets:

As commented before, SARENS supplied 16 sets composed each one by the following equipments (see Figures 5 and 6 in the next page):

- One 105t single capacity SJ.
- One strand bundle. With the proper maintenance and care, all the liftings performed by each SJ were performed with the same strands.
- One "automatic" (without electronics) strand coiler. Installed on a frame over thee the SJ, the coiler is located in a strategic position in order to roll by itself during the liftings or lowerings coiling the strand bundle without the help of no personnel at all. This fact speed the manoeuvers and reduced also



the amount of required personnel to perform all these liftings.

- One 105t single capacity lifting anchor. At the end of the strand bundle this lifting/lowering eyes including a pin connection is the part of the SARENS equipments that is connected to the equalizer beams mentioned at point 2).
- One electro-hydraulic power pack. Each SJ is controlled by means of a power pack, which supplies the required power to perform its task. The average speed achieved during these liftings was 12-15 m/h.

And all these equipments were manged by 3 computer systems that controlled at any time all the main features as load, lifting heights, etc.



Figure 5: Detailed view of the SJs set installed in the front lifting gantry.



Figure 6: Detailed view of the SJs set installed in the rear lifting gantry.

SARENS faced the challenge required to lifting two segments of the same bridge's cross section on the same day, and with two different barge transports.

Furthermore, we had to achieve this without any closure of road traffic on the bridge. SARENS personnel worked up to 60 metres above the water controlling all these liftings.

Working along half a year with 16xSJs and 3 different control computers systems SARENS supervisors and operators completed all these 56 liftings without a single incident.

It was also mandatory a good coordination among our client and the rest of main subcontractors (barges, steel shop, etc.) in order to program all these operations at a time and The standard lifting cycle for a steel segment was done in a day shift. Once the barge was in its lifting position under the SJs, it took a couple of hours to connect the lifting points, check the loads and level the segment. Later on, the lifting itself took an average of 4-5 hours till the fitting process with the deck could start.

5. Lifting of the first segment:

On the following Figures 7 and 8 in the next page, the reader can see a sequence showing how the first segment was installed.

It is easy to realize the 2 SJs installed on the rear lifting gantries (see Figure 7) and the transversal front gantry (see Figure 8).



Figure 7: General view from the water of the first segment.

Most of the segments were sailed to their lifting position on a barge (see Figure 11, e.g.). But some of them close to the abutments were over the ground and not the water.

As the barge was not able to reach that lifting positions, these segments had to be unloaded from the barge by cranes and later on moved the segment to its final vertical position.

And due to the lack of space, final operation was the most critical (see Figure 9): these segments had to be connected to the SJs once they were already on the air hanging from the crane right below their final vertical position.



Figure 8: General view of the first segment close to its final position.



Figure 9: Installation of segments on ground.



5. Lifting of the last segments:

On the following pictures the reader can see a sequence of general pictures showing how the last bridge segments were installed.



Figure 10: General view of the bridge with of one the last segments lifted during the sunset.



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Figure 12: Figure 11: Central view of the bridge during the closing with the lifting of the last segment.

Acknowledgments

This operation was performed on behalf of joint venture client RANDE, which is composed by the companies DRAGADOS and PUENTES Infraestructuras and owner AUDASA. SARENS wants to thank the trust and confidence showed by these companies for awarding this job to us.

Sarens is proud to be associated with the construction of the Rande Bridge which has won, among other prices, the second IABSE Best Structure Awards job globally for the year 2019 (IABSE Outstanding Structure Award, OStrA 2019). The award recognizes the most notable, innovative, creative, and stimulating structural works in the world, where sustainability and respect for the environment

are positively valued aspects. The presentation of the award took place in New York City on September 4, 2019, on the occasion of the 2019 IABSE Congress.

The success of this widening has already lead to the owner AUDASA to request a preliminary project for widening again this bridge by 2030-2035, depending of the future traffic needs.

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 liftings.