



THE WHARF OF LAAYOUNE: REPLACEMENT OF TWO POST-TENSIONING DECKS BY METALLIC BOX GIRDERS

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The wharf of Laayoune is a 3150m long bridge made of double decks consisting of 75 isostatic spans with a reach of 45 m and a loading dock



The wharf of Laayoune

DESCRIPTION

The bridge was built in 1968 and has been in service since its construction.

The purpose of this wharf is loading phosphate for export in ships with a capacity of 80,000 tons.

Phosphate is extracted from a mine which is located 100 kms to the East towards the Algerian border. The phosphate is transported by band for more than 100 kms to Laayoune where it is washed and treated then routed to the ships via one of the two decks of this wharf.

The second deck is used for as a road maintenance vehicles and personnel transport.

PATHOLOGY

The washing of the Phosphate requires important quantities of water. This water is pumped off shore at a level 1750m and then transported to the processing plant via a pipeline diameter of 900 mm.

As this pipeline has not been maintained, it is no longer waterproof and sea water flows over the prestressed concrete beams which increases the corrosion of the structures and the bursting of the concrete until breakage of the prestressing tendons.



Breaking of the tendons

REPAIRS

1-Reinforcement of the piles

The piles have a diameter of 2.5 m and are hollow with a 20 cm thick and they are prestressed vertically.

An opening was created in the upper part to create a passage for a person, then a reinforcement was added to the inside and then concreted over the entire height, then an exterior transplant was made by a metal liner of 10 mm thick metal sheets.

The void between the outside walls of the pile and the metal liner was grouted.



2- The reinforcement of the pile head

Prefabricated pile head were replanted, a reinforcement was added and a concrete grout through an exterior framework were done.





3-Beams removal of the road deck

The adopted method is to cut the prestressed concrete beams into 3 pieces of 100 tons each and deposit it at the bottom of the water, then replace them with 45m long and 80T metallic box girder.

To do this, a launching metal girder equipped with diamond wired cutting machines and 12 strand jacks was designed and supplied



The launching girder is used also as a support for the prestressed concrete beams during the cutting for the descent of the 3 pieces.

Once the span is emptied of its prestressed concrete deck, a metallic box girder is rolled down from the dike (level of the abutment to the ground)

For the passage of the caisson on the affected span, a truss metal girder was transported by flotation and then lifted by strand jacks.

The caisson passes over the truss beam using guided rollers.

Meanwhile The launching girder, goes for cutting of the next span, and so on.

4 The pumping Platform

In the middle of the wharf at 1575 m, a pumping platform made of 11 prestressed beams and 2 transversal prestressed beams of 1x2m height.

The used method is to support the whole platform with 10 truss beams (a free space is left for the prestressed beams descent).



5-Special case: removal of the additional post-tensioning tendons.

The previous repair work (20 years ago) was accomplished as follows : 2 spans have been hitched together with 4 cables 12T15 into a additional exterior post-tensioning.

This post-tensioning tendons has been dismantled after the creation of an re-anchoring blocks.

The two spans were cutted simultaneously including the external postensionning tendons which is set in the re-anchoring blocks.



6-Deck support of the convey

The deck under conveyor is made of 3 prestressed beams interconnected with a transversa post-tensioning tendons made of 4T15 each 50 cm.

The beam No. 3 (axis side of thi deck) is used as a support for the water pipe: the latter has been disconnected from the other two by the longitudinally cutting.

This beam is cut and removed first and this according to the same method stated earlier.

An additional constraint is that on this deck: the conveyor has two conveyor belt that , must remain in operation during the entire construction period.

It has been lifted on several spans and supported by metallic truss beams loaded on the pier heads.

This dual beams is cut and lowered down with the same method as stated previously with a special feature is that the strand jacks are integrated in each beams (2 per beam) and the entire beam is cut in one piece and each piece and is removed.

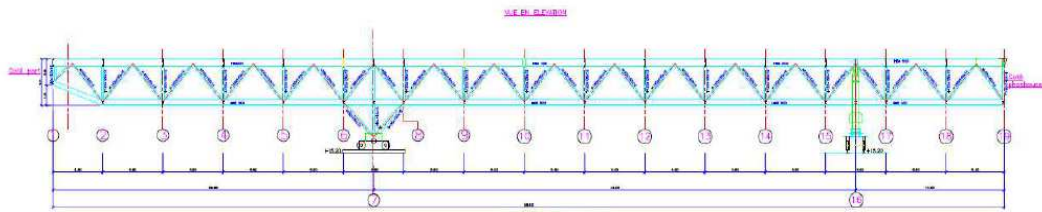
Once freed from its concrete deck, a metallic box girder comes through rolling and sliding from the next deck, then down and slided it is layed on its finalbearings . As the metallic box girder is slided, the conveyor supports are transferred to the lattice girder supporting to the box girder and the girder is lowered and evacuated by flotation to make way for metal truss beam.

7- Dismantling of the loading machine nr 5

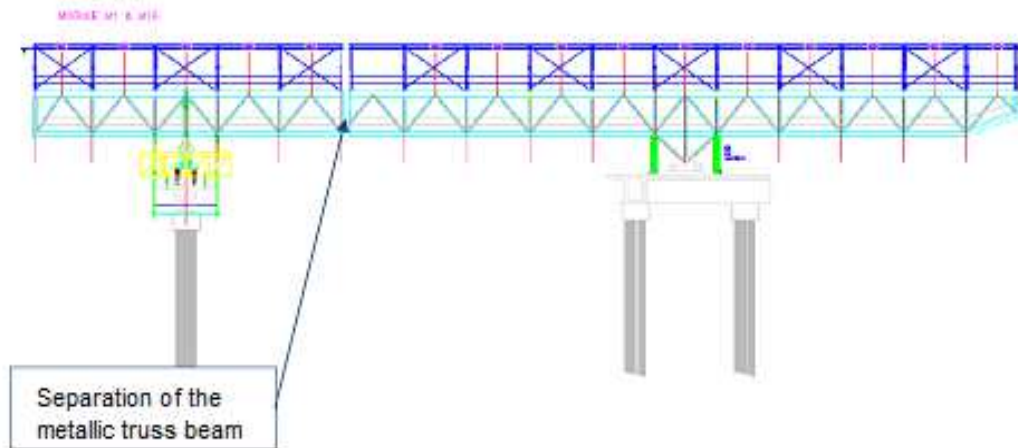


The loading docks at the end of the wharf, are equipped with loading machines. These machines lay on a 100 m long metallic truss with a total weight of 400 Tons

The used technique is reversed successive dismantling



The dismantling is thus carried out through the simultaneous cutting of the two modules (on each side of the span)



REPAIR TECHNIQUES:

Re-anchoring of additional external post-tensioning
Re-anchoring of transversal post-tensioning
Concrete repair
Concrete cutting with the diamond wire technique
Launching, sliding and jacking
Post-tensioning by bars
Expansion joints

PARTICIPANTS:

Owner: **Office Cherifien des Phosphates (OCP)**
Main Contractor: **SOMAGEC SUD**
Engineering, launching, sliding and jacking works: **SOFEQ**
Control Offices: **SYSTRA + SOCOTEC INTERNATIONAL**