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Autor: Rito, A.
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2. Arade Bridge, Portimão (Portugal)

Owner: *Junta Autónoma de Estradas (Highway State Administration)*
Designers: *Armando Rito*
Contractor: *Conduril SARL*
Works duration: *36 months*
Service date: *1991*

General

The Arade bridge is located on the E.N. 125, a coastal road in the Algarve. The road crosses the river Arade 1 km North of the seaside city of Portimão. Future dredging operations will cause the river to move forcing the project to contemplate existing and future riverbeds. The resulting structure is reasonably long. The soil has a low load capacity being characterized by alluvionar deposits of loamy sand and clay about 40 m deep, over a bedrock constituted by a shale formation with basaltic intercalations. The area has a considerable seismic activity corresponding to the worst seismic zone in Portugal.

Description

The bridge is a full suspension cable stayed bridge with fan shaped stays. The approaching viaducts have multiple 30 m spans and a 24 m span near each abutment. There are 8 spans on the East side and 5 spans on the West side. The viaduct piers have an elliptical shape and are founded in piles. The main span is 256 m long with two side spans of 107 m each. Together with the approaching viaducts they form a continuous structure 842 m long. The two concrete towers have an inverted Y shape specifically designed to withstand the seismic forces and also to be aesthetically pleasing. The foundation is made of piles approximately 45 m long. The bridge deck is a prestressed concrete two-cell box girder 17 m wide with the two cells connected transversely by prestressed transverse beams 4 m spaced. The stays are arranged in two planes forming with the deck a tridimensional system which provides the necessary torsional stiffness. The cables are made of parallel strands running over saddles in the upper part of the towers and being anchored to the deck. The anchorages are 8 m spaced exept for the last four backstay cables.

Construction

The entire structure is cast in place. The viaducts are constructed span by span with a self-launching form carrier running below the superstructure and supported by the viaduct piers. The towers are erected using climbing forms in 3 m segments and one of them will need the construction of an artificial island in the riverbed. The deck is built in 4 m sections using cast-in-place segmental construction (cantilever construction). Constructive exterior prestress is used during the construction process to keep the strains in the deck to an acceptable level.

Stability under wind and seismic actions

The dynamic analysis showed that the structure responds very well to severe seismic actions with the deck having maximum displacements inferior to 44, 14 and 19 cm respectively in the transversal, longitudinal and vertical directions. The fundamental vibration modes of the bridge – transversal, longitudinal, vertical and torsional – have frequencies of 0.14, 0.16, 0.37 and 1.03 Hz, respectively. The deck cross-section was found to be aerodynamically stable to winds with speed of up to 240 km/h.

(A. Rito)

Quantities of Materials

Concrete	
Foundations	8000 m^3
Towers and piers	2800 m^3
Deck	8800 m^3
Prestressing steel	
Bar tendons	125 ton
Strand (deck)	190 ton
Strand (stays)	290 ton
Mild steel	
Foundations	300 ton
Deck, towers and piles	1400 ton

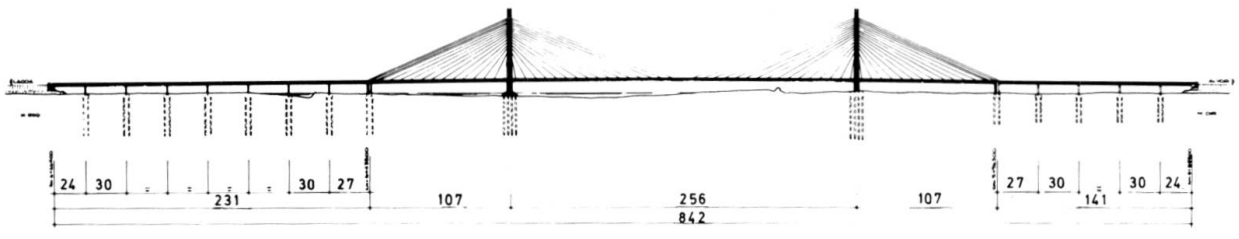

Fig. 1 Side elevation

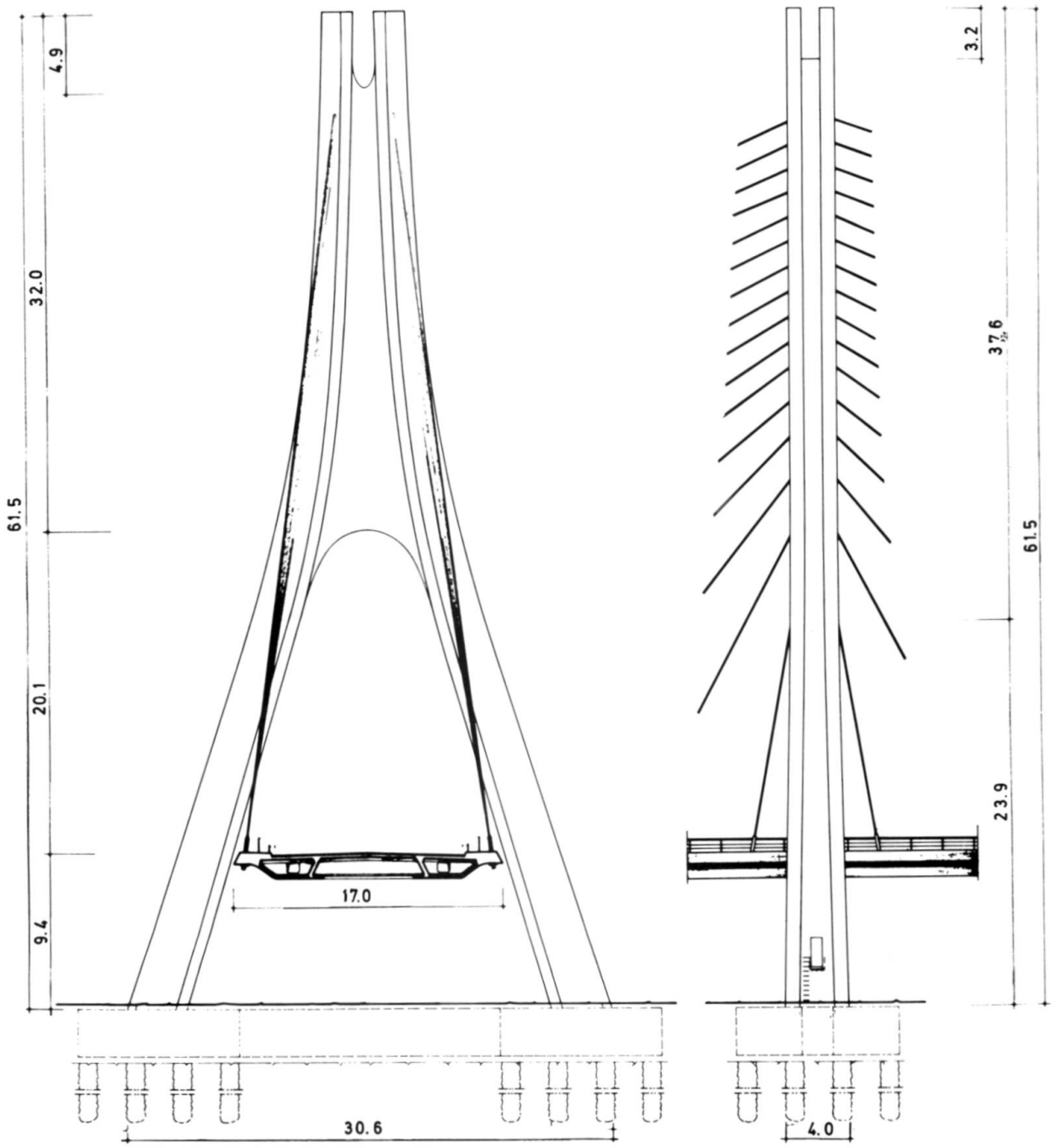

Fig. 2 Geometry of the pylons

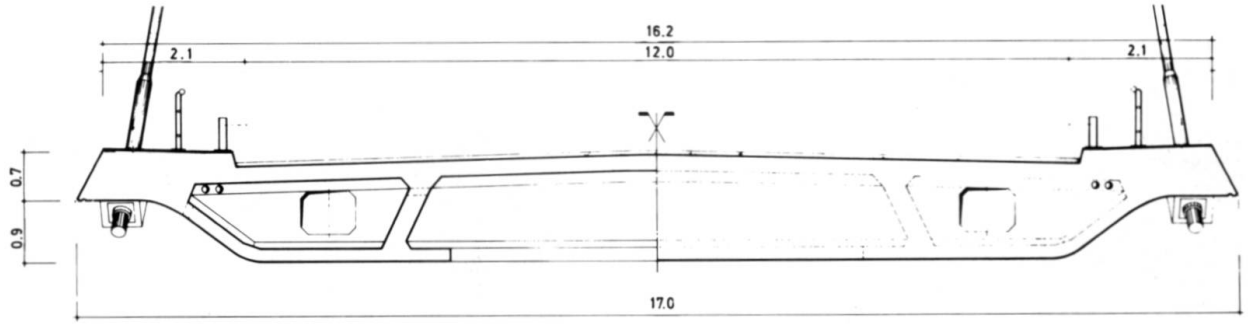

Fig. 3 Cross section of the deck