

FEATURE OF TECHNICAL SERVICE

Subject	Executive design concerning the construction of «New drawbridge for crossing the Candiano canal – Port of Ravenna»			
Carried out by	SGAI S.r.l. of E. Forlani & C.			
Client	CMC			
Service length	2007 - 2010			
Value of works	€ 10'160'140,34			
Categories value	V.02	€ 994'031,95	D.01	€ 651'052,70
	IA.04	€ 3'092'335,73	IA.01	€ 872'960,00
	S.04	€ 2'606'819,28	S.05	€ 1'888'940,68

CANDIANO RIVER BRIDGE - Computational aspects - Simulation, results and checks

The design of the substructures and the bridge deck was carried out by creating a 3D global model using PROSap and SAP2000 software, including both the deck and the foundations (abutments and piers), to which the loads required by technical regulations were applied. Moreover, the acceptance static tests of the bridge were carried out, preparing specific calculation models necessary to identify the load configuration that ensure the mobilization of at least 80% of the maximum stresses provided in the project. The bridge balancing system has been sized in such a way that, when the bridge is closed, the weight of the structure prevails over the balancing effect of the counterweight, stabilizing the operating position.

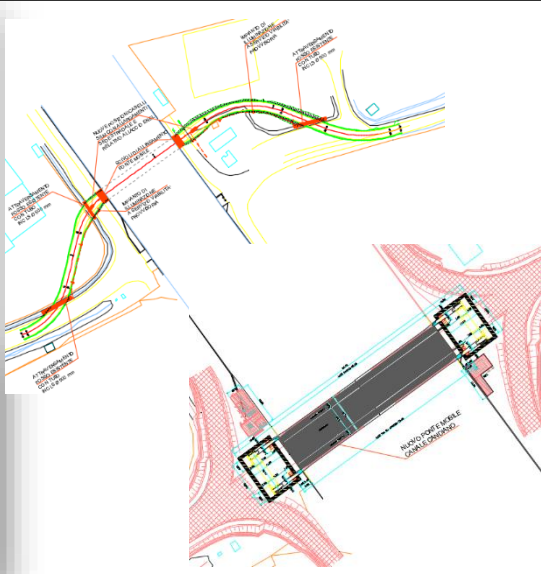
CANDIANO RIVER BRIDGE - Design issues and their resolution

The project consists in the construction of a new bridge for crossing the Candiano canal, which is located in the port of Ravenna. The structure consists of a **metal drawbridge**, with a span of 73.35m and two symmetrical spans able to rotate around special hinges arranged on the relative abutment. The **deck** is of the orthotropic plate type, with trapezoidal section stiffeners and consists of two main box section beams; these beams are supported by stays connected to the stiffener element that has the function of both counterweight and constraint of the opening system. This structure was realized by building the two bays on the ground and, subsequently, launching them from each shore of the canal. The **bridge pavement** consists of two layers of protective material (Primer FONKOR 1411 type), covering the sheet metal of the deck, using an epoxy-polyurethane elastomeric material, with quartz to ensure the adhesion of the vehicles. The two **abutments**, shaped like a box, house the final part of both main beams and the lifting jacks, in the open bridge configuration. Inside the boxes, in correspondence with the ballast, there are the devices for contrasting the vertical loads. At the center line of the bridge, a **locking system** has been installed to constrain the two parts of the deck during the closed bridge condition, allowing the continuity of the road level during vehicle and pedestrian transit; in the same way this connection allows relative sliding between the main beams due to thermal expansion. In order to prevent the boats from hitting the bridge structures in case of incorrect maneuver, **four protective structures** are built on both shores of the canal at a distance of approximately 4.60m from the current pier. In this way it is possible to guarantee a safety distance between boats and bridge and a free clearance in height of 30m between the canal level and the desk in opened configuration. The **movement** of each bay is achieved by **4 piston mechanisms powered by a hydraulic control unit**, housed in the foundations below the road level and connected to the support towers of the deck. In order to guarantee both safety and management of infrastructure, during vessel traffic, the bridge is equipped with control and maneuvering devices. This system allows the lifting of the structure in all the wind conditions examined, up to an opening of about 72°, allowing the passage of ships up to a maximum width of 50m. Besides, the project involved the construction of **two embankments** on both sides of canal, for easy access to the bridge, as well as **two ramps** connecting the bridge to the road network on both shores. With a view to allow the **demolition of the old revolving bridge**, located closed to the construction area of the new work, the traffic was diverted to a specific temporary roadway, providing for the construction of a **temporary floating bridge**. Moreover, the project included both the lighting system for the temporary and definitive roads, and the design of wiring for the bridge control, writing a specific use and maintenance plan.

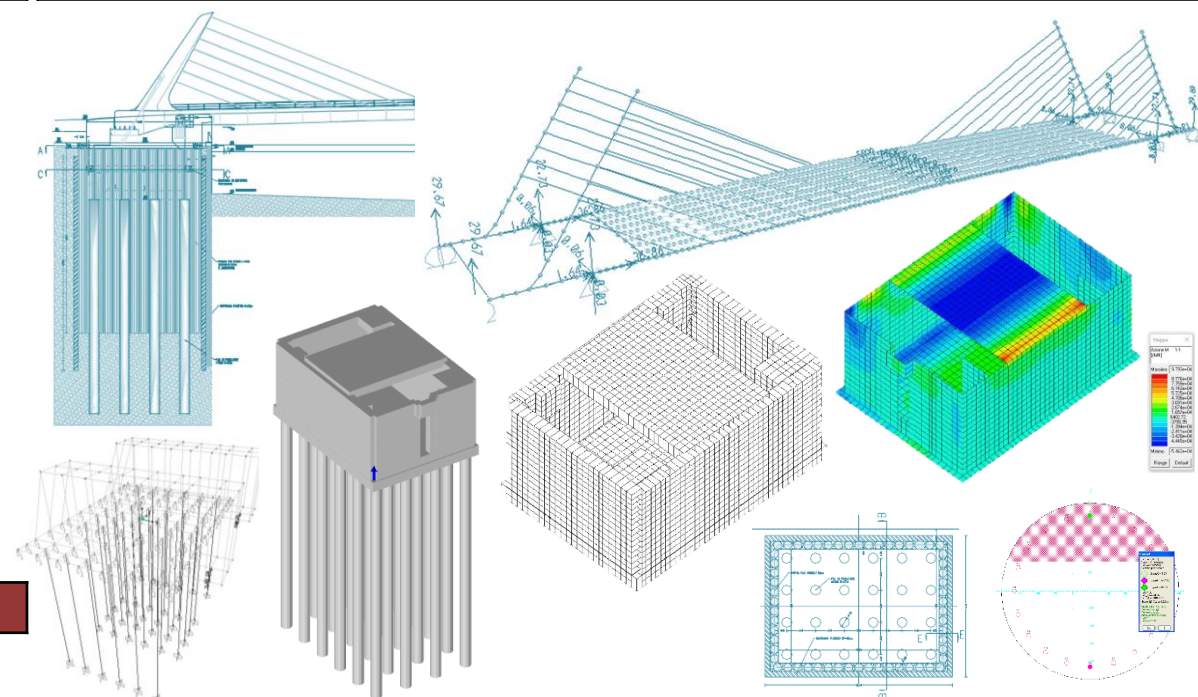
Aerial view of completed structure



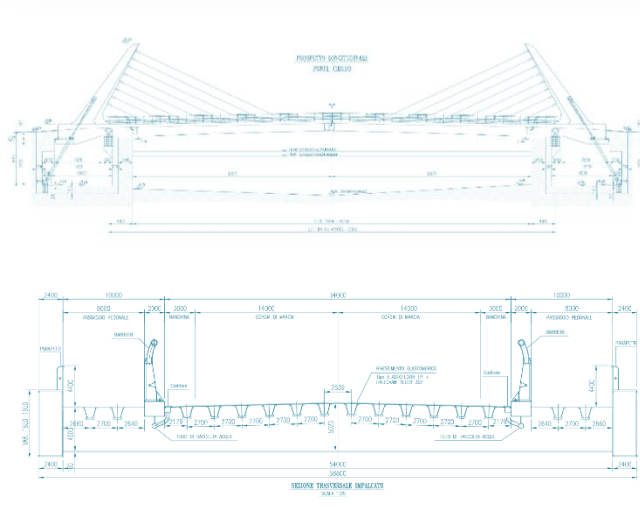
Temporary deviation and final configuration



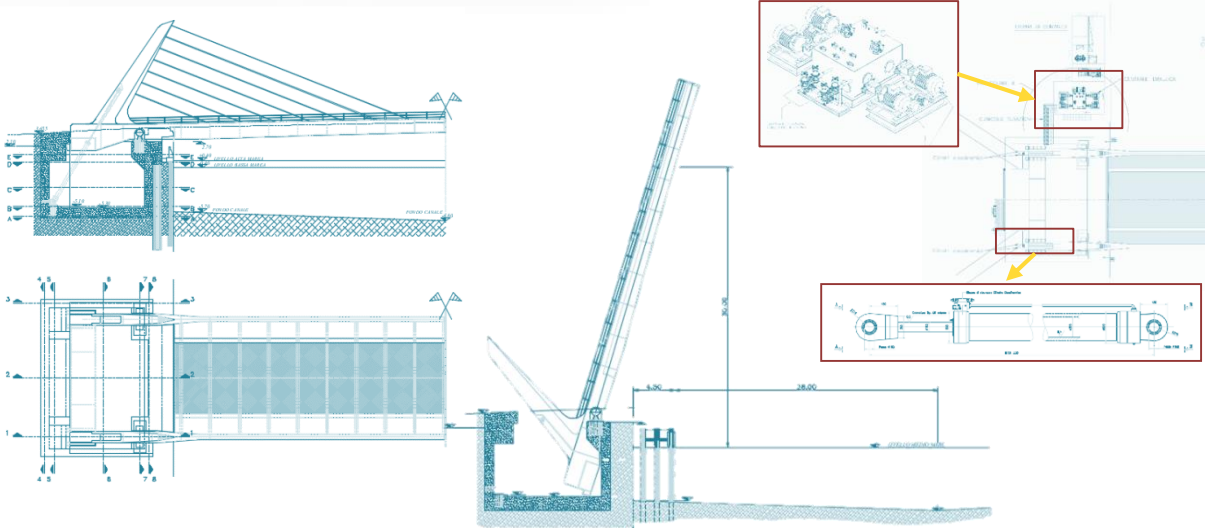
CANDIANO RIVER BRIDGE - structural analysis and FEM numerical modeling



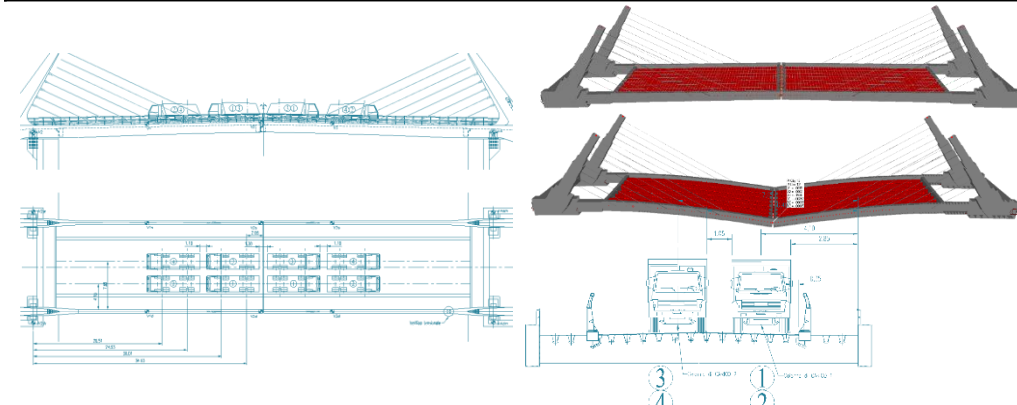
Bridge design sections



Dimensions and construction details of bridge and hydraulic system



CANDIANO RIVER BRIDGE - 3D analysis for the acceptance static test



BRIDGES AND VIADUCTS