



Refurbishment of an arch bridge increasing its stiffness and reducing its weight

Tobia ZORDAN
Civil Engineer, PhD
IUAV
University of Venice
Venice, Italy
zordan@iuav.it

Bruno Briseghella
Civil Engineer, PhD
IUAV
University of Venice
Venice, Italy
bbrisegh@iuav.it

Ettore de la Grennelais
Civil Engineer, PhD
Project Manager
ANAS SpA
Venice, Italy
e.delagrennelais@stradeanas.it

Enzo SIVIERO
Professor
Head of Department
IUAV
University of Venice
Venice, Italy
siviero@iuav.it

Summary

Not infrequently, in Italy, building yards of important infrastructures take remarkably long time to be accomplished and are characterized by several interruptions and resumptions.

This is the case of the bridge over the Piave river in San Donà, commissioned in 2000 by the Italian National Road Corporation, ANAS SpA, an outstanding 500m arch structure on five bays of 100m each, located in a strategic area just outside the city of Venice.

The interruption of the construction works was, for the case mentioned, contemporary to the introduction of a new regulation, the O.C.P.M. n° 3274, concerning seismic design and seismic classification of the National territory. This fact, since the original project was characterized by a massive box girder concrete deck on pile foundations (thus not conceived for horizontal loads at first), gave rise to the necessity of starting with an updated design aiming to achieve a much lighter composite steel and concrete box girder deck.

The new deck was connected to the already built piers by means of non conventional steel-to-concrete connections ensuring hogging moment resistance at supports.

The new design of the deck is characterized by a sophisticated aesthetics and by an optimized distribution of structural material obtained through an iterative design-and-check process that, starting from a FE model of the structure with a full bottom flange of the box girder would lead to a layout with the material taken away from the zones with reduced levels of stress. At the beginning of the process, a model with a continuous and full steel bottom flange was created; in the end, two wide elliptical holes were created in the lower flange of the steel box girder.

Keywords: Refurbishment, Composite bridges, Composite connections, Seismic design

1. Introduction

The building yard of the San Donà bridge over the Piave river is characterized by several interruptions and resumptions. Originally, the layout proposed for the bridge was characterized by five arch pre-stressed concrete structure over a total length of 500m divided in 5 bays of 100m each (Fig.1) [1].

The cross section, with a total width of 17.86m, as presented in Figure 2, is made of cast-in-place concrete, poured on prefabricated arched concrete segments (Fig.2) supported by provisional scaffolding. By the way the solution presented was just partially built (Fig.3).

The parts of the bridge built before the interruption of the works are highlighted in Figure 4 and listed in succession: abutments (both), pier 1 (partially built), pier 3 and pier 4 (partially built).

The interruption of the works was contemporary to the introduction of a new Italian seismic code (O.C.P.M. n° 3274) and seismic classification of the National territory. This gave rise to the necessity of starting with an updated design involving the deck of the bridge, the piers being already