Structural modelling of the piers of the Paderno d'Adda Bridge (1889, Italy)

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Summary

This note focuses on a specific aspect of the structural modelling of the Paderno d'Adda Bridge, a marvellous Italian historic wrought iron bridge with riveted connections that was completed in 1889 and opened to both railway and road traffics [1-2]. Within the current attempt of building a full 3D FEM model of the structure [3-7], the metallic piers of the bridge are considered [5-6], specifically the *pier on the arch*. The morphology of the piers has been reconstructed from the inspection of the original design drawings and implemented into a FEM model. Then, a structural analysis has been performed in the elastic range, by considering loading distributions that were conceived at design stage and also conditions that are nearer to present-state railway standards.

Keywords: 19th-century historic bridge, railway arch iron bridge, FEM model, structural analysis.

1. Introduction

The Paderno d'Adda Bridge, sometimes called San Michele Bridge, is an impressive iron viaduct located in Lombardia, northern Italy, near Milano, North-East from it (Fig. 1). It allows the elevated crossing of the river Adda between Paderno d'Adda (Lecco province) and Calusco d'Adda (Bergamo province), to a height of about 85 m from water [1-2]. It was completed in 1889 by the *"Società Nazionale delle Officine di Savigliano" (SNOS)* and designed through the practical application of graphical-analytical methods such as the *"Theory of the ellipse of elasticity"* [3-4]. The bridge is composed of (Fig. 2): a 266 m long upper continuous box beam on 9 supports, 4 of them resting on the underneath arch; 5 vertical piers that provide 5 of the 9 bearings of the beam; a marvellous doubly-built-in parabolic arch with inclined faces of about 150 m of span and 37.5 m of rise.

Fig. 1: View from downstream of the Paderno d'Adda Bridge, Lombardia, Italy (1889).

Despite its age, the bridge is still in service, for both railway and automotive traffics. However, its state of conservation gives today some concerns, since maintenance seems to have been scarce, especially in the last twenty years or so. In light of this, it appears worthwhile to attempt the formulation of a complete structural model of the bridge [3-7], useful to assess its structural performance for different loading scenarios, under static and dynamic environments and according to both design-state conception and present-state conditions. Towards this modelling, as a first step, the design morphology of the different parts of the structure has been determined by the inspection of the original technical drawings made by the SNOS, which are guarded at the Archivio Storico Nazionale di Torino, in view of assembling a complete FEM model of the bridge that would be loyal, as much as possible, to the design conception.

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