



The Oporto São João Railway Bridge – maior design improvements through experimental tests

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Summary

In the early 1980's the Portuguese Government considered the possibility of replacing the aging 1877 Maria Pia railway bridge. Due to traffic constraints in the Portuguese north-south communications network a new bridge was necessary. A major competition was organized for a new railway bridge to improve the rail traffic between the twin cities of Oporto (north bank) and Gaia (south bank), where a larger traffic velocity (120km/h), higher axle loads and improved safety regarding derailment was required. This new innovative structural concrete bridge, with a strong aesthetic impact, had to use the existing network tracks but major adaptations had to be made on a 4km extension from Gaia to Oporto. The experimental tests carried out on the site laboratory were critical to guarantee a long lasting durable solution.

Keywords: Railway bridges, structural concrete, durability, experimental tests, aesthetics.

1. Introduction

In the North of Portugal, crossing the steep river Douro granite v-shaped valley, the Oporto Railway Bridge (1991) has recently completed 23 years of continuous and intensive use under growing traffic conditions. This railway bridge linking the cities of Oporto (north bank) and Gaia (south bank) still represents a unique challenge to structural bridge designers. Within the Oporto region, it became in 1991 the Oporto fourth bridge over the river Douro: (1) the 1877 Maria Pia iron arch railway bridge, by Gustave Eiffel, see Figure 1; (2) the 1886 Luiz I twin deck roadway iron arch bridge, by Theophile Seyrig (a former partner of G. Eiffel); and, (4) the 1963 Arrábida reinforced concrete highway bridge, by Prof. Edgar Cardoso. The magnificent π -shaped 1028,85m long portal span fording the Douro river, 66,5m above the stormy waters, see Figure 2, represents the ultimate achievement of one of the foremost Portuguese bridge designers, author of several unique bridge designs in Portugal and overseas.

2. The São João Railway Bridge

2.1 The Initial concepts

The 1,03 km long bridge is a portion of a total 4.0 km long new railway link between the cities of Gaia (Devesas) and Oporto (Campanhã) central railway stations. The Douro river crossing is done now at 66,5m above the water level which is 4,0m slightly above the previous crossing with the old Maria Pia bridge. Important aspects deserve to be considered: (a) structural safety; (b) aesthetics; (c) economics; (d) the bridge design scientific knowledge; (e) aesthetics; and, (f) construction process. The 1983 initial construction cost estimate– train stations, railway lines, one tunnel, the São João bridge and several overpasses reached nearly 50mEuro. This value was reviewed and, eight years later (1991), the total amount reached 150mEuro.