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Cable-Stayed Bridges for Urban Spaces

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Abstract

Aesthetics and Structural Performances of cable stayed bridges are essential conditions to improve the competitiveness of short to medium span cable-stayed bridge solutions for urban spaces. Environmental conditions, complex geometrical constraints, due to in-plan curved alignments, traffic maintenance requirements during erection and many other conditions are a challenge for the design of a cable-stayed bridge at an urban site. For such cases, Owners tend to prefer more classical solutions, for economical reasons and environmental integration.

Design concepts and case studies for cable stayed bridges, in which aesthetics and environmental conditions required particular consideration related to its integration in urban spaces are reported.

The solutions adopted for decks, towers and cable-stayed arrangements are compared. Structural, aerodynamic behaviours and execution methods are discussed for concrete cable stayed bridges.

Classical cable-stayed solutions namely, symmetrical solutions with two pylons, even if they are the most structurally efficient, are not always the most convenient ones to overcome difficult urban site conditions. In particular, the following case studies are reported:

- A curved bridge, open to traffic in 1998, where a single pylon and three planes of stays were adopted (Fig.1).
- A viaduct under construction, where a cable-stayed solution with 92m main span was shown to be the best solution for environmental integration (Fig.2).
- A viaduct with a main span of 120m and where an innovative shape for the tower was adopted, allowing a central walkway (Fig.3).

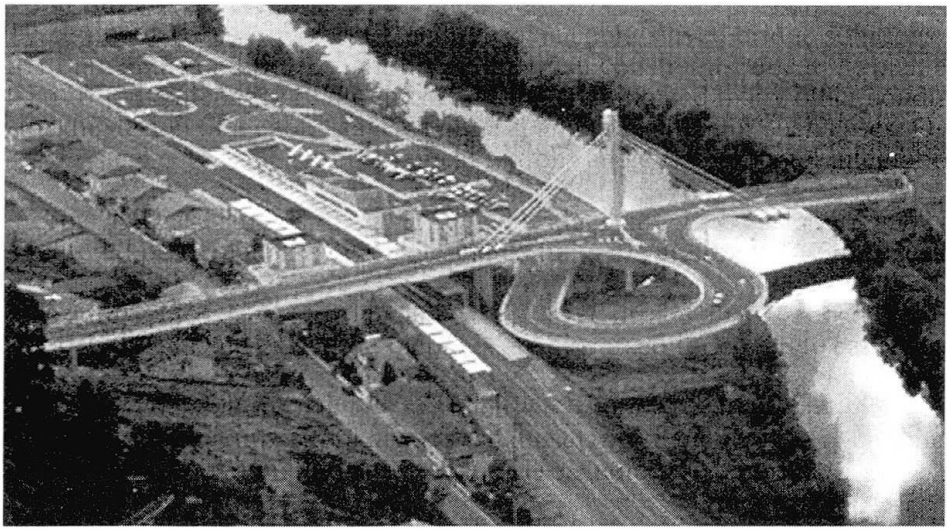
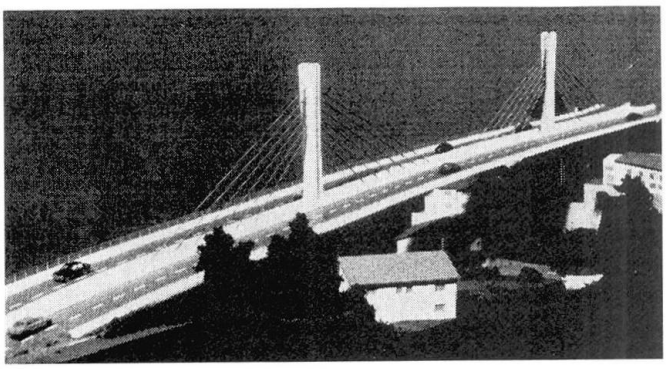


Fig.1 – A cable-stayed bridge, in St° Tirso.



For the case of Fig. 1, the use of stays allowed to keep the same type of cross section of the typical spans (a voided slab deck) at the severe end span 61m long. For the viaduct in Fig. 2, it was important to use an axial stay-cable deck with a slender cross section. A triangular type box girder section was adopted and wind tunnel tests have shown an excellent aerodynamic stability.

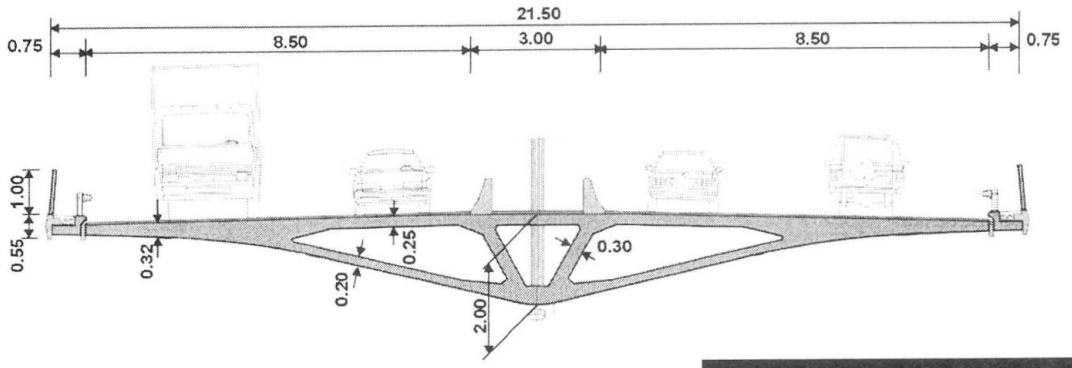


Fig. 2 – A cable-stayed viaduct in Funchal.

For the case of Fig. 3 and 4, a completely asymmetric solution was adopted for aesthetic and environmental integration, with one plan of stays on the main span and two planes of backstays.

In summary, aesthetics, environmental integration, structural performance and erection methods are discussed for the referred design cases. The advantages of using axial cable-stayed solutions and asymmetric configurations are discussed, as well.

The extension of these concepts to a long span cable-stayed bridge (with a 185m main span), located into an urban site, is presented.

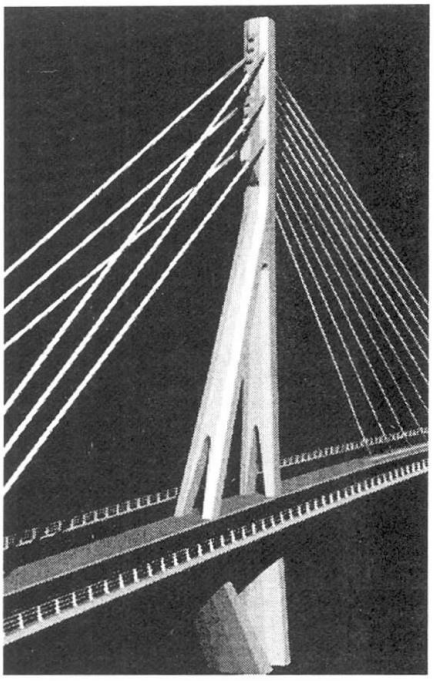


Fig. 4 The tower of the viaduct in Oporto.

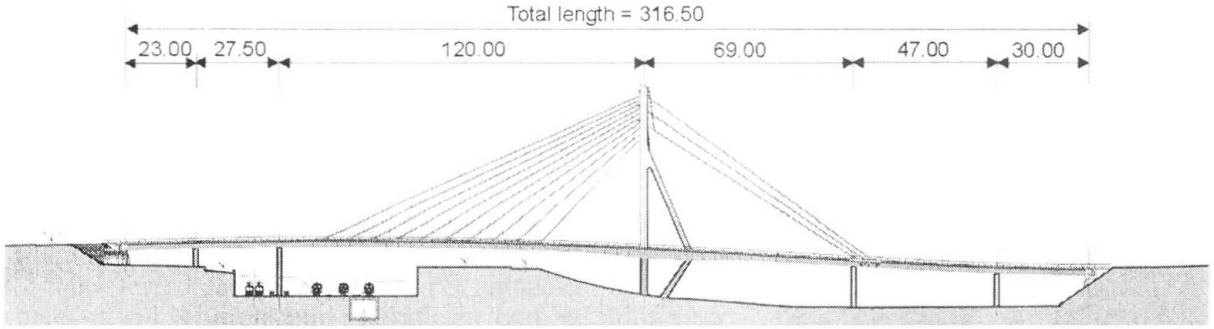


Fig. 3 – A cable-stayed viaduct in Oporto.