Exploring Structural Shapes in Steel Bridges: Bending Constraints

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Summary

During the final decades of the XXth Century and these early years of the XXIst Century, steel structures' design and fabrication techniques, as the CAD-CAM systems, modern welding, and powerful construction systems give the designer a new freedom, making possible almost any dreamt form. In this paper some of the possible fields of innovation in steel bridges are presented.

Keywords: Bridge; Steel; Cables; Stays; Hangers; Conceptual Design; Innovation; Typology.

1. Introduction

Steel structures were traditionally link to standardize systems formed by straight linear profiles. These members were normally assembly following the rules dictated by the canonical structural types. These kinds of solutions were extremely successful for implementing and consolidating the steel as the predominant material in construction industry. Nevertheless, using only profiles to configure structural member is a limitation to the real possibilities of the material, only bended recently. During the final decades of the XXth Century and these early years of the XXIst Century, steel structures' design and fabrication techniques, as the CAD-CAM systems and modern welding, and powerful installation systems give the designer a new freedom, making possible almost any dreamt form. In a way steel has beaten concrete in the field of free form solutions.

In this paper, examples of heterodox fields of applications of steel in bridges designed by the author are shown (figure 1).

Fig. 1: Exploring structural shapes in steel bridges

2. Non canonical truss structures and folded webs

2.1 Non canonical truss structures

Metal trusses are intimately linked to the railway industry. This is a type employed for these works since the 19th century due to their structural efficiency. Currently, truss girders continue to be an economic solution for railway bridges with medium spans and limited clearances.

One possible field of investigation is the combination between linear profiles and box sections. When the standard rolled profiles are not enough the cross sections can be constructed by welding different plates to reach the required resistance.

Ruidellots Bridge crossing [1] is a good example of the aforementioned approach. The bridge serves the high speed railway line from Barcelona to Paris and crosses over the busy motorway Barcelona-France (figure 2). The two lateral beams are trussed Warren type. However, in this bridge, instead of using a traditional distribution of depths (constant or variable with the maximum

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