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PLAYING STRUCTURAL EFFICIENCY WITH ARCHITECTS

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Summary

This paper describes the experience of working together with architects in the design of footbridges where aesthetics and structural efficiency are intrinsically linked.

It is quite common to say that the deep understanding of the function and the location (physical and human environment) dictate the form of a bridge.

In the specific cases presented in the paper, the particularities of several footbridges where the main advantages of their structural behaviour came from the symbiosis between architectural and structural conception, are emphasized. In some details, it can be said that the aesthetic choices intuited the good structural behaviour. As in other cases, it was the structural optimization that became the reason of the aesthetic options.

Keywords: conceptual design; aesthetics; structural efficiency; architects

1. Introduction

The classical discussion about the necessity and the consequences of Architects' presence in the design of bridges, especially footbridges, is far from being over. It is usual to argue that pedestrian bridge projects, when led by architects, often lead to illogical solutions from a structural point of view, with lack of efficiency and therefore with obvious economic disadvantages. However, it is undeniable that aesthetic and landscape integration considerations are of prime importance in the design of pedestrian bridges, because of their scale and proximity to their users and to the urban environments in which they are located.

2. Footbridges, Portugal

In the examples shown, the experience of working together with architects in the design of footbridges where aesthetics and structural efficiency are intrinsically linked is described.

In one hand, we have the arch(itectural) anti-symmetry of Pedro and Ines Footbridge which resulted in a benefic increase of transversal stiffness, important for the horizontal vibration control. On the other hand, the "strange rhythm" of the truss diagonals chosen for the S. Pedro Creek Footbridge was a result of the mathematical topology optimization.

Fig. 1. Footbridges, a) Pedro and Ines Footbridge, b) S. Pedro Creek Footbridge

Other examples such as the Carpinteira Footbridge, the Overpass in the 2nd Circular in Lisbon or the "Forte da Casa" Footbridge are listed to complete this story where global structural response (longitudinal and transversal), static and dynamic behaviour, stiffness and resistance, cross section definition and structural material choice are discussed.

Fig. 2. Footbridges, a) Overpass in the 2nd Circular, b) Carpinteira Footbridge

The bridges listed are the result of the fruitful collaboration with architect/designer – and former structural engineer – Cecil Balmond (www.balmondstudio.com); architect João Luís Carrilho da Graça (www.jlcg.pt) and "MXTstudio Architects" (www.mxtstudio.com) .

3. Conclusions

At a time when the means of calculation and construction technologies allow practically everything, in the face of a great confusion of forms, typologies and images, the objective of the solutions for all these bridges was to avoid any formal excess and reach with its structure the essence of its architectural conception.

A bridge is like a centaur, half material and half design [3], and each one of these footbridges is a 4 hands piano piece where collaborative work between Structural Engineering and Architecture since the initial design phase led to efficient and economic solutions with extraordinary artistic results.

The cases listed illustrate how mechanical performance was connected with formal architectural decisions. And we realize how beautiful it is when architecture can be that simple, effective, intentional, useful, intelligent.

Aesthetics of the given examples result from architectonic concepts that reflect structural demands and physical laws, but that aim at optimized structures and keep designs in the initial budgets.