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DESIGN OF A PEDESTRIAN BRIDGE IN A HISTORICAL SPOT

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THE BACKGROUND

This paper describes a proposal for a new pedestrian bridge located close to the Luiz I Bridge, over the Douro River, in Porto, Portugal. The proposed location coincides with that of the old Pensil Bridge, which was destroyed in the XIXth century, shortly after the conclusion of the Luiz I Bridge. The necessity for a new bridge stems from the increasing traffic and the overload of the sidewalks of the Luiz I Bridge, which are intensively used by tourists.

Figure 1 – Motorized traffic and pedestrians in the existing Luiz I Bridge.

THE CONCEPT

Since the need for a new river crossing is evident, the next step is to select its location and structural solution. In recent years several proposals have already been presented, but none has been adopted. The solution described in this paper can be regarded as the rehabilitation of the old Pensil Bridge, which was located in the river's narrowest point. The main concern regarding this solution is the necessity of not obstructing the sight over the old Luiz I Bridge, which is now classified as world patrimony. For these reasons, the main concept behind the design of the new bridge is its transparency. The desired utilization of the old pylons in the reconstruction implied the adoption of a suspension bridge, similar to those that were common in the XIXth century.

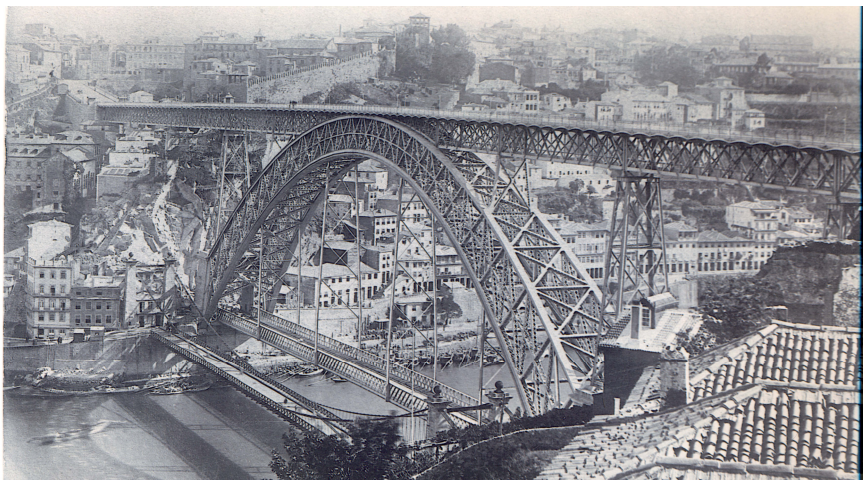

Figure 2 – XIXth century photo showing both bridges during their brief co-existence.

NEW MATERIALS

In order to achieve the desired goal of a considerable transparency, the cable system has to be as thin as possible. Instead of using a traditional material, such as steel, a modern one was adopted for its lightness and high resistance: a carbon fiber reinforced polymer (CFRP). This material is available with a wide variety of properties, being the most important in this context its high tensile strength, high Young's modulus, low density and low creep coefficient. Since it is also desired to achieve a high transparency in the bridge deck, glass is an evident solution. The industrial progress in this area allows for the construction of a solid and fully transparent glass deck, which is also slip and scratch resistant.

STRUCTURAL SOLUTION

One of the main problems associated with light pedestrian bridges is the high susceptibility of significant vibrations, since their stiffness is usually low. In order to avoid strong vertical and lateral oscillations, a pair of inverted cables is installed below the bridge deck. These cables are contained in inclined planes and are prestressed.

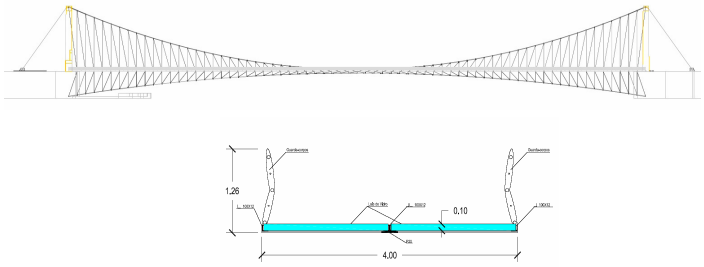

Figure 3 - Elevation view of the bridge and cross section of the deck.

TUNNING THE BRIDGE

A pedestrian bridge must have natural frequencies that do not cause the crossing uncomfortable to the user. Avoidance of critical wind induced oscillations is also a main concern. Since the behavior of the proposed bridge can be tuned by means of the amount of prestress applied to the cable system, an acceptable solution could be obtained. This study was carried out using a numerical model that takes into account the geometrical nonlinear behavior of the prestressed cables.