Chapter 15

On the *Biais Passé*:
The Olivier String Model and the Representation of Constructive Solutions for the Skew Arch

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**ABSTRACT**

Among the famous dynamic string models conceived by Théodore Olivier (1793-1853) as a primary didactic tool to teach Descriptive Geometry, there are some that were strictly related to classic problems of stereotomy. This is the case of the biais passé, which was both a clear illustration of a special warped ruled surface and an example of how constructors dealt with the problem of building a skew arch, solving structural and practical stone cutting demands. The representation of the biais passé in Olivier’s model achieved a perfect correspondence to its épure with Monge’s Descriptive Geometry. This followed from the long development of representational tools, since the 13th century sketch of an oblique passage, as well as the improvement of constructive procedures for skew arches. Paradoxically, when Olivier presented his string model, the importance of the biais passé was already declining. Meanwhile, other ruled surfaces were appropriated by architecture, some of which acquiring, beyond their inherent structural efficiency, a relevant aesthetic value.

**INTRODUCTION**

The museum of the ISEP, Instituto Superior de Engenharia do Porto, in Portugal, has a remarkable collection of string models of ruled surfaces — surfaces that are generated by the movement of a straight line in space — originally conceived, since 1830, by Théodore Olivier (1793-1853), a disciple of Gaspard Monge (1746-1818).

These dynamical models reflect an innovative methodology in the study of ruled surfaces, and an adequate didactic strategy to the widespread teaching of Descriptive Geometry. Therefore they were
acquired over the 19th century by several schools of arts and crafts, polytechnic academies, military academies and other schools where this new branch of Geometry, “the engineer’s language” as Monge puts it, was considered a basilar knowledge.

It is not surprising, thus, that they have also arrived to the old Instituto Industrial do Porto, the precursor of ISEP, by the hand of its director Gustavo Adolfo Gonçalves e Souza (1818-1899), a teacher of Descriptive Geometry himself.

This article highlights one of the Olivier models — the biais passé or skew arch— which enables the exemplary visualisation of the geometrical and constructive features involved in shaping this surface, and is a privileged witness of the relationship between theory and practice that characterized the development and teaching of Descriptive Geometry.

The non-developable ruled surface biais passé arises as a constructive solution for the stone skew arch, associated with a particular stonework. The description of this structure appears in several treatises of architecture and stereotomy, follows the evolution of the languages of representation and communication of geometric shapes and clearly illustrates the revolution that Descriptive Geometry represented.

When Monge’s geometric statements were discussed in terms of their adequacy as building principles, the skew arch was one of topics addressed, thus including the surface/stonework biais passé in a live and fracturing debate that influenced the subsequent importance and scope of Descriptive Geometry. The model biais passé is also a symbol of the anachronisms that often punctuate the teaching curricula, since the diffusion of the Théodore Olivier string models collection happens in a moment where the biais passé is no longer considered an eligible method for the skew arch (see Figure 1).

**Description of the Biais Passé**

The oblique or skew arch is the vault of a passage along an axis that is not perpendicular to the faces of the wall. Thus, in plan, this arch is a parallelogram. The construction of stone skew arches followed
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