



Geometry and Parametric modeling in the Conceptual Design of Bridges

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Abstract

Parametric techniques are developing as an agile tool in both civil engineering and architectural design. What is especially powerful is the ability of these softwares to relate and iterate through multiple options with minimal effort. The tools that combine a parametric definition of the bridge with a 3D graphic and a FEM model gives the designer the opportunity to analyse instantaneously, the effect in the variation of the variable parameters in terms of visual appearance as well as structural behaviour simultaneously. Therefore parametric design is a valuable tool in the conceptual design phase where the geometric decisions made are the most structurally and architecturally impactful.

Keywords: Parametric Design, Conceptual Design, Bridges, Optimization.

1 Introduction

Mathematics is a field where engineers feel comfortable. During their first University courses they receive an intensive training in mathematics, therefore when they start working as young designers they have a good capability to deal with complicated mathematical and geometrical problems. Architects on the other hand learn relatively little math, especially in North America and Britain, and are much more comfortable dealing with form.

Structural analysis from its origins was based on calculus and therefore a strong competence in mathematics was required for any engineer. Nevertheless those analytical methods became much less used when the use of computers

became popular in structural engineering. The consequence of that situation was a substantial reduction of the use of mathematics in the daily work of the engineers. Moreover, the introduction at the same time of CAD system entailed a limited use of complex geometry in Architecture as well as in Structural Engineering.

But nowadays there is a substantial modification of that tendency because of the development of a new generation of computer graphics for generating and representing curves and surfaces. Complex geometry can be efficiently handled by computer programs with a friendly interface for human interaction.

Also, the visual programming languages used mainly to build generative algorithms to create 3D