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Conceptual and parametric design of steel bridges

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Abstract

Greater challenges are being faced by engineers in modern bridge design to seek the optimal solution. This is due to the increasing structural complexity of steel bridges being demanded by higher client expectations, while there remains the need for the designs to be economic. The authors have developed a framework of parametric design practice which enables common bridge types to be rapidly modelled and compared. The benefits of parametric design and modelling for steel bridge design is first addressed with a primary focus on conceptual design, including a discussion on different structural forms and the components of parametric design. Furthermore, an innovative digital design workflow is promulgated for reducing design effort and increasing the coordination efficiency in an integrated design platform. A case study of a suspension footbridge concept design in Otago, New Zealand is presented which demonstrates the application of the parametric design workflow.

Keywords: Conceptual design; parametric design; steel; bridges; design; modelling; workflow; digital design.

1 Introduction

Traditional design and structural analysis methods can be time consuming to carry-out and have limited ability to cope with changes as the design develops, which is an ever-increasing demand being expected by this fast-changing industry. In response to this situation, the authors believe advanced computer analysis and adopting a parametric design approach is one of the key tools to push the design to the limits while meeting the increasing industry demands. The conceptual design phase of a project is when most of the creative aspects and problem solving occur and, in this paper, an innovative digital design workflow is presented for reducing design effort and increasing co-ordination efficiency at the conceptual design phase.

Conceptual design can be considered the most important phase of the design. At the conceptual design phase, this when all considerations are combined, drawing on the creative and problem-solving skills of the designer, where initial concepts can be tested as possible solutions, and is the reason why adopting a parametric design approach at this stage can yield the greatest benefits.

The use of steel as an engineering material offers almost limitless use for engineering applications, due to its high strength to low weight ratio, ease of fabrication and its adaptability to take any structural form. This crucial understanding of the behaviour of an engineering material together with creative and problem-solving skills enables an engineer to develop conceptual designs, and due to the versatility and application of steel for bridge construction, the authors have chosen this material to focus this paper.

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