

Structural Form Enhancement for Aesthetic Bridge Design

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Summary

The significance of bridge aesthetics has been acknowledged among multidisciplinary participants over several decades. However, there exists a large gap among the participants because of their different perspectives. In order to reduce the gap the concept of force flow must be shared because many of existing bridges show that their elegant forms come from structural efficiency. This paper will discuss how to enhance structural forms based on the concept of force flow in an early design stage right after an artistic sketch is generated. This enhancement process includes the following tasks: (1) calling an artistic sketch into a Graphics window; (2) structural analysis of the sketch using parametric structural system; and (3) refinement of the structural shape considering structural behavior of the force flow. The parametric structural system must be predefined with an appropriate structural analysis tool. The main objectives of this paper are to address the two issues: (1) the development of a structural analysis tool supporting the structural analysis task for the communication among multidisciplinary participants and (2) the development of collaborative design paradigm among multidisciplinary participants useful in early design stages. The structural analysis tool will be implemented using graphic statics combined with the concept of dynamic graphics available through 3D Graphics software. It is expected that the proposed way of structural form enhancement using the structural analysis tool implemented directly using 3D Graphics software may reduce the gap deeply rooted among multidisciplinary participants.

Keywords: Structural form enhancement, dynamic graphics, force polygon, structural form generation

1. Introduction

Aesthetics of bridge structures means its visual attractiveness and the beauty of bridge is one of the most important goals in bridge design. Authors have researched on bridge aesthetics since the research project on the development of a design guideline for good looking bridges opened authors' view point beyond engineering aspects [Hong and Koh 2007]. While directing the research, many important things have been realized to address toward aesthetic bridge design. Among them, collaboration with multidisciplinary participants is essential as a design project becomes large in scale and more important in function. Also, the visual effect of structural members of larger bridges is much greater than those of smaller bridges. This means that the aesthetics of larger bridges must be achieved by shaping structural members to express structural elegance. However, there still lacks of communication tool for the collaborative team and design tool appropriate to support early design stages. In order to address these issues, the authors have proposed a collaborative design paradigm [Hong et al. 2010] and have investigated the potential of graphic statics as a supportive design tool for conceptual design [Hong et al. 2011]. Along with the previous researches, the