Exploration of Structural Form of Hybrid Cable-Supported Structures

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Summary

Structural forms of cable structures are broadly grouped into three categories depending on load-resisting system: (1) suspension system; (2) cable-stayed system; and (3) hybrid cable system. In this study, the term 'hybrid' refers to the combination of both suspension and cable-stayed systems. Nowadays the hybrid system has been attempted targeting on various purposes including loner span of cable-supported and unique structural shape. In early design stages, when the relationships between structural form and structural behavior can be predictable to some degree, it can be easier to develop structural forms that are both visually and structurally sound. However, when a structure is designed adopting the hybrid cable system, its structural behavior seems more complicated than that of the structure adopting only one system. This study has focused on the development of structural forms of the hybrid cable-supported structures considering load path. The main objectives of this paper are to address two issues: (1) the understanding of the relationship between structural form and structural behavior of the hybrid cable system and (2) the parametric simulation for the exploration of structural forms of the hybrid cable system considering the load path of cable stays and hangers. Some non-scale models were tested to help understand some important aspects including the relationship between structural form and behavior of the hybrid cable system; the constructability; and the relationship between geometric form and visual appealing.

Keywords: hybrid cable-supported structure, load path, strcutural art, conceptual design

1. Introduction

Generally structural forms of cable structures are broadly grouped into three categories depending on load-resisting system: (1) suspension system; (2) cable-stayed system; and (3) hybrid cable system. Note that the term 'hybrid' in this study refers to the combination of both cable-stayed system and suspension system. Recently designers have realized numerous advantages of using the hybrid cable system are possible by making up the deficiencies accompanied with using pure systems only. Thereby, the hybrid of cable-stayed system and suspension system has been appeared as competitive design alternatives for the design of long-span bridges. Nowadays the way of bridge design considering safety, sustainability, and savour has been rooted. Moreover this approach has obtained strong momentum by the awareness of the visual quality of social infrastructures including bridges. To comply with such design approach, form exploration for bridge design must be based on the triad of structural art: (1) form; (2) function; and (3) behaviour [Hong et al. 2013]. In early design stages, when the relationships between structural form and structural behaviour can be predictable to some degree, it can be easier to develop structural forms that are both visually and structurally sound. To address this issue, the authors had made some researches on the development of structural form considering force flow for typical cable-supported structures [Hong et al 2012].

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