



## Parametric Simulation of Structural Silhouette for Hybrid Cable Bridges

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### Summary

This study has focused on conceptual design of long-span cable bridges where parametric simulation of structural silhouette plays a key role. Specifically the generation of various structural silhouettes of hybrid cable system will be focused in this study. The term 'hybrid' refers to the combination of both suspension and cable-stayed bridges. The use of the hybrid system is to explore an innovative and unique structural shape for long-span of cable bridges. The main objective of this paper is to provide a framework for the parametric simulation for the exploration of structural forms of hybrid cable bridges considering the load path of cable-stays and hangers in conceptual design. The understanding of the load path for the hybrid cable systems will be made by relating the structural form and the corresponding force polygon using the static approach. Imposing the close relationship between a structural form and its structural behavior on the generation of design alternatives in early design stages, it will become easier to obtain structural silhouettes that are both visually and structurally sound. The design variables for the parametric simulation include geometric variables of major structural components and some variables that are sensitive to visual appealing. It is expected that this parametric simulation help develop an innovative structural silhouette considering multi-aspects including safety, sustainability, economy, and aesthetics.

**Keywords:** structural silhouette, hybrid cable bridge, bridge aesthetics, conceptual design

### 1. Introduction

Cable-supported bridges that inherently come with tall towers are generally utilized to design a long-span bridge or to create a landmark structure. These long-span cable-supported bridges as they are become dominant objects in the visual space. It should be noted that the aesthetics is not implemented by adding something else to the bridge structures, but it is obtained by performing a series of structural design from conceptual to the detailed through multidisciplinary design process. This study has focused on the conceptual design of hybrid cable bridges with their feasible structural silhouettes.

### 2. Structural Silhouette Factors

The hybrid cable bridges that combine the structural systems of a cable-stayed and suspension consist of major structural components of the two systems i.e., towers, cables, decks, and anchorages. Thereby, these structural components become structural silhouette factors that control the visual quality of bridge shapes.

### 3. Structural Silhouette and Behavior of Hybrid Cable bridges

The initial geometry of the hybrid system is governed by the dead load. In this study, the relationship between the structural silhouette and structural behaviour of a hybrid cable bridge can be understood by assuming that the cable structure under dead load is so flexible that it behaves like a funicular curve.

### 4. Framework for Parametric Simulation

To reflect all different perspectives in a harmonious way, this study has proposed a framework that is used to perform parametric simulation for hybrid cable bridges in conceptual design. Within the integrated framework, multi-aspects are addressed in terms of each of the triad for bridge aesthetics: form, function, and structural behaviour. The relationships among the triad components are closely related to each other, as shown in Fig. 8.

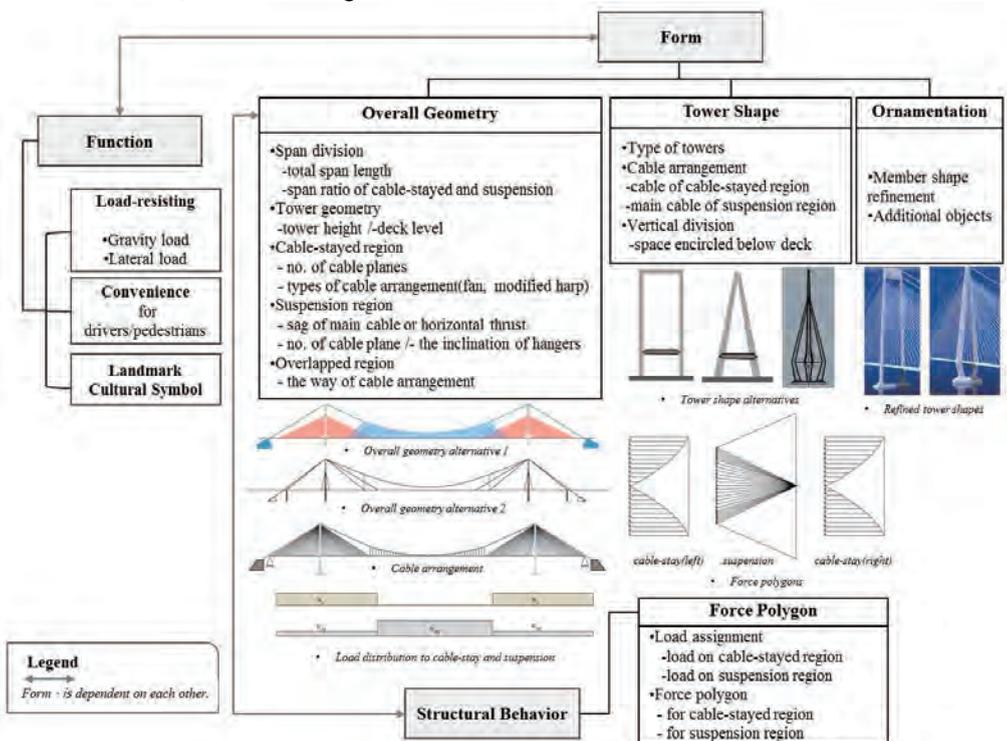


Fig. 8 A framework for parametric simulation for structural silhouette.

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