Conceptual Design of Long-Span Suspension Bridges: Tower Structural Forms

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Abstract

Towers are highly visible and characteristic structural components in long-span bridges. Although several tower arrangements have been proposed for medium-span cable-supported bridges, few solutions have been feasible and optimal for long-span suspension bridges. The most widely adopted form is the H-frame, where vertical (or slightly inclined) legs are connected by one or more cross beams. Another solution is the A-frame in which two inclined legs, not necessarily connected by intermediate cross beams, merge at the tower top. On a few occasions single-shaft towers, often used in cable-stayed bridges, have also been used in suspension bridges. This paper compares alternative tower forms for long-span suspension bridges, based on COWI experience in recent bridge design projects. Different arrangements are investigated, with the objective of improving structural efficiency and reducing material quantities. Finally, constructability aspects and the interaction between the towers and other bridge elements are discussed.

Keywords: suspension bridges; bridge towers; pylons; long-span structures.

1 Introduction

In long-span suspension bridges, aesthetics is often as important as structural efficacy since these structures represent way more than mere crossings. They are landmarks affecting the way people live and interact with the environment. Towers are the most visible element of a suspension bridge, and their form can become as iconic as the whole structure.

Several structural forms have been adopted for cable supported bridges; however, long-span structures impose several constraints on the tower design, thus reducing the available options. This paper investigates the concept design of towers for long-span suspension bridges. First, structural aspects related to design and construction are analysed. Then, advantages and limitations of typical tower forms are highlighted. Finally, some reference projects from COWI portfolio are presented to compare competing solutions in terms of efficiency and aesthetics.

2 Concept design of suspension-bridge towers

This section highlights the key factors driving the conceptual design of long-span suspension bridges.

2.1 Material

As the predominant force carried by the tower is compressive axial load from the cables, combined with bending due to eccentricities and horizontal loads, concrete towers are typically the first choice. However, the considerably increased self-weight over that of an equivalent steel structure may

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