Comparison of a Single and Double Main Span Suspension Bridge for the Western Scheldt Crossing

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Summary

The option of a double main span suspension bridge has thoroughly been studied in the Netherlands as an alternative to a bridge with a very long single main span. This paper presents the conclusions of that study, along with comparative conceptual designs of both bridge options. The study and the designs allowed pronouncing the double main span bridge feasible despite the large horizontal loads on its middle pylon. The results can be indicative for prospective multi-span suspension bridges.

Keywords: Suspension bridge, main span, multiple span, main cable, cable-stayed bridge, pylon, middle pylon, anchor block, bridge girder.

1. Introduction

The idea of a double (or multiple) main span suspension bridge enjoys much interest recently – especially in the fast developing countries like China. In the Netherlands, it was one of the options in conceptual designs of the long bridge crossing of the tidal Western Scheldt mouth near Terneuzen. The other bridge options were: a 'conventional' single-span bridge, a multi-span cable stay bridge with a steel girder and a multi-span cable stay bridge with a concrete girder. None of these options was eventually realized. For the reasons which are beyond the scope of this paper, a 6 km long tunnel was chosen for the river crossing. Nevertheless, the performed studies and designs delivered many valuable conclusions. Several of them are still valid, although the designs were completed in 1992. In this paper, the main general conclusions are presented with a focus on the feasibility of a double main span suspension bridge.

The attempts to construct a double or multiple main span suspension bridge are probably as old as the suspension bridges themselves. Until recently, these attempts were little successful. The general opinion was that a large multiple main span suspension bridge is not feasible or, at least, structurally unfavourable. The main reason was a substantial and highly located horizontal load from the main cable atop the middle pylon. The overturning moment produced by this load could barely be carried by both the pylon and its foundation (Fig. 1). Yet, even the greatest bridge constructors of the XIX century 'flirted' with this idea. The most well-known is probably the Ralph Modjeski's Oakland Bay Bridge (Fig. 2) which, however, has a system of two coupled suspension bridges rather than one bridge with multiple main spans.

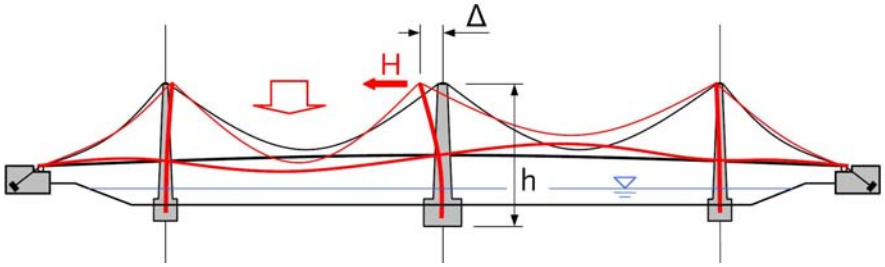

Fig. 1: The middle pylon problem in a double main span suspension bridge

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