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Independent Design Verification of 1915 Çanakkale Bridge: Global Analyses of Construction Stages

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ABSTRACT

The 1915 Çanakkale Bridge stretches the boundaries of what has previously been achieved for suspension bridges. To ensure a safe, reliable and fast-track construction, detailed global analyses of tower, cable and deck construction were performed by the Independent Design Verifier (IDV). Modelling and simulation of all construction stages, including a detailed model of the catwalk, is a far more complex and complicated task than analysing the completed bridge. The completed bridge analysis model was extended by adding thousands of elements representing cranes, temporary cross beams, bents, pullback cables, catwalk, temporary deck joints, and temporary hangers, among others.

To effectively handle the large number of element activations and deactivations and adjustments of hangers and joints throughout the construction process, the analysis setup was automated by extensive use of TCL and Python programming. At the end, a total of 183 construction stages were defined, which were analysed in two batches. The first 31 stages were simulating the tower erection, while the following 152 stages started by catwalk rope installation and ended by applying long-term settlements.

In addition to provide a comprehensive verification of the construction engineering and identifying possible issues at an early stage, the IDV was also able to provide the contractor enhanced understanding of the bridge behaviour during construction. The value of independent analysis contributed significantly to the structural safety and risk reduction for the construction activities.

Keywords: Suspension Bridge, Construction Engineering, Global Analysis, RM Bridge

1 INTRODUCTION

The 1915 Çanakkale Bridge client, KGM, specified that the contractor, DLSY, had to provide independent design verification for all the permanent works. Arup and Aas-Jakobsen were appointed by DLSY as Independent Design Verifiers (IDV). In addition, DLSY chose to add nearly all temporary works to the verification scope. This required further specialist support, and DLT Engineering (catwalk and cable) and Tony Gee (deck lifting gantries) were included in the IDV team.