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Cable replacement of the Tacitus cable stayed bridge

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Abstract

As part of a major renovation programme of critical highway infrastructure in the Netherlands, the Tacitus Bridge at Ewijk, a 1055-metre-long orthotropic steel box girder deck of ten spans, with a main cable-stayed span of 270 metres, has undergone extensive strengthening and refurbishment. Due to the presence of micro-fissure defects identified in the existing lock coiled stay cables and an increase in permanent load on the bridge deck resulting from the addition of a high strength concrete overlay acting compositely with the orthotropic steel deck, it was concluded that the existing stay cables needed replacement. This paper presents the analytical approach developed to verify that the existing stay cables could be removed with no additional temporary supports and the use of advanced non-linear techniques to predict and monitor the performance of the bridge during each step of destressing the existing stay cables and of tensioning the new parallel strand cables.

Keywords: Stay cable replacement, steel orthotropic box girder, non-linear analyses.

1 Introduction

The Tacitus Bridge near the village of Ewijk in the Netherlands, located south of the River Waal and carrying the A50 motorway, is one of eight landmark bridge structures that were selected for renovation by the Dutch Highways and Waterways Agency, Rijkswaterstaat (RWS). The renovation of these typically 40-year-old steel bridges is necessary because they suffer from fatigue cracking in the orthotropic deck due to the increased number and weight of heavy vehicles on the highways. The Managing Contractor (MC), a joint venture of Greisch, RHDHV and Arup, was appointed by RWS to undertake the assessment of the bridge, design of the strengthening, procurement of the works and supervision during construction. The scope of the renovation programme was to solve the fatigue damage present in each of the orthotropic steel decks by strengthening the deck with a high strength concrete (HSC) composite overlay and to extend the design life of the bridges for a further 30 years.

Another objective of renovating the eight bridges (Figure 1) in this manner, was to gain further knowledge and experience in the use of HSC to strengthen steel bridges. Many steel bridges in Western Europe built in the 1960s and 1970s are suffering from similar fatigue induced damage and so developing a functional solution is of great benefit to bridge owners when assessing future refurbishment projects.

High strength concrete was first tested by RWS on the Caland bridge and then applied on the Hagestein bridge and Moerdijk bridge. In the first phase of the MC project, this same solution was adopted in strengthening the Muider bridge, an arch bridge at Beek and Scharberg bridge. The second phase of the MC project entailed the large-scale renovations of the Galecopper bridge, Tacitus bridge and Kreekrak bridge. Finally, renovation solutions for the Van Brienenoord bridge and Suurhoff bridge are currently still in development. These bridges would require a large amount of strengthening to facilitate the HSC overlay on the

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