Verification calculation of the Cortenoeverse bridge using finite element analysis

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Abstract

The Cortenoeverse bridge is a multi-span pre-stressed concrete box girder bridge near Zutphen, the Netherlands. Following the discovery of certain damages at the sides of the bridge where post-tensioned tendons are stressed, several repairs have already taken place. The Dutch agency Rijkswaterstaat (RWS) still deemed it desirable to further investigate the structural safety and usability of the whole bridge during the residual service life. Subsequently. ABT was commissioned to perform a verification calculation. Finite element analysis (FEA) was applied to analyse the structural behaviour of the bridge. Compared to analytical methods, FEA can simulate the occurring forces more accurately and give more insights into the structural behaviour of the bridge. The bridge was modelled using 2.5D curved shell elements with embedded reinforcements subjected to post-tensioning loads. An overview is given for the FEM model, the calculation procedure and the results.

Keywords: pre-stressed concrete; box girder bridge; lightweight concrete; FEM analysis; DIANA FEA

1 Introduction

The Cortenoeverse bridge is a prestressed concrete box girder bridge near the city of Zutphen in the Netherlands that spans over the IJssel river with 12 spans and has a total length of 810 m (Figure 1). The bridge was opened in the year of 1976.

Figure 1. Cortenoeverse bridge over the IJssel near Zutphen, the Netherlands

ABT was commissioned by Rijkswaterstaat (RWS), the executive agency of the Ministry of Infrastructure and Water Management of the Netherlands to perform a verification analysis of the Cortenoeverse bridge. The goal of the verification analysis is to evaluate the structural safety and usability of the bridge. The verification analysis follows the Dutch guideline RBK 1.1 published by RWS. Use was made of a finite element model created in the FEM package DIANA.

2 Structural assumptions

2.1 Safety level and consequence class

Bridges in and over main roads and waterways are classified in consequence class CC3 in accordance with NEN-EN 1990. Furthermore, RWS has introduced a safety level "*gebruik*" which uses a reliability index β = 3.3 as a lower limit for the structural safety for its physical infrastructure.

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