



Extended linear finite element calculation of a 70-years old prestressed concrete viaduct

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Abstract

The many bridges and viaducts in the Netherlands that were built in the 1950s and 1960s are approaching the end of their service life. Instead of replacement, which costs a lot of money and resources, reassessments and rehabilitation can be used to extend the expected service life of existing structures. For one of these structures, Spoorviaduct Uitgeest (a viaduct in the Dutch highway A9), a refined reassessment was requested to investigate whether this viaduct is sufficiently reliable.

In a comprehensive reassessment, performed by Arcadis Netherlands BV, the total viaduct was modelled in a 3D FE model. With this FE model, creep, shrinkage, permanent loads, traffic loads and imposed deformations were considered. It turned out that the cross-sectional shear checks and the rotational capacity were governing. By sufficient use of monitored material properties and refined shear calculations, sufficient shear capacity could be proven. Moment-curvature diagrams were used to prove enough rotational capacity.

Keywords: Prestressed concrete; existing viaduct; reassessment, FE model; rotational capacity; shear force capacity.

1 Introduction

In 2016, Rijkswaterstaat (the Dutch Ministry of Infrastructure and Water Management) had applied a quick scan method to investigate the structural reliability of structures with prestressed T-shape girders. For most of these structures sufficient resistance against traffic load according to the current design codes could be proven by using this quick scan method. For a few structures, the quick scan method could not prove sufficient load bearing capacity. One of these structures is Spoorviaduct Uitgeest. For this viaduct, the quick scan method resulted in a unity check for the shear

strength verification of 2.04, which means that the loads on this viaduct result in shear forces which are more than twice the shear load bearing capacity of the structure. However, investigations on the viaduct did not show any structural damage. No single crack had been observed during the investigations. This indicates that the structure is stronger than the quick scan method implied. It was expected that a comprehensive reassessment using extended FE calculations could avoid replacement or strengthening of the viaduct. The FE calculations were performed by Arcadis Netherlands BV.