Capacity of prestressed concrete bridge decks under fatigue loading

Eva O.L. Lantsoght

Universidad San Francisco de Quito, Quito, Ecuador

Delft University of Technology, Delft, the Netherlands

Cor van der Veen

Delft University of Technology, Delft, the Netherlands

Rutger Koekkoek

BAM, Gouda, the Netherlands

Henk Sliedrecht

Rijkswaterstaat, Utrecht, the Netherlands

Contact: e.o.l.lantsoght@tudelft.nl

Abstract

In The Netherlands, existing slab-between-girder bridges with prestressed girders and thin transversely prestressed concrete decks require assessment. The punching capacity was studied in a previous series of experiments, showing a higher capacity thanks to compressive membrane action in the deck. Then, concerns were raised with regard to fatigue loading. To address this, two series of large-scale experiments were carried out, varying the number of loads (single wheel print versus double wheel print), the loading sequence (constant amplitude versus variable amplitude, and different loading sequences for variable amplitude), and the distance between the prestressing ducts. An S-N curve is developed for the assessment of slab-between-girder bridges. The experiments showed that compressive membrane actions enhances the capacity of thin transversely prestressed decks subjected to fatigue loading.

Keywords: Assessment, Fatigue, Live loads, Punching shear, Shear, Slab-between-girder bridges.

1 Introduction

The Dutch bridges from the decades following the Second World War were designed for the live loads of that era, which were lower than the currently code-prescribed live loads. At the same time, the previously used national codes in The Netherlands, such as NEN 6720:1995 [1] contained provisions that resulted in larger calculated shear and punching shear capacities than when using NEN-EN 1992-1-1:2005 [2]. As a result, an analytical assessment of existing concrete bridges often results in the conclusion that the shear or punching shear capacity is insufficient [3]. One bridge type that upon assessment is often found to be insufficient for punching shear is the slab-between-girder bridge. These bridges consist of prestressed girders and thin transversely prestressed concrete decks that are cast between the prestressed girders. In total, about 70 of these structures are present in the Dutch road network [4].

https://doi.org/10.2749/ghent.2021.0313
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