

Fatigue behaviour of cracked concrete decks under cyclic shear loading

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Abstract

In large steel-concrete composite road bridges cracking occurs in the concrete deck due to tension resulting from negative bending moments at the support area. Simultaneously, high wheel loads from the traffic act as cyclic shear loading on the concrete. As a result, tension forces coming from the global load-carrying effect need to be superimposed with local vertical forces due to the wheel loads acting as cyclic shear loading. In this paper, the results of experimental investigations regarding the fatigue strength of the cracked concrete deck in tension are discussed. Furthermore, the effect of the longitudinal reinforcement ratio and the height of the tensile stress is pointed out.

Keywords: composite bridges, cracked concrete deck, fatigue shear loading.

1 Introduction

New developments of composite bridges avoid prestressing of the deck as in concrete bridges and moreover allow to use precast concrete elements supported by transverse beams when the on-site concrete layer is poured. In this design (see Figure 1), cracking occurs at the support areas because the concrete is subjected to tensile forces due to hogging moments from the global action effects. High ratios of longitudinal reinforcement limit the crack width at serviceability limit state. However, simultaneously, traffic loads induce direct cyclic shear loading in the concrete deck. As a consequence, the global tension forces need to be superimposed with local vertical forces due to the cyclic wheel loads acting as cyclic shear loading.

The static behaviour of concrete decks in tension without shear reinforcement under direct shear loading has already been investigated by an experimental testing program [2]. The corresponding rules were already included in Eurocode 4-2 (EC4-2, 6.2.2.5 (3)) [3]. Experimental studies on the load behaviour of the cracked concrete deck in tension under cyclic shear loading

so far are not known. At the University of Stuttgart, a comprehensive testing programme on cracked concrete decks is conducted as part of a research project [1]. The aim of these tests is to determine the behaviour of the axially loaded cracked concrete deck under fatigue loading in order to allow for a more than 100 years service life.

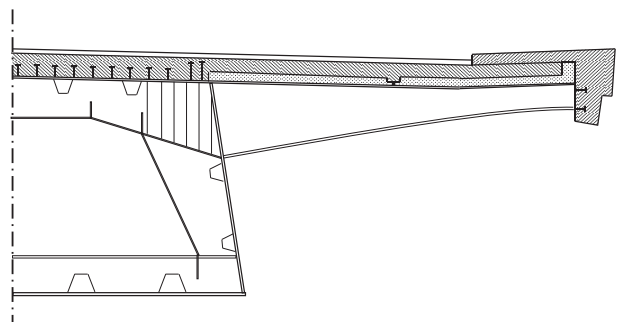


Figure 1. Cross-section of Heidingsfeld viaduct, Germany