Shear Capacity of Prestressed Continuous Concrete Beams

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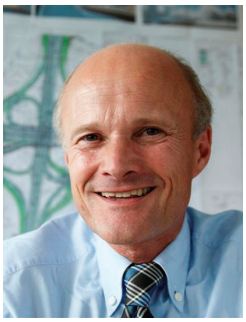

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Summary

A better part of the existing bridges of the German Federal Highways are built as prestressed concrete continuous beams [1]. Since traffic loads have been rising since their construction, the shear capacity of some bridges is insufficient according to current standards. However, the shear capacity of concrete beams can be increased in different ways, e.g. by using external tendons.

In this paper a research programme, funded by the Federal Highway Research Institute of Germany (BASt) and carried out by the Institute of Structural Concrete at RWTH Aachen University, is presented. Six tests on three continuous beams with parabolic tendons and additional external prestressing are performed within this project. This paper presents the testing programme and a preliminary numerical analysis of the specimen in comparison with different approaches for the calculation of the shear capacity.

Keywords: shear capacity; prestressed concrete; continuous beams; parabolic tendon; external prestressing

1. Introduction

The requirements concerning bridge constructions have grown in the past due to increasing traffic loads. Therefore, some of the existing bridges of the German Federal Highways will not or to a limited extent have a sufficient capacity. Many of these bridges were designed according to the so-called “Load Model SLW60” of the German code DIN 1072 (1952) [2], which consists of a vehicle with a total wheel load of 600 kN and a uniformly distributed load of 5 kN/m^2 in the main lane and additional uniformly distributed loads of 3 kN/m^2 in the remaining lanes. The vehicle had to be placed at the most unfavourable position depending on the check that had to be performed. The verification procedure was based on the shear tension resistance according to DIN 4227 [3]. In contrast to that the verification procedure of the currently applicable design code for concrete bridges DIN FB 102 [4] is a simplified procedure developed by Reineck [5] based on the so-called “strut-and-tie model with crack friction”, similar to the procedure given by EC2[6]. Using this procedure including the load model SLW60/30 of the successional code DIN 1072 (1985), shows that in many cases more shear reinforcement is now required in the web. In contrast to SLW60 the load model SLW60/30 includes an additional vehicle with a total wheel load of 300 kN in the adjacent lane. It can thus be assumed that a considerable amount of post-strengthening measures is necessary for these bridges, since the loads have been increased in the following design codes as well. In order to minimize the obstruction of traffic, post-tensioning seems to be reasonable. Therefore, the effect of additional external tendons on the shear capacity of prestressed continuous beams is investigated within a research project funded by the Federal Highway Research Institute of Germany (BASt). Within this research project six shear tests on three continuous beams with and without external prestressing will be performed.

The verification procedure in DIN FB 102 accounts for prestressing in form of a variable

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