



Long-term behaviour of timber-concrete composite bridges

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Summary

The construction method using timber-concrete composites became more interesting for bridge constructions in the last years. At the Bauhaus-University Weimar, long-time shear tests as push-out-tests with three different connector types being suitable for bridge constructions were arranged. The paper presents the results of these long-time tests. In analysis of the shear tests a proposal for the creep coefficients of the tested connector types is given. The different time and climatic dependent behaviour of timber and concrete does not only influence the serviceability but also the load bearing capacity of hybrid timber bridges. These effects are investigated using a numerical parametrical study based on a special finite element program.

Keywords: Timber-concrete composite, hybrid bridge, long-term behaviour, creep, shrinkage, shear test, creep coefficient, mechano-sorption, FE-model, wood moisture content

1. Introduction

A timber-concrete-composite bridge consists of a concrete slab ductile connected with timber main girders. Combining concrete in the compression zone with timber in the tension zone to a composite structure, the favourable properties of both materials could be used efficiently. This new type of hybrid timber bridges has a lot of advantages in comparison to simple timber bridges. The concrete deck provides an ideal constructive wood preservation. The distribution of high loads per axle and the transmission of horizontal loads can be realised much easier by the concrete deck. Construction details proved in building of concrete bridges could be transferred easily.

In construction of timber-concrete composite bridges there is only one critical point – the different time and climatic dependent behaviour of the composite materials. The variation of moisture and temperature, which has to be taken into consideration for the design of bridges, is much higher than that for constructions inside a building. Therefore, cognitions used in building engineering concerning this problem could not be transferred easily to bridge building. Additionally, the special creep behaviour of connectors being suitable for bridge building is only marginally observed. Therefore systematic long-time shear tests with special joints have been performed at Bauhaus-University Weimar. In addition, a parametrical analysis should contribute to quantify the time- and climatic dependent influences on the load bearing capacity and serviceability of hybrid timber bridges.

2. Experimental program

2.1 Test configuration and specimens

Since February 2006 long-time shear tests have been arranged as a part of systematic shear tests with three special connector types. The whole experimental program consisted of push-out-tests under short-time, long-time and dynamic loading [1]. Short-time shear tests have been performed to determine the stiffness and the ultimate load of each joint at the initial state. The influence of moisture and temperature variations under long-term loading on the stiffness of the connectors has