Multidimensional load-bearing behaviour of timber-concrete-composite road bridges with consideration of flexibility of connections

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Abstract

Timber-concrete-composite structures for road bridges could be much more often used in the field of medium-span road bridges due to their good ecological and structural performance. Therefore, an appropriate consideration of the punctual connections usually used for such bridges is necessary. Those connectors have a large load-bearing capacity and stiffness. While there are established methods for determining the stiffness and load-bearing capacity in the main longitudinal load-bearing direction, the secondary load-bearing behaviour in transverse and vertical direction is usually not determined for those bridges. By assessing test results and evaluation of FE simulations, this article presents an approach of how a calculation method can be derived that makes the structural design of timber-concrete-composite bridges safely even in more demanding application scenarios.

Keywords: timber-concrete-composite; road bridges; flexible composite theory, shear connector

1 Introduction

Timber-concrete-composite bridges with spans of 20 to 35 meters offer with consideration of the overall life-cycle costs a feasible alternative to steel-, prestressed concrete-, and steel-composite bridges. Examples are the Punt la Resiga brigde (CH) from 1998, the two timber-concrete-composite bridges in Winschoten (NL) from 2012 and the bridge over the Agger in Lohmar built in 2014 (GER). By using timber as bottom chord in a composite bridge structure, a large amount of the structural volume can be realized in a renewable material without deteriorating the structure's static performance. However, in order to introduce this construction method to a broader range of applications within the field of road bridges, it is necessary to understand the exact load-bearing behaviour of this type of structure.

2 Multidimensional flexible composite

2.1 Flexible composite

The connectors are essential to achieve a composite action between the two different members concrete slab and timber girder. The arrangement and stiffness of the connectors determines the performance of the composite

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