39th IABSE Symposium – *Engineering the Future*
September 21-23 2017, Vancouver, Canada

Timber bridges – Load carrying behaviour according to climate changes

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Abstract

Timber road bridges have been built worldwide for centuries. The high performance of wood as structural material is approved. However the influence of moisture induced stresses in cross sections according to the varied ambient climate are still questioned. Results observed in the long term monitoring of six timber bridges provide first guidelines for practitioners. Further on, first numerical simulations are carried out for the assessment of the long term behaviour of timber bridges over the life cycle. The numerical simulations include the moisture diffusion transport in wood as well as the resulting stress strain behaviour of the timber member. The research results provide new guidelines for the planning engineers, the definition of an active or passive zone of the cross sections, and provide a differentiation of the service class over the cross section.

Keywords: Road bridges, moisture content, stresses, service classes.

1 Introduction

Timber road bridges have been built worldwide since centuries. The high performance of wood is proven over many constructions. However, there are still doubts using wood by the planning engineer, which reduce the number of realized project. One main point for timber bridges is the influences of the varied moisture content according to the ambient climate. Wood is a hygroscopic material and reacts in a change of the moisture content, mainly due to the change of the air temperature and relative humidity. The moisture content influences the physical and mechanical properties. Therefore, the correct estimation of the moisture content is important for the design and life cycle of timber structures.

Further on for timber bridges the moisture distribution is not constant over the cross section due to daily, weekly or seasonal changes of the climate situation. Subsequently, moisture gradients develop. The moisture gradients produce stresses over the cross sections which can result in cracked beams, [1]. For example, an increase of the moisture content at the outer part leads to moisture induced transverse tension stresses in the inner part of the cross section. If these stresses exceed the very low tension strength perpendicular to grain of wood, the cross section can crack and lead to a reduction of the load carrying capacity for transverse tension or shear. These cracks are not visible during maintenance, inspection, and assessments periods.

https://doi.org/10.2749/vancouver.2017.1153
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