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Moisture induced deformations in glulam members - Experiments and 3-D finite element model
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Abstract
Experiments were performed on scaled spruce glued-laminated timber (glulam) bending specimens to observe time dependent development of deformations during drying and wetting. Measurements determined changes in the average moisture content and external shape and dimensions, between when specimens were placed into constant or variable climates and when they had responded to those climates. Alterations in the external shape and dimensions reflected changes in the average value and distribution of moisture and mechanosorptive creep in the glulam. Two experimental arrangements were used, with the first representing horizontal members with nominally zero external loading effects (i.e. supported underneath so that self-weight could not produce bending deformations), and the second arrangement representing horizontal members with external loading effects (self-weight plus external loads that cause bending deformation). Test results are being used to develop a sequentially-coupled three-dimensional hygrothermal Finite Element (FE) model for predicting temporally varying internal strains and external deformations of dried or wetted structural components. The model implies temporally varying and eventual steady state internal stress distributions in members, based on elastic and creep compliances that represent wood within glulam as a continuous orthotropic homogenised material. Thus, predictions are consistent with smeared engineering stress analysis methods, rather than being a physically correct analogue of how glulam behaves. This paper discusses limitations of and intended improvements to the FE model. Complementary investigations are underway to address other aspects of the hygrothermal behaviour of structural components of glulam and other materials (e.g. reinforced concrete) embedded within multi-storey hybrid building superstructures. The eventual goal is to create the capability to predict, and therefore be able to counteract, adverse deformations and material incompatibilities that can exist within hybrid building systems. Copyright © (2012) by WCTE 2012 Committee.

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