HYBRID GLT-LVL GLULAM – MODELLING AND EXPERIMENTS

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It is reported on the ultimate limit states calculation and respective experimental full scale verification of hybrid glued laminated timber (GLT) members subjected to bending. The beams are built up asymmetrically with unjointed and jointed laminations made of laminated veneer lumber (LVL) placed at the bending tension edge, whereas the majority of the cross-sectional depth consists of finger jointed spruce-fir laminations as in case of usual GLT. The number of LVL laminations, i.e. the ratio of LVL depth vs. total depth, may vary from very few percent to about 25 %, depending on the targeted reinforcement degree and capacity gain. The LVL material can consist of spruce/fir, or from hardwoods such as beech and birch, showing rather different stiffness and strength properties. It is evident that the LVL reinforcement leads to a bending capacity increase depending on the reinforcement ratio. It is further sensible to expect a decreasing reinforcing effect with higher LVL ratios. The composite action is strongly influenced by the non-linear yielding and compressive damage effects of the solid wood laminations in the compression zone of the cross-section. Further, the maximum reinforcement gain may be influenced by a normal-shear stress interaction, too.

Figure 1: GLT beam with 25 % Beech LVL Reinforcement

The paper firstly describes some aspects of an iterative moment-rotation model based on Bernoulli's theorem of preservation of plane sections, hereby accounting for the compressive non-linearity (yielding and softening of the compression zone). Some quantitatively significant differences to usual unsymmetrical GLT beam buildups are highlighted. Secondly, the quasi analytical model is compared to results from finite element simulations, taking into account the localisation of compression damage and its impact on the spacious load redistribution.

Finally, the calculation results are compared to the findings of an extensive full-scale experimental campaign on hybrid GLT-LVL beam buildups. It is revealed that the employed iterative semi-analytical calculation approach enables a good and safe assessment of the regarded new high performance GLT build-up configurations.

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