Splitting of Joints Made of Different Species

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Abstract

The load-carrying capacity of mechanical timber joints is often governed by a brittle failure of the joint. Stable crack growth starting from the fastener can often be observed in advance of the brittle failure. Because of this macroscopically observed behaviour a model was developed, based on a fracture mechanics approach. Using this model the probability of a brittle failure mode depends on the material properties, the geometry of the joint and of the loading. The model is confirmed by empirically developed results of other studies, using numerous tests with joints.

Fracture mechanics does not use stresses and strains for design but new properties of action and resistance. Because of the structure of wood, it's strong orthotropic cylindrical anisotropy and inhomogeneities, the use of the concept of energy release rates is advantageously compared to the concept of stress intensity factors.

The critical energy release rate as a value of resistance of eleven species and spruce laminated veneer lumber (LVL) was determined using the compliance method. The species and the LVL revealed significant differences, caused by the microscopic structure and the macroscopic configuration of the LVL.

Tests with joints confirmed the influence of the critical energy release rate on the load-carrying capacity of the joint, if brittle failure takes place.

The developed method for determining the energy release rates and the models based on fracture mechanics can be applied on further species and further wood-based materials. An improvement of the joint area of species or wood-based materials with high energy release rates is possible.