Nonlinear computational modelling of cross-laminated timber buildings

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Cross-laminated timber (CLT) is a relatively new construction building system based on structural panels made of several layers of boards stacked crosswise and glued together on their faces [1]. As CLT panels are light-weight structural elements with high stiffness and strength to bending, compression and shear, they are an economically competitive building system when compared to traditional options and therefore, are a suitable candidate for some applications which currently use concrete, masonry and steel. Given the numerous advantages of building with timber, an increasing number of multi-story CLT buildings is sprouting around the world.

In this work we investigate the nonlinear computational modelling and collapse of CLT buildings by means of a multi-scale modelling strategy. In order to determine the mechanical properties of CLT, a computational homogenisation scheme based on the volume averaging of the stress and strain fields over a representative volume element (RVE) of material is adopted. CLT floors and walls are modelled with mechanical properties obtained by the present multi-scale approach. Metallic connectors are modelled with their hysteretic non-linear behaviour, including damage. The behaviour of each connector is defined along three orthogonal axes. The building chosen for this investigation includes angle brackets, hold-downs, shear connectors and panel-to-panel screws. Some of our numerical predictions are compared with experimental results and are validated successfully. This is part of an ongoing research.

References

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