

Timber-concrete composite frame joint for high-rise buildings

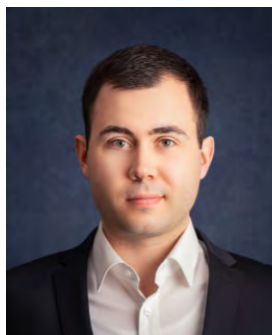
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1 Abstract

Timber is one of the few renewable materials that improves its structural properties when combined with concrete. The composite of timber and concrete increase stiffness and fire protection, unlike timber when used alone. In contrast to concrete structures, timber-concrete composite (TCC) structures reduce the carbon footprint and the specific weight of a building. At the Chair of Hybrid Structures - Structural Concrete of BTU Cottbus-Senftenberg a moment-resistant TCC joint was developed for multi-story frames, which can be used as a structural system for high-rise buildings. Facts like a modular construction, a fast assembly and a plug-in connection were aspects that shaped the development. A high rotational stiffness and load-bearing at the composite joint was also achieved using high strength beech laminated veneer lumber (LVL).

The TCC frame works on its own and in combination with other bracing systems. Initial investigations on the load-bearing behavior were carried out using numerical analysis followed by experiments on real-sized joints in further studies. First results will be presented in this paper. The developed TCC joint as part of structural systems offers a high variability and can thus contribute to tomorrow's sustainable vertical growth of cities.

Keywords: moment-resistant TCC joint, hybrid structures, high-rise building, beech laminated veneer lumber

2 Introduction

The increasing use of timber and TCC structures for high-rise buildings is described in (Smith and Frangi, 2014). Example projects such as the "LifeCycle Tower" (Zangerl et al., 2010), the "Brock Commons Tallwood House" (Poirer et al., 2016) and the "Timber Tower" (Baker et al., 2014) show, that high-rise buildings in timber are feasible. High-rise buildings made of timber only have so far been mainly braced against horizontal loads by timber and concrete shear walls. This structural system can have restrictions on the floor plan layout of the

building. A more flexible layout is possible using multi-story frames with moment-resistant joints. Interaction of shear walls and frames is even more efficient (cf. Fig. 2a).

Frames with moment-resistant TCC joints have not been investigated so far. Material properties of the usually used coniferous wood complicate the construction of moment-resistant joints due to the high inhomogeneity and low strength. For this reason further developments of timber and TCC joints should take high-strength timber-based materials into account like the beech LVL manufactured by (Pollmeier, 2019). The