Investigations on transversal load sharing in Timber-Concrete floors

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Despite timber-concrete slab-type structures are known and commonly used, some questions are not fully understood yet. Among them is the lateral load distribution in the composite floors if a load is applied to a part of the structure only (compare figure 1 left). By using finite element (FE) models, different parameters, like span of the slab, joist spacing, dimensions of beams, level of connection, load level as well as type and position of load, on the transversal load sharing were investigated to provide distribution factors for different load cases. The FE-model used was validated on basis of experimental investigations. They included push-out testing as well as short-time full-scale bending tests. The cluster of parameters included in the investigations was chosen in accordance to common dimensions of existing timber beam ceilings. In this paper 24 FE-models of timber-concrete composite (TCC) slabs with different geometrical dimensions are presented. The span of the beams was changed between 3 and 6 m, the timber beam distance between 0.5 and 1.0 m. The corresponding dimensions of the beams are based on the required dimensions for pure timber beam ceilings related to the presented span and interjoist of the beams. Among the described geometrical properties the height of screed (40 mm) and interlayer (20 mm) were kept constant. During the analysis applied forces as well as strain and deflections on bottom side of every beam (at midspan) were recorded.

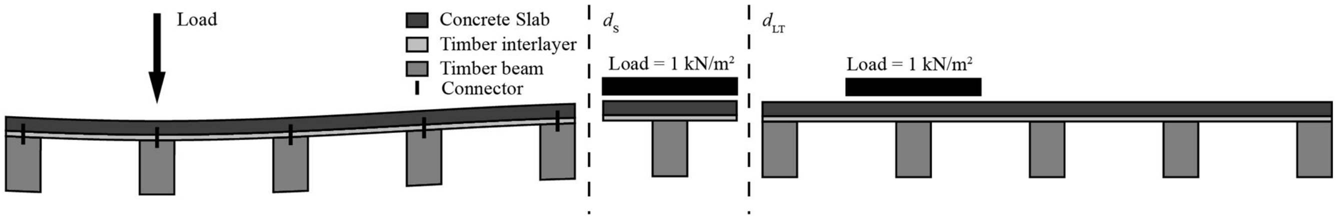

Figure 1: Principle of load sharing (left), Concentrated load applied to one beam of a slab-type system (middle), single composite beam (right)

In additional calculation only one single composite cross section with span *l*, beam distance *a*, timber beam width *b* and timber beam height *h* corresponding to the cluster of parameters, but without any bi-dimensional load transfer was considered. From that calculation the deflection without lateral load transfer (d_S – deflection single, figure 1 middle) was obtained. The deflections with lateral load transfer were received from the previously described FE-analysis of the same models (d_{LT} – deflection load transfer, figure 1 right). The relation between both deflections can be interpreted as a load reduction factor η for the loaded beam (compare equation (1)).

$$\eta = \frac{d_{LT}}{d_S} \tag{1}$$

Different geometrical properties of the timber beam ceiling have reasonable impact on the transversal load-bearing behaviour of TCC structures. Immanent impact factors are, for instance, the type of concrete topping, and the type of connection members. Loads in TCC structures are distributed more efficiently in the case of decreasing the beam spacing of the structure, and increasing of span of the system. In every considered model the deflections with consideration of load transfer were smaller than 60 % of those without consideration of load transfer. A reduction factor of 0.7 due to the deflection resulting from a concentrated loading of one composite beam is proposed for systems within the range of the parametric study.

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References

[1] H. Kieslich: Zum Quertragverhalten von Holz-Beton-Verbunddecken. PhD-thesis (in German) Dresden (not published yet).
[2] H. Kieslich, K. Holschemacher: Transversal Load Sharing in Timber-Concrete Floors – Experimental and Numerical Investigations. In: J. Eberhardsteiner, W. Winter, A. Fadai, M. Pöll: CD-ROM Proceedings of the World Conference on Timber Engineering (WCTE 2016), Vienna, Austria, 2016.

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