

## Development of an Innovative Multifunctional Roof and Ceiling Design in Timber-Concrete Composite Construction

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Office buildings are usually built using a flat ceiling construction to gain the maximal space utilization. Therefore sandwich constructions are typically used because of their simple installation. The transfer of this construction to residential and multi-storey buildings is inefficient due to the high dead weight of this construction. A lighter construction could satisfy these requirements. In a cooperative research project at the University of Kaiserslautern such a light system in timber-concrete composite construction is going to be developed. From a static point of view the timber-concrete cross section presents the optimal load-bearing system with a high bearing capacity in combination with minimized dead weight and the possibility to implement wide spans for transverse roof surfaces. Furthermore, it should be possible to use the timber-concrete composite construction as a roof as well as a ceiling. The concrete slab should be orientated to the rooms, which are going to be conditioned thermally by the heating and cooling pipes integrated in the concrete slab. In case of a roof, the wooden beam is on the top and in case of a ceiling, the wooden beam is under the concrete slab.

The new construction consists of two elements which should be connected easily at the construction side. The first element of the multifunctional construction is a wooden beam with a formed steel sheet fastened in two slots in the beam. The transmission of the shear forces to the wooden beam will be realized with self-screwing steel studs. The second element is a precast concrete element with a similar formed steel sheet integrated in the concrete. To finally get a load-carrying connection the cavity will be filled with a cementitious suspension. During the manufacturing processes of the steel sheets, the sheets will be shaped with cams and holes to transmit the longitudinal shear forces.



Figure 1: Schematic Sketch of the New Timber-Concrete Composite Construction

To determine the load bearing capacity of the new construction for the combination of tension and longitudinal shear, pull-out and push-out tests will be carried out. The results of the push-out and pull-out tests, performed at the laboratory, will be presented in comparison with numerical simulations. The aim of these investigations is to define the separate carrying components of the different materials and elements. As a result of these conclusions a new design model considering all failure mechanisms will be developed. In addition to that, the long-term behavior, especially the temporally different creep behavior of wood and concrete, will be another important point to include in the design method.