# Bonded Hybrid Slabs of Light-Weight Concrete and Glued Laminated Timber

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## Summary

Typical wooden beam ceilings often have problems with excessive vibrations and inadequate sound insulation. Due to increasing live loads and a stronger sense of safety over the years, wooden beam ceilings with a span up to 10 m cannot fulfill the serviceability limit states of Eurocode 5. A concrete layer applied to the timber increases the stiffness of the whole structure and thus contributes to the improvement of serviceability performance. In such applications, both materials are utilized according to their mechanical properties; the concrete is used in the compression zone and the wood in the tension zone. Such a composite construction is advantageous not only for rehabilitation, but also for new construction as a prefabricated segment, especially due to its low weight compared to concrete elements.

**Keywords:** composite, timber, light-weight concrete, adhesive bond, serviceability limit states.

## 1. Introduction

The analysis of recent studies on timber-concrete-composites shows that the combination of light-weight concrete and glued-laminated timber is promising. The shear tests conducted by Faust in 2003 on timber-lightweight-concrete composite structures with mechanical fasteners demonstrated that material failure occurs in the lightweight concrete and at lower loads than when using a standard concrete on equivalent composites. In the case of light-weight concrete, the separate pin-shaped connections of the mechanical fasteners are disadvantageous as they create localized stress concentrations on the concrete [1]. In order to transfer the shear stresses more uniformly, this paper suggests gluing the concrete and timber together, using a high-viscous two component epoxy resin adhesive. Different methods of gluing as well as the wet-on-wet-method are analyzed and tested. To analyse the composite behaviour of timber together with light-weight concrete and its failure modes, shear and bending tests are carried out. To maximise the efficiency of the composite beams a light-weight concrete with a low ratio between dry density and compressive strength is being developed. This reduces the weight and allows transmitting the shear forces in the composite joint. The tests show that composite beams with an adhesive bond between the fresh light-weight concrete and the glulam beam have an increased load capacity compared to composite beams with screws connecting the light-weight concrete and the glued laminated timber. Composite beams with glued light-weight concrete slabs have a similar strength as common timber-concrete-composite beams. Computer simulations on the basis of a linear material model confirm the observed structural behaviour and explain the differences in load transfer between shear and bending tests.

## 2. Epoxy Resin Adhesive

Gluing is the simplest way to achieve a strong and stiff composite action between concrete and timber. The glue fills the pores of the timber, resulting in a toothing which strengthens the

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