12. Dani Hrvatske komore inženjera građevinarstva

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Pokrovitelji skupa

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OPATIJA

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Tema: **DRVENE KONSTRUKCIJE**
Theme: **TIMBER STRUCTURES**

Predavanje: **PROJEKTIRANJE I PRORAČUN HOHO VIENNA – NAJVIŠEG NEBODERA OD CLT-A (KRIŽNO-LJEPLJENOG LAMELIRANOG DRVA)**
Lecture: **DESIGN AND CALCULATION OF HOHO VIENNA - THE WORLD'S TALLEST CLT (CROSS-LAMINATED TIMBER) TOWER**

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Summary

The basic concept of the bearing structure consists of a massive, stiffening mineral core, running vertically, with attached staircases. This is combined with horizontal corridors and connected areas. The massive core is fronted by a wood structure (see Fig. 1). This wood structure is, in turn, fronted by the wood façade. The separation of the mineral core from the wood structure means both can be constructed at the same time, which optimises and simplifies the construction process. While the massive structure is produced on site, the pre-fabricated wood elements are manufactured in the factory independent of weather and with strict quality controls. The logical carrier structure ensures easy, and thus economical, assembly at the construction site.

Fig.1: Basic concept of the bearing structure

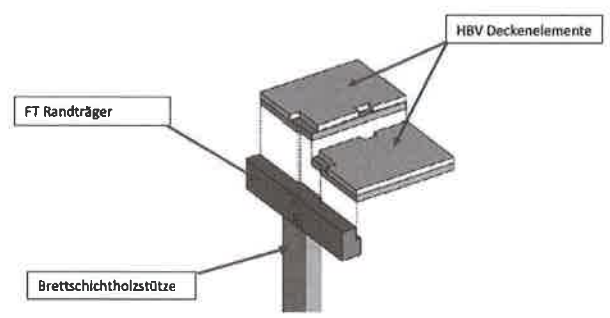

Fig. 2: Assembly of bearing system–beam–ceiling

Horizontal and Vertical Load Deflection: The ceiling carrier system consists of a rigidly bonded wood-concrete-ceiling with massive wooden boards. For the facade, supports out of laminated timber will help to deflect the weight vertically. In the corridor zones inside, this is done by ceilings and bracing cores out of reinforced concrete. To use as much pre-fabricated material as possible, HVB ceiling elements will be used (wood-concrete-combination ceilings). Thanks to the prepared concrete in the factory, the cross-laminated timber board is provisionally protected from the weather during assembly on site. The Fig.2 shows the logistics of assembly on the construction site: In this case, the wood supports – concrete edge beams (pre-fabricated) – HVB ceiling elements. The ceiling is bonded even more firmly by filling the gaps in the HBV ceiling elements with concrete. In the following image, you can see how the wood support is combined with the edge beams and the HBV ceiling elements. Supports and ceiling elements are force-fitted to the FT-carrier with the help of reinforcing bars and local overlapping zones. Tension anchors further guarantee the required sturdiness.

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The building is braced by rigidly bonded ceilings and the massive staircase cores or bulkheads. For the diagonal bracing of the high tower (construction part 2, ~84m), this is force-fitted to the lower construction segment (construction part 1, ~40m) by means of reinforced concrete walls and ceilings. The construction segment 3 (~57m) is also coupled to the staircase core with firmly bonded ceilings.

Strategy to Avoid Progressive Collapse: In order to limit damage from local failure of unspecified origin following static measures to enhance robustness and fight progressive collapse, according to ÖN EN 1991-1-7 appendix A:, have been investigated 1) vertical tension anchors for the wooden support beams (reinforcement rods); 2) horizontal tension anchors around every HBV ceiling (ring tension rods all round); 3) compensation for support failure with an FT continuous beam. The horizontal tension anchor is made up of reinforcement rods as well as rebending connectors, and runs all around the HBV ceiling elements (see Fig. 3). The local connections are reinforced by filling in recesses in the concrete layer.

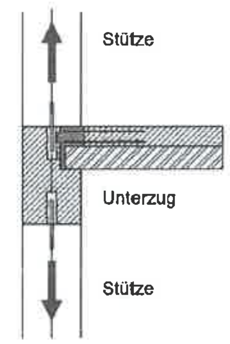

Fig.3 Vertical tension anchor

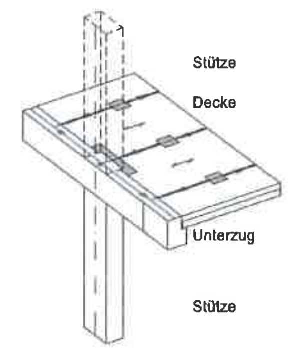

Fig.4 Horizontal tension anchor

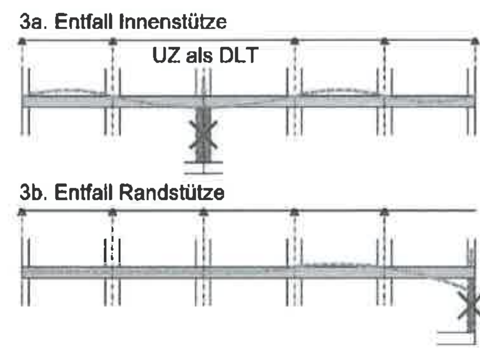

Fig.5 Continuous beam at ceiling edge

In order to compensate for the possible failure of a support beam, the ceiling edge beam has the dimensions of a continuous beam, so that it can take the load normally weighing on a support beam and distribute this evenly among the other support beams (Fig. 5).

Lab Experiment: Rule Node: To test the rule node consisting of wood beam, FT carrier and HBV ceiling, a sample node on a scale of 1:1 was built (Fig.6). It was exposed to fire from below for 90 minutes, according to the standard temperature curve. Using temperature sensors built into the component at varying depths, the temperature inside the construction element was measured. A

Further goal was to determine how deep the fire had penetrated the cross-laminated timber board of the ceiling and the remainder of the wooden beam.

Fig.6 Experimental Rule Node

Keywords: Keywords: wood skyscraper, mineral core, HVB ceilings, lab experiment, rule node