Timber-steel-hybrid beams for multi-storey buildings

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ABSTRACT: For modern multi-storey buildings timber-steel-hybrid elements present a very efficient construction method. The combination of these two materials leads to economic and ecologic benefits as the construction height can be optimized, the earthquake resistance can be improved and the assembling can be executed more efficiently. Steel reinforced timber structures are light, fast and clean. Based on research activities of the Institute of Architectural Sciences, Structural Design and Timber Engineering, presented at the WCTE 2010, some static tests on hybrid timber-steel beams have been carried out.

KEYWORDS: Timber-steel, hybrid, beam, multi-storey

1 INTRODUCTION
The application of timber-steel-hybrid-elements for multi-storey buildings will be one objective in the future. Several ideas and details have been carried out. First economical calculations and static analyses were presented by the authors at the WCTE 2010 Trento [1].

2 BENEFITS OF TIMBER-STEEL-HYBRID BEAMS
"Flitch-beams" were the first generation of timber-steel-hybrid beams. A further development of "flitch-beams" is economically and statically advantageous and should be considered as the future generation of timber-steel-hybrid beams. The idea is to optimize the geometry of the timber-steel-hybrid beam regarding cost effectiveness and load bearing capacity. A new idea is to use cold formed "U" profiles made of thin (1mm approximately) steel plates. The cold formed section works together with a timber beam (fig. 1a-1b). 2 mirror-inverted timber-steel beams (fig. 1c) are fixed together with some bolts and can be reinforced with steel plates on both sides. These are connected with gun driven nails (fig. 1d).

Figure 1: Assembly process of completed timber-steel-hybrid beam

Figure 2: Elements of the timber-steel-hybrid beam

The assembly process is shown in Fig. 2 – 5.

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Based on structural performance requirements, some static calculations of middle-span (4-10 m) timber-steel-hybrid beams with loads up to 30 kN/m have been done. The good results of the static calculations demonstrate the efficiency of timber-steel-hybrid beams. In comparison to GL-beams, a cost reduction of 10-20% and steel-steel connections become possible. The benefits of such connections are the possibility to produce semi rigid column-beam joints in a simple way. These moment-resisting frames can resist lateral loads. This concept was presented at the WCTE 2010 Trento [1], fig. 6.

Gun driven nails, which are developed for the connection of steel-steel plates, can also be used for timber-steel connections. One topic of this research project is the suitability of gun driven nails to build composite profiles. Some simplified tests for these connectors are also planned to be carried out in the next months.

Some timber-steel-hybrid beams with different cross-sections and timber grades will undergo a bending test in order to verify the results of the numerical calculations. These tests will be carried out till the end of 2011 and the results will be presented in the full paper.

3 CONCLUSION

Prefabricated timber-steel-hybrid beams seem to be very advantageous for multi-storey structural systems. These beams have a high load bearing capacity without increasing cross sections. High loads can be transmitted with simple connections which accelerate the erection time. The light weight construction is advantageous in case of earthquakes. The results of upcoming static test will be presented in the full paper.

REFERENCES

[1] Kamyar Tavoussi; et al.: Steel reinforced timber structures for multi storey buildings; paper nr. 820; Vienna University of Technology; Proceeding of WCTE 2010.