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Proceedings
- home
- preface
- contents
- authors
- keywords
- copyright
- reference

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Paper 247

Collapse Analysis of Timber Structures

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Timber is an efficient building material, not least with respect to its mechanical properties. Thus, the strength-to-weight ratio of timber is higher than for steel, making it ideal for the construction of lightweight building structures. However, considering its beneficial properties, timber is still not used to its full potential in the building and construction sector. Many building developers, architects and structural engineers do not consider timber as a competitive building material compared to concrete, steel or masonry. Therefore, further research is required before timber can achieve recognition as a high-quality building material such as steel and concrete. Whereas the codes and regulations for the design of concrete and steel have undergone a remarkable modernisation over the last decades, codes and regulations for the design of timber structures are falling significantly behind. Issues regarding the robustness of timber structures especially need some investigation.

The present paper has investigated the collapse characteristics of timber structures based on the framework for robustness analysis introduced in the Danish Code of Practice for the Safety of Structures [1] and a probabilistic modelling of the timber material proposed in the probabilistic model code (PMC) of the Joint Committee on Structural Safety (JCSS) [2]. The approach has been used for a case considering a glulam frame structure supporting the roof over the main court in a Norwegian sports centre. Compared with a recommend target value the reliability analysis of the glulam frame indicates a structure with a little too high probability of failure for one out of eleven considered failure modes. Progressive collapse analyses are carried out by removing three columns one by one implying that the timber structure can be characterized as robust with respect to the robustness framework used for the evaluation. However, the results are obtained based on a simplified modeling of the timber structure which does not consider a non-linear behavior

of the joints. Future investigations should also consider redistribution of load effects, system effects and a modelling of possible gross errors, i.e. unintentional loading and defects.

References

1 Danish Standards Association, "DS409: Code of practice for the safety of structures" 2006.

2 JCSS, "Probabilistic model code" www.jcss.ethz.ch 2001.