GEOMETRIC NONLINEAR ANALYSIS OF A PITCHED ROOF STRUCTURE OF WOOD

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ABSTRACT

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Abstract: Instability failures of timber structures are often characterized by sudden lateral deformations (lateral buckling or lateral torsional buckling) that typically lead to failure in a single loadbearing element or collapse of the entire structure. This work deals with buckling analysis and geometrical nonlinear stress analysis of pitched roof structures of wood. The model has been used to study how different parameters have influence on buckling modes and force distribution in the lateral bracing system of the roof structure. The initial imperfections needed for the nonlinear analysis was based on the buckling modes shown in the figure.

The roof structure was loaded to failure to study how the internal forces vary within the structure and how they were increasing nonlinearly close to the critical stability load. The numerical results indicate the size of the bracing forces to be highly affected by parameters such as initial imperfection used for the truss structure, c/c distance between the bracing members, axial stiffness of the bracing members and the bending stiffness about the weak axis of the top chord. Comparison between alternative design methods (FE-model and two hand calculation methods [1] and [2]) show in some cases significant differences between the force results in the bracing members.

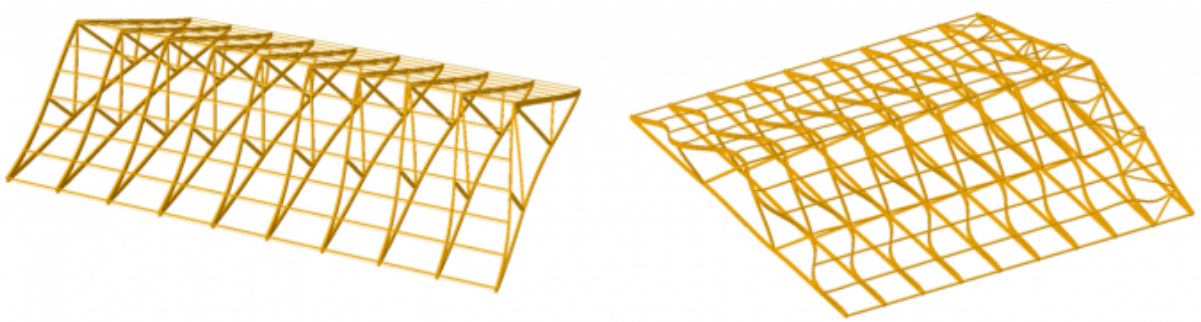

Figure 1: *Failure modes for roof structures with and without bracing truss.*

References

[1] En 1995-1-1 - eurocode 5: Design of timber structures
[2] Kessel M.H., Kühl A.: Aussteifung von Nagelplattenkonstruktionen. Reihe Wissenschaft, Band 24, Frauenhofer IRB Verlag, Stuttgart, 2011.