Blockhaus buckling analyses: Numerical and analytical models to evaluate the critical load

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The problem of instability has been dealt with at the mathematical as well as at engineering level since ancient times; a slender columns stressed by an axial compression force, undergoes to an instability phenomenon called instability for peak loads.[MF1]

Over time, this type of instability has also been found in other slender structural elements, equally stressed, behaving as slabs and plates such as profiles and panels; these elements have been the subject of study by various Authors.

The wooden structural elements, due to the anisotropy of the material, the presence of defects and deviations of the grain, are particularly sensitive to this problem. This work investigates the elastic instability of Blockhaus walls, which are prone to the phenomenon of instability for peak loads because of the mechanical factors described above but also for the lack of metallic connections that solidarize the constructive elements [1]. Two different mechanical models (fully discrete and longitudinal continuous-transversal discrete) have been analytically formulated in order to estimate the critical load of walls without openings; two different load cases (concentrated and distributed loads), top restraint conditions (restraint and unrestraint) and lateral boundary restraint (simply supported and clamped) have been considered. The results obtained analytically have been compared with those deriving from numerical analyses on 3D elements implemented in ABAQUS software package and with previously conducted experimental tests [2]. Afterwards, to increase the accuracy of proposed analytical models, the effect of small notches and grooves has been added. Geometrical factors causing a decrease in critical load such as load eccentricity and geometric imperfections have been considered.

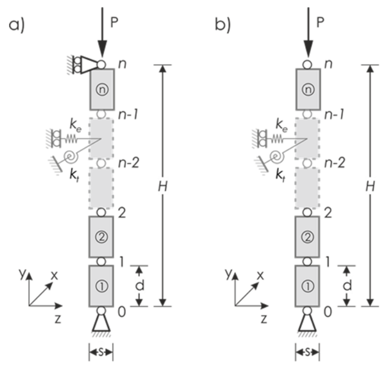

Figure 1: Fully discrete mechanical model of the wall with a) Top restraint condition and b) Top unrestrained condition

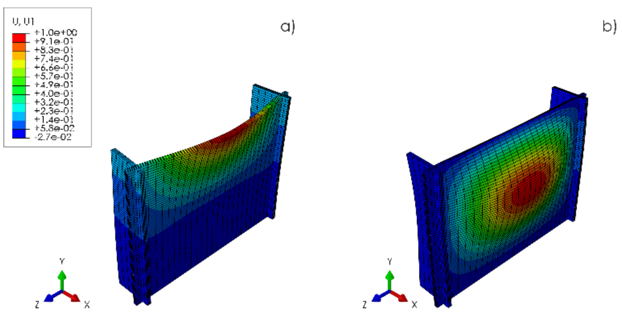

Figure 2: Linear Buckle Analysis first mode shape under distributed load for a) Top unrestrained condition and b) Top restraint condition obtained by ABAQUS Software Package

References

[1] C. Bedon, M. Fragiacomo. Numerical and analytical assessment of the buckling behavior of Blockhaus log-walls under in-plane compression. *Engineering Structures,* 82 (2015), 134–150.

[2] B. Heimeshoff, R. Kneidl. Bemessungsverfahren zur Abtragung vertikaler Lasten in Blockwänden. (Methods of calculationfor walls of log houses under vertical loads) (In German). *Holz Roh-Werkst*, 50 (1992), 441–448.

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