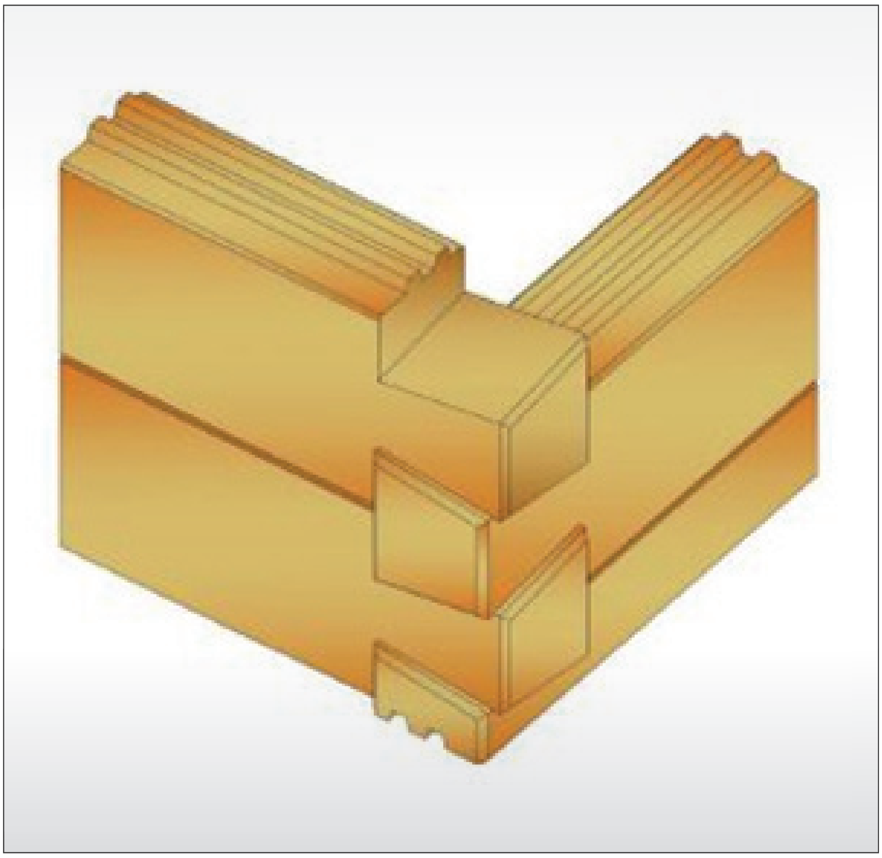
Research Summary

Summary of selected timber research projects presented at:

INTER 2015

(24th – 27th August, Šibenik, Croatia)



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Acknowledgement

Exova BM TRADA first published a research summary based on the research work presented and discussed at the International Network of Timber Engineering Research (INTER) in 2014, when the research group changed its name from the long-held CIB-W18.

The group has been gathering annually since 1973 and the research discussed here laid the foundations for the first version of a European Model Code for Timber Engineering. In the 2014 INTER research summary we discussed the group's beginnings in detail and Exova BM TRADA's involvement with the group to date. Readers are invited to take a look at it within our online library of research summaries.

This year too, the INTER group gathered in the historic, scenic Adriatic coastal town of Šibenik in Croatia, under the invitation of Prof. Vlatka Rajcic, the Head of Structural Engineering Department of University of Zagreb.

Exova BM TRADA would like to extend our sincere thanks to Prof. Rajcic and her team of organisers for the excellent hospitality extended during the event. We would also like to express our appreciation and thanks to Prof. Hans Blass and Dr. Rainer Görlacher of Karlsruhe Institute for Technology, Germany for giving leadership to INTER over the years, both under CIB-W18 and now under INTER.

Exova BM TRADA approached the authors of the papers cited here for their approval and comments before publication. We would like to express our gratitude for their co-operation in publishing these summaries. It is hoped that many TRADA members will find these summaries useful.

The views expressed here however are not necessarily those of Exova BM TRADA, and readers are encouraged to contact the authors directly if further clarification is sought on any of the subjects discussed.

A full list of INTER (and CIB-W18) papers can found on any of the proceedings downloadable at http://holz.vaka.kit.edu/392.php or http://cib-w18.com/proceedings, where the unique numbering system assigned to papers since 1973 is also explained.

1 (INTER/48-2-1) Proposal of a Eurocode-based method for the buckling design of timber log walls

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Blockhaus structural systems are commonly obtained by assembling multiple timber logs, which are stacked horizontally on top of one another. Although based on simple resisting mechanisms, the structural behaviour of Blockhaus systems is rather complex to predict, and few design recommendations are available in current standards for timber structures. This paper focuses on the assessment of the buckling behaviour of a typical vertically compressed timber log wall.

The researchers have looked at the effects of mechanical and geometrical variables such as possible load eccentricities and/or initial curvatures and openings (for example for doors or windows – see *Figure 1*).

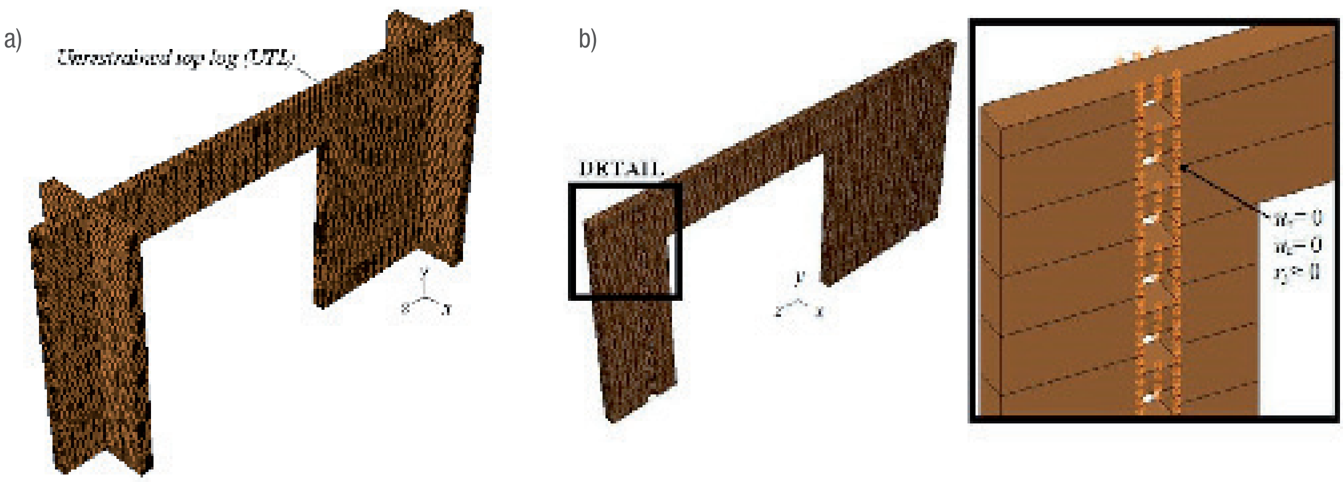

Figure 1 Example of the typical FE-numerical model of a timber log wall with single door opening (ABAQUS/Standard)
a) FE model with outriggers
b) FE model with equivalent boundaries along the vertical edges

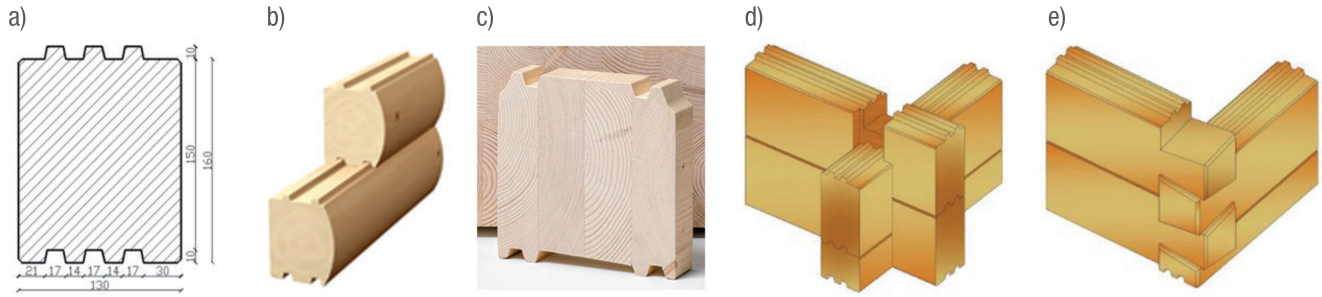

Figure 2 Examples of timber log cross-sections
a) www.haus.rubner.com/de
b) www.lincolnlogs.com
c) www.polarlifehaus.de

Typical corner joints:
d) “Standard” and
e) “Tiroschloss” www.haus.rubner.com/de

These log wall systems are investigated by means of detailed finite-element (FE) numerical models validated on buckling test results available in literature (Heimeshoff and Kneidl, 1992; Bedon *et al.*, 2015). By taking into account a wide set of geometrical configurations of practical interest, the effects of the main input parameters on the observed compressive buckling responses are highlighted.

The authors summarise the paper by providing buckling design recommendations of practical use, through the use of normalized design curves derived from standards such as Eurocode 5.

In current practice the traditional Blockhaus log wall is obtained by stacking horizontally a series of spruce logs with strength class C24 according to EN 338:2009. These logs typically have cross-sectional dimensions of height h by width b, with the h/b ratio generally in the range 1.6 to 2.4 but, in some cases, also down to ≈0.8, and are characterized by small protrusions and tongues providing interlocking with the upper and lower logs (*Figure 2a*). Several log wall profiles are available on the market (*Figure 2b and 2c*).

Independent of the cross-sectional properties of logs, the design concept and structural assembly of log wall structural systems is strictly related to interlocking of multiple timber elements. The structural interaction between the main perpendicular walls composing the full structural assembly is usually provided by appropriate corner joints (*Figure 2d and 2e*). Each log wall is connected to the reinforced concrete (RC) foundation slab by means of steel angular brackets. The permanent gravity loads are thus transferred onto each main wall by the inter-storey floors. Depending on their assembly, these inter-storey floors can realize in-plane rigidity, resulting in a further lateral restraint resisting out-of-plane deflections of the wall top logs.

The current Eurocode 5 for timber structures does not provide formulations and recommendations for the prediction of the critical load of log walls under in-plane compressive loads. In order to provide practical design recommendations, the researchers have previously proposed an analytical model backed by a FE investigation, where a preliminary assessment and calibration of closed-form formulations derived from classical buckling theories was presented. In this current work, a standardized design method consisting of non-dimensional buckling curves is proposed for timber log walls under in-plane compression.

Based on extended FE parametric investigations validated with past analytical and experimental data, the paper investigates the buckling response of timber log walls under in-plane compression. Consideration has been given both to the influence of geometrical aspects and to further influencing parameters, such as initial curvatures and/or load eccentricities of variable amplitude. Approximating curves have been calibrated by the authors, in order to provide normalized design curves for all the examined log walls. A standardized buckling design method conceptually similar to that used for the design of timber columns in Eurocode 5-1-1 is presented.

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