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Modelling approaches for innovative tailored laminated timber

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In ongoing research, several concepts of "next-generation" cross laminated timber (CLT) are being investigated aiming at creating innovative and optimized CLT-alike products. In the project InnoTLT ("Innovative Tailored Laminated Timber") one main aim is to show how today's CLT production could be made more material efficient by introducing alternative geometries, including large gaps between laminations, and alternative materials. Thus, studies are undertaken, which involve both numerical and experimental investigations [1].

This presentation deals with FE-modelling approaches in characterizing the static stiffness and vibrational response of floor panels. The main aim of the study has been to a) find efficient and accurate modelling approaches that can be used for future product development and b) characterize the mechanical behaviour of panels with innovative lay-ups.

The study examines concepts including large gaps, variations in the number of layers, their thicknesses, and orientations. The focus is on the serviceability limit state (SLS) and, consequently, the characterization is focused on static stiffness and analysis of frequency response functions. Previous studies have investigated the influence of non-orthogonal orientations of the CLT layers, resulting in so-called Diagonal Laminated Timber (DLT), see [2, 3, 4], but the dynamic (vibrational) response of such products has, to the knowledge of the authors, not been investigated. The presentation gives examples of different modelling approaches for static stiffness and vibrational response (analytical, solid 3D elements, shell elements), and how the detailed modelling of non-edge-bonded laminations affects the results. The presentation will in particular discuss how such simplifications affect the predicted static stiffness and the vibrational response of floors.

Preliminary results indicate that, for large gaps in transverse layers (up to approximately 40% void ratio), it is possible to obtain relevant estimates of static bending stiffness using analytical approaches, at least for uniaxial bending. As regards the vibrational response of DLT and the modelling approach of such products, results obtained so far indicate that typically the eigenfrequencies of torsional modes and modes involving bending in the weak direction of the plate are affected by a non-orthogonal lay-up. Results also indicate that the detailed modelling of non-edge-glued laminations (whether the edge gaps are included as a model feature or not) has a limited influence on the predicted vibrational response in terms of the root mean square of the accelerance. In the current study, the frequency range 0–562 Hz was used for one 5-layer plate and one 7-layer plate, measuring 2.4×5.0 and 2.4×9.0 m^2, respectively.

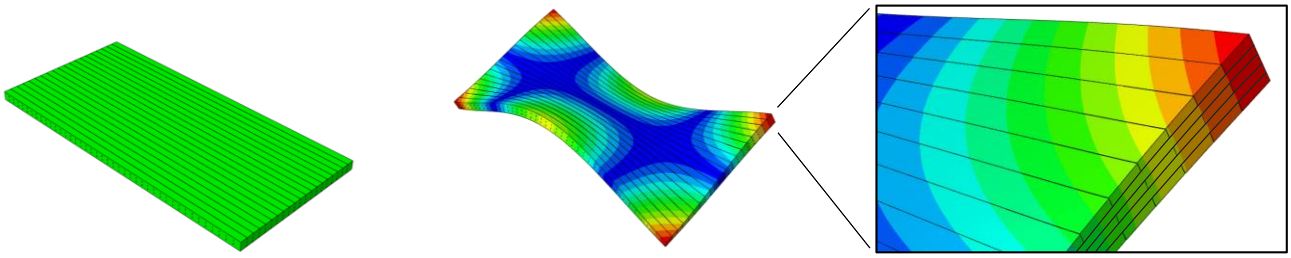

Figure 1: Example of model used in vibration analysis and its response in terms of the third eigenmode.

References

[1] https://www.innotlt.com/

[2] I. Bejtka. "Cross (CLT) and diagonal (DLT) laminated timber as innovative material for beam elements", Karlsruher Berichte zum Ingenieurholzbau, Band 17, KIT Scientific Publishing, Karlsruhe, 2011.

[3] M. Arnold, P. Dietsch, and S. Winter. "Mechanical Properties of Innovative Multifunctional Cross-Laminated Timber", WCTE 2020/21, 2021.

[4] A. Svensson. "Innovativ utformning av KL-trä – Diagonalt orienterade brädor" [Innovative design of CLT – Diagonal laminated timber], MSc dissertation, Report TVSM-5269, Division of Structural Mechanics, Lund University, Sweden, 2024.