Numerical study on de elastic buckling of CLT Walls subjected to compressive loads

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The use of Cross Laminated Timber (CLT) as a building material has been growing for the last 20 years. This impulse has been driven by the lower environmental impact of timber construction compared to concrete and steel, good structural and thermal performance and cost competitiveness [1]. Moreover, in recent years the use of CLT in mid-rise buildings has been consistently increasing, with examples present in Austria, Canada and the UK among other countries. This surge in the use of CLT as a construction material has fuelled research in CLT structural mechanics, leading to deeper understanding of its structural response [2-4]. Despite the considerable progress made on the study of CLT structural response, little have been done to fully understand their buckling behaviour.

In this work, a numerical-experimental approach is used to study the elastic buckling of CLT panels [5]. First, a finite element-based multi-scale model is developed to study the linear elastic buckling behaviour of CLT panels [4,5]. The model incorporates wood's most relevant microstructural features, such as the volume fraction of hemicellulose, lignin and cellulose, their mechanical and physical properties, microfibril angle, etc.; which are crucial to capture the inherent orthotropic nature of wood observed at the macroscopic level. Furthermore, the values of key microstructural parameters are determined through a parameter identification procedure, in which experimentally measured values of density and longitudinal Young's modulus of radiata pine grown in Chile are used as target values. The model is successfully validated with results from buckling tests performed on CLT panels' specimens with different thickness and slenderness ratios. The validation clearly shows the capability of the model to predict the buckling response of CLT panels (Figure 1). Finally, the model is used illustrate how parameters such as wood density and panel number of layers influence the buckling response of CLT panels.

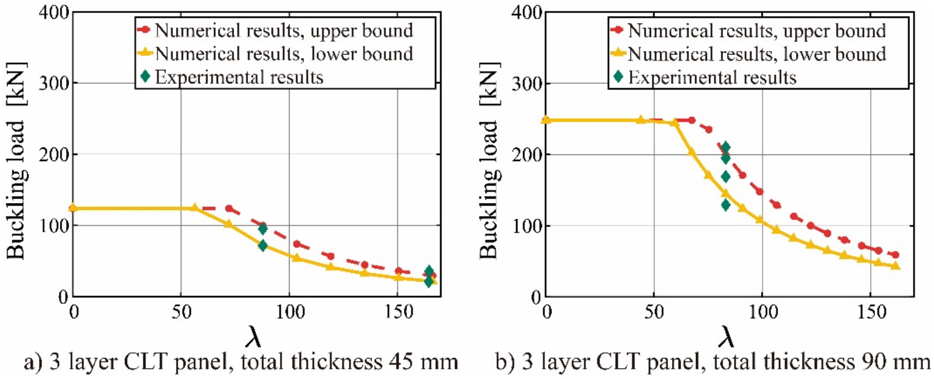

Figure 1: Numerical predictions vs experimental results: a) CLT panel with 45 mm total thickness, b) CLT panel with 90 mm total thickness [5].

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