Bamboo/Wood Composites and Structures Shear and Normal Strain Distributions in Multilayer Composite Laminated Panels under Out-of-Plane Bending

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Summary:

Innovative mass timber panels, known as composite laminated panels (CLP), have been developed using lumber and laminated strand lumber (LSL) laminates. In this study, strain distributions of various 5-layer CLP and cross-laminated timber (CLT) were investigated by experimental and two modelling methods. Seven (7) different panel types were tested in third-point bending and short-span shear tests. During the tests, the digital imaging correlation (DIC) technique was used to measure the normal and shear strain in areas of interest. Evaluated component properties were used to determine strain distributions based on the shear analogy method and finite element (FE) modelling. The calculated theoretical strain distributions were compared with the DIC test results to evaluate the validity of strain distributions predicted by the analytical model (shear analogy) and numerical model (FE analysis). In addition, the influence of the test setup on the shear strain distribution was investigated. Results showed that the DIC strain distributions agreed well with the ones calculated by the shear analogy method and FE analysis. Both theoretical methods agree well with the test results in terms of strain distribution shape and magnitude. While the shear analogy method shows limitations when it comes to local strain close to the supports or gaps, the FE analysis reflects these strain shifts well. The findings support that the shear analogy is generally applicable for the stress and strain determination of CLP and CLT for structural design, while an FE analysis can be beneficial when it comes to the evaluation of localized stresses and strains. Due to the influence of compression at a support, the shear strain distribution near the support location is not symmetric. This is confirmed by the FE method.

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