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Feasibility of using Uruguayan *Eucalyptus* for sustainable timber connections

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Uruguayan fast-growing *Eucalyptus grandis* has emerged as a promising sustainable material for structural building components. However, traditional methods for joining timber components, such as beams and columns, typically rely on metallic fasteners, and mass timber products like glued laminated timber often use adhesives. In response to growing environmental concerns over the past five years, researchers have explored the substitution of petroleum-based adhesives and metallic fasteners with wooden pegs or dowels. To create effective connections, these dowels must be fashioned from denser wood than the lamellae. The embedment strength of both woods with varying densities is a critical factor in the design of timber connections using fasteners. This paper presents the results of a structural performance analysis of fully eucalyptus dowelled connections, constructed by combining *Eucalyptus grandis* ($\rho = 473.2 \text{ kg/m}^3$, COV = 13.2 %) for the lamellae and *Eucalyptus tereticornis* ($\rho = 1042.4 \text{ kg/m}^3$, COV = 3.2 %) for the dowel. The bending strength of dowels was determined for specimens with 15- and 18-mm diameters, yielding 173.0 MPa (COV = 10.7 %) and 184.0 MPa (COV = 8.3 %), respectively. Four series of connections were tested, varying the fiber orientation of the lamellae (longitudinal L, transversal T) and dowel diameter (15, 18), following the half-hole method described in ASTM D 5764 standard. The embedment strength values obtained for the connections are as follows: L-15 = 31.3 MPa (COV = 9.3 %), T-15 = 11.2 MPa (COV = 28.7 %), L-18 = 29.6 MPa (COV = 10.1 %), T-18 = 16.7 MPa (COV = 25.7 %). These results reveal that the longitudinal application of the load, aligned with the fiber orientation, exhibits approximately twice the strength of the transversal orientation, with less variability in the outcomes. Furthermore, a strong correlation with the lamellae density was observed, while no significant dependency on the dowel diameter was found. These findings represent a crucial initial step in characterizing and designing glue-free wood-wood connections. The utilization of different eucalyptus species presents a promising path for the development of connections that promote more sustainable timber construction systems.

Keywords: connections, adhesive free, dowel, embedment strength

