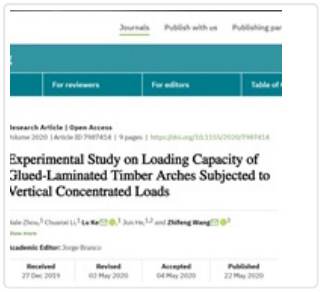

Experimental Study on Loading Capacity of Glued-Laminated Timber Arches Subjected to Vertical Concentrated Loads

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Summary:

Glued-laminated timber arches are widely used in gymnasiums, bridges, and roof trusses. However, studies on their mechanical behaviours and design methods are still insufficient. This paper investigates the in-plane loading capacity of circular glued-laminated timber arches made of Douglas fir. Experiments were conducted on four timber-arch models with different rise-to-span ratios under concentrated loads at mid-span and quarter-point locations. The structural responses, failure modes, and loading capacity of the timber arch specimens were obtained. The results show that the timber arches presented symmetric and antisymmetric deformation under mid-point and quarter-point loading conditions, respectively. The downward shifting of the neutral axis of the cross section was observed under mid-point loading condition, which contributes to higher loading capacity compared to that under quarter-point loading condition. The loading condition significantly affects the ultimate loads and the strain distribution in the cross section. Based on the design formula in current standards for timber structures, an equivalent beam-column method was introduced to estimate the loading capacity of the laminated timber arches under vertical concentrated loads. The moment amplification factor in the formula was compared and discussed, and the value provided in the National Design Specification for Wood Construction was recommended with acceptable accuracy.

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