Enhancing Bamboo Structural Grading under Axial Compressive Load: A Comparative Analysis of Green and Yellow Bamboo

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This study enhanced the structural grading of two Sri Lankan bamboo species subjected to axial compressive loads. It created strength and capacity grading systems for *Dendrocalamus giganteus* (Green bamboo) and *Bambusa vulgaris* (Yellow bamboo). Bamboo exhibits nature's inventiveness by providing a renewable and environmentally beneficial alternative to conventional building materials. Its quick growth and adaptability make it ideal for sustainable buildings, particularly in hot, humid climates and earthquake-prone areas. Despite its strong performance bamboo's full potential in modern building remains largely untapped due to insufficient design guidelines and the material's natural diversity. This work attempts to improve bamboo structural grading under axial compressive load whereas develop standardized testing and design methodologies by looking at the physical and mechanical properties of aforementioned two bamboo species. 60 samples from Green bamboo and 35 samples from Yellow bamboo were obtained to perform mechanical tests. Various diameters and ages were chosen to ensure sample representativeness. Compressive testing was performed adhering to ISO 22157 guidelines. The Universal Testing Machine measured compressive strength parallel to fibers. The maximum compressive loads (F_c) were recorded. Compressive strengths of bamboo samples were calculated by assuming hollow and solid circular sections (σ_{cw} and σ_{cc}, respectively). Linear mass (q) demonstrated a significant correlation with compressive force F_c, with coefficient of determination, R^2=0.78, making it an excellent predictor for bamboo structural grading. The correlation between q and F_c was relatively low (R^2=0.25) for yellow bamboo. Culm density and wall density were identified to be better predictors to estimate σ_{cc} with R^2=0.69 and σ_{cw} with R^2=0.68 in green bamboo. All the predictors indicate low R^2 values (R^2<0.25) when predicting σ_{cc} and σ_{cw} of yellow bamboo. Results show that the compressive capacity of the bamboo can be predicted more accurately than the compressive strength. Hence capacity grading of bamboo is more effective comparing with strength grading.

Keywords: Bamboo, Compressive Strength, Linear Mass, Correlation Values, Sustainable Construction.

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