

Comparative Structural Performance of Bamboo Reinforced Concrete (BRC) and Reinforced Cement Concrete (RCC) Short Circular Columns: Experimental Testing and ETABS Analytical Verification

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Abstract

This paper presents an experimental and analytical investigation into the structural performance of Bamboo Reinforced Concrete (BRC) short circular columns compared with conventional Reinforced Cement Concrete (RCC) short circular columns. Circular columns of 150 mm diameter and 300 mm height were cast in two concrete grades, M20 and M25, giving four configurations BRC-CL M20, RCC-CL M20, BRC-CL M25 and RCC-CL M25 with three specimens tested per configuration under monotonic axial compression. Parallel analytical models of all four configurations were developed in ETABS under IS 456:2000. A central objective of the study is to establish, through quantitative verification, that the ETABS design axial load P_u and design moment M_u are factored quantities inclusive of the IS 456:2000 partial safety factor $\gamma = 1.5$, since physical test results are inherently un-factored. Dividing the ETABS P_u values by 1.5 reproduces the experimental average ultimate loads to three significant figures for all four configurations, confirming this relationship. Unfactored ETABS axial stress is thereby shown to be numerically identical to the experimental compressive stress. The results further show that the IS 456 Clause 25.4 minimum eccentricity bending stress exceeds the pure axial stress even at the service level, and that RCC columns exhibit approximately 17% higher experimental compressive stress than BRC columns across both grades, a deficit attributable to the lower modular ratio of bamboo relative to steel. Despite this deficit, BRC columns achieve about 83% of the structural efficiency of RCC columns while offering ductile failure behaviour and improved sustainability, indicating that bamboo reinforcement is a technically viable alternative for non-critical load-bearing elements.

Keywords

Bamboo Reinforced Concrete, ETABS, IS 456:2000, Minimum Eccentricity, Short Column, Stress Verification.