Comparative Evaluation of Bolted, Plug-in Self- Lock, and Wall Beam-Strut Joints for Modular High-Rise Buildings

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Abstract:

The structural performance of modular high-rise buildings significantly depends on the efficiency of connections between prefabricated units. This research presents a comparative evaluation of three joint types—bolted, plug-in self-lock, and wall beam-strut—through both theoretical analysis and MATLAB-based multi-criteria optimization. Key structural parameters, including stiffness, damping, slip resistance, and load transfer efficiency, were assessed and normalized using published literature data. Weighted suitability scores were calculated to reflect the distinct functional demands of intra-modular and inter-modular joints. The analysis revealed that bolted joints are most suitable for intra-modular connections, offering superior stiffness and slip control, while plug-in self-lock joints are best suited for inter-modular applications, owing to their high damping capacity and reliable load transfer behavior. The findings were visualized using bar charts, radar plots, and pie diagrams to support informed design decisions.

Keywords:

Bolted joint, modular construction, plug-in self- lock joint, structural behavior, wall beam-strut joint.