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Seismic Performance of Various Grades of Steel Columns Through Finite Element Analysis

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Abstract : This study presents a numerical analysis of the cyclic behavior of H-shaped steel columns, focusing on different steel grades, including austenitic, ferritic, duplex stainless steel, and carbon steel. Finite Element (FE) models were developed and validated against experimental data, demonstrating a predictive accuracy of up to 6.5%. The study examined key parameters such as energy dissipation, and failure modes. Results indicate that duplex stainless steel offers the highest strength, with superior energy dissipation but a tendency for brittle failure at maximum strains of 0.149. Austenitic stainless steel demonstrated balanced performance with excellent ductility and energy dissipation, showing a maximum strain of 0.122, making it highly suitable for seismic applications. Ferritic stainless steel, while stronger than carbon steel, exhibited reduced ductility and energy absorption. Carbon steel displayed the lowest performance in terms of energy dissipation and ductility, with significant strain concentrations leading to earlier failure. These findings provide critical insights into optimizing material selection for earthquake-resistant structures, balancing strength, ductility, and energy dissipation under seismic conditions.

Keywords : Energy dissipation, finite element analysis, H-shaped columns, seismic performance, stainless steel grades
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