Effect of Ductility Factor on the Performance of PEB Industrial Steel Structure

M. Zaid Mulla
Department of Civil Engineering, Sanjay Ghodawat University, Kolhapur, Maharashtra, India

Dr. N. K. Patil
Department of Civil Engineering, Sanjay Ghodawat University, Kolhapur, Maharashtra, India

Dr. R. M. Desai
Department of Civil Engineering, Sanjay Ghodawat University, Kolhapur, Maharashtra, India

Abstract

Pre-Engineered Buildings (PEBs) have emerged as a preferred solution for industrial infrastructure in seismically active regions such as India, owing to their cost efficiency, rapid construction, and modularity. However, their seismic performance is critically influenced by the assumed ductility factor (Response Reduction Factor, R) used during design. This study investigates the effect of varying ductility factors on the seismic behavior of a typical industrial PEB frame. Nonlinear static pushover analysis is employed on a representative PEB model to evaluate seismic response parameters including base shear, lateral displacement, plastic hinge formation, and energy dissipation. The analysis is performed in accordance with IS 800 and IS 1893 seismic design provisions, considering site-specific hazard conditions. Results indicate a direct correlation between span length and displacement, highlighting increased ductility demand for longer spans. While steel material ductility remains constant, its required utilization increases significantly in longer spans to ensure structural stability under seismic loading. The findings provide valuable insights into optimizing the selection of ductility factors for PEB structures, aiming to enhance seismic resilience without compromising economic viability. This research supports more rational and performance-based design approaches for PEBs in seismic zones.

Keywords

Ductility Factor (R), Industrial Structures, Nonlinear Static, Pre-Engineered Buildings (PEB), Pushover Analysis, Response Reduction Factor, Seismic Performance.