Seismic Risk Assessment of a Substandard Reinforced Concrete School Building Using Different Numerical Approaches

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Abstract:
Nonlinear pushover analysis is an important tool for evaluating the seismic performance of existing reinforced concrete structures, particularly those designed without modern seismic provisions. However, the accuracy and reliability of the results depend heavily on the capabilities and assumptions of the analysis software. This study presents a comprehensive comparative investigation of the nonlinear pushover analysis capabilities of three widely used structural analysis platforms: VecTor2, VecTor5, and SeismoStruct, with a focus on the seismic assessment of substandard reinforced concrete (RC) school buildings. The study compares the adopted modeling philosophies, constitutive formulations, and response prediction capabilities of each software platform. A representative deficient RC school building is analyzed using identical geometric, material, and loading conditions to ensure a consistent basis for comparison. The key response parameters include capacity curves, hinge formation sequences, displacement demands, stiffness degradation, and failure mechanisms. The paper further examines the practical limitations of each method in terms of computational efficiency, modeling complexity, convergence behavior, and applicability to irregular or deficient structures. The findings provide valuable insights into the reliability, accuracy, and suitability of these analytical tools for seismic vulnerability and risk assessment of existing RC school buildings. VecTor2 demonstrated the highest prediction accuracy for local damage evolution and approximately 10% higher base shear capacity than VecTor5, while SeismoStruct achieved balanced computational efficiency with nearly 75% lower computational time compared to detailed continuum FEM simulations.

Keywords:
Seismic evaluation; Reinforced concrete; Nonlinear pushover analysis; substandard buildings.