DETECTING AND QUANTIFYING DAMAGE IN BUILDINGS USING EARTHQUAKE RESPONSE DATA AND CAPACITY CURVES

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Abstract

In the process of designing a building for seismic resistance, structural engineers design with the intent of preventing collapse while expecting inelastic behavior to occur in extreme strong ground motion events. Structural engineers rely on idealized mathematical models of the structural systems and nonlinear analysis methods to estimate the capacity of a building to resist the demand of strong earthquake ground motions. Compared to estimates and approximations based on numerical nonlinear analyses, a capacity curve constructed from actual building response data would be a more realistic representation of the behavior for the building. A method is presented on how capacity curves can be extracted from the response data of a building and how damage can be quantified using the hysteretic response and capacity curves in terms of stiffness degradation and ductility ratios either at an inter-story or fundamental mode resolution. The method is calibrated by implementation on numerical simulations and experimental models and applied to the historical response data of the 7-story hotel in Van Nuys, CA and the Imperial County Services Building in El Centro, CA.