國家地震工程研究中心
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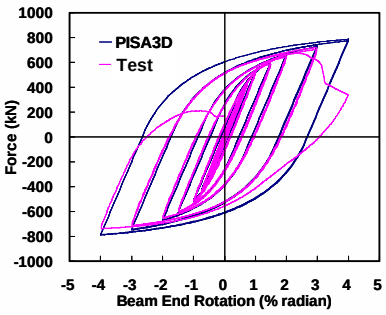
Case Study on Seismic Retrofit Design and Performance Evaluation of A 34-Story Steel Building

Summary: The construction of a five-floor basement and 34-story steel building was started in 1993. The erection of the steel structure and the pouring of concrete slabs up to the 26th floor were completed in 1996. However, due to the financial difficulty of the hotel developer, the construction of the original structure has been suspended for more than 10 years. Recently, this building is being retrofitted and re-constructed for residential purposes. This study introduces the change of seismic force requirements for buildings in Taiwan after the 1999 Chi-Chi Earthquake first. Then the new seismic performance requirement for this building is discussed. Buckling restrained braces (BRB) and eccentrically braced frames (EBF) with shear links were incorporated into the seismic design of the new residential tower. Moreover, a novel stiffening scheme was applied in strengthening one of the as-built beam-to-column connections before the tests for verification of the rotational capacity. Simplified methods of simulating the experimental responses in presented. Finally, the nonlinear seismic resisting performance of the building model subjected to earthquakes in two principal axes is concluded.

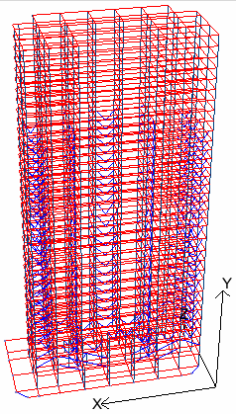
Analytical Model: The Platform of Inelastic Structural Analysis for 3D Systems (PISA3D), developed in National Center for Research on Earthquake (NCREE), Taiwan, is used to build the 3D numerical models using the material and element libraries. In this study, PISA3D has been applied to model BRBs and EBFs in order to investigate the seismic performance of the 34-story steel structure.

NCREE

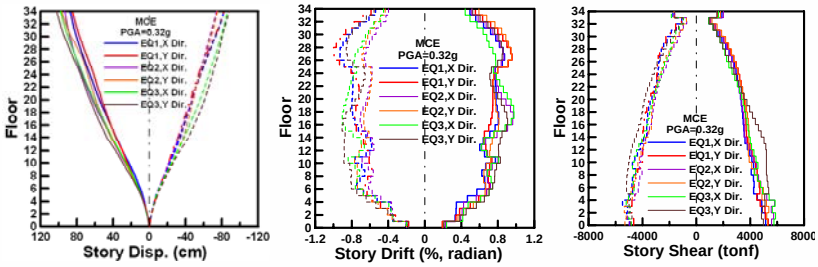
Conclusions: (1) Nonlinear dynamic analyses were employed to identify nonlinear dynamic characteristics, including yielding mechanisms, deformational demands, and detailing requirements. (2) A novel stiffening scheme was verified by full-scale cyclic loading tests. (3) Analytical results suggest that the seismic retrofit design of the building is effective. The deformational demands of the proposed seismic force resisting elements are smaller than those found in the laboratory tests.



Comparison of analytical and test results



Analytical Model



The peak response

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