PERFORMANCE-BASED ASSESSMENT OF EXISTING STRUCTURES ACCOUNTING FOR RESIDUAL DISPLACEMENTS

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The evaluation of residual displacements plays an important role for determining the feasibility of retrofitting structures that have been damaged due to earthquake ground motions. For example, as a consequence of large permanent deformations, on the order of 1.75% drift, more than 100 reinforced concrete bridge piers were demolished after the 1995 Kobe earthquake even though the bridges did not experience collapse. In addition, an adequate estimation of permanent deformations is important to assess seismic risks from aftershocks events. Thus, an adequate estimation of residual displacement demands that existing structures may experience after earthquake ground shaking is of primary importance in performance-based assessment. For this reason, recently published FEMA 356 *document* includes limiting residual deformation drifts corresponding to different performance levels for commonly used structural systems. However, this document does not provide with simplified procedures to estimate residual drifts in an early stage of the evaluation of existing structures when limited information is available (known dynamic properties and lateral strength).

Recently, several researchers have emphasized the need to incorporate the estimation of residual deformations in performance-based assessment criteria. However, currently there is a lack of adequate information of the main parameters that influence residual deformations on structures and of procedures that can be implemented to evaluate residual deformations of existing structures.

The main objective of this investigation is to propose a performance-based approach for the evaluation of existing structures that take into account residual displacements demands. For this purpose, the following tasks are being performed:

- Comprehensive statistical studies to evaluate maximum inelastic displacement demands and residual displacement demands of single-degree-of-freedom (SDOF) systems considering a relatively large earthquake ground motion database, and considering a large number of structural parameters.

- Comprehensive statistical studies to evaluate maximum and residual deformation demands of multi-degree-of-freedom (MDOF) systems (generic and "real" frame buildings as well as buildings with innovative energy dissipation devices) through incremental dynamic analyses.

- Formulation and implementation of a probabilistic displacement demand analysis approach (PDDA) to estimate maximum and residual deformation demands of SDOF and MDOF systems. The proposed approach will allow obtaining hazard curves and uniform hazard spectra which can be related to multiple performance objectives.