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COMPARISON OF SEISMIC PERFORMANCE OF SPECIAL CONCENTRIC BRACED FRAMES WITH BUCKLING-RESTRAINED BRACED FRAMES IN VIEW OF SEISMIC-INDUCED LOSSES

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Comparison of seismic performance for various lateral-resisting systems applicable in structures is of great importance towards appropriate structural system selection. The comparison can be implemented based on various parameters (i.e. seismic structural responses, energy dissipation capacities, structural yield strengths …). One of the most public lateral-resisting systems is the concentric braces. Special Concentric Braced Frames (SCBFs) and Buckling-Restrained Braced Frames (BRBFs) are two types of concentric braced systems. The main goal of this research is to present and to compare the structural seismic-induced losses in the mentioned types of concentric braced frames. To compute the structural seismic-induced losses the conditional method, which is proposed by PEER (Porter, 2003; Kircher et al., 2010) is applied. To implement the method, probabilistic seismic hazard, probabilistic seismic structural response, probabilistic seismic-induced damages and probabilistic seismic loss models are needed. Seismic hazard is presented by the power formulation. This formula presents the mean annual frequency of exceedance (MAFE) for the assumed earthquake intensity measure (IM). Structural response is calculated according to the nonlinear time-history analysis of the sampled structures against numbers of increasing-intensities strong ground motions (the process is entitled as Incremental Dynamic Analysis (IDA)). Probabilistic seismic demand model, which presents the probability distributions of seismic-induced responses, is achieved by IDA results. Probabilistic seismic-induced damages are presented by fragility curves. These probability distributions are adopted from HAZUS (HAZUS report, 2003) for Slight, Moderate, Severe and Complete structural damage states. Probabilistic seismic loss model, which presents probability of structural losses in various damage states, are adopted from HAZUS (HAZUS report, 2003) in view of building replacement cost (BRC).

Three sampled frames with 4, 8 and 12 stories are considered as case studies. The sampled frames are designed based on regular gravity and lateral loads according to national seismic design code (Standard No. 2800). Two scenarios (i.e. BRBF and SCBF) are considered as lateral-resisting system. Seismic hazard curves (based on power formulation) are shown in Figure 1. Probabilistic seismic demand models are achieved through nonlinear dynamic analysis of the sampled frames by OpenSEES tools applying the corresponding numerical models. The applied models have been verified based on relevant experimental results (Uriz, 2008). PSDM for 4-story sampled frames are shown in Figure 2. Applying the corresponding fragility and loss curves based on (HAZUS report, 2003), the achieved seismic loss curves for the sampled frames are shown in Figure 3.

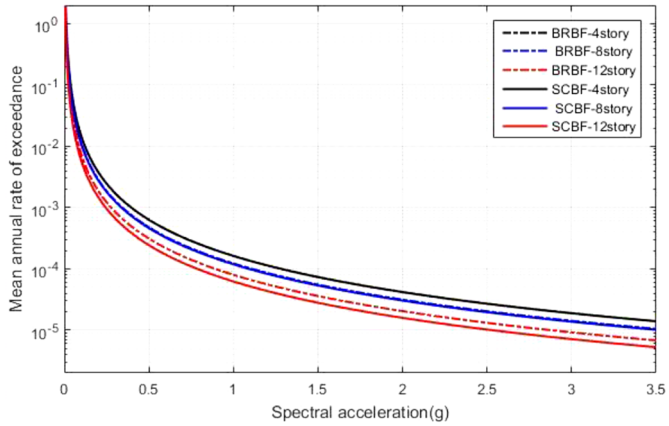

Figure 1. Seismic Hazard Curves for the sampled frames.

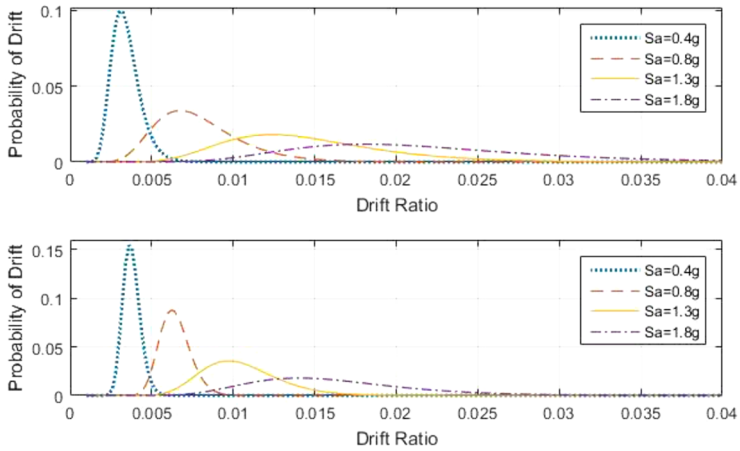

Figure 2. PSDM for 4-story sampled frames (Top: BRBF and Bottom: SCBF).

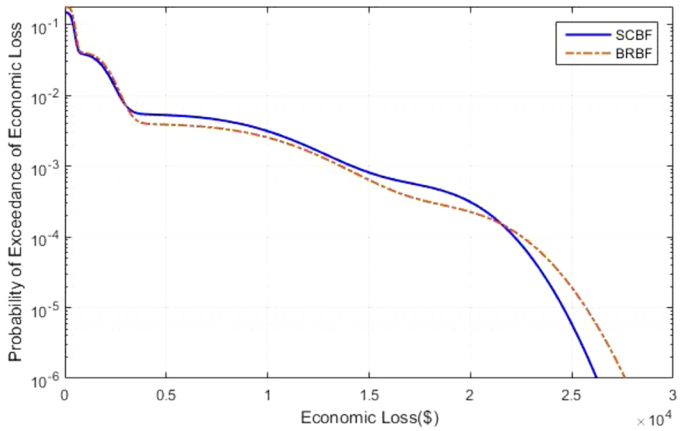

Figure 3. Seismic loss curves.

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