Fragility Curves for RC Buildings of Duzce (Turkey) Using Simulated Records

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Background and Objective

• Probabilistic seismic loss estimation studies inherently require use of fragility curves to assess the level of seismic damage to the structures. Correspondingly, fragility curves which are developed analytically necessitate utilization of ground motion records either seismologically consistent with the probable hazard for the area studied or chosen arbitrarily without considering the seismological characteristics, but covering a range of intensity levels. In both cases, the analyst should select several records to be able to perform the probabilistic studies accurately.

• For regions with limited number of records available, region-specific stochastically simulated ground motions could be utilized. The appropriateness of using simulated ground motions for nonlinear time history analyses has been investigated by various researchers and certain advantages have been displayed along with their shortcomings.

• Karimzadeh et al. recently examined the suitability of region-specific stochastically simulated ground motions records in determination of nonlinear response of typical moment resisting frames particular to Duzce, which is located in a highly active seismic zone of Turkey.

➢ This study takes a step forward and investigates the suitability of simulated records in development of fragility curves based on alternative intensity measures.

➢ This study utilizes;
  ▪ Stochastically ‘Simulated’ ground motion records generated for Duzce region
  ▪ ‘Real’ records selected from NGA-West2 ground motion database of PEER
  ▪ 3 low-to-mid-rise moment-resisting frames typical for Duzce region
Ground Motion and Frame Database

- F2-3S2B: $\Sigma M = 226.50 \text{ t}$, $T_1 = 0.72 \text{ s}$
- F5-4S3B: $\Sigma M = 75.30 \text{ t}$, $T_1 = 0.49 \text{ s}$
- F7-5S4B: $\Sigma M = 166.02 \text{ t}$, $T_1 = 0.52 \text{ s}$
The reason for not obtaining some of the fragility curves for F2-3S2B and F5-4S3B could be attributed to the fact that these two frames are relatively stronger with respect to F7-5S4B and ground motion records specific to Duzce region are low in energy content to trigger nonlinear response.

The discrepancies observed in the results could be attributed to the lack of real records (i.e., original unscaled records) at higher intensity levels.
Conclusions

- In cases of linear elastic responses or structures with low levels of inelasticity (IO limit state), dynamic analyses conducted with real and simulated records yield similar results.

- Although incomplete fragility data for the other two limit states LS and CP due to lacking nonlinear response at these levels prevent from making a general conclusion, F7-5S4B results suggest that it is convenient to use simulated records for derivation of fragility curves (PGV-based fragility curves especially), but with more caution being aware of the potential differences in exceedance probabilities.

- Different intensity measures result in peculiar differences of exceedance probabilities in between real and simulated-based curves. Further evaluations in terms of loss estimation studies are necessary to validate the obtained curves with observed damage data.
Come see my Poster!

**Today Poster Session:**

- **Time:** 5:15 – 7:00 pm
- **Room:** Pasadena (Exhibit Hall)
- **Poster location:** Number 083