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ASSESSMENT OF THE FAILURE PROBABILITY OF SHEAR WALLS AND BEAMS IN DUAL SYSTEMS OF MOMENT FRAME AND SHEAR WALLS

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According to probability of exceedance of strong ground motions in different places in the world, precise investigation of damages in structures under destructive earthquakes and preventing it, is of a huge concern and challenge in earthquake engineering.

Fragility curves are among important implements for investigation of vulnerability of structures which is used to determine the damage probability in structures underground motions with different intensities. Typically the failures caused by inter story displacements, the plastic rotation of plastic hinges in structural members, etc., are considered in vulnerability assessments. Damage and failure of structures under strong ground motions are appeared in two forms, local collapse and global collapse. In local damage and failure usually one or more load bearing structural members have minor damages because of entering the nonlinear zone or are removed due to extended imposed damages, and a part of the structures will be damaged or even fails. In general failure, the whole structure loses its bearing capacity so that the relative displacements in one or more stories will be much more than other floors and causes the structure to be unable to get back to its stable state under the secondary moment caused by self-weight of the structure and in that case, the general failure will happen.

In this paper, the peak ground acceleration (PGA) is considered as intensity measure, and maximum plastic rotation of the first beam that enters the nonlinear region and peak plastic rotation of first story shear walls are considered as engineering demand parameters which represent the local damage measure. Fragility curves were plotted to obtain the damage probability of beams and shear walls.

5, 10 and 12 story building structures were investigated once with RC (reinforced concrete) intermediate moment frame systems and another time with steel intermediate moment frame along with RC shear walls. The structures were 3D modeled and seven pairs of far field records were applied in two horizontal directions.

Figures 1 to 4 illustrate fragility curves corresponding to different states of damage (exceedance of performance level) for structural beam and shear wall of the first story in RC buildings with shear walls and steel buildings with RC shear walls (i.e. 5st).

According to fragility curves it is concluded that:

1- The probability of shear wall damage in both steel moment frame system with RC shear wall and RC moment frame with RC shear wall reduces by increasing the number of stories.
2- The probability of exceedance from life safety and collapse prevention of shear walls in 10 and 12 story buildings were negligible even in strong ground motions. On the other hand the probability of exceedance from immediate occupancy level in shear wall of 5 story building is more than 50 percent and for 10 and 12 story buildings, is less than 50 percent.
3- The probability of exceedance from life safety and collapse prevention in shear walls of 10 and 12 story structures are negligible even in strong ground motions. However, the probability of exceedance from immediate occupancy performance level in shear walls of 5, 10 and 12 story buildings are more than 50 percent.
4- The probability of exceedance from performance levels in beams of steel structures are less than those of RC structures.

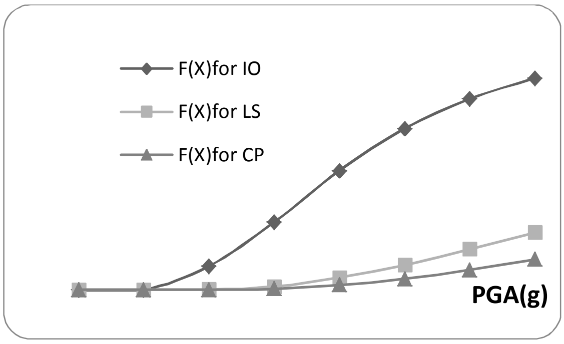

Figure 1. Fragility curves for first story shear walls in desirable performance levels (5 story concrete structure).

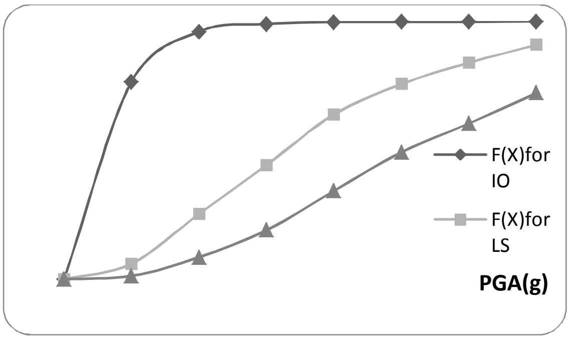

Figure 2. Fragility curves of the beam in desired performance level (5 story concrete structure).

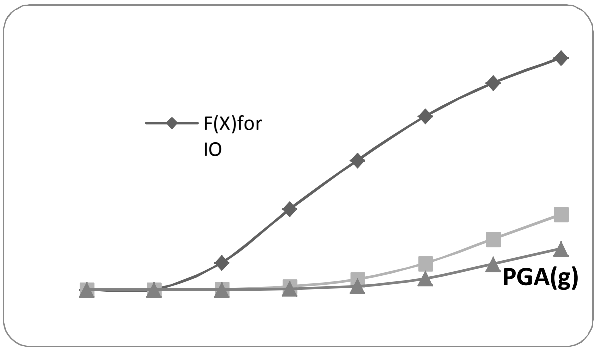

Figure 3. Fragility curves for first story shear walls in desirable performance levels (5 story steel structure).

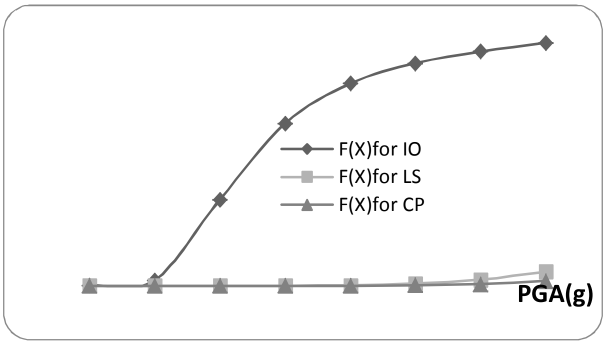

Figure 4. Fragility curves of the beam in desired performance level (5 story steel structure).

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