Experimental Fragility curves of Non-structural RC Walls

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Introduction

In Japan, the popular choice of infill in reinforced concrete moment-resisting framed buildings is **lightly reinforced concrete walls.** They are constructed monolithically with the frames. The 2011 Tohoku earthquake and 2016 Kumamoto earthquake have shown that even if there is minor or no damage to structural components, damage to non-structural walls can cause severe dysfunction, sometimes leading to demolition.

Resilience and functionality can be targeted through performance objectives that precede collapse by means of the non-prescriptive Performance-Based Earthquake Engineering (PBEE) framework.

Fig: Damage to NS walls in past earthquakes

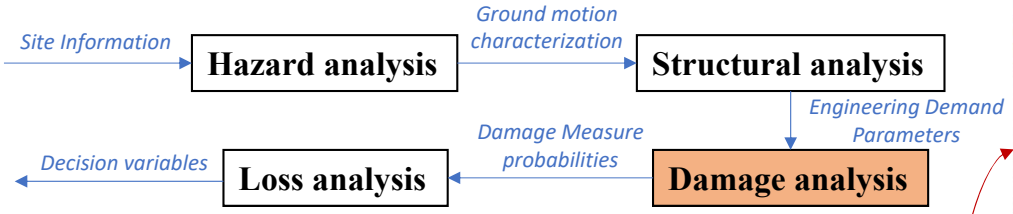

Fig: General Framework of PBEE methodology

Component fragility denotes '**Damage analysis**' and relates the probability of exceeding one or more damage states to probable demand calculated from structural analysis. There has not been any research on the component fragility of non-structural RC walls for limit states defined in the 2004 AIJ Guidelines. The present study fills this gap.

Table: AIJ Limit states Definition

Limit state	Damage state		Residual crack width (mm)	Required repair work
	Longitudinal reinforcement	Concrete		
Serviceability	Elastic	Nearly elastic	≤0.2	no repair
Repairability I	Slightly yielded	In good condition	0.2-1	small repair work
Repairability II	No buckling	Healthy core	1-2	extensive repair work

Results

The results are based on quasi-static cyclic loading test on six specimens

Table: Computed fragility parameters

	θ	β
Serviceability LS	0.08	0.35
Repairability I LS	0.37	0.36
Repairability II LS	0.97	0.38

θ: median demand value
β: dispersion

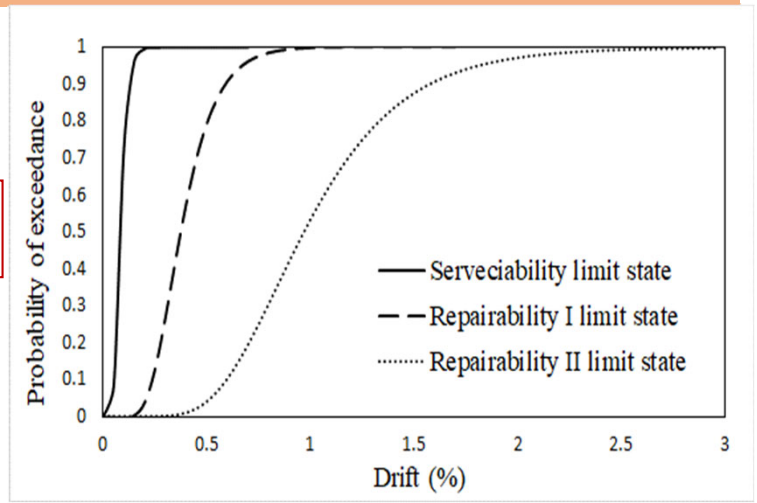

Fig: Fragility curve for non-structural walls

Conclusion

Drift-based fragility function provides information about the probability of exceeding (or experiencing) a specific limit state as a function of drift ratio experienced by the wall, which is crucial in PBEE.

Impact on the Society

Component fragility curves can be used in performance evaluation and economic loss assessment of building component which ultimately contributes to the risk state of the entire structure.