# Topic 1 Panel Discussion

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Multiple Hazards

- Consider multiple hazard in risk space, not hazard space
  - Probability of damage to structure from different hazard
  - Not probability of the demands from different hazards
- Risk Calculation
  - Requires fragility and hazard
  - Relation between hazard and risk depends on the slope of the hazard and slope of the fragility
  - For earthquake hazards (ground motion, surface rupture, slope deformation) in active regions, key part of the fragility curve is the 0.05-0.15 failure probability, not the median failure point

Example Hazard and Fragility for a Dam in NE California
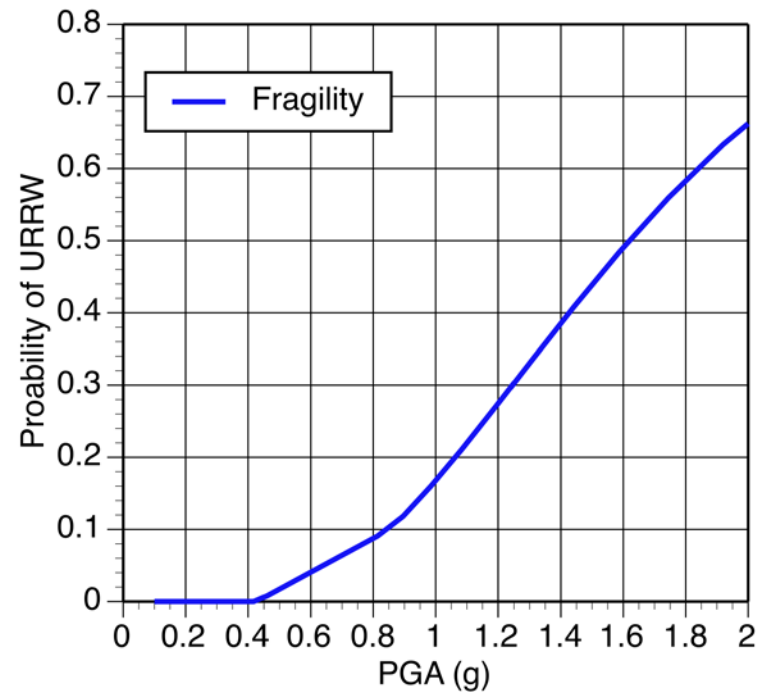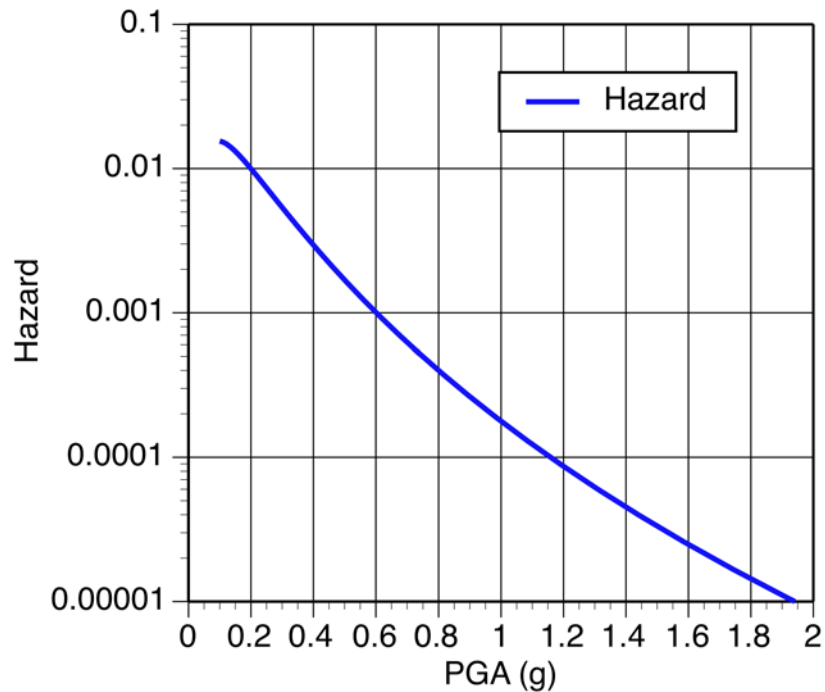
Failure Probability Contribution
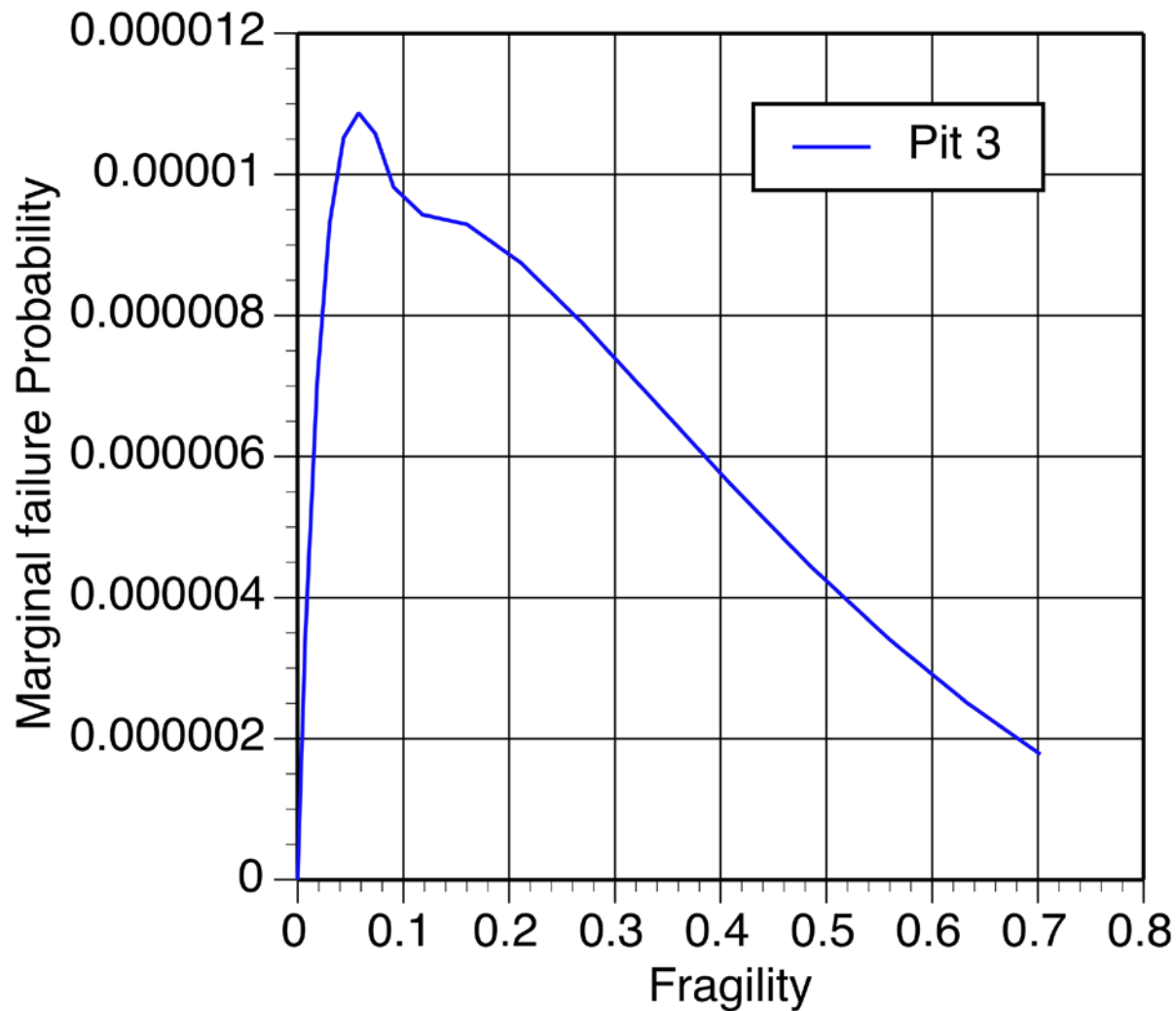
Issues for Shake Table Testing for Fragility

- How can the ground motion corresponding to the 0.10 failure probability be reliably estimated in a cost effective manner?
  - Using spectral acceleration only, there is a large variability of the structural response for different time histories with the same SA value
    - Need about 35 tests for 15% accuracy in ground leading to 0.1 probability of failure
    - Need only 7 tests for 15% accuracy in ground motion leading to 0.5 probability of failure

Issues for Shake Table Testing for Fragility

- How can the ground motion corresponding to the 0.10 failure probability be reliably estimated in a cost effective manner?

  - Reduce the number of tests required by identifying the vector of ground motion parameters that are important to cause failure
    - What other ground motion parameters are important?
      - Duration, velocity pulse, arias intensity …
      - Simple measures of yielding: Inelastic response spectra …
    - Do they change for each structure?