

## Structures 2 - Japan

### A. Uniqueness

1. Two extreme events: Near-source shaking followed by tsunami impact
2. Multiple after-shocks. [Scalability: little damage in one bldg ok, but if its in lots of building then it's a problem]
3. Increased awareness in other subduction zones, especially where plate is subducting directly below large population centers; even stronger shaking followed by tsunami, [e.g. Cascadia and south off-shore Tokyo].
4. Extent and quality of data provide unique opportunities



Japan and NZ Earthquakes RAPID and Research Needs Workshop  
Arlington, VA Feb 9 and 10, 2012



## Structures 2 – Japan (2)

### A. Uniqueness

5. Felt vibration in tall buildings was alarming [Osaka: 52 stories, 0.03 g, 1.2 m, duration 20 minutes, market value drop by 40%]
6. Importance of resiliency

### B. Larger-than-expected (designed / considered)

1. Tsunami was larger than expected – need performance-based design strategies
2. Recorded accelerations were larger expected but shaking damage was not strongly correlated
3. Duration longer than expected – effect is inclusive, so far.



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## Structures 2 – Japan (3)

### C. Collaboration

1. Improving our analytical modeling to have confidence in varying performance expectations up to collapse in extreme loads.
2. Improving the performance of tall buildings (limit vibrations) with protective systems/dampers
3. Understanding the tsunami hazard and mitigating the risk.
4. Using the extensive data sets to validate
  - a. numerical models and develop new mitigation strategies
  - b. retrofit techniques for buildings and bridges.

