Performance Expectations of New Tall Building Construction

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Tuesday, March 5– Friday, March 8
Code-Targeted Seismic Reliability

- Risk Category I & II—Ordinary Occupancies 10% probability of collapse given MCE_R shaking
- Risk Category III—Special Occupancies 5% probability of collapse given MCE_R shaking
- Risk Category IV—Essential Facilities 2.5% probability of collapse given MCE_R shaking
  - Also includes qualitative functional objectives at the Design Earthquake

- Typically Tall Building Risk Categories:
  - Office Buildings < ~750,000 sf Risk Category II
  - Office Buildings > ~750,000 sf Risk Category III
  - Residential Buildings Risk Category II

- Overall, the safety goals for tall buildings are largely being met with the current seismic provisions
Current Tall Building Design Approach

- Most tall buildings (>240’) in high seismic areas designed using Performance-Based Design Methods
  - However, targeted performance is typically code equivalency NOT enhanced performance

- Why Performance-Based Design Methods:
  - Proposed design does not meet the code-prescriptive requirements (typically height limits), so an alternative approach is required
  - Required by the Authority Having Jurisdiction (e.g., Seattle, San Francisco, Los Angeles)
Current Tall Building Design Approach
Current Tall Building Design Approach

Along-wind

Pressure keeps constant with height (Leeward)

Across-wind

Pressure keeps constant with height (Wind ward)
New Building Archetype Studies

City Team

Naomi Kelly, City Administrator
Mary Ellen Carroll, Dept. of Emergency Management
Kathryn How, Public Utilities Commission
Tom Hui, Dept. of Building Inspection
Brian Strong, Office of Resilience and Capital Planning
Danielle Mieler, ORCP Project Manager
### New Building Archetype Studies

**March 5-8, 2019 EERI 2019 ANNUAL MEETING**

**Vancouver, BC, Canada**

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**Project Team**

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<tr>
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<th>Stanford</th>
<th>AGI</th>
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New Building Archetype Studies

40-story RC Residential Building

40-story Steel BRBF Office Building
New Building Archetype Studies

40-story RC Residential Building
EQ Drift*: 0.8% (1.3% racking)
Expected Repair Cost: 8% replacement value
Functional Recovery Time: 5 to 6-1/2 months

40-story Steel BRBF Office Building
EQ Drift*: 1.0%
Expected Repair Cost: 3% replacement value
Functional Recovery Time: 3 to 4-1/2 months

* Maximum permissible drift per SF Building Code is 2%
** Costs and recovery time are for Site Class D; values would be about half for Site Class B.
Building Performance (Design Earthquake)

Functional Recovery - Days

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BRB Frame, Median and 90%
RC Shear Wall, Median and 90%
Effect of Reduction in Impeding Factors

Baseline Case

with Resilience Planning

Contributions to Downtime, (Days)
(excluding cases requiring replacement)
Seismic Drift Requirements (MCE Shaking) Shaking

Comparison of Calculated Story Drifts under MCE Ground Motions
Influence of increased building drift on damage, repairs and recovery time
QUESTIONS?