

# PBEE - How will it affect Seismic Engineering Practice and Decision Making for Nonstructural Components ?

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# Defining the Issue

- **What are Nonstructural Components ?**

Nonstructural components are the architectural, mechanical and electrical components and systems typically found in buildings

- **What is the current the Seismic Engineering Practice and Decision Making for Nonstructural Components ?**

For most buildings, the current seismic practice is to satisfy building code requirements. In California, hospitals have more stringent practice.

# Further Defining the Issue

- PBEE = PEER Methodology implemented by Guidelines developed by the ATC-58 Project
- Restrict Discussion to California
- Current Seismic Practice will be changing significantly the next 2 years – 2006 IBC
- Will discuss current practice and decision making
- Will discuss the new practice in 2 years
- Will discuss how PBEE might affect the new practice in say 10 –15 years

# Current Seismic Engineering Practice for Nonstructural Components

- Structural Engineer for building not much involved
- Architects
  - Specify architectural features – meet code / no details
  - Left to suppliers and installers to satisfy
- Mechanical and Electrical Engineers
  - Specify MEP systems – meet code /no details
  - Left to building subcontractors to satisfy
- Current Code Requirements (1997 UBC) focus on design forces for bracing and anchorage of nonstructural components with a few components (exterior wall panels) also accommodating drift

# Seismic Engineering Practice for Nonstructural Components in 2 Yrs

- Structural Engineers have more involvement
- Seismic Code Requirements for nonstructural components based on ASCE 7-05
- All components must consider both forces and maximum drifts if they might be effected.
- Designated components must themselves be designed or seismically qualified
- All components can satisfy seismic requirements by shake table testing, experience data or analysis
- Many detailing requirements which will force architects, suppliers and engineers to discuss design options

# Examples of New Collaboration that will happen in 2 years

- Suspended ceiling systems will be required to have either
  - large openings around sprinklers
  - Articulating or flexible hose sprinkler drops
  - Ceiling and sprinkler and HVAC integrally constructed to act as a unit
- Glazing systems must have adequate clearance around its edges to accommodate max. drifts

# Additional Examples

- Many components will be seismically qualified by shake table testing (AC-156)
- Active mechanical and electrical components that designated systems will be required to qualified by shake table testing or experience data
- Much more focus on functionality after design earthquakes for essential facilities
- Base isolation should be much more prevelant

# PBEE Effects on Seismic Engineering Practice and Decision Making in 10 -15 years

- Most structures will still be designed to meet code
- Codes will still be primarily rule based with fixed loads and fixed allowables – some PBEE effect on codes.
- However more buildings will be designed using using PBEE procedures
- Owners will be more sophisticated and involved in decision making including pallet of decisions on nonstructural components and systems
- Nonlinear dynamic analysis more common



# PBEE Effects on Seismic Engineering Practice of Nonstructural Components

- Testing Protocols improve shake table and relative displacement testing
- Suppliers much more interested in developing fragility function rather than just seismic qualification
- Full scale testing of assemblies (performance groups) to obtain fragility functions
- Large catalog of fragility damage and loss functions for nonstructural components and performance groups – built into PBEE design and evaluation tool

# PBEE Effect on Seismic Engineering Practice

- Structural system selection much more effected by performance of nonstructural components
- More sophisticated owners will require much more design and installation coordination between nonstructural subcontractors
- Architects and building officials will require much more inspection of installed components
- In many cases, code requirements are reduced with no loss of performance resulting in lower cost