

**Asian Institute of Technology**  
**School of Engineering and Technology**

**Performance Based Seismic Design**

**Semester: January**

**Course Objective:** Performance-based design is a major shift from traditional structural design concepts and provides a method for determining acceptable levels of earthquake damage. Also, it is based on the recognition that yielding does not constitute failure and that preplanned yielding of certain members of a structure during an earthquake can actually help to save the rest of the structure. This course provides the theory and practical application of nonlinear analysis and performance-based design of tall buildings.

**Learning Outcomes:** The students on the completion of this course would be able to:

- Understand concepts of performance based design.
- Carry out performance based seismic assessment of tall buildings.

**Course Outline:**

- I Performance-based design
  1. Basic philosophy and methodology
  2. Quick overview of seismic analysis
  3. Failure modes of structural components
  4. Capacity-based design
  5. Seismic hazard definition and representation
  6. Overall PBD procedure
  7. Basis of Design
  
- II Nonlinear behavior and modeling of structural components
  1. Types of nonlinearity
  2. Modeling of beams , columns, slabs and walls
  3. Modeling of special elements
  4. Hysteresis behavior, strength loss
  5. Nonlinear analysis procedures
  
- III Interpretation of results
  1. Moment frame beams and columns
  2. Shear walls
  3. Coupling beams
  4. Foundations
  5. Diaphragms
  6. Basement Walls
  
- IV Structural performance and cost optimization
  1. Level of Optimization
  2. Local and Global Optimization

3. Cost Performance and Cost Effectiveness
- V Seismic Performance Based Evaluation of Non-Structural Components in Tall Buildings
1. PBD of Nonstructural Components
  2. Methodologies for Performance Assessment of Non-structural Components
  3. A Typical Performance Based Evaluation and Loss Estimation Framework
- VI Case-studies for Performance-based Design of Tall Buildings with Different Structural Systems
1. Performance based design of ductile core wall building
  2. Performance based seismic design of RC Dual System Buildings
- VII Hands-on training on Modeling and Analysis for PBD of Tall Buildings
1. Code-based design in ETABS
  2. PBD of 40-story in ETABS
  3. PBD of 40-story in Perform 3D

### **Learning Resources:**

#### Textbooks:

- No designated textbook, but lecture notes will be provided by the instructor.

#### Reference Books:

1. An Alternative Procedure for Seismic Analysis and Design of Tall Buildings Located in the Los Angeles Region, 2017 Edition with 2018 Supplements, Los Angeles Tall Buildings Structural Design Council, March 20, 2018
2. Seismic Evaluation and Retrofit of Existing Buildings, ASCE/SEI 41-17, American Society of Civil Engineers, 2017
3. Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE/SEI 41-17, American Society of Civil Engineers, 2017
4. Modeling and Acceptance Criteria for Seismic Design and Analysis of Tall Buildings, PEER/ATC 72-1, Applied Technology Council and Pacific Earthquake Engineering Research Center, October 2010
5. Tall Buildings Initiative - Guidelines for Performance-Based Seismic Design of Tall Buildings, ver. 2.03, Pacific Earthquake Engineering Research Center, May 2017
6. Building Code Requirements for Structural Concrete (ACI 318M-14) and Commentary (ACI 318RM-14), American Concrete Institute, 2015.
7. Modeling for Structural Analysis, Graham H. Powell, Computers & Structures Inc., 2010
8. Guidelines for Nonlinear Structural Analysis for Design of Buildings, Part I – General, NIST GCR 17-917-46v1, Applied Technology Council, April 2017
9. Guidelines for Nonlinear Structural Analysis for Design of Buildings, Part IIb – Reinforced Concrete Moment Frames, NIST GCR 17-917-46v3, Applied Technology Council, April 2017

Journals and Magazines:

- Earthquake Spectra, EERI
- Earthquake Engineering and Structural Dynamics, John Wiley & Sons, Ltd

**Instructor:**

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