ASCE | CONTINUING EDUCATION

Innovative Seismic Design

Purpose and Background

The seismic resistance of a structure (to ground shaking) depends its: (i) weight, (ii) strength, (iii) deformability, and (iv) damping. Tall buildings weigh more (than short buildings) but they are also more deformable (than short buildings). Therefore, the height of a structure does not make it more vulnerable to ground shaking. An engineer may not have much control over the weight of a structure, but an engineer can control a structure's strength, deformability and damping. Prescriptive seismic design relies only on strength to increase the seismic resistance of a structure. Therefore, the prescriptive seismic design can be very costly or even impractical at times. Innovative seismic design incorporates deformability and damping to reduce the strength-demand on a structure. Therefore, it results in a more economical seismic design.

This class describes innovative solutions for the design of building structures, equipment, and nonbuilding structures. Real life examples are presented with emphasize on understanding. An intuitive approach is used to describe complex ideas. Questions and discussions are encouraged throughout the class.

Seminar Instructor

Praveen K. Malhotra, Ph.D., P.E., M.ASCE, is a Principal at StrongMotions, Inc. in the Boston Area. After completing his Ph.D. in engineering from Rice University, Dr. Malhotra went on to work alongside prominent geologists and seismologists at the California Geological Survey (CGS) for seven years. This experience helped Dr. Malhotra close the gap between earth sciences and engineering and to realize the uncertain nature of earthquake ground motions. After CGS, Dr. Malhotra joined a property insurance company to help underwrite and engineer earthquakes risk around the globe. This experience allowed Dr. Malhotra to combine his knowledge of earth sciences and engineering to assess and mitigate the risk from earthquakes. Dr. Malhotra soon realized that there were two very different perspectives of the risk: aggregate risk from the insurance company's or government's perspective and site-specific risk from the insured's or owner's perspective. Both risks needed to be managed. After 13 years of working with the insurance company, Dr. Malhotra started his own consulting practice in 2010. Many of his projects require: (1) prediction of future ground motions, and (2) performance-based evaluation, design and retrofit of structures. He publishes extensively and presents seismic training seminars throughout the USA and abroad. He is a licensed engineer in California and holds two patents.

- **For group training, contact John Wyrick (JWyrick@asce.org) or Stephanie Tomlinson (STomlinson@asce.org)**

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Summary Outline

TWO-DAY SEMINAR (1.4 CEUs)

Session 1. Ground Motions from Past Earthquakes
- Acceleration, velocity and displacement histories
- Response spectrum of ground motion
- Acceleration-deformation response spectrum (ADRS)

Session 2. Ground Motions for Future Earthquakes
- Site-specific response spectra for static analyses
- Site-specific ground motion histories for dynamic analyses

Session 3. One-Story Building Structures
- Moment frames
- Braced frames
- Plastic rotations, strain hardening, P-Δ effect
- Effect of torsional-irregularity

Session 4. Multi-story Building Structures
- Moment frames
- Braced frames
- Effect of soft-story (vertical irregularity)

Session 5. Sliding Response of Unanchored Equipment
- Nonlinear-static analysis
- Nonlinear-dynamic analysis
- Effect of friction on sliding response

Session 6. Rocking Response of Unanchored Equipment
- Nonlinear-static analysis
- Nonlinear-dynamic analysis
- Toppling response spectrum of ground motion

Session 7. Storage Racks
- Sliding of pallets in cross-aisle direction
- Collapse of racks in the down-aisle direction
- Cyclic tests of beam-column moment connections
- P-Δ effect

Session 8. Liquid-Storage Tanks
- Sloshing response of liquid
- Uplifting, sliding and plastic rotation at the base of tank
- Elephant-foot buckling
- Soil-structure interaction (SSI)

Session 9. Gantry Cranes
- Nonlinear-static (pushover) analysis
- Plastic rotations in beams and columns
- Ductile versus nonductile base anchors

Seminar Benefits

- An intuitive understanding of complex ideas in seismic design
- An opportunity to ask questions on a variety of topics related to seismic resistance
- A condensed knowledge of ground motions and seismic resistance
- Role of strength, deformability, and damping in seismic resistance

Learning Outcomes

- A state-of-the-art knowledge in seismic resistance
- An ability to quantify seismic performance of structures
- Pros and cons of linear, nonlinear, static, dynamic methods of analysis
- Role of damping and deformability in seismic design
- Sources of damping and deformability in structures
- Performance-based seismic design
- Seismic design without the use of R factors
- Acceptable level of seismic risk

Who Should Attend?

- Structural engineers
- Geotechnical engineers
- Architects
- Regulators
- Building officials
- Owners
- Operators
- Geologists
- Seismologists
- Insurers
- Educators
- Students

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ASCE seminars are available for On-Site Training. For details regarding On-Site Training and/or needs-based training opportunities, please contact:

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