

# TOPICS IN PERFORMANCE-BASED EARTHQUAKE ENGINEERING



Instructional Materials Complementing FEMA 451, *Design Examples*

Introduction 15-1 - 1

This brief introduction serves as a prelude to sets of slides that are intended to form an advanced course in earthquake engineering. Topics 15-2 through 15-8 have been taught in the past as part of a four-day course offered at FEMA's Emergency Management Institute in Emmitsburg, Maryland.

Some of the material in Topics 15-5, Advanced Analysis, is covered in FEMA 451, *NEHRP Recommended Provisions: Design Examples*. For example, Chapter 3 of FEMA 451 focuses on a steel structure that is analyzed using nonlinear static pushover and nonlinear dynamic response history analysis.

Topic 15-7, Seismic Isolation, is also covered in FEMA 451 but there are no shared examples.

# Topics Covered

- Principles of performance-based earthquake engineering
- Seismic hazard and seismic risk analysis
- Geotechnical earthquake engineering
- Methods of analysis
  - Pushover-based methods
  - Nonlinear response history methods
- Passive energy systems
  - Displacement dependent
  - Velocity dependent
- Seismic isolation
- Nonbuilding structures



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Introduction 15-1 - 2

Structural engineering is  
the Art of using materials  
*that have properties which can only be estimated*  
  
to build real structures  
*that can only be approximately analyzed*  
  
to withstand forces  
*that are not accurately known*  
  
***so that our responsibility to the  
public safety is satisfied***



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Introduction 15-1- 3

This is the essence of performance-based earthquake engineering. It also shows why probabilistic methods are so important . . . uncertainties!

This quote comes from the inside cover of Ed Wilson's book on structural analysis. There are other versions that end instead in the words "to the extent that the public is not remotely aware."