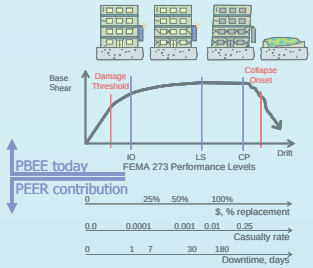
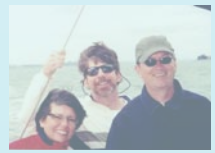
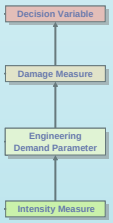
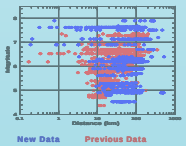
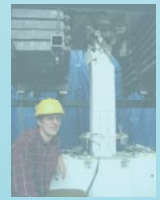


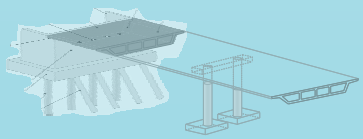


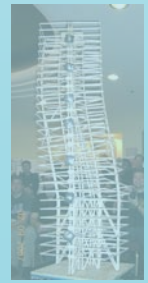


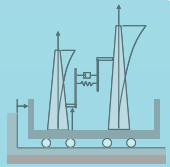
"The Story of PEER"











Jack Moehle

EARTHQUAKE ENGINEERING RESEARCH CENTERS

Earthquake Hazard Mitigation Program

Program Announcement

Division of Civil and Mechanical Systems
Directorate for Engineering

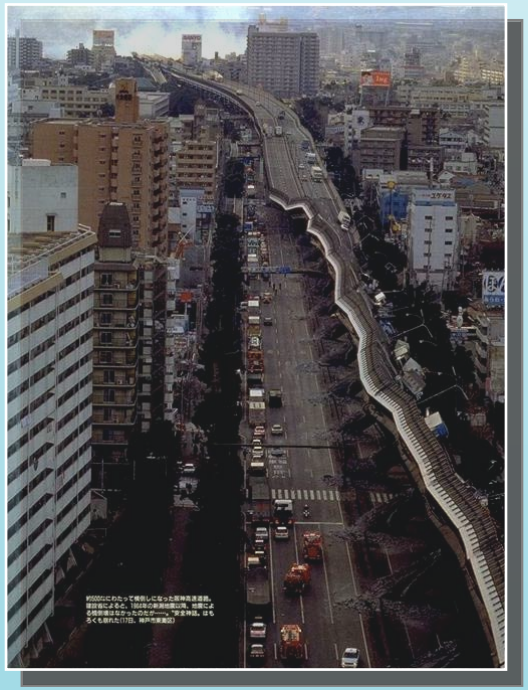
Deadline for Receipt of Proposals: *October 15, 1996*

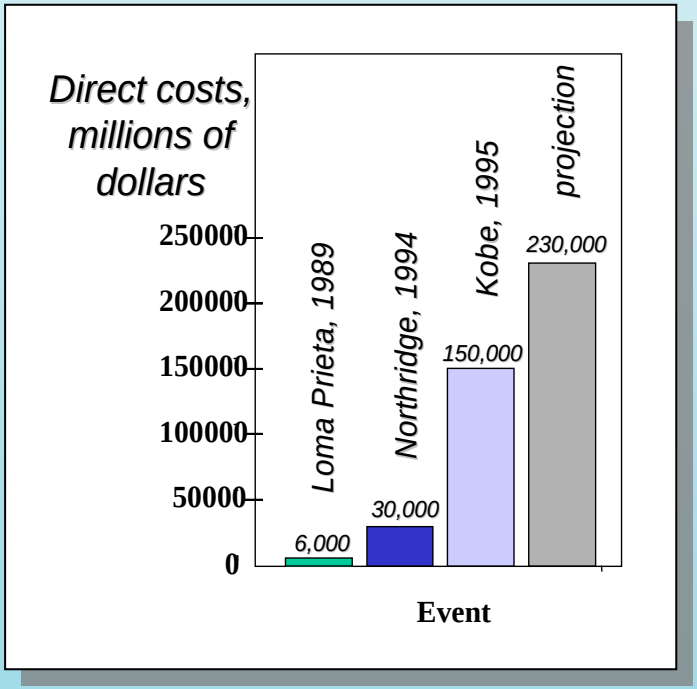
NATIONAL SCIENCE FOUNDATION

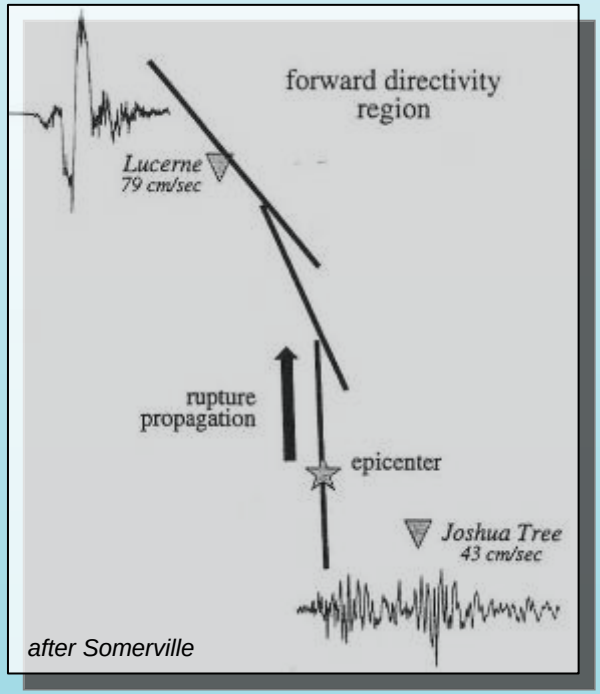
Ten Years of NSF reviews

Jack Moehle
ca 1996

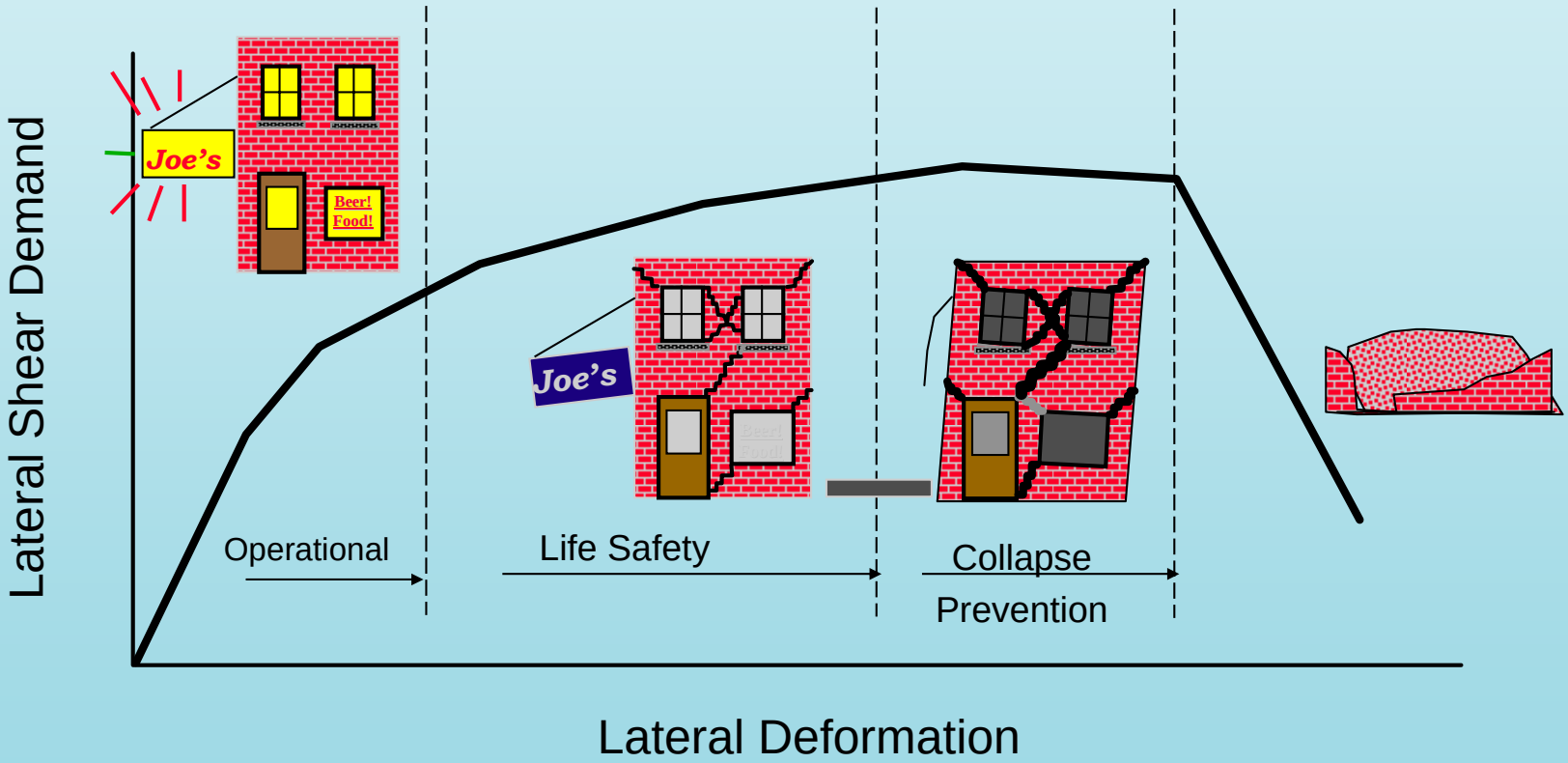
Ten Years Ago





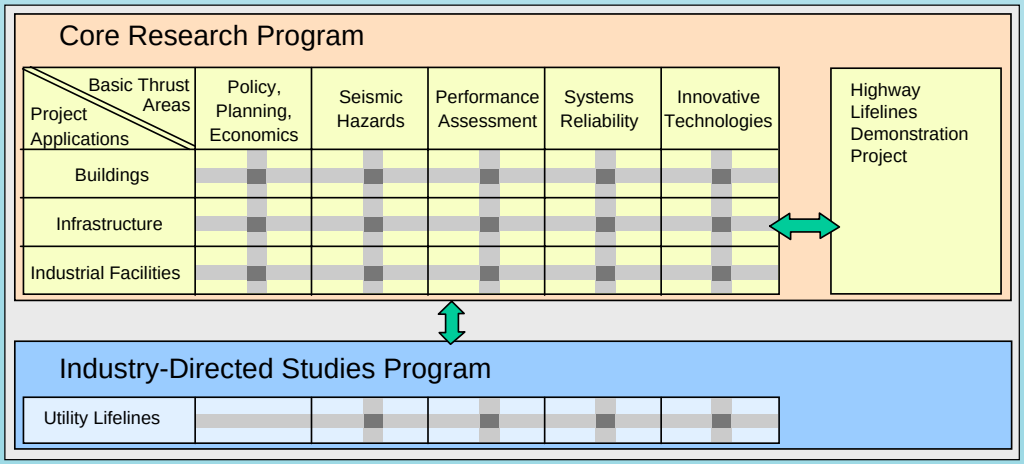


Ten Years Ago



Year 1

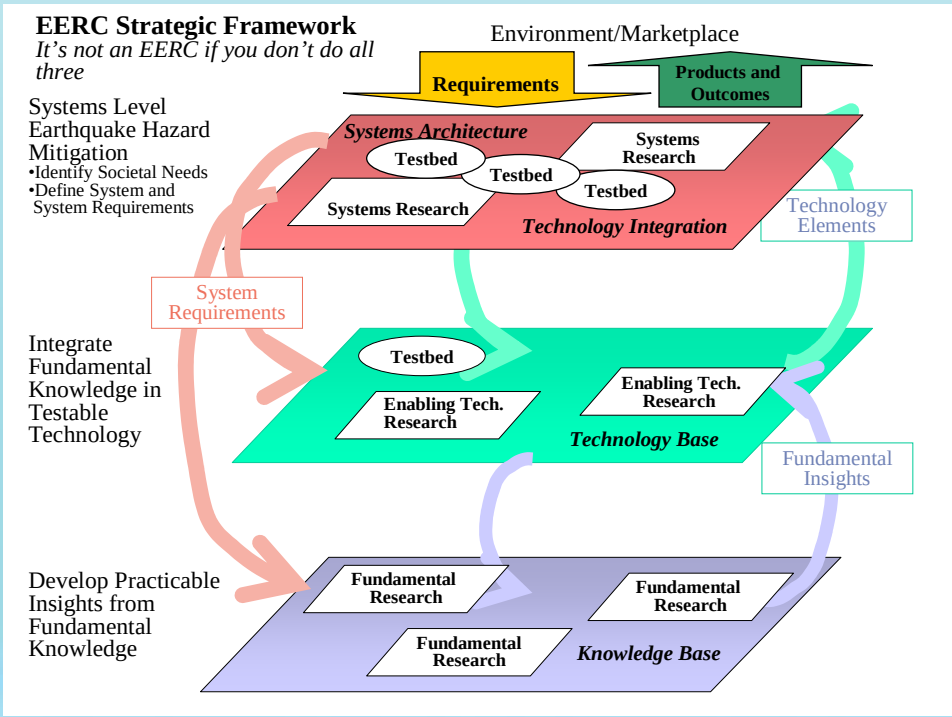
- The mission of PEER is to develop and disseminate urban earthquake risk reduction technologies…. Because of the need to optimize the use of limited resources for earthquake risk mitigation, PEER will develop its earthquake risk reduction technologies within a performance-based earthquake engineering framework.

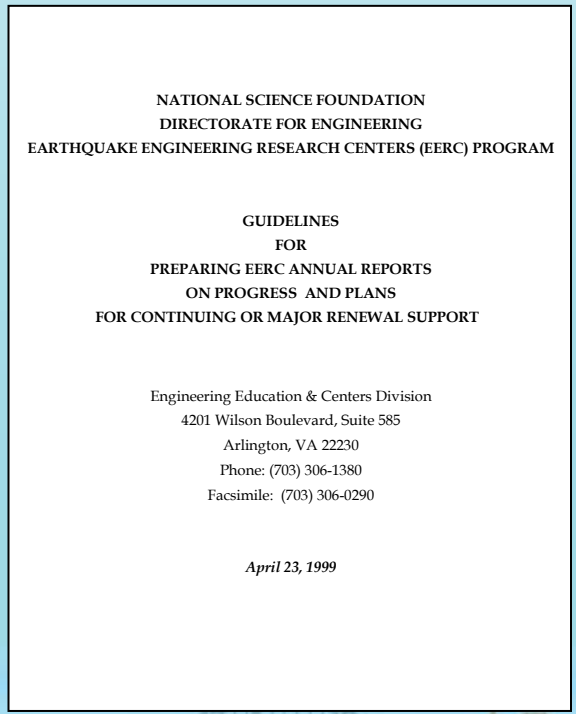


Year 2

PEER is adopted by the NSF Engineering Research Centers Program

PEER Mission - *To develop and disseminate technology for design and construction of buildings and infrastructure to meet the diverse seismic performance objectives of owners and society.*





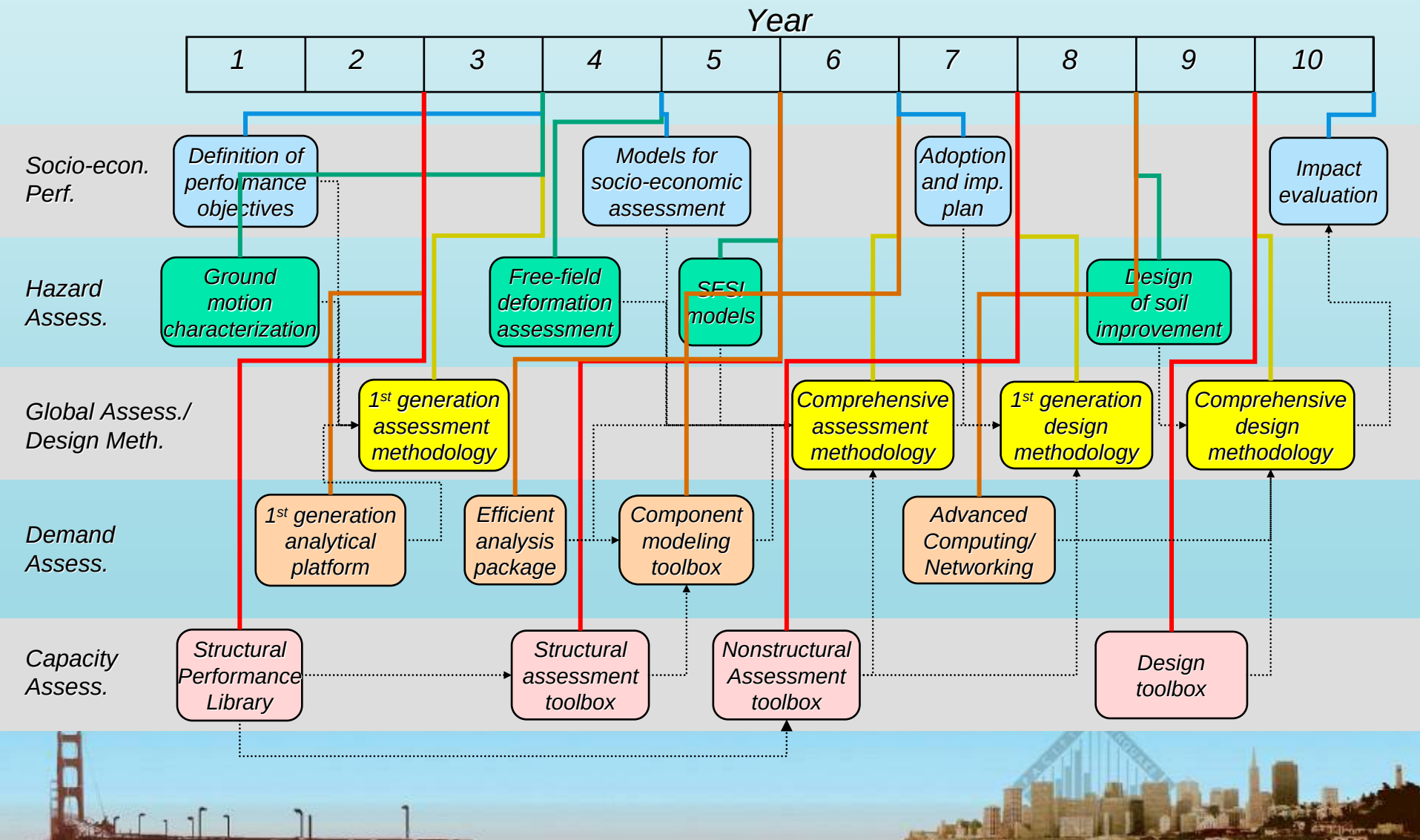
NATIONAL SCIENCE FOUNDATION
DIRECTORATE FOR ENGINEERING
EARTHQUAKE ENGINEERING RESEARCH CENTERS (EERC) PROGRAM

GUIDELINES
FOR
PREPARING EERC ANNUAL REPORTS
ON PROGRESS AND PLANS
FOR CONTINUING OR MAJOR RENEWAL SUPPORT

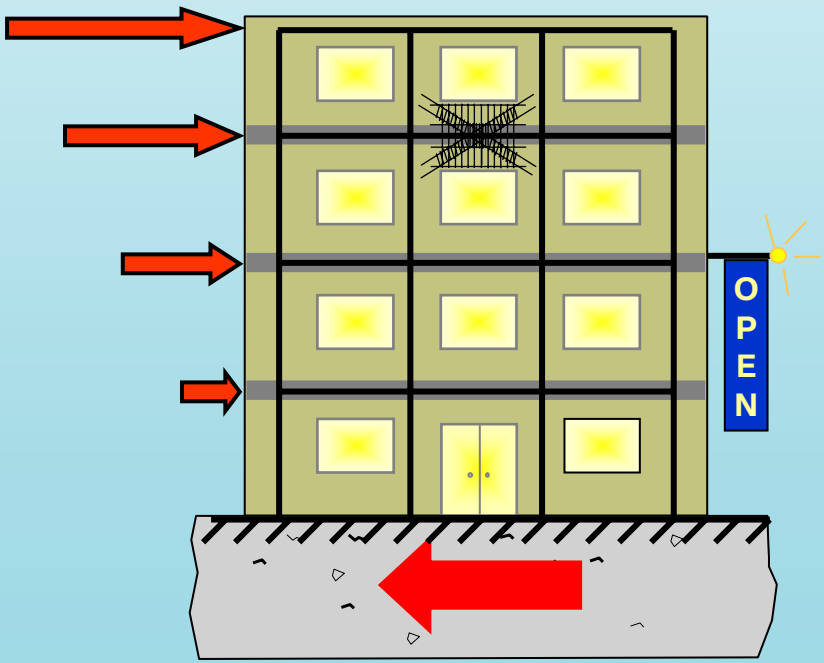
Engineering Education & Centers Division
4201 Wilson Boulevard, Suite 585
Arlington, VA 22230
Phone: (703) 306-1380
Facsimile: (703) 306-0290

April 23, 1999

Thrust Area Major Milestones



Prescriptive design approach

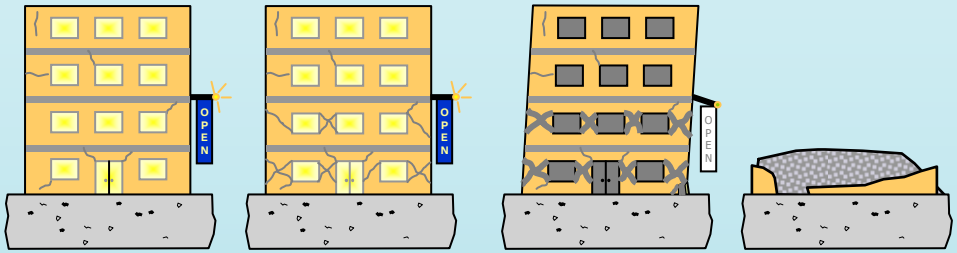


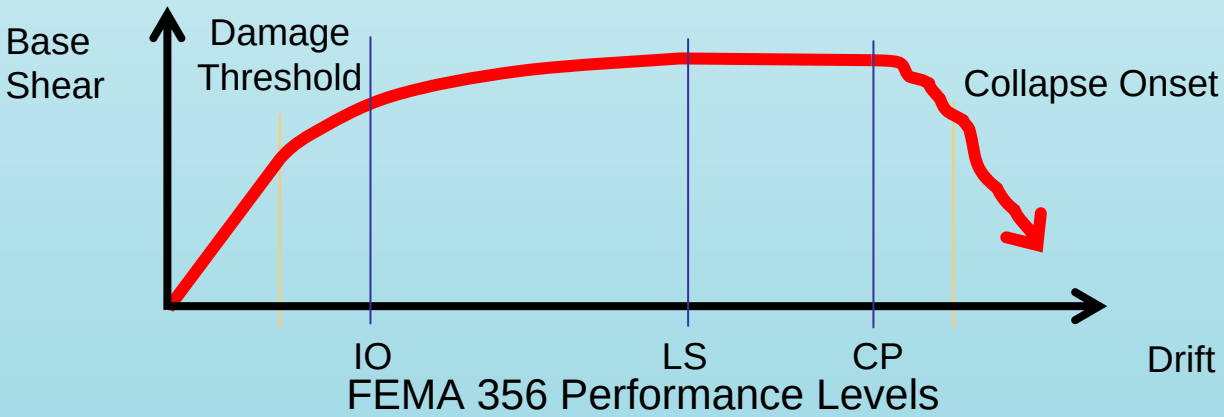
$$V_{design} = \frac{CI}{R}W$$

- Linear analysis model
- Prescribed strength
- Prescriptive details
- The outcome:
  - performance as an undefined byproduct of design
- An observation:
  - limited role for the engineer

UBC 97, IBC 2000, etc.

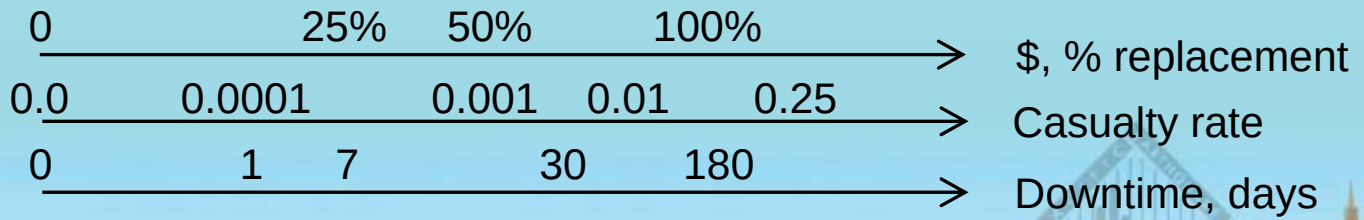
Performance-Based Earthquake Engineering Concepts





PBEE ten years ago

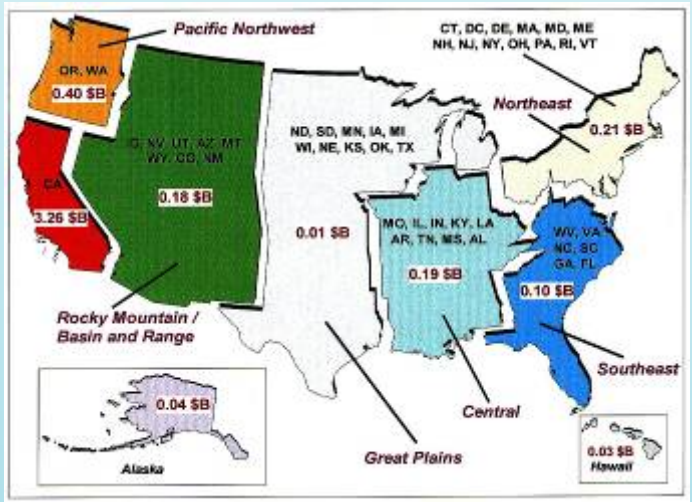
PEER contribution



PBEE Decision-Making

1. Individual facilities

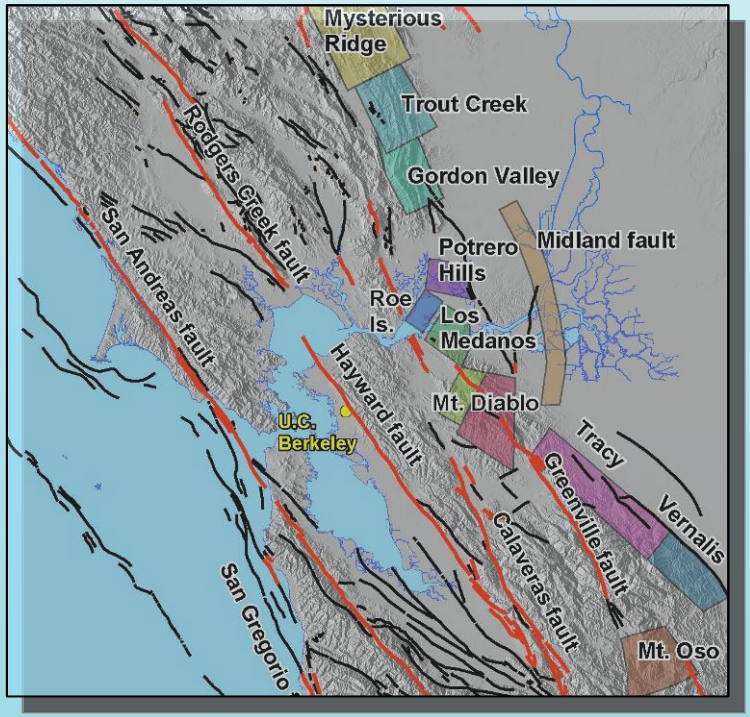
2. Portfolios



3. Societal impacts and regulatory choices

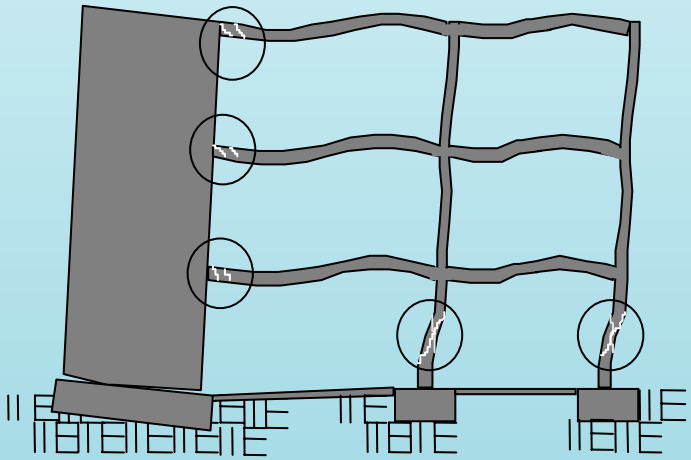
PBEE Decision-Making

- individual facilities -



PBEE Decision-Making

- individual facilities -

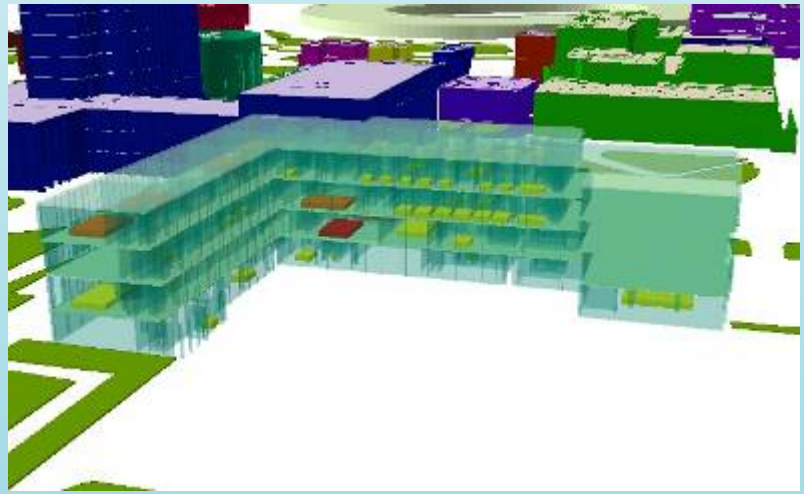


PBEE Decision-Making

- individual facilities -

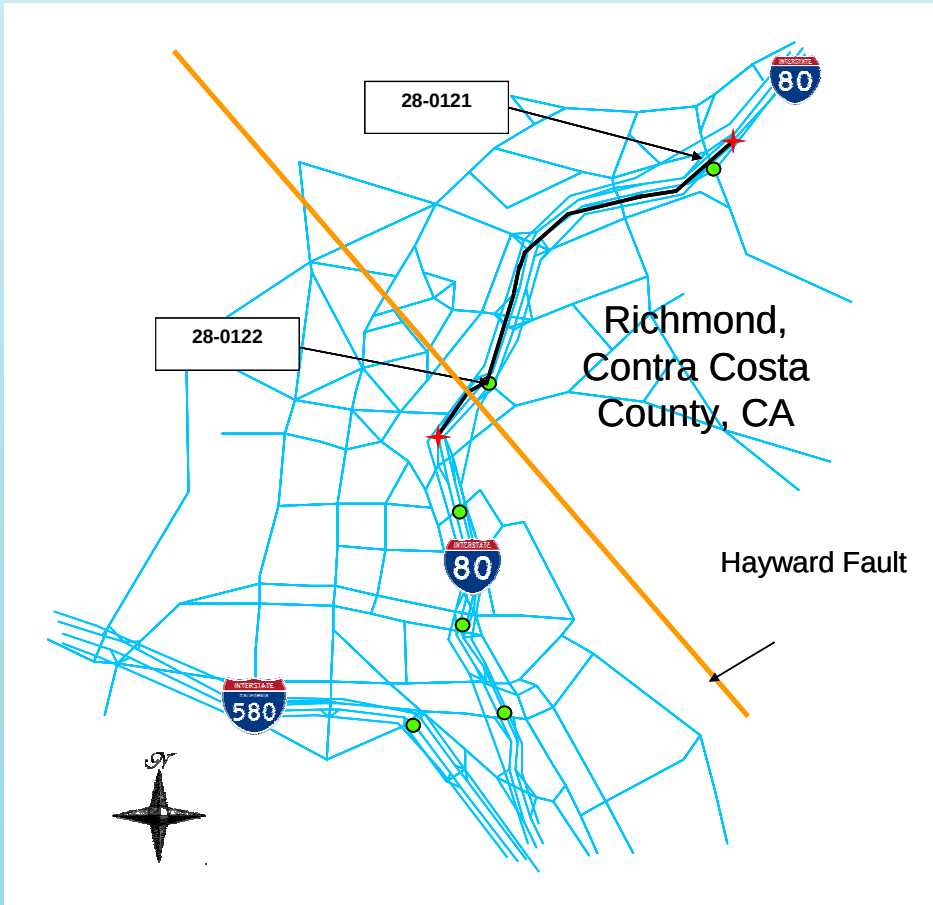
PBEE Decision-Making

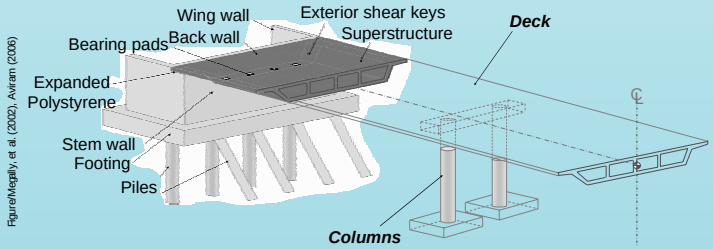
- individual facilities -

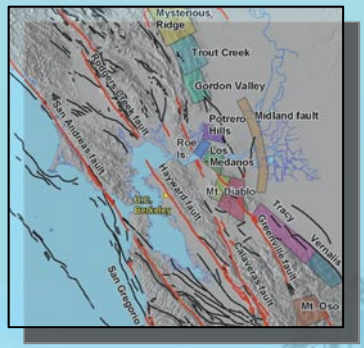


PBEE Decision-Making

- portfolios -



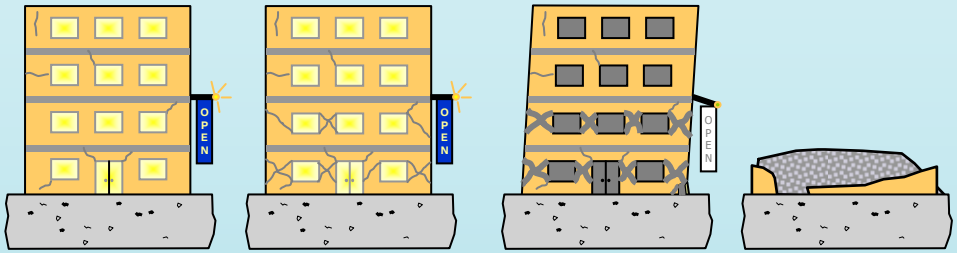


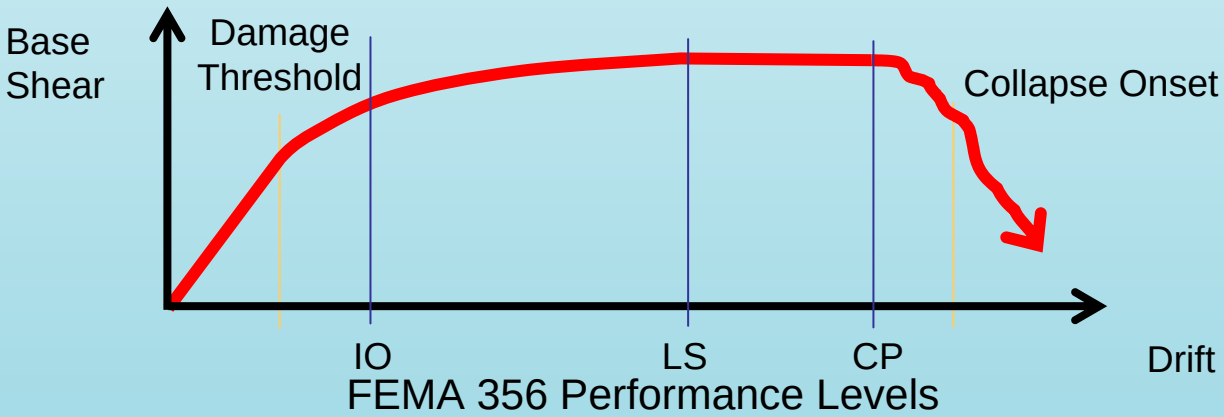


PBEE Decision-Making

- societal impacts and regulatory choices -

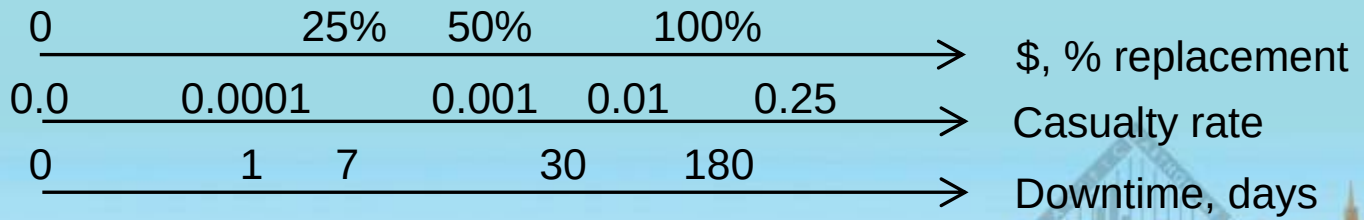
Performance-Based Earthquake Engineering Concepts



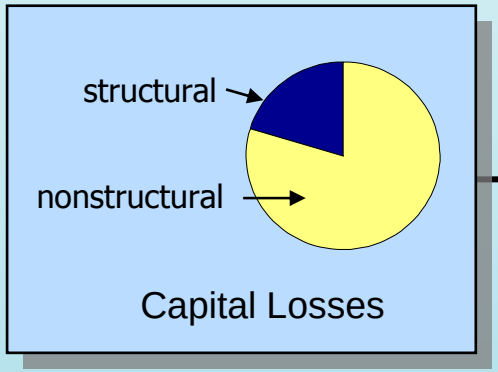


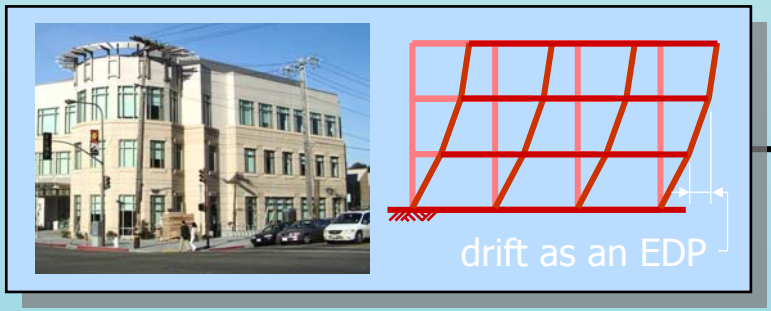
PBEE ten years ago

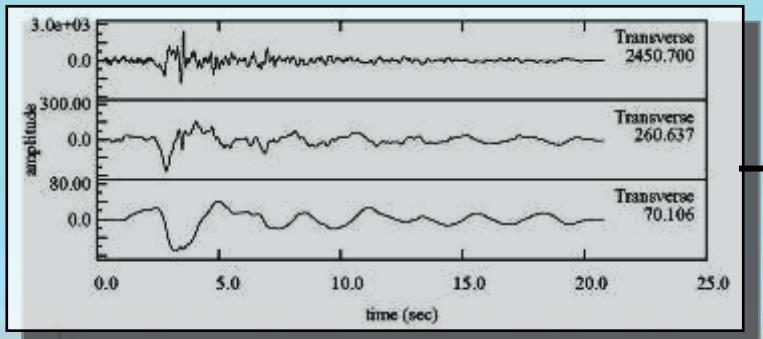
PEER contribution



PBEE Approach and Application







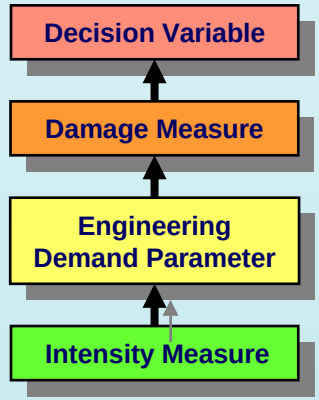
Decision Variable

Damage Measure

Engineering Demand Parameter

Intensity Measure

Program Evolution



Year

0 1 2 3 4 5 6 7 8 9 10

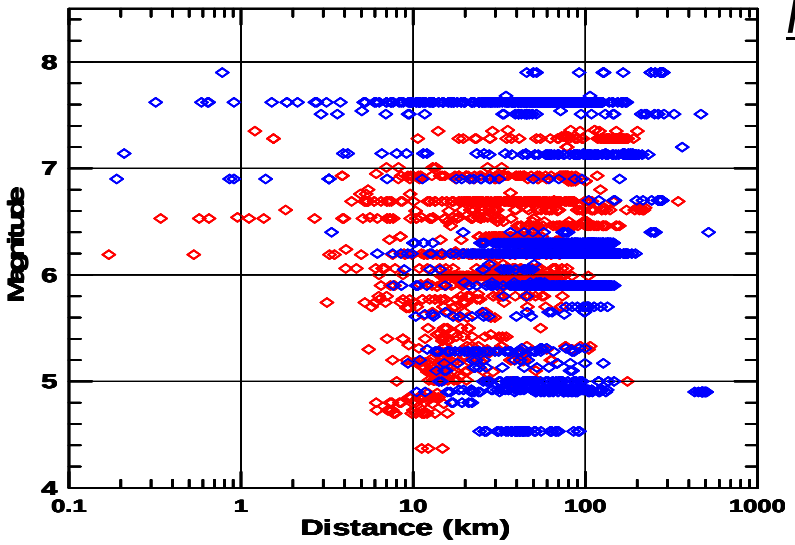
- Disciplinary focus
- Field laboratories

- Methodology focus
- Proof-of-concept test beds

- System focus
- Benchmarking studies

Accomplishments/Leadership/Collaborations

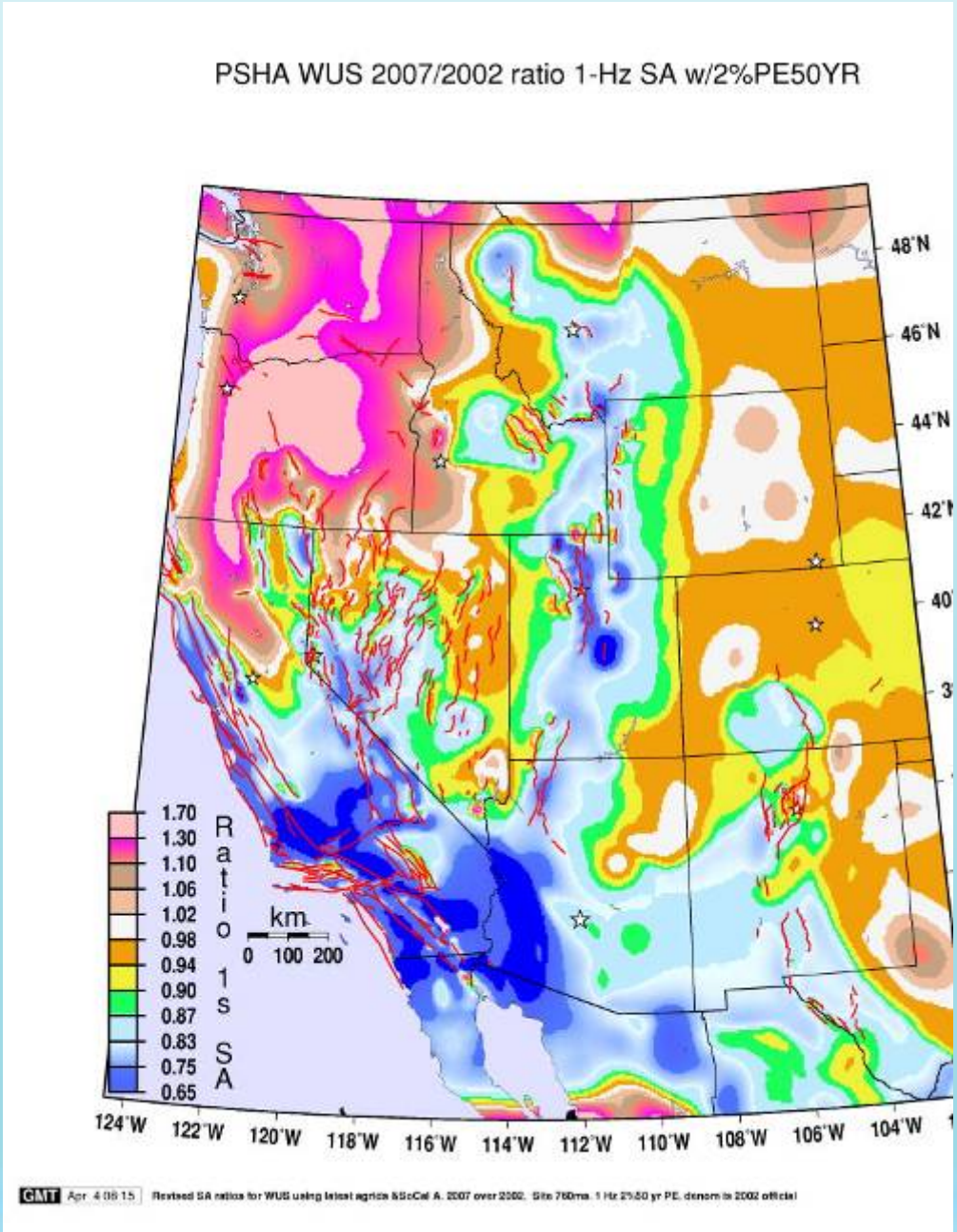
- PBEE standards/guidelines
  - FEMA 356, ASCE 41
  - FEMA 350
  - ATC 55, 58, 63
  - ACI, NEHRP, etc. code committees
- California Seismic Safety Commission
  - Risk Reduction Plans
  - Research Plan
  - Proposals to Legislature
- BART Seismic Retrofit Review
- COSMOS
- SCEC 1 / SCEC 2
- EERI
  - 2005 Distinguished Lecturer
  - 2006 Centennial Conference
  - Practitioner seminar series
- Caltrans
  - Network Research Collaboration
- NEES Collaborations
  - Planning, sites, NEES-GC project
  - Simulation IT
- FEMA
  - Action Plans for PBEE
  - Disaster-Resistant Campus
- International Programs
  - ANCER
  - PEER/MCEER/NCREE/NAPHM Center-to-Center Initiative
  - PEER/NCREE collaborations
  - PEER/US-Japan/FIP Collaboration
- International Workshops
  - PBEE Methodology
  - Near-source ground motions
  - Instrumentation programs
  - Bled Int'l Workshop on PBEE (2004)
  - NEES/E-defense Workshop on Collapse (2005)
- Lifelines Program expansion
  - PG&E, Caltrans, CEC, FEMA, CEA, etc.
- EERC Programs
  - Research and Education co-planning
- Human Resource Development
  - .....



New Data **Previous Data**

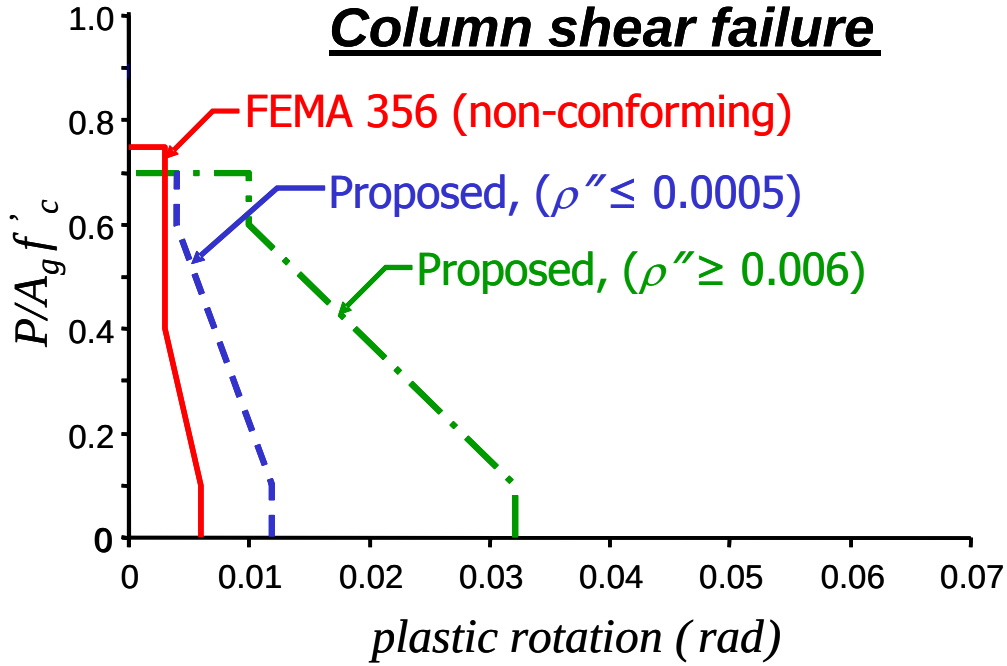
PEER Ground Motion Database

- *One of the largest uniformly-processed ground motion databases in the world*
- *More than 10,000 records*
- *Processed uniformly*
- *173 worldwide earthquakes*
- *Magnitude: 4.3 to 7.9*
- *New database is about three times larger than PEER's previous ground motion set*

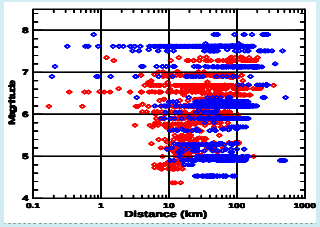


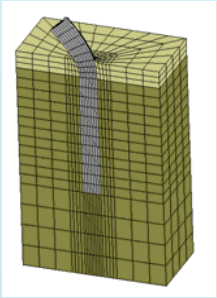
US national seismic hazard maps: Ratio of 1-sec spectral acceleration, 2% probability of exceedance in 50 years. Ratios shown are 2007 values divided by 2002 values.

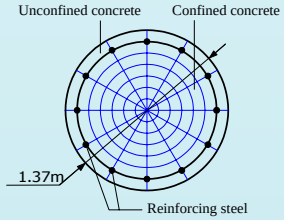
Column shear failure

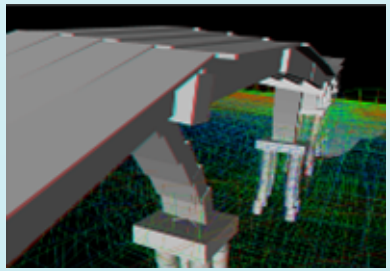


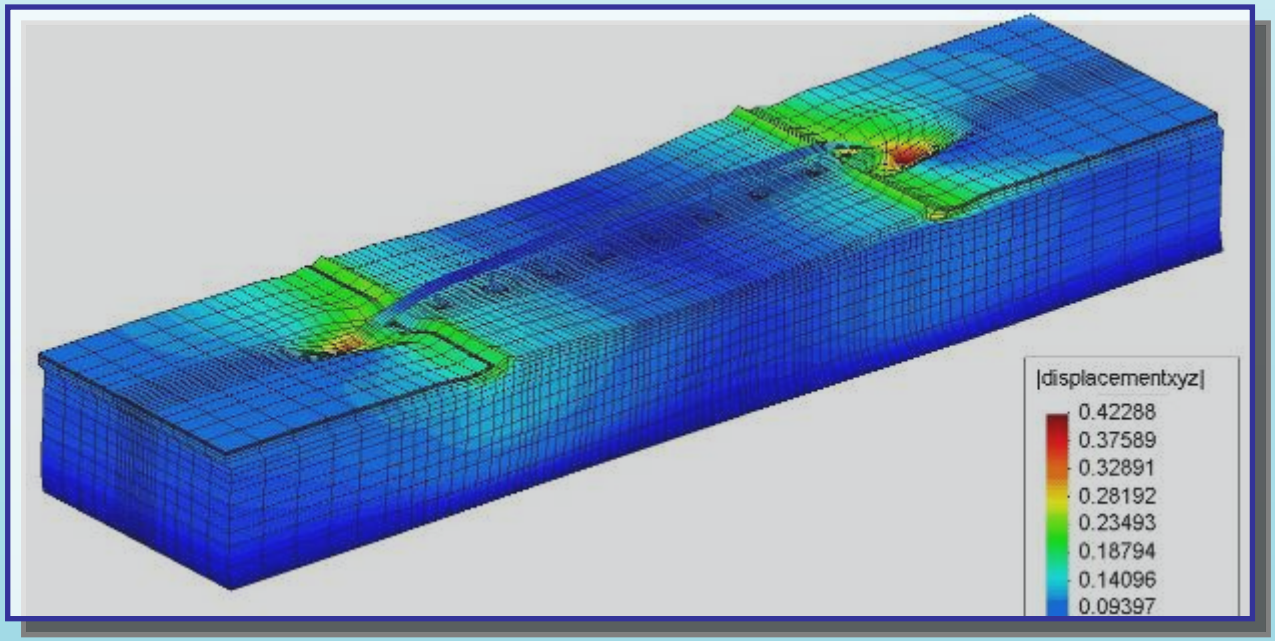
Improved models and acceptance criteria can save millions of dollars in retrofitting costs. See ASCE/SEI 41 Supplement 1.





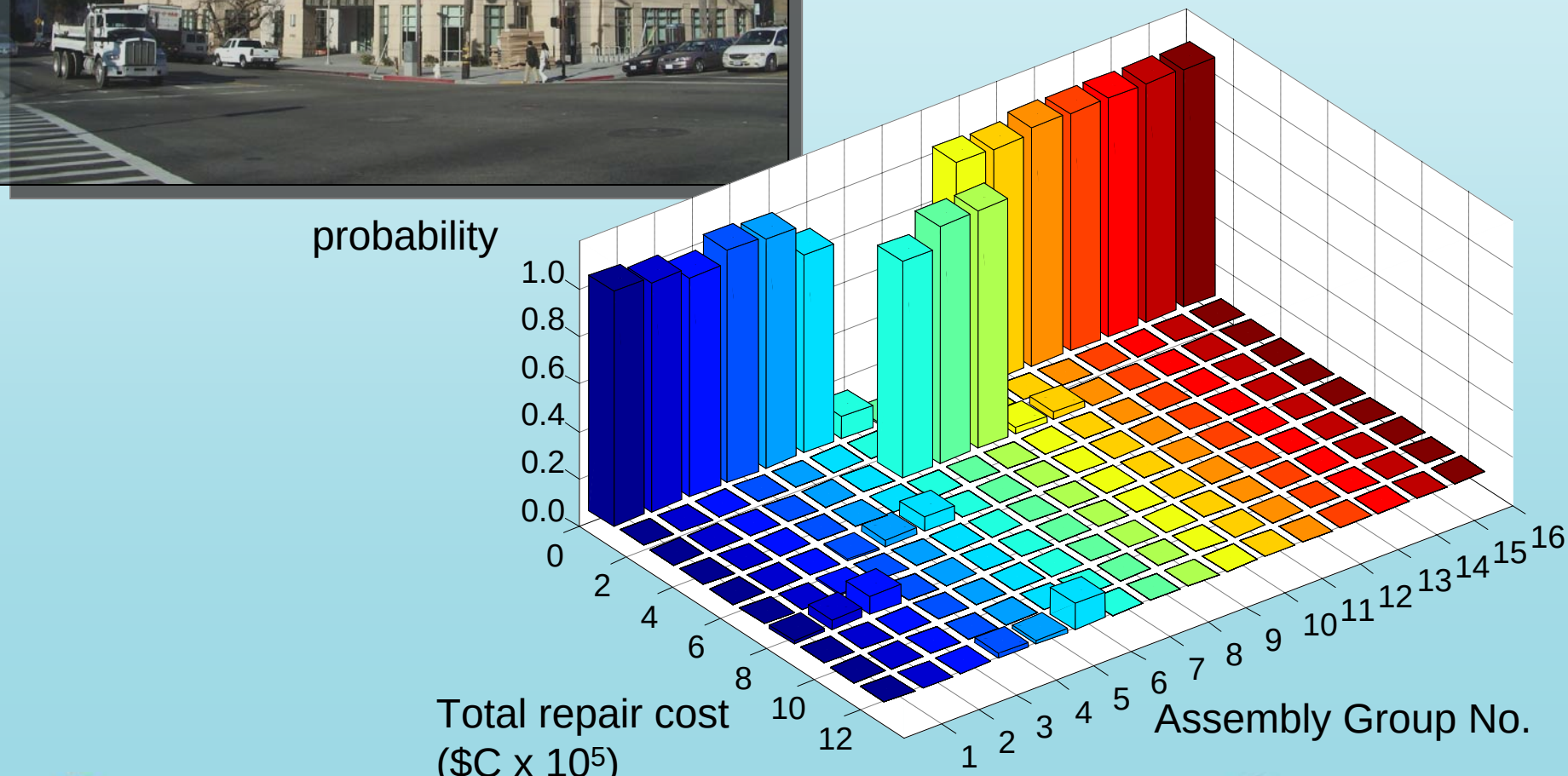






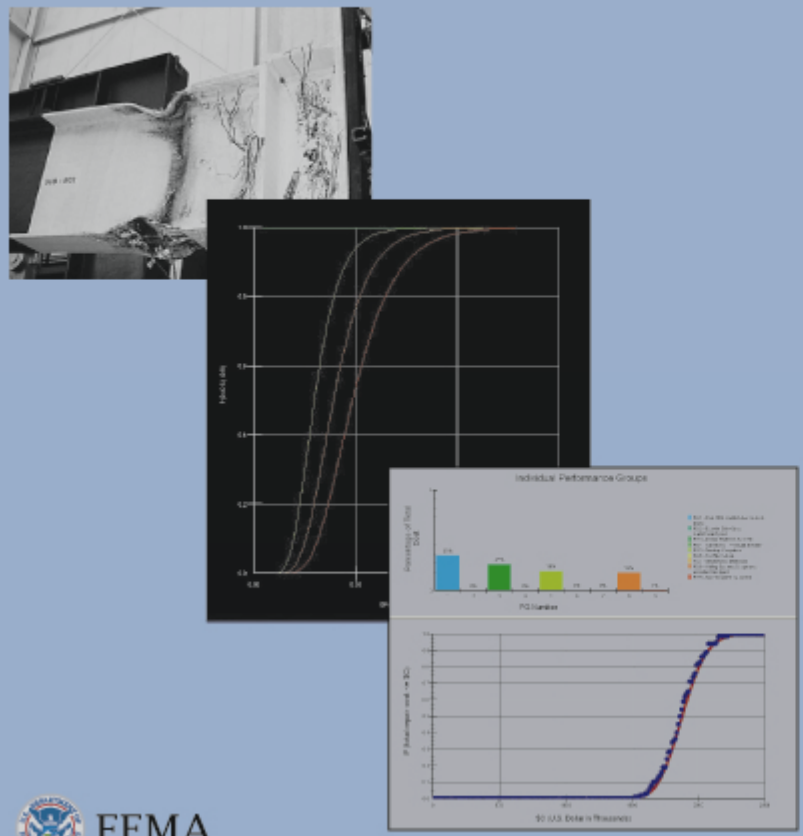
OpenSees

http://opensees.berkeley.edu


probability
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
Total repair cost
($C x 10^5)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Assembly Group No.

PACT Performance Assessment Calculation Tool

Beta Version 1.0, Released May 24, 2007



ATC-58 Guidelines for Seismic Performance Assessment of Buildings

Prepared for:
DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
Mike Mahoney, FEMA Project Officer
Bob Hanson, FEMA Technical Monitor

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Based on Work Developed by:
PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER
Jack P. Moehle
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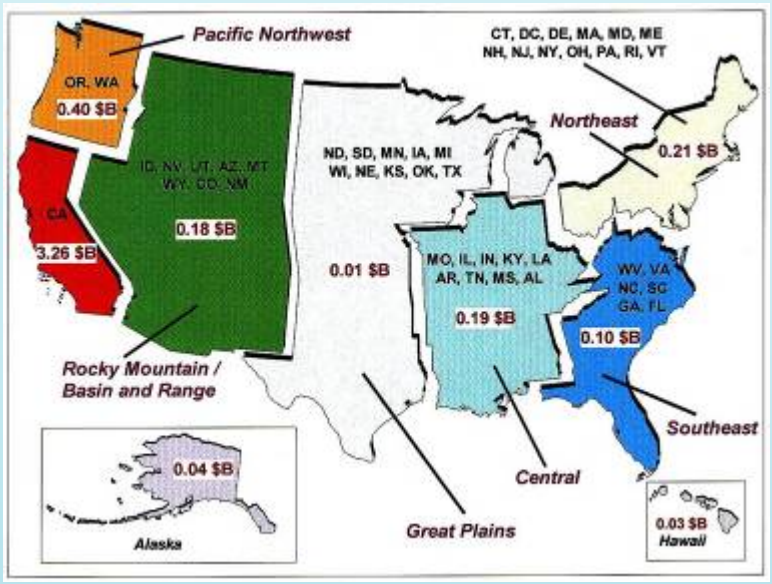
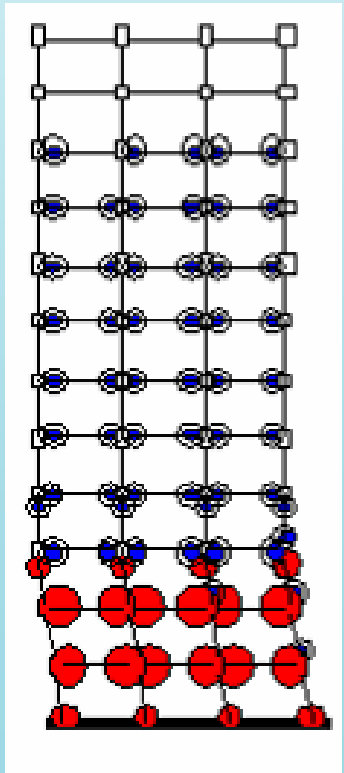
FEMA

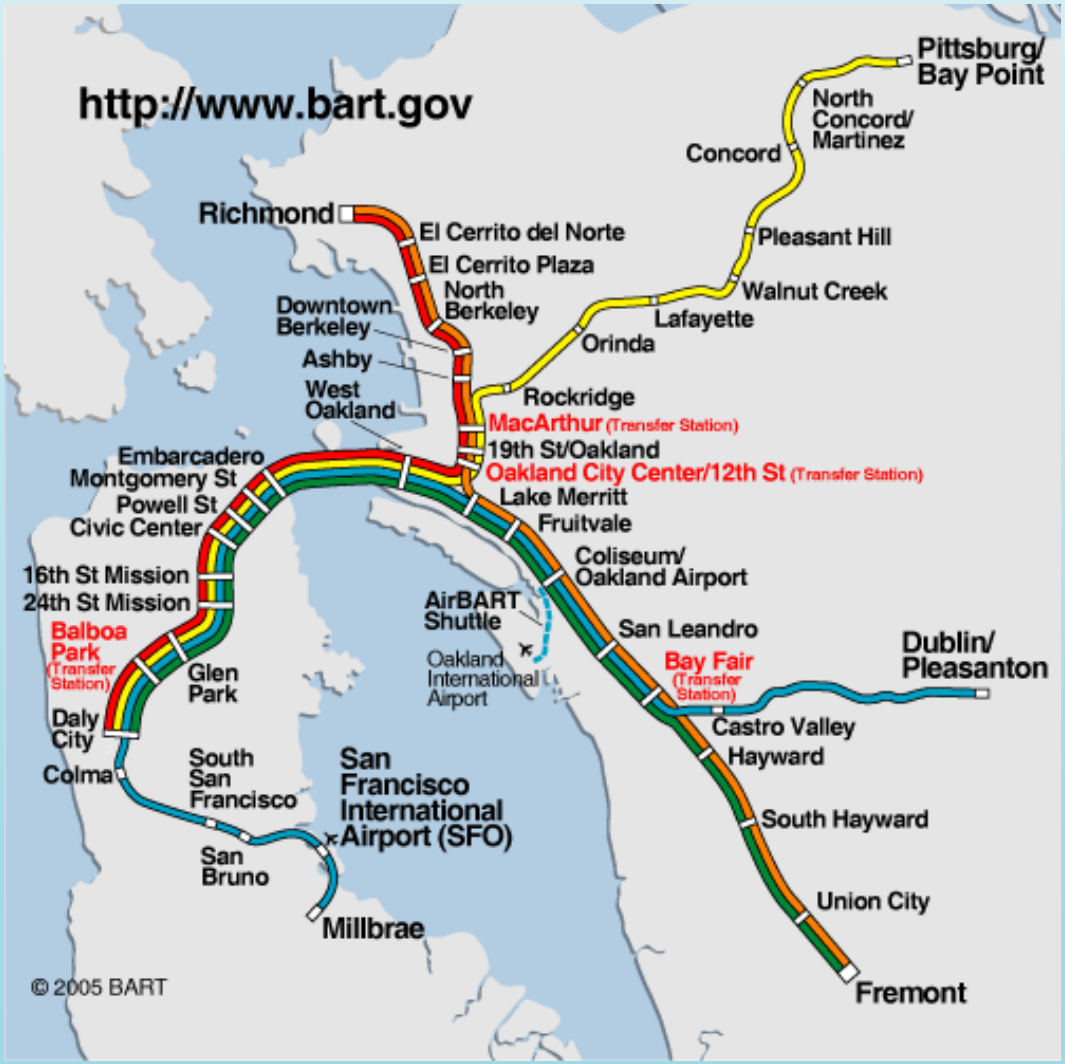
ATC
Applied Technology Council



FEMA 366

Building benchmarking





PBEE Tradeoffs

1. Status Quo
   - After 3 days, 27% operations
   - ….

Cost - $0

2. Systemwide Safety, Core System Operability
   - After 3 days, 68% operations
   - …

Estimated cost $0.8B
Post-EQ cost avoided: $2.6B

3. Systemwide Safety, Systemwide Operability
   -After 3 days: 83% operations
   - …

Estimated cost $1.1B
Post-EQ cost avoided: $2.7B

Industry Participation

- Earthquake professionals and government agency representatives are involved in
  - Strategic planning
  - Decision making
  - Funding research
  - Technology transfer

after T. Hutchinson

PEER Shake-Table Competitions

Students engineer model buildings, meet other students, interact with graduate students and practicing engineers

Tara Hutchinson

- SLC member
- Ph.D, 2001
- Asst. Professor, UC Davis
- Assoc. Professor, UCSD
- NSF Career Award
- Chancellors Award for Excellence in Fostering Undergraduate Research

Ken Elwood

- SLC member for 2 years
- Ph.D, 2002
- Asst. Professor, UBC
- 2007 ACI Siess Award for Excellence in Structural Research
- ASCE/SEI 41 ad hoc committee
- 2007 President's Award, LATBSDC

Curt Haselton

- SLC Yrs 8, 9, 10
- Advised PEER Interns
- Hosted several K-12 shake table events
- Building benchmarking
- Ph.D, 2006
- Asst. Professor, Chico State
- ATC 63, PEER working group

Scott Ashford

- Asst. Professor, UCSD (1996)
- PEER Education Director (2002)
- Department Chair, OSU (2007)

Greg Deierlein

“The Story of PEER”