
Implementation, Adoption, and Stakeholder Perspectives

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PEER Summative Meeting – June 13, 2007

Relevant PEER Research

PEER research has addressed:

Decision Considerations and Heuristics

- How stakeholders think about earthquake performance
- Role of experts, codes, and uncertainty in these choices

Implementation and Adoption Considerations

- Lessons from past earthquake engineering innovations
- Barriers to adoption and future scenarios for PBEE adoption

Regulatory and Societal Considerations

- Regulatory systems implications
- Benefits of performance-based approaches

Decision Considerations

Stages in Low Probability High Consequence Investment Decisions

Individuals,
Consortium
have varied
concerns



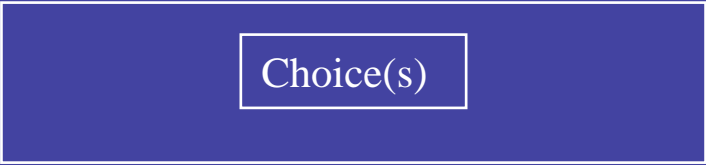
Code-based Environment
0-1 Logic

3-D model:
Deaths
Dollars
Downtime



Site specific
Preferred Metrics

(J. Meszaros
PEER research)



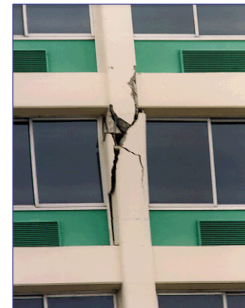
Contributions of PEER Decision Research

Lessons for Communicating PBEE results

- Role of “the three D’s” – death, dollars, and downtime as they relate to decision-making by owners and others
- Importance of multiple ways of presenting PBEE assessments

Results from the Van Nuys Testbed

	Expected NPV (Structural)	Downtime	Deaths
Do nothing	\$0	16 days	0.13
Moderate retrofit	\$142,178	7.6 days	0.06
Extensive retrofit	-\$61,319	3.2 days	0.02



Implementation and Adoption Research

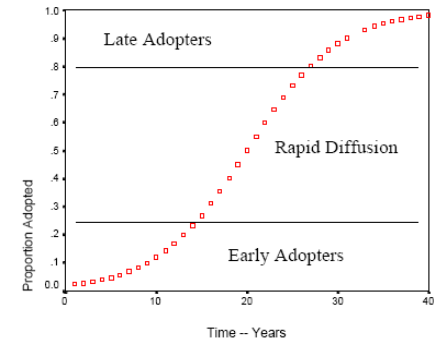
Adoption Issues for Prior Earthquake Engineering Innovations

➤ Key Barriers

- High perceived (or real) costs of the required analyses or technologies
- Lack of agreed upon standards or guidelines
- Lack of necessary computational power and analysis routines
- Lack of data concerning performance of structures
- Reluctance of some of the engineering community to incorporate the advances into practice

➤ Key Facilitators

- Actions to overcome the above barriers
- Documented uses of methodologies and their benefits
- Willingness of early adopters to share experiences



Typical Diffusion Pattern for Innovations



(May and Koski PEER research)

Contributions of PEER Implementation and Adoption Research

Shaping PEER's efforts to stimulate adoption and implementation

OUTREACH GOALS

GOAL 1:
Demonstrate Methodology

GOAL 2:
Disseminate Tools and Data

GOAL 3:
Facilitate Early Adoption

GOAL 4:
Guidelines and Standards

Make it Work – Moving beyond testbeds to develop simplified, modular approach to the PEER methodology for assessment.

Influence Future Research – development of data collection protocols, repositories, and OpenSees as living legacies of PEER's research efforts.

Influence Practice – working closely with IAB and "early adopters" to stimulate use of and feedback about the PEER methodology.

Influence Policy (and Practice) – working closely ATC 58 effort and transportation organizations to move research into the next generation of seismic code provisions and guidelines.

Scenario	Expectation
<ul style="list-style-type: none"> High-end engineering practice 	<ul style="list-style-type: none"> Adoption by high-end engineering firms and their clients for highly-valued new and existing facilities; limited adoption beyond this (status quo).
<ul style="list-style-type: none"> Broader engineering practice 	<ul style="list-style-type: none"> Adoption driven by changes in code provisions that embrace these concepts, but only as alternatives to prescriptive-based code provisions.
<ul style="list-style-type: none"> More fundamental code revisions 	<ul style="list-style-type: none"> Adoption driven by more fundamental changes in code provisions that embrace these concepts as foundations for codes with simplified methods and design guidelines replacing prescriptive provisions where applicable.
<ul style="list-style-type: none"> Societal demands for seismic safety 	<ul style="list-style-type: none"> Adoption driven by client demands for seismically resistant facilities and for functionality much as the "green building" movement entails embracing healthy buildings.

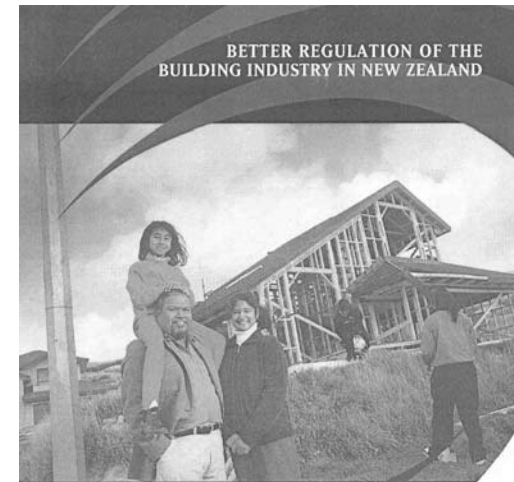
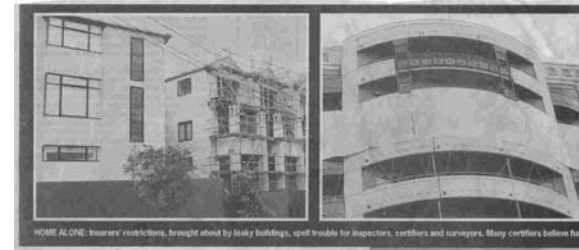
Imagining future scenarios for PBEE adoption

Regulatory and Societal Considerations

Consideration of regulatory systems implications of performance-based approaches

Criterion	Expectation
<ul style="list-style-type: none"> • <u>Effectiveness</u> in Reaching Regulatory Objectives • <u>Flexibility</u> in Means of Adhering to Regulation • <u>Innovation</u> Potential 	<ul style="list-style-type: none"> • <u>Increased</u>, but limited incentive to go beyond minimum performance objectives. • <u>Increased</u>, given ability to use alternate means to reach objectives. • <u>Increased</u> incentives for innovation, but depends on industry structure and cost of innovation compared with current approaches.
<ul style="list-style-type: none"> • <u>Consistency</u> in Application of Rules 	<ul style="list-style-type: none"> • <u>Potential for inconsistencies</u> in interpretation of what is acceptable for which the standards and skills of inspectors are important.
<ul style="list-style-type: none"> • <u>Predictability</u> in Regulatory Expectations 	<ul style="list-style-type: none"> • <u>May decrease</u> due to lack of understanding of what is a workable means for achieving desired ends; code of practice guidelines are useful in this respect.
<ul style="list-style-type: none"> • <u>Cost</u> to: <ul style="list-style-type: none"> • <u>Government Regulators</u> • <u>Regulated Entities</u> • <u>Public Beneficiaries of Regulation</u> 	<ul style="list-style-type: none"> • <u>Uncertain</u> -- Greater costs of developing rules and enforcement, but not necessarily so for costs of developing rules. • <u>Decreased or no change</u> in compliance costs (Project on Alternative Regulatory Approaches 1981), but some entities may choose to develop more costly alternative approaches. • <u>Decreased or no change</u> – not explicitly addressed in the literature; presumably benefit from lower costs to regulated entities and innovations spurred by performance-based approach.
<ul style="list-style-type: none"> • <u>Distributive Impacts</u> in Addressing Regulated Harms 	<ul style="list-style-type: none"> • <u>Mixed</u> – Focuses attention on a given harm no matter where it is, but leaves potential for gaps in coverage of attention to that harm if performance is gauged on an area-wide basis through "hot spots".
<ul style="list-style-type: none"> • <u>Equity</u> in Treatment of Regulated Entities 	<ul style="list-style-type: none"> • <u>Uncertain</u> -- Competitive differences may emerge due to large firms having advantage in developing alternative approaches for heterogeneous industry. How rules are enforced will also affect equity.

Rotting homes crisis
Heading down
the gurgler



(May and others PEER research)

PEER Contributions to Higher-Level Regulatory Discussions

PEER research has entered into policy considerations of:

- Regulatory systems implications of performance-based regulation
- Need for more rigorous quantification of performance and tradeoffs

“[W]e need to be thinking about the entire regulatory regime, or system, and what it means holistically and not in isolation by parts.... In addition, the issue of being able to quantify, measure and predict performance remains a paramount issue ...”
[NAS/IRCC Global Summit Summary Report, 2003, p. 3]



Societal Perspectives -- Benefits

The benefits of PBEE are the “value added” of information in quantifying performance and in addressing uncertainties

Dimension	Components	Potential Benefits
Quantification of Performance	<ul style="list-style-type: none"> • Understanding of risk objectives – predictions about casualties, downtime, and damages • Understanding of costs of achieving different objectives • Better understanding of components of vulnerability (e.g., structural versus nonstructural) • Understanding of vulnerability of components of portfolios (e.g. multi campus buildings, highway system) • Better understanding of existing code provisions (benchmarking of codes) • Better understanding of the performance of non-prescriptive seismic designs 	<ul style="list-style-type: none"> • Better understanding of objectives and the tradeoffs they entail in attempting to avert prospective losses • Improved basis for making informed decisions about risk management • Improved basis for design choices for reducing risks • Improved basis for prioritizing risk management and recovery choices among different facilities or structures • Improved basis for greater precision in codes • Improved basis for evaluation of non-traditional structures and for rehabilitation of structures; basis for alternative code guidelines
Reduced Uncertainties	<ul style="list-style-type: none"> • Better estimation of components of risk (seismic hazards, fragilities, damages) • Better estimation of potential losses (damages, casualties, downtime) 	<ul style="list-style-type: none"> • Greater precision in predicting vulnerabilities • Improved basis for risk management decisions including quantification of uncertainty.

(May Research 2007)

Related PEER Research Activities

PEER Catastrophic Risk Workshop

- Engaging economists, engineers, and others in discussing risk
- Earthquake performance and “cat bonds”

PEER Inter-jurisdictional Regulatory Coordinating Committee Workshop

- Regulatory officials from around the world met with PEER experts to discuss risk-based regulatory standards

Tri-Center FEMA “Guidance for Seismic Safety Advocates”

- Project to take lessons from social science research for communicating about policy considerations for earthquake hazard reduction



Promoting Seismic Safety

Guidance for Advocates

FEMA 474 / September 2005

PEER research is about more than buildings, bridges, lifelines, or technologies

We have sought to influence:

- How policy and other decisions about seismic safety investments are made
- Future codes and guidelines as a primary means for enhancing seismic safety
- Engineering practice and education
- Future research directions for improving the scientific base for performance-based engineering





The broadest societal benefits of the performance-based approach are *not* just wiser decisions about seismic objectives and design, but the design and construction of *safer facilities* and of more *resilient infrastructure*

