

*Risk Decision Making for Buildings –
From Owners to Society*

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Defining Links Between Planning, Policy, Economics and Earthquake Engineering

Workshop in May 1998 Raised Questions:

- How to integrate disciplines and find a common language?
- Can models from various disciplines be linked?
- What should performance standards look like?
- **Can a standardized loss-accounting system be developed?**
- **What are meaningful metrics?**
- What are financial implications of performance standards?
- What is known about adoption, implementation and enforcement of performance based codes?

Key Milestone: Defining Loss Metrics

What the 3 D's Mean to Decision Makers

◆ Deaths

- Casualty and Injury Prevention
- Reduces Risks to Users

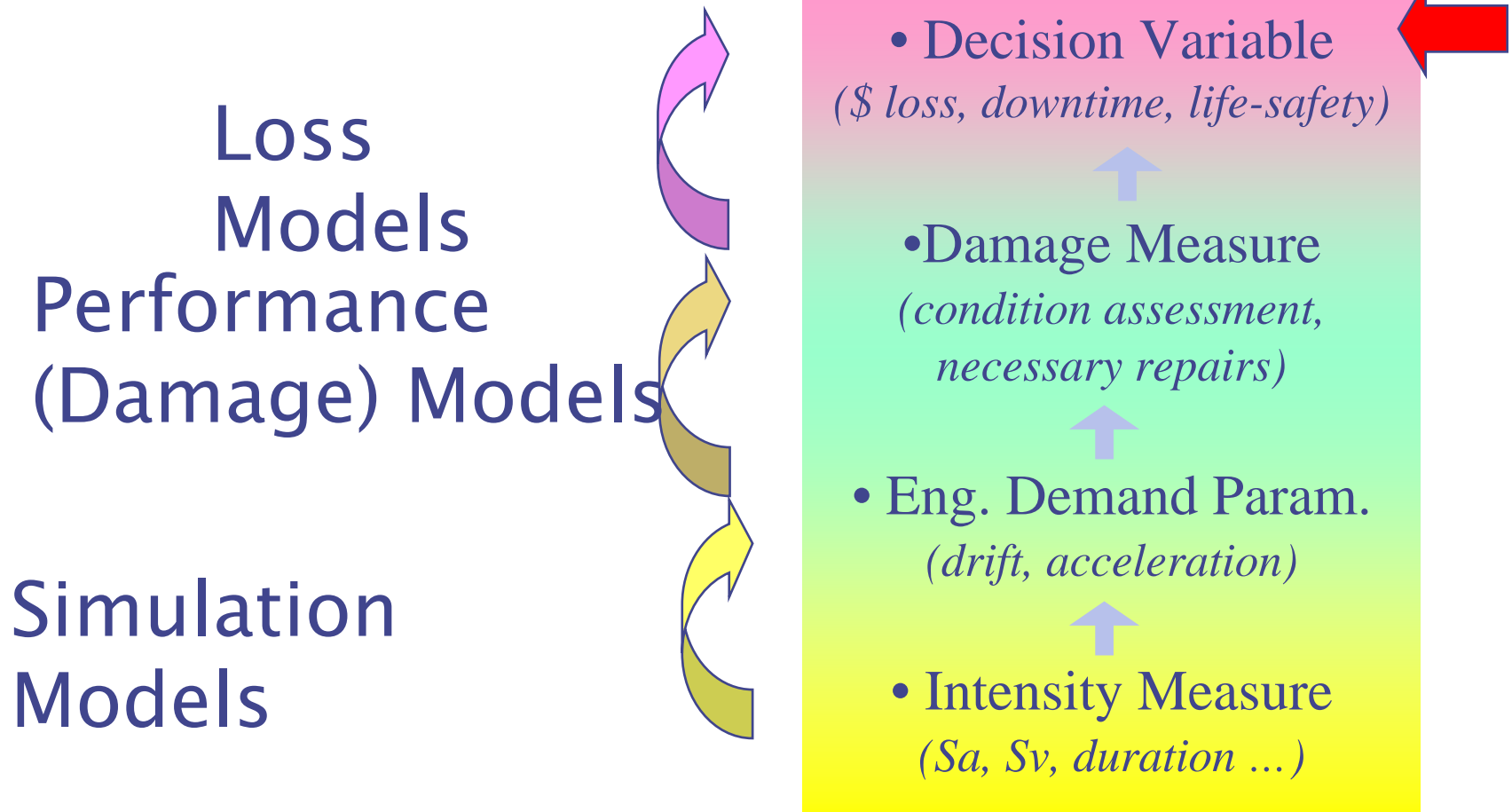
◆ Dollars

- Estimated Losses in Scenarios or Annualized
- Allows Comparison of Losses vs. Mitigation Costs

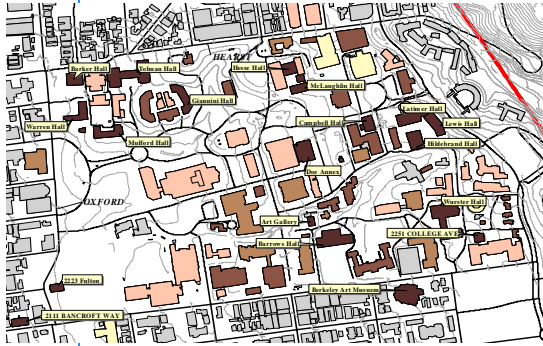
◆ Downtime

- Impact of Building Damage on Operations
- Sets value of recovery time

PEER - PBEE Methodology Components



Testbeds Applied Methodology



Lab	Floor	Hazard level					
		$S_a = 0.71g$ 50%/50 yr (0.0139 yr ⁻¹)		$S_a = 1.62g$ 10/50 (0.0021 yr ⁻¹)		$S_a = 2.74g$ 2/50 (0.0004 yr ⁻¹)	
		Safety	Operability	Safety	Operability	Safety	Operability
S	1	0.14	< 0.01	0.62	0.06	0.96	0.50
M	3	0.50	0.18	1.00	0.72	1.00	0.98
L	4	0.58	0.44	0.94	0.82	1.00	0.98
XL	4	0.72		0.96		1.00	
XO	5		0.36		0.78		1.00

	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



Benchmark Project Integrated Loss Studies

Discussion Point	Beck, Mitrani-Reiser, & Porter	Miranda, Aslani, & Ramirez	Moehle, Stojadinovic, Der Kiureghian, & Yang
Definition of damageable components	Group damageable building components into <i>assembly groups</i>	Divided by building components by floors	Group damageable building components into <i>performance groups</i> sensitive to the same EDP.
Casualty	Use Shoaf and Seligson data to estimate value of a statistical life		
Downtime	Use Comerio data	ABAG/Building Department Data on Wood Residential Buildings: 2 Years to Repair 4 Years to Rebuild Stanford and UC Case Study Experience: 2-3 Years Min Repair of Large Buildings Plus Mobilization Time and External Conditions	

Benchmark Study Integrated "3 D" Losses

Design Description	EAL (\$)	EALD (\$)	EALF (\$)	EAL _{TOTAL} (\$)
A: Baseline perimeter frame design.	66,585	20,519	4,900	92,004
B: Same as A, but with code-min strengths.	95,656	28,362	4,550	128,568
C: Same A, but with uniform beam/column throughout.	51,933	22,207	5,600	79,740
D: Same as C, but no SCWB provision.	112,930	32,726	79,800	225,456
E: Baseline space frame design.	49,422	19,517	3,500	72,439

UCB Implementation of Performance Goals

- ◆ Risk Management: Building-Specific and Inventory Performance Objectives
- ◆ No closure > 30 days

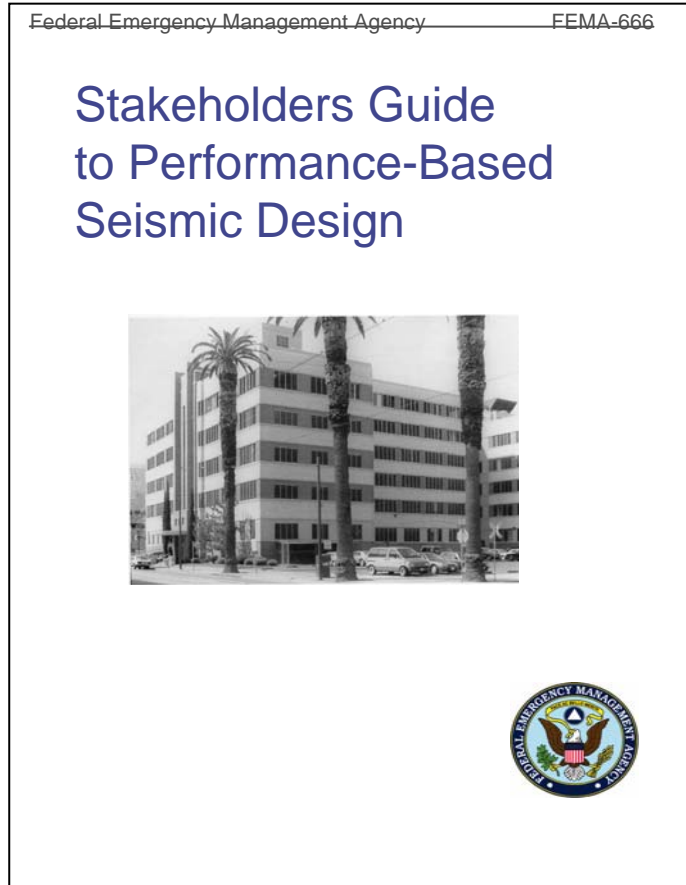


UC Risk Reduction – Seismic Retrofits (2000-06)

Source and Loss Parameter	Scenario Earthquake Level		
	Occasional (50%/50 Yrs.)	Rare (M7.0)	Very Rare (M7.25)
Economic losses w/Closure (\$ millions) - 10 Buildings (approx. \$1.1 billion)			
Before Seismic Retrofit	\$171	\$568	\$761
After Seismic Retrofit	\$31	\$219	\$337
Risk Reduction	\$140	\$349	\$424
Deaths and Serious Injuries based on ECO (approx. 1,350 people)			
Before Seismic Retrofit	23	104	153
After Seismic Retrofit	0	3	7
Risk Reduction	23	101	146

Ref: C. Kircher

ATC 58 Products Use PEER Methods



◆ Guidelines for Seismic Performance

◆ Recommendations for:

- building officials
- building owners
- lenders
- tenants
- insurers

how to take
advantage of PBEE

Ref: R. Hamburger

Performance Goals for Risk Management

- ◆ Non-owners Use Performance to Set and/or Limit Annualized Losses
 - Insurance and Re-insurance
- ◆ Real Estate Owners Use Performance Goals to Manage Assets Pre- and Post-Disaster
 - Government, Institutions
 - Lenders, Portfolio Managers
 - e.g. St. Louis Art Museum
 - ◆ Set Design Criteria for Addition
 - e.g. Arden Realty, LA
 - ◆ Requires Tenant Insurance
 - ◆ Plans for Downtime in Leases



PEER Established a Performance Vocabulary

- ◆ Defining and Costing Damage to Structural and Nonstructural Systems and Contents
- ◆ Defining and Incorporating the Risk to Life in Financial Terms
- ◆ Defining Mobilization and Repair Time; Establishing Baseline Data
- ◆ Used by Engineers, Owners, Insurance, Portfolio Managers, Government, etc.