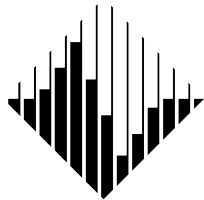


# Performance Based Earthquake Engineering as a Resilience Option

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PEER

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# What is Performance Based Earthquake Engineering?

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- PBEE focuses on consequences of earthquake damage to a building

FEMA P-58 calculates:

- Structural damage
  - Non-structural damage
  - Repair cost
  - Repair time
  - Chance of unsafe placard
  - Casualties
  - Carbon impacts of repairs
- This information can be used to guide decision making

# Comparison of PBEE approach to code-based approach for design

Type of Loss	Code	FEMA P-58
<b>Structural damage</b>	Damage at or below level for safety	Evaluates
<b>Nonstructural damage</b>	Some components designed to remain in place	Evaluates
<b>Casualties</b>	Safety expected in newer buildings	Evaluates
<b>Financial losses</b>	Not evaluated	Evaluates
<b>Chance of unsafe placard</b>	Not evaluated	Evaluates
<b>Repair time</b>	Not evaluated	Evaluates
<b>Environmental impacts</b>	Not evaluated	Evaluates

# How can PBEE be used?

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New Buildings	Existing Buildings
1. Designing for High Performance	3. Risk Evaluation
2. Improved Design Flexibility (Code Equivalency)	4. Seismic Retrofit

Most common usage currently

# Comparing PBEE process to code based process

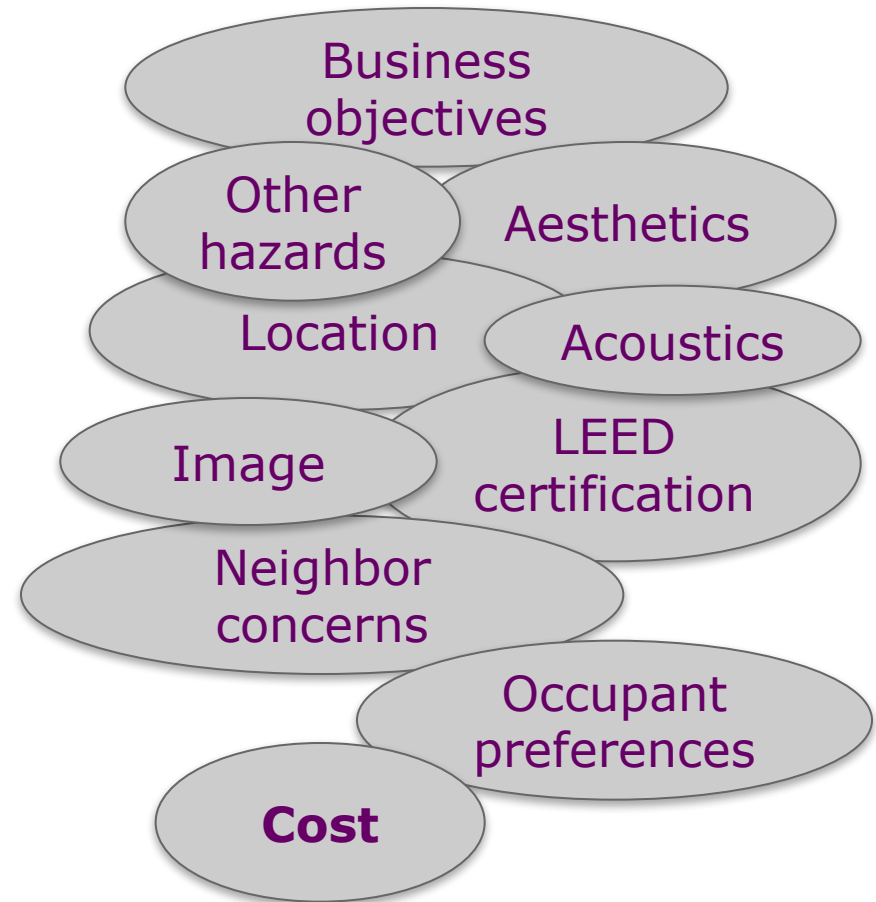
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# What matters to building decision makers?

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Building decision makers consider many issues when undertaking a building project



# Upfront Cost Considerations

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- Aspects that can affect upfront cost:
  - Time needed to set goals
  - Time needed for additional analysis
  - Structural elements for higher performance
  - More resilient components
  - Knowledgeable team members
- Not always more expensive, but can be more complex

# Using PBEE to enhance resilience

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- Most likely users:
  - large corporations, institutions, governments
- Most likely to use for buildings where:
  - Quick reoccupancy is important
  - Building represents significant financial investment
  - High value assets or activities inside
  - Seek to maintain long-term interest
  - Historic, cultural, symbolic, or brand importance



# PBEE in the future

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- PBEE analysis methods are improving
- Ease of use is improving
- Cost of use is decreasing
- Awareness of resilience concerns increasing
- Questions about adequacy of code standards increasing