RISK ASSESSMENTS
KNOWING YOUR PML

City of Los Angeles Resource Fair

STRUCTURAL ENGINEERS ASSOCIATION OF SOUTHERN CALIFORNIA

Kenneth O'Dell, S.E. (Partner : MHP, Inc. Structural Engineers)

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How does a Risk Assessment fit in with the Retrofit Ordinance for Soft-Story Wood Framed Buildings?

- Why do I need a Risk Assessment?
- What does it tell me?
- What is a PML?
- Why do I need the PML?
- What do I do with the PML?

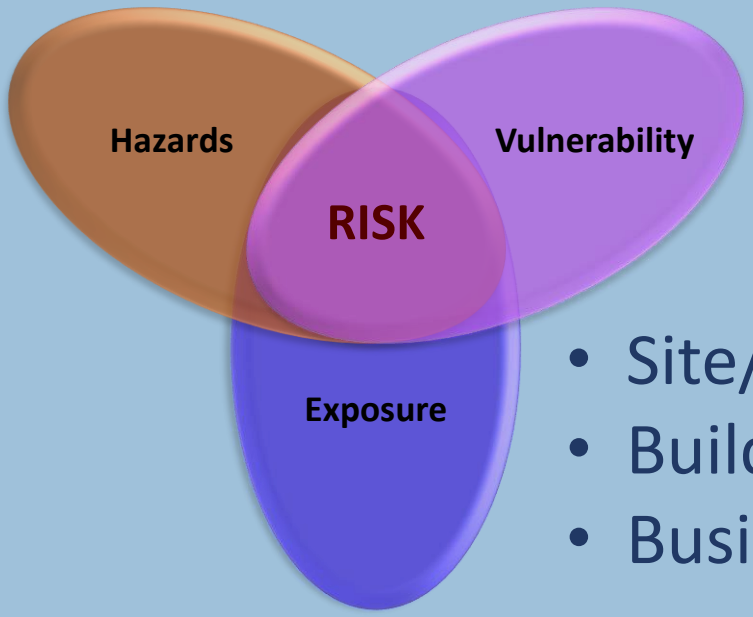
Depends on the value of "knowing" your asset

Asset Knowledge

Risk Assessment vs. PML Value

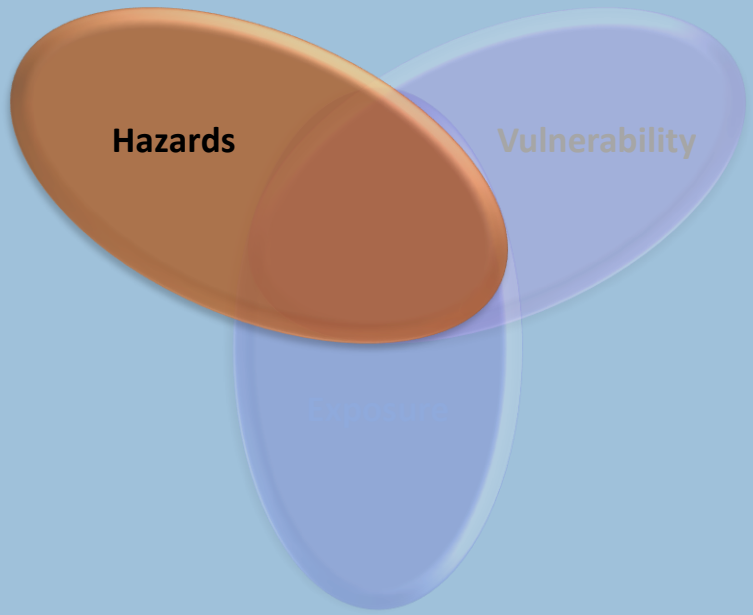
- The PML is not the Structural Risk Assessment
- The PML is an outcome of a Structural Risk Assessment
- An Assessment addresses three components of Risk
  - Hazards
  - Vulnerabilities
  - Exposure
- A PML quantifies results in terms of replacement $$s

Three Components of Risk

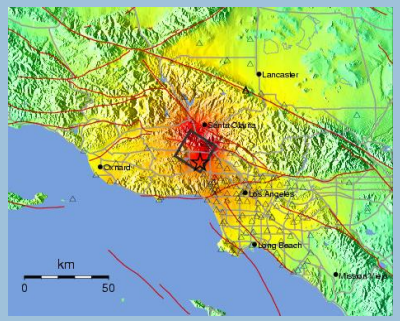


- Site/Regional Considerations
- Building/Property Considerations
- Business/Community Considerations

Three Components of Risk



Hazards



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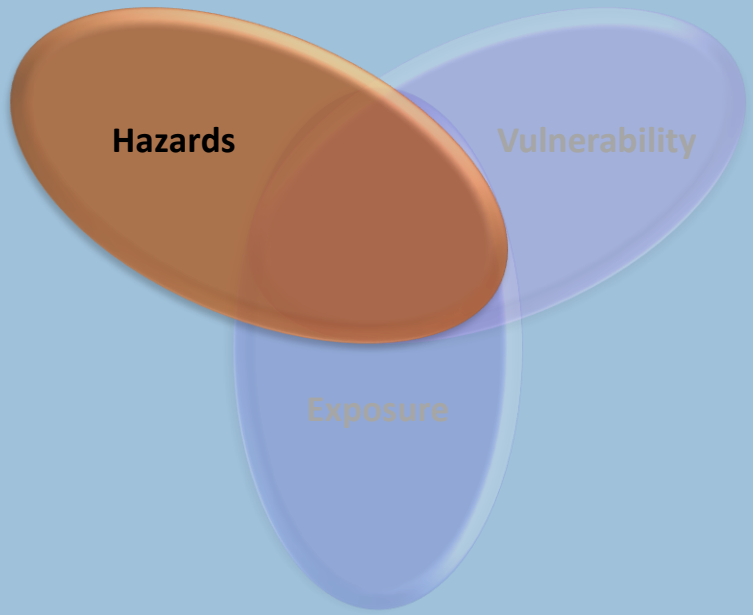
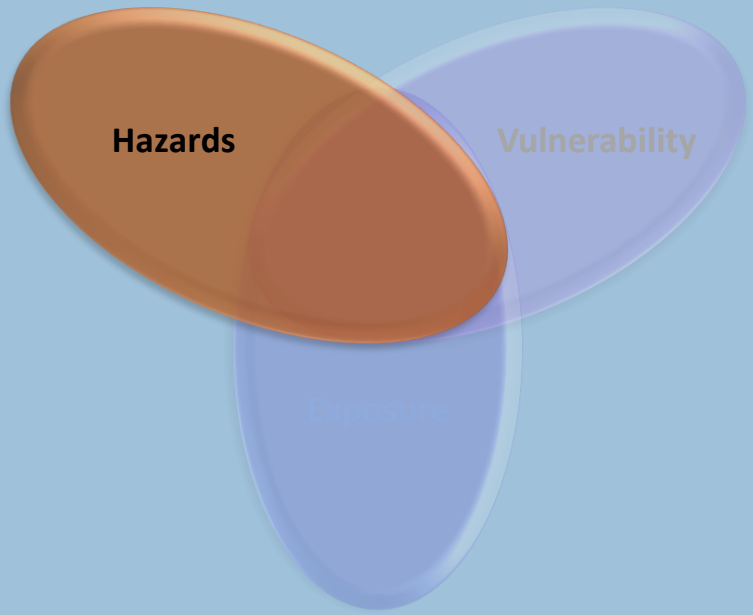


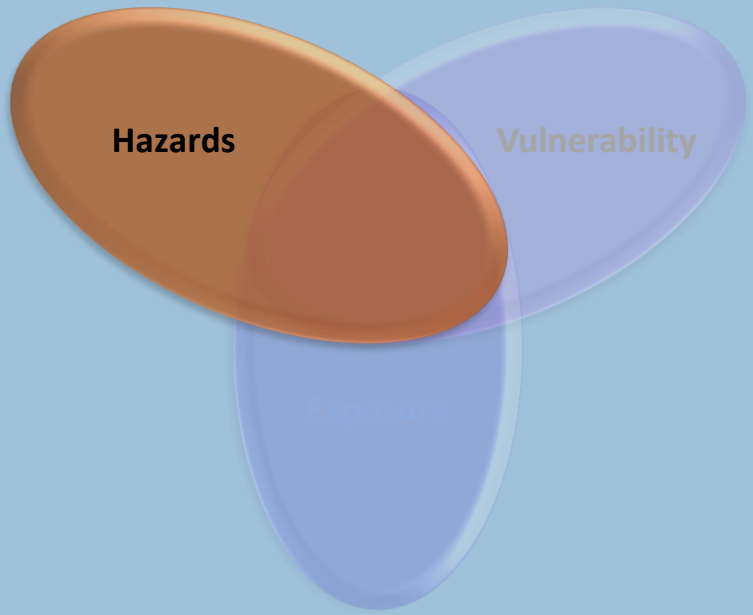
Landslide

Three Components of Risk



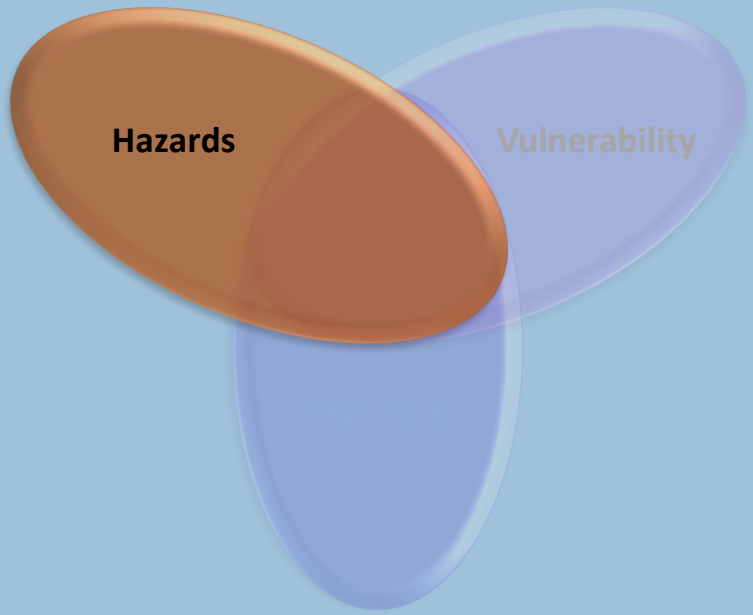
Liquefaction

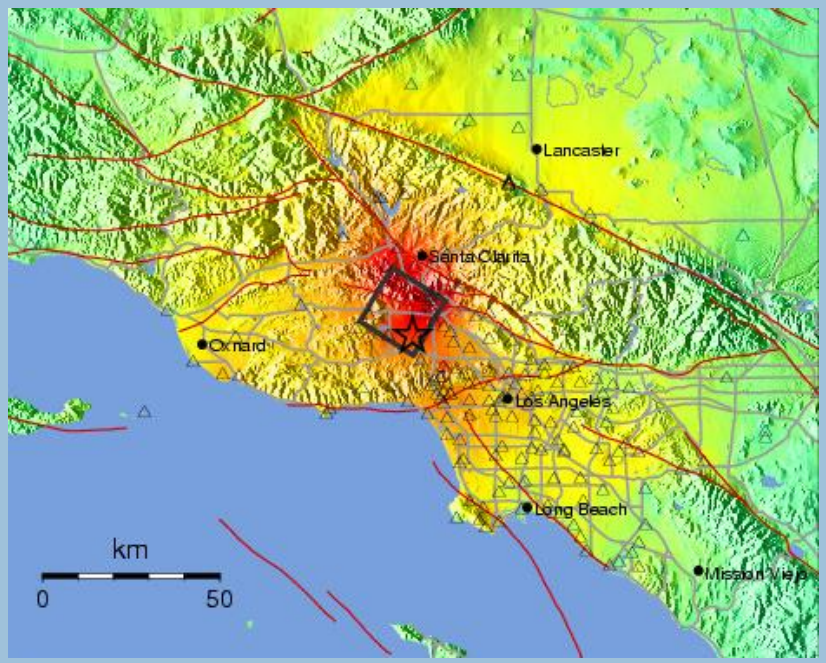
Three Components of Risk



Fault Rupture

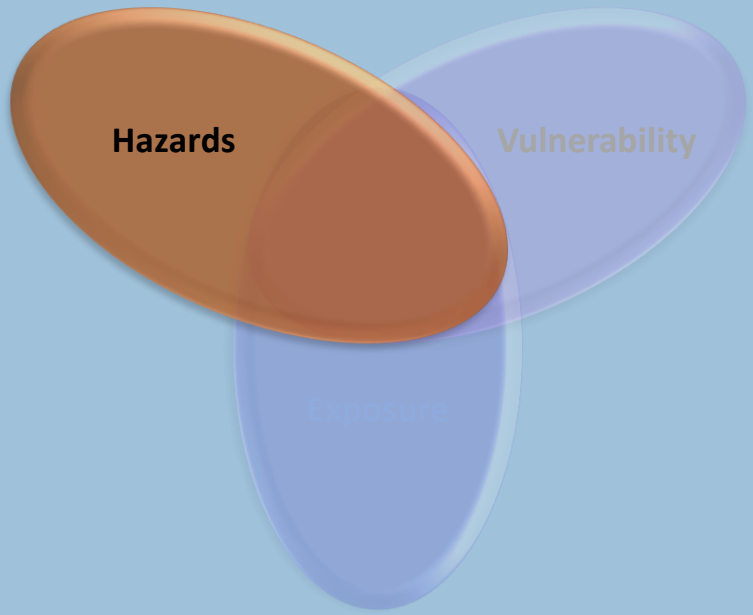
Three Components of Risk





Intense
Ground Shaking

Three Components of Risk



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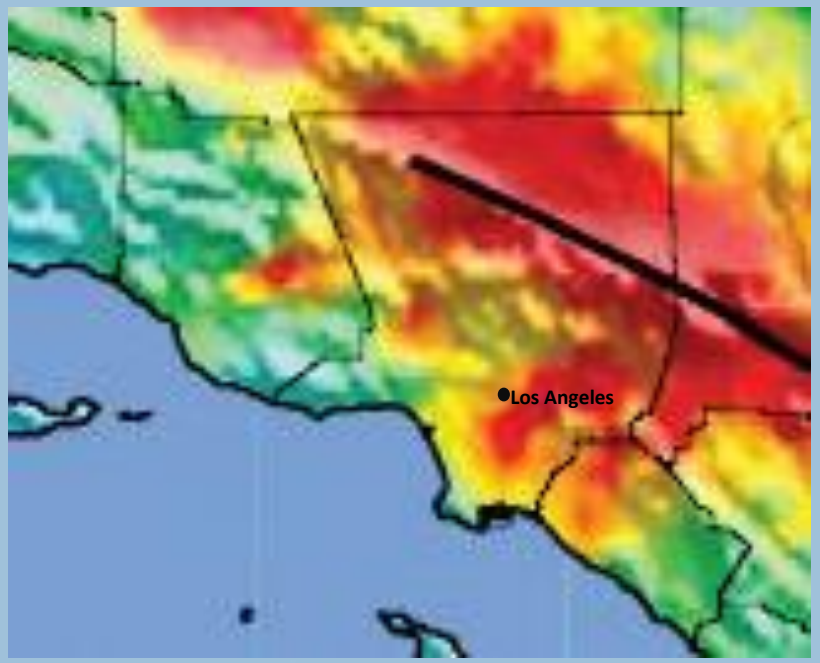

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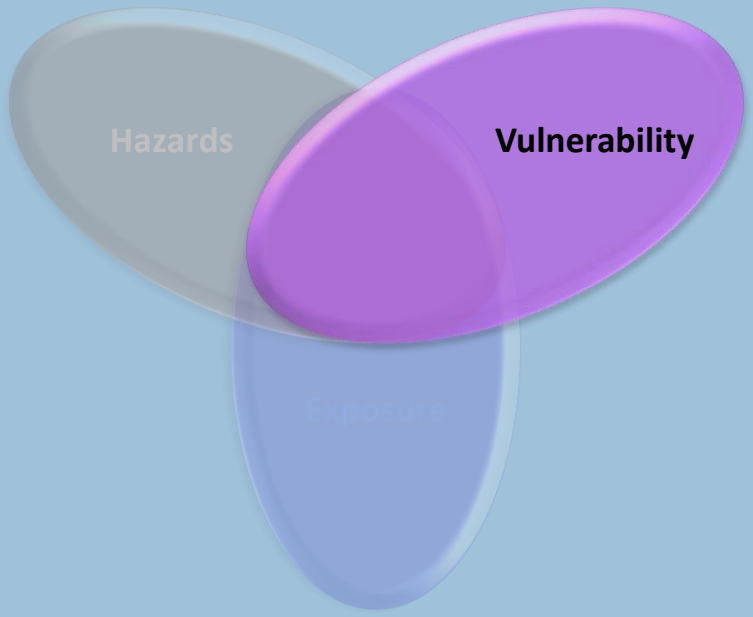
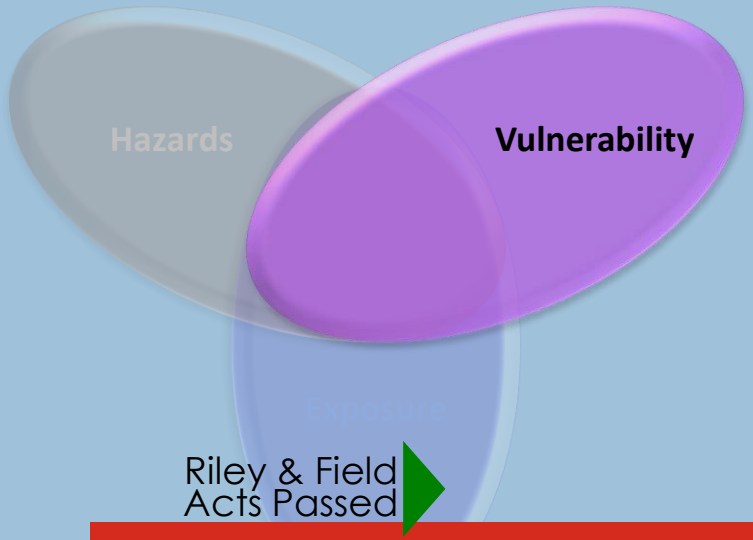


Vulnerability

Three Components of Risk



Age

Condition, Detailing

Riley & Field Acts Passed

Benchmark 1976 UBC

2nd Benchmark 1997 UBC

Future Developments

Pre-UBC | 1925 | 1935 | 1945 | 1955 | 1965 | 1975 | 1985 | 1995 | 2005 | Today

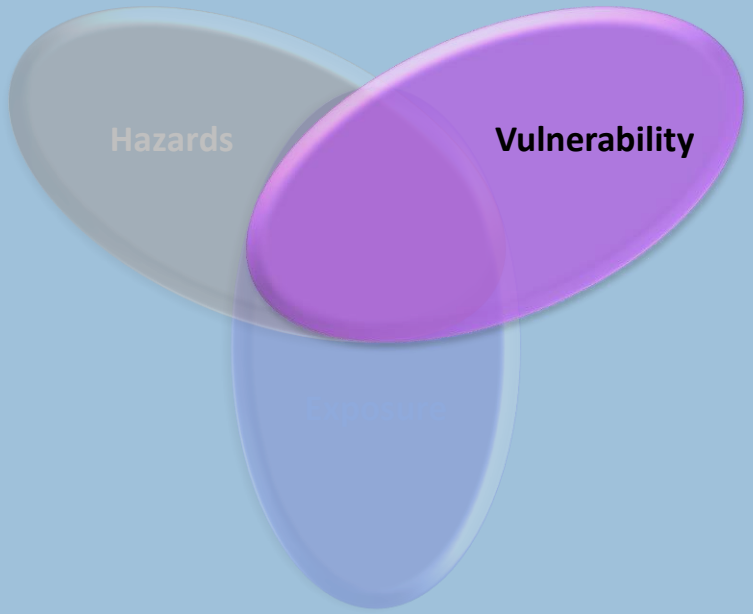
1906 & 1925 San Francisco & Santa Barbara Earthquakes

1933 Long Beach Earthquake

1971 San Fernando Earthquake

1989 & 1994 Loma Prieta & Northridge Earthquakes

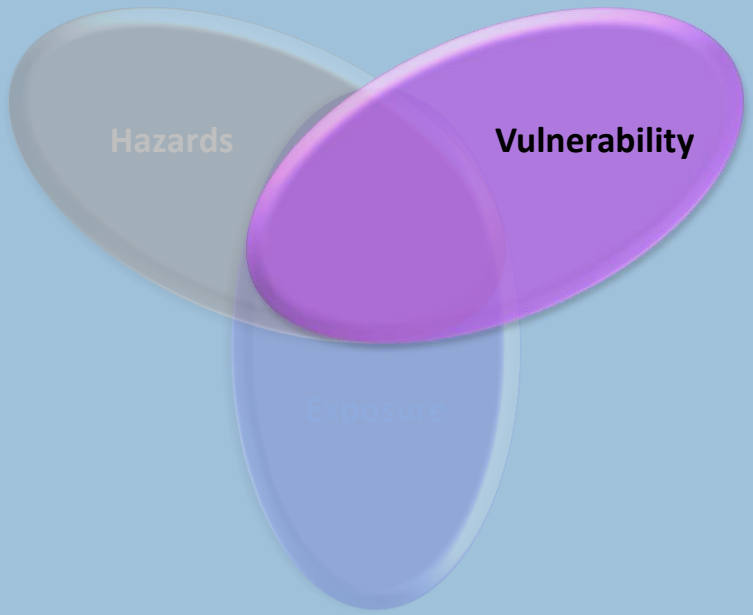
Three Components of Risk



Materials

Ductility, Strength

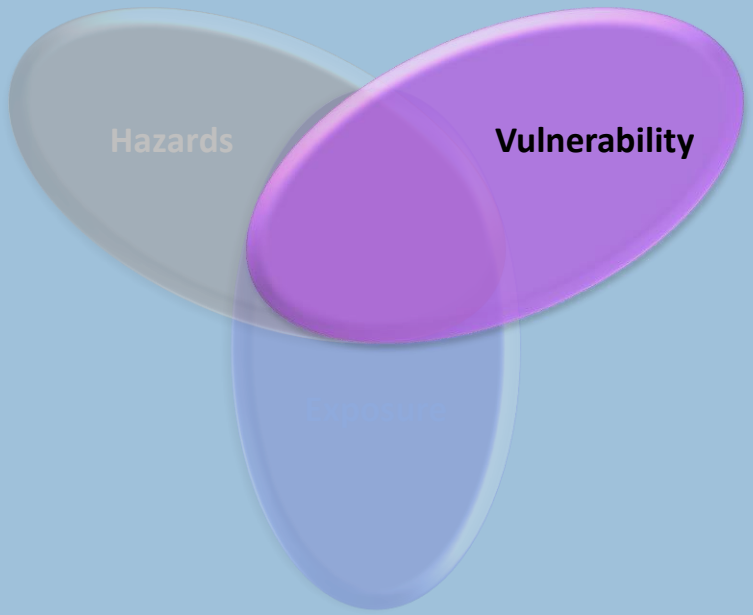
Three Components of Risk



Load Path

Connections, Redundancy

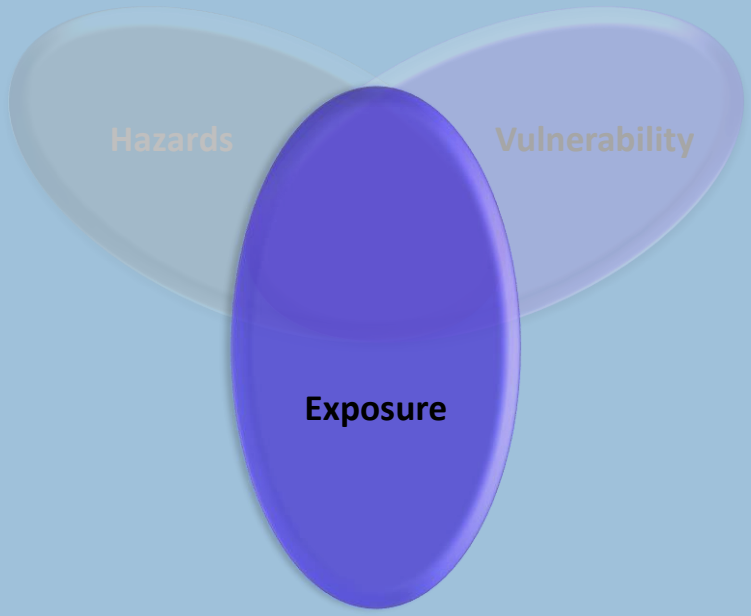
Three Components of Risk



Configuration

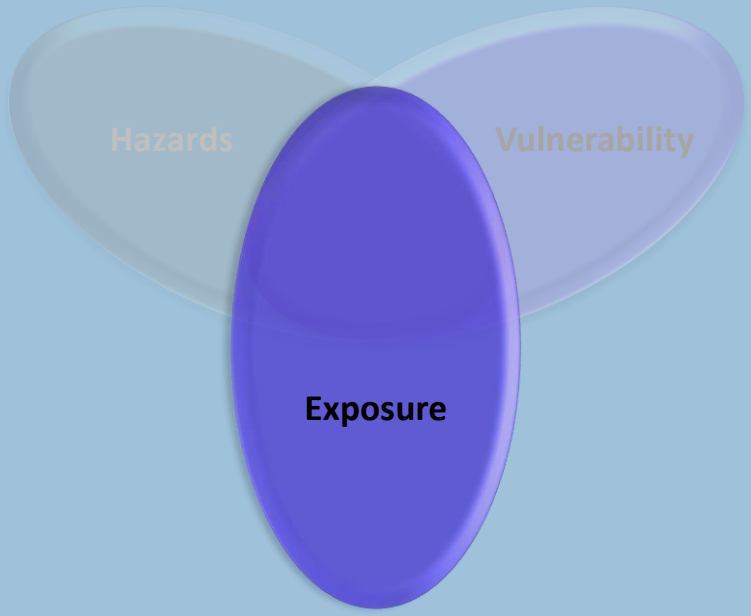
Shape, Mass/Weight, Stiffness

Three Components of Risk



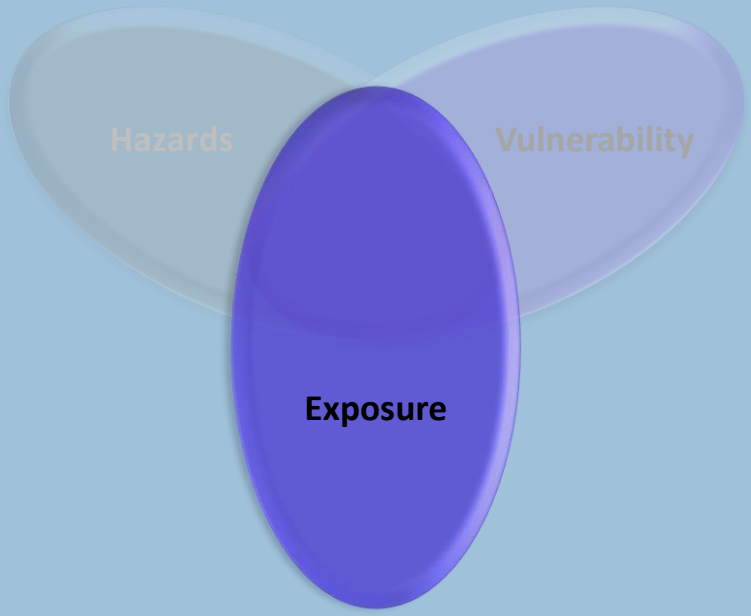
Exposure

Three Components of Risk



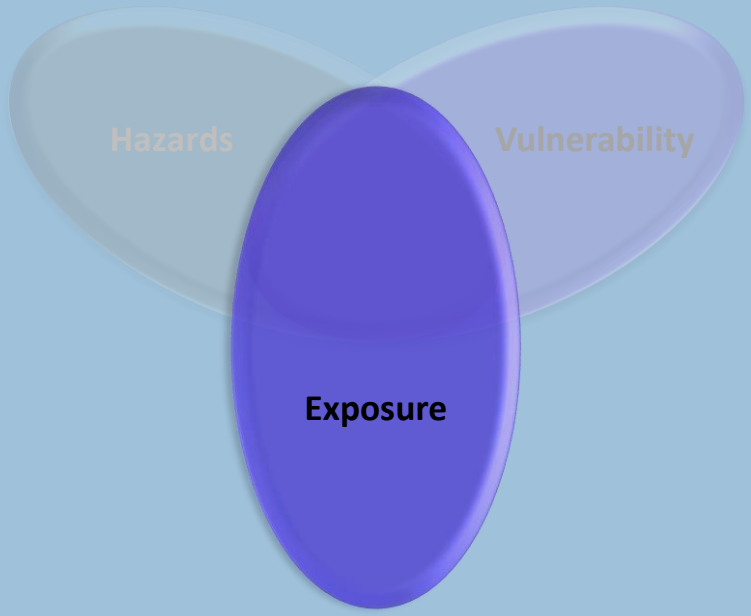
Financial Investment

Three Components of Risk

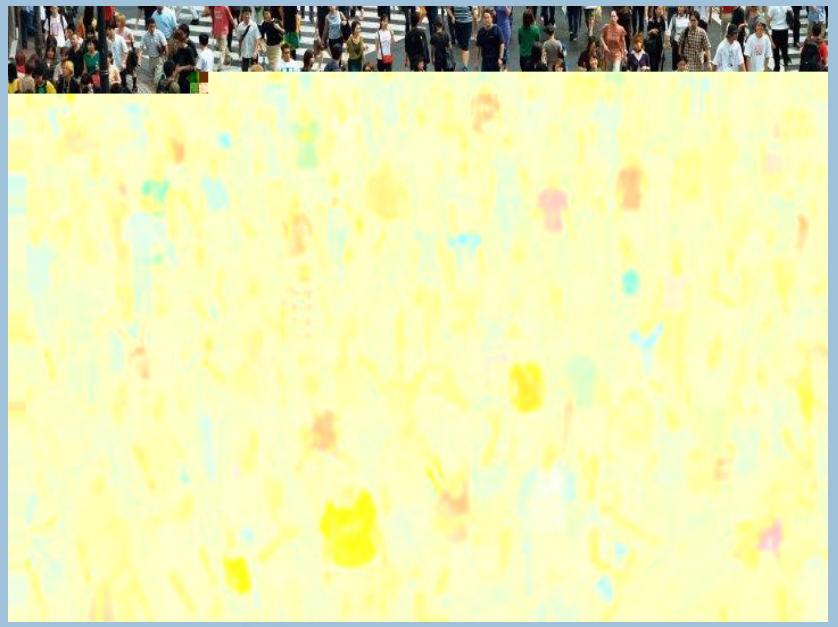


Occupancy/Income

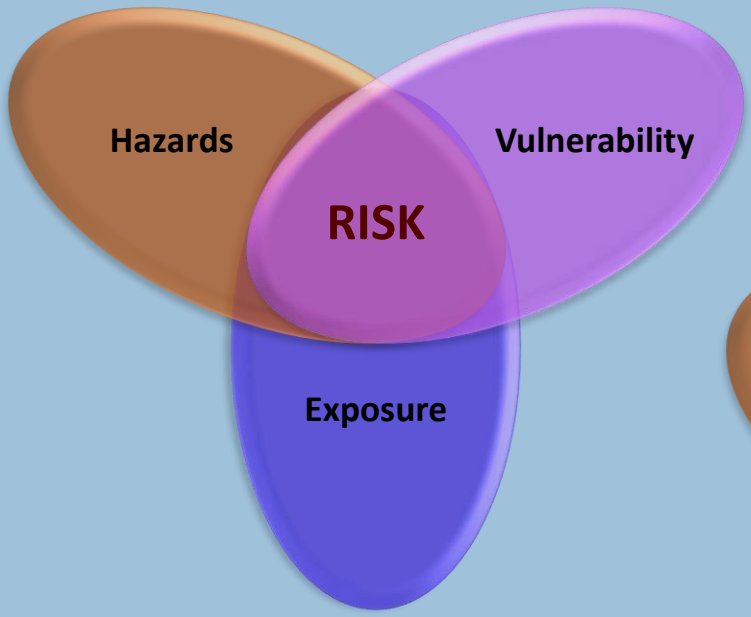
Three Components of Risk

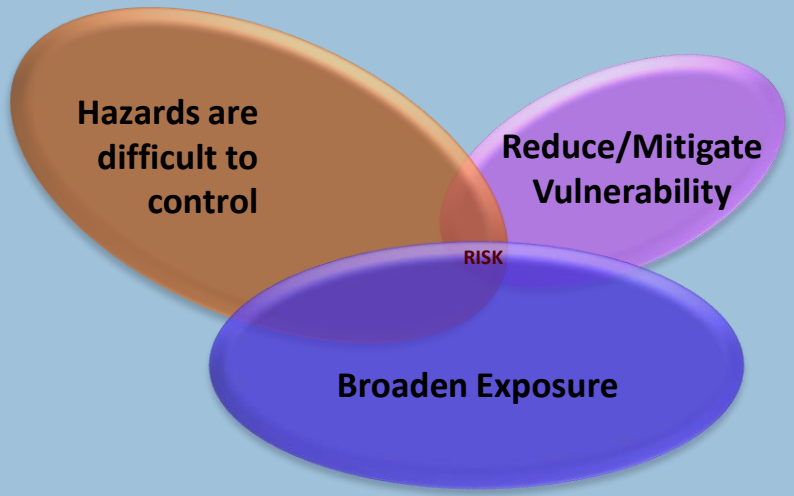


Community



Changing the Risk Profile





So How Do we Do this??

ASTM E 2026 and ASTM E 2557

"Standard Guide for Seismic Risk Assessment of Buildings"

"Standard Practice for PML Evaluations for Earthquake Due Diligence"

ASTM Defines:

- Scope of Assessments
- Terminology (PGA, SEL, SUL, PML)
- Level of Investigation (0, 1, 2, or 3)
- Qualifications of Reviewer

ASTM is the American Society for Testing and Materials

ASTM E 2026 - "Standard Guide for Seismic Risk Assessment of Buildings"

Considerations that are or can be addressed:

- **Seismic Ground Motion Hazard Assessment:**
  The objective of the seismic ground motion hazard assessment is to characterize the earthquake ground motions at the site(s) with a specified probability of being exceeded in a given time period and/or scenario earthquake ground motions associated with specific source events that are likely to impact the site(s).

- **Site Stability Assessment:**
  The objective of the site stability assessment is to determine if the building is located on a site that may be subjected to instability due to earthquake-induced surface fault rupture, soil liquefaction, subsidence, settlement, landslide, tsunami, seiche, etc.

- **Building Stability Assessment:**
  The objective of the building stability assessment is to determine if the building can be reasonably expected to remain stable under earthquake loadings. A building should be deemed stable if it is able to maintain the vertical load carrying-capacity of its structural system under the inelastic deformations caused by the earthquake ground motion prescribed for the building and site by the current edition of the International Building Code or other nationally applicable building code as specified by the User.

ASTM E 2026 - "Standard Guide for Seismic Risk Assessment of Buildings"

Considerations that are or can be addressed:

- **Building Damageability Assessment:**
  The objective of the building damageability assessment is to characterize expected earthquake losses associated with earthquake ground shaking and possible other earthquake hazards as prescribed by a User by performing an engineering analysis and evaluation of the damageability characteristics of the building(s) at given levels of earthquake ground motions.

- **Building Content Damageability Assessment:**
  The objective of the building content (contents) damageability assessment is to perform an analysis of the earthquake performance of contents within the building. This analysis is concerned with contents that are not part of the building systems.

- **Business Interruption Assessment:**
  An analysis of the site, building, equipment, contents, inventory systems, infrastructure, interdependent businesses, and all other relevant parameters to determine if the building will suffer business interruption from onsite effects such as direct damage to buildings, equipment or loss of critical contents & supplies; impacts to other facilities or services not part of the property; damage to buildings of interrelated businesses; lost availability of utility services, transportation modes, supplies, or services; lost availability or access to interrelated businesses, supplies or materials; and offsite damage to infrastructure, i.e. transit systems, telecommunications, utilities, water, power and waste supply and treatment facilities.

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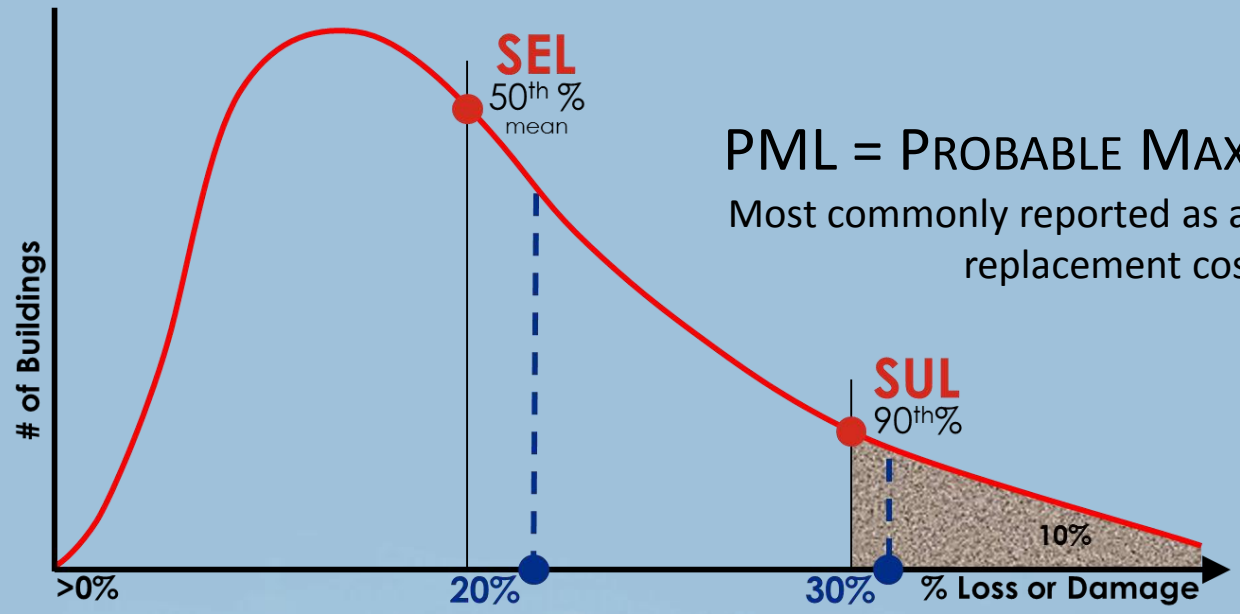

PML = Probable Maximum Loss

Most commonly reported as a percentage of replacement cost

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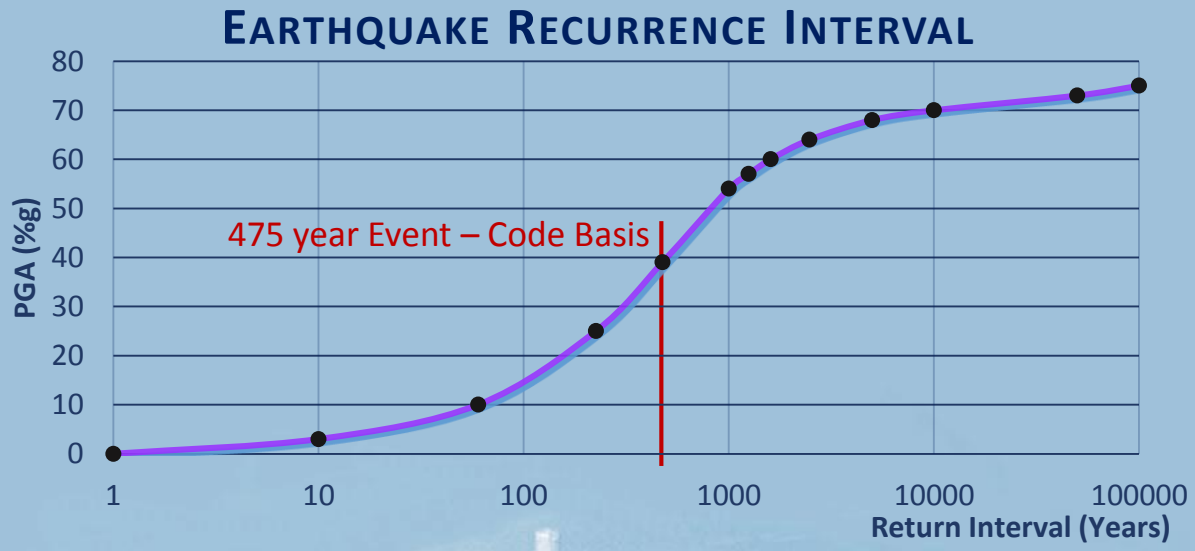
Earthquake Return Period: 225, 475, 2475 Years? …. 10% in 50 Years?



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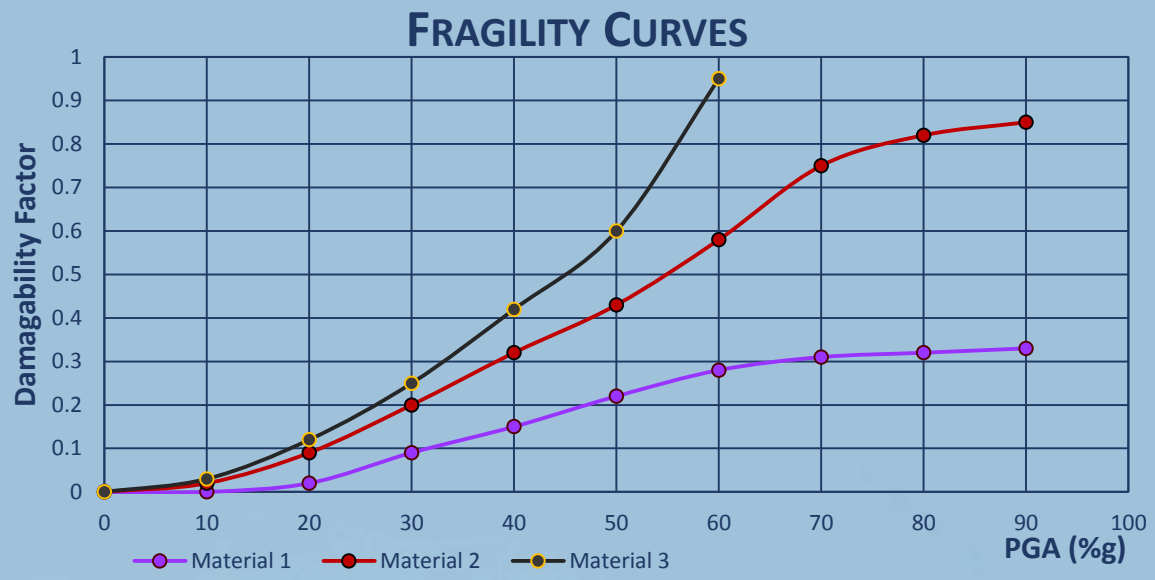

Thiel Zsutty, STRisk, ATC13, SeismiCat, HAZUS, FEMA P58

So Now What?

The goal of any study is to provide the user with important information from which to base critical decisions:

- Do I need to retrofit?
- Can I lower my exposure by transferring a portion (or all) of the risk to a third party…insurance?
- What do I need to do to ensure my property maintains rental income viability.

So Now What?

The goal of any study is to provide the user with important information from which to base critical decisions:

- Do I need to retrofit?

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Which One is Better?

Artificial, Completely Random, Made-up Case Studies:

One Level Over “Soft Story”

Floor Framing Perpendicular

Single Car Depth Parking

“Long” 1-Story Shear Wall

0.45g ground Acceleration

Moderate Liquefaction

Slender Columns with Grade Beams

Two Levels Over “Soft Story”

Floor Framing Parallel

Car & Half Depth Parking

“Short” 2-Story Shear Walls

0.25g ground Acceleration

Negligible Liquefaction

Pin at Column/Beam Joint

Two Levels Over “Soft Story”

Floor Framing Perpendicular

Double Car Depth Parking

“Short but Uniform” 2-Story Shear Walls

0.56g Ground Acceleration

High Liquefaction

Moment Frame

Thank You & Questions?

City of Los Angeles Resource Fair

Structural Engineers Association of Southern California
Email: seaosc@seaosc.org
www.seaosc.org
(562) 908-6131

Kenneth O'Dell, S.E.
MHP, Inc. Structural Engineers
Email: kodell@mhpse.com
www.mhpse.com
(562) 985-3200

MHP
STRUCTURAL ENGINEERS