

Fundamental of Seismic Risk Management

What is "Risk"?

Examples of "Risk" in various areas

- Accident and disaster
- Loss due to accident or disaster
- Probability of loss occurrence, etc

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2

What is "Risk"?

Both of the below senses are used in the field of seismic risk management.

- Risk $R = \text{Loss } C \times \text{Probability of loss } P$
 - In case with various damage patterns with combination of loss C_i and probability p_i ,

$$R = \sum (C_i \times P_i)$$

- Combination of Loss C and its probability of occurrence P

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3

What is "Risk management"?

- Recognize and analyze seismic risk and evaluate loss and its probability.
- Consider a method of risk reduction and set up a plan.
- Execute the plan.



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Evaluation of loss by event-tree

- Analyze damage patterns caused by an event and evaluate loss and probability of occurrence.
- Loss ratio R_i is a product of loss C_i and probability of occurrence P_i .

$$R = \sum (C_i \times P_i)$$

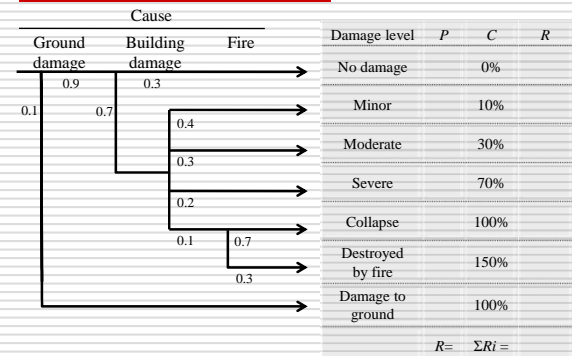
C_i : Loss value. Generally normalized by initial cost.

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6

Example of event-tree



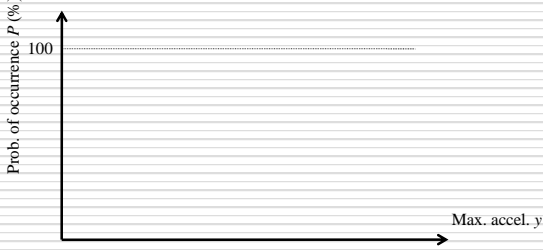
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7

Damage level curve

- Relation of max. ground accel. and probability of occurrence of damage
- Evaluated from event-tree at each accel.



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Seismic loss function

- Summation of products of loss and probability for different damage levels

$$R = \sum (C_i \times P_i)$$



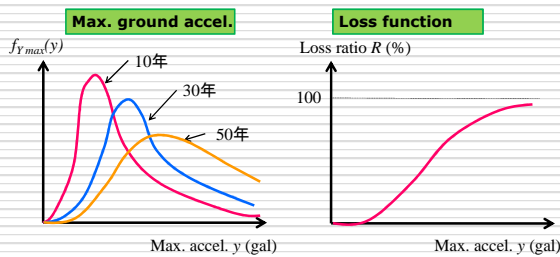
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Seismic risk density function

- Product of maximum ground acceleration, $f_{y\max}(y)$ and seismic loss function



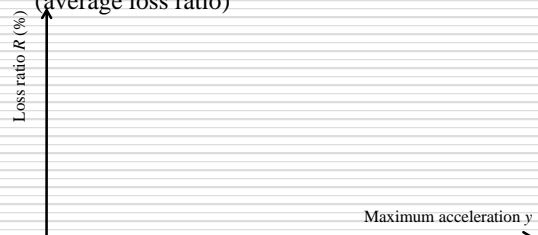
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Seismic risk density function

- Total area of seismic risk density curve is equal to... expected value of loss for t years. (average loss ratio)



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Life cycle cost and action against EQ

Life cycle cost (LCC) =

- (1) initial and maintenance cost +
- (2) loss due to disaster

- Lower LCC is more cost effective to building owners and/or investors.
- Cost (1) is necessary during service period. However, cost (2) is probabilistic and needed to be examined by risk management method.
- LCC can be applicable to arrangement of initial strength and/or retrofit scheme.

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Risk management by life-cycle cost

Life cycle cost (LCC) = Initial cost + Loss expectation



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15