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

What is "Risk"?

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

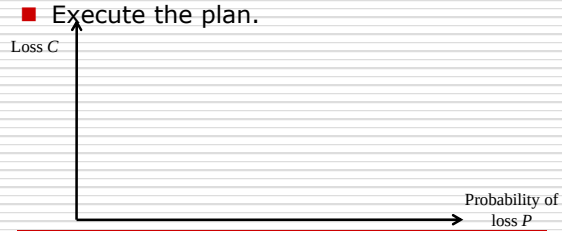
- Risk R= Loss C × Probability of loss P
  - In case with various damage patterns with combination of loss C_i and probability p_i,

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

- Combination of Loss C and its probability of occurrence P

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.



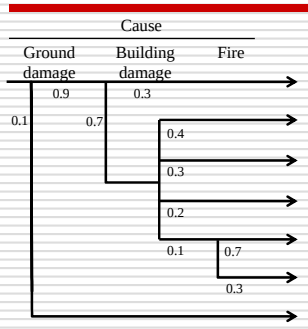
Evaluation of loss by event-tree

- 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.

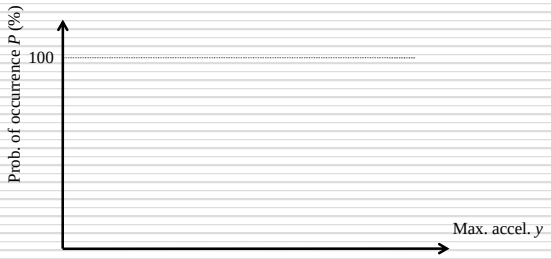
Example of event-tree



Damage level	P	C	R
No damage		0%	
Minor		10%	
Moderate		30%	
Severe		70%	
Collapse		100%	
Destroyed by fire		150%	
Damage to ground		100%	
	R=	ΣRi =	

Damage level curve

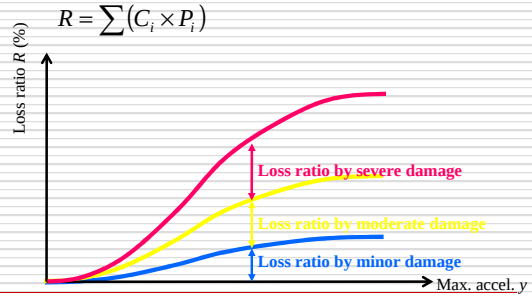
- Relation of max. ground accel. and probability of occurrence of damage
- Evaluated from event-tree at each accel.



Seismic loss function

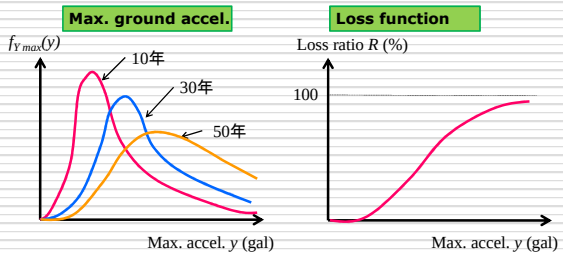
- Summation of products of loss and probability for defferent damage levels

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



Seismic risk density function

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

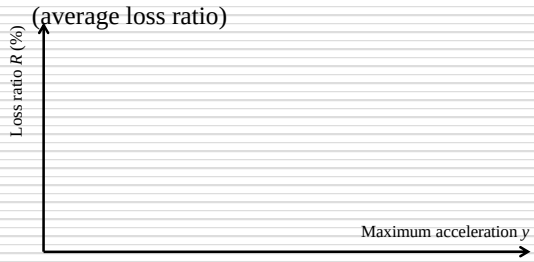


Seismic risk density function

- Total area of seismic risk density curve is equal to…

  expected value of loss for t years.

  (average loss ratio)



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.

Risk management by life-cycle cost