

SEISMIC PROBABILITY DIAGRAMS FOR RISK EVALUATION
IN THE INDIAN SUBCONTINENT

by
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Like floods and cyclones earthquakes are probabilistic in nature. By analysing the past data of earthquakes in any region it is possible to associate an earthquake of given intensity with some probability of occurrence. Risk is the monetary loss of property, life, economy and loss of national security in the event of failure of a structure. Risk factors are computed by probability methods. This factor is ignored in the usual method of aseismic design. The method of allowing limited risk so as to optimize the overall cost of the structure has recently gained recognition in the developed nations. By this method a distinction in the design criterion has to be made between a warehouse with less occupancy and a hospital with high occupancy and between a structure with 10 years life and another with 100 years life. Its economics and desirability are mentioned below.

Projects like river valley and coastal structures usually involve massive and expensive structures like spillway dams. Their economies depend upon their physical life spans and rate of interest. The structures are classified according to their importance, life span and functions, and assigned different risk factors instead of designing all of them for the same acceleration. To reduce earthquake risk to negligible probability would mean extra investment on the project costs with no increase in the benefits. It reduces the benefit-cost ratio which may inhibit the project. Risk analysis is thus useful in decision making and optimal planning of water resources and other public projects.

Probability of exceedence of a given magnitude is the reciprocal of the recurrence interval of that event. The regional data of earthquakes in the Indian subcontinent are analysed statistically and plotted on log-probability paper as straight lines. The procedure consists of the following steps; (1) determine the limits of earthquake intensity which make differences in structural design and the costs, (2) determine the return periods for these intensities from the probability diagrams, (3) calculate risk for the given life of the structure and the design return period, (4) compute risk cost depending on the initial cost and rate of interest, (5) compute modification cost to avert such damages, and (6) decision requires minimization of total cost (4+5).

It is concluded that use of earthquake risk as a design criterion aids in the selection of public projects which are otherwise financially not justifiable. The people in a country like India should be informed of its economics.

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DISCUSSION

P.K. Swamee (India)

1. The author may clarify if a very high return period of occurrence of earthquake is found to be optimal from the risk criterion, will it substantially increase the initial investment ?

2. Is this risk criterion adopted in engineering project design in India ?

Author's Closure

With regard to the questions of Mr. Swamee, we wish to state that

- (1) An earthquake of high return period will increase the initial investment. However, if the life of the structure and permissible damage are included in the risk analysis as outlined in the paper, an earthquake of lesser magnitude may prove to be optimal and it reduces the capital cost.
- (2) Risk criterion is not adopted in the design of dams and other flood control, irrigation and hydro-power structures. A favourable public opinion has to be first created through mass media about the economic advantages of this criterion in planning.