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Discussion on "Zonation of Central U.S. Earthquake Sources" by G. L. Hempen

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G.L. Hempen.

In the western part of the United States, earthquake potential is estimated by analyzing recorded data on active faults. However, because active earthquake faults are not recognized in the Central United States, the "tectonic province or structure" approach has to be used to analyze earthquake hazard in this area. A typical analysis consists of four steps: (1) defining the boundary of the source zone, (2) estimating recurrence rate, (3) selecting an attenuation model, and (4) evaluating the seismic hazard at the site. Because we do not know enough about the seismicity of the Central United States, the seismic hazard analysis for any site in this region presents considerably more difficulty than such analysis for a site in the Western United States. The paper by Hempen et al contributes to understanding of the zonation of earthquake sources within the Central United States.

The earthquake source is generally defined using the hypocentral position of past earthquakes and the geological and seismological information available for the source zone. In the Central United States, most of the earthquake sources are defined to be area sources with shallow depth of activity. The intra-plate tectonics is not well understood for the Central United States, and therefore geologic considerations do not provide sufficient information for bounding the earthquake source zones. Current practice defines the boundaries of the seismo-tectonic zones using the limits of major geologic features. Based on interpretations of available information, an earthquake source in the Central United States can be modeled by various zone alternatives. Because of this uncertainty in defining the seismotectonic model, it is generally suggested that several alternate models, covering the range of possible seismotectonic variations, be considered for seismic hazard analysis. Such an approach is desirable because of the fact that the seismicity catalogues are biased and incomplete. For example, the authors have pointed out that "Prior to the establishment of the St. Louis University seismic array for the New Madrid, Missouri area in 1973, considerable inaccuracies were inherent in the reduction of hypocenters and magnitudes for smaller earthquakes of the Central United States."

Within each defined source boundary the seismicity is assumed to be uniform and is generally assigned an earthquake potential equal to the maximum recorded event for the entire source zone. Such an assumption may be regarded as a conservative assumption because each source zone boundary may contain areas of potential weakness corresponding to maximum historical seismic activity as well as other areas of aseismic stable blocks which are stronger in nature.

The recurrence rate for earthquake is estimated from the existing data for each earthquake source zone, corrected for completeness. Unfortunately, the seismicity data base for the Central United States is biased because of scatter in data, small events resulting from an earthquake series, and inaccurate and incomplete reporting of historic shocks.

At present, there are several computer programs available for seismic hazard analysis based on theoretical considerations presented by Cornell in 1968. A frequently used computer program has been developed for this purpose by McGuire (1976) of United States Geologic Survey. By and large, all seismic hazard analysis computer programs require as input the definition of seismotectonic model that provides the basis for source boundary, recurrence rate, the maximum earthquake magnitude corresponding to the seismic zone, and some attenuation model. As stated by Hempen et al, it is much more difficult to obtain and properly define these input parameters with a degree of confidence for the low seismic intra-plate area of the Central United States than for the active faults regions of the Western United States. The authors have carefully and appropriately suggested that the degree of allowable risk attributable to earthquake must be assigned by the owner of the facility.

REFERENCES

Cornell, C. A. (1968), "Engineering Seismic Risk Analysis", Bulletin of the Seismological Society of America, Vol, 58, No. 5, pp. 1583-1606.

McGuire, R. K. (1976), "FORTRAN Computer Program for Seismic Risk Analysis", United States Geological Survey, Open File Report 76-67.