

Evaluation of Ground Failure Susceptibility
Opportunity and Potential
in Anchorage, Alaska Urban Area

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Investigations

The collection, interpretation, and evaluation of available geological and geotechnical data in Anchorage have been completed. A summary of ground damages in Anchorage due to the 1964 Alaskan earthquake has been made. The liquefaction potential of major sandy formations in Anchorage has been evaluated using a probabilistic method similar to that described in Woodward-Clyde Consultants (1986). Basic engineering properties of soils in Anchorage have been summarized following the facies classification by Dr. R. Updike of Alaska Division of Geological and Geophysical Surveys. A modification to probabilistic seismic hazard analysis to incorporate the effects of seismically-induced displacements is now almost complete. The report covering these results is being prepared at this time.

Results

In this summary, some results of the evaluation for liquefaction potential in Anchorage and some preliminary results of the seismic hazard analysis for Anchorage are presented.

Table 1 presents probabilities of liquefaction for various geological units in Anchorage as a function of various peak ground acceleration levels given a magnitude 7-1/2 earthquake has occurred. As can be seen in Table 1, sandy soils in the Bootlegger Cove Formation have the largest probabilities of liquefaction. However, all the values shown in Table 1 are considered to be low when compared to expected behavior of loose sandy deposits under similar conditions.

In a typical probabilistic seismic hazard evaluation, equal weights are assigned to earthquakes of all magnitudes.

However, although different magnitudes can produce identical levels of peak ground acceleration, the smaller the magnitude the shorter is the duration. A weighting procedure to incorporate these considerations in probabilistic seismic hazard evaluation for liquefaction assessment is presented by Idriss (1985).

For Anchorage, potential for seismically-induced ground movements through mainly clayey parts of the bootlegger Cove Formation may be of more concern than liquefaction. For this reason, a weighting procedure using the data from Makdisi and Seed (1978) and Woodward-Clyde Consultants (1982) was developed in this study. The preliminary weighting relationships are shown in Figure 1 for seismically-induced displacements of 1, 15, and 100 cm. The results of probabilistic seismic hazard analyses for a downtown Anchorage area corresponding to displacements of 1 and 100 cm are shown in Figures 2a and 2b.

As can be seen in Figures 2a and 2b, the displacement of 1 cm is dominated by the Megathrust for acceleration levels lower than about 0.2 g, but by the Border Ranges fault for those higher than about 0.2 g. However, the displacement of 100 cm is completely dominated by the Megathrust. These relationships are being refined at present.

Reports

Idriss, I.M. (1985). Evaluating seismic risk in engineering practice, Theme Lecture, Proceedings of the Eleventh International Conference on Soil Mechanics and Foundation Engineering, San Francisco.

Makdisi, F.I., and Seed, H.B. (1978). Simplified Procedure for Estimating Dam and Embankment Earthquake-Induced Deformations. ASCE J. Geotech. Engr. Div., v. 104, no. GT7, 849-867.

Woodward-Clyde Consultants (1982). Anchorage Office Complex, Geotechnical Investigation, Anchorage, Alaska. Report to Alaska Department of Transportation and Public Facilities, Central Region, Design and Construction, Anchorage, Alaska.

Woodward-Clyde Consultants (1986). Evaluation of Liquefaction Opportunity and Liquefaction Potential in the San Diego, California Urban Area, Final Technical Report, U.S. Geological Survey, Contract No. 14-08-0001-20607.

TABLE 1

ESTIMATED PROBABILITY OF LIQUEFACTION
GIVEN A MAGNITUDE OF 7-1/2 EARTHQUAKE HAS OCCURRED

Geologic Unit	Number of SPT Data	Mean Probabilities of Liquefaction		
		* $A_{max} = 0.1g$	* $A_{max} = 0.2 g$	* $A_{max} = 0.3g$
Alluvium, Q_{al}	32	0.1×10^{-9}	0.0012	0.025
Naptowne Outwash, Q_o	238	0.14×10^{-9}	0.0008	0.019
Bootlegger Cover Formation, Q_{bc}	580	0.0045	0.025	0.089

* Peak horizontal acceleration at ground surface.

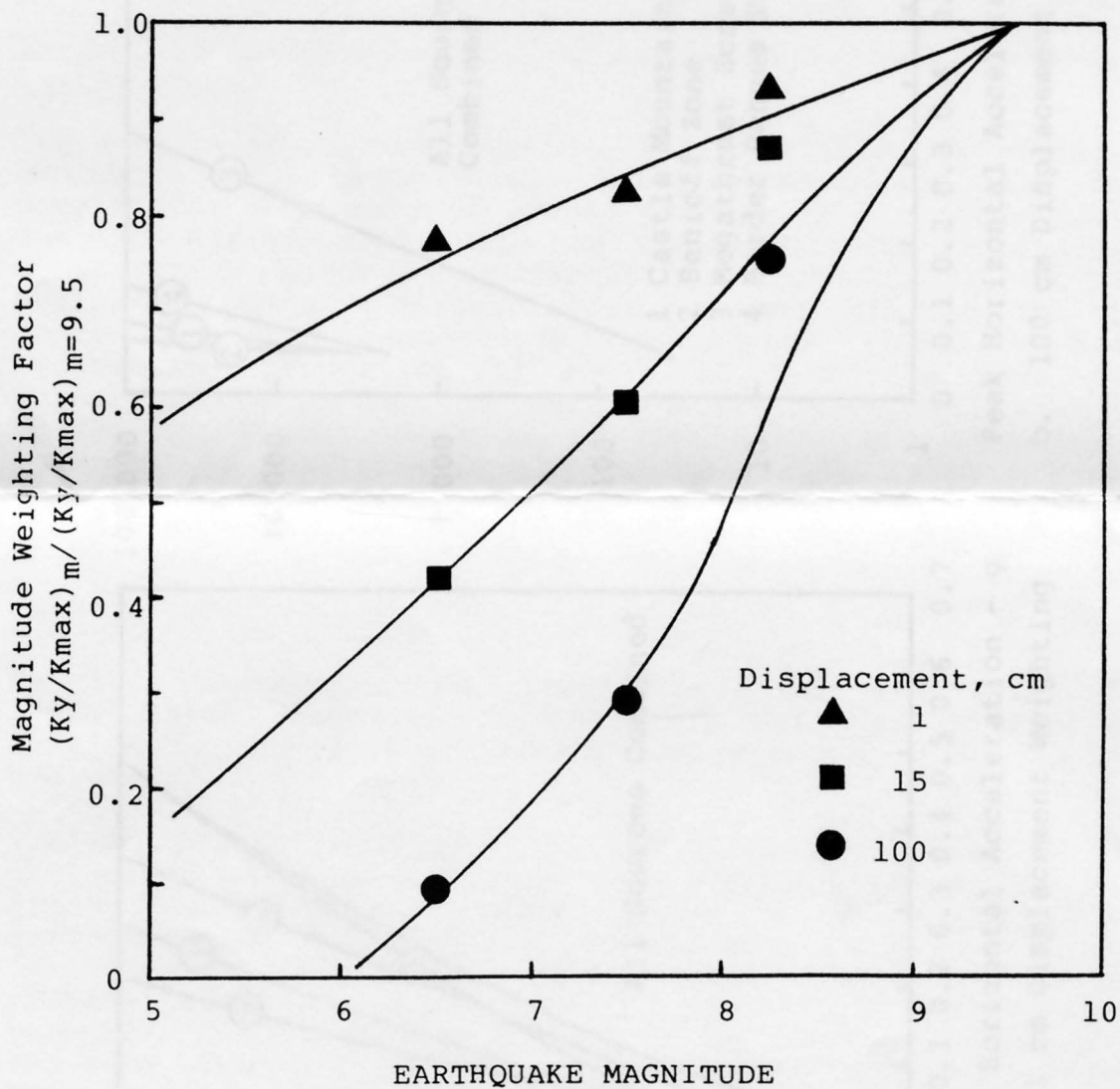
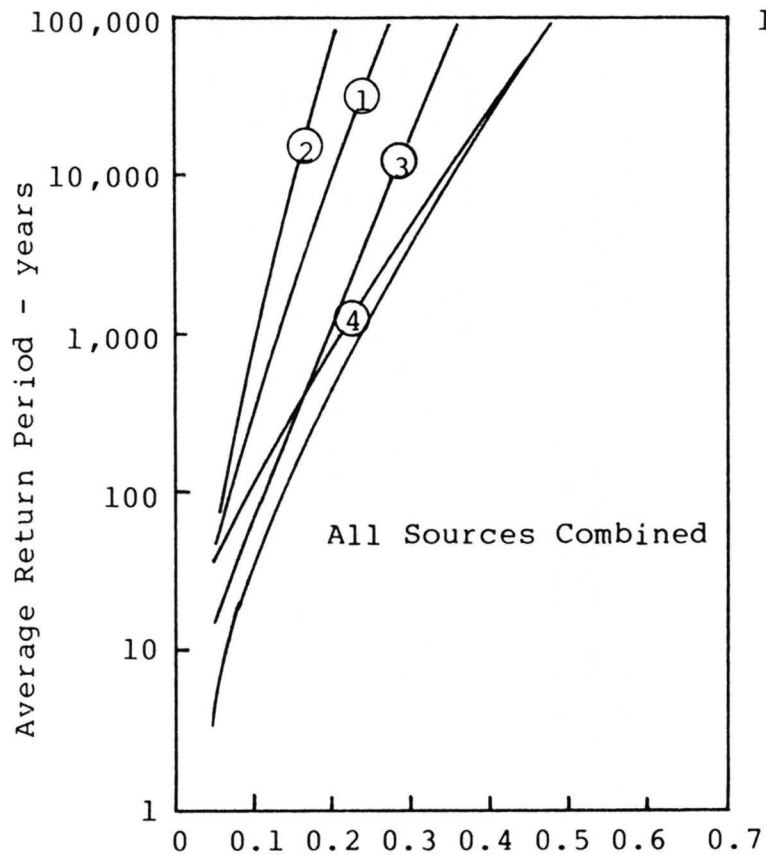
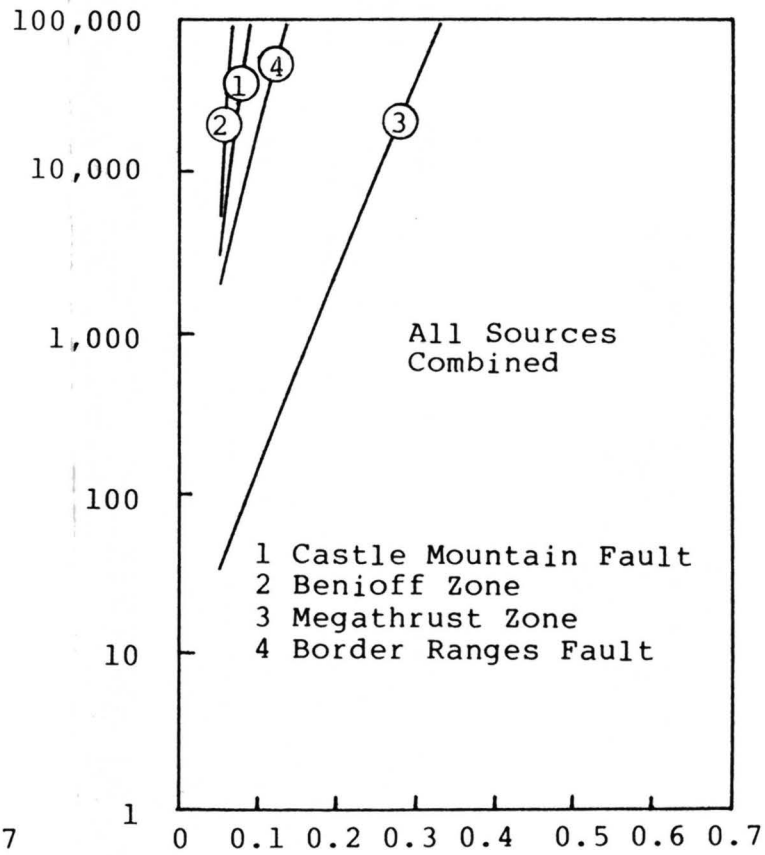


Figure 1 Magnitude Weighting Factors for Seismically-induced Displacements



Peak Horizontal Acceleration - g

a. 1 cm Displacement Weighting



Peak Horizontal Acceleration - g

b. 100 cm Displacement Weighting

Figure 2 Results of Probabilistic Seismic Hazard Evaluation
With Magnitude Contributions Weighted With Respect to $m=9.5$