

Seismic Performance of the Columbia River Levee Along NE Marine Drive, Portland, Oregon

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Portland District, in affiliation with the Multnomah County Drainage District No. 1, studied the seismic performance of the Columbia River levee along NE Marine Drive. The levee system along Marine Drive is particularly important because of the infrastructure it protects. The study evaluated a “worst case” situation involving concurrent flood and earthquake events to determine the statistical probability of damage or failure of the levee.

A flood and seismic hazard investigation was performed by engineers specialized in soils and earthquake engineering from Oregon State University. The study focused on a two-mile long stretch of levee in the center of the drainage district. The objectives included performing a static (hydrologic) stability analysis for the levee, and a seismic stability analysis for the levee at three different river levels including the potential extent of earthquake-induced deformations.

The static stability analysis showed that the levee was stable with excess capacity for a river level at elevation 29.2 feet NGVD (1% flood risk or the 100-year flood event); the levee was found to be unstable for a river level at elevation 42.2 feet NGVD (top of levee). Based on the seismic analysis for the 1% flood risk, the levee is considered safe for a 0.2% seismic risk (M_w 6.2) as well as for a 0.04% seismic risk (M_w 7.0).

The Corps performed an assessment of the risk of interior flooding due to damage of the earthen levee from concurrent hydrologic and seismic events. The combined risk of a seismic event occurring during a major flood event on the Columbia River is very low. A seismic event by itself would not result in interior flooding unless a major flood event was in progress. The risk of these two events occurring at the same time was computed by multiplying the probability of the flood event by the probability of the seismic event. The following risk scenarios were computed in this manner.

- A 100-year flood and a magnitude 6.2 earthquake causing no significant levee damage yields an annual probability of 0.00002 (0.002% risk), or a 1 in 50,000 year chance.
- A 100-year flood and a magnitude 7.0 earthquake causing damage but not levee failure yields an annual probability of 0.000004 (0.0004% risk), or a 1 in 250,000 year chance.
- A 400-year flood and a magnitude 6.2 earthquake causing damage but not levee failure yields an annual probability of 0.000005 (0.0005% risk), or a 1 in 200,000 year chance.
- A 400-year flood and a magnitude 7.0 earthquake causing significant levee damage yields an annual probability of 0.000001 (0.0001% risk), or a 1 in 1,000,000 year chance.