

USGS Award Number 99-HQ-GR-0030

**GROUND MOTION MAPS THAT ACCOUNT FOR SITE EFFECTS, BASIN  
EFFECTS, DURATION OF SHAKING AND RUPTURE DIRECTIVITY IN THE  
SAN FRANCISCO BAY AREA**

**FINAL REPORT, JUNE 30, 2001**

Paul G. Somerville, Arben Pitarka, and Nancy Collins

URS Group, Inc.  
566 El Dorado Street, Pasadena, CA 91101  
Tel: (626) 449-7650, Fax: (626) 449-3536  
Email: paul\_somerville@urscorp.com

**Abstract**

This report describes ground motion maps for scenario earthquakes on the San Andreas and Hayward faults in the San Francisco Bay area that include rupture directivity effects, site effects, and basin effects. The ground motion maps made in our previous report (Somerville et al., 1999a) were for response spectral acceleration for a range of periods. In this report, we have generated maps of new ground motion parameters for these five scenarios. The new parameters include the peak ground velocity, and the period of the wave that contains the peak velocity. The purpose of these maps is to provide a description of the peak velocity and period of the near-fault pulse caused by forward rupture directivity.

Complex patterns of ground motion amplitudes and periods are caused by rupture directivity effects, basin effects and soil effects. The ground motion patterns are different for rupture of the same fault segment starting at different hypocenter locations. The peak velocity increases along strike away from the epicenter. The peak velocity is generally amplified in shallow basin regions. The period of the pulse is generally shortest along the fault, lying in the range of about 1 to 3 seconds. Although the peak velocity grows with distance along the fault away from the epicenter, the period does not. The period is generally shorter on rock sites than on soil sites.

Along the eastern shore of San Francisco Bay, the largest basin structure lies mostly beneath the central part of the east bay but also underlies a narrow strip of the shoreline extending from Oakland Airport to south of the San Mateo Bridge in Hayward. The deepest basin lies east of the Hayward fault, so the strongest basin effects are in the Coast Ranges. For earthquakes on the Hayward fault, the main effect of the sedimentary basins on ground motions is to increase the peak velocity along the southeastern shore of San Francisco Bay between the Oakland Airport and the San Mateo Bridge, and to the east of the Hayward fault in the Coast Ranges. Along the San Andreas fault, the main basin structures lie east of the fault in Daly City, and west of the fault between Redwood City and Portola Valley. For earthquakes on the San Andreas fault, the main effect of the sedimentary basins is to increase the peak velocity in these two regions.