

Reverse Faults in the Western Santa Clara Valley – The Foothills Fault System: Knowns, Unknowns, and Possible Effects on Transportation Systems

Keith I. Kelson and Christopher S. Hitchcock
William Lettis & Associates, Inc.
Walnut Creek, CA

The heavily urbanized western margin of the Santa Clara Valley, within the southern San Francisco Bay Region, is underlain by several potentially active reverse faults (Hitchcock et al., 1994; Hitchcock and Kelson, 1994, 1999). These faults include the Monte Vista, Cascade, and Shannon faults, which underlie the municipalities of Cupertino, Sunnyvale, Saratoga, Los Gatos, San Jose, and unincorporated parts of Santa Clara County. The faults are grouped together as the Foothills fault system, and each of the faults is of sufficient length to generate moderate to large earthquakes. Some of the faults are “blind”, meaning that they do not reach the ground surface, but nevertheless are viewed as being potentially active. These faults appear to be similar to faults beneath the San Fernando Valley in southern California that produced damaging earthquakes in 1971 and 1994. Because the Foothills fault system traverses the populated Santa Clara Valley, a moderate or large magnitude earthquake on the fault system likely would result in damage comparable to that from the 1994 Northridge earthquake.

To date, however, the basic characteristics of these reverse faults are either poorly understood or unknown. In fact, until the Loma Prieta earthquake in 1989, there was little or no consideration that these faults were potential sources of large earthquakes. Since 1989, we have developed the understanding that an earthquake on the Monte Vista fault, or another similar reverse fault within the western Santa Clara Valley, will probably produce damage to roads and highways over a broad area. Liquefaction of saturated soils near the Bay will occur, and likely will affect highways, airports, and other transportation lifelines. Landsliding in the Santa Cruz Mountains also will affect many major and minor thoroughfares. Lastly, strong ground motions during the earthquake will produce building damage that may block some transportation corridors. All of these possible results may affect emergency response efforts in the southern Bay region.

Our understanding of the Monte Vista fault and others beneath the Santa Clara Valley is lacking in several important ways. At this point, the lack of knowledge of the fault system hampers better estimation of where and how much damage will occur. For example, we do not know the answers to these questions:

- ◆ Where will future ground rupture or folding occur?
- ◆ How much ground rupture will occur?
- ◆ How often do large earthquakes occur on these reverse faults?
- ◆ When did the last large earthquake occur on the Foothills fault system?

At present, earthquake hazards related to the Foothills fault system can be estimated on a regional basis (as shown on ABAG maps). Understanding potential responses of specific components of the transportation system (e.g., bridges, roadways, and airports) in the southern San Francisco Bay region requires local, site-specific assessments of potential geologic hazards and of seismic characteristics of the components themselves. Answers to the questions posed above will enable much better assessment of where and how much damage is likely to occur to transportation systems in the southern Bay Region. In addition, this information will assist in calculating the

probability of a large earthquake occurring on the fault system during the lifetime of extant transportation facilities.

Related Publications

Hitchcock, C. S., Kelson, K. I., and Thompson, S. C., 1993, Geomorphic analyses of late Quaternary range front deformation, northeastern margin of the Santa Cruz Mountains, California [abstract]: EOS (Supplement), American Geophysical Union, 1993 Fall Meeting, v. 74, no. 43, p. 433.

Hitchcock, C. S., Kelson, K. I., and Thompson, S. C., 1994, Geomorphic investigations of deformation along the northeastern margin of the Santa Cruz Mountains: U.S. Geological Survey Open-File Report 94-187, 52 p., 2 plates.

Hitchcock, C. S., and Kelson, K. I., 1994, Geomorphic signatures of potentially active "blind" reverse faults: Comparison of Santa Clara and San Fernando Valleys [abstract]: EOS (Supplement), American Geophysical Union, 1994 Fall Meeting, v. 75, no. 44, p. 682.

Hitchcock, C. S., and Kelson, K. I., 1999, Growth of late Quaternary folds in southwest Santa Clara Valley, San Francisco Bay Area, California; Implications of 'triggered slip' for seismic hazard and earthquake recurrence: *Geology*, manuscript accepted for publication (in press).