



# DEPARTMENT OF CONSERVATION

*Managing California's Working Lands*

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## CALIFORNIA GEOLOGICAL SURVEY PROGRAM PLACES QUAKE INSTRUMENTS AT BAY AREA HOSPITAL, OFFICE BUILDING

SACRAMENTO – The California Geological Survey (CGS) has expanded its inventory of seismic instruments in the Bay Area to help enhance public safety during earthquakes. The locations include a new San Francisco office building and a Castro Valley hospital. These “accelerographs” are not an early warning system, but instead collect data about the response of buildings and structures to ground motion. After an earthquake, the information – used to improve public safety, and help emergency responders and local planners – is transmitted from the instruments to central computers at headquarters in Sacramento.

“The information we gather with these instruments ultimately can help make structures better able to withstand damaging earthquakes, which are infrequent but inevitable in California,” said Dr. John Parrish, the State Geologist of California and chief of CGS.

CGS’s Strong Motion Instrumentation Program (SMIP) recently completed the installation of 19 instruments in a new building at Sutter Health’s Eden Medical Center in Castro Valley. Currently, SMIP is also placing a “free field” accelerograph nearby to measure ground response to hard shaking.

“This is an important place for our instruments for several reasons,” said Dr. Anthony Shakal, head of SMIP. “First, because hospitals are such important parts of the infrastructure, and built to special standards, we want to instrument as many as we can. Second, this particular hospital campus is located half a mile from the Hayward Fault, and we’re trying to improve the density of instruments near that fault. Finally, the building seismic design type – steel braced frame atop a concrete shear wall – is unusual. We try to instrument as wide a variety of construction types as we can.”

SMIP had no hospitals instrumented at the time of the Loma Prieta earthquake in 1989. Now, fifty hospitals are instrumented up and down the state. SMIP is wrapping up sensor installation at a hospital in Escondido and next spring will be working at a county owned hospital in San Jose.

SMIP also is installing 24 instruments at the Public Utilities Commission building at 525 Golden Gate

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## **SMIP Places Seismic Instruments in Bay Area 2-2-2**

Avenue in downtown San Francisco, near City Hall. The award-winning 13 story building, being built by the city's Public Works Department, is designed to the latest seismic standards and is also a "green" building. It includes a built-in wind turbine to generate energy. There is a seismic sensor near the turbine itself.

"Two of the most damaging earthquakes in California history affected San Francisco," Shakal noted. "Clearly, the more we know about how shaking impacts the city's buildings and infrastructure, the more help we can provide to ensure that San Francisco is well prepared for future large earthquakes."

Other Bay Area SMIP projects either underway or planned in the near future include:

- ◆ The installation of 72 accelerographs – with 36 coming from the U.S. Geological Survey in a cooperative project -- at the One Rincon Hill Tower next spring. SMIP personnel are in the process of marking the final locations for instruments in the landmark 60-story building so the actual sensor installation can begin.

- ◆ Work on the new Bay Bridge continues as construction work proceeds. SMIP has 73 instruments operational on the Skyway section of the bridge and is gathering data from those. In total, more than 200 accelerographs will be placed on the span.

- ◆ This spring, SMIP plans to install instruments on both ends of the Dumbarton Bridge, which connects Fremont to Menlo Park. The bridge's piles go into soft mud, and a set of four instruments will be placed near each end, with the instruments spaced vertically from the surface to 300-foot depth. As Caltran's retrofitting work allows, new seismic instruments will replace the 30-year-old units on the bridge itself.

- ◆ Also on the horizon: work at the new Devil's Slide tunnel near Pacifica (SMIP already has marked instrument locations); the fourth Caldecott tunnel through the Oakland Hills (the tunnel "breakthrough" – when the east and west sides met – occurred Nov. 29); the Antioch Bridge, which has old instrumentation that will be upgraded as part of a seismic strengthening process; San Francisco General Hospital (the new nine-story building is under construction, so installation is a couple of years out); and the BART transbay tube.

"The front-end work for planning the projects is extensive," Shakal said. "Deciding where the sensors should be placed is one aspect, but the real intensive part is, how do you make it happen? Wherever there's a sensor, it has to be cabled back to a recording unit. So you have to have safe access, and often conduit. You have to have power. And get it all into the plans. Finally, our folks have to get it done working around all the other contractors on the project, each of which have their own goals."

The accelerographs measure the vertical and horizontal response of buildings and soils. When activated by earthquake shaking, the devices produce a digital record from which the critical characteristics (acceleration, velocity, displacement) of ground motion can be calculated. The information gathered by

### **SMIP Places Seismic Instruments in Bay Area 3-3-3**

SMIP is processed and disseminated to seismologists, engineers, building officials, local governments and emergency response personnel throughout the state.

SMIP data has verified the performance of new types of earthquake-resistant construction, and has contributed to improved formulas in the California Building Code for calculating building vibration periods, which is vital in earthquake-resistant design.

CGS, part of the California Department of Conservation, established SMIP in 1971 after the damaging San Fernando earthquake. SMIP has installed and maintains recording instruments at more than 1,150 locations statewide, including the city halls of Los Angeles, San Francisco and Oakland, and at the State Capitol. A number of high-rises, dams and all major bridges are instrumented.

“Gathering data about how structures such as bridges, dams and hospitals react to earthquake shaking helps ensure that California’s building codes are the most effective in the world in guiding structural design so that that critical infrastructure will withstand a large earthquake,” Shakal said.

The goal of SMIP and its partners in the California Integrated Seismic Network (CISN) – the California Institute of Technology, UC Berkeley and the U.S. Geological Survey – is to have at least one instrument in every ZIP code in the state.

Within a few minutes of a large earthquake, data from the SMIP and CISN seismic instruments are used to create a “ShakeMap.” Among other things, the ShakeMap helps emergency responders determine where the highest levels of shaking have occurred and thus where critical infrastructure – such as transportation corridors and water lines – is most likely to be damaged.

SMIP data is available at the joint state-federal data center at [strongmotioncenter.org](http://strongmotioncenter.org) as well as the Department of Conservation's Web site, [www.conservation.ca.gov](http://www.conservation.ca.gov), and at [www.quake.ca.gov](http://www.quake.ca.gov). Data from many earthquakes can be viewed and downloaded conveniently for use in engineering and scientific applications. There is also information about how the public can prepare for future earthquakes.

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