USGS
science for a changing world

Reducing Earthquake Losses Throughout the United States

Southern Californians Cope With Earthquakes

For decades Southern Californians have worked to reduce their vulnerability to earthquakes. The 1994 North-ridge shock, damaging as it was, proved the value of these efforts. Yet, much more needs to be done. Scientists are preparing new maps of the earthquake shaking hazard in Southern California. Such maps help make living in the region safer by focusing efforts to strengthen existing structures and by providing guidance in building new structures.

The striking landscapes and hospitable climate of Southern California are home to more than 20 million people and vital elements of the Nation's economy. Unfortunately, the region is also laced with many active faults that can produce strong earthquakes. The best-known example is the San Andreas Fault, which runs almost the entire length of California and generates shocks as large as magnitude 8. In Southern California the last such great earthquake was in 1857. Much more frequent are smaller temblors like the 1971 San Fernando and 1994 Northridge earthquakes; both of these magnitude 6.7 quakes were very damaging.

(Click on image for a full size version - 131K)
Millions of people reside in Los Angeles and its surrounding communities. This area is laced with numerous active faults that can produce strong earthquakes. Such faults underlie most of Southern California, a region that is home to more than 20 million people and vital elements of the Nation's economy. (Photo by I.K. Curtis Services.)

For residents of Southern California, earthquakes are an unavoidable part of life. Ask someone there about the pros and cons of living in the area, and invariably the disadvantages will include earthquakes. Nonetheless, Southern Californians have learned, through experience, that it is possible to live with some measure of safety in their earthquake-prone land.

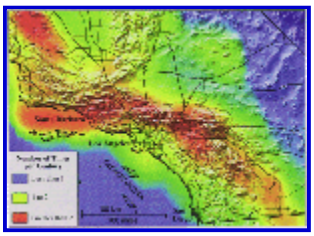

(Click on images for full size versions - 108K, 121K)
Improved construction standards help buildings survive earthquakes. The Olive View Hospital in Sylmar, California, was built in 1964 to meet the earthquake provisions of building codes in place at that time. It partially collapsed (left) in the devastating 1971 magnitude 6.7 San Fernando earthquake. Rebuilt to stricter design and construction standards, the hospital was again subjected to strong shaking in the 1994 Northridge earthquake. This quake, of the same magnitude as the 1971 quake, caused no serious damage to the rebuilt hospital (right).

Advances in engineering and earth science help Southern Californians better prepare for future temblors. New knowledge is applied to make both old and new structures safer in earthquakes. For example, analyses of

damage in past earthquakes have prompted increasingly strict standards of design and construction. The benefits of more stringent building codes were seen in the Northridge quake; structures built to recent standards generally survived with little or no damage.

Older structures that have not been strengthened to meet recent seismic design codes, in particular unreinforced masonry buildings, are the most serious safety threat in earthquakes. Recognizing this danger, the City of Los Angeles began strengthening such buildings in the early 1980's. More than 6,000 had been reinforced when the 1994 Northridge shock hit. This one program undoubtedly prevented substantial loss of life and property in that temblor.

Further efforts to reduce the risk from earthquakes in an effective and practical way requires knowledge of the level of hazard in different areas. Future earthquakes are most likely to originate where energy along a fault has built up and has not yet been released in earthquakes. Studies supported by the National Earthquake Hazards Reduction Program enable scientists to evaluate the hazard level in different areas. In Southern California, scientists estimate that the probability of a magnitude 7 or greater earthquake by the year 2024 is as high as 80 to 90%.



(Click on image for a full size version - 115K)
This new earthquake hazard map of Southern California shows the expected number of times per century that bedrock shaking from earthquakes will be strong enough to cause damage. Most of the Los Angeles metropolitan area can expect a minimum of 1 to 2 damaging shocks per century; some neighboring areas can expect 3 or more. Because this map refers to shaking on bedrock and does not account for increases in shaking on soft ground, it underestimates the number of times per century that damaging shaking is likely in basins and valleys. Areas of cool colors on the map are not necessarily "safe", as damaging earthquakes can occur occasionally even there.

How the threat from earthquake ground shaking varies across Southern California is shown on a new hazard map. This map, derived from decades of work by scientists in government, universities, and private industry, shows how often any location in the region is likely to experience earthquake shaking strong enough to inflict damage. The map was prepared by the Southern California Earthquake Center, a consortium funded largely by the U.S. Geological Survey and the National Science Foundation.

Such maps of expected earthquake shaking help those responsible for public safety decide where actions to reduce future earthquake losses will be most effective. For example, these maps help the California Department of Transportation (Caltrans) decide which bridges should have priority for seismic strengthening. In the years between the 1971 San Fernando and the 1994 Northridge earthquakes, Caltrans reinforced more than 100 freeway overpasses in Los Angeles and Ventura Counties. Not one of these reinforced freeway overpasses failed in the 1994 shock, whereas seven unreinforced spans in the same area collapsed. These positive results have led Caltrans to step up the pace of this program-they are convinced that every dollar spent on seismic reinforcements will save many dollars by averting future losses. Another 700 bridges and overpasses in the two counties are scheduled for strengthening by the end of 1997.

(Click on images for full size versions - 79K, 66K)
Hazard maps help the California Department of Transportation (Caltrans) decide which freeways should have priority for seismic strengthening. The Interstate 5/Route 14 interchange, north of Los Angeles, was one of only seven overpasses to collapse in the devastating 1994 Northridge earthquake. This low number of failures resulted from a vigorous program of freeway reinforcement undertaken by Caltrans following the 1971 San Fernando earthquake. Since 1994, Caltrans has accelerated its program of seismic reinforcement. At right a Cal-trans worker welds a steel jacket around a concrete column to strengthen an overpass.

As well as guiding such seismic strengthening projects, earthquake hazard maps are used by engineers in designing earthquake-resistant structures, by planners in establishing wise land-use policies, by emergency managers for drawing disaster response plans, and by insurance experts for analyzing risks and loss exposure. Furthermore, the data underlying the maps are used by engineers to assess specific hazards at particular sites and develop safe design solutions.

Earthquakes may be inevitable, but earthquake disasters are not. Scientists and engineers are continuously working to understand earthquake hazards better. This improved knowledge helps guide steps to reduce future earthquake losses. The result is that residents of Southern California and other seismically active areas of the United States can live with greater peace of mind in earthquake country.

Kenneth W. Hudnut, James J. Mori, William H. Prescott, and Peter H. Stauffer

COOPERATING AGENCIES, COMPANIES, AND INSTITUTIONS
California Department of Transportation California Division of Mines and Geology California Institute of Technology City and County of Los Angeles Columbia University National Science Foundation Southern California Earthquake Center University of California, Los Angeles University of California, Santa Barbara University of California, San Diego University of Southern California

For more information contact:
Earthquake Information Hotline (650) 329-4085
U.S. Geological Survey, MS 977
345 Middlefield Road, Menlo Park, CA 94025
USGS Menlo Park Earthquakes Home Page

U.S. Geological Survey Fact Sheet-225-95, March 1995
URL of this page: http://pubs.usgs.gov/fs/1995/fs225-95/

Web created by Will Prescott, April 9, 1996 Modified by Miie Diggles May 9, 2005