Learning from Earthquakes

CSMIP Issues Strong-Motion Data from South Lake Tahoe Earthquake of September 12, 1994

CSMIP stations in the vicinity of the September 12, 1994, earthquake located southeast of Lake Tahoe.

The California Strong Motion Instrumentation Program (CSMIP) has issued strong-motion data recorded during the magnitude 6.1 earthquake that occurred near the California-Nevada border about 32 km southeast of South Lake Tahoe on September 12, 1994. The preliminary hypocenter is located at 38.82 N, 119.64 W with a shallow depth near 5 km.

Data from five stations, ranging in epicentral distance from 14 to 163 km, is included in the release. The largest horizontal ground acceleration

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News of the Profession

Ray Clough Wins National Medal of Science

Ray W. Clough, a retired University of California, Berkeley, structural engineering professor who developed some of the major tools used today by engineers to analyze and design large, complex structures to withstand earthquakes, is one of eight new recipients of the National Medal of Science.

Clough now lives in Sunriver, Oregon, with his wife Shirley. He will join other scientists and engineers receiving the medal, the nation’s highest scientific honor, in a ceremony at the White House later this year.

Clough, who retired in 1987, holds the title of Nishkan Professor of Structural Engineering emeritus in the Department of Civil Engineering at UC Berkeley. He is a member of both the National Academy of Sciences and the National Academy of Engineering.

Clough was the key figure in developing the so-called finite-element method used in the design of bridges, buildings, and nearly all types of structures. The method allows a more accurate calculation of the forces and stresses on each piece or “finite element,” as compared with earlier methods that modeled structures as combinations of one-dimensional beams and columns, like Tinker Toys.

“One-dimensional elements are good for simple buildings constructed of beams and columns, but as soon as you try to model a gravity dam, there is no way you can approximate it as an assemblage of one-dimensional elements,” Clough said. The development revolutionized the analysis and design of all types of structures, ranging from high-rise buildings and suspension bridges to airplanes and oil pipelines.

“Clough’s contributions have had extraordinary influence on the development of modern engineering analysis, design, and practice,” said friend and colleague Alex Scordelis, professor emeritus of structural engineering. “The methods he developed have been extended to many other fields of engineering as a way to analyze complex systems.”

“The finite-element method is the most important development in engineering analysis since the advent of digital computers,” said Scordelis.

Clough also was a pioneer in earthquake engineering and the dynamic analysis of structures, a new field in the 1950s. He and colleague Joseph Penzien were instrumental in setting up the Earthquake Engineering Research Center at Berkeley in 1967, and Clough served as its second director from 1973-77.

His seismic design recommendations have been included in building codes around the world. Among the buildings for which he performed a dynamic analysis before construction was the Transamerica pyramid in San Francisco.

As an expert on dams, Clough has traveled the world consulting on dam projects. He also worked with UNESCO to survey earthquake damage around the world. He was awarded the Berkeley Citation, the university’s highest honor for a faculty member, on his retirement in 1987.


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recorded was 0.09 g in Woodfords, about 16 km southwest of the epicenter. The largest acceleration recorded in a structure was 0.35 g at the crest of a small earth dam at Indian Creek Reservoir, about 14 km southwest of the epicenter.

Files of the processed data are available on the Internet. They are in the directory pub/csmip_eq_data at ftp.netcom.com by anonymous ftp. The report is CSMIP Report OSMS 94-19.

CSMIP Reports on Strong-Motions Recorded During Offshore Eureka Quake, September 1, 1994

A magnitude 6.8 earthquake occurred on September 1, 1994 approximately 145 km west of Petrolia, California, beneath the Pacific Ocean. The strike-slip earthquake probably occurred along the Mendocino Fracture Zone. Strong-motion records from three CSMIP stations are available in CSMIP Report OSMS 94-18. Two ground response stations, at Cape Mendocino and Shelter Cove, are included. (Cape Mendocino had the very high acceleration during the April 1992 earthquake.) The third record is for a Caltrans bridge near Eureka.

The early processing and release of these data take advantage of new developments in instrumentation and communications. Files of the processed data are on the Internet, in directory pub/csmip_eq_data on ftp.netcom.com by anonymous ftp.