EARTHQUAKE ENGINEERING RESEARCH INSTITUTE

NEWSLETTER

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Tsunami Hits Nicaraguan Coast

An earthquake ($M_s = 7.0$) 200 miles off the Pacific coast of Nicaragua occurred on September 2, 1992 at 00:16:01 UTC (local time September 1, 1992 at 6:16 PM), and generated a destructive tsunami. The National Earthquake Information Center reported the epicentral coordinates of the earthquake as 11.8 N and 87.4 W. Numerous smaller magnitude earthquakes followed.

The tsunami, rather than the shaking, caused loss of property and approximately 200 lives along the coastal areas of Nicaragua. In addition, approximately 500 injuries requiring treatment were reported. The local coastal economy, which relies on fishing, tourism, and harbor activities, was severely disrupted. An ancillary impact of the tsunami was an outbreak of cholera in villages where the water supply (wells) was contaminated.

Nicaragua has a history of earthquakes and other natural disasters. A December 23, 1972 earthquake leveled the Nicaraguan city of Managua (EERI Reconnaissance Report, May 1973). Tsunamis have been recorded in Nicaragua in 1859, 1919, 1950, and 1956.

With support from AID/OFDA,

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News of the Institute

EERI Dispatches Team to Investigate Quake Damage in Egypt

EERI has sent a team of four U.S. scientists and engineers to investigate the effects of the October 12th earthquake. Centered about 20 miles southwest of Cairo and lasting 20 seconds, this was the strongest quake on record so close to Cairo.

The EERI team is led by Nabih Youssef, Nabih Youssef & Associates (Structural Engineer). Other members include: Samy Adham, Agbabian Associates (Structural Engineer); Mehmet Çelebi, U.S. Geological Survey (Strong Motion Instrumentation); and Josephine Malilay, Centers for Disease Control (Epidemiologist).

As of October 21, 557 people were reported dead and almost 10,000 injured. While collapsed buildings and falling debris caused most of the deaths and injuries, there were also reports of deaths and injuries, particularly among school children, due to trampling in the panic that followed the quake.

Thousands of buildings are reported as destroyed or badly damaged. Most of the collapsed structures were old, poorly maintained stone or mud brick masonry. However, several modern multi-story buildings also collapsed in the quake and aftershocks.

National Earthquake Hazards Reduction Program

USGS Issues First Volume of Planned Loma Prieta Series

The first publication in a planned 24 volume series on the 1989 Loma Prieta earthquake has been issued by the U.S. Geological Survey. The report provides a comprehensive technical summary of the effects of the magnitude 7.1 earthquake in the Marina District of San Francisco. Subjects range from geologic conditions to evaluations of the behavior of the Marina District's seawalls during the earthquake.

Although the report is being published by the USGS, many of its contributors are scientists from other government and academic institutions. Publication of the Marina District report and those to follow is a jointly sponsored effort of the USGS and the National Science Foundation. The entire series will comprise the official report of investigations of the Loma Prieta earthquake.

The report, *The Loma Prieta, California, Earthquake of October 17, 1989 - Marina District*, was published as USGS Professional Paper 1551-F. It is available for purchase for $13 at the USGS Earth Science Information Center at 345 Middlefield Road, Menlo Park, or by mail from USGS Book and Report Sales, Box 25425, Denver, CO 80225. Orders must specify the name and number of the report (PP 1551-F) and include checks or money orders payable to the Dept. of the Interior - USGS.

NSF Publishes Lifeline Proceedings

The National Science Foundation has announced that a limited number of copies of *Proceedings of the 4th US-Japan Workshop on Earthquake Disaster Prevention of Lifeline Systems* are available. For a free copy, send a self-addressed label to: Ms. Sherri Swann, NSF, 1800 G Street NW, Room 1132, Washington, DC 20550.

Nicaragua, cont.

NSF, and EERI, a team of nine engineers and scientists was dispatched to investigate the effects of the earthquake and tsunami. The team members included M. Çelebi, team leader (USGS), A. Aburto (U. Neveda), J. Bourgeois (U. Washington and NSF), F. Gonzalez (NOAA), D. Harlow (USGS), J. Preuss (Urban Regional Research), K. Satake (U. Michigan), C. Synolakis (USC) and H. Yeh (U. Washington).

Eyewitness reports of wave heights varied from 3-4 m to 15 m. Most people interviewed did not feel ground shaking. Many people in more than one location indicated that they saw a "flashing light" before the tsunami struck. Those who reported feeling ground shaking stated that the flashing light occurred after the earthquake.

There are no strong-motion records available from this earthquake because the network deployed in the early 1970's with USGS cooperation was left to deteriorate during the 1980's. Reconnaissance surveys reveal that ground shaking was not a damaging factor in this event. Almost all of the observed damage appears to have been the result of the tsunami. The level of inundation and the height of waves were visible in almost all coastal areas. Tidal wave gauges in Corinto recorded the arrival of the tsunami.

Typical construction on the coast consists of single or two-story buildings of timber construction or a mixture of materials, including unreinforced brick or stone masonry and lightly reinforced concrete frame construction with masonry infill walls. Some steel construction exists, particularly in port facilities. Most of the structures that were damaged were substandard and not engineered. Well-built homes and planned resorts constructed with better quality material were either not damaged or lightly damaged.

The largest port, Corinto, was not damaged because of a natural geological barrier island and the shape of the bay. To the south, the unique half-moon shape of the San Juan del Sur, with cliffs on one side, resulted in focusing of wave energy.

The tsunami also damaged coastal roads, which hindered the arrival of response teams. There is no continuous coastal highway; access to coastal communities is typically along roads radiating from regional cities. These roads range from all-weather hard surface highways to loose surface roads and cart tracks, usable only in dry weather. Communities serviced by unpaved roads were the most severely cut off, with first assistance reaching some communities only 36 to 48 hours after the event.

Submitted by M. Çelebi and J. Preuss.