Learning from Earthquakes

EERI LFE Team on Bhuj Recovery Issues

Recognizing that the recovery phase holds many important observations and lessons for the global earthquake engineering community, EERI's Learning from Earthquakes Committee has initiated the first in a series of reconnaissance missions focusing on observations of the post-earthquake recovery process. A multidisciplinary team was asked to investigate rebuilding following the Bhuj, India, earthquake of January 2001. Taking advantage of a small invitational workshop held last month by the government of Gujarat on earthquake reconstruction practices in several countries, a team was put together under the leadership of C. V. R. Murty, professor of structural engineering at the Indian Institute of Technology (IIT), Kanpur. Team members included Marjorie Greene, EERI (urban planner); Sudhir K. Jain, IIT Kanpur (structural engineer); Vipul V. Mehta, Bhuj (consulting structural engineer); and N. Purendra Prasad, University of Hyderabad (social anthropologist). Team members included those familiar with earthquake engineering in India as well as the government of Maharashtra's rebuilding experience.

The reconstruction program for this earthquake holds many important lessons for the United States as well as other countries, particularly with regard to the management of a large rebuilding effort spread over a vast geographic area. An emphasis on mitigation and future disaster preparedness, advances in the use of information technology, innovative planning techniques for rebuilding in urban areas, and creative strategies for involving citizens in their rebuilding are among the relevant lessons emerging from this earthquake.

The 2001 Bhuj, India, earthquake was a devastating event, causing over 13,800 deaths and 167,000 injuries, the loss or damage to 1.2 million housing units and over $4 billion in property losses. The scope and breadth of the reconstruction program are staggering. The government of the state of Gujarat quickly set up the Gujarat State Disaster Management Authority (GSDMA), with direct control over the entire rebuilding program and an explicit mandate to promote long-term disaster mitigation during the recovery phase and into the future. The GSDMA has supported the rebuilding of over 200,000 housing units and the repair of another 900,000. In most cases, owners have participated actively in the rebuilding, assisting in the design and construction of their homes. In 20% of the cases, partnerships between nongovernmental organizations and the government have rebuilt the housing. Little construction work has been done by government agencies themselves. Over 1,000 materials banks were established to supply cement and steel at subsidized prices. The GSDMA has brought in technical assistance to help in the rebuilding process, focusing in particular on promoting earthquake-resistant technology by providing training to almost 30,000 masons and 6,200 engineers. Much of this information can be tracked on the GSDMA web site, where many statistics and other background documents for the project are available (**www.gsdma.org**).

Four towns with substantial damage in the earthquake are developing new town and development plans that will include adjusting property lines and developing a more accessible road system. Even while facing pressures to rebuild quickly, the government is taking the additional time needed to develop these plans in a thoughtful manner. A pilot project has been developed in Bhuj to allow citizens access to information on the earthquake rehabilitation process through interactive computers at several kiosks around the city. A major change in India is taking place in giving greater priority to seismic safety on the national agenda. The central government, the government of Gujarat, and the academic and practicing engineering communities are beginning discussions that will result in higher standards of seismic safety and changes in codes and practice. Social science academics are stimulating discussion on models of disaster recovery and the relationship between earthquake recovery and ongoing development.

A full report from the reconnaissance team documenting its observations on this major reconstruction program will be available in a few months and sent to all EERI members. Further information can be obtained by contacting EERI's LFE Program Manager Marjorie Greene at **mgreene@eeri.org**.

8.3 Earthquake near Hokkaido

The following report was provided by Professor Scott Ashford of the Department of Structural Engineering at the University of California, San Diego. He was joined by his Ph.D. student, Yohsuke Kawamata, who is associated with Japan's Port and Airport Research Institute (PARI). Their trip, consisting of five days on the ground and covering 1,200 km, was funded by EERI's Learning from Earthquakes Program.

A magnitude 8.3 shallow earthquake struck at 4:50 a.m. local time Friday, September 26, 2003, about 60 km offshore from Hokkaido, Japan. The closest city to the epicenter (41.827 N, 143.83 E, depth of focus 33 km) was the port of Tokachi. The focal mechanism and preliminary location of this earthquake indicate that it resulted from thrust faulting on the plate interface between the overriding North American plate (which extends into the northeast corner

continued on page 5

Hokkaido Earthquake

continued from page 4

of the Eurasian landmass) and the subducting Pacific plate. The Pacific plate is moving west-northwest at a rate of about 8.2 cm per year relative to the North American plate. The recent earthquake appears to have involved rupture of the same section of the plate interface that ruptured in 1952.

The lack of damage, considering the strong recorded ground motions (as high as 0.9g in Hiroo), was surprising. Liquefaction occurred over a broad geographic area, but was localized and almost exclusively limited to man-made fills. Even for the dozens of uplifted manholes, only the backfill around the pipe liquefied, not the adjacent soil. A series of liquefaction-induced ground failures were observed in a farming area covering one km^2. One of these failures expelled 5,000 to 10,000 m^3 of sand.

Port facilities performed well, with the exception of Pier 4 in Kushiro. Structural damage to bridges and buildings was isolated but covered a broad area. For the most severely damaged bridges (all of which were still in operation), it appeared that the relative movement between spans was greater than that designed for, resulting in some bearing or key damage.

For lifelines, the damage appeared to be concentrated in storm sewers and some sanitary sewers. A few telephone poles were tilted, but still functioning. In one case a manhole was being bypassed by pumping. The damaged storm drains may cause trouble during the next rainy season.

There was concern among the Japanese that coastal evacuations after the tsunami warnings were not taken seriously. The evacuation rate was only about 50%. To see photos of damage caused by this event, visit **www.eeri.org/lfe/japan.html.**

Publications

International Handbook of Earthquake and Engineering Seismology

The *International Handbook of Earthquake and Engineering Seismology* is a new reference book published by the International Association of Seismology and Physics of the Earth's Interior (IASPEI) in collaboration with the International Association of Earthquake Engineering (IAEE).

IASPEI appointed a committee on education in 1995 "to promote sharing of seismological knowledge worldwide and transferring of technology to developing countries, and to ensure the continuation and coordination of training courses." One of the committee's activities was to prepare a reference book that summarizes present knowledge about earthquake and engineering seismology as a whole. In order to foster more communication between seismologists and earthquake engineers, IAEE accepted the invitation to collaborate in the preparation.

The aims of the *Handbook* are to (1) summarize the well-established facts, (2) review relevant theories, (3) survey useful methods and techniques, (4) summarize the historical development and current status of seismology and earthquake engineering, (5) document and archive some basic seismic data, and (6) include computer readable files of some important publications of seismology and earthquake engineering.

The *Handbook* (published in 2002 and 2003) consists of two printed volumes (Parts A and B) of nearly 2,000 total pages and three CD-ROMs containing supplementary materials that are equivalent to about 1,000 books. It is intended as a general reference on earthquake and engineering seismology, and also as a comprehensive resource library for anyone interested in earthquakes and related subjects.

EERI contributed an institutional report and granted permission for the *Handbook* to include seven EERI monographs, the *Proceedings of the First World Conference on Earthquake Engineering,* and a special issue of *Earthquake Spectra* as computer readable files on CD-ROM #2.

The *Handbook* was edited under a team of four general editors (C. Kisslinger and EERI members P. C. Jennings, H. Kanamori, and W. H. K. Lee). More than 2,000 scientists and engineers from over 60 countries participated. The printed volumes have 90 chapters under 11 sections: (1) History and Prefatory essays, (2) Theoretical Seismology, (3) Observational Seismology, (4) Earthquake Geology and Mechanics, (5) Seismicity of the Earth, (6) Earth's Structure, (7) Strong-Motion Seismology, (8) Selected Topics in Earthquake Engineering, (9) Earthquake Prediction and Hazards Mitigation, (10) National and International Reports: Seismology and Earthquake Engineering, and (11) General Information and Miscellaneous Data.

Frank Press, president emeritus of the U.S. National Academy of Sciences, praised the *Handbook* as "monumental in scope, authoritative in treatment, and historic in impact," and as "...the most important source book for seismology and its applications for years to come. This is one of those exceptional books that libraries and professionals ... cannot do without."

The *Handbook* was published in two parts by Academic Press. Each part has a list price of US$150, and can be purchased separately. For more information, visit the Academic Press web site at **books.elsevier.com.**