

MCEER Teams with NCREE in Taiwan Reconnaissance Effort

In the early morning hours of September 21, 1999, a devastating earthquake struck the central region of Taiwan. This earthquake became known as the 921 earthquake or the "Ji-Ji" or "Chi-Chi" earthquake. The magnitude of the 921 earthquake was $M_s = 7.7$ (according to the USGS National Earthquake Information Center) or $M_L = 7.3$ (the system used in Taiwan). There were 10 aftershocks greater than magnitude 6. Of these, an $M_L = 6.8$ occurred about 30 hours and 120 hours after the main shock, respectively. An $M_L = 5.3$ aftershock was recorded as long as 260 hours later causing collapses of already damaged structures. As of October 8, the death toll stands at more than 2,350. Over 8,700 people were injured, and dozens remain missing. Approximately 10,000 buildings/homes collapsed and over 7,000 more were damaged.



Shortly after the earthquake, MCEER contacted fellow researchers at the [National Center for Research on Earthquake Engineering \(NCREE\)](#) at the National Taiwan University. The two centers have had a cooperative research agreement since 1995, and discussions focused on how to best learn from the 921 earthquake. It was decided to conduct a workshop, where researchers could identify important short-term strategies/actions for post-earthquake restoration and research needs, and develop specific cooperative projects for investigators from both centers to work as teams based on the 921 experience.

The workshop, which took place on October 3-5, 1999 in Taiwan, began with a briefing led by Professor Loh and colleagues about the earthquake. This was followed by a brief presentation by Paul Flores, EQE, on short-term restoration strategies follow-



Workshop attendees listened to Kobe's experience with short-term restoration strategies.

ing the Northridge earthquake and by Mr. Tomio Saito, Director of Hyogo Prefecture in Japan, on Kobe's experience with short-term restoration strategies. The group then began its reconnaissance mission with a visit to Taichung. The next day was dedicated to reconnaissance, with MCEER and NCREE investigators paired together to focus on specific areas.

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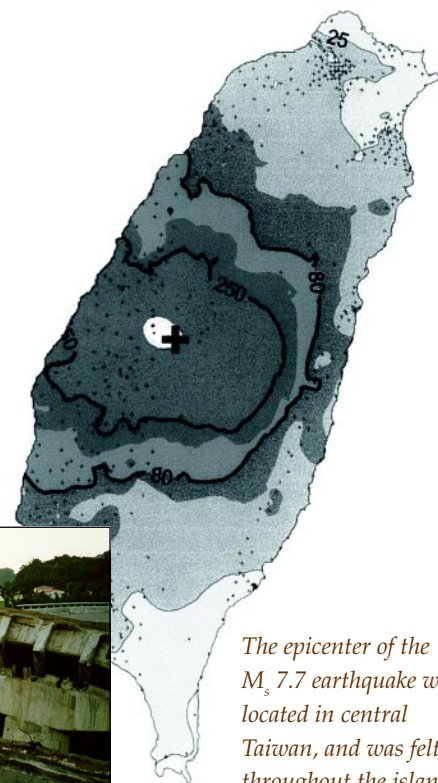
The 921 Taiwan Earthquake (cont'd)

On the third day, participants made brief presentations concerning their field observations, discussed the mechanics of authoring reconnaissance reports, and identified additional individuals to contribute to the reports. Their preliminary reports are available on our web site at <http://mceer.buffalo.edu>. The web site also includes a link to EQNet, which provides a one-stop page integrating many Internet sites related to the 921 earthquake. A more substantial reconnaissance report will be published early next year. This report will be jointly prepared by the reconnaissance team members and invited authors, from both MCEER and NCREE. The MCEER contributors include:

- George C. Lee, *Director, MCEER and the University at Buffalo*
- Michel Bruneau, *Deputy Director, MCEER and the University at Buffalo*
- Ian G. Buckle, *University of Nevada-Reno*
- Stephanie E. Chang, *University of Washington and EQE International*
- Paul J. Flores, *EQE International*
- Thomas D. O'Rourke, *Cornell University*
- Masanobu Shinozuka, *University of Southern California*
- Tsu T. Soong, *University at Buffalo.*

The NCREE Contributors include:

- Chin-Hsiung Loh, *Director, NCREE and the National Taiwan University*
- Kuo-Chun Chang, *National Taiwan University*
- Zhe-Jung Chen, *National Central University and Center for Space and Remote Sensing Research*
- Jenn-Shin Hwang, *National Taiwan University, NCREE*
- Meei-Ling Lin, *National Taiwan University*
- Gee-Yu Liu, *NCREE*
- Keh-Chyuan Tsai, *National Taiwan University*
- George C. Yao, *National Cheng Kung University*
- Chin-Lien Yen, *National Taiwan University, Office of National Science and Technology Hazard Mitigation.* ❖



The epicenter of the M_s 7.7 earthquake was located in central Taiwan, and was felt throughout the island.



MCEER's reconnaissance team, from left, Paul Flores, Larry Soong, George Lee, Stephanie Chang, M. Shinozuka and Thomas O'Rourke. Michel Bruneau and Ian Buckle are not pictured.



The Shiu-Tuan Hospital, the largest in Nantou County, was forced to close following the earthquake due to extensive damage.



There were many examples of building failures due to soft first stories.



Newly constructed buildings suffered severe damage.

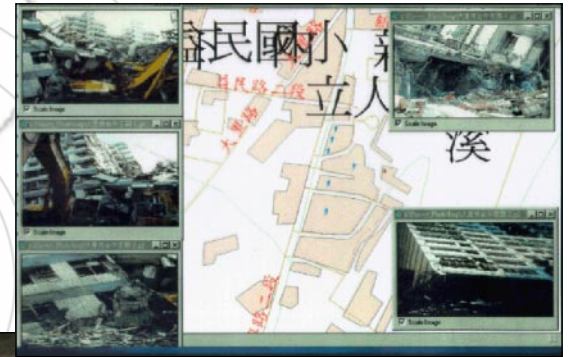


The 921 Taiwan Earthquake (cont'd)

Tilting of Pier 2 and subsequent collapse of three spans of the Shiwei bridge (Route 3).



The Office of the National Science and Technology Program for Hazard Mitigation in Taiwan combined a GIS map with post-earthquake aerial photos of the damaged area to support search and rescue and emergency response activities.



Surface faulting caused major damage to the Shih-kang Dam.

A stadium in Taichung City was used as an emergency staging area.



T. Atsumi, Osaka University



T. Atsumi, Osaka University

Urban search and rescue operations dominated the initial emergency response.