

## NEHRP Sets Discovery in Motion

Workshops Chart Paths for Learning from 2010 Earthquakes in Chile and Haiti

The magnitude 7.0 temblor that struck Haiti on January 12, 2010, was among the deadliest earthquakes in recorded history, while the magnitude 8.8 event that occurred in Chile on February 27, 2010, was among the most powerful. The lessons of these extreme events can be discovered through targeted, coordinated research in the physical sciences, social sciences, and engineering. The agencies participating in the National Earthquake Hazards Reduction Program (NEHRP) have begun this process of discovery.

The Federal Emergency Management Agency (FEMA), National Science Foundation (NSF), National Institute of Standards and Technology (NIST), and U.S. Geological Survey (USGS) have each participated in or supported field reconnaissance associated with one or both of the earthquakes in Haiti and Chile. As described below, NSF and NIST have also sponsored workshops, with participation from FEMA and USGS, focused on research needs and opportunities arising from these two major seismic events.

### NSF Workshops Guide Fundamental Research

NSF sponsored separate workshops on the Chile and Haiti earthquakes; with major differences between the environments in which they occurred, these two events produced very different effects and offer differing lessons. The workshops were intended to identify and focus the attention of researchers on the most pressing and promising basic-research priorities emerging from each disaster.

Both workshops were planned and conducted by the Earthquake Engineering Research Institute (EERI). The Chile Research Needs Workshop, held at NSF on August 19, 2010, brought together more than 40 U.S. and Chilean researchers and other earthquake risk reduction experts and stakeholders from government and industry.

Finding that the 2010 Chile earthquake “was a landmark event in which the largest earthquake ever recorded by scientific instruments affected a vast populated region containing natural, built, and social systems representative of those in the United States,” the participants concluded that



Residential area in Port-au-Prince, Haiti, following the magnitude 7.0 earthquake of January 12, 2010, which is estimated to have killed more than 222,000, injured 300,000, and displaced 1.3 million people.<sup>1</sup> Photo courtesy of Anna Lang, University of California, San Diego.

this event was “arguably the most important earthquake in the past two decades from which to learn.”<sup>2</sup> They outlined focused research that could take timely advantage of the lessons made available by the disaster. Their recommended priorities for study included

- how earthquake shaking affected the many buildings designed under modern building codes comparable to those used in the United States, and how the results of this real-world test can improve seismic design and construction codes, standards, and practices;
- the ground motions recorded during the earthquake and their attenuation by distance, regional geology, and local site conditions, and how these data can advance ground-motion simulation methodologies;
- the plate subduction mechanism and its effects, and their implications for understanding and preparing for the large earthquake expected in the Cascadia subduction zone of the U.S. Pacific Northwest;
- the sources, characteristics, and effects of the tsunami generated by the earthquake, and the translation of this information into vitally needed improvements in tsunami hazard assessment and risk mitigation; and
- how ground failures produced by the quake impacted the built environment, and how these findings can advance geotechnical earthquake engineering.

<sup>1</sup> USGS. “Magnitude 7.0—Haiti Region: Earthquake Summary,” [earthquake.usgs.gov/earthquakes/eqinthenews/2010/us2010rja6/#summary](http://earthquake.usgs.gov/earthquakes/eqinthenews/2010/us2010rja6/#summary).

<sup>2</sup> EERI. “The 27 February 2010 Central South Chile Earthquake: Emerging Research Needs and Opportunities,” November 2010, p. 2–3, [www.eqclearinghouse.org/20100227-chile/wp-content/uploads/2010/11/Chile-Workshop-Report\\_FINAL.pdf](http://www.eqclearinghouse.org/20100227-chile/wp-content/uploads/2010/11/Chile-Workshop-Report_FINAL.pdf).

The Haiti RAPIDs and Research Needs Workshop, held at NSF on September 30 and October 1, 2010, featured initial findings from research supported under NSF's Rapid Response Research (RAPID) funding mechanism and other NSF-supported field reconnaissance awards. Researchers described their projects and heard perspectives on research needs and opportunities presented by Haitian researchers and by U.S., Haitian, and international agencies and organizations that are using or supporting research related to the 2010 Haiti earthquake.

The participants' recommendations about future research priorities were shaped by the earthquake's immense toll in lives and property and by Haiti's status as a developing nation with limited resources. As in many other such countries, the built environment in Haiti is highly vulnerable to earthquakes and other hazards. Research is needed to develop methods of identifying and targeting resources to the most vulnerable and essential buildings and infrastructure, and methods of cost-effectively retrofitting and building structures to make them more resistant to earthquakes and other hazards. This, in turn, will require more knowledge about the earthquake hazard in Haiti, another subject in urgent need of research attention.

The workshop highlighted the need for approaches to earthquake mitigation, preparedness, response, and recovery that are sustainable in the developing world. In Haiti, where a prominent feature of the social environment is the presence of multilevel networks of international aid organizations, research is needed to better understand how these networks function, how they relate to indigenous resources, the factors that hamper or facilitate multi-organizational coordination, and how to involve and build capacity among local citizens, groups, and institutions.

### **NIST Workshop Focuses on Design and Construction Standards**

On June 2, 2010, more than 20 earthquake engineers from the United States and Chile met in San Francisco to discuss how U.S. and Chilean building codes, and the design and construction standards referenced by those codes, can be improved in response to the 2010 Chile earthquake. NIST organized the meeting in partnership with the

American Society of Civil Engineers (ASCE) and the Pacific Earthquake Engineering Research (PEER) Center. Participants shared observations about the effects of the Chile earthquake and discussed potential research studies that could translate these observations into improved seismic provisions for building codes and standards. They concluded by recommending 10 specific research and data-collection efforts.

NIST has already initiated several research projects, scheduled for completion in 2011, in response to these recommendations. In one, U.S. and Chilean experts are comparing the building codes and seismic design practices prevailing in both countries at the time of the 2010 Chile earthquake, so that researchers can accurately assess the implications of the disaster for U.S. codes and practices. Another project is evaluating how stairways and other elements not designed to be part of the seismic-force-resisting systems in reinforced concrete buildings affected how these structures performed in the earthquake. The results will be used to formulate rele-



Damage to Torre O'Higgins Building in Concepción, Chile, caused by the magnitude 8.8 earthquake of February 27, 2010. The quake reportedly killed at least 521, injured 12,000, and displaced 800,000 people.<sup>3</sup> Photo courtesy of Jay Harris and Jeff Dragovich, NIST.

vant changes to U.S. model building codes, as will the results of a third project, which is developing a shared, online repository for information about how buildings performed in the quake.

Additional information about the NSF workshops is available in EERI's [Chile Earthquake Clearinghouse](#) and [Haiti Earthquake Clearinghouse](#). Further information on NIST's Chile earthquake workshop is available from NEHRP at [www.nehrp.gov/library/ChileMeeting.htm](http://www.nehrp.gov/library/ChileMeeting.htm).

<sup>3</sup> USGS. "Magnitude 8.8—Offshore Maule, Chile: Earthquake Summary," [earthquake.usgs.gov/earthquakes/eqinthenews/2010/us2010tfan/#summary](http://earthquake.usgs.gov/earthquakes/eqinthenews/2010/us2010tfan/#summary).

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