Applied Technology Council
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Advancing Engineering Applications for Hazard Mitigation
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Chilean Earthquake of February 27, 2010
ATC Team Initial Observations

The Applied Technology Council (ATC) is a non-profit organization, headquartered near San Francisco, California, and founded in 1973 to conduct studies to advance earthquake and structural engineering practice.

The four-person ATC team of earthquake and structural engineers arrived in Chile on March 28, 2010 and ended its trip on April 3, 2010. The purpose of the trip was to observe the effects of the recent magnitude-8.8 earthquake on buildings, with the goal of developing new information that can be used to improve engineering practice and perhaps revise and update the engineering guidelines and applications, including guidance on emergency response, that ATC has developed to date.

Our trip included brief visits to Santiago, Rancagua, San Fernando, Nancagua, Santa Cruz, Peralillo, Poblacion, Pumanque, Lolol, Curico, Talca, Constitucion, Chanco, Pelluhue, Concepcion, Talcahuano, and Vina del Mar. We met with several engineers, observed damaged and undamaged buildings, and, in some communities, in terviewed local citizens. We empathize with the losses the Chilean people have endured.

Our initial observations are as follows.

- **Extent and duration of ground shaking:** We were impressed by the geographic extent of the heavily shaken area, and thus the number of structures and people impacted by the earthquake.
- **Tsunami damage:** The tsunami that affected coastal communities caused devastating damage. We observed that nearly all of the surviving buildings in the flooded region had first story walls made of concrete.
- **Casualties:** Based on information reported to us, the tsunami and adobe building damage accounted for the majority of the casualties. Casualties in engineered buildings were a small proportion of the total.
- **Poor performance of adobe buildings and unreinforced brick masonry buildings:** The amount of damage to adobe buildings and unreinforced brick masonry buildings is very significant. Buildings with deteriorated adobe, corner buildings, and those with heavy tile roofs, particularly those with unsecured tiles, were the worst performers. The widespread damage to these types of structures poses tremendous challenges to the affected communities and to the country as a whole. These buildings represent an important national heritage. Repairing and strengthening them is a significant economic and technical challenge.
- **Good performance of engineered buildings:** Buildings composed of modern confined masonry, light weight steel buildings, and the vast majority of concrete wall buildings performed well. (We did not visit high-rise steel buildings.)

- **Significantly damaged engineered buildings:** A number of multi-story residential concrete shear wall buildings sustained significant damage and in a few cases, collapsed. These buildings need to be studied to determine the causes of damage in order to learn if changes to design, construction, and inspection practices should be implemented.
- **Nonstructural damage**: In many structures we observed significant damage to nonstructural components. In order to provide better performance, it appears that increased attention to nonstructural anchorage and bracing is needed.
- **Postearthquake safety evaluation of buildings:** Postearthquake safety evaluation of buildings appears to have been carried out by a variety of groups, with inconsistent signage providing directions to potential occupants. Developing a standardized methodology and process for postearthquake safety evaluation, with clear responsibilities and public communications, would be highly desirable.
- **Strong-motion records:** The six strong ground-motion records available to the engineering community at large (as of March 31, 2010) provide critically important information for assessing the seismic forces sustained by buildings in the vicinity of those recordings. We understand that additional records will become available from locations south of Santiago, including Concepcion, as soon as they are digitized. The Chilean population should be pleased to learn that funding and authorization have been provided to install strong-motion recording instruments at 300 free-field stations throughout the seismic regions of the country. Augmenting the existing network in this way is critically important. A country-wide network of instruments in all of the populated regions will provide improved information for seismic hazard mapping and could be used to provide instrumental intensity information to emergency response personnel, as well as the public at large, on a real-time basis. The installation of multi-channel strong-motion instruments to record the structural response of typical buildings is also critically important to the engineering community.