UNR's Seismic Testing of Low-Cost Housing Technology

By Mark E. Smith

In March, University of Nevada, Reno's Large-Scale Structures Laboratory completed the first ever full scale test of a strawbale house for large earthquake loading. Strawbale construction is ideal for use in rural and developing areas as an affordable, appropriate construction technology and has important applications for mine development in terms of aiding impacted communities in the developing world. This testing program was carried out by Pakistan Straw Bale and Appropriate Building (PAKSBAB), a US-based NGO, and sponsored by the Earthquake Engineering Research Institute and the Network for Earthquake Engineering Simulation. UNR has one of the most advanced large-scale structural testing facilities in North America.

The testing program started in 2008 with full size wall segments, the conventional approach to such testing. The latest test used a full scale 14-ft x 14-ft dwelling unit constructed at UNR using Pakistan builders and construction methods. The building was loaded on to the testing platform or "shake table" and subjected to a series of loading to simulate different earthquake intensities. According to Darcey Donovan, CEO of PAKSBAB, "Our strawbale house performed exceptionally…The input motion was the Canoga Park Topanga Canyon record of the 1994 Northridge, California earthquake, Mw 6.7. The house was subjected to increasing levels of seismic shaking, beginning at 25% of the recorded ground acceleration and increasing at 25% increments until failure. The house survived 0.82g, twice the acceleration of the Canoga Park [Northridge] record." The 2005 Pakistan earthquake (Mw 7.6), which killed 100,000 people and left 3.3 million homeless, delivered an estimated maximum ground acceleration of 0.6g, and this testing indicates that the building would not only survive that level of shaking but remain structurally sound and, with repair, inhabitable after the event.

PAKSBAB's strawbale construction method is of interest for reconstruction efforts as well as aiding mining's communities because it is low cost, requires few special tools or skills, most of the construction material is locally available, the buildings are up to 80% more energy efficient, they reduce carbon emissions by up to 300 tonnes of CO2-equivalents over the life of a dwelling, and they are much safer in earthquakes than traditional construction methods used in much of the developing rural world. Strawbale construction also evaluates well under sustainable development's "triple bottom line" accounting.

Demonstration programs are underway in the Northwest Frontier province of Pakistan and (with a varied building method) Heilongjiang province, China. Habitat for Humanity is also considering incorporating the PAKSBAB technology into their program. PAKSBAB can be contacted through their website at www.paksbab.org.

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