

Earthquake Safety Action Plans in India and Bhutan

In 2012, GHI expanded its work with the governments of Bhutan and India to develop the first national action plans for school and hospital earthquake safety in these South Asian countries.

The action plans will outline short-, medium-, and long-term steps to be taken at national and local levels. These steps could include building vulnerability assessments and retrofit programs, improvements to designs for new buildings, increased construction standards enforcement, the creation of emergency preparedness plans, increased emergency response capacity, public education campaigns, and the review and improvement of relevant academic curricula, among other items.

National and local government agencies, school principals, hospital administrators, civil society representatives, and other stakeholders are participating in the two-year effort—funded by the Global Facility for Disaster Reduction and Recovery—to draft consensus-based national action plans.

When implemented, the plans have the potential to produce widespread improvements in earthquake safety in both countries. Neither India nor Bhutan currently has an overarching strategy to improve safety in its education or health care sector.

In Bhutan, the action plans are already on their way toward implementation. Almost every



Hari Kumar, GHI's regional coordinator for South Asia, speaks with members of the school earthquake safety working group during a national action plan meeting in Thimphu, Bhutan. Once completed, the action plan will outline steps to be taken at the national and local levels to improve earthquake safety in the country.

“immediate priority” item that Bhutanese stakeholders identified during the action plan development process has been incorporated into Bhutan’s forthcoming Five Year Plan, an official development policy document created by the Royal Government of Bhutan.

Inclusion in this important policy document means that the priority items will likely be implemented within the next five years.

GHI has been working toward improved earthquake safety in South Asia for more than a decade, with offices now in New Delhi, India, and Thimphu, Bhutan. The national action plan project builds upon the successes of GHI’s past work in South Asia. Our strong reputation in the region has given each government and the project’s funder the confidence to work with us on these important and highly visible initiatives.

Bhutan's National Referral Hospital



This year, GHI and California-based structural engineer Bill Holmes of Rutherford & Chekene Engineers conducted a seismic vulnerability assessment of Bhutan's Jigme Dorji Wangchuck National Referral Hospital, located in the capital, Thimphu. The hospital (pictured above) is the country's largest, best-equipped, and most important health facility. Due to Bhutan's geographic isolation, the hospital will probably have to confront the immediate aftermath of a major earthquake without any outside assistance. An earthquake that causes heavy damage in Thimphu is also likely to damage the area's only airport and to cause landslides that will block roads into the city.

The goal of the assessment, which was funded by the World Health Organization, was to provide the

hospital and the country's Ministry of Health with an overview of the hospital's seismic vulnerabilities, including structural weaknesses and other potential problems that could hinder functionality, such as equipment failure. The U.S. Geological Survey donated staff time and provided estimates of the likely ground shaking following three earthquake events, which illustrate the range of shaking that the hospital should anticipate. For each of the three events, the assessment team developed impact scenarios that present, in narrative form, the anticipated effects of each hypothetical earthquake on the hospital's facilities and ability to function.

The assessment concluded that in a very large earthquake, the main hospital building would not experience

major structural damage, but the staff would only be able to deliver austere care, due to the loss of electrical power and water and disruption inside the building. The assessment also included recommended actions to improve the hospital's ability to deliver medical care following a major earthquake.

In November, GHI staff presented the study's findings to Bhutanese and World Health Organization officials. These officials would like to immediately implement the highest priority recommendations—including, among others, strengthening the hospital's back-up utility systems, drafting an emergency plan, and training hospital staff. GHI will continue to advocate for implementation of all the recommendations in the assessment report.

Seismic Network Expands to Bhutan

This year GHI helped to expand the Quake-Catcher Network—an initiative across seven academic institutions that aims to build the world's largest, low-cost network for monitoring seismic activity—into Bhutan. Through GHI's facilitation, the initiative provided free strong-motion sensors, or seismographs, to Bhutan's key governmental groups that focus on seismology and disaster management.

Quake-Catcher sensors are portable, plug-in devices for standard desktop and laptop computers and have user-

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GHI's Janise Rodgers (far left), Karma Tshering (middle right), and Hari Kumar (far right) stand with Quake-Catcher Network project leader and Stanford Assistant Professor Jesse Lawrence, who holds one of the network's low-cost sensors.

India's Health Care Sector Prepares for Earthquakes



GHI significantly increased its earthquake safety work in India's health care sector in 2012. With funding from the Swiss Reinsurance Company and the World Health Organization, GHI worked with eight major government hospitals to train more than 1000 doctors, nurses, and other health care professionals based in New Delhi and other large cities in the north and northeast along the Himalayas. The populations in those areas face very high levels of earthquake risk.

GHI trained hospital staff to identify and strengthen equipment, critical building utility systems (such as backup power), and other items that are vulnerable to falling, toppling, or damage during strong earthquake shaking. Damaged equipment

Hari Kumar, GHI's regional coordinator for South Asia, leads a preparedness course for nurses in New Delhi, India.

or utility systems or staff injured by falling hazards can jeopardize a hospital's ability to function following large earthquakes, the very time when the facilities are most needed to care for earthquake victims. GHI is also helping the hospitals to develop emergency plans.

India's health care sector has traditionally focused its earthquake safety efforts on mass casualty management, triage, and structural safety. GHI is the only organization working closely with Indian hospitals to reduce the threats to hospital functionality posed by falling

hazards and equipment failure due to earthquakes.

GHI's hospital work follows the guidelines described in the GHI-Swiss Reinsurance Company manual entitled *Reducing Earthquake Risk in Hospitals from Equipment, Contents, Architectural Elements and Building Utility Systems*, which was published and made available for free online in 2011. GHI has mailed copies of the manual to more than 500 Indian hospital administrators and staff working in the country's highest seismic zones, and the manual has been downloaded from GHI's website more than 10,000 times.

GHI has been concentrating its training on prominent hospitals, which, as early adopters of these new practices, will display leadership in India's health care sector. This first group of hospitals will serve as models that, we hope, other Indian hospitals will emulate. GHI is also advocating for the inclusion of a recommendation related to bracing equipment, contents, architectural elements, and building utility systems in India's forthcoming national action plan for hospital earthquake safety (see article on page 4). The adoption of such standards would improve hospital safety and functionality throughout India by providing engineering design requirements that could be enforced during construction.

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friendly software that makes them relatively easy to operate. Once set up, the sensors are linked into the Quake-Catcher's Internet-based seismic network. The initiative currently has more than 2000 devices deployed and plans to install at least 6000 more by 2015.

Bhutan's Department of Geology and Mines is presently exploring

one potential application of the Quake-Catcher sensors: to augment a planned seismic monitoring network, consisting of a small number of traditional instruments, with a larger number of low-cost Quake Catcher sensors. Bhutan does not currently have a seismic monitoring network in place, because of the high costs of building one using traditional technologies.

Larger, more sophisticated sensors can cost as much as \$50,000 each and several thousand dollars per year to maintain, while Quake-Catcher's sensors cost only about \$150 each and are often donated to users. The more expensive sensors are more accurate, but the low-cost sensors could still capture important strong-motion data that would otherwise go unrecorded.

Earthquake Safety in the Land of the Thunder Dragon



GHI worked this year with Bhutanese engineers to develop a suite of tools for rapidly assessing the earthquake safety of schools and health care facilities known as Basic Health Units, which are common throughout Bhutan. California-based structural engineers Bill Holmes of Rutherford & Chekene and Mel Green of Melvyn Green and Associates, both widely recognized experts in seismic assessment and retrofit techniques, contributed significantly to the effort.

Mel Green (left), Bill Holmes (center), and Karma Tenzin, an engineer for the Thimphu City Municipality, inspect buildings in and around Bhutan's capital.

developing countries reduce their vulnerability to natural hazards.

The GHI team visited nearly five dozen schools and health care buildings throughout Bhutan, including buildings damaged in September 2011 by a M6.9 earthquake centered

along the India-Nepal border region. In developing the tools, the project team also drew lessons from rapid assessment methodologies created for buildings in the United States.

Besides creating valuable new tools, the project will help to strengthen the country's engineering community. GHI formed a core group of engineers from major Bhutanese government engineering agencies to help develop the assessment tools and provide peer review. In late October and early November, engineers from central government engineering agencies and from all 20 of Bhutan's dzongkhags (districts) participated in a three-day training course—led by GHI team members and Bhutanese engineers—on using the assessment tools.

GHI is now working with the government of Bhutan to draft a plan for evaluating every primary and secondary school in the country. GHI and partner Bhutanese government agencies intend for the evaluations to form the basis for long-term programs to replace or retrofit the most vulnerable schools and Basic Health Units throughout the Himalayan nation.

The new tools help engineers to quickly identify structural vulnerabilities, categorize buildings according to how much damage they are likely to experience from strong ground shaking, and determine whether or not seismic strengthening is needed. Assessment forms with questions and prompts guide engineers through the process of identifying seismic vulnerabilities, as well as vulnerability to other potential natural hazards, such as landslides or flooding.

Funding support for developing the tools—which are the first of their kind to be tailored to common construction practices in Bhutan—was provided by the Global Facility for Disaster Reduction and Recovery, an international partnership that helps

GHI Opens Office in Bhutan



This year, GHI opened an office in Thimphu, Bhutan, and hired two staff there. Karma Doma Tshering (left), is GHI's national coordinator for Bhutan. Sonam Tenzin (right) is a mitigation specialist.