

GEOHAZARDS INTERNATIONAL

2016 Highlights



Geoscientist Leonardo Seeber (Columbia University) analyzes geologic structure and the high potential for landsliding in the Indo-Burma Ranges, with professional geologists, geotechnical engineers, and university students in Aizawl, India. PHOTO: PAUL BETKA

The Nitty Gritty on Landslides, Muddy Boots Included

Deadly landslides can deliver sudden ruin, but their triggers are often predictable. Geologists and engineers in Aizawl, India are learning to avert these disasters and keep people out of harm's way.

In October 2016, they attended an intensive geologic field course organized by GeoHazards International, and delved into the "hows and whys" of landslide hazard.

"One thing we often heard in Aizawl is that geologists and engineers do not work together enough to reduce risk. We brought 65 of them together. Many met for the first time in these sessions," said Hari Kumar, GHI's South Asia coordinator.

The capital of Mizoram state in the northeast, Aizawl is located atop steep hills of the Indo-Burmese range. Not surprising, the views are stunning, but things get complicated underground. People in Aizawl live amid some of the highest natural hazard risk in India. Lives

are lost every year in landslides, and major earthquake faults underlie the region.

"We designed the course to provide classroom instruction on the fundamentals of landslide mechanics as well as field techniques to recognize and record slope hazards," explained Kevin Clahan, Principal Engineering Geologist at Lettis Consultants International and co-instructor of the course.

Steep terrain is one cause for Aizawl's landslides. More dangerous conditions, such as weak interbedded rock layers parallel to the slope, often exacerbate the

hazard. Annual monsoon rains lubricate fine grained layers, adding even more impetus for weak rock to shear.

The deadliest trigger for landslides, though, is an earthquake. One strong earthquake could potentially unleash hundreds of landslides at the same time.

People in rapidly growing Aizawl are beginning to understand that uncontrolled development adds to their landslide risk. Excavations for new buildings and roads destabilize fragile slopes and existing buildings. So does poor drainage, which saturates and weakens rock layers.

GeoHazards International has helped Aizawl create an action plan for landslide safety, *Roadmap to Stability*. Its first priority is to avoid new construction that would destabilize slopes. Other priorities are to divert water away from potential slide areas and to mitigate ongoing landslides.

Detailed maps, developed by our team and local geologists, categorize landslide *continued on page 2*

Many Thanks!

Your contributions are the seeds that make our work grow. In our 26th year, we continue to help vulnerable communities outsmart disasters.

- Brian Tucker, President



Gina Marie Belair and Adeleine Tran document seismic vulnerabilities in the water supply system of Aizawl, India for their internship research. PHOTO: LALRINPUII TLAU

Opportunity Knocks for Student Interns

If you ask GeoHazards International's interns from University of California, Berkeley what they did over the summer, you'll probably learn about tricky geology or precarious buildings on the other side of the world. These earth science and civil engineering students traveled to Aizawl, India to assist with risk reduction efforts.

The experience was anything but textbook, and that was the point. Aizawl is home to active earthquake faults, frequent landslides, heavy rainfall, and more than 300,000 people.

Funded by the Heising-Simons Foundation, six internships over three summers provided under-represented students in science, technology, engineering and mathematics (STEM) with real-world experience in emerging economies.

An earth science and an engineering student were paired each year. They conducted inter-disciplinary research with mentors from GeoHazards International, UC-Berkeley, and Pacific Earthquake Engineering Research Center.

One pair assessed structural and landslide vulnerabilities at 22 schools; another mapped cracking and drainage of a fast-moving landslide and slow-moving sinking areas; and a third pair investigated the seismic vulnerability of the municipal water system. Their field work confirmed

the importance of effective policies to safeguard people from natural disasters.

The paid positions provided an opportunity that would otherwise be out of reach for some students. Work that aligned with their studies and aspirations prepared them to apply for graduate school and pursue professional careers. There is a good chance they will apply their talents where the need is great.

"I saw how my civil engineering studies can have humanitarian applications," said Carly Schaeffer, 2014 intern. She went on to earn an MS in Geosystems Engineering and now works as a geotechnical engineer.

Donor Gifts Make Up Half of Our Annual Budget

"With GeoHazards International, you get bang for your buck. It's wonderful how they step up, finding innovative solutions to help vulnerable communities to not, literally, fall apart. It's a lean, strategic organization and they really need your support."

- Jeff Slade, donor since 2004

Landslides, continued from page 1

hazards throughout the city. Planners use them to identify dangerous conditions and avoid mishaps.

New regulations, developed by the local government with GHI's guidance, restrict earthmoving, prescribe setbacks from neighbors, and limit slope cutting. City building permits now require a site assessment report and approval from a professional geologist.

Hence, trained geologists will be in high demand. We created the geologic field course because few local professionals had expertise in the services required for the new site development regulations.

Training side-by-side with experts, 34 geologists learned techniques for interpreting sites, mapping, monitoring activities, and reducing hazardous conditions. The Governor, Mayor, Municipal Commissioner and District Collector also attended sessions. All this was coordinated by our mitigation specialist based in Aizawl, Lalrinpuii Tlau.

"Professors at the local university, professional geoscientists and geotechnical engineers mingled with students and worked just as hard on their field exercises, collecting field data and analyzing them late into the evening," said Leonardo Seeber, the course co-instructor and a seismologist at Lamont-Doherty Earth Observatory, Columbia University.

Delighted by everyone's progress and now recovered from the all-out pace, Kevin Clahan said, "I look forward to getting the band back together for the next tour."

Global reinsurer Munich Re has provided generous support for GHI's work in Aizawl. Columbia University participation was made possible by National Science Foundation.



Earthquake Desks do not guarantee safety in all building failures. Rather, they add some protection in dangerous conditions.

IMAGE: SOLLY BABA



Retooling the Standard School Desk

When Israeli industrial designers Arthur Brutter and Ido Bruno decided to rethink the standard school desk, little did they know that the result, their award-winning Earthquake Desk, would take on a life of its own.

An encounter with them last year in Sendai, Japan sparked our idea to introduce Earthquake Desks in Bhutan. Big earthquakes are a threat in this small Himalayan nation, but many schools are not yet earthquake resistant. Children have little protection in these schools if heavy roofs or stone walls collapse during shaking.

Unlike a standard school desk, the Earthquake Desk was designed to withstand a heavy load.

Until Bhutan can fix all of its vulnerable schools, why not equip them with sturdy desks? And why not make the desks locally to keep the cost low?

In a pilot project coordinated by our Bhutan office, carpenters, welders, and government engineers in Bhutan set to work learning from Ido and Arthur. A combination of structure and materials creates the Earthquake Desk's strength. If the team could produce affordable desks that meet design specifications, and that outperform current desks, then students, the Ministry of Education, and Bhutan's

small furniture industry would all come out winners.

No one said it would be easy. The team made a set of wooden jigs, which they used to precisely align steel pieces while welding. The method allows fabricators to make the same component repeatedly with little error. Each section has a corresponding jig, and one jig set can be used to make hundreds of desks.

Jigs were a new concept in Bhutan. Improvisation, on the other hand, is a practiced art. Inadequate tools were quickly adapted. And highly skilled carpenters helped Ido and Arthur devise improvements to the desktop, further enhanced by the excellent quality of Bhutan plywood.

Above: Welders in Bhutan use wooden jigs to hold steel pieces in precise position. PHOTO: IDO BRUNO

Right: A Bhutan Earthquake Desk painted in one of 4 colors selected by the team. The painted top is a special edition for the pilot effort. PHOTO: APARAJITA ACHARYA

"This was collaboration at its best," declared Ido.

They made an initial batch of 14 Earthquake Desks and capped the training with a "crush" test. A Bhutan-made Earthquake Desk withstood the drop of boulders and concrete weighing 930 pounds (the facility's maximum load), while a standard desk was flattened under a much lesser load.

The team's conclusion after a week of sawing, chiseling, welding and inspired troubleshooting was the local equivalent of "We're in!" in four languages. They realized that their work to build a better school desk may save lives, perhaps the lives of their own children.

Impressed by the jig system, the Ministry of Education will work with Arthur and Ido to initiate a similar system in Bhutan's Vocational Training Institutes and also train students to produce Earthquake Desks, which will ensure lower costs and sustainable production.

Next steps? Bhutan manufacturers will produce a larger supply, and the Ministry of Education will develop a phased plan to equip schools most at risk. Then Bhutan will have the skills and vision to sustain an Earthquake Desk program on its own.

The combination of earthquakes and poorly built schools poses a lethal threat to millions of children worldwide. The best way to protect these children is to replace or retrofit all vulnerable school buildings. But until that day they need safe cover. That's why we hope to introduce Earthquake Desks in more countries.

AIR Worldwide, a Verisk Analytics company, provided major support for this program. A.D. Meraz Industries contributed patent rights.





Dr. Garmalia Mentor-William (left) and Dr. Michelle Meyer (right) interview 94-year-old Mme Seide Dely about her long experience with disasters in South Haiti. PHOTO: JANISE RODGERS

Acting Smart in the Face of Disaster

“Come back again if you want to know more!” said Mme Seide Dely, 94. A lifelong resident of Anse-a-Veau in southern Haiti, she has braved her fair share of disasters and lost her home more than once. Now, her rich trove of stories is in demand, not to mention her animated telling.

Sociologist Michelle Meyer of Louisiana State University interviewed survivors like Mme Dely and organizational leaders when she accompanied GeoHazards International’s team in Haiti. She also coordinated surveys conducted by a Haitian firm. The purpose was to find out what people know about disasters and what they do during crises.

Why does this matter in a place where earthquakes, tsunamis, hurricanes and floods destroy lives?

While our science and engineering experts focus on physical improvements such as safer buildings, a sociologist brings a perspective about how to influence changes in behavior so people will better protect themselves from tragedy.

Values and customs influence the actions people take before, during, and after disasters, and studying these actions is Dr. Meyer’s forte. For example, she noticed that children and teens were often out in the towns without adult supervision.

They were in groups, or on their own carrying water or doing chores.

“You cannot assume that parents will be near their children during an earthquake or tsunami,” she commented. “Children will act independently. For that they need messages that teach the warning signs of disasters and where to go. Teaching only adults leaves children vulnerable during the periods they are away from parents’ watchful eyes.”

According to a United Nations report, over the past 20 years five times more people died in disasters in poor countries than in rich countries where early warning and preparedness are routine. Haiti lost more lives to natural hazards in this period than any other country in the world.

“Our task is to turn preparedness into something that people can manage step by step. We build local capacity not just in technical fields but also in disaster-smart habits,” said Dr. Brian Tucker, president of GeoHazards International.

“As a Haitian living close to vulnerable areas, I am a direct witness of the suffering. My medical background helps me look beyond the obvious and consider public health in our work,” added Garmalia Mentor-William, a medical doctor and GHI’s representative in Haiti.

Dr. Meyer and Dr. Mentor-William found that women may behave differently than men in a disaster evacuation. Female interviewees noted that women are reluctant to use shelters or distribution centers for fear of gender violence, so protecting women at these locations should be part of disaster relief planning.

At the heart of our work, we help people who face hazards make their communities safer. That’s why we partner with local leaders, including those in religious and social organizations for women, children, and people with special needs. They influence local change and lay the groundwork for disaster resilience.



GHI is working in Haiti (Cap-Haitian and Anse-a-Veau) and Dominican Republic (Santiago) to strengthen disaster readiness. Major earthquake faults are in red; those with triangles also generate tsunamis. Hurricanes and floods are annual threats. IMAGE: adapted from Prentice et al., 2013.