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Grassroots Concrete

By Brandon Keim

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Grassroots Concrete

Build Change is shaking up construction practices in earthquake-prone areas

By BRANDON KEIM

ON THE MORNING of Jan. 26, 2001, a magnitude 7.6 earthquake struck the western Indian state of Gujarat. More than 20,000 people were killed and 160,000 injured, many of them crushed by falling buildings. International aid agencies flocked to the scene and began reconstruction.

One year later, civil engineer Elizabeth Hausler traveled to Gujarat on a Fulbright scholarship, hoping to learn how she could use her skills to build homes that withstand tectonic shifts. She found that many survivors didn't want to live in their new, donor-built earthquake-resistant houses because they were made from odd materials and in strange styles.

"One approach I kept seeing over and over was designing a house with the toilet inside," says Hausler. "People don't want the toilet in the house, because the houses are so small. So that ends up being wasted space. And they don't use the toilet, so they don't have a toilet."

It wasn't enough for a house to be solid, realized Hausler. It needed to fit.

Even when donor-built homes suited people's needs, they were frequently too expensive. "I didn't see a single example of a technology introduced by a local or foreign organization that continued to be used without some kind of subsidy," says Hausler. "If the change we're suggesting is too expensive, people aren't going to buy it."

With a more grassroots approach in mind, Hausler founded Build Change, a Mill Valley, Calif.-based nonprofit whose mission is "to greatly reduce deaths, injuries, and economic losses caused by housing collapses due to earthquakes in developing countries." The organization also works with survivors to find out not only what they need, but also what they want.

Originally a one-woman operation with roughly \$65,000 in seed funding, Build Change now employs 34 people. Hausler and her team have traveled to disaster sites in Indonesia and China, studying how buildings stand and fall following seismic events. Although certain construction styles are ubiquitous throughout the develop-

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An earthquake victim shows Elizabeth Hausler (left) where his collapsed house is in Tumen, Sichuan, China.

ing world, engineers in wealthier nations know little about them. Build Change first figures out how to strengthen these local styles, and then teaches local contractors how to execute the designs.

"Earthquake engineering isn't rocket science," says Hausler. "If we explain it well enough, everyone should be able to construct an earthquake-resistant house."

DEEP FOUNDATIONS

The daughter of a bricklayer, Hausler grew up in the Chicago area. At age 13 she began working with her father during the summer, picking up broken bricks at construction sites; in high school she drove a forklift. By the time she received her bachelor's degree in engineering from the University of Illinois at Urbana-Champaign, she was a skilled bricklayer.

After working as an engineering consultant and picking up a master's degree in environmental science, Hausler went to the University of California, Berkeley. She was working on her doctoral dissertation in civil engineering when the earthquake struck Gujarat. Although tempted to travel to India on a Fulbright scholarship, she let the Sept. 10 deadline come and go without submitting her application.

The next morning, she watched the World Trade Center collapse. "From that point forward, I had no more ambivalence," says Hausler. "I realized that I had to do something to make the world better." She finished her application that day.

CEMENTING A STRATEGY

Five years later, the Asian tsunami laid waste to Aceh, located on the Indonesian island of Sumatra. Although flooding wrought the greatest damage to the area, earthquakes still threatened local building styles. With donor money for reconstruction pouring in, the region was an ideal place for Build Change to apply its ideas.

With \$80,000 from Mercy Corps for materials, Build Change constructed 33 houses and supervised relief organizations in building 4,200 more. Hausler describes this work as a pilot project, during which Build Change developed an understanding of the everyday construction realities in Aceh—from local architectural styles to the region’s unusually porous bricks and gritty mortars. (On a tip from her father, Hausler began soaking the bricks in water to shrink their pores and make a better bonding surface for mortar. This remains a basic Build Change trick.)

In September 2007, the organization put this local knowledge to use when a magnitude 6.0 earthquake and its powerful aftershock killed 70 people in West Sumatra. As had been the case in Aceh, the dominant building style was confined masonry—bricks stacked together like so many blocks, bound by concrete, and anchored into roofs and floors with steel rebar. Relatively cheap and easy to build, it’s the most common building style in the developing world. Hausler saw that surviving structures tended to have strong connections between walls and floor and ceiling, with bricks tightly confined between columns of reinforced concrete.

“It’s just a matter of making sure that the buildings are tied together, in the right positions, with proper spacings between the doors and columns,” says Hausler. “You don’t have to make much more expensive buildings.”

“That’s the real change that she’s innovated—taking the type of architecture that people already aspire to, and making minor modifications to it,” says Martin Fisher, a member of Build Change’s board of directors and executive director of KickStart, a nonprofit organization that provides practical technologies to impoverished people. “It’s hard to get people to adopt what they’ve never used before,” he notes. “It’s easier to get people to make small changes to existing technologies.”

Build Change also worked closely with homeowners and local contractors in Sumatra. The organization drew up customer-specific floor plans, and then helped teach residents to read the plans and demand necessary changes from contractors. The organization also taught better building techniques to the contractors and worked with the local public works department to develop better building codes for rural houses.

A little more than a year later, in August 2008, a magnitude 8.0 earthquake struck rural Sichuan province, China. Nearly 8 million buildings were destroyed, and 69,000 people died—including 5,000 schoolchildren who were crushed in their schools.

Like Indonesia, rural China relies heavily on confined masonry. And so the houses in Sichuan stood or fell for the same structural reasons as in Sumatra, with one notable difference: Local builders

BUILD BACK BETTER

Adapt local practices, rather than imposing outside ones

Heed people’s preferences and price points

Educate contractors, consumers, and government officials

Create not just laws, but also ways to enforce them

favored precast concrete slab roofs, which they laid flat across the walls, without any joiners. During the earthquake, these heavy, unsecured roofs turned buildings into deadly houses of cards.

To remedy these problems, Hausler’s organization developed floor plans requested by homeowners, but with stronger connections and tighter confinement. Build Change then trained contractors, instructed homeowners, guided new home construction, advised development agencies, and pleaded the case for sounder construction to gov-

ernment officials. The government has been receptive, even asking Build Change to inspect buildings on its behalf, says Hausler.

Among the earthquake’s victims, Hausler found a receptive audience. “They really trust Build Change,” says Maya Alexandri, a Beijing-based lawyer and journalist who consults for Build Change. “If Build Change tells them a construction is safe, then they feel confident moving into it.”

BUILDING A LEGACY

To date, Build Change has improved the design and construction of 5,300 houses, trained 360 builders, mentored 80 construction professionals, and trained several hundred technical high school students. Hausler and the organization have received many plaudits, including Echoing Green’s Best Emerging Social Entrepreneurs tag and the Tech Museum of Innovation’s Equality Award. With funding from the Kingdom, Mulago, and Draper Richards foundations, as well as consulting fees from aid agencies, Build Change is on stable financial ground.

Yet Hausler has not stopped with Build Change. She has also pushed the Earthquake Engineering Research Institute to form the Confined Masonry Network, a consortium that sets guidelines for high-quality confined masonry and promotes its use.

Although a severe earthquake has yet to test Build Change’s homes, smaller quakes in Indonesia did not structurally damage a single residence. But the ultimate measure of the organization’s success will be its cultural legacy. “People are getting houses that are earthquake resistant,” says Alexandri. “But will the contractor turn around and implement those changes in the next house he builds?”

On this front, Hausler sees promising early signs. “In Indonesia, we have seen builders continue to implement changes without further instruction and inputs from us,” she says. In West Sumatra, moreover, the public works department recently committed to working with Build Change on guidelines for a simple rural house. “The department is already implementing some of our changes on some duplexes they are building,” she adds.

Similarly, in Tumen, the rural Sichuan township where Build Change has worked, the local government has created not only clear building codes, but also an inspection process for enforcing them. “Enforcing building standards in rural China didn’t exist before last year,” notes Hausler. Now, these codes and processes are being expanded to other parts of Sichuan.

“We’ll try to get all of rural China to use this,” she says. ■