Stabilizing collapsed or shock-damaged buildings

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In the gathering gloom of late afternoon, September 11, 2001, building engineers—as well as the rest of the world—watched in horror as the desperately fragile remains of the World Trade Center shifted and settled into their final positions. All immediately knew the risks that would be taken by those brave individuals who would plunge into what was left of those shaky remains in the search for survivors.

The same was true after the Haiti earthquake in 2010, and after the tsunami in Japan, 2011. Buildings collapse the world over due to shoddy construction, storms, tornadoes, earthquakes and tsunamis, as well as acts of terrorism. Stabilizing the remains of any shock-damaged or collapsed building or structure is of the utmost importance in the hours immediately following the event.

Research scientists and engineers at the University of Kentucky Center for Applied Energy Research (CAER) proposed a solution: a product that could be applied quickly and which would set rapidly to allow rescue operations to proceed safely. The National Institute for Hometown Security (NIHS), based in Somerset, KY, teamed up with Homeland Security's Science and Technology Directorate (DHS S&T) to fund the CAER project.

Working with Minova North America Inc. of Georgetown, Kentucky—makers of many steel, chemical and cement products for the mining, tunneling, and civil engineering market—the CAER researchers developed Tekcrete Fast and Tekcrete Fast M (the 'M' is for mining).

These products are very rapidly setting, high strength spray-on cement products that are "unlike anything else out there," says Dr. Sam Varnado, chief technical officer at NIHS.

"Anything you spray on a collapsed building is going to add weight to a structure that is already very fragile, and that might further weaken it," says NIHS CEO Ewell Balltrip. "Whatever you come up with must act very, very rapidly to quickly stabilize that structure."

"It was a very tough assignment," adds Lawrence Skelly, S&T Program Manager on the project. "We had to come up with a product that would go over anything, in any condition. In these kinds of situations, there's no time to clean up a collapsed structure, which may not only be hot due to fires, but may have lots of dust and debris that has settled onto it as well."

Minova's "Tekcrete Fast and Tekcrete Fast M" are simple, single bag concretes designed for shotcrete applications. When mixed with water, it not only sets exceedingly quickly, but develops an incredible strength in just a few minutes. "We're talking structural strength in as little as 15 minutes—unheard of in the cement world," says Skelly. In 15 minutes it develops the same strength that regular cement would take two weeks to develop.

Tekcrete Fast is fiber-reinforced which keeps the concrete intact if cracks try to form when it adheres after applying. Tekcrete Fast M, specifically formulated for the mining industry, is almost dust free. Both form a crystal cement, rather than a gel, which aids in the speed of its hardening. Another key feature of the product is just how "sticky" it is—unusually so for cement-based products. It readily forms strong bonds with almost any kind of concrete, wood or steel. The formula is now patented by the University of Kentucky.

Tekcrete Fast M is currently being tested in underground mines to shore up roofing. The product resulting from the research funded by DHS S&T is now on the market. Aside from the great boon to first responders dealing with shock-damaged buildings, Tekcrete Fast also has many commercial uses in mining, tunneling and bridge construction, and other civil engineering projects.

This summer, Tekcrete Fast was demonstrated to Congressman Hal Rogers (R-KY). A concrete beam was placed horizontally across the top of a vertical concrete column. Tekcrete Fast was applied to the joint with a hose, and 15 minutes later, Congressman Rogers hung from the end of the crossbeam.

"It works," declared Rogers.

Provided by The Nat Institute for Hometown Security