'Smart Concrete' Could Improve Levees

The failure of levees in the wake of Hurricane Katrina points out the need for new technologies to strengthen levees and monitor their reliability, according to Deborah D. L. Chung, Ph.D., a University at Buffalo materials scientist and inventor of "smart concrete."

"The technology used to build levees is really very primitive -- sometimes it involves just the piling of dirt. Surely there's a lot of room to use higher technologies than that," says Chung, Niagara Mohawk Professor of Materials Research and director of the Composite Materials Research Laboratory in the UB School of Engineering and Applied Sciences.

Chung's smart concrete, patented in 1998, may be one such technology whose time has come for commercial use -- not only in the construction of levees, but for a range of disaster and homeland security applications.

With smart concrete, short carbon fibers are added to the conventional concrete mixture. This modification gives the concrete the ability to detect stress and tiny deformations in the concrete. In the presence of structural flaws -- within a levee made of smart concrete, for example -- the concrete's electrical resistance increases. This change can be detected by electrical probes placed on the outside of structures.

"You could use a meter to continuously monitor stress and deformation within levees made of smart concrete," Chung explains. "When deformations in the levee deviate from an acceptable baseline, an alarm could be triggered."

Similarly, the electrical properties of smart concrete could be used to detect underground stress that builds prior to an earthquake, to monitor building occupancy for intruders or for stragglers during an evacuation, and to monitor traffic flow in an emergency or around U.S. borders, Chung says.

Chung, who also has studied the use of continuous carbon fibers in the form of composites, suggests that some levees could be encased in a shell composed of such composites, which are similar to the material used to form the bodies of jet aircraft.

"If you use that as the outer shell of a levee, you could make use of the carbon fiber's electrical conductivity to monitor fiber breakage," she says. "So in addition to serving as levee reinforcement, the shell also serves as a sensor of damage."

According to Chung, use of smart concrete would increase construction costs by 30 percent, which is a main reason industry has not adopted its use, she says. Of course, reconstruction costs after a disaster can run much higher, she points out.

"People might say they like sensing, but in real life do they really want their bridge or their highway to be smart," Chung asks. "When it comes to real construction projects, all they really care about is mechanical behavior, and every penny counts in the bidding process."

Source: University at Buffalo