Nondestructive Testing: Part 1

Electromagnetic testing aids concrete scanning

Over the last several years of writing this column, I have periodically featured new technologies for inspecting concrete. I think it's an important topic, so this time I'm devoting a two-part series to newly patented technology. This month I'm focusing on electromagnetic signals (essentially radar), while next month I'm reporting on a cutting-edge but non-patented technology using sound waves (essentially sonar).

Somehow from the science fiction introductions of Superman's ability to see through walls and Dr. Spock's tricorder, development engineers have embraced the idea of being able to "scan" for things they couldn't "see" in the conventional sense. Sure, radar, sonar, and X-rays had been around for some time, but their applications had historically been military and, to a lesser extent, medical.

But as with most military innovations, commercial applications of military innovations are becoming more common.

The latest contribution to the evolution of scanning technology came August 6, 2002, with the issuance of U.S. patent No. 6,429,802 to inventor Roger L. Roberts of Amesbury, Mass., for "Determining the Condition of a Concrete Structure Using Electromagnetic Signals." The patent, now assigned to Geophysical Survey Systems of North Salem, N.H., uses reflected images from Ground-Penetrating Radar (GPR) that are analyzed to determine what is happening to rebar embedded within concrete structures.

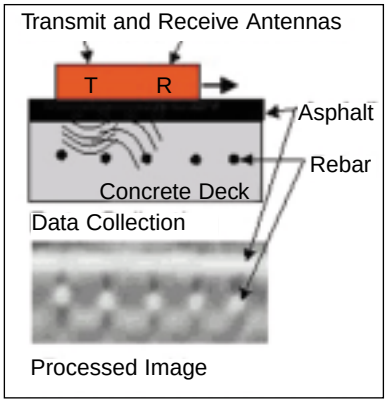
Technically, the patent doesn't refer to the technology as "radar;" instead, the applicant used the term "electromagnetic signals." But certainly radar qualifies as one of those types of signals. In fact, a preferred device called for in the patent is a Subsurface Interface Radar System.

Although this patent is long and grueling, I doubt very much that it was issued on the GPR's strength, which is not really all that new. Rather, it seems to be based on the collection of data and the unit's size. The developers have created a suitcase-sized radar unit and the rather sophisticated analyzing software that makes it easier to transport the system.

Instead of having to personally decipher cryptic images, the system provides the operator with several options on how to receive the data. Most notably is the system's ability to display a three-dimensional image of the concrete's subsurface on a laptop computer screen. It is a bit like having a portable X-ray machine capable of looking inside things.

For what I am sure are legal reasons, the patent does not specify a penetration depth that the machine is capable of reaching. However, the newest systems listed on the Geo-

Investigators performing nondestructive testing on concrete pavements are mobile now thanks to the innovations in using easy-to-transport radar sending, receiving, and data-recording units.



Using this new GPR technology and collection system, investigators can determine the condition of the embedded rebar, even when it's buried in concrete 18 inches thick.

physical Survey Systems' Web site at *www.geophysical.com* claim their devices for concrete inspection can reach a depth of 18 inches. To equal that with an X-ray based machine, if it were possible at all through 18 inches of concrete, would require massive power input, and require the area around inspection to be evacuated for several hundred feet.

The invention not only tells where things are located within the concrete but tells the operator what they are and what condition they are in. For example, the device can tell if there is an embedded void in the concrete, or it can locate a rebar and determine what amount, if any, of corrosion or other degradation there is in that bar. These data can also be saved electronically or printed for possible historical comparison with future readings.

For those of you who just have to have your monthly dose of "geek speak," the device under the patent was developed using a 1.5 GHz signal with a duration of approximately 700 picoseconds (7×10^{-10} seconds). Scan rates, again according to information on the Web site, are 800 scans per second.

One may wonder, "Once I've found a subsurface anomaly, how will I know where it is and what kind it is for future reference?" Excellent question.

Well, you could probably resort to the old paint can routine, but that seems pretty crude after going to the expense of a scanner. But the patent holder has offered another idea.

The location corresponding to a detection point of a detected electromagnetic signal may be marked by using a global positioning system (GPS) receiver. The inspector then receives position information from the GPS receiver and sends the position information, along with the detected signal, to the recording medium. Now the data will tell anyone who uses them what the anomaly is, what condition it is in, and where to find it for future study or immediate repair.

In another way that proves technology is advancing fast into the concrete industry, you'll be able to see this new technology at next year's World of Concrete. Geophysical Survey Systems will be displaying their new products and technology at Booth 7558.

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