By Luke Snell

Evaluating Metal Locators

The author was in Ethiopia, so he asked some students there for help.

A simple and quick way of locating steel reinforcement has become important on the construction site. The reasons for locating steel include:

- A quality control check to determine if reinforcement was installed;
- To avoid hitting reinforcement when removing a core or drilling a hole;
- When doing a rebound hammer test. This test requires that you be at least 1 inch from any reinforcement;
- When determining relative humidity in concrete slabs using in situ probes. Although avoiding the reinforcement is not stated in the test method, installing the in situ probe in or directly against the reinforcement will result in erroneous values.

There are many metal locators available to the contractor, with costs varying from $30 to several thousand dollars. The ease of using the metal locator also varies; some are relatively easy to use while others require extensive training to interpret the results.

Students at Addis Ababa University in Ethiopia using a metal locator according to the manufacturer's instructions.

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While students played the DVD with the equipment's instructions several times before attempting to use it, few read the printed instructions.

In most cases, the contractor will only occasionally use the metal locator. Unlike forensic engineers that need detailed information about the reinforcement, the contractor usually needs equipment that is easy to use and will answer basic questions, such as was the reinforcement installed or how can I avoid the reinforcement if coring or drilling a hole into the concrete?

Zircon, the manufacturer of two inexpensive metal locators, asked me to evaluate its equipment to determine if it was easy to use and whether it meets most of the needs of the contractor. While I was recently in Ethiopia to start an ACI chapter, I found that the concrete construction industry there was rapidly developing, and I discovered that the industry there is interested in improving its technology.

So I proposed to Zircon that we evaluate the equipment at universities in Ethiopia with college students. The reasons for this would be:

1. The students will be the next generation of engineers and project managers. This would introduce the concept and idea of non-destructive testing and give them some first-hand experiences in doing it.
2. The students have learned English as a second language. This would provide a good evaluation of the instructions. If the students can follow the written instructions and the provided DVD, and then use the equipment correctly, then the instructions would be considered adequate.
3. Most students have little or no field experiences and are unfamiliar in using construction equipment. This will emphasize to them the need to learn the correct procedures of using the equipment before using it on the construction site.

During the laboratory exercise, we told the students our company had just bought these metal locators and they were responsible to learn how to use them. They had the instructions and the DVD that came with the metal locators. Thus, the students had to learn the procedures on their own.

Before the laboratory, we had prepared some test beams with various sizes of reinforcement which were off center so that the students could get four readings of cover (depth of reinforcement) on each beam. Due to limited time, each group was given one of the metal locators to evaluate. The following is a summary of the students' evaluation.

Two models

MetalliScanner m40 is Zircon's least expensive metal locator. It will only determine location; it does not provide the cover or depth of the reinforcement. The DVD and written instructions were easy to follow and students were able to use the m40 within 15 minutes. They were able to find the #3 through #9 reinforcement accurately to a depth of at least 3 inches.

Their main complaint was that the m40 did not measure the cover. They did recognize that this equipment would be useful in avoiding reinforcement if they needed to drill a shallow hole in the concrete or answer the simple question, "was the reinforcement installed?"

The MT 6 is Zircon's most advanced metal locator. It will locate the reinforcement, plus give an estimate of the cover or depth of the reinforcement up to a depth of 6 inches. Students found the DVD and the written instructions easy to follow and were able to use the equipment within 20 minutes.

The instructions are more complex than the m40 and the DVD instructions are longer, so it takes a little longer to "learn" how to use the MT6. The MT6 is calibrated to #4 ($^1/_2$ -inch diameter) reinforcement. Smaller reinforcement will appear to have greater cover than actually exists; larger reinforcement will appear to have less cover than actually exists. In our experiments, the students were able to locate the reinforcement accurately. They were able to measure the depth on our prepared samples (samples had reinforcements varying from $^3/_8$ to 1 $^1/_4$ inch diameter) to within 1 inch of the actual depth.

Some students attempted to use the MT6 on a slab with reinforcement going in both directions. Some were able to do this while others had trouble locating the reinforcement. This more complex type of investigation takes time to learn and with the number of students and limited time, we were not surprised that they struggled with this. Given more time, we're confident they wouldn't have had problems.

What did we learn?

The students were surprised by our

Students test a beam with the MT6 metal locator. The tool is used to locate rebar in concrete.

approach of teaching how to use the metal locators. They were used to doing a detailed set of experiments and working in large groups. Our approach of having them learn to use this equipment on their own (watching the DVD and reading the instructions) and by having enough equipment so everyone could use it was a refreshing change of pace.

The students played the DVD several times before they attempted to use the equipment. Few read the instructions. This is typical of how most us learn; we would rather watch a DVD or YouTube than read detailed written instructions.

Having several people learning how to use the equipment at the same time was beneficial. Several students said to each other, "That is not how they did it on the DVD." They were able to teach each other and become fairly competent in using the equipment in a short period of time.

Zircon wanted to know if people with English as a second language were able to use the equipment with the written and video instrucitons. The DVD was adequate and the students were able to use the equipment by following its instructions. The written instructions were probably only read if issues were not covered in the DVD.

All new equipment takes some time and effort to learn how to use. Although the DVD covered the basics, the students did have some difficulty in determining the location of the reinforcement in a slab that had a more complex placement pattern. This would take more time than we had for our laboratory class.

The Zircon m40 and the MT6 metal locators can provide useful information that is needed on construction sites. By following the DVD, users can teach themselves how to use it. With practice, they should be able to locate and thus avoid most reinforcement. **CC**

For more information visit the manufacturer at www.zircon.com.

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