Rebar Locators

Curved stair constructed with cast-in-place concrete

How Do They Measure Up?

By Gregory J. Riley, P.E.

In this article, one structural engineering firm discusses an ongoing challenge they face when working on addition and renovation projects… the difficulty in determining information about existing reinforcing in concrete and masonry structures.

Engineers from Steve Schaefer and Associates, Cincinnati, Ohio, took it upon themselves to perform an evaluation of the features, capabilities and comparative costs of several rebar locators. The following article is an overview of their experience.

At Steven Schaefer Associates, we work on several addition and renovation projects each year. Unfortunately, as-built drawings of the existing structures are not always available, and we often need to make decisions that depend on knowledge about the existing construction. While some aspects of the existing construction can be visually determined, it is more difficult to determine information about the reinforcing steel used in concrete or masonry. A common way of estimating this information is to use a rebar locator.

There are several rebar locators available on the market. These locators vary significantly in their level of sophistication, features, capabilities, and cost. Our firm has used several different locators in the past, with varying degrees of success. We were looking for one rebar locator that met our needs for accuracy and reliability, while at the same time being cost-efficient for a firm that used the equipment only on an occasional basis. Therefore, we decided to review and test several different rebar locators. The rebar locators that were included in our test, along with some of their capabilities and features, are summarized in *Table 1*.

Manufacturer	Model	List Price	Maximim Cover[1] (inches)	Estimates Cover?	Estimates Bar Size?
Fisher	M-101	$500	9	No	No
Hilti	Ferroscan FS 10 Steel Reinforcement Detection Sytem	$14,535	7.1	Yes	Yes
Hilti	PS 20 Multi-Detector	$720	4	Yes	No
James Instruments	HR Rebar Locator	$1,190	10	Yes	Yes
Proceq	Profometer 5 Rebar Locator (Scanlog Model)	$3,105	7	Yes	Yes
Protovale	Covermaster CM9	$4,040	3.5	Yes	Yes
Protovale	Covermaster CM42	$1,790	3.5	Yes	Yes
Protovale	Rebar Plus	$995	6	Yes	No
Zircon	MT6	$199	6	Yes	No

[1] Maximum published values shown. Maximum cover varies as a function of bar size.

Rebar Locators tested by Steven Schaefer and Associates, Inc.

Test Specimens

The rebar locators were tested on 4 parts of an existing tilt-up concrete building, and a circular concrete bridge column. The reinforcing for each specimen is summarized below:

1. The underside of a curved, cast-in-place concrete stair with #5 bars at 12-inches o.c. (on center) each way. The bottom layer of bars was located 2-inches clear above the bottom of the slab.
2. A 7¼" concrete tilt-up wall panel with #4 vertical bars at 12-inches o.c., and #5 horizontal bars at 18¼-inches o.c. The reinforcing was located in the approximate center of the panel.
3. A 7¼-inch concrete tilt-up wall panel with #4 vertical bars at 8-inches o.c. in each face, and #3 ties at 9 5/8-inches o.c. in the door jambs.
4. An 18-inch diameter building column with (8)-#9 vertical bars and #3 hoop ties at 10-inches o.c.
5. A 36-inch diameter bridge column with unknown reinforcing.

18-inch diameter building column.

Results Summary

Fisher M-101: This model is intended to detect the presence of metallic objects only. It does not provide information regarding the depth of cover to the reinforcement, or the rebar size. This locator was able to adequately detect the presence of the rebar in all cases except the building column. One potential issue we discovered was that it was difficult to reduce the sensitivity of the M-101 enough to distinguish between bars that were located closely together, or avoid interference from other metallic objects such as door frames and conduit. It may be appropriate for use when there is much higher concrete cover than is suitable for the other pieces of equipment we tested.

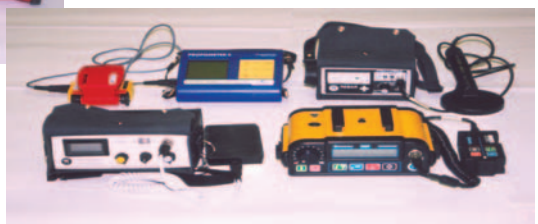
Hilti Ferroscan FS10: The Ferroscan FS10 did the best overall job of locating bars, measuring the cover depths, and determining sizes. It was able to detect the bars and provide reasonable cover measurements for all the test locations except the building column. We were able to obtain reasonable bar measurements for the stair slab, the tilt-up panel with bars each face, and the ties of the bridge column. We were unable to obtain bar size measurements for the panel with bars centered or the building column.

Clockwise from left: Zircon MT6, James Instruments HR Meter, Hilti PS 20, Hilti

The FS10 has an LCD screen that can display the bar locations, giving more confidence in the measured results. Also, the FS10 comes with software that allows for uploading and analysis of the measured data.

Hilti PS 20: The PS 20 was able to adequately locate the bars and measure the cover depths in all the tested scenarios except the building column. It does not determine the bar sizes. The PS 20 was easy to use and fairly consistent.

James Instruments HR Rebar Locator: The HR locator was able to identify the bar locations in all cases except the building column. However, for rough concrete surfaces, the meter readings occasionally spiked due to the movement of the meter, not due to reinforcing. Using the charts included in the manual, it was possible to determine the bar covers and diameters. This was accomplished by using the difference in two meter readings: one with the meter directly on the concrete surface and one with the meter off the surface by a certain shim distance. However, in addition to the meter readings, the accuracy of this measurement was closely related to the ability of the user to properly calibrate the meter. In order to calibrate the meter, it was necessary to hold it at the same attitude (angle to the earth's surface) that the meter would be in at the concrete surface and also parallel to the rebar. For a curved surface, such as the underside of the stair, this had to be estimated and probably contributed to some of the error.



Clockwise from top left: Proceq Profometer 5, Protovale Rebar Plus, Protovale Covermaster CM9, Protovale

Proceq Profometer 5 (Scanlog model): The Profometer 5 was able to locate the rebars and estimate the amount of concrete cover in all cases except the building column. The audible tone indicating a rebar with the Profometer 5 seemed to consistently sound approximately 1" past the rebar, unless care was taken to move the probe slowly. The cover depth estimates varied somewhat, but the mean cover measurements were fairly reliable. We had difficulty obtaining bar diameter measurements at locations where the bars were not within 3" of the concrete surface. The bar diameters were successfully measured at the stairs, although we had some trouble getting consistent readings. The on-screen data collection feature and statistical analysis of the cover depths was useful. The stored data may also be uploaded to a computer or printer. The scanlog model of the Profometer 5 also has a graphical display feature, which was not thoroughly reviewed.

Protovale Covermaster CM9: The CM9 was able to locate the rebars and estimate the amount of concrete cover in all cases except the building column. The cover depth measurements were consistent. Similar to the Profometer 5, we had difficulty obtaining bar diameter measurements in areas where the bars were not located within 3" of the concrete surface. In the stair slab, the bar size measurements were reasonable. However, bar size measurements were too large in the wall panel.

Protovale Covermaster CM42: The CM42 was able to locate the rebars and determine the bar depths for all locations except the building column. The cover estimates were somewhat inconsistent but overall were reliable. The bar sizes could be calculated based on meter readings. Similar to the HR Rebar Locator, the dependability of the measurements depended on the accuracy of the meter readings. This is problematic if the meter readings are not steady, which can occur when scanning over a rough surface.

Protovale Rebar Plus: The Rebar Plus is designed mainly as a rebar locator only, but can also be used for rough cover estimates. It was able to both locate the rebar and provide the cover depths adequately in all cases except the building column. Similar to the Fisher M-101, the Rebar Plus experienced some difficulty with nearby door frames and metallic conduit.

Zircon MT6: The MT6 was able to adequately locate the bars and measure the cover depths in all cases except the building column. It does not determine the bar sizes. The MT6 was easy to use and fairly consistent.

	Contact Information	
Manufacturer	**Phone**	**Website**
Fisher	209-826-3292	www.fisherlab.com
Hilti	800-879-8000	www.us.hilti.com
James Instruments	800-426-6500	www.ndtjames.com
Proceq	41-1-389-98-00	www.proceq.com
Protovale	44-01865-821277	www.protovale.co.uk
Protovale	44-01865-821277	www.protovale.co.uk
Zircon	408-866-8600	www.zircon.com
Note: Proceq and Protovale are international calls. Domestic distributers can be found from links on their respective websites.		

Conclusions

The inability to consistently locate bars and measure cover in the building column was troublesome. Therefore, we included the round bridge column with the test samples to see if the geometry of the building column was causing a problem. Although the cover on the bridge column prevented us from getting consistent bar diameter measurements, the fact that we were able to consistently locate the bars and measure cover with all the locators seemed to indicate that the problem was not the column's shape.

In our opinion, the best locator to use depends on the particular project. For example, if the information must be obtained without damaging the existing construction, then the Hilti Ferroscan would be the best choice of the locators that we reviewed. It provided the most consistent and accurate results. However, if it would be acceptable to remove the rebar cover at some of the bars and measure the bar sizes by hand, or if one is only interested in where the bars are located and how much cover there is to the bars, it is certainly reasonable to use one of the less sophisticated rebar locators.

Tilt-up concrete wall panel with grid paper for use with Hilti Ferroscan FS10

Hilti FS10 in use.

Article Note: Opinions expressed in this article are those of the author and may, or may not, reflect the opinion of STRUCTURE magazine.

Greg Riley is a project engineer and stockholder with Steven Schaefer Associates, Inc., a structural engineering consulting firm located in Cincinnati, Ohio.

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