Productivity Tools for the Concrete Testing Laboratory

Improving processes through automation

BY RICHARD GEDNEY

All concrete testing laboratories produce essentially the same product—strength test reports. So, how can a laboratory manager create a distinctive product while boosting profitability? The answer is through quality and productivity gains by means of automation.

SPEED CONTROL

Concrete exhibits loading-rate sensitivity relative to compressive strength,[1,2] so ASTM C39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens,"[3] limits loading rate to 0.2 to 0.3 MPa/second (28 to 42 psi/second). This helps ensure consistency within and among laboratories.

Almost 70% of the testing machines now in service are manually operated. The operator is therefore required to manually adjust a valve to achieve a loading rate within specification. Unfortunately, these adjustments can be inaccurate, particularly because only about half of the concrete testing machines now in service have any provision to indicate load rate. One-fifth of testing machines now in service do have digital indicators that provide loading rates, but the attained rates aren't verifiable after the tests.

A step in the right direction

To address the shortcoming of nonverifiable loading rates, manually operated machines are now being offered that calculate and report the average loading rate according to ASTM C39 requirements and can generate load and stress versus time curves to verify that a test was performed according to specification. They also offer digital indicators that provide a live indication of loading rate. These systems don't, however, eliminate the possibility that an operator could perform tests at rates exceeding ASTM C39 limits.

More control

There is clearly a need for an automatic concrete testing system that can control loading rate. Control systems used on conventional universal testing machines, however, aren't appropriate for concrete testing applications. Most concrete testing machines in operation are hydraulically actuated and operate at oil pressures as high as 69 MPa (10,000 psi). In contrast, conventional servo-hydraulic testing systems operate at maximum pressures of about 31 MPa (4500 psi). These systems therefore have large—and very expensive—actuators, and their high cost precludes them from widespread use in concrete testing.

Over the past 3 years, ADMET, Inc., has offered a low-cost, reliable, automatic concrete testing system that addresses these issues. As shown in Fig. 1, the new MegaForce II automatic testing system works with compression machines that operate to 69 MPa

Fig. 1: ADMET MegaForce II system mounted on a concrete compression testing machine for breaking concrete cylinders, prisms, and beams

(10,000 psi), prevents the operator from overriding the testing process, and provides verification of loading rates—all for 50 to 75% less cost than for a comparable servo-controlled testing machine. The automatic testing system can be installed on new machines or retrofitted to existing machines, generating further cost savings.

For greater testing flexibility and control at minimal cost, the MegaForce II system can be combined with our MTESTWindows materials testing system to retrofit existing universal testing machines as shown in Fig. 2. The MegaForce II system replaces the manual controls on the existing testing machine to provide full automatic control, while the MTESTWindows system adds monotonic and segmented profiles operating in load, position, or strain control. These features allow existing universal testing machines to perform tests that were impractical or even impossible using manual control methods.

AUTOMATED REPORTING

Many concrete testing laboratories generate thousands of compressive strength test reports annually. If these are submitted to clients and others via the postal service,

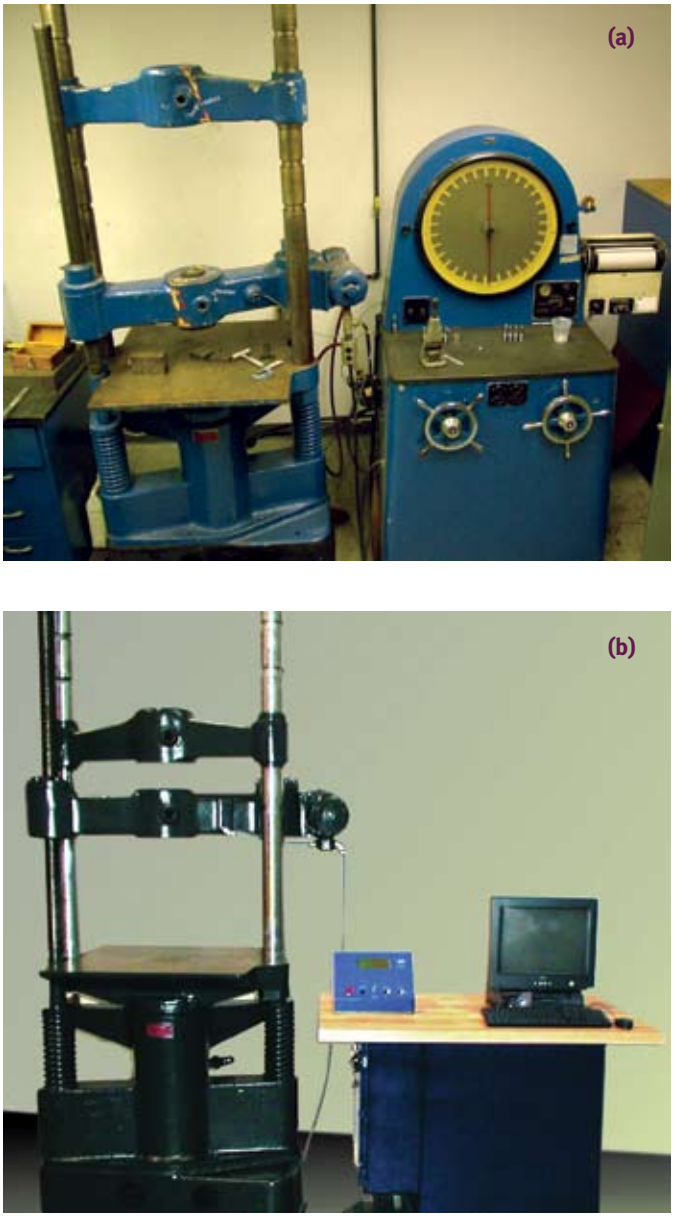
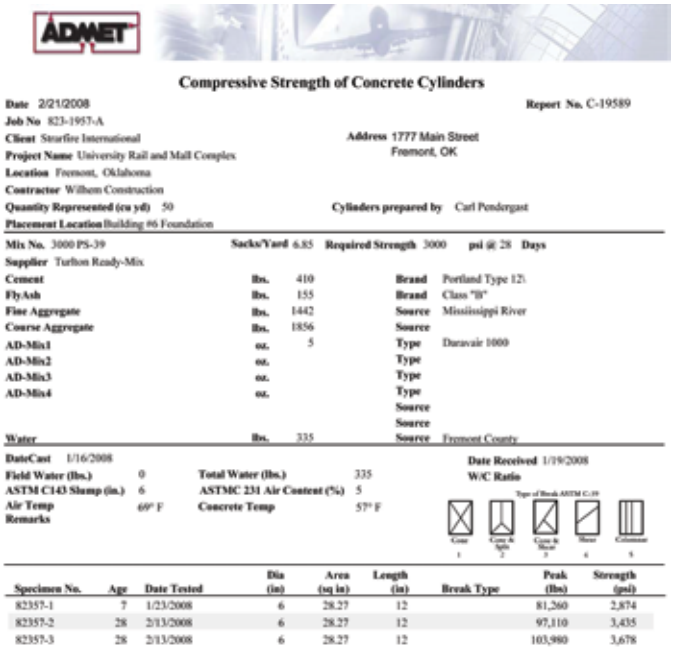


Fig. 2: The MegaForce II system can also be used in conjunction with the MTESTWindows system to retrofit existing universal testing machines: (a) a Baldwin 270 kN (60 kip) universal testing machine with the original manual controls; and (b) a similar testing machine retrofitted with the MTESTWindows system

reports not only create additional handling and postage costs, they have the potential of slowing the construction process itself. This is unnecessary, as testing laboratories can now provide electronic access to all their reports and thereby eliminate mailings and potential delays.



ADMET

Compressive Strength of Concrete Cylinders

Date 2/21/2008 Report No. C-19589
Job No 823-1957-A
Client Strurfire International Address 1777 Main Street Fremont, OK
Project Name University Rail and Mall Complex
Location Fremont, Oklahoma
Contractor Wilhem Construction
Quantity Represented (cu yd) 50 Cylinders prepared by Carl Pendergast
Placement Location Building #6 Foundation

Mix No. 3000 PS-39 Sacks/Yard 6.85 Required Strength 3000 psi @ 28 Days
Supplier Turlton Ready-Mix

Cement	lbs.	410	Brand	Portland Type 12\
FlyAsh	lbs.	155	Brand	Class "B"
Fine Aggregate	lbs.	1442	Source	Mississippi River
Course Aggregate	lbs.	1856	Source	
AD-Mix1	oz.	5	Type	Duravair 1000
AD-Mix2	oz.		Type	
AD-Mix3	oz.		Type	
AD-Mix4	oz.		Type	
			Source	
			Source	
Water	lbs.	335	Source	Fremont County

DateCast 1/16/2008 Date Received 1/19/2008
Field Water (lbs.) 0 Total Water (lbs.) 335 W/C Ratio
ASTM C143 Slump (in.) 6 ASTMC 231 Air Content (%) 5
Air Temp 69° F Concrete Temp 57° F
Remarks

Type of Break ASTM C-39

Specimen No.	Age	Date Tested	Dia (in)	Area (sq in)	Length (in)	Break Type	Peak (lbs)	Strength (psi)
82357-1	7	1/23/2008	6	28.27	12		81,260	2,874
82357-2	28	2/13/2008	6	28.27	12		97,110	3,435
82357-3	28	2/13/2008	6	28.27	12		103,980	3,678

Fig. 3: Compressive strength test reports can be automatically generated, saving the time and money required to manually generate reports while decreasing the chance of errors

Our company offers a database program tailored for concrete testing laboratories and is capable of combining client, contractor, mixture proportion, and field data with the compressive strength data for concrete cylinders. When used with a testing machine that has a digital indicator, it's possible to calculate and store the strength of each cylinder with the date, time, specimen number, specimen geometry, and break type.

At the end of each shift, the test results can be transferred to a computer running the database program and automatically imported into the database tables. Once imported, the results are automatically aligned with the field, client, and mixture proportion data, and compressive strength reports like the one shown in Fig. 3 are only a mouse click away. The computer running the database program can be connected to a web server that has separate, secure folders for each client and contractor. When a compressive strength report is generated, it's written in Adobe Acrobat® PDF format to the appropriate folder on the server where the customer has immediate 24-hour online access to all reports.

The benefits? Besides saving thousands of dollars a year in postage costs, eliminating the administrative work needed to generate paper reports, and minimizing data entry errors, the process can reduce construction delays by shortening the time organizations wait for information.

AUTOMATIC BENEFITS

As each enterprise attempts to remain competitive, the need to reduce testing times, eliminate data entry errors, and speed the delivery of results becomes increasingly important. Employing testing systems that automatically perform the tests according to specification, automatically calculate results, and seamlessly communicate with other computers and programs running on their corporate network will be paramount to success.

References

1. Carino, N.J.; Guthrie, W.F.; Lagergren, E.S.; and Mullings, G.M., "Effects of Testing Variables on the Strength of High-Strength (90 MPa) Concrete Cylinders," *High-Performance Concrete: Proceedings, ACI International Conference, Singapore, 1994*, SP-149, V.M. Malhotra, ed., American Concrete Institute, Farmington Hills, MI, 1994, pp. 589-632.

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3. ASTM C39/C39M-05e1, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens," ASTM International, West Conshohocken, PA, 2005, 7 pp.

Selected for reader interest by the editors.

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CIRCLE 52

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