Case Study: Interstate 40 Bridge Reconstruction; Webbers Falls, Oklahoma

On May 26th, 2002, a barge collided with the Interstate 40 Bridge near Webbers Falls, Oklahoma, collapsing multiple spans and killing 14 people. The flow of traffic in both directions of this major east-west national transportation corridor was abruptly severed. State transportation officials predicted a six-month reconstruction schedule, however, the bridge reopened to traffic after just 47 days of construction. The intelliRock concrete strength measurement system played a major role in the effort, helping the contractor earn a $1.5 million early completion bonus.

Project Background

The Interstate 40-bridge near Webbers Falls, Oklahoma is a heavily-traveled, transconti-nental interstate route – an average of 22,000 vehicles traverse the bridge each day. Estimated user costs of rerouting this traffic around the bridge were $475,000 per day, negatively impacting the economies of the surrounding communities as well as the commuters. The two-lane detour routes began deteriorating quickly under the increased traffic loads and were simply not able to adequately accommodate the increased traffic flow.

The Oklahoma Department of Transportation (ODOT) awarded a $10.9 million bid for reconstruction of the bridge to Gilbert Central Corporation, a unit of Peter Kiewit Sons' Inc. At any given time, contractors and sub-contractors had between 60 and 130 people on the site working two extended shifts, resulting in around the clock activity. It was literally a race against the clock, as the ODOT contract specified a $6,000 per hour bonus for early completion, or a $6,000 penalty for late completion, with no limit set on the amount either way.

The urgency of the project led ODOT to allow contractors to utilize the maturity method to non-destructively determine in-place concrete strength. The maturity method, an American Society for Testing and Materials standard since 1987 (ASTM C 1074), enables contractors and engineers to measure concrete strength in a structure at any time and as many times as necessary until the required strength is achieved.

Measuring Strength with Maturity Meters

ODOT realized that use of the maturity method on this project would save time by allowing the contractor to expedite strength-dependent construction activities such as removing forms, setting beams, and opening to traffic. Because the maturity method has only recently found its way into mainstream use in the United States, ODOT had not used it on a project.

A barrier to more widespread adoption of the maturity method had been the reliability of conventional maturity meters, which have a history of failures for the following reasons:

- Moisture in the maturity meter.
- Theft of the maturity meter.
- Damage to the maturity meter.
- Battery failure of the maturity meter.
- Sensor wires being severed or otherwise disconnected from the maturity meter.
- Maturity meter malfunction due to electrical and/or magnetic interference.
- Chemical discoloration of the maturity meter display cover.
- Inability to read the maturity meter's LCD display due to exposure to sunlight.

Furthermore, conventional maturity meters must remain physically connected to the embedded temperature probes for the entire duration over which maturity readings are desired, exposing them to theft or damage.

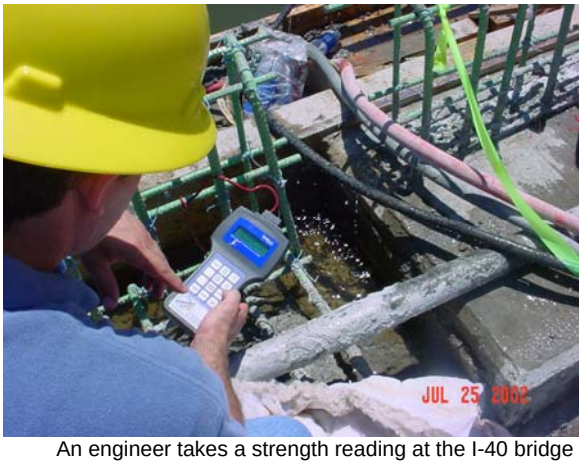
By contrast, the intelliRock system uses an embedded microprocessor with a high-precision temperature sensor to measure temperature and calculate maturity in real time with no permanently affixed external devices. The embedded microprocessor and sensor (called a "logger") is placed into the concrete structure and then activated using a handheld reader. The reader is then disconnected, leaving only two lead wires protruding from the concrete. Whenever a strength measurement is desired, the handheld reader is simply reattached to the two wires and the current temperature and maturity is displayed. In addition, a history of temperature and maturity values and time-stamped minimum and maximum temperatures can be viewed and then downloaded to a personal computer in a secure, unalterable format.

The Texas Experience

ODOT took advantage of experience the Texas Department of Transportation (TxDOT) had as a pioneer in the use of the maturity method for construction projects, and with the intelliRock system. ODOT opened a dialogue with TxDOT, who sent a representative to the I-40 bridge construction site. "We've been using maturity with great success for the past seven years," states James Hill, TxDOT lead inspector, Dallas District. TxDOT had been using the intelliRock system exclusively on its SH-66 project since early 2002 and had found it to be reliable, rugged and easy to use. The TxDOT experience with maturity and intelliRock has resulted in a savings of 3- to 5-days for each concrete placement.

Pete Byers, ODOT Resident Engineer for the I-40 bridge project, was influenced by the success TxDOT experienced with concrete maturity methods and the intelliRock system. "We developed confidence in the intelliRock system when we learned about the success they were having with it in Texas," says Byers. The expectation was that the use of intelliRock would let the contractor better plan the timing of subsequent construction activities without sacrificing quality or safety.

In addition to scheduling advantages, the intelliRock system added a new dimension of quality control to the project. Based on methods pioneered by TxDOT, periodic destructive testing results were compared to the strengths predicted by the maturity method. Any discrepancy could indicate an unintentional change in the concrete mix provided to the job site. However, engineers on site were impressed with the across-the-board agreement between the cylinder break strength and the strength predicted by the intelliRock system.



An engineer takes a strength reading at the I-40 bridge construction site using intelliRock.

Project Details

The reconstruction of the bridge required replacing three piers and four spans – just over 500 feet of bridge. Gilbert Central Corporation used ODOT spec AA high early concrete with super plasticizer for pouring abutments, piers, drill shafts, curbs, walls and the deck. The project consumed about 5,000 cubic yards of concrete, and as it was placed in the formwork, one or more intelliRock maturity loggers were placed in each structural element. The loggers process the time-temperature history of the structure and store the resulting maturity history of the concrete at the specific location of the logger. Project engineers using a handheld reader, were able to connect to these embedded loggers and easily determine the corresponding strength of the structure at any time from the maturity data provided by the logger. The intelliRock system provided data to project engineers that allowed stripping of forms from the crash wall and pier caps in record time. In fact, forms were stripped just 12 ½ hours after pouring pier cap #3!

intelliRock Helps Land $1.5 Million Bonus

On July 29, 2002, Mary Peters, administrator for the U.S. Department of Transportation's Federal Highway Administration, presided over the ribbon cutting for the completed Interstate-40 bridge, just 47 days after the reconstruction project began, a full ten days ahead of schedule. This remarkable feat earned the contractor a $1.5 million dollar bonus. The maturity method and the intelliRock system played a role in this success. "When coupled with the high-early concrete used on the project, intelliRock resulted in significant overall time savings, and enabled considerable acceleration of form removal operations," concludes Byers.

Engius, LLC
1414 S. Sangre Road
Stillwater, OK 74074
1-866-6ENGIUS (1-866-636-4487)
www.engius.com