

WAITING ON YOU

Rapid-setting concrete cures almost as fast
as crews can place in California

- By William & Patti Feldman

Evolving technology centered on an innovative rapid-setting concrete mix is paving the way for faster fixes on California highways and helping the state's DOT meet the challenge of rapid road repair. For Caltrans, the mix is the key to dramatically reducing the length of time lanes undergoing repair must be closed to traffic. Contractors recently achieved a pavement milestone by placing the 200,000th cu yd of this concrete on California highways.

Road repairs performed with traditional concrete mixes, made with conventional portland cement concrete (PCC), take up to 28 days to reach a strength high enough to accept traffic. In comparison, road repairs made with rapid-setting concrete are traffic-ready in less than two hours.

Instant mix

To date, the material, which incorporates a unique rapid-setting cement, has been used in over 135 projects on busy highways around the state for fast-track replacement of individual fatigued concrete panels.

The cement, Rapid Set Cement, was developed by CTS Cement Manufacturing Corp., Cypress, Calif., specifically to expedite highway and airport concrete repair projects. A unique chemistry allows it to set extremely quickly. Concrete formulated with this advanced cement forms a crystalline matrix which is more durable and shrinks only about a quarter of the amount of PCC. It features rapid hardening and high early strength gain and easily exceeds compressive strength of 3,000 psi in one hour. It is ready for highway traffic in just two hours or less after placement.

Specified by Caltrans as part of its Pavement Preservation Strategy, rapid-setting concrete facilitates removal and replacement of full-depth pavement in less than 10 hours. Typically, the



Above: The milestone 200,000 cu yd of rapid-setting concrete was poured during rehabilitation of 12 miles of Highway 4 in Martinez and in Concord, about 40 miles east of San Francisco. The milestone amount is equivalent to about 114 lane-miles.

work occurs at night during off-peak hours. It has become a specified method for repairs in heavy traffic areas where timing presents a challenge and minimizing delay to the public is paramount.

All in a night's work

This past May, the milestone 200,000th cu yd of the rapid-setting concrete was poured during the rehabilitation of 12 miles of Highway 4 in Martinez and in Concord, about 40 miles east of San Francisco. The concrete was produced by Redmond's Concrete Solutions, North Highlands, Calif., and the pour was performed by RGW Con-

struction, Livermore, Calif. As a point of reference, 200,000 cu yd is equivalent to about 40,000 concrete replacement panels, or 114 lane-miles. A typical panel is 12 ft wide x about 15 ft long and at least 9 in. deep.



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"We are now able to perform repairs that were once considered unthinkable in the short time frames allotted each night," noted Asghar Rezaei, P.E., resident engineer, Caltrans District 4 Construction, who oversaw the Highway 4 project. "Depending upon what part of the freeway we were working on, in some situations we had only four to six hours to remove and replace the worn-out panels. And on occasion, we had just three hours for the concrete to set before traffic would resume."

RGW Construction poured approximately

80 to 100 cu yd per night for 15 nights. Over the past 10 years, the industry developed procedures designed specifically to accommodate and maximize the benefits of rapid-setting concrete.

The concrete supplier produces the rapid-setting concrete fresh on the spot, using volumetric mixers. Volumetric mixers are essentially concrete batching plants mounted onto truck chassis. Each material is held in its individual bin or tank until it is ready for mixing by volume on the jobsite.

Caltrans began using volumetric mixers for pavement replacement projects in the mid-1990s. Gregg Redmond, chairman and CEO of Redmond's Concrete Solutions, had used volumetric mixers for portland cement concrete since the early 1980s. In 1995, he pioneered the use of fast-setting concrete with Caltrans and obtained approval for use of the volumetric mixers.

The Caltrans C109 Ready Mix Batch Plant Certification also is required by the volumetric mixer to ensure accuracy and

uniformity.

There are other key benefits of controlling the mix right at the job. The producer can mix exactly what is needed for each pour without the waste that invariably occurs with batch-produced concrete.

"And there is no risk with delay at the jobsite—there are no barrels sitting there turning volatile concrete," Redmond pointed out. "Rather, the concrete is ready to go when called for. Also, unlike with a barrel mix, where what you see is what you get, with mobile batch mixers we can adjust the slump of our materials, which is helpful when there are steep grades.

"In response to ambient temperature, it is also possible to control the set time of rapid-setting concrete by increasing or decreasing the amount

of the retarder going into the concrete, even on the fly in response to how the crew is working with the pour,” he noted.

“For a last hole that requires less than a full barrel, rather than having to turn a full drum of mix to finish the project, we mix only the amount of concrete we need and only charge the state accordingly for what was needed,” Redmond said. “And there is no waste left over in the truck, eliminating the need for quick disposal.”

Speed training

For the Highway 4 project, Redmond’s Concrete Solutions typically used five volumetric trucks, each capable of holding 10 yd. The staging yard was about three miles from the jobsite.

When placing and finishing the mix, the contractor typically uses a hydraulic roller screed and standard finishing tools to work with rapid-setting concrete.

The strength of the concrete is tested on 6-in. x 6-in. x 18-in. beams cast in plastic molds. The material cures on-site and is tested in a portable lab. The load at which the concrete breaks translates to the flexural strength of that concrete. Concrete samples are taken at the beginning and at the end of the pour and at about every 100 yd in between.

Caltrans specifies flexural strength of 2.8 megapascals (Mpa) (406 psi) or greater before a lane is opened to traffic and a seven-day flexural strength of 4.2 Mpa (608 psi) or greater for slabs 255 mm or less. With this rapid-setting concrete produced with volumetric mixers, the Caltrans seven-day strength requirement can be achieved in five hours or less.

Mandatory training is part of the Caltrans specification. Caltrans requires Just-In-Time Training for the rapid-setting concrete pavement projects. Contractors and engineering personnel directly involved with these projects are required to attend. Once the training is completed, a one-year certificate is given to each participant.

“Prior to the start of the project, we poured a test panel, as required by contract, to demonstrate that we know how to work with the material before we open holes on the highway,” noted Mike Hepner, the project manager for RGW Construction. “We also had to demonstrate to the state that

the concrete reaches full design strength in two hours, which leaves time in each shift to get the traffic back up so the closure does not affect the morning rush hour.”

The project was RGW’s first venture with rapid-setting concrete, Hepner pointed out. “We saw how effectively other contractors were using it, so we decided to get involved as well. And we quickly discovered it is good stuff. It lets us deliver a much better highway to drive on, fast.”

Even preliminary work is organized for expediency, efficiency and maximized productivity. For example, the existing concrete panels are saw-cut around the perimeter no more than two days prior to removal and replacement. During the same shift as the pour and after the concrete hardens, crew members saw-cut in control joints. Panels requiring control joints are saw-cut during the pour as well.

“In the old days, with PCC, workers could not start sawing joints in hot weather for perhaps six to eight hours after the concrete was poured because the road was not ready for the necessary equipment,” pointed out Mike De Cremer, who has been building highways since 1972 and was superintendent of the project for RGW. “With rapid-setting concrete, crews can saw the transverse joints in 30 to 40 minutes.”

“Rapid-setting concrete works very well for projects where lane closure requirements do not allow the time to use traditional concrete,” noted Andrew Baskerville, P.E., senior construction engineer, Caltrans District 4. “We are using it increasingly often instead of PCC paving and it is, in fact, becoming a standard material for us.”

Another perk of the material—tests indicate that it has double the life of traditional concrete and 10 times that of asphalt alternatives. ■

Based in New York, William and Patti Feldman are freelance writers specializing in construction-related topics.

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