

CONSTRUCTIONNEER



Route 26 Bridge Patch May Have Big Consequences

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Bridge Maintenance Experts Repair Technology Applied



Maintenance crew prepares for demonstration of MALP concrete repair technology on Route 26 bridge over Nanticoke Creek in Maine, New York.

Bridge maintenance and construction materials officials from Region 9 of the New York State Department of Transportation (NYSDOT) are evaluating non-Portland cement based concrete repair technology that was applied in a mid-June demonstration in Maine, New York, a community of 5,400 people in Broome County.

Using a repair product based on magnesium aluminum liquid phosphate (MALP) binder technology, Region 9 maintenance workers patched a deteriorated section of deck of a small bridge carrying Route 26 over Nanticoke Creek.

Region 9, headquartered in Binghamton, New York, is one of 11 NYSDOT regions, and is responsible for maintaining

some 12,400 centerline miles of local and state highways within seven counties of southern New York. One of those highways is Route 26, a north-south route running from the village of Alexandra Bay in Jefferson County, New York, to Vestal, New York, on the Pennsylvania border.

Managers from NYSDOT's Region 9 hosted the demonstration of MALP technology on the Route 26 bridge. Region 9 personnel included Ron Shapley, Keith Dodd and Todd Evans, who coordinated the June 17 event. NYSDOT's Albany-based Materials Bureau was represented by Guy Hildreth, P.E., and Salah Ali.

Also present for the demonstration were Mark Leighton and Andrew Mabe, representatives of A.H. Harris & Sons

Inc. A.H. Harris has a long history of distributing cement concrete related products including concrete forming systems, chemicals and repair products. Harris has just become the Northeast distributor of MALP concrete repair products manufactured by Phoscrete Corp.

"We wanted to see the actual application of this product," said Leighton. "This is a new technology and we wanted to get some first-hand experience with its use in the field in order to better inform our customers about it," he said.

Bridge Preservation Emphasized

Originally developed for patching industrial concrete floors, MALP technology is being evaluated by a growing

number of transportation engineers who are seeking better ways to patch both horizontal and vertical concrete as part of their bridge preservation efforts. Adding impetus to this search is the support of the Federal Highway Administration (FHWA) for these activities and corresponding availability of federal funds.

FHWA champions bridge preservation, defining it as "actions or strategies that prevent, delay or reduce deterioration of bridges or bridge elements, restore the function of existing bridges, keep bridges in good condition and extend their life. Preservation actions may be preventive or condition-driven. (For further information, see "Bridge Preservation Guide," FHWA Publication Num-

How to Evaluate MALP Concrete to Route 26 Span

By Paul Fournier

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Mark Leighton, A.H. Harris & Sons Inc.



Sawcut is made delineating deteriorated section of concrete deck to be removed for patching demonstration.

ber: FHWA-HIF-11042 Published Date: August 2011). In line with this, bridge concrete repairs are considered to be condition-based elements of preventive maintenance practices, which in turn are components of bridge preservation.

Funding is on the rise as Congress places greater emphasis on systematic preventive maintenance including making Highway Bridge Program funds available for bridge preservation – with less emphasis on bridge replacement and rehabilitation. Therefore, there is considerable federal funding available for concrete repairs, spurring greater interest in alternative technologies on the part of bridge maintenance officials.

Evolving Technology

When MALP technology was developed about 20 years ago, it was initially employed in patching concrete floors and other surfaces exposed to high-temperature spills and other punishing industrial activities. However, about five years ago MALP concrete was introduced to state transportation agencies as an alternative technology for full-depth and partial depth repairs of spalled concrete bridge decks and expansion joint nosings, and



With loose and damaged concrete removed, the section is ready for patching material. Note heavy-duty drill and auger used to mix two patching ingredients.

ASTM Tests Determine Physical Properties of MALP Technology

Physical properties determined by ASTM standard testing procedures of MALP technology concrete include a compressive strength of 4,000 psi in one hour and more than 7,000 psi in 7 days (ASTM test C109); and flexural strength modulus of rupture of 450 psi in one day and 500 psi in 7 days (C78). Results of other ASTM tests show the material doesn't exhibit shrinkage cracking, with a negligible percentage of length change after 28 days of .05 or -0.05 depending on water-curing or air-curing methods (C157); in addition, it has a low chloride ion permeability of 0.32 (C1152); and high bond strength by slant shear testing of 1,000 psi after 7 days (C882).

Furthermore, this technology does not off-gas after setting, unlike technology based on magnesium-ammonia-phosphate cements (MAPC). The latter activate with ammonium di-hydrogen phosphate and water, and reportedly off-gas after setting, producing a discernible odor and affecting the effectiveness of subsequent coatings.



While one 5 gallon pail of powder and liquid activator are mixed with auger, a second pail receives activator for second batch.



Pallet of magnesium-alumina-aggregate dry powder and containers of mono-aluminum-liquid phosphate activator are stored on trailer till needed for job-site mixing.



A worker deposits MALP concrete into the repair section as two others screed the fast-setting material.

horizontal, vertical, and overhead surfaces such as concrete beams and piers.

Phoscrete's products incorporate a pre-packaged magnesium-alumina-aggregate dry powder and a mono-aluminum-liquid phosphate activator. The two ingredients are mixed at the job site in 5 gallon pails or with paddle-style mortar mixers, or it is pre-mixed and introduced to shotcrete apparatus for spraying on vertical, slanted or overhead surfaces. No water is used in MALP concrete.

NYS DOT Protects Huge Inventory

Region 9 officials held the MALP concrete repair demonstration in line with the NYS DOT's policy of evaluating emerging technologies for road and bridge preservation in order to protect its enormous investment in infrastructure while maintaining public safety.

Headquartered in Colonie, a village in Albany County, NYS DOT oversees the development and operation of a 5,000 mile rail network, 12 major public and private ports, more than 450 public and private aviation facilities, 110,000 miles of highway and over 17,000 bridges.

Bridge safety is of prime importance to NYS DOT officials, who make sure that all spans are inspected in accordance with state and federal mandates. While it owns about 44 percent of the bridges in the state, NYS DOT also inspects mu-

nicipal bridges, which amount to roughly half of the state's spans, bringing the total portion of bridges it inspects to approximately 94 percent. The remaining bridges are owned by other state and local authorities, commissions and railroads, who are required to submit their inspection data to NYS DOT.

All publicly owned highway bridges receive a general inspection at least once every two years. Some of them are even inspected annually if they meet certain condition deficiency criteria or are posted for limited load weights. To accomplish this, NYS DOT typically fields about 65 teams of state employees and consultants to conduct biennial and interim inspec-



Standard trowels and floats are used to finish the material, which will set up to a compressive strength of 4,000 psi in one hour and more than 7,000 psi in 7 days.

tions on approximately 9,500 state and municipal bridges each year. According to NYS DOT, bridge inspectors evaluate, assign a condition score, and document the conditions of up to 47 bridge elements.

In its Bridge Inspection and Repair Manual NYS DOT states it "has investigated the effect of preventive maintenance treatments and has concluded that the benefits of applying... maintenance repairs to bridges significantly extends service life and a preventive maintenance program... combined with present guidelines for improving deficient bridges, gave the lowest long term cost for the state bridge program."

NYS DOT uses bridge condition infor-

mation to establish preventive and corrective maintenance programs, as well as bridge rehabilitation and replacement programs. When an inspection of a bridge reveals the need for condition-based preservation actions such as patching deteriorated concrete on sections of decks, beams or piers, engineers will select methods and materials that will best help extend the service life of the span. Typically, they look for cost-efficient materials that are high-strength, rapid-setting, crack-resistant, and durable.

Evaluating Repair Technology

The performance of the MALP concrete used to repair a section of the Route 26 bridge in Maine will be evaluated over time by Region 9 and Materials Bureau officials. They will prepare a report recommending or rejecting the use of MALP technology for NYS DOT's bridge preservation activities.

Thus the June demonstration on a small bridge in a small town could have major ramifications for contractors, materials suppliers and engineers engaged in the state's massive bridge improvement program.

Construction contract commitments for bridge replacement, rehabilitation and maintenance have averaged more than \$485 million annually during the past 5 years, according to NYS DOT.