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Unique NH Route 101 Paving Nets $2M Highways for Life Award

Resurfacing of southern New Hampshire's major east-west highway is recognized by feds for its innovative features.

A material transfer vehicle feeds highly modified asphalt mix to Pike Industries' paver during NHDOT's innovative Highways for Life resurfacing of NH101 in Auburn.

By Paul Fournier

A $10 million resurfacing project on Route 101, southern New Hampshire's major east-west highway, includes so many innovative features the state's Department of Transportation was awarded a $2 million grant from the federal Highways for Life (HfL) program. This grant is in addition to the Federal Highway Administration's usual 80 percent contribution under the 80/20 Federal-aid highway funding program.

NHDOT is currently resurfacing the highway between Manchester and Epping, which lies within the agency's Maintenance District 5. Resurfacing is divided into three projects, the first of which is for a segment of Route 101 from the Manchester-Auburn line to the Auburn-Candia line.

Railroad cars deliver neat asphalt binder to All States Materials Group's Deerfield, Mass., facility for blending with Kraton's D0243 polymer to produce HiMA binder.

The Auburn-Candia contract involves resurfacing approximately 14.4 miles of highway – 7.2 miles eastbound, 7.2 miles westbound. The divided highway has two lanes in each direction and includes Exits 2 and 3. Rehabilitation of seven bridges along NH Route 101 is also part of the contract.

This work consists of a mill-and-fill operation with a 2-inch-thick intermediate course placed in the two travel lanes, followed by a 1.5-inch wearing course installed over both lanes. Other work includes upgrading guardrail, adjusting roadway drainage structures, and pavement work on the Exit 2 and Exit 3 Ramps.

Qualifying for Highways for Life

NHDOT wanted to take part in the HfL program and chose the Auburn-Candia project as the subject of its discretionary grant application to the federal government. This segment

of NH Route 101 was last paved under the 1999/2000 Federal Resurfacing Program, and had been slated for NHDOT's Proposed 2012 Federal Resurfacing Program.

The Route 101 project qualified for the $2 million grant because it met all of the criteria of the HfL program. Unique in the history of New Hampshire highway construction, this project combines six primary construction innovations that have never been used together in the Granite State – and that doesn't include new methods relevant to the project.

The HfL program was established in a provision of congressional highway legislation, "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy For Users" (SAFETEA-LU, Pub. L. 109-59).

HfL aims to accelerate the rate of adoption of innovations and technologies that will result in fast construction of efficient and safe highways and bridges while reducing congestion caused by construction. An "innovation" must be one that the applicant has never before, or rarely, used, with the exceptions of emergency or unique projects. The grant applicant's proposed innovations must be available and ready for use and not require further development or test and evaluation. In addition, an innovation must have standards, specifications, test procedures, training and operations guidance to support its application in routine highway design and construction. What's more, an innovation must have been used successfully with documentation or sufficient evidence of its benefits available.

This singular, Route 101 paving project incorporated the following innovative features:

- High Recycled Asphalt Pavement (RAP) binder content
- Warm Mix Technology (WMA)
- Asphalt-Rubber (AR) Wearing Surface Mix (ASTM D-6114)
- Highly-Polymer Modified Asphalt (HiMA, with Kraton D0243 polymer) Wearing Surface Mix
- Safety Edge Pavement
- Smart Work Zone Techniques

A HAMM HD-110 Compactor is employed as finish roller for wearing course

Innovative Materials

-High-Rap Content: The Auburn-Candia contract requires that the total recycled asphalt binder content of the mill-and-fill portion of the project amounts to roughly a third of the total liquid asphalt content in the pavement mix. Since the total asphalt binder amounts to 6 percent of the total weight of mix, this means the total RAP binder amounts to about 2 percent of the total weight of the mix – higher than ever before used in a New Hampshire non-research project. High-RAP is also used in the Asphalt-Rubber and HiMA wearing course mixes. To ensure consistency, RAP binder for these mixes comes from millings generated from this project.

-Warm Mix Asphalt: The mill-and-fill portion of the project calls for using warm mix asphalt technology to aid compaction of the high-RAP mixture at reduced mix temperatures and thus meet required in-place voids in the stiff mix.

-Asphalt-Rubber (AR) Wearing Surface: AR binder mix, not currently permitted in the NHDOT Standard Specification, is specified for this project for one half of each barrel to promote longevity and prolonged crack resistance (and has the added benefit of recycling scrap tires). The AR mix is gap graded with a minimum asphalt cement binder of 7.6 percent. This project has a 0.5 percent goal for total recycled binder in the mix. Surface mixes in New Hampshire are typically in the range of 5.8 percent to 6.2 percent asphalt. This mix requires a minimum percentage of granulated rubber passing a #16 sieve of 15 percent by weight of total asphalt-rubber binder. WMA technology is also being applied to this mix to lower the mix temperature and eliminate the potential strong rubber odors associated with this product above 300 degrees ferenheit.

-High-Polymer Modified Asphalt (HiMA) Wearing Surface: HiMA mixes are permitted in the NHDOT Standard Specification, and was first installed in New Hampshire in 2011 as a thin-lift overlay on U.S Route 202 in Rochester (more information below). HiMA binder contains 7.5 percent Kraton D0243 polymer, a new type of styrene-butadiene-styrene (SBS) polymer developed and manufactured by Houston-based Kraton Performance Polymers Inc. This polymer loading is about twice as much polymer as used in conventional SBS modified binders. The NH101 project requires a minimum asphalt binder content of 6.5 percent to increase durability. This mix includes high-RAP content with total recycled binder goal of 1 percent. Until now, there has not been a high-RAP, highly polymer-modified, asphalt-rich mix placed in New Hampshire.

Left: A dump truck picks up a load of HiMA mix at Pike's H&B plant in Hooksett, New Hampshire.

Safe and Smart Innovations

The four innovations listed above relate to pavement materials, while the fifth element, Safety Edge, is a mechanical feature. Job specifications call for the use of a "Ramp Champ" Safety Edge device made by Advant-Edge Paving Equipment LLC on the wearing course pavement. NHDOT has established a recent guideline to apply the device to roadways with a 5-foot or less paved shoulder. Although NH

View of completed HiMA mix wearing course which contains high-RAP content, with shoulder at right awaiting leveling gravel course.

Route 101 has a 10 foot shoulder, a Safety Edge is being applied to all non-guardrail locations along the project to improve edge compaction of the wearing course and to provide additional safety.

The Federal Highway Administration says this simple but effective device can help save lives by allowing drivers who stray off highways to return to the road safely. Instead of a vertical drop–off, the Safety Edge shapes the edge of the pavement to 30 degrees, which research indicates is the optimal angle to allow drivers to re–enter the roadway safely. After paving is completed, the Safety Edge is backed with crushed gravel for shoulder leveling.

The final innovative feature listed above refers to two Smart Zone techniques being used to address specific worker safety problems experienced in this corridor. Daytime traffic levels require that paving on this highway be performed at night. The Department notes that the lighter traffic and rural atmosphere of this highway promote faster speeds, in spite of normal traffic control packages. This is particularly hazardous near the paver, where workers are on foot alongside the active travel lane. The solution to this problem was to post excessive speed warning and changeable work zone speed limit signs along the highway near the work area.

Special Testing Protocols

Approximately 21,000 tons of millings associated with mill-and-fill work have been estimated to be enough for the contractor to use for RAP in the new asphalt mixes. NHDOT wants the total quantity of millings to be used either within the binder pavement or salvaged to the Department's Maintenance District 5 storage area.

Normally, DOT calls for a PG64-28 neat binder for wearing courses but due to the high percentage of RAP in the wearing courses for this project, a softer neat asphalt binder with a performance grade of PG58-34 is being used. The compositions of millings and neat asphalt for the mixes are being analyzed using both standard NHDOT protocol tests plus a number of tests not currently employed by the Department. In addition, new equipment has been purchased by the department for some of the tests.

The testing, required to develop and pre-qualify job mix formulas and mix production evaluations, is being performed by the Highway Sustainability Research Center at UMASS' Dartmouth, Massachusetts, campus. UMASS Dartmouth is reporting test data and evaluations to the contractor and NHDOT, with a final report summarizing all data and any general findings. As part of this testing, wearing courses will be compared with each other, and the three individual mixes will be compared against respective control mixes.

Producing Binders and Mixes

Pike Industries is not only the prime contractor for the Auburn-Candia resurfacing but is supplying the hot mix asphalt as well. The Belmont, New Hampshire-based company is producing the various mixes for the project at its H&B asphalt plant in Hooksett, New Hampshire. using asphalt binders supplied by All States Material Group, headquartered in Sunderland, Massachusetts.

According to Ron Simbari, All States' marketing Director, the company manufactures the ASTM D-6114 AR binder (they also refer to it as CRMA, or crumb rubber modified asphalt) by blending ground rubber tires with neat liquid asphalt binder, the wet process, at their Deerfield, Massachusetts plant. They also can ship special portable manufacturing and storage equipment to a mix producer's site for production and storage of AR binder at their hot mix plant, as will be done with Pike in this case. Simbari said the AR binder must be agitated and heated to between 325 and 350 degrees ferenheit to manufacture asphalt mix.

All States manufactures the HiMA binder at its Deerfield plant by blending neat asphalt binder with Kraton D0243 polymer. The HiMA binder is shipped to Pike's Hooksett plant where it can be fed by the tanker directly to the asphalt mix plant, or pumped into storage tanks at the site for future use. Kraton's HiMA binder does not require agitation and is heated to 325 degrees ferenheit to manufacture asphalt mix.

Choosing Binders for Route 101 Test

Simbari said All States has been manufacturing AR binder for about 7 years but this is their first experience with the Kraton HiMA binder.

"We didn't notice any difference between making HiMA binder and making a typical SBS modified binder," Simbari said.

This is not the first time that NHDOT has tried AR binder. Early in 2011, they had a 1.5 inch thick overlay containing AR binder installed on Route 38 in Pelham. About 5600 tons of the gap-graded mix was applied to a 3 mile section of the highway. The Route 101 Auburn-Candia resurfacing project offered another opportunity to observe the material's performance.

Likewise, a previous experience with HiMA binder influenced the NHDOT's decision to choose the material for the Route 101 test, according to Denis Boisvert, P.E., Chief of Materials Technology for NHDOT's Materials & Research Bureau.

"Eric Thibodeau, our Chief of Pavement Management, represented the department for the installation of a 1 inch pavement preservation overlay with HiMA binder on a section of U.S. Route 202 in Rochester in 2011," said Boisvert. "It was part of a national demonstration of thin-lift overlays containing HiMA hosted by the AASHTO TSP2 Program," Boisvert said.

Boisvert was on site to observe that demonstration and commented on the process.

"You couldn't tell the difference in appearance and handling between the conventional mix and the highly polymer-modified mix as they were installed," Boisvert said. "Simply stated, both were hot, black and smooth. Our biggest problem with pavements up here in New Hampshire is cracking due to our cold temperatures. Regular asphalt binder gets brittle and cracks and then water gets in and we have frost heaves. We'll watch the test section and see if any cracks develop over time," he had noted then.

Boisvert said that Thibodeau went back recently to the Route 202 test site to check on results so far and reported that after 2 years, there were no surface cracks visible anywhere on that section of the highway.

"The decision to include a HiMA binder wearing course for the 101 resurfacing project was made right after the Rochester work was completed. It was an opportunity to compare it to another performance pavement," Boisvert said.

The Benefits of Route 101 Innovations

According to NHDOT, the project will add to the department's experience base with modified binder pavements. It will showcase the value that these products bring to the pavement preservation strategy of highway maintenance by extending the life of the pavement surface and reducing the necessary frequency for resurfacing.

The agency points out furthermore that extended project life results in such indirect additional benefits as improved worker safety and reduced traffic congestion through reduced construction frequency.

The project's innovative features help support NHDOT's "green" initiatives. The high RAP requirement promotes the recycling of asphalt products. The use of AR pavement in this project diverts 1,500 used automobile tires per lane mile from the waste stream, while providing long-lasting pavements with reduced spray and noise for both added safety and user satisfaction. Warm Mix Asphalt has many benefits, including reduced fuel use and emissions, improved worker safety and improved compaction, a key element to achieve extended project life. Ultimately, extended project life serves all of the goals of the Highways for Life program, says NHDOT.