16 State House Station
Augusta, Maine 04333

MaineDOT

Transportation Research Division

Technical Report 05-6

Full Depth Reclamation with Cement

Fourth Interim, December 2009

Transportation Research Division

Full Depth Reclamation with Cement

Introduction

Due to the rising cost of virgin aggregate and asphalt products the Maine Department of Transportation (MaineDOT) utilizes a number of reconstruction and rehabilitation processes to cost effectively maintain Maine's highway system. One rehabilitation process in particular is full-depth reclamation (FDR) with cement. This process rebuilds deteriorated roadways by recycling the existing Hot Mix Asphalt (HMA). The old HMA and a portion of base material are pulverized in-place, mixed with cement and water, then shaped and compacted to produce a strong and durable stabilized base material that is sealed with a HMA surface. With the added strength of the stabilized base, thickness of the HMA surface can be reduced resulting in additional cost savings. By recycling the existing HMA materials, construction costs are reduced by 25% to 50% as compared to conventional construction methods.

Problem Statement

There are a number of reasons for roadway failure but one major reason is insufficient support for the HMA surface. Maine has a variety of aggregate base soils that range from well draining granular soils in the southeast and sandy soils in the southwest that provide sufficient roadway support to fine grained, silty, moisture retaining soils in the central and northern portions of the state that have less stability which in turn reduces pavement life.

On projects that have somewhat sufficient aggregate base support, the Department utilizes the FDR process combined with stabilizing agents to increase aggregate base stability. With the added subbase support, the amount of HMA to resurface the project can be reduced resulting in a cost savings for the Department.

In an effort to increase support of the HMA surface and bridge the various soil types or reduce the amount of HMA to resurface a project, the Department has been using the FDR process and blending the material with stabilizing agents such as calcium chloride, lime, emulsion, or asphalt. Stabilizing methods utilizing asphalt products have worked well and were cost effective until recent price increases. To reduce the cost of stabilizing reclaimed HMA, the Department experimented with the use of cement as a stabilizing agent. Cement is a lower cost material that is easily incorporated into reclaimed HMA.

The process involves determining existing HMA layer thickness and obtaining HMA and aggregate base material samples from the project by means of test pits or core samples. The samples are tested for maximum dry density and optimum moisture content. The mix design is determined in the same manner as for soil-cement. Construction begins with pulverizing the existing HMA and aggregate base to a depth of between 6 and 10 inches. If areas of the project do not have sufficient HMA thickness to meet design, stockpiled reclaimed asphalt pavement (RAP) can be spread ahead of the reclaiming machine. A pad foot roller is utilized to compact the lower portion of the RAP. The reclaimed material is then shaped, graded and compacted. At this point traffic can use the roadway until cement is added. To stabilize the reclaimed material, cement is spread in the desired quantity in either a dry or slurry form ahead of the pulverizing equipment and the reclaimed HMA and cement are blended. A pad foot roller is used to compact the lower portion of the stabilized RAP then water is added and the stabilized RAP is shaped, graded and compacted with a vibratory roller. A rubber tired roller is used to seal the surface to prevent water infiltration prior to surfacing. After a short curing period the stabilized base is sealed with HMA. Total layer thickness of new HMA can be reduced by as much as 50 percent with the added strength of the stabilized base.

Project Information

Project Identification Number (PIN) 11326.00 is located in Aroostook County on US Route 2A between the townships of North Yarmouth Academy Grant and Reed Plantation (Figure 1). The project is 5.02 miles in length and is scheduled for Highway Rehabilitation with drainage and safety improvements. Annual Average Daily Traffic is somewhat low at 700 in 2005 with 38 percent heavy trucks. Table 1 contains current (2005) and future (2017) traffic data. Prior treatments include a resurfacing in 1995 and a thin overlay of maintenance mix in 2001. The project has many areas with transverse, alligator, and block type cracks as displayed in Photo 1.

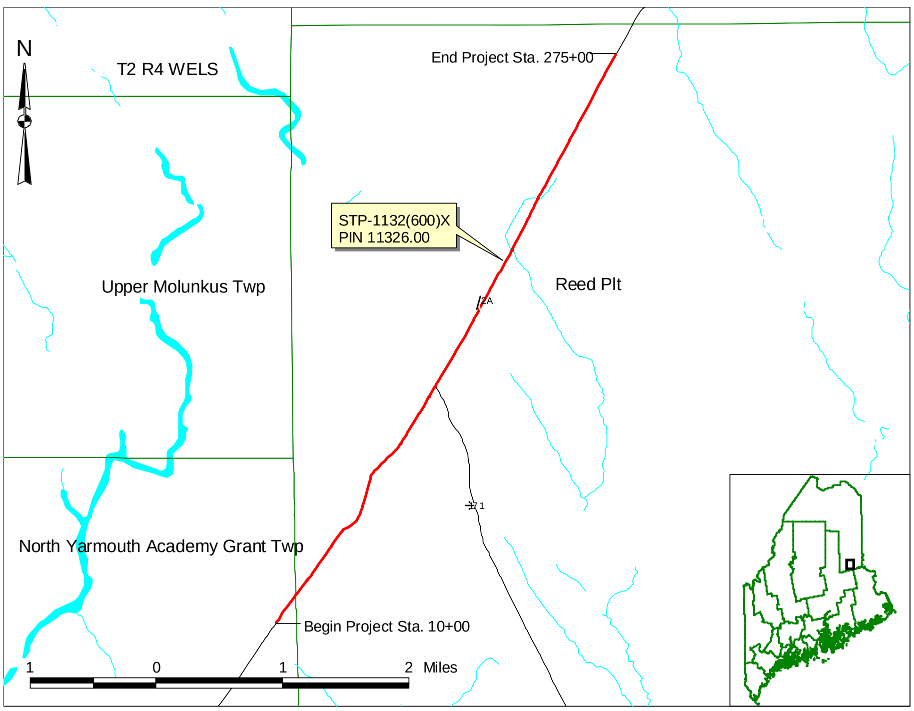

Figure 1: PIN 11326.00 Location Map

Table 1: Traffic Data

Current (2005) AADT………………	700
Future (2017) AADT………………...	780
DHV - % of AADT…………………..	11
Design Hour Volume………………...	92
% Heavy Trucks (AADT)……………	38
% Heavy Trucks (DHV)……………..	26
Directional Distribution (DHV)……...	59
18 kip Equivalent P 2.0………………	402
18 kip Equivalent P 2.5………………	382
Design Speed (mph)………………….	50

Photo 1: Typical Cracking in the North Lane

Mix Design

For Mix Design information, please refer to Construction and First Interim Report dated February, 2007.

Construction

For Construction information, please refer to Construction and First Interim Report dated February, 2007.

Project Evaluation

An experimental section was established between stations 265+00 and 270+00. A control section is located between stations 270+00 and 275+00. The Control Section was constructed using the same pulverizing and compaction procedures as the cement treated areas with the exclusion of cement.

The Control section had in-place densities of 96 percent at station 273+50, 8’ Rt. and 99 percent at station 273+00, 8’ Lt.

Structural Summary

Structural strength measurements using the FWD were not collected in 2009.

Rut and Ride Quality Summary

Rut depth readings and Ride (IRI) were collected using the ARAN on 10/19/09. Previous rut depths from 2007, using a straight edge, were reported in the December 2008 interim report

Readings from the 2009 ARAN data collection are summarized below.

	Control		**Soil Cement**	
	Northbound Lane	**Southbound Lane**	**Northbound Lane**	**Southbound Lane**
Average (in.)	0.135	0.190	0.170	0.175

2009 Rut data comparison between the Control and Soil Cement Sections show no significant differences. Overall rut values indicate good condition.

2009 IRI data from the ARAN is as follows:

	Control		**Soil Cement**	
	Northbound Lane	**Southbound Lane**	**Northbound Lane**	**Southbound Lane**
IRI (in./mile)	50	56	51	64

IRI data is overall very good and comparisons show no real significant differences between sections.

Visual Summary

Visual evaluations were completed on September 16th, 2009. The Control Section remains in very good condition with virtually no transverse or load associated cracking. There is one significant longitudinal crack in the Northbound Lane shoulder, however, as noted in previous Interim reports. The Soil Cement Section has three (3) full width transverse cracks and numerous partial width cracks. In addition, there is approximately 250 ft. of load associated longitudinal cracking in the lanes. Exact length and location of cracks were not documented for this Interim report but will be for the final inspection and report.

Photo 2: Shoulder Crack in Control Section – 2009

Photo 3 – Control Section

Photo4 – Soil Cement Transverse Cracking

Photo 5 – Soil Cement Longitudinal Cracking

Conclusions

Transverse and longitudinal cracking in the soil cement section is a concern. A general observation during the 2009 field inspection is that the majority of the entire project has this type of cracking as well. It is possible that too much cement (4%) may have been used on this project making the pavement section less flexible in this harsh environment. Comparisons of rut and ride data show no significant differences between the control and soil cement sections.

Prepared by:

Dale Peabody
Transportation Research Division
Office Safety, Training and Research
Maine Department of Transportation
16 State House Station
Augusta, Maine 04333-0016
Tel. 207-624-3305
e-mail: dale.peabody@maine.gov