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# Maine Department of Transportation Transportation Research Division

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**Construction Report & Second Year Interim Report 03-09**  
*Shoulder Rehabilitation Using Portland Cement and  
Recycled Asphalt Pavement  
Winslow, U.S. Route 201*

*October 2003*

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# Transportation Research Division

## *Shoulder Rehabilitation Using Portland Cement and Recycled Asphalt Pavement*

### Introduction

Maine has hundreds of miles of roadway originally constructed with Portland Cement Concrete that now are covered with Hot Mix Asphalt overlays. In 2001 the Maine Department of Transportation utilized an experimental construction technique on one of these PCC highways. The project was a rehabilitation and resurfacing project located in Winslow. In an effort to provide a more durable roadway, recycled materials were used in an innovative way. The project utilized Portland cement, together with reclaimed asphalt pavement (RAP) milled from the highway, together with new aggregate to reinforce and stabilize road shoulders adjacent to the existing old concrete slabs. The goal was to strengthen the shoulder adjacent to the existing concrete slabs and widen the travel lanes to prevent future premature deterioration in the shoulder. Figure 1 shows the project location. In this report the mixture of pavement grindings (RAP) and Portland cement material will be referred to as RAP/PC blend.

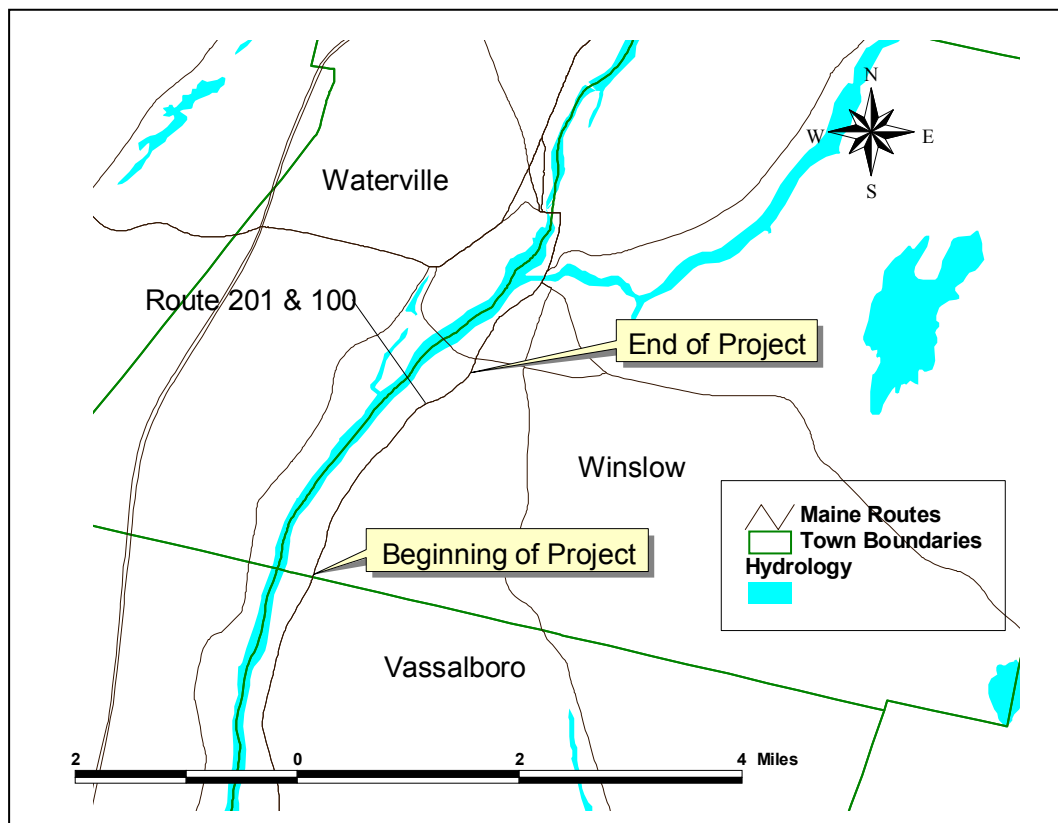


Figure 1. Location Map

## Material Used

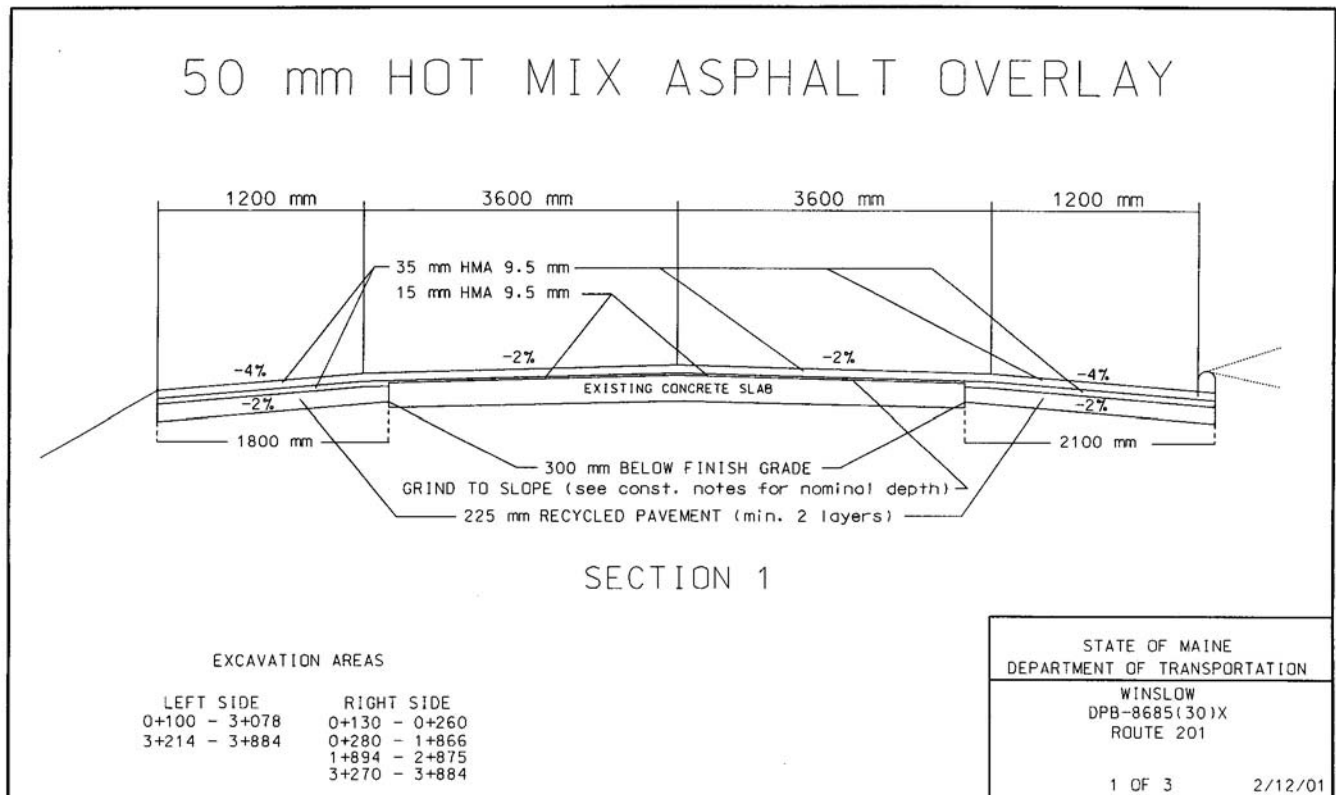
The project required placing approximately 12,500 square meters of PC-RAP blend. The specified percentage of cement was  $4 \pm 1\%$ . The actual cement percentage achieved was 5.8%. Maximum RAP size was 37.5 mm. The mix was placed 1200 mm wide, in two lifts over a 300 mm gravel base. Total depth of the PC-RAP blend was 225 mm deep. The final average composition of the blend was: 62.1% RAP millings, 9.5% stone, 22.7% sand, and 5.8% cement. Anticipated core strengths were around 400 psi, however with the slightly higher cement content, cores tested at an average of 900 psi. A copy of the contract specifications for the material is contained in the Appendix.

## Construction Procedure

The sequence of construction was as follows:

- 1) Grind existing HMA pavement across full width.
- 2) Shim one side of roadway to the edge of existing concrete slab where slope requires correction.
- 3) Excavate from edge of concrete out and place grindings.
- 4) Switch to opposite side and repeat procedure.
- 5) Place HMA pavement.
- 6) Construct ditching and inslope work.

Figure 2 below shows the typical cross-section.



## Construction Photos

The following photos show several stages in the construction process.



Figure 3. Initial Asphalt Grinding Operation



Figure 4. One of the Old Damaged Concrete Slabs Being Repaired



Figure 5. Excavation of Trench Adjacent to PCC Slabs



Figure 6. Placement of Gravel Base



Figure 7. Shoulder Spreader Equipment Placing Gravel Base



Figure 8. Preparation of Gravel Base



Figure 9. Placing the RAP Mixture



Figure 10. Final Lift of RAP Mixture





Figure 11. Rolling the Final Lift of RAP



Figure 12.



Figure 13. Shoulder Ready for Paving



Figure 14.



Figure 15. Paving Operation



Figure 16. Customized Mixing Equipment for Preparing the RAP & PC



Figure 17. Preparing the Mix



Figure 18. Mixture being Loaded into Trucks



Figure 19.



Figure 20.



Figure 22.



Figure 23.





Figure 24.



Figure 25. Core Showing PC-RAP & HMA Asphalt Surface Pavement

## Long Term Performance

The section was reviewed for performance during the spring of 2003. Numerous reflective cracks have developed at the edges of the original concrete slabs. In addition some cracking was noticed in the shoulder areas. Localized severe cracks were noted on some areas. The worst cracking occurred near a drainage ditch on the north end of the project. This cracking may have been due to frost action. Perhaps more extensive drainage installation would have been warranted in this area. The following photos were taken during the 2003 inspection.



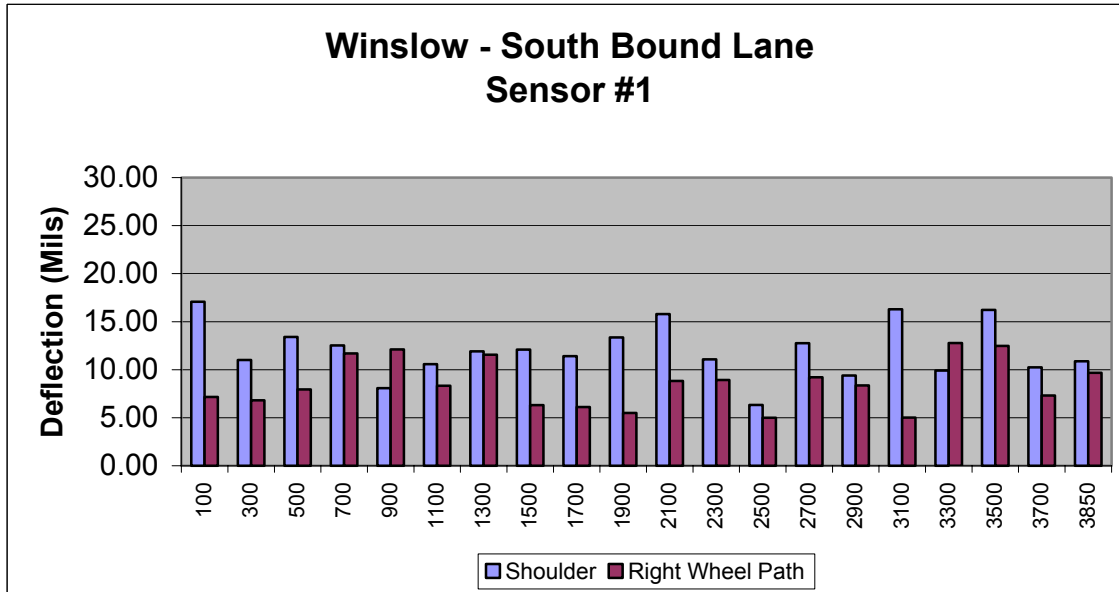
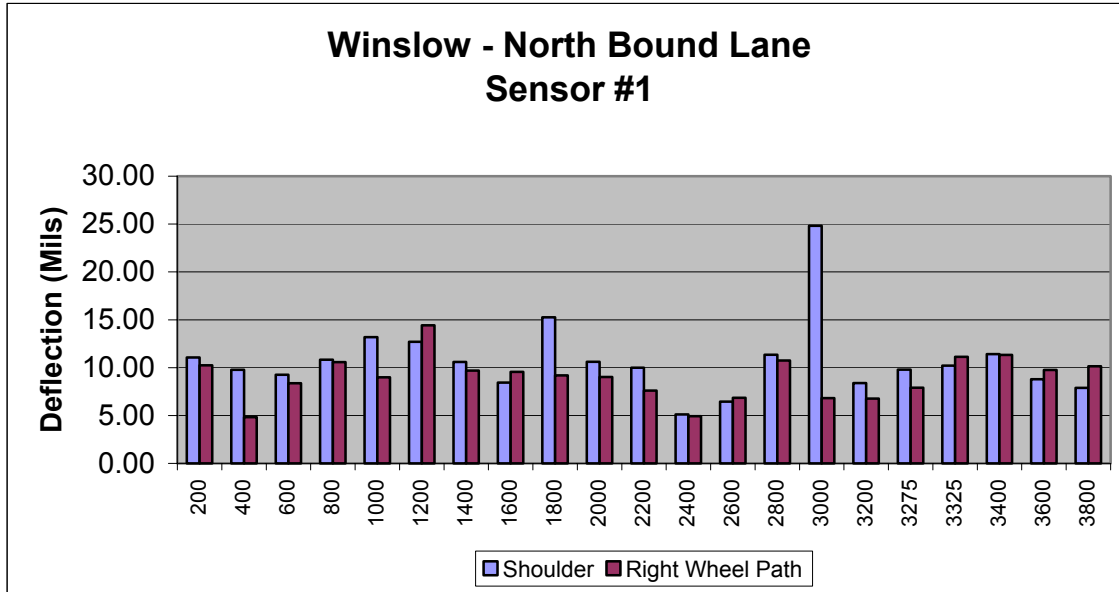






## FWD Data

The sections were tested for strength using a Falling Weight Deflectometer (FWD). The charts below show the average deflections taken every 50 meters.



The tests show that the shoulder area has significantly more deflection than the wheelpath. The difference in shoulder deflections vs. wheelpath deflections is statistically significant. Curiously the pattern of the deflections does not appear random but shows a tendency toward a wavelike pattern perhaps following the general elevations of the highway. The lowest and highest deflections in both northbound and southbound sections appear to approximately coincide. This phenomenon will be investigated further in future monitoring.

## Conclusions and Recommendations

This experimental construction technique did not, nor was it expected to, prevent longitudinal reflective cracking along the joints with the existing concrete slabs. The technique has for the most part successfully stabilized the shoulders. From that standpoint, it has been a successful technique. A few areas, however, show severe longitudinal cracking which is made worse by frost heaving. It is believed that more extensive drainage could have prevented some of this problem. If this technique is used on future projects more attention needs to be paid to enhancing and improving subsurface drainage in these problem areas. In addition, methods to prevent longitudinal cracking, such as pavement reinforcing geosynthetics may prolong the service life of these roadways.

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Photo Credits:

Construction photos were generously provided by Bridgecorp, 319 Water Street, Augusta, ME 04338-2588



**Special Provision**  
**Section 307**  
**Plant Mixed Recycled Asphalt Pavement**  
**(With Portland Cement)**

307.0] Description. This work shall consist of furnishing and placing one or more courses of plant mixed recycled asphalt pavement on an approved base in accordance with these specifications and in reasonable close conformity with lines, grades, thickness, *and* typical cross sections shown on the plans or established by the Resident.

**Materials**

307.02 Composition of Mixture. The mixture shall be composed of recycled asphalt pavement and Portland Cement. The recycled asphalt pavement shall be processed by the Contractor so all material will be no larger than 37.5 mm (1.5 inches) and stockpiled so as to minimize segregation. The stockpile shall be free of any material not generally considered to be asphalt pavement.

The Mixture shall contain 4% ± 1% Portland Cement by weight.  
A Job Mix Formula for the percent of cement and water will be established by the MDOT lab.

307.022 Portland Cement. The Portland Cement shall be Type I or II meeting requirements of ASHTO M85-S9.

**Equipment**

307.03 Mixing Plant. The Mixing Plant shall be of sufficient capacity and coordinated to adequately handle the proposed construction. Either a continuous pugmill mixer or a continuous drum type mixing plant shall be used. If a drum mixing plant is used it shall meet the requirements of section 401.08 of the Special Provisions. The mixing plant shall be capable of producing a uniform mixture meeting the requirements of the Job Mix Formula.

307.04 Hauling Equipment Trucks used for hauling the mixture shall meet the requirements of Subsection 401.09 of the Special Provisions.

307.05 Bituminous Pavers. Pavers shall meet the requirements of Subsection 401.10 of the Special Provisions.

307.06 Rollers. Rollers shall meet the requirements of Subsection 401.11 of the Special Provisions.

## Construction Requirements

307.07 Mixing The recycled asphalt pavement shall be delivered to the mixer at a temperature of not less than 5°C (41°F). the Recycled Pavement and Portland Cement shall be proportioned and the mixing time set to produce a mixture in which uniform distribution of the Portland Cement and Recycled Pavement is obtained.

307.08 Weather Limitations. The Plant Mixed Recycled Asphalt shall not be placed under any of the following conditions: (A) When there is standing water on the surface., (B) When the air temperature in the shade is less than 5°C (41°F), (C) When the surface is frozen, (D) When weather conditions otherwise prevent proper handling, finishing, or curing of the mixture.

307.09 Spreading and Finishing The mixture shall be spread and finished in accordance with Subsection 401.16 of the Special Provisions.

307.10 Compaction Density of the Plant Mixed Recycled Asphalt Pavement will be determined by the MDOT by using nuclear density gauges. A 90 meter (295 Feet) section at the start of the pulverizing operation will be designed as the control section. After the control section has been pulverized, the Portland Cement added and mixed, and the roadway brought to proper shape, it will be rolled as directed until the nuclear density readings show an increase in dry density of less than 16 kg/NI<sup>3</sup> (1 pcf) for the final four vibratory roller passes. This density will be used as the target density for the Plant Mixed Recycled Asphalt Pavement. The remaining Plant Mixed Recycled Asphalt Pavement shall be compacted to a minimum density of 98% of the target density as determined in the control section or to the satisfaction of the Resident.

307.11 Surface Tolerances. The surface tolerances shall be specified in Subsection 401.111 of the Special Provisions, except that the maximum allowable variation shall be 10 mm (3/8 inch).

307.12 Curing No new pavement shall be placed on the Plant Mixed Recycled Asphalt Pavement until a curing period of 24 Hrs. has elapsed.

307.13 Method of Measurement Plant Mixed Recycled Asphalt Pavement shall be measured by the square meter (square yard).

307.14 Basis of Payment The accepted quantity of Plant Mixed Recycled Asphalt Pavement will be paid for at the contract unit price per square meter (square yard), complete in place which price will be full compensation for furnishing all equipment and labor for processing, mixing, placing, and compacting and for all incidentals necessary to complete the work.

Payments will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
307.50 Plant Mixed Recycled Asphalt Pavement	Square Meter (Square Yard)