STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSPORTATION RESEARCH DIVISION
BUREAU OF PLANNING

April 2001

EXPERIMENTAL CONSTRUCTION REPORT 99-11

INNOVATIVE SOLUTIONS to BURIED
PORTLAND CEMENT CONCRETE ROADWAYS

SECOND INTERIM

INTRODUCTION

Maine has hundreds of miles of highway that were constructed of Portland Cement Concrete (PCC) roughly 6 to 6.1 m (18 to 20 ft) wide forty or more years ago. Since that time these same highways have been paved and widened to 6.7 or 7 m (22 or 24 ft) with hot bituminous pavements to accommodate increased traffic volumes. Bituminous materials were used in place of concrete due to the ease of placement and price of material.

PCC is a rigid pavement capable of supporting weight with little deflection. Hot bituminous pavement is flexible and will bend to distribute weight across the roadway. When the highway is expanded beyond the concrete slab there is a sharp decrease of support for this bituminous pavement resulting in settlement over prolonged use. This settlement may also be compounded by poor drainage capabilities of the underlying soils causing the unsupported pavement to drop lower than the existing height of the concrete supported pavement. This creates a longitudinal crack aligning with the concrete slab edge about 0.3 to 1 m (1 to 3 ft) from the right edge of pavement. Pavement to the right of this crack deteriorates to the point where maintenance crews attempt to smooth it out with cold patch year after year. Paving over the entire roadway is an option but, due to reflective cracking, the edge of pavement begins to deteriorate within 2 or 3 years.

It is the intent of this experimental project to explore various shoulder treatments to increase support of the extended roadway and hopefully decrease or eliminate deterioration of the shoulder pavement.

BACKGROUND

Project No. STP-8651(00)X on Route 100 between the towns of Benton and Palmyra is 30.6 km (19 mi) long and scheduled for an overlay of maintenance mix. This is a 7.3 m (24 ft) bituminous roadway over 6.2 m (20 ft) of PCC. The 0.6 m (2 ft) edge of pavement on both sides has deteriorated, creating a traffic hazard and maintenance problem for years. Condition of the drainage ditch is poor along the entire project and there is very little underdrain. A section of this project beginning 4.5 km (2.8 mi) north of the junction of Route 100A in Benton and extending north 2.5 km (1.6 mi) to the town of Clinton was selected to construct four experimental shoulder rehabilitation sections. This project was activated in August with a deadline of October 30, 1998, so time and available money to develop experimental sections was limited. An E-mail request, phone interviews, and literature search of AASHTO members were conducted to gather information on techniques used to correct composite roadway shoulder problems. A panel, with personal from Highway Design, Construction, and Geotechnical Divisions plus the Bureau of Maintenance and Operations, used this information as well as ideas of their own to design four experimental sections, each 500 m (1640 ft) in length plus a control section 500 m (1640 ft) in length.

Another shoulder rehabilitation experiment that is not part of the Benton - Clinton project but will be included in this report was constructed in 1997-98 on Route 2 in Veazie. This is a 6.6 m (22 ft) bituminous highway over 5.2 m (18 ft) of PCC. This project also had poor drainage and a deteriorated pavement edge causing traffic hazards and maintenance headaches. The experimental section begins 100 m (328 ft) north of Chase Road in Veazie and extends north 190 m (623 ft).

CONSTRUCTION

Benton - Clinton Project No. STP-8651(00)X

Construction of each shoulder treatment went smoothly. Most of the material excavated from the shoulders consisted of granular soil not clay as expected and the depth of each trench did not penetrate the clay subgrade.

Figures 1 - 4 contain cross sections for each experimental treatment. Limits and a brief description for each section is as follows:

Section 0 Maintenance Mix (control)

This section is located between station 0+500 and 1+000. There is no shoulder rehabilitation and the roadway is treated with an estimated average thickness of 20 mm (0.75 in) of 9.5 mm (0.374 in) maintenance mix.

Section 1 Cold Recycled Pavement

This section is located between station 1+000 and 1+500. The existing pavement was ground to slope to a nominal depth of 50 mm (2 in). The shoulders were excavated adjacent to the existing PCC slab edge to a depth of 680 mm (27 in) and width of 1200 mm (47 in). This boxed shoulder was then filled with 300 mm (12 in) of Type D Aggregate Subbase Coarse Gravel (ASCG) MDOT Standard Specifications Item Number 703.06 and 380 mm (15 in) of Cold Recycled Pavement.

The roadway and shoulders were then paved with a 60 mm (2.4 in) layer of 19 mm (0.75 in) Superpave Binder and topped with a 40 mm (1.6 in) layer of 12.5 mm (0.5 in) Superpave wearing coarse.

Section 2 Flowable Fill

Flowable Concrete Fill is a concrete mixture that includes 245-105 kg cement/M^3 with a water-cement ratio low enough to prevent segregation of the mix and a target Air Content of 5-15 percent. A modified slump test spread of 225 - 350 mm (8.9 - 13.8 in) is considered flowable. The slump spread is obtained by setting a 75 mm x 150 mm (3 in x 6 in) cylinder mold, open on both ends, on a flat surface, then filling the cylinder and striking off the top. During a count of three seconds, lift the cylinder straight up allowing the sample to spread on the flat surface. The spread diameter is measured to the nearest 15 mm (0.6 in).

All existing pavement was removed to the PCC surface and the shoulders were excavated adjacent to the PCC slab to a depth of 530 mm (21 in) and width of 1200 mm (47 in). The exposed PCC slab could not hold up to traffic and had to be shimmed with 9.5 mm (0.374 in) bituminous mix.

There are two separate shoulder treatments within this section. Section 2A located between station 1+500 to 1+970 right and 1+500 to 2+000 left.

This section has 300 mm (12 in) of ASCG and 230 mm (9 in) of Flowable Fill.

Section 2B is located between station 1+970 and 2+000 right. This section has no ASCG and 530 mm (21 in) of Flowable Fill.

Surface treatment for Section 2 consists of 60 mm (2.4 in) of 19 mm (0.75 in) Superpave Binder and 40 mm (1.6 in) of 12.5 mm (0.5 in) Superpave wearing coarse.

Section 3 Superpave

This section is located between station 2+000 and 2+500. The existing pavement was removed and shoulders were excavated beside the PCC slab to a depth of 530 mm (21 in) and width of 1200 mm (47 in). As with Section 2, the exposed PCC slab could not hold up to traffic and had to be shimmed with 9.5 mm (0.374 in) bituminous mix.

MDOT specifies that traveled way surface mix can be placed between the dates of April 15th and the Saturday following October 15th. The surface deadline was nearing before Section 3 shoulder construction was completed. To avoid the deadline, the roadway was paved with 60 mm (2.4 in) of 19 mm (0.75 in) Superpave Binder and 40 mm (1.6 in) of 12.5 mm (0.5 in) Superpave wearing coarse to an offset of 3 m (10 ft) left and right of centerline. Reconstruction of the shoulder continued after the roadway was paved. The shoulder treatment consists of 300 mm (12 in) of ASCG and 230 mm (9 in) of 25 mm (1 in) Superpave Binder. Binder and surface mix was placed on the shoulders after shoulder reconstruction was complete. This left a longitudinal joint 3 m (10 ft) left and right of centerline.

Section 4 Heavy Overlay

Section 4 is located between station 2+500 and 3+000. The existing shoulders were graded and compacted. All unsuitable material was removed and areas that were below grade were filled with ASCG and compacted to required grade. The roadway was then shimmed with a minimum of 13 mm (0.5 in) of 9.5 mm (0.374 in) bituminous mix. Then the roadway and shoulders were paved with 40 mm (1.6 in) of 12.5 mm (0.5 in) Superpave wearing coarse.

Construction of this shoulder treatment and application of the self-adhesive mesh went smoothly with no setbacks. Figure 5 contains a typical section of the self-adhesive mesh.

A description and location for each section is as follows:

Self-Adhesive Mesh Section

This experimental area begins at station 2+140 and ends at 2+330. The project entails grinding 75 mm (3.0 in) of existing pavement then shimming with 5 mm (0.2 in) of 4.75 mm (0.187 in) bituminous mix.

The shoulders were trenched to a depth of 150 mm (6 in) below height of the milled and shimmed pavement and to a variable width of 0.6 to 2.5 m (2 to 8 ft). This trench is then filled with 150 mm (6 in) of Hot Recycled Pavement made up of a blend of 60 percent virgin aggregate and 40 percent recycled pavement with an asphalt content of 2.5 to 4.5 percent using AC-20 grade asphalt cement. A layer of PavePrep SA 7 self-adhesive mesh, manufactured by Contech Construction Products Incorporated, 508 millimeters (20 inches) wide was placed to bridge the transition between concrete supported pavement and Hot Recycled shoulder.

The roadway and shoulders were then paved with 40 mm (1.5 in) of 19 mm (0.75 in) binder and 30 mm (1.2 in) of 12.5 mm (0.5 in) wearing coarse.

Control Section

This section is located between station 3+230 and 3+420. The existing pavement was milled to a depth of 75 mm (3.0 in) then shimmed with 5 mm (0.2 in) of 4.75 mm (0.187 in) bituminous mix.

Shoulders were excavated to a width of 600 mm (22 in) beyond the PCC edge and depth of 150 mm (6 in) below the milled pavement surface. This boxed shoulder area was filled with 150 mm (6 in) of Hot Recycled Pavement.

The highway and shoulders were then surfaced with 40 mm (1.5 in) of 19 mm (0.75 in) binder and 30 mm (1.2 in) of 12.5 mm (0.5 in) wearing coarse.

COST ANALYSIS

A cost per Section summary for the Benton - Clinton project is listed in Table 1. The Section/Meter totals for each treatment represents the cost per centerline meter from shoulder to shoulder. Please note that Section 0 and 4 shoulder treatment costs represent a 0.6 m (2 ft) wide shoulder whereas Section 1, 2 and 3 costs are for a 1.2 m (4 ft) shoulder.

A review of the data reveals that Section 3 Superpave had the highest cost followed by Section 2B Full Depth Flowable Fill, Section 2A 230 mm (9 in) Flowable Fill, Section 1 Cold Recycled Pavement, Section 4 Heavy Overlay and finally Section 0 Maintenance Mix.

Table 2 contains a summary of costs per meter for the Veazie - Orono project. The column labeled Section/Meter represents the cost per centerline meter from shoulder to shoulder. Since the Experimental Section has a wider shoulder treatment than the Control Section, the cost analysis for this section will be based on a 0.6 m (2 ft) shoulder.

FALLING WEIGHT DEFLECTOMETER TEST RESULTS

Falling Weight Deflectometer (FWD) readings were collected on 10/17/00. Deflections were recorded on the experimental shoulders and on the PCC supported roadway adjacent to each shoulder test. Table 3 illustrates average FWD deflections recorded from sensor # 1 as well as the difference between roadway and shoulder deflections and the average three-year variance. Raw deflections were used due to software limitations when processing data collected on composite roads containing PCC. FWD data was not collected on the Veazie - Orono project due to utility construction.

Average roadway deflections per Section are very consistent throughout the three-year test period.

Shoulder deflections on the other hand are consistent for 1998 and 2000 but low for all Sections in 1999 with the exception of Section 3. FWD tests in 1999 may have been collected on or very close to the PCC edge resulting in low deflection readings. For this reason we will be evaluating 1998 and 2000 data only. Section 3 shoulder tests for all three years are typical readings possibly due to the defined longitudinal pavement joint (see Section 3 photo) paralleling the PCC edge directing the FWD operator more toward the shoulder. In the future FWD tests will be monitored to assure accurate data collection.

Section 0 (maintenance mix) has the highest average shoulder deflection (high deflections denote weak roadways) at 34.73 mils, 22.85 mils higher than the average adjacent roadway deflection. This section also has the greatest amount of PCC related edge cracking.

Section 1, which was constructed using Recycled Pavement, is very stable with an average shoulder deflection of 14.73 mils, 4.97 mils higher than the average roadway deflection. This section is performing very well with very little pavement cracking.

Section 2A using 230 mm of Flowable Fill has an average deflection of 17.30 mils, 6.99 mils higher than average roadway deflections. This shoulder treatment is supporting the pavement better than Sections 0 and 4, with no shoulder treatment, but has the highest deflections and the greatest amount of PCC related edge cracking of the four experimental sections.

Section 2b with Full Depth Flowable Fill also had strong deflections with an average deflection of 9.44 mils, 1.2 mils higher than the roadway average. This Section, although very short in length at 30 meters, is also supporting traffic very well with very little PCC related edge cracking.

Section 3 using Superpave mix had the lowest average shoulder deflection at 9.05 mils, 1.6 mils higher than the average roadway deflection. This shoulder application is structurally sound but there is evidence of PCC related edge cracking and shoulder elevation changes possibly due to the construction method (mentioned earlier).

Section 4, which consists of a heavy overlay over rehabilitated shoulders, has an average shoulder deflection of 30.65 mils, 22.3 mils higher than the adjacent roadway deflection. This section is supporting the shoulder slightly better than Section 0 (maintenance mix) but deflections are nearly twice as high as the weakest experimental section.

VISUAL OBSERVATIONS

A visual evaluation was conducted on September 9, 2000. Table 4 contains a pavement condition summary for the Benton - Clinton and Veazie - Orono projects.

Benton - Clinton Project No. STP-8651(00)X

Section 0, Maintenance Mix (control)

Rutting was observed throughout this section. Thirty-two percent had rut depths of less than 6 mm (0.25 in), 64% had rut depths between 6 and 13 mm (0.25 and 0.5 in), and 4% was over 19 mm (0.75 in) in depth caused by a truck traveling on un-compacted mix during paving operations.

The centerline joint looked very tight with no raveling and only 6.1% of the joint has separated.

Transverse cracking has increased considerably since last year's evaluation and 85.7% of the section has PCC related edge cracking, an increase of 36.2 %. Typical cracking patterns are exhibited in the Section 0 (Control) photo.

Shoulder elevation remains stable with no change since last year.

Section 1, Cold Recycled Pavement

Slight rutting, less than 6mm (0.24 in) in depth, was observed throughout the entire section.

Centerline joint condition has not changed from last year with 90% of the joint raveled with no cracking.

There is very little transverse cracking, with two half width cracks (across one lane) and two cracks between wheel paths.

PCC related longitudinal cracking has increased since last year from 0.6% to 7.7% with no shoulder elevation change. This increase is the second lowest increase of PCC edge cracking within the experimental sections.

Section 2A, 230 mm Flowable Fill

Last year this section had 100% of less than 6mm (0.25 in) rutting. This year 96.7% is rutted less than 6mm (0.25 in) and 3.3% is rutted 6 - 13 mm (0.25 - 0.5 in) in depth.

Raveling has remained the same at 83% of the section with 0.2% showing signs of separation.

Transverse cracking has increased with 2 half width cracks and 2 cracks between wheel paths.

PCC related edge cracking was evident on 25.3% of the section with no change in shoulder elevation (see Section 2A photo). This is the highest amount of PCC related edge cracking within the experimental sections.

Section 2B, 530 mm Flowable Fill

Although this section is small, it is outperforming all other experimental sections with slight rutting (less than 6mm (0.35 in) in depth) a very tight centerline joint with no raveling and 3% of separation and one full width transverse crack.

This section has the lowest amount of PCC edge related cracking at 3.3% and there is no change in shoulder elevation.

Section 3, 230 mm of 25 mm Superpave

The longitudinal shoulder construction joint 3 m (10 ft) left and right of centerline has separated from the roadway throughout 93.2% of this section (see Section 3 photo).

Rutting has increased since the last evaluation with 91.7% at less than 6 mm (0.25 in), 6.4% at 6 - 13 mm (0.25 - 0.5 in), and 1.9% at greater than 13 mm (0.5 in). Centerline joint ravel remains the same at 30% with no joint separation.

There were no transverse cracks but there was an increase in PCC related cracking from 10.7% to 14.5% (see Section 3 photo) and shoulder elevation has increased from 6 mm (0.25 in) to 13 mm (0.5 in).

Section 4 Heavy Overlay

Rutting has remained the same since the last evaluation as well as centerline joint raveling but there was 0.3% of separation in the joint. Transverse cracking also increased slightly.

PCC related edge cracking has increased from 0.4 to 14.6% with no elevation change (see Section 4 photo).

A natural gas pipeline was installed at an offset of between 4 and 5 m (13 and 16 ft) right of centerline.

Self Adhesive Mesh Section

This section is performing very well. Rutting, joint condition, transverse cracking and PCC edge cracking has not changed since last year (see Self Adhesive Mesh photo).

Control Section

Rutting, centerline joint condition, and transverse cracking has not changed from last year's evaluation.

PCC related cracking has increased from 28% to 30.6% and shoulder elevation has dropped 10 mm (0.4 in) possibly due to utility construction (see Control Section photo).

SUMMARY

Benton - Clinton Project No. STP-8651(00)X

All sections are showing signs of rutting and have increased amounts of PCC related edge cracking.

Section 2B (Full Depth Flowable Fill) is outperforming all other sections. Although this section is short (30 m (100 ft) in length) and has the second highest cost per meter, it has the lowest amount of PCC related edge cracking, second lowest average shoulder deflection, and very little pavement cracking. This adds up to a very stable shoulder treatment.

Section 3 (Superpave) has a large amount of PCC related edge cracking, an increase in rutting, and shoulder elevation has increased from 6 mm (0.25 in) to 13 mm (0.5 in). However, pavement deflections are the lowest of all sections. Although edge cracking has increased, the increase is very small indicating this treatment may be stabilizing. Edge cracking could also be caused by the unusual construction procedure (mentioned earlier). Future evaluations may verify the stability of this treatment. Even though this treatment has the highest cost, the low deflections and small increase in edge cracking indicates this treatment may be used as a shoulder treatment for composite roads.

Section 1 using Recycled Pavement has shoulder pavement deflections 58% lower than the control section and the second lowest amount of PCC edge cracking. There was no increased rutting or centerline joint separation and three additional transverse cracks were observed. This section is supporting the shoulder very well at the lowest cost per meter and could be used as a shoulder treatment for composite roads.

Section 2A using 230 mm of Flowable Fill has the highest shoulder deflections of the four reconstructed shoulders. This section also has increased rutting and transverse cracking as well as the largest amount of PCC edge cracking (with the exception of Section 0). Although this application is supporting the shoulder, it is also showing signs of deterioration more so than the other treatments. Future evaluations will determine if this shoulder treatment should be used.

Section 4 (Heavy Overlay) shoulder deflections are very high, in fact they are only 12% lower than Section 0 shoulder deflections. However, PCC edge cracking is less severe than Section 2A using Flowable Fill. Rutting has not increased but the number of transverse cracks has. This is expected since Section 4 was not milled before resurfacing, allowing reflective cracking of the surface mix. Since there is little edge cracking and the shoulder condition is good this treatment is performing well after two years. Future evaluations will determine if this treatment should be used as a shoulder treatment for composite roads.

Rutting and transverse cracking has increased considerably in Section 0 (Control). Shoulder deflections and the amount of PCC edge cracking has also increased. This Section has very little pavement support beyond the PCC supported roadway and is not recommended as a shoulder treatment for composite roads.

Veazie - Orono Project No. STP-6683(00)X

The Self Adhesive Mesh combined with recycled pavement has reduced the amount of edge cracking in this Section. Future evaluations of this application will determine if this can be used on composite roads.

The Control Section experienced a 2.6% increase in edge cracking from last year and an elevation change of 10 mm (0.4 in). Utility construction in this section could be contributing to the increased edge cracking. Although there is an increase in edge cracking and rutting, the section is appears to be performing well.

Prepared by:	Reviewed by:
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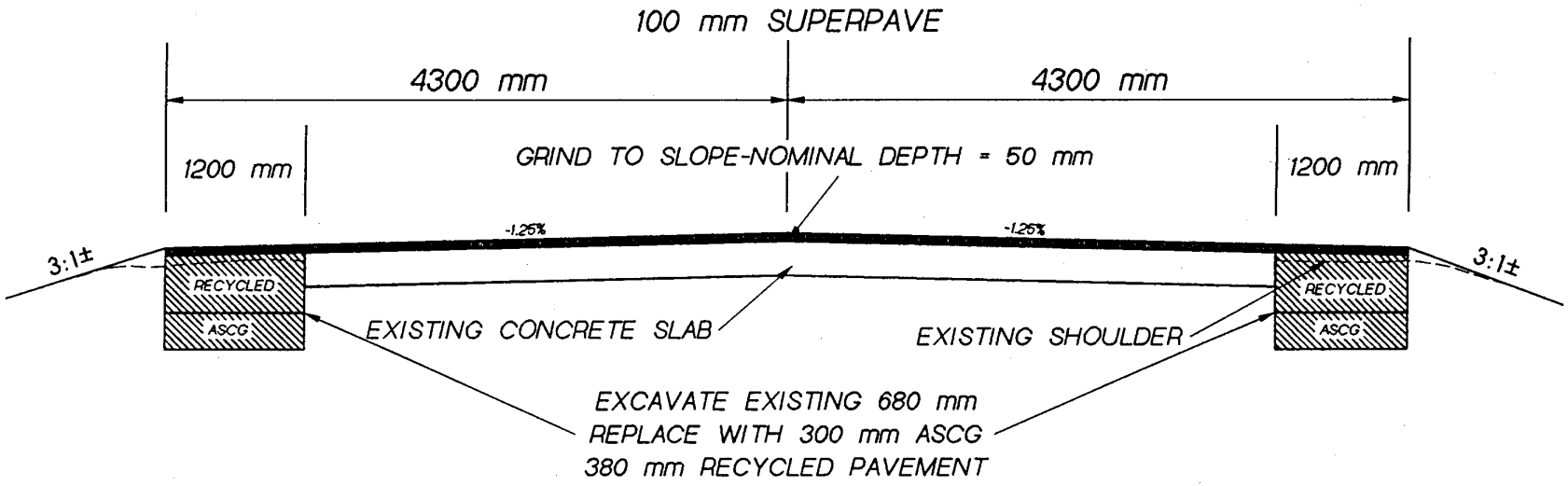
Transportation Planning Analyst	Transportation Research Engineer

TYPICAL SECTION
RECYCLED PAVEMENT



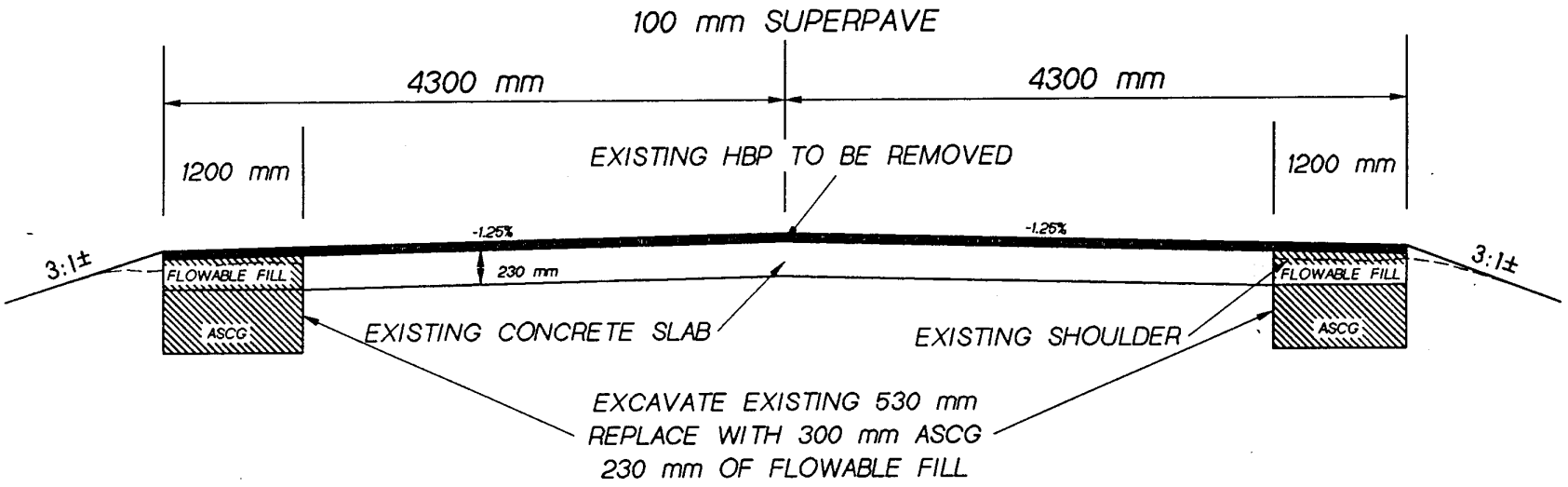
SECTION 1

STATE OF MAINE
DEPT. OF TRANSPORTATION

BENTON–CLINTON
STP–8651(00)X
ROUTE 100

Figure No. 1 Cold Recycled Pavement

TYPICAL SECTION
FLOWABLE FILL



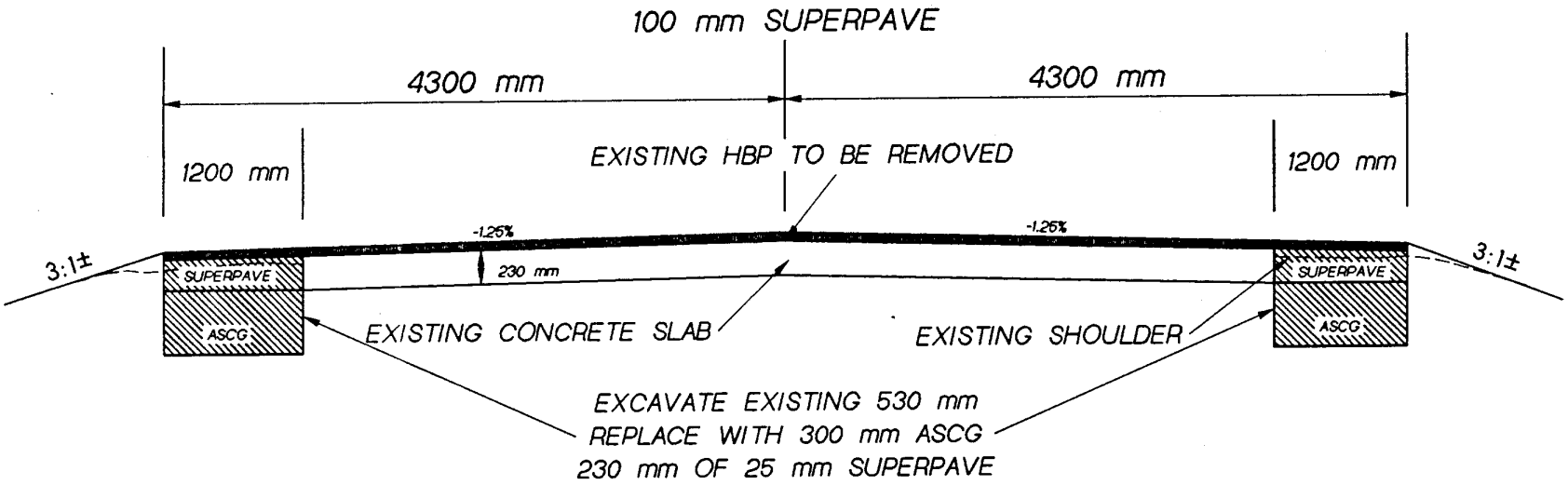
SECTION 2

STATE OF MAINE
DEPT. OF TRANSPORTATION

BENTON–CLINTON
STP–8651(00)X
ROUTE 100

Figure No. 2 Flowable Fill

TYPICAL SECTION
25 mm SUPERPAVE



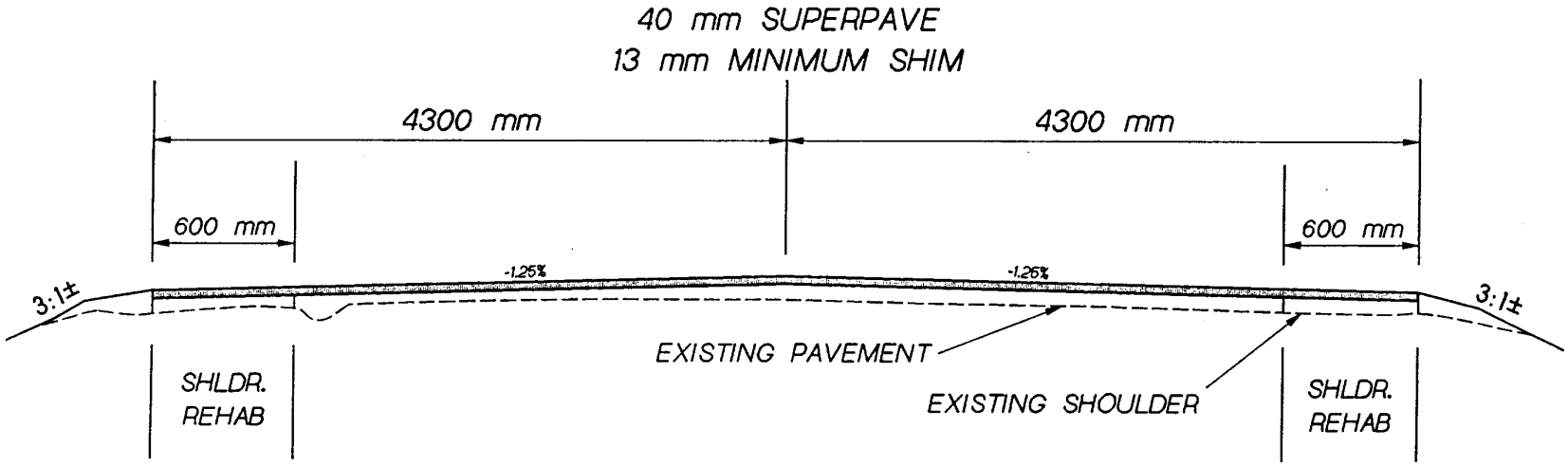
SECTION 3

STATE OF MAINE
DEPT. OF TRANSPORTATION

BENTON–CLINTON
STP–8651(00)X
ROUTE 100

Figure No. 3 Superpave

TYPICAL SECTION
HEAVY OVERLAY



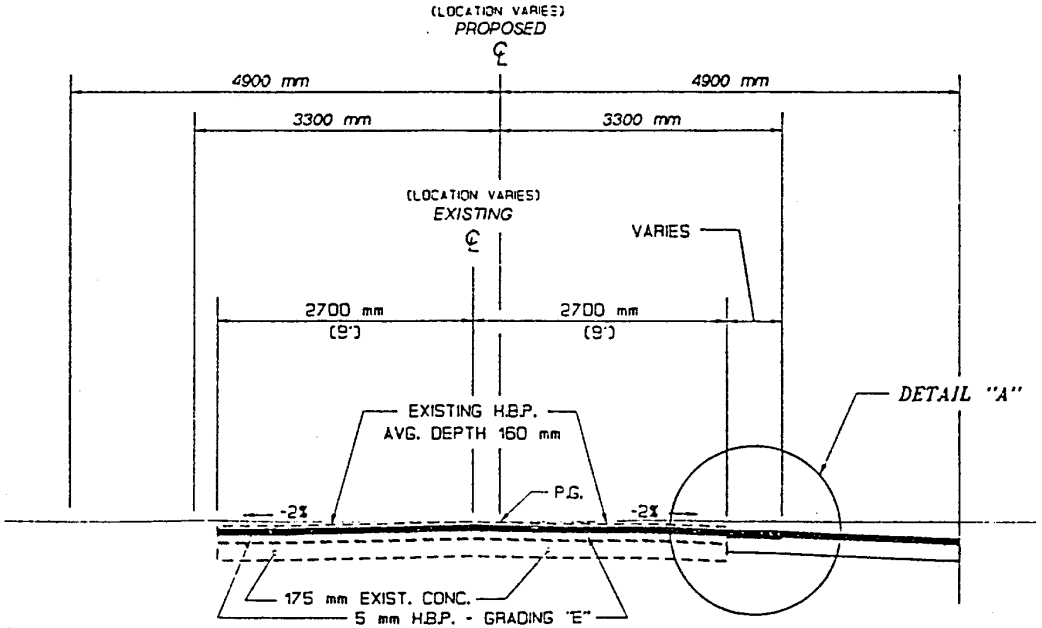
SECTION 4

STATE OF MAINE
DEPT. OF TRANSPORTATION

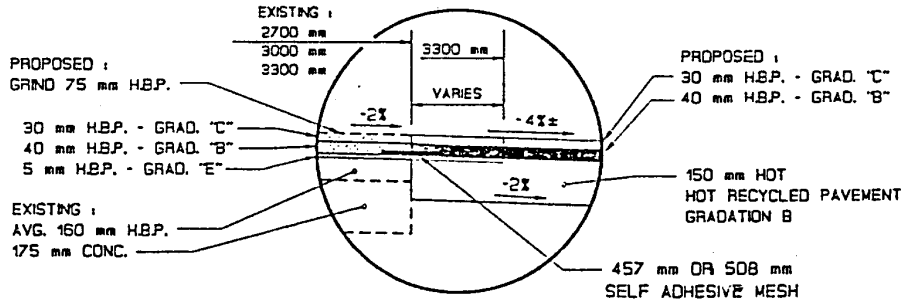
BENTON–CLINTON
STP–8651(00)X
ROUTE 100

Figure No. 4 Heavy Overlay

TYPICAL SECTION
SELF ADHESIVE MESH



STA. 2+140± TO STA. 2+330±



DETAIL "A"

(NORMAL)

STATE OF MAINE
DEPT. OF TRANSPORTATION

VEAZIE-ORONO
STP-6683(00)X
ROUTE 2

Figure No. 5 Self Adhesive Mesh

TABLE 1

BENTON - CLINTON Route 100, Project No. STP-8651(00)X, PIN 8651.00
Cost Summary
Section 0, Maintenance Mix, Station 0+500 to 1+000

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
No shoulder rehabilitation	$0.00	$0.00	$0.00
Shoulder Treatment Total:	$0.00	$0.00	$0.00
Surface Treatment			
Maintenance Mix: 500 m x 8 m x 2 cm = 189.84 Mg @ $29.02 / Mg =	$5,509.16		$11.02
Trucking costs =	$783.95		$1.57
Surface Treatment Total:	$6,293.11		$12.59
Section 0 Total:	**$6,293.11**		**$12.59**

Section 1, Cold Recycled Pavement, Station 1+000 to 1+500

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
Excavation: 500 m x 2 x 1.2 m x 0.68 m = 816 m³ @ $14.00 / m³ =	$11,424.00	$11.42	$22.85
ASCG: 500 m x 2 x 1.2 m x 0.3 m = 360 m³ @ $29.50 / m³ =	$10,620.00	$10.62	$21.24
Cold Recycled Pavement: 500 m x 2 x 1.2 m x 0.38 m = 456 m³ @ $14.25 / m³ =	$6,498.00	$6.50	$13.00
Shoulder Treatment Total:	$28,542.00	$28.54	$57.09
Surface Treatment			
Grind pavement to slope: 500 m x 7.3 m = 3650 m² @ $4.00 =	$14,600.00		$29.20
19 mm Superpave: 500 m x 8.6 m x 6 cm = 612.23 Mg @ $34.25 / Mg =	$20,968.88		$41.94
12.5 mm Superpave: 500 m x 8.6 m x 4 cm = 408.16 Mg @ $34.75 / Mg =	$14,183.56		$28.37
Surface Treatment Total:	$49,752.44		$99.51
Section 1 Total:	**$78,294.44**		**$156.60**

Section 2A, 230 mm Flowable Fill, Station 1+500 to 1+970 Rt. and 1+500 to 2+000 Lt.

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
Excavation: 485 m x 2 x 1.2 m x 0.53 m = 616.92 m³ @ $14.00 / m³ =	$8,636.88	$8.90	$17.81
ASCG: 485 m x 2 x 1.2 m x .3 m = 349.2 m³ @ $29.50 / m³ =	$10,301.40	$10.62	$21.24
230 mm Flowable Fill: 485 m x 2 x 1.2 m x 0.23 m = 267.72 m³ @ $65.00 / m³ =	$17,401.80	$17.94	$35.88
Shoulder Treatment Total:	$36,340.08	$37.46	$74.93
Surface Treatment			
Remove pavement: 485 m x 7.3 m = 3540.5 m² @ $4.00 =	$14,162.00		$29.20
19 mm Superpave: 485 m x 8.6 m x 6 cm = 593.87 Mg @ $34.25 / Mg =	$20,340.05		$41.94
12.5 mm Superpave: 485 m x 8.6 m x 4 cm = 395.91 Mg @ $34.75 / Mg =	$13,757.87		$28.37
Surface Treatment Total:	$48,259.92		$99.51
Section 2A Total:	**$84,600.00**		**$174.44**

Section 2B, Full Depth Flowable Fill, Station 1+970 to 2+000 Rt.

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
Excavation: 15 m x 2 x 1.2 m x 0.53 m = 19.08 m³ @ $14.00 / m³ =	$267.12	$8.90	$17.81
ASCG:	$0.00	$0.00	$0.00
530 mm Flowable Fill: 15 m x 2 x 1.2 m x 0.53 m = 19.08 m³ @ $65.00 / m³ =	$1,240.02	$41.33	$82.67
Shoulder Treatment Total:	$1,507.14	$50.23	$100.48
Surface Treatment			
Remove pavement: 15 m x 7.3 m = 109.5 m² @ $4.00 =	$438.00		$29.20
19 mm Superpave: 15 m x 8.6 m x 6 cm = 18.37 Mg @ $34.25 / Mg =	$629.17		$41.94
12.5 mm Superpave: 15 m x 8.6 m x 4 cm = 12.24 Mg @ $34.75 / Mg =	$425.34		$28.36
Surface Treatment Total:	$1,492.51		$99.50
Section 2B Total:	**$2,999.65**		**$199.98**

Section 3, Superpave, Station 2+000 to 2+500

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
Excavation: 500 m x 2 x 1.2 m x 0.53 m = 636 m³ @ $14.00 / m³ =	$8,904.00	$8.90	$17.81
ASCG: 500 m x 2 x 1.2 m x 0.3 m = 360 m³ @ $29.50 / m³ =	$10,620.00	$10.62	$21.24
25 mm Superpave: 500 m x 2 x 1.2 m x 23 cm = 654.95 Mg @ $65.00 / Mg =	$42,571.75	$42.57	$85.14
Shoulder Treatment Total:	$62,095.75	$62.09	$124.19
Surface Treatment			
Remove pavement: 500 m x 7.3 m = 3650 m² @ $4.00 =	$14,600.00		$29.20
19 mm Superpave: 500 m x 8.6 m x 6 cm = 612.23 Mg @ $34.25 / Mg =	$20,968.88		$41.94
12.5 mm Superpave: 500 m x 8.6 m x 4 cm = 408.16 Mg @ $34.75 / Mg =	$14,183.56		$28.37
Surface Treatment Total:	$49,752.44		$99.51
Section 3 Total:	**$111,848.19**		**$223.70**

Section 4, Heavy Overlay, Station 2+500 to 3+000

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
Shoulder rehabilitation(grading): 500 m x 2 x .6 m = 600 m² @ $9.50 =	$5,700.00	$5.70	$11.40
Shoulder Treatment Total:	$5,700.00	$5.70	$11.40
Surface Treatment			
Superpave Shim(est.): 500 m x 7.3 m x 3 cm = 259.84 Mg @ 36.75 / Mg =	$9,549.12		$19.10
12.5 mm Superpave: 500 m x 8.6 m x 4 cm = 408.16 Mg @ $34.75 / Mg =	$14,183.56		$28.37
Surface Treatment Total:	$23,732.68		$47.47
Section 4 Total:	**$29,432.68**		**$58.87**

TABLE 2

VEAZIE - ORONO Route 2, Project No. STP-6683(00)X, PIN 6683.00
Cost Summary
Experimental Section Self Adhesive Mesh
Station 2+140 to 2+330

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
Shoulder rehabilitation (ditching): 190 m x 2 x 0.6 m = 228 m² @ $3.80 =	$866.40	$2.28	$4.56
Hot Recycled Pavement: 190 m x 2 x 0.6 m x 15 cm = 81.16 Mg @ $28.00 / Mg =	$2,272.48	$5.98	$11.96
Self Adhesive Mesh: 190 m x 2 x 0.5 m = 190 m² @ $18.00 / m² =	$3,420.00	$9.00	$18.00
Shoulder Treatment Total:	$6,558.88	$17.26	$34.52
Surface Treatment			
Grind pavement to slope: 190 m x 5.4 m = 1026 m² @ $1.35 =	$1,385.10		$7.29
Bituminous Mix Gradation "E": 190 m x 5.4 m x 0.5 cm = 12.17 Mg @ $38.00 / M	$462.46		$2.43
Bituminous Mix Gradation "B": 190 m x 6.6 m x 4 cm = 119.03 Mg @ $29.90 / Mg	$3,559.00		$18.73
Bituminous Mix Gradation "C": 190 m x 6.6 m x 3 cm = 89.27 Mg @ $33.80 / Mg	$3,017.33		$15.88
Surface Treatment Total:	$8,423.89		$44.33
Experimental Section Total:	**$14,982.77**		**$78.85**

Control Section
Station 3+230 to 3+540

	Costs per:		
Shoulder Treatment	**Section**	**Meter**	**Section / Meter**
Shoulder rehabilitation (ditching): 190 m x 2 x 0.6 m = 228 m² @ $3.80 =	$866.40	$2.28	$4.56
Hot Recycled Pavement: 190 m x 2 x 0.6 m x 15 cm = 81.16 Mg @ $28.00 / Mg =	$2,272.48	$5.98	$11.96
Shoulder Treatment Total:	$3,138.88	$8.26	$16.52
Surface Treatment			
Grind pavement to slope: 190 m x 5.4 m = 1026 m² @ $1.35 =	$1,385.10		$7.29
Bituminous Mix Gradation "E": 190 m x 5.4 m x 0.5 cm = 12.17 Mg @ $38.00 / M	$462.46		$2.43
Bituminous Mix Gradation "B": 190 m x 6.6 m x 4 cm = 119.03 Mg @ $29.90 / Mg	$3,559.00		$18.73
Bituminous Mix Gradation "C": 190 m x 6.6 m x 3 cm = 89.27 Mg @ $33.80 / Mg	$3,017.33		$15.88
Surface Treatment Total:	$8,423.89		$44.33
Control Section Total:	**$11,562.77**		**$60.85**

TABLE 3
Falling Weight Deflectometer Tests

Benton - Clinton Project No. STP-8651(00)X

								Shoulder vs Roadway Comparison			
		Avg Shoulder Deflection (mils)			Avg Roadway Deflection (mils)			Variance (mils)			Average
Section	**Direction**	**1998**	**1999**	**2000**	**1998**	**1999**	**2000**	**1998**	**1999**	**2000**	**Variance**
0	EBL	30.11	18.97	35.22	9.17	12.68	10.54	20.94	6.29	24.68	17.30
Maintenance	WBL	30.40	21.77	34.23	12.54	10.21	13.21	17.86	11.56	21.02	16.81
Mix	Section	**30.26**	**20.37**	**34.73**	**10.85**	**11.44**	**11.88**	**19.41**	**8.93**	**22.85**	**17.06**
1	EBL	14.89	12.11	14.92	9.56	10.04	10.45	5.33	2.07	4.47	3.96
Recycled	WBL	16.03	14.81	14.54	9.33	7.87	9.07	6.7	6.94	5.47	6.37
Pavement	Section	**15.46**	**13.46**	**14.73**	**9.44**	**8.96**	**9.76**	**6.02**	**4.5**	**4.97**	**5.16**
2A	EBL	18.52	13.73	17.56	9.18	8.48	10.20	9.34	5.25	7.36	7.32
230 mm	WBL	17.21	13.47	17.03	9.41	7.67	10.43	7.8	5.8	6.6	6.73
Flowable Fill	Section	**17.87**	**13.60**	**17.30**	**9.29**	**8.07**	**10.31**	**8.58**	**5.53**	**6.99**	**7.03**
2B	EBL	N/A	4.73	9.44	N/A	6.12	8.24	N/A	-1.39	1.2	-0.10
530 mm	WBL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flowable Fill	Section	N/A	**4.73**	**9.44**	N/A	**6.12**	**8.24**	N/A	**-1.39**	**1.2**	**-0.10**
3	EBL	7.47	7.82	7.82	7.67	6.38	7.64	-0.2	1.44	0.18	0.47
Superpave	WBL	9.40	10.83	10.28	7.32	6.88	7.27	2.08	3.95	3.01	3.01
	Section	**8.44**	**9.32**	**9.05**	**7.49**	**6.63**	**7.45**	**0.95**	**2.69**	**1.6**	**1.75**
4	EBL	28.11	22.49	27.81	7.57	7.09	8.14	20.54	15.4	19.67	18.54
Heavy	WBL	31.20	25.72	33.49	7.21	7.19	8.57	23.99	18.53	24.92	22.48
Overlay	Section	**29.66**	**24.11**	**30.65**	**7.39**	**7.14**	**8.35**	**22.27**	**16.97**	**22.3**	**20.51**

Lower deflection (mils) denotes stronger highways

Table 4

Pavement Condition Summary

Benton - Clinton Project No. STP-8651(00)X

	Rutting (%)						Centerline joint condition				Number of transverse cracks						PCC related longitudinal cracking (%)		Shoulder elevation change (mm)	
	< 6 mm		6 - 13 mm		> 13 mm		Ravel (%)		Separation (%)		Full width (across two lanes)		Half width (across one lane)		Between Wheelpaths					
Section	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
0	65	32	0.8	66	4	2	0	0	0	6.1	25	47	12	20	102	321	49.5	85.7	0	0
1	100	100	0	0	0	0	90	90	0	0	0	0	1	2	0	2	0.6	7.7	0	0
2A	100	96.7	0	3.3	0	0	83	83	0	0.2	1	3	0	5	0	4	0	25.3	0	0
2B	100	100	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	3.3	0	0
3	100	91.7	0	6.4	0	1.9	30	30	0	0	0	0	0	0	0	0	10.7	14.5	6	13
4	100	100	0	0	0	0	85	85	0	0.3	8	9	11	12	13	16	0.4	14.6	0	0

Veazie - Orono Project No. STP-6683(00)X

	Rutting (%)						Centerline joint condition				Number of transverse cracks						PCC related longitudinal cracking (%)		Shoulder elevation change (mm)	
	< 6 mm		6 - 13 mm		> 13 mm		Ravel (%)		Separation (%)		Full width (across two lanes)		Half width (across one lane)		Between Wheelpaths					
Section	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
SAM	100	100	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	0	0
Control	100	100	0	0	0	0	0	0	0	0	2	2	0	0	1	1	28	30.6	0	10

Typical PCC related edge cracking

Section 0 (Control)

Section 2A

Section 3

Section 4

Typical PCC related edge cracking

Self Adhesive Mesh (Veazie Project)