STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TRANSPORTATION RESEARCH DIVISION
BUREAU OF PLANNING, RESEARCH & COMMUNITY SERVICES

SEPTEMBER 2001

FEDERAL EXPERIMENTAL REPORT 96-2

LONGITUDINAL JOINT STUDY

FINAL REPORT

INTRODUCTION

In previous years there has been a problem with longitudinal joint deterioration, due in part to poor construction techniques.

The degradation of the longitudinal joints has increased the cost of maintaining these projects and caused unnecessary reflective cracking when overlaid.

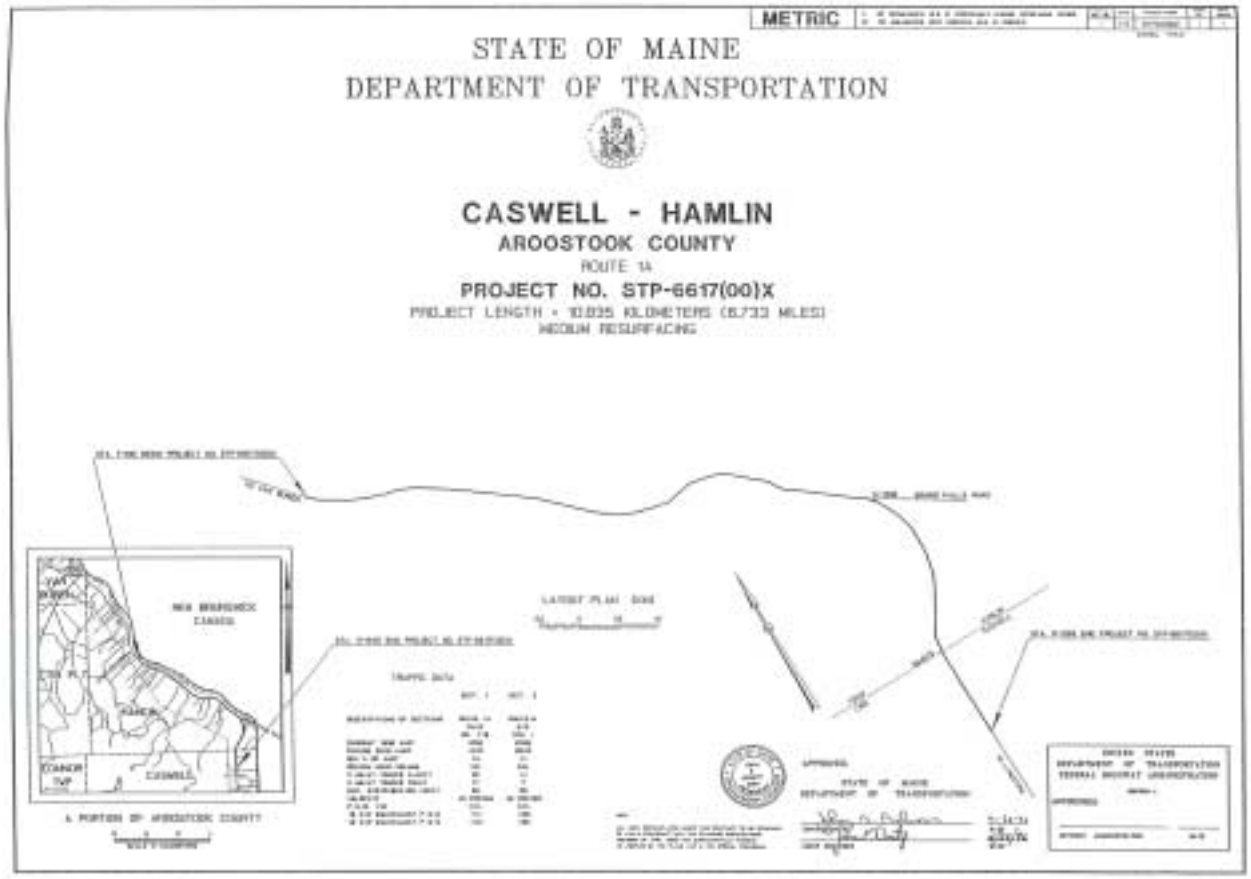
To reduce the effects of this type of cracking the Maine Department of Transportation (MDOT) is proposing the use of an experimental product as well as various hot mix asphalt (HMA) rolling techniques to increase longitudinal joint densities.

EXPECTED BENEFITS

It is anticipated that a standard paving technique can be developed to reduce the amount of joint separation, thus extending the service life of the pavement.

PROJECT LOCATION/DESCRIPTION

The project selected for this experiment is located on U.S. Route 1A between the towns of Caswell and Van Buren. Project number STP-6617(00)X is a medium resurfacing treatment beginning 1.2 km (0.73 mi) south of the Hamlin-Caswell town line and extends northwesterly 10.835 km (6.733 mi)(see enclosed map).



The experimental area begins 4.4 km (2.73 mi) northwest of the Hamlin-Caswell town line from station 12+300 to 8+700 and contains six sections, four 600 m (1970 ft), one 700 m (2300 ft) and one 500 m (1640 ft) in length.

Three rolling techniques, a cutting wheel and the Joint Maker, a commercially manufactured product, were used to increase longitudinal joint densities.

PRODUCT DESCRIPTION

The contractor purchased the Joint Maker, Edge Follower and Kicker Plate as a package from TransTech Systems, Inc.

The Joint Maker (Photo 1 courtesy of TransTech Systems, Inc.) is attached to the inside of each paver end plate and applies precompaction technology to the construction of longitudinal joints. By pre compacting HMA in a 10 cm (4 in) wide area on both sides of the paver there is less lateral movement of the mix when rolling the first mat thus creating a higher density edge that aids in knitting the longitudinal joint together when paving and rolling the second mat.

The Edge Follower (Photo 2 courtesy of TransTech Systems, Inc.) is attached to the screed end gate. This is a non-contact electronic sensing unit that

automatically positions the end gate to the cold mat to insure precise mat alignment.

The Kicker Plate (Photo 3 courtesy of TransTech Systems, Inc.) is also attached to the screed end gate. This device aligns excess HMA so there will be a ±25 mm (±1 in) overlap of hot mix on the cold mat when paving the second mat.

PRE CONSTRUCTION SURVEY

Project STP-6617(00)X was selected because of the excellent condition of the existing longitudinal joint, thus reducing the chance of reflective cracking. Also, the experimental area within the project is relatively void of super elevated curves to help assure proper placement of the HMA.

CONSTRUCTION PROCEDURES

Lane Construction paved the experimental area on September 19 and 20. A BLAW KNOX PF180H paver, INGERSOLL RAND DD90 knock down roller, BOMAG BW20R pneumatic roller and a HYSTER C350C back roller were used to construct the project. The weather was partly cloudy and mild after brief morning fog delays each day. The Grade “C” mix used on the project was very uniform and paving proceeded smoothly after the morning delay.

Sections I, II and III were paved on September 19, 1996.

First mat rolling procedure*:*

The Blaw Knox was equipped with a Joint Maker on the inside of the left and right end plate. The first mat was placed in the North Bound lane in the opposite direction of stationing from 12+300 to 10+430. TransTech has two preferred rolling patterns, one for the first mat and one for the second. The rolling pattern for the first mat consists of a first pass with the knock down roller on the high side of the mat, next the mat is rolled from the low side to high side. At station 11+700 the Joint Maker was removed from the left end plate and paving continued to station 10+430 using a rolling pattern from the low to the high side of the mat.

Second mat observations:

When placing the second mat on all sections, the contractor had a ±25 mm (±1 in) overlap of HMA onto the cold mat.

SECTION I: JOINT MAKER

The second mat for Section I was paved from sta. 12+300 to 11+700. The Blaw Knox, with a Joint Maker on the right end plate, had the Edge Follower and a Kicker Plate installed. TransTech's rolling pattern for the second mat, from the low to high side, was used. The Kicker Plate luted the HMA at the joint making it difficult to knock down, so it was removed at sta. 12+200. The Joint Maker was removed from the right end plate at station 11+700.

SECTION II: CONTROL

The second mat for Section II was paved from sta. 11+700 to 11+100. The rolling pattern is from the low side of the mat to within 150 mm (6 in) of the longitudinal joint, then pinched with 610 mm (2 ft) of the roller over the cold mat.

SECTION III: TECHNIQUE A

The second mat for Section III is from sta. 11+100 to 10+400. Technique A involves a first pass from the hot mat with a 150 mm (6 in) overlap on the cold mat, then rolled from the high to low side. This left a ridge about 1 m (3 ft) from the longitudinal joint, which the rubber tire and static roller had to knock down with considerable effort, so the second pass of the roller was changed to the low side then the third in the middle. Even with the modified rolling pattern the back roller had to make extra passes to smooth out the ridge mentioned earlier.

Section IV, V and VI were paved on September 20, 1996.

First mat rolling procedure:

From station 10+430 to 8+700 in the North Bound lane a rolling pattern from the low to high side was used.

SECTION IV: TECHNIQUE B

The second mat for Section IV is from sta. 10+400 to 9+900. Technique B involves a first pass, with the roller in the static mode, from the cold mat with a 150 mm (6 in) overlap on the hot mat then from the low to high side in the vibratory mode.

SECTION V: TECHNIQUE C

The second mat for Section V is from sta. 9+900 to 9+300. Technique C involves a first pass on the hot mat 150 mm (6 in) from the joint, the second pass pinching the joint then rolled from the low to high side.

SECTION VI: EDGE TRIM

The second mat for Section VI is from sta. 9+300 to 8+700. The leading edge of the first mat was trimmed back 50 mm (2 in) using a cutting wheel attached to a grader. Waste was removed and the pavement cleared of debris. Tack was applied to the joint prior to paving. This Section was rolled using the same technique as Section II.

CORE SAMPLE EVALUATION

Lane Construction cut a total of 52 cores at offsets of Centerline, 60 mm (2.5 in) left and right and 457 mm (18 in) left and right of centerline. Eight cores were cut in Sections II, III, IV and V and ten were cut in Sections I and VI. Visual observation of the centerline cores revealed very tightly knit longitudinal joints for Sections I - V. Section VI (Cutting Wheel) cores have a defined longitudinal joint with very little or no interlocking aggregate that may cause premature deterioration with time.

Table I contains average pavement densities by Section, mat and offset.

Pavement densities taken from the first mat at an offset of 63 mm (2.5 in) from the edge of pavement reveal that the Joint Maker Section had the highest density followed by Control, Edge Trim, Technique C, Technique A and Technique B Sections.

Core samples taken from the second mat at an offset of 60 mm (2.5 in) right of the joint reveal that the Edge Trim section produced the highest density readings, followed by Control, Technique B, Technique C, Joint Maker and Technique A sections.

Additional analysis of pavement densities at an offset of 457 mm (18 in) left and right of centerline reveal that the Control Section had the highest average densities followed by Technique A, Joint maker, Technique C, Edge Trim and Technique B Sections.

Centerline core densities strongly reflect the true condition of the joint. The Control Section had the highest density by 0.8 percent followed by Joint Maker, Edge Trim, Technique A, Technique B and Technique C Sections.

TABLE I.
PAVEMENT DENSITIES

Section		First Mat		Second Mat		Center Line
Number	Type	63 mm (2.5 in) Lt.	457 mm (18 in) Lt.	63 mm (2.5 in) Rt.	457 mm (18 in) Rt.	
I	Joint Maker	91.0	93.6	92.1	92.3	93.8
II	Control	89.2	94.7	94.7	94.3	94.6
III	A	88.2	94.9	91.8	92.6	92.8
IV	B	87.0	92.4	92.6	91.6	91.8
V	C	88.4	92.0	92.5	92.4	90.0
VI	Edge Trim	89.1	92.0	94.8	92.2	93.0

VISUAL EVALUATION

A visual evaluation was conducted on August 7, 2001. Joint wear and raveling has not increased since the 2000 evaluation. Figure I illustrates the amount of centerline cracking that has occurred in each Section over the five-year study period. Table II contains crack severities for the 2001 field evaluation and photos of each Section are attached to the end of this report.

Section IV had no increase in cracking from the last evaluation and has the lowest amount of cracking at 6%. The centerline joint looks very good and the severity of cracking is limited to 13 mm (0.5 in) or less.

Eleven percent of Section VI has cracked with an increase of 2% from last year. Although this Section has the second lowest amount of cracking it has the greatest severity of cracking with a 17 m (56 ft) section that is greater than 25 mm (1 in) wide (see Photo 9). A number of reasons may have caused this cracking, poor placement of mix on the second mat (not enough overlap), the higher density edge of pavement on the first mat bridging the knockdown roller reducing density of the second mat or a poor joint on the existing pavement may have reflected through in this area. Tack is visible along 90% of the joint

Section II had 14% of joint separation, an increase of 5%, most of it being less than 6 mm (0.25 in) in width. The joint looks very tight with little ravel. Section V had 15% joint separation with no increase from last year. There was 21 m (69 ft) of cracking in the 13 to 19 mm (0.5 to 0.75 in) range. The remaining joint is slightly visible and worn from winter plowing.

Section III has cracked throughout 27% of the section with the majority of cracking in the less than 6 mm (0.25 in) range. Portions of this section have raveled.

FIGURE I.
CENTERLINE JOINT CRACK SUMMARY

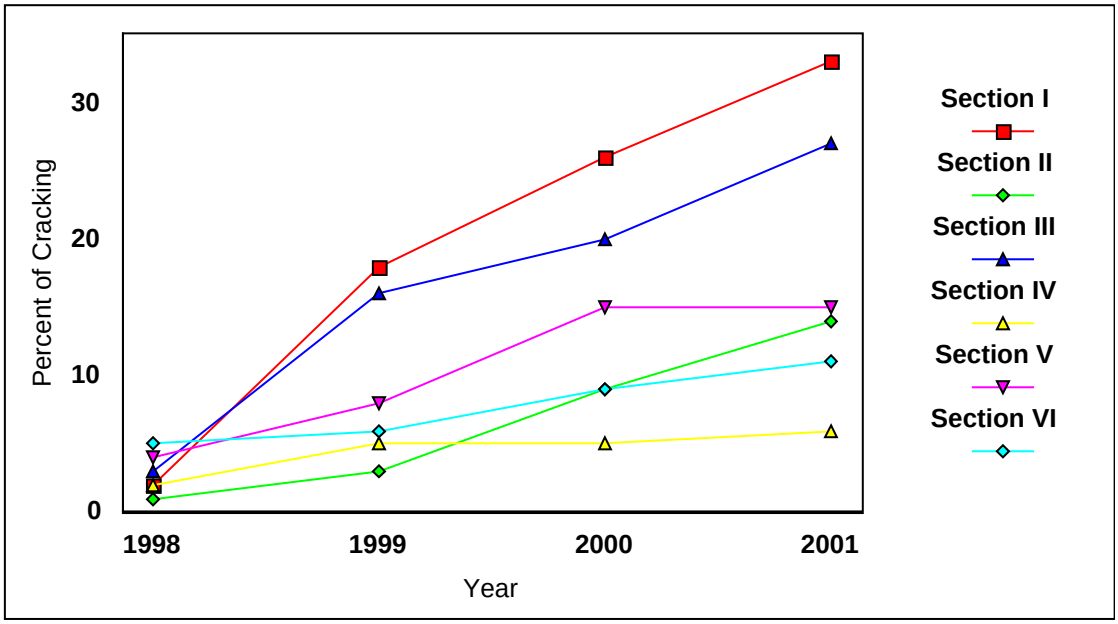


TABLE II.
2001 FIELD EVALUATION SUMMARY

SECTION	SEVERITY / LENGTH (m) OF CRACKING					% Of Total Length	% Increase from last evaluation
	< 6 mm	6 - 13 mm	13 - 19 mm	19 - 25 mm	> 25 mm		
I	151	33	13			33%	7%
II	66	17				14%	5%
III	133	41	12			27%	7%
IV	13	15				6%	<1%
V	38	32	21			15%	0%
VI	26	14	2	8	17	11%	2%

Section I had the greatest amount of cracking at 33%. All of the cracking occurred in the first half of this Section suggesting adjustment of the Kicker Plate and Edge Follower, as mentioned in the Construction Report, may have interfered

with correct placement of mix along the joint. The remaining centerline joint is very tight and difficult to see.

SUMMARY

Section IV (first pass of roller in the static mode from the cold mat with a 150 mm (6 in) overlap on the hot mat) had the lowest amount and severity of cracking. This rolling technique appears to sufficiently compact the centerline joint and could be used as a standard rolling technique to reduce the amount of centerline cracking.

Section II (control section rolling from low to high side of mat pinching the last 150 mm (6 in) of centerline joint) had the third lowest amount of cracking and the second lowest severity of cracking. This method of compaction combined with a conscientious paving crew should also be used to prevent premature joint separation.

Section V (first pass 150 mm (6 in) from the joint second pass pinching the joint) is very similar to the rolling technique of Section II and has produced nearly the same results. This method is very time consuming for the knockdown roller to roll the entire mat and is not suggested as an alternative rolling technique.

Section III is also not recommended as an alternative rolling technique due to the amount of time necessary to smooth the ridge created at the center of the mat and the amount of cracking in this Section.

Section VI (edge trim) is not recommended as an alternative unless the paving crew pays close attention to placing the mix. When trimming the edge of the first mat, it was difficult to keep a straight edge on the mat. This makes it difficult for the paver operator to follow the edge for proper mix placement resulting in premature joint separation.

Section I using the Joint Maker had the highest amount of joint separation due to adjustments of the equipment but did precompact the mix prior to rolling producing a higher density on the first mat at an offset of 63 mm (2.5 in) left. Using the Joint Maker combined with Section II rolling technique could produce a very tight and stable centerline joint. It should be noted when this project was paved in 1996 the department used Hveem designed Grade “C” mix we now use Superpave type mix. C mix is finer than Superpave making it easier for the Joint Maker to precompact. Trans Tech has had difficulty precompacting Superpave mix using the Joint Maker and is working on developing a Joint Maker for Superpave mix.

Overall the project has performed well over the five-year study with the exception of a few areas in Section VI. The paving crew on this project was one of the most conscientious paving crews in the area, which helped produce a stable centerline joint regardless of the rolling technique. If a paving crew paid attention to minor details of placing and rolling mix properly the centerline joint as well as the entire mat will be stable and withstand time and daily traffic.

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Other Available Documents

Construction Report January 1997
1st Interim Report May 1998
2nd Interim Report September 1998
3rd Interim Report February 2000
4th Interim Report October 2000

PHOTO 1.
JOINT MAKER

PHOTO 2.
KICKER PLATE

PHOTO 3.
EDGE FOLLOWER

PHOTO 4.
SECTION I

PHOTO 5.
SECTION II

PHOTO 6.
SECTION III

PHOTO 7.
SECTION IV

PHOTO 8.
SECTION V

PHOTO 9.
SECTION VI