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Alaska University Transportation Center

Work Plan for Special Design Features & Crack Sealing Maintenance for

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Parks Highway M.P. 239-252 Rehabilitation

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The Alaska DOT&PF wants to construct and maintain asphalt concrete (AC) paved highways in a way that minimizes roadway lifecycle costs while preserving acceptable performance. Thermal cracking is a natural feature of most paved Alaska roadways that influences both long term maintenance costs and the driving public's perception of road performance. This work plan for a research test section provides construction and maintenance procedures to address what is arguably the most severe form of thermal cracking — major transverse thermal cracks.

A newly constructed AC pavement surface will be modified with the addition of presawn transverse cracks (placed according to specified spacing and cut depths). Based on previous experience it is expected that many of the presawn cracks will become active transverse thermal cracks. Alaska experience suggests that this controlled form of thermal cracking result in a "better thermal crack" in terms of ride roughness and visual appearance. Alaska experience further suggests that such cracks should require little if any sealing maintenance over the life of the pavement. The work plan includes long term monitoring and maintenance methods that will be used to evaluate the performance of the experimental sections.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

Work Plan For
SPECIAL DESIGN FEATURES AND CRACK SEALING MAINTENANCE

IM-0A4-4(15)/61275
Parks Highway M.P. 239 – 252 Rehabilitation

CONTENTS

BACKGROUND/OBJECTIVE OF SPECIAL WORK PLAN 1
WORK PLAN FOR CONSTRUCTION PROJECT 3
Prior to Destruction of the Existing Pavement Surface 3
Saw Cutting New Pavement 5
After Saw Cutting New Pavement 6
As-Built Saw Cut Locations 6
Construction Report 7
WORK PLAN FOR DOT&PF MAINTENANCE 8
Highway Pavement Maintenance 8
Recommended M&O Performance Monitoring/Reporting 9
RECOMMENDED FURTHER STUDY AND POSSIBLE IMPLEMENTATION BENEFITS 11

WORK PLAN
FOR
SPECIAL DESIGN FEATURES AND CRACK SEALING MAINTENANCE

Project:
IM-0A4-4(15)/61275
Parks Highway M.P. 239 – 252 Rehabilitation
(scheduled for construction in 2014)

BACKGROUND/OBJECTIVE OF SPECIAL WORK PLAN

The Alaska DOT&PF wants to construct and maintain asphalt concrete (AC) paved highways in a way that minimizes roadway lifecycle costs while preserving acceptable performance. Thermal cracking is a natural feature of most paved Alaska roadways that influences both long term maintenance costs and the driving public's perception of road performance. This work plan provides construction and maintenance procedures to address what is arguably the most severe form of thermal cracking — major transverse thermal cracks (see Figure 1 for photo examples).

By definition major transverse thermal cracks span the entire pavement width. After post-construction exposure to even a single winter of Alaska's low temperatures, major transverse thermal cracks appear (to some degree) on nearly any road constructed in central or interior areas of Alaska. With the passing of additional winters it is normal that transverse cracking continues to develop at a decreased spacing, and individual cracks often become wider. Major transverse thermal cracks penetrate completely through the asphalt concrete pavement and extend downward, sometimes several feet, into underlying aggregate materials. Such cracking produces the rhythmic bumps that are familiar to most Alaska drivers. Because major transverse cracks are the most noticeable type of thermal cracking, they have traditionally received the lion's share of maintenance sealing effort.

Development of major transverse cracking is, to date, an inescapable fact throughout much of Alaska. However, based on previous field tests in Alaska, it appears possible to improve road surface appearance, reduce ride roughness, and justifiably minimize much of the maintenance effort associated specifically with this crack type.

The objective of this work plan is simple. At selected locations within the subject construction project, the new AC pavement surface will be modified with the addition of presawn transverse cracks. As was demonstrated by a Fairbanks, Alaska field test site constructed in the mid-1980s, it is expected that many of the presawn cracks will eventually become active transverse thermal cracks. Alaska experience suggests that this controlled form of thermal cracking result

in a “better thermal crack” in terms of ride roughness and visual appearance over the life of the pavement. Experience further suggests that such cracks will require little if any sealing. This work plan specifies that pre-cutting be done at specific project stationing intervals. Within those intervals the spacing and depth of the cuts in the pavement will be varied to learn how those variables influence eventual transverse thermal crack development.

In addition to the special construction feature (presawn cracks), this work plan includes a modified maintenance plan. The modified plan applies only to areas of the Parks Highway within the boundaries of the subject construction project. It specifies that normal crack sealing maintenance be done within specified sections of the project, and that no sealing maintenance be done in other sections. Because results of the two forms of maintenance within the construction project area will be compared over a number of years, the special maintenance sections are defined in terms of permanently established reference locations, i.e., historic mile post locations (M.P.s) and Coordinated Data System locations (CDS mile points).

WORK PLAN FOR CONSTRUCTION PROJECT

Prior to Destruction of the Existing Pavement Surface

The contractor will record the location of all existing (natural) major transverse cracks within each test section in a format indicated in Table 1. In order to recognize and record existing major transverse thermal cracks, the contractor will need to become familiar with the appearance of that crack type. This section contains 10 "training photos" that should be sufficient to accomplish the task.

The contractor will provide location data for existing transverse thermal cracks in terms of: 1) project stationing and 2) latitude/longitude data for each natural major transverse crack at both the right and left edges of the pavement. Note that there are two station locations (Station Left and Station Right) indicated in Table 1 for each natural crack. The reason that two stations are necessary is because the natural cracks are rarely perpendicular to the centerline, and therefore two station locations are usually necessary to define the general skew of the crack.

Table 1 provides an example of the required spreadsheet format for recording location data. The table shows example data for four individual, natural transverse thermal cracks—prior to construction. Record data using the Table 1 format:

Table 1. Format of existing major transverse cracks data record

Station Left	Station Right	Latitude Left	Longitude Left	Latitude Right	Longitude Right
985+40	985+46	64.71937256	147.2196215	64.71926680	147.2196435
986+43	986+45	64.71929555	147.2189806	64.71919395	147.2190357
987+09	987+09	64.71924776	147.2185769	64.71914680	147.2186418
1038+93	1038+95	64.71412855	147.1877628	64.71400145	147.1878836

Latitude and longitude locations indicated above will <u>not</u> be accurate enough if measured by a hand-held GPS unit. Latitude and longitude must be defined using survey-quality equipment capable of ± ¼ foot accuracy or better, and using a WGS84 reference datum. Record latitude and longitude data to sufficient significant figures to correctly represent the required ± ¼ foot accuracy.

In order to record the locations of major transverse thermal cracks it is first necessary to recognize that form of cracking. Through a series of 10 photos, Figure 1 shows the normal range of appearance of major transverse thermal cracks. **The most critically important single distinguishing characteristic of this crack type is that <u>it extends across the full width of the paved surface</u>.**

(a) Regular appearance of major transverse thermal cracks

(b) Major transverse thermal cracks with new sealant (lt) and old sealant (rt)

(c) Examples of crooked major transverse thermal cracks

(d) Examples of bifurcated major transverse thermal cracks

(e) Examples of spalled zones along major transverse thermal cracks

Figure 1. Appearance of major transverse thermal cracks

Note that many individual major transverse thermal cracks exhibit a combination of the characteristics indicated in Figure 1. For example, a crack may be crooked and exhibit spalling as well as one or more bifurcations.

Saw Cutting New Pavement

The contractor will make transverse saw cuts in the new pavement, within each test section, according to depths and intervals (spacings) prescribed by the designer. All saw cuts will be made perpendicular to the centerline. Table 2 lists proposed saw cut test sections.

Table 2. Proposed saw cut test section

Section Designation	Begin Station	End Station	Cut Spacing	Cut Depth	Typical Section Represented	Length (ft)
Test Section A	4585+00	4590+50	25’	2”	VI	550
	4590+50	4596+20	Control	Control	VI	570
	4596+20	4601+80	35’	2”	VI	560
Test Section B	4603+00	4610+00	25’	2”	I	700
	4610+00	4617+00	Control	Control	I	700
	4617+00	4624+00	35’	2”	I	700
Test Section C	4858+00	4865+75	25’	0.6”	III	775
	4866+00	4873+75	25’	1.3”	III	775
	4874+00	4881+75	25’	2”	III	775
	4881+75	4890+00	Control	Control	III	825
	4890+00	4897+70	35’	0.6”	III	770
	4898+05	4905+75	35’	1.3”	III	770
	4906+10	4913+80	35’	2”	III	770
Test Section D	4915+00	4924+00	25’	2”	IV & V	900
	4924+00	4933+00	Control	Control	IV & V	900
	4933+00	4941+75	35’	2”	IV & V	875

Section Designations are provided with the intent that the beginning and end of each of each test section be permanently marked in the field with signs.

Stationing intervals labeled “Control” indicate control sections centered within each of the four test sections indicated in Table 2. Do no saw cutting within any control section.

Saw Equipment Requirements:
Saw Devil walk-behind saw machine with 12 inch diameter by 1/8 inch thick diamond blade is suggested for saw cutting operation. Concrete saw shall be water cooled and capable of cutting asphalt concrete pavement layer to a depth of 2.5 inches. Blade thickness shall be no more than ¼ inch.

After Saw Cutting New Pavement

As-Built Saw Cut Locations

After all saw cutting has been completed, the contractor will document the as-built location of each precut transverse crack. Since every saw cut will be oriented perpendicular to the centerline of the road, as-built saw cuts can be designated using a single location.

The contractor will provide as-built location data for each saw cut including: 1) project stationing and 2) latitude/longitude data for each saw cut at the left pavement edge, i.e., edge of pavement in north bound lane. Table 3 is an example of an acceptable spreadsheet format for recording these data for four as-built saw cut locations. Record as-built data using the format suggested in Table 3.

Table 3. Format of as-built data record

Station	Latitude @ Right Edge of Pavement	Longitude @ Right Edge of Pavement	Spacing Between Saw Cuts in this Section(feet)	Depth of Cut (inches)
985+40	64.71937256	147.2196215	25	2.0
986+43	64.71929555	147.2189806	25	0.6
987+09	64.71924776	147.2185769	35	1.3
1038+93	64.71412855	147.1877628	35	2.0

Latitude and longitude must be located using survey-quality equipment capable of ± ¼ foot accuracy or better, and using a WGS84 reference datum. Record latitude and longitude data to sufficient significant figures to correctly represent the required ± ¼ foot accuracy.

Construction Report

An informal construction report will be provided by DOT&PF construction project personnel. The report will contain sufficient text and photos to thoroughly explain each general task involved in the above work. A recommended outline is as follows:

- Recording Locations of Each Natural Major Transverse Thermal Crack
    - Include a few photos of natural major transverse thermal cracks before construction
    - Include spreadsheet listing of locations
- Describing Sawing Operations
    - Include a few photos showing equipment, cutting operations, and completed saw cuts
    - Include comments on dates of cutting operations and weather
    - Include comments about problems encountered (if any)
- Recording As-Built Location of Each Saw Cut
    - Include spreadsheet listing of locations
- Finished construction report will consist of a neat, concise MS Word document (.docx) with title page and simple table of contents. No special format is required, although the report is expected to have been proof read for errors, and made presentable for DOT&PF staff engineers and management as an informational document.

WORK PLAN FOR DOT&PF MAINTENANCE

The total length of the proposed 2014 construction project is 13 miles (M.P. 239 to M.P. 252).

Highway Pavement Maintenance

Do all necessary patching, re-leveling type maintenance, and all other kinds of normal highway and embankment maintenance as usual between M.P. 239 and M.P. 252—except for normal sealing within the intervals designated in Table 4.

Do **no sealing-type maintenance** within the mile post/mile point intervals (10 miles total) indicated in Table 4.

Table 4. Locations for no-sealant maintenance

Interval Designation	Begin Mile Post	End Mile Post	Begin Mile Point	End Mile Point
Interval #1	239	242	203.42	206.41
Interval #2	245	252	209.40	216.44

Note that the 10 centerline miles of roadway indicated above includes all of the precut crack and control sections (about 2.26 miles) as well as about 7 ¾ miles of additional centerline miles. There are two reasons for not sealing within this large area:

1. No sealing within the precut test areas or indicated control sections so that physical details of precut and natural cracks within these sections can be monitored with time. Sealing materials will obscure such details. It is strongly recommended that Northern Region M&O apply no sealant within the 2.26 miles of experimental roadway (sections indicated in Table 2).

2. No sealing within the additional designated 7 ¾ miles in order to further investigate the long term effects of not sealing a large number of natural major transverse thermal cracks. These additional miles of "no seal" maintenance will shed much additional light on the general need for thermal crack sealing in interior Alaska. Northern Region M&O is encouraged to do no sealing maintenance within the full 10 miles of Interval #1 plus Interval #2, although areas outside the 2.26 miles of precut test sections may be excluded from the "no seal" experiment at the discretion of the Department.

It is recognized that individual major transverse thermal cracks sometimes become a hazard (bump) for vehicles. Where deemed a significant problem, individual cracks of this sort should be maintained as necessary using patching or banding methods regardless of road location.

Recommended M&O Performance Monitoring/Reporting

Annual Monitoring Summers of 2015 – 2020 *

Drive the Mile 239 to 252 construction project from south to north while observing and comparing the general condition of the pavement surface and of thermal cracking in areas where sealing is and is not done. Obtain sufficient photos (say ≈ 10 to 30) to illustrate and support your observations and professional opinion of the condition of sealed versus non-sealed areas. Photo requirements are described in General Notes * below.

Provide a brief annual report discussing the relative condition of sealed versus non-sealed roadway sections, and include any conclusions you may have regarding your observations. Include sufficient photos to support your observations and conclusions.

Additional Biennial (every other year) Monitoring Summers of 2016, 2018, and 2020 **

The following monitoring will be done only within Intervals #1 and #2 indicated in Table 4.

Obtain a high quality photo every 1,000 feet beginning @ M.P. 239 (for Interval #1) and M.P. 245 (for Interval #2). Photo requirements are described in the General Notes ** below.

Observe the condition of major transverse thermal cracks that have been presawn versus those that have formed naturally (all of the presawn cracks are within areas of Interval #2).

Observe the general condition of the major transverse cracks. Form an opinion about the condition (appearance) of saw cut major transverse cracks versus natural major transverse cracks.

Observe the general condition of wheel path versus non-wheel path locations for both natural and saw cut transverse cracks. Form a general opinion about the condition of natural versus saw cut cracks for wheel path versus non-wheel path locations. In other words, do the wheel path versus non-wheel path areas of saw cut cracks look significantly different than those areas for natural cracks?

Provide a brief interim report comparing: 1) the general condition of natural versus saw cut thermal cracks, 2) the wheel path versus non-wheel path areas of natural major transverse thermal cracks, and 3) the wheel path versus non-wheel path areas of saw cut major transverse thermal cracks. Include the photos, in order from south to north as part of the report. Label each photo. Label photos as being from Interval #1 or #2 and by sequence within the interval (e.g., Interval #1, photo 1 — Interval #1, photo 2 — etc.).

* General Notes—for regular annual monitoring (2015 – 2020).

For consistency of general lighting intensity and sun angle, observe road condition and obtain photos according to the following guidelines.

- When to make road condition observations and obtain photos—between noon and 4 pm, during early September.
- Required picture quality—camera must have resolution high enough to provide clear evidence of road surface condition (a good quality, 12+ megapixel camera is recommended as a minimum).
- Do not perform observations or obtain photos while the pavement surface is wet.

** General Notes—for additional biennial monitoring (2016, 2018, and 2020).

For consistency of general lighting intensity and sun angle, observe road condition and obtain photos according to the following guidelines. Photos at each 1,000 foot interval location should be taken according to the following guidelines:

- When to make road condition observations and obtain photos—between noon and 4pm, during early September.
- Where to stand while taking photo—on north bound lane pavement edge, facing northward.
- Where to aim while taking photo—aim approximately 30 degrees to left of pavement edge and slightly downward.
- Required picture quality—camera must have resolution high enough to provide clear evidence of road surface condition (a good quality, 12+ megapixel camera is recommended as a minimum).
- Use of wide angle or telephoto lens—do not use special telephoto or wide angle lenses. For popular electronic cameras with focal length adjustment capability, use a mid-range focal length setting that will provide photos equivalent to those taken with a 35mm film camera using a 50mm or 55mm “standard” lens.
- Do not perform observations or obtain photos while the pavement surface is wet.

RECOMMENDED FURTHER STUDY AND POSSIBLE IMPLEMENTATION BENEFITS

- Very long term monitoring of performance by Alaska DOT&PF M&O personnel, beyond 2020, will continue examining the necessity for sealing thermal cracks and the advantages (or disadvantages) of presawn major transverse thermal cracks. It will also ensure that at least some M&O personnel gain a better understanding of thermal cracking damage.

  Implementation payoff may be in the form of less required sealing and a potentially very useful understanding, by M&O personnel, of how thermal cracks actually form and develop in the field. Long term monitoring of performance will help convince M&O whether or not reduced sealing and pre-cutting of major transverse cracks are economically attractive concepts with respect to roadway maintenance.

- Until future repaving, the pre-cut and no-sealant tests will continue to provide an easily accessible field exhibit for government agency or construction industry representatives and university students interested in thermal crack maintenance in Alaska.

  Implementation payoff will be in the area of public relations with respect to pavement research in the State of Alaska. The easily accessible location, with its readily observed and explained test sections is a "natural" for touting ongoing University and DOT&PF pavement research.

- University of Alaska researchers should conduct field studies to determine how precut spacing and cut depth influences development of natural thermal cracking.

  Implementation payoff will result from knowing optimal cut spacing and depth if pre-sawing of major transverse thermal cracks becomes a standard construction feature in Alaska.

- University of Alaska researchers should conduct field studies to determine how the various thicknesses of new pavement structure layers influence development of reflection cracking. The experimental sections are located within various areas of the project that will be constructed according to several different plan typical sections, each built with a different thickness of new pavement structure.

  Implementation payoff will result from knowing which kinds of pavement construction projects will benefit from presawn thermal cracks and which might not.

- University of Alaska researchers should conduct field studies necessary to support or refute recent Alaska field studies that indicate thermal cracking damage is not

significantly related to other forms of pavement surface damage such as fatigue cracking, rutting, etc.

Implementation payoff will result from knowing whether reduced sealing maintenance of thermal cracks influences other aspects of pavement damage.

- University of Alaska researchers should conduct field studies to determine the amount of water actually entering major transverse thermal cracks in response to actual rain events, and its effect on base/subbase moisture contents and stiffness.

  Implementation payoff will result from a better understanding about how thermal cracking actually influences pavement structural support. This will address the important question of whether the presence of unsealed thermal cracking should be accounted for in the pavement structural design process—or should be considered an insignificant factor.