GEOSYNTHETICS FOR REFLECTIVE CRACK CONTROL

CONSTRUCTION REPORT

STATE RESEARCH PROJECT NUMBER 537

by

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16. Abstract

Reflective cracking due to shrinkage and brittleness in asphalt pavements can seriously degrade an asphalt overlay before it is near its design life. Geosynthetics have been used to impede the reflection of existing transverse cracking to the new overlay. The geosynthetics are intended to minimize the tension transferred to the overlay from the existing pavement. The Oregon Department of Transportation (ODOT) installed a test section consisting of 120 transverse cracks treated with five different geosynthetic types, 22 transverse cracks treated with crack filling only and a control section of 20 untreated transverse cracks.

The test and control sections were constructed over an open-graded asphalt concrete pavement. The overlay was also an open-graded mix. The 140 transverse crack section is located on US Highway 97 between Milepoint 213.58 and Milepoint 217.64.

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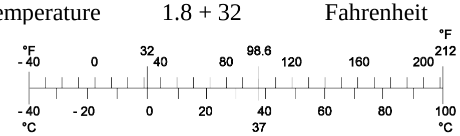
SI* (MODERN METRIC) CONVERSION FACTORS

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	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	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	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

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	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8 + 32	Fahrenheit	°F



* SI is the symbol for the International System of Measurement

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GEOSYNTHETICS FOR REFLECTIVE CRACK CONTROL CONSTRUCTION REPORT

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1.0 INTRODUCTION

1.1 BACKGROUND

Transverse cracking has been a major distress on the southern portion of Oregon State Highway Number 4 (US 97) for decades. The large cracks form at almost regular intervals in the asphalt pavement due to shrinkage and brittleness during very cold temperatures. The cracks create a bumpy ride and tend to spall which further deteriorates the highway surface. When the old surface is overlaid, the same transverse cracks reflect through the new overlay in a short time, allowing water to reach the base and subgrade, which ultimately shortens the design life. A successful reflective crack prevention program would extend the life of an overlay and reduce the cost of maintaining US 97 in an acceptable condition. The same treatment could be used on other state highways reducing transportation cost in general.

Just adding a new overlay will extend the life of the pavement, but it is of limited value in retarding reflective thermal cracking. Performance Based Asphalts (PBA) are used to help prevent the occurrence of temperature related cracking but do not solve the reflective cracking problem.

One method to slow the recurrence of reflective cracking is to use geosynthetics. The geosynthetics introduce an interlayer within the overlay to reduce the effects of reflection cracking, to dampen stress, relieve strain, and provide tensile reinforcement to the asphalt.

Research into geosynthetics with open-graded asphalt overlays is of interest since the combination has not been studied in Oregon.

1.2 OBJECTIVES

The objectives of this study are to test six reflective crack prevention methods over a three-year period. The prevention methods will be compared to a control section. The seven total sections were constructed as follows:

1. Overlay only (control).
2. Clean crack, fill with D-mix (12.5 mm max. aggregate size), overlay.
3. Clean crack, fill with D-mix, place Glasgrid 8502® over crack, overlay.
4. Clean crack, fill with D-mix, place GeoTac® over crack, overlay.
5. Clean crack, fill with D-mix, place PavePrep SA® over crack, overlay.
6. Clean crack, fill with D-mix, place Polyguard Cold Flex 2000 SA™ over crack, overlay.
7. Clean crack, fill with D-mix, place Polyguard 665™ over crack, overlay.

The treatments will be inspected each spring for three years as per Section 6.0.

1.3 OTHER STUDIES

The Oregon Department of Transportation (ODOT) has conducted other studies of reflective crack prevention. One study on Interstate 5 (I-5) was continued for over 12 years and was considered successful. However, the project was a 150 mm dense-graded asphalt overlay of jointed concrete. A continuous roll of geotextile was placed before the asphalt concrete (AC) overlay. A special technique called bond breaker, which included fine gravel and tarpaper, was placed over the cracks, prior to overlaying (Bish, 1989).

The City of Portland with ODOT's assistance also conducted a study. East Burnside Street, which was a jointed concrete section with a dense-graded AC overlay, had 50 mm of deteriorated AC removed and replaced. Selected transverse cracks had either Glasgrid 8502® or Polyguard® geosynthetics placed over them after a leveling course was placed. The sections were overlaid with 50 mm of AC (Phipps, 1992). After seven years only a few lineal meters of the cracks have reflected through the overlay. The success of this application was believed to be due to a well-designed and placed overlay rather than the geotextiles (Armstrong, 1994).

In another study on I-84 near Ontario, Oregon, one 610 mm geotextile strip of AMOCO CEF style 4545 was placed on the existing asphalt concrete over the cracks before a polymer modified dense-graded Class "B" (25 mm max. aggregate size) asphalt concrete mix was laid. These cracks reflected through before the end of the first year (Scholl, 1990).

2.0 SITE CONDITIONS

2.1 LOCATION

The project is located along Oregon State Highway Number 4 (US 97). The test section starts at Milepoint 213.58 and ends at Milepoint 217.64, south of Chemult, Oregon.

2.2 ENVIRONMENTAL CONDITIONS

The monthly temperature means and extremes for Chemult, Oregon are in Appendix A. The weather information was taken from the Oregon Climate Service, available at http://www.ocs.orst.edu or by calling (541) 737-5705. Of particular importance to reflective cracking are the extreme low temperatures. For the years 1961 through 1990, the extreme low temperature was -34° C.

2.3 TRAFFIC

The average daily traffic (ADT) for 1997 is approximately 3700 vehicles per day. The vehicle classification breakdown, based on a permanent automatic traffic recorder (ATR) station near Chemult, is in Table 2.1.

Table 2.1: Vehicle Classification Breakdown (ATR 18-006)

Vehicle Classification	Percent of ADT
Passenger cars	42.17
Other 2 axle 4 tire vehicles	21.62
Single Unit 2 axle 6 tire	4.26
Single Unit 3 axle	1.27
Single Unit 4 axle or more	0.30
Single Trailer Truck 4 axle or less	0.66
Single Trailer Truck 5 axle	22.62
Single Trailer Truck 6 axle or more	2.14
Double-Trailer Truck 5 axle or less	1.78
Double-Trailer Truck 6 axle	0.26
Double-Trailer Truck 7 axle or more	2.05
Triple Trailer Trucks	0.16
Buses	0.33
Motorcycles and Scooters	0.38

2.4 PAVEMENT HISTORY

Table 2.2 describes the information gathered from core samples taken at the project site. The ODOT Pavement Services Unit provided the information. The average pavement depth prior to overlay was 278 mm. The type and depth of materials varied, as shown in the pavement lift depth and pavement lift type columns.

Table 2.2: Existing Pavement Materials

Pavement Lift Number	Pavement Lift Depth	Pavement Lift Type
1	40-50 mm	Open-Graded Asphalt Concrete
2	50 mm	Dense-Graded Asphalt Concrete (Heavy Oil)
3	40-100 mm	Dense-Graded Asphalt Concrete
4	0-70 mm	Open-Graded or Dense-Graded Asphalt Concrete
5	30-60 mm	Loose Red Rock Asphalt Concrete
6	30-60 mm	Red Rock Dense Asphalt Concrete

The overlay material is 50 mm of Class “F” (25 mm max. aggregate size) asphalt concrete mix wearing course, placed full-width.

3.0 TRANSVERSE CRACK RATING AND PRETREATMENT

3.1 TRANSVERSE CRACKING SEVERITY LEVELS

The crack rating system used is based on the *Distress Identification Manual for the Long-Term Pavement Performance Project* (National Research Council, 1993). Measures of crack severity will be used throughout the study to record crack characteristics. The following describes the rating method used:

The inspector records the number and length of transverse cracks at each severity level. The inspector rates the entire transverse crack at the highest severity level present for at least 10% of the total length of the crack. The inspector also records length (meters) of transverse cracks with sealant in good condition at each severity level.

Note: The length recorded is the total length of the well-sealed crack and is assigned to the severity level of the crack. Record only when the sealant is in good condition for at least 90% of the length of the crack.

The definitions of crack severity level are contained in Table 3.1.

Table 3.1: Cracking Severity Level

Severity	Mean Width
Low	An unsealed crack with a mean width <= 6 mm; or a sealed crack with sealant material in good condition, and with a width that cannot be determined.
Moderate	Any crack with a mean width> 6 mm and <= 19 mm; or any crack with a mean width <=19 mm, and adjacent low severity random cracking.
High	Any crack with a mean width > 19 mm; or any crack with a mean width <=19 mm, and adjacent moderate to high severity random cracking.

3.2 TRANSVERSE CRACK CLEANING AND FILLING

Virtually all of the cracks were filled with “sanding” material from previous winter ice control operations. Accordingly, only the larger cracks needed a better means of being filled to achieve the various geosynthetic manufacturers’ stated requirements of filled cracks. As D-Mix is the preferred material to fill cleaned cracks and the maximum aggregate size of this mix is 12.5 mm, the following procedure was followed:

1. All cracks that were less than 19 mm overall nominal width were not cleaned.
2. All cracks 19 mm and greater were “blown-out” with compressed air to a depth of 50 mm. The blown-out material was removed from the pavement in the area where the geosynthetic was placed.
3. D-Mix asphalt concrete at a minimum temperature of 140° C was placed in the cleaned crack to achieve a “tightly” filled crack. The finished elevation of the D-Mix is the same as the abutting pavement as closely as could be achieved, never exceeding the abutting pavement surface.

4.0 GEOSYNTHETICS

4.1 GEOSYNTHETIC SPECIFICATIONS

The manufacturers' material parameters of interest are listed in Table 4.1.

Table 4.1: Specifications

Material	Tensile Strength	Tensile Strength Test	Thickness (mm)	Width (m)
Glasgrid 8502® Pavement reinforcing mesh consisting of fiberglass reinforcement coated with an elastomeric polymer and a pressure sensitive adhesive backing (Bayex, 1997)	200 x 100 kN/m	G.R.I. GG 1-87	1.73	1.52
GeoTac® Peel-and-stick, thick waterproofing membrane manufactured from a rubberized asphalt, with a top layer of durable, tightly bonded polyester geotextile (Contech, 1994)	8.9 kN/m	ASTM D882 (Modified)	2.03	0.61
PavePrep SA® Heavy-duty crack reduction/stress relief interlayer consisting of a flexible high density asphaltic membrane laminated between a nonwoven and woven polyester geotextile, with an adhesive backing (Contech, Guide, 1996)	167 kg/cm*cm	ASTM D412-87	3.43	0.61
Polyguard Cold Flex 2000 SA™ Peel-and-stick pavement repair membrane consisting of two layers of high strength polypropylene fabric with a layer of flexible mastic to provide stress relief (Polyguard, May-June 1998)	53 kN/m	ASTM D412	3.43	0.61
Polyguard 665™ Pavement waterproofing membrane consisting of a rubberized asphalt waterproofing adhesive, laminated to a strong woven polypropylene backing, with a silicone treated release sheet (Polyguard, January 1998)	16 kN/m	ASTM D882 (Method B)	1.65	0.61

4.2 PRE-TEST OF GEOSYNTHETICS

In addition to reviewing the technical literature and geosynthetic manufacturers' information, placement tests were performed on Glasgrid 8502® with and without a nonwoven geosynthetic backing, Polyguard Cold Flex 2000 SA™ and PavePrep SA®. The objective of the placement test was to evaluate the ease/difficulty of covering the crack and having the geosynthetic remain in place under traffic prior to the overlay. The Polyguard™ and PavePrep SA® geosynthetics were easy to place and the geosynthetics were still bonded to the pavement after one month of being exposed to 4000 vehicles per day. The Glasgrid 8502® with nonwoven geosynthetic backing did not bond well to a CSS-1 tack coat, which is not considered an acceptable way of holding the geosynthetic in place. Glasgrid 8502® without backing, relying on the self-adhesive properties, placed just prior to hot mix overlay would probably remain in place if well rolled. Care should be taken to not have vehicles "shove" it by stopping on it.

5.0 GEOSYNTHETIC INSTALLATION

5.1 GENERAL NOTES

The contractor placed the geosynthetics from September 21st through the 24th, 1998. The contractor swept off both shoulders prior to placing the geosynthetics in order to have good adhesion with the pavement. There was dust and other material littering the shoulder edges from the recently placed windrows of shoulder rock. The geosynthetics were not overlapped due to concern regarding the impacts on ride quality. Where the geosynthetic was placed in pieces, the edges were butted against each other, creating a seam.

Colored tags were placed on posts set on both sides of the roadway to mark the start of a new section. The color is annotated in the following notes. The initial crack survey forms are in Appendix B. The layout of the geosynthetics is in Appendix C. Also, portions of the installation operation were videotaped and the tapes are kept in the Research Unit.

5.2 GEOSYNTHETIC INSTALLATION NOTES

5.2.1 Cracks 1 – 5: Control

The first five cracks are part of the 20 that form the "baseline" or control. These cracks were not cleaned, filled nor treated with geosynthetic.

5.2.2 Cracks 6 – 15: Crack Fill Only

The ten cracks are part of the 22 that were cleaned and filled with D-Mix as needed, but were not treated with geosynthetics.

5.2.3 Cracks 16 – 35: Glasgrid 8502®

The 20 cracks were cleaned and filled with D-Mix as needed, and then covered with Glasgrid 8502® (no non-woven backing) during the time of lane closure for paving. On September 23, 1998, the product representatives started applying a specially formulated tack at 11:30 AM. At 12:30 PM, the contractor stopped the operation due to an asphalt plant break down. The application of tack resumed at 3:00 PM. Air temperature was 26° C.

Before paving, a hot mix truck turned around on the geosynthetic. The trailer wheels pulled up approximately 0.5 m of material from the edge of the southbound shoulder of crack 22. The 0.5 m of material was left in-place as it seemed to be in good order. Later one of the empty trucks leaving the paver picked up the 0.5 m of material again. The 0.5 m of material was removed to prevent further damage.

When the paver paved over crack 30, the shoulder ski hooked the material and pulled approximately two meters of geosynthetic from the shoulder. The two meters of material was removed from the southbound shoulder edge towards centerline.

This process was labor intensive as the tack was applied by hand, since the tack truck for the paver could not apply tack over the geosynthetic. The tack was applied with paint rollers. The application of the geosynthetic went better when the geosynthetic was cut to length. The geosynthetic was laid on the tack, the workers walked on the geosynthetic to set it and then the geosynthetic was wheel rolled with vehicle tires. As the paving operation approached, the geosynthetic seemed to adhere to the pavement fairly well. As the paver paved over the geosynthetic it still seemed to adhere to the pavement. The paver went over the first crack at 4:30 PM. The contractor only placed Glasgrid 8502® to crack 31 as the paver caught up to them.

On September 24, 1998, the product representatives started applying the specially formulated tack at 11:30 AM. They started applying geosynthetic at 12:30 PM. They used the same process as that of September 23rd. They finished applying geosynthetic at 1:30 PM. Cracks 16 – 31 received full width treatment, with the exception of the previously mentioned damage at cracks 22 and 30. Cracks 32 through 35 received treatment from centerline to edge of pavement in the northbound lane only. There were no problems getting the paver over the geosynthetic. There was no truck damage this day.

5.2.4 Crack 36 – 37: Crack Fill Only

The two cracks are part of the 22 that were cleaned and filled with D-Mix as needed, but were not treated with geosynthetics. There is a pink colored tag on a post set in the right-of-way on both sides of the roadway at crack 36.

5.2.5 Crack 38 – 55: GeoTac®

The 18 cracks were cleaned and filled with D-Mix as needed, and then covered with GeoTac® waterproofing geosynthetic several days in advance of the overlay. The contractor placed GeoTac® from crack 54 to 38 in descending order on September 22, 1998. The geosynthetic was placed on crack 55 on September 21, 1998. The geosynthetic is designed as a moisture barrier. The GeoTac® was fairly easy to apply. The geosynthetic was in good condition, and the backing came off easily.

5.2.5.1 Crack 38

There is one seam between two pieces of geosynthetic located in the southbound lane. There is a green colored tag on a post set in the right-of-way on both sides of the roadway.

5.2.5.2 Crack 39

There is one seam between two pieces of geosynthetic located in the northbound lane.

5.2.5.3 Crack 40

<u>Good application example</u>. One piece of geosynthetic, straight, no wrinkles.

5.2.5.4 Crack 41

There are two seams between three offset pieces of geosynthetic located in the northbound lane.

5.2.5.5 Crack 42

There are two seams between three offset pieces of geosynthetic located in the southbound lane.

5.2.5.6 Crack 43

There are three seams between four offset pieces of geosynthetic.

5.2.5.7 Crack 44

There is one piece of geosynthetic, fairly straight. Southbound shoulder has an asphalt branch crack that extends outside the geosynthetic.

5.2.5.8 Crack 45

There are two seams between three offset pieces of geosynthetic located in the center of the northbound lane and the northbound shoulder. There is a partial road width crack about 1 m to the north of and parallel to the reflective crack, treated with one separate piece of geosynthetic. The piece spans from the east pavement edge to the center of the northbound lane.

5.2.5.9 Crack 46

There is one piece of geosynthetic, slightly curved to match the crack.

5.2.5.10 Crack 47

There is one seam between two offset pieces of geosynthetic located on the centerline of the roadway.

5.2.5.11 Crack 48

There is one seam between two pieces of geosynthetic located on the southbound shoulder.

5.2.5.12 Crack 49

There is one seam between two angled pieces located at the centerline of the roadway.

5.2.5.13 Crack 50

There is one seam between two pieces of geosynthetic located in the center of the northbound lane.

5.2.5.14 Crack 51

There is one seam between two offset pieces of geosynthetic located at the centerline of the roadway.

5.2.5.15 Crack 52

Good application example. One piece of geosynthetic, straight, no wrinkles.

5.2.5.16 Crack 53

One piece of geosynthetic, with wrinkles. Some of the wrinkles were cut out and the remaining material laid flat.

5.2.5.17 Crack 54

The contractor got started at 9:00 AM. The air temperature was around 14° C. Traffic was allowed on the first piece of geosynthetic placed. The first car picked up the geosynthetic. The contractor then waited until 10:00 AM. The air temperature was 18° C. From 9:00 to 10:00 AM, the contractor had unrolled three rolls of geosynthetic attempting to warm the adhesive in the direct sunlight, making it more tacky. The contractor replaced the same piece of geosynthetic a second time. The first car over it picked it up again. The contractor waited until 11:00 AM and tried again. The air temperature was 22° C. This third time the geosynthetic adhered to the pavement. The piece of geosynthetic tried three times, spans from the southbound shoulder to centerline of the roadway. There is one seam at the centerline of the roadway between this piece of geosynthetic and a new piece.

5.2.5.18 Crack 55

There was one piece of geosynthetic with some wrinkling and folding. Wrinkles and folds were mostly flattened by vehicular traffic. Some wrinkles were cut out and the geosynthetic laid back over.

5.2.6 Crack 56 – 75: PavePrep SA®

The 20 cracks were cleaned and filled with D-Mix as needed, and then covered with PavePrep SA® self-adhesive heavy-duty crack reduction/stress relief interlayer material several days in advance of the overlay. For PavePrep SA® placement on cracks 56, 57 and 58, the contractor rolled out the geosynthetic on the shoulder of pavement, cut off a piece to span the roadway width, pulled off the protective backing, turned the geosynthetic over, and carried it over and placed it on the crack. No tack coat was used as there is adhesive on the geosynthetic. The geosynthetic was in good condition, and the backing came off very easily. This geosynthetic was a little harder to cut to length than the other geosynthetics, due to the thickness. For PavePrep SA® placement on cracks other than 56, 57 and 58, the contractor rolled out the geosynthetic over the crack, removing the backing as the geosynthetic was rolled out. It was challenging to remove the backing due to high static electricity. On September 21, 1998, the contractor placed geosynthetic over cracks 56 – 66. On September 22, 1998, the contractor started placing PavePrep SA® at 1:00 PM. The application of geosynthetic on cracks 67 – 75 was completed by 2:00 PM. The air temperature throughout the application for September 22nd was around 23° C. There are no comments recorded for crack 57.

5.2.6.1 Crack 56

One piece of geosynthetic. There is an orange colored tag on a post set in the right-of-way on both sides of the roadway.

5.2.6.2 Crack 58

There is one seam between two pieces of geosynthetic located in the center of the southbound lane.

5.2.6.3 Crack 59

One piece of geosynthetic.

5.2.6.4 Crack 60

One piece of geosynthetic, rolled from the end of the roll. The geosynthetic was not flat, but bumpy and wrinkled.

5.2.6.5 Crack 61

There are three seams between four pieces of geosynthetic cut at angles to match the crack. The seams are located on the southbound fogstripe, center of northbound lane, and the northbound lane shoulder.

5.2.6.6 Crack 62

One piece of geosynthetic, wrinkled and bumpy.

5.2.6.7 Crack 63

One piece of geosynthetic, fairly straight.

5.2.6.8 Crack 64

There is one seam between two offset pieces of geosynthetic located in the center of the southbound lane.

5.2.6.9 Crack 65

One piece of geosynthetic, with minor edge wrinkling due to matching path of crack.

5.2.6.10 Crack 66

There is one seam between two pieces of geosynthetic located in the southbound lane.

5.2.6.11 Crack 67

There are two seams between three pieces of geosynthetic located in the northbound and southbound lanes.

5.2.6.12 Crack 68

There is one seam between two pieces of geosynthetic located on the northbound shoulder.

5.2.6.13 Crack 69

There are two seams between three pieces of geosynthetic located in the southbound lane and on the southbound fog stripe.

5.2.6.14 Crack 70

There is one seam between two pieces of geosynthetic located at the centerline of the roadway.

5.2.6.15 Crack 71

There are two seams between three pieces of geosynthetic located at the centerline of both the southbound and northbound lanes.

5.2.6.16 Crack 72

There is one seam between two pieces of geosynthetic located in the center of the southbound lane. There is alligator cracking along the southbound lane fog stripe in the area around the crack.

5.2.6.17 Crack 73

There is one seam between two pieces of geosynthetic located on the northbound shoulder.

5.2.6.18 Crack 74

Good application example. One piece, no wrinkles.

5.2.6.19 Crack 75

There is one seam between two pieces of geosynthetic located on the northbound shoulder.

5.2.7 Crack 76 – 85: Control

The ten cracks are part of the 20 that form the "baseline" or control. These cracks were not cleaned, filled nor treated with geosynthetic. There is a purple colored tag on a post set in the right-of-way on both sides of the roadway at crack 76.

5.2.8 Crack 86 – 105: Polyguard Cold Flex 2000 SA™

The 20 cracks were cleaned and filled with D-Mix as needed, and then covered with Polyguard Cold Flex 2000 SA™ highway geosynthetic several days in advance of the overlay. On September 22, 1998, the contractor started applying this geosynthetic at 2:15 PM. The air temperature was around 23° C. The geosynthetic was difficult to place. The delivered geosynthetic was in poor to fair condition. The geosynthetic appeared to have been stored in a hot area. It appeared the adhesive had run to the bottom of the roll and stuck the roll of geosynthetic to the box. There was not any wax paper on the end of each roll to keep the roll from bonding to the cardboard box. This also presented some problems with unrolling the geosynthetic with a glob of adhesive on one end of the roll. The contractor also had some trouble removing the backing due to the adhesive on one end of the roll. The backing tore easily and did not remove in one piece. The backing shredded into pieces, making it difficult to roll out. Small pieces would tear off and stay on the roll. The geosynthetic edge on the opposite end of the roll from the glob of adhesive raveled from the tack layer, with fibers sticking out. The geosynthetic also looked like there were shrinkage wrinkles in it. The geosynthetic seemed to adhere to the pavement. Traffic did not pick-up any of the geosynthetics on the cracks treated. The application was finished at 5:00 PM. The geosynthetic is more flexible than PavePrep SA®. The self-adhesive is similar to GeoTac®, maybe even better, as it is very tacky. A few rolls were spliced mid roll. Overall, the material used for this project seemed second rate. There are no comments recorded for cracks 95, 97, 99, 102, 103, and 104.

5.2.8.1 Crack 86

There is one seam between two pieces of geosynthetic located at the centerline of the roadway.

5.2.8.2 Crack 87

There are two seams between three pieces of geosynthetic located at both of the fog stripes.

5.2.8.3 Crack 88

There are two seams between three offset pieces of geosynthetic located at the center of the southbound lane and the fog stripe of the northbound lane.

5.2.8.4 Crack 89

There are two seams between three pieces of geosynthetic located at the centerline of the roadway and the fog stripe of the northbound lane.

5.2.8.5 Crack 90

There is one seam between two pieces of geosynthetic located in the center of the northbound lane.

5.2.8.6 Crack 91

There is one seam between two pieces of geosynthetic located at the fog stripe of the southbound lane.

5.2.8.7 Crack 92

One piece of geosynthetic, straight.

5.2.8.8 Crack 93

There are two seams between three pieces of geosynthetic. There is extensive edge raveling.

5.2.8.9 Crack 94

There are two seams between three pieces of geosynthetic. There is extensive edge raveling on the north side of the geosynthetic.

5.2.8.10 Crack 96

There is one seam between two pieces of geosynthetic.

5.2.8.11 Crack 98

There is one seam between two pieces of geosynthetic located on the northbound fog stripe.

5.2.8.12 Crack 100

Good application example. One piece.

5.2.8.13 Crack 101

There are three seams between four pieces of geosynthetic. The geosynthetic was slightly wrinkled.

5.2.8.14 Crack 105

There are two seams between three pieces of geosynthetic.

5.2.9 Crack 106 – 125: Polyguard 665™

The 20 cracks were cleaned and filled with D-Mix as needed, and then covered with Polyguard 665™ several days in advance of the overlay. The geosynthetic was much easier to place than the Polyguard Cold Flex 2000 SA™. This material is a fairly rigid material. The self-adhesive is very tacky, similar to that of the Polyguard Cold Flex 2000 SA™. On September 22, 1998, the contractor started this application @ 5:15 PM. The air temperature was around 21° C. The geosynthetic was in good condition. This geosynthetic seemed to be the easiest to install of all the geosynthetics tested. The contractor encountered no problems. The installation was completed at 6:30 PM. There are only comments recorded for cracks 110, 111, and 121.

5.2.9.1 Crack 110

There are three seams between four pieces of geosynthetic.

5.2.9.2 Crack 111

<u>Good application example</u>. One piece, straight, placed well.

5.2.9.3 Crack 121

<u>Good application example</u>. One piece.

5.2.10 Crack 126 – 135: Crack Fill Only

The ten cracks are part of the 22 that were cleaned and filled with D-Mix as needed, but were not treated with geosynthetics.

5.2.11 Crack 136 – 140: Control

The five cracks are part of the 20 that form the “baseline” or control. These cracks were not cleaned, filled nor treated with geosynthetic.

6.0 INSPECTION PLAN

The following plan will be used for each inspection throughout the test.

6.1 ACTIONS PRIOR TO SITE INSPECTION

1. Watch pavement material installation video (~30 run time-VHS format) to refresh memory on construction process.
2. Borrow the VHS-C camera from Region 2, District 3.
3. Assemble the following items to take to the site inspection:
   -A copy of this construction report
   -Two VHS-C videotapes of the installation
   -Two blank VHS-C videotapes
   -Digital camera with spare 1.5” floppy discs
   -Research Unit laptop computer with spreadsheet file loaded for data input
   -Research Unit metric distance measuring wheel
   -Silver spray paint cans (inverted tip)
   -Plenty of blank Research Unit Crack Survey forms
4. Plan to inspect in May or June of each year since the chance for snow is low and the daily maximum temperature is never below freezing. Attempt to inspect during a period of light precipitation. The reflective cracking will be easier to locate in a recently wetted pavement. Inspect in the spring 1999, 2000, and 2001.

6.2 SITE INSPECTION

1. First, locate crack 1. Crack 1 is marked with a piece of steel rebar set near the right-of-way on the west side of the roadway. To confirm project start point, locate the pink colored tag on a post set in the right-of-way on both sides of the roadway at crack 36, near milepoint 214.333. Then wheel off 1209 meters to the north along the center of the southbound shoulder. Compare this location to the milepoint 213.582.
2. Layout the cracks and spray the number at each crack. Use the colored tags in the right-of-way mentioned in Section 5.0.
3. Walk the entire test section, focusing on the 140 transverse cracks. Also, note the cracking severity plus any cracking in between. Use the Research Unit Crack Survey forms to record all cracking. Measure the length (meters) of each crack.
4. Analyze the crack survey forms located in Appendix B. Attempt to deduce which cracks are reflective.
5. If the information gathered from the site inspection would be of interest, publish the information in a research note.
6. Write the final report in sections as the work progresses. After an inspection, record the findings and begin to draw conclusions.

7.0 REFERENCES

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APPENDIX A

OREGON CLIMATE SERVICE
MONTHLY MEANS AND EXTREMES (1961 – 1990)
CHEMULT, OREGON

APPENDIX B

CRACK SURVEY FORMS

APPENDIX C

LAYOUT OF GEOSYNTHETICS

Table C.1: Layout of Geosynthetics (For key information see bottom of table)

CRACK #	CONST STATION KM'S +	CONST STATION M'S	CONST STATION METERS	METERS FROM LAST CRACK	CRACK STATION METERS	CRACK MP	TREATMENT TYPE	CRACK L,M,H
1	343	891	343891	0	0	213.582	CONTROL(NONE)	M
2	343	931	343931	40	40	213.607	CONTROL(NONE)	M
3	343	962	343962	31	71	213.626	CONTROL(NONE)	M
4	343	989	343989	27	98	213.643	CONTROL(NONE)	M
5	344	22	344022	33	131	213.663	CONTROL(NONE)	M
6	344	36	344036	14	145	213.672	CRACK FILL ONLY	M
7	344	59	344059	23	168	213.686	CRACK FILL ONLY	H
8	344	95	344095	36	204	213.709	CRACK FILL ONLY	H
9	344	140	344140	45	249	213.737	CRACK FILL ONLY	M
10	344	178	344178	38	287	213.760	CRACK FILL ONLY	M
11	344	206	344206	28	315	213.778	CRACK FILL ONLY	H
12	344	230	344230	24	339	213.793	CRACK FILL ONLY	M
13	344	258	344258	28	367	213.810	CRACK FILL ONLY	H
14	344	301	344301	43	410	213.837	CRACK FILL ONLY	H
15	344	353	344353	52	462	213.869	CRACK FILL ONLY	H
16	344	377	344377	24	486	213.884	GLASGRID 8502®	M
17	344	427	344427	50	536	213.915	GLASGRID 8502®	M
18	344	469	344469	42	578	213.941	GLASGRID 8502®	M
19	344	505	344505	36	614	213.964	GLASGRID 8502®	H
20	344	551	344551	46	660	213.992	GLASGRID 8502®	H
21	344	575	344575	24	684	214.007	GLASGRID 8502®	M
22	344	614	344614	39	723	214.031	GLASGRID 8502® (-0.5m SB Shoulder)	H
23	344	634	344634	20	743	214.044	GLASGRID 8502®	H
24	344	667	344667	33	776	214.064	GLASGRID 8502®	H
25	344	694	344694	27	803	214.081	GLASGRID 8502®	H
26	344	736	344736	42	845	214.107	GLASGRID 8502®	M
27	344	768	344768	32	877	214.127	GLASGRID 8502®	M
28	344	810	344810	42	919	214.153	GLASGRID 8502®	H
29	344	824	344824	14	933	214.162	GLASGRID 8502®	H
30	344	869	344869	45	978	214.190	GLASGRID 8502® (-2m SB Shoulder/Lane)	H
31	344	894	344894	25	1003	214.205	GLASGRID 8502®	M
32	344	912	344912	18	1021	214.216	GLASGRID 8502® (NB ONLY)	M
33	344	961	344961	49	1070	214.247	GLASGRID 8502® (NB ONLY)	M
34	345	8	345008	47	1117	214.276	GLASGRID 8502® (NB ONLY)	H
35	345	52	345052	44	1161	214.303	GLASGRID 8502® (NB ONLY)	H
36	345	100	345100	48	1209	214.333	CRACK FILL ONLY	H
37	345	148	345148	48	1257	214.363	CRACK FILL ONLY	H
38	345	180	345180	32	1289	214.383	GEOTAC®	H
39	345	225	345225	45	1334	214.411	GEOTAC®	H
40	345	268	345268	43	1377	214.438	GEOTAC®	M
41	345	319	345319	51	1428	214.469	GEOTAC®	H
42	345	391	345391	72	1500	214.514	GEOTAC®	M
43	345	473	345473	82	1582	214.565	GEOTAC®	M
44	345	541	345541	68	1650	214.607	GEOTAC®	M
45	345	577	345577	36	1686	214.630	GEOTAC®	H
46	345	614	345614	37	1723	214.653	GEOTAC®	M
47	345	695	345695	81	1804	214.703	GEOTAC®	M
48	345	800	345800	105	1909	214.768	GEOTAC®	M

CRACK	CONST		CONST	METERS	CRACK	CRACK	TREATMENT	CRACK
#	STATION		STATION	FROM LAST	STATION	MP	TYPE	L,M,H
	KM'S +	M'S	METERS	CRACK	METERS			
49	345	860	345860	60	1969	214.805	GEOTAC®	M
50	345	980	345980	120	2089	214.880	GEOTAC®	M
51	346	4	346004	24	2113	214.895	GEOTAC®	H
52	346	59	346059	55	2168	214.929	GEOTAC®	M
53	346	123	346123	64	2232	214.969	GEOTAC®	H
54	346	174	346174	51	2283	215.001	GEOTAC®	H
55	346	221	346221	47	2330	215.030	GEOTAC®	M
56	346	279	346279	58	2388	215.066	PAVEPREP SA®	M
57	346	323	346323	44	2432	215.093	PAVEPREP SA®	H
58	346	354	346354	31	2463	215.112	PAVEPREP SA®	M
59	346	392	346392	38	2501	215.136	PAVEPREP SA®	M
60	346	438	346438	46	2547	215.165	PAVEPREP SA®	H
61	346	487	346487	49	2596	215.195	PAVEPREP SA®	M
62	346	561	346561	74	2670	215.241	PAVEPREP SA®	M
63	346	623	346623	62	2732	215.280	PAVEPREP SA®	M
64	346	673	346673	50	2782	215.311	PAVEPREP SA®	H
65	346	728	346728	55	2837	215.345	PAVEPREP SA®	M
66	346	786	346786	58	2895	215.381	PAVEPREP SA®	H
67	346	832	346832	46	2941	215.409	PAVEPREP SA®	H
68	346	902	346902	70	3011	215.453	PAVEPREP SA®	M
69	346	934	346934	32	3043	215.473	PAVEPREP SA®	H
70	346	991	346991	57	3100	215.508	PAVEPREP SA®	H
71	347	27	347027	36	3136	215.531	PAVEPREP SA®	H
72	347	93	347093	66	3202	215.572	PAVEPREP SA®	H
73	347	145	347145	52	3254	215.604	PAVEPREP SA®	M
74	347	244	347244	99	3353	215.665	PAVEPREP SA®	H
75	347	314	347314	70	3423	215.709	PAVEPREP SA®	M
76	347	373	347373	59	3482	215.746	CONTROL(NONE)	H
77	347	465	347465	92	3574	215.803	CONTROL(NONE)	H
78	347	502	347502	37	3611	215.826	CONTROL(NONE)	H
79	347	533	347533	31	3642	215.845	CONTROL(NONE)	M
80	347	576	347576	43	3685	215.872	CONTROL(NONE)	H
81	347	644	347644	68	3753	215.914	CONTROL(NONE)	H
82	347	674	347674	30	3783	215.933	CONTROL(NONE)	M
83	347	725	347725	51	3834	215.964	CONTROL(NONE)	H
84	347	795	347795	70	3904	216.008	CONTROL(NONE)	H
85	347	869	347869	74	3978	216.054	CONTROL(NONE)	H
86	347	938	347938	69	4047	216.097	POLYGUARD COLD FLEX 2000 SA™	H
87	348	31	348031	93	4140	216.154	POLYGUARD COLD FLEX 2000 SA™	H
88	348	93	348093	62	4202	216.193	POLYGUARD COLD FLEX 2000 SA™	H
89	348	127	348127	34	4236	216.214	POLYGUARD COLD FLEX 2000 SA™	H
90	348	200	348200	73	4309	216.259	POLYGUARD COLD FLEX 2000 SA™	M
91	348	256	348256	56	4365	216.294	POLYGUARD COLD FLEX 2000 SA™	M
92	348	276	348276	20	4385	216.307	POLYGUARD COLD FLEX 2000 SA™	H
93	348	315	348315	39	4424	216.331	POLYGUARD COLD FLEX 2000 SA™	H
94	348	394	348394	79	4503	216.380	POLYGUARD COLD FLEX 2000 SA™	H
95	348	453	348453	59	4562	216.417	POLYGUARD COLD FLEX 2000 SA™	H
96	348	500	348500	47	4609	216.446	POLYGUARD COLD FLEX 2000 SA™	H
97	348	517	348517	17	4626	216.456	POLYGUARD COLD FLEX 2000 SA™	M

CRACK	CONST		CONST	METERS	CRACK	CRACK	TREATMENT	CRACK
#	STATION		STATION	FROM LAST	STATION	MP	TYPE	L,M,H
	KM'S +	M'S	METERS	CRACK	METERS			
98	348	558	348558	41	4667	216.482	POLYGUARD COLD FLEX 2000 SA™	H
99	348	606	348606	48	4715	216.512	POLYGUARD COLD FLEX 2000 SA™	H
100	348	651	348651	45	4760	216.540	POLYGUARD COLD FLEX 2000 SA™	H
101	348	684	348684	33	4793	216.560	POLYGUARD COLD FLEX 2000 SA™	H
102	348	710	348710	26	4819	216.576	POLYGUARD COLD FLEX 2000 SA™	H
103	348	739	348739	29	4848	216.594	POLYGUARD COLD FLEX 2000 SA™	H
104	348	767	348767	28	4876	216.612	POLYGUARD COLD FLEX 2000 SA™	M
105	348	807	348807	40	4916	216.637	POLYGUARD COLD FLEX 2000 SA™	M
106	348	830	348830	23	4939	216.651	POLYGUARD 665™	M
107	348	856	348856	26	4965	216.667	POLYGUARD 665™	H
108	348	885	348885	29	4994	216.685	POLYGUARD 665™	H
109	348	928	348928	43	5037	216.712	POLYGUARD 665™	M
110	348	955	348955	27	5064	216.729	POLYGUARD 665™	M
111	348	977	348977	22	5086	216.742	POLYGUARD 665™	M
112	349	6	349006	29	5115	216.760	POLYGUARD 665™	M
113	349	32	349032	26	5141	216.776	POLYGUARD 665™	M
114	349	59	349059	27	5168	216.793	POLYGUARD 665™	M
115	349	98	349098	39	5207	216.817	POLYGUARD 665™	H
116	349	139	349139	41	5248	216.843	POLYGUARD 665™	H
117	349	179	349179	40	5288	216.868	POLYGUARD 665™	M
118	349	207	349207	28	5316	216.885	POLYGUARD 665™	M
119	349	237	349237	30	5346	216.904	POLYGUARD 665™	M
120	349	305	349305	68	5414	216.946	POLYGUARD 665™	H
121	349	354	349354	49	5463	216.977	POLYGUARD 665™	M
122	349	413	349413	59	5522	217.013	POLYGUARD 665™	M
123	349	470	349470	57	5579	217.049	POLYGUARD 665™	M
124	349	556	349556	86	5665	217.102	POLYGUARD 665™	H
125	349	694	349694	138	5803	217.188	POLYGUARD 665™	M
126	349	751	349751	57	5860	217.223	CRACK FILL ONLY	H
127	349	817	349817	66	5926	217.264	CRACK FILL ONLY	M
128	349	844	349844	27	5953	217.281	CRACK FILL ONLY	H
129	349	901	349901	57	6010	217.316	CRACK FILL ONLY	M
130	349	937	349937	36	6046	217.339	CRACK FILL ONLY	M
131	349	994	349994	57	6103	217.374	CRACK FILL ONLY	M
132	350	49	350049	55	6158	217.408	CRACK FILL ONLY	M
133	350	90	350090	41	6199	217.434	CRACK FILL ONLY	H
134	350	141	350141	51	6250	217.466	CRACK FILL ONLY	H
135	350	206	350206	65	6315	217.506	CRACK FILL ONLY	M
136	350	250	350250	44	6359	217.533	CONTROL(NONE)	H
137	350	298	350298	48	6407	217.563	CONTROL(NONE)	H
138	350	343	350343	45	6452	217.591	CONTROL(NONE)	M
139	350	384	350384	41	6493	217.617	CONTROL(NONE)	H
140	350	417	350417	33	6526	217.637	CONTROL(NONE)	H

Key:

Crack #:	Sequential number of the transverse crack.
Const Station KM's + M's:	The stationing used to locate the reflective crack location at the center of the west side shoulder.
Const Station Meters:	Meters used to locate geosynthetic location.
Meters from Last Crack:	Distance between crack and the previous crack.
Crack Station Meters:	Distance in meters from the first crack.
Crack MP:	The milepoint for each crack. Use as a reference only as the mileposts are not placed exactly, are missing, etc. Crack 1 was found using a vehicle and an in-vehicle distance computer. With the exception of the starting value, the numbers are not measured, they are converted from the construction stationing.
Treatment Type:	How the reflective crack is treated.
Crack LMH:	The severity of the crack - low, moderate, or high.

Notes on measuring the mileage with a Numetrics Distance Measuring Instrument in a vehicle:
At Crack 21, had to rezero out the computer to correct on MP 214. MP 215 is missing. Milepost 216 was at 215.989. MP 217 was at 216.992.