

**EVALUATION OF BONDED OVERLAY AND  
DOWEL BAR RETROFIT ON I-40**

**Interim Report  
August, 2001**

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16. ABSTRACT <p>In October, 1998, The Oklahoma Department of Transportation (ODOT) constructed a 1,000 foot long, experimental section of fiber-reinforced PCC overlay over an existing jointed concrete roadway.</p> <p>The ODOT Research and Development Division has been monitoring the site since completion. Field performance has been satisfactory to date. However, some cracking has been observed. The cracking has not affected ride or caused pieces of the overlay to spall out. This report summarizes the field performance of the experimental section as of June, 2001.</p>				13. TYPE OF REPORT AND PERIOD COVERED Interim, October, 1998 through June, 2001.	
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## SI (METRIC) CONVERSION FACTORS

<i>Approximate Conversions to SI Units</i>					<i>Approximate Conversions from SI Units</i>				
Symbol	When you know	Multiply by	To Find	Symbol	Symbol	When you know	Multiply by	To Find	Symbol
<b>LENGTH</b>					<b>LENGTH</b>				
in	inches	25.40	millimeters	mm	mm	millimeters	0.0394	inches	in
ft	feet	0.3048	meters	m	m	meters	3.281	feet	ft
yd	yards	0.9144	meters	m	m	meters	1.094	yards	yd
mi	miles	1.609	kilometers	km	km	kilometers	0.6214	miles	mi
<b>AREA</b>					<b>AREA</b>				
in <sup>2</sup>	square inches	645.2	square millimeters	mm <sup>2</sup>	mm <sup>2</sup>	square millimeters	0.00155	square inches	in <sup>2</sup>
ft <sup>2</sup>	square feet	0.0929	square meters	m <sup>2</sup>	m <sup>2</sup>	square meters	10.764	square feet	ft <sup>2</sup>
yd <sup>2</sup>	square yards	0.8361	square meters	m <sup>2</sup>	m <sup>2</sup>	square meters	1.196	square yards	yd <sup>2</sup>
ac	acres	0.4047	hectares	ha	ha	hectares	2.471	acres	ac
mi <sup>2</sup>	square miles	2.590	square kilometers	km <sup>2</sup>	km <sup>2</sup>	square kilometers	0.3861	square miles	mi <sup>2</sup>
<b>VOLUME</b>					<b>VOLUME</b>				
fl oz	fluid ounces	29.57	milliliters	mL	mL	milliliters	0.0338	fluid ounces	fl oz
gal	gallons	3.785	liters	L	L	liters	0.2642	gallons	gal
ft <sup>3</sup>	cubic feet	0.0283	cubic meters	m <sup>3</sup>	m <sup>3</sup>	cubic meters	35.315	cubic feet	ft <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.7645	cubic meters	m <sup>3</sup>	m <sup>3</sup>	cubic meters	1.308	cubic yards	yd <sup>3</sup>
<b>MASS</b>					<b>MASS</b>				
oz	ounces	28.35	grams	g	g	grams	0.0353	ounces	oz
lb	pounds	0.4536	kilograms	kg	kg	kilograms	2.205	pounds	lb
T	short tons (2000 lb)	0.907	megagrams	Mg	Mg	megagrams	1.1023	short tons (2000 lb)	T
<b>TEMPERATURE (exact)</b>					<b>TEMPERATURE (exact)</b>				
°F	degrees Fahrenheit	(°F-32)/1.8	degrees Celsius	°C	°C	degrees Celsius	9/5+32	degrees Fahrenheit	°F
<b>FORCE and PRESSURE or STRESS</b>					<b>FORCE and PRESSURE or STRESS</b>				
lbf	poundforce	4.448	Newtons	N	N	Newtons	0.2248	poundforce	lbf
lbf/in <sup>2</sup>	poundforce per square inch	6.895	kilopascals	kPa	kPa	kilopascals	0.1450	poundforce per square inch	lbf/in <sup>2</sup>

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## **INTRODUCTION**

On October 23, 1998, The Oklahoma Department of Transportation (ODOT) constructed a 1,000 ft - long, experimental section of fiber- reinforced concrete overlay over an existing jointed concrete roadway. The research project was done to demonstrate the construction aspects of the overlay and dowel bar retrofit process and to provide ODOT with actual field performance information regarding this method of restoring PCC pavements. The ODOT Research & Development (R & D) Division has been monitoring the site since completion. The latest annual Survey of the site was completed June 12, 2001. Survey findings are discussed in this report.

### **JUNE 12, 2001 SURVEY**

Operations conducted during the survey consisted of Falling Weight Deflectometer (FWD) testing, profilograph testing, measuring faults, inspecting the test section for cracks and other distresses, and mapping distresses observed. Only the outside (north) lane could be closed at the time of the survey. Because of this, testing could not be done on the inside (south) lane. The inside lane was inspected for cracks and distresses from the (closed) outside lane and the inside shoulder.

#### **FWD Testing**

Test results are listed in Appendix A. Load Transfer Efficiencies (LTE's) calculated for individual drop measurements are approximately equal to those done March 3, 1999 (the survey before this one). Ten of a total of 13 LTE's calculated are above 90%, with the remaining three in the eighties.

#### **Profilograph Testing**

Smoothness of the outside wheel path of the outside (north) lane was tested using the R & D Division's profilograph. The resulting profile index (PI) was 1.74 inches per mile. The same wheel path was tested in October, 1998. The resulting PI was 0.977 in per mi at that time. Although PI from the current survey is slightly higher, 1.74 in /mi indicates an excellent level of smoothness.

## **Inspections for Cracks and Other Distresses**

Cracks observed during the survey are mapped in Appendix "A". In addition to those shown, there were numerous cracks across the outside corners of the slabs (too small to show up on the crack maps). These were located approximately 2 inches in from the corners and went across the slab at roughly a 45 degree angle. Typical corner cracks are shown in Figure 1. Since the last survey, a new longitudinal crack (Figures 2,3 and 4) has appeared. This crack, located as shown in Appendix A, is approximately 1/8 in wide. The inside (south) lane was inspected for cracks from the (closed) inside lane and from the inside shoulder. No cracks were found in that lane. The only other distress observed was a small amount of spalling on the outside edges of some of the slabs (Figure 5). The U - shaped cracks located at the 10<sup>th</sup> joint (Figure 6) have not continued to deteriorate as was expected when they were discovered (December, 1999). It may be that the fiber reinforcement is holding the pieces which were expected to separate (pieces surrounded by cracks) in place.

### **Fault Measurements**

Faults were measured (Figure 6) in the outside wheel path of the outside lane. Measurements ranged from 0.00 (no measurable fault) to 0.10 inch. Out of a total of 61 measurements 6 had values of 0.10 while 18 measurements were 0.0). Faults measuring 0.10 in or less would be unlikely to affect ride quality. No particular pattern on where faults occurred was apparent except that there were 0.10 faults at each end joint and the west half of the project generally had smaller faults than the east half. Measurements for all 61 joints are listed in Appendix "A".

## **DISCUSSION**

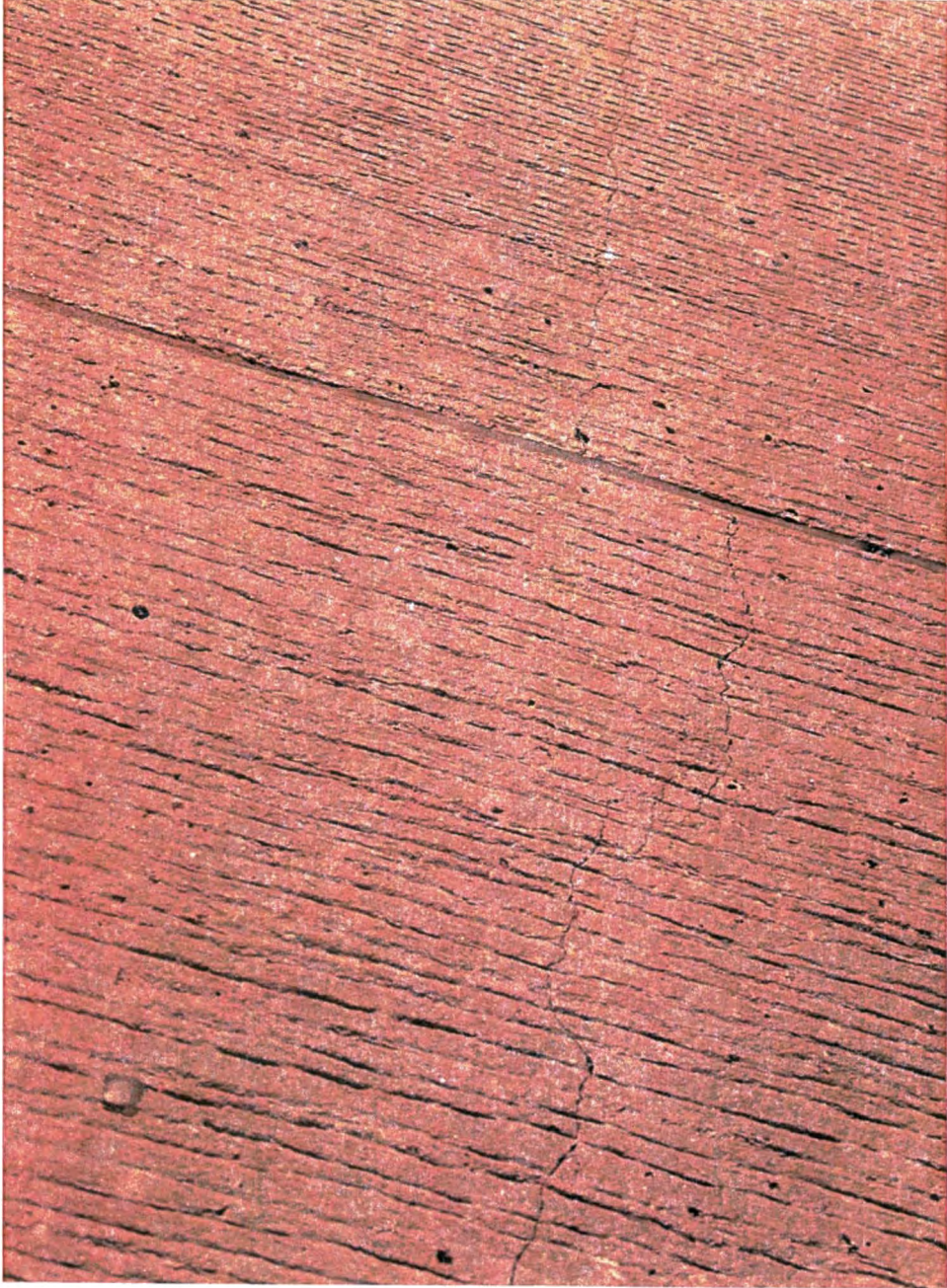
Condition of the experimental section is briefly summarized as follows. Profile Indexes indicate (very) acceptable smoothness. Load transfer shown by the FWD tests had a low value of 83 per cent Load Transfer Efficiency (LTE), with most values over 90 per cent. The pavement surrounded by the U-shaped cracks at the 10<sup>th</sup> joint has not spalled out, as previously expected. However, a longitudinal crack running through parts of four slabs is a new development. The maximum fault size measured was 0.10 inch. To summarize, the overlay is performing at an adequate level, as of the date of the survey. ADT at this location is 61, 356, with a high percent of trucks (exact percentage not available). Some cracking has been noticed, but so far, the crack widths have remained narrow (1/8 inch or less).



**Figure 1 Typical Corner Crack and Spalling at Outside Edge of Slab**



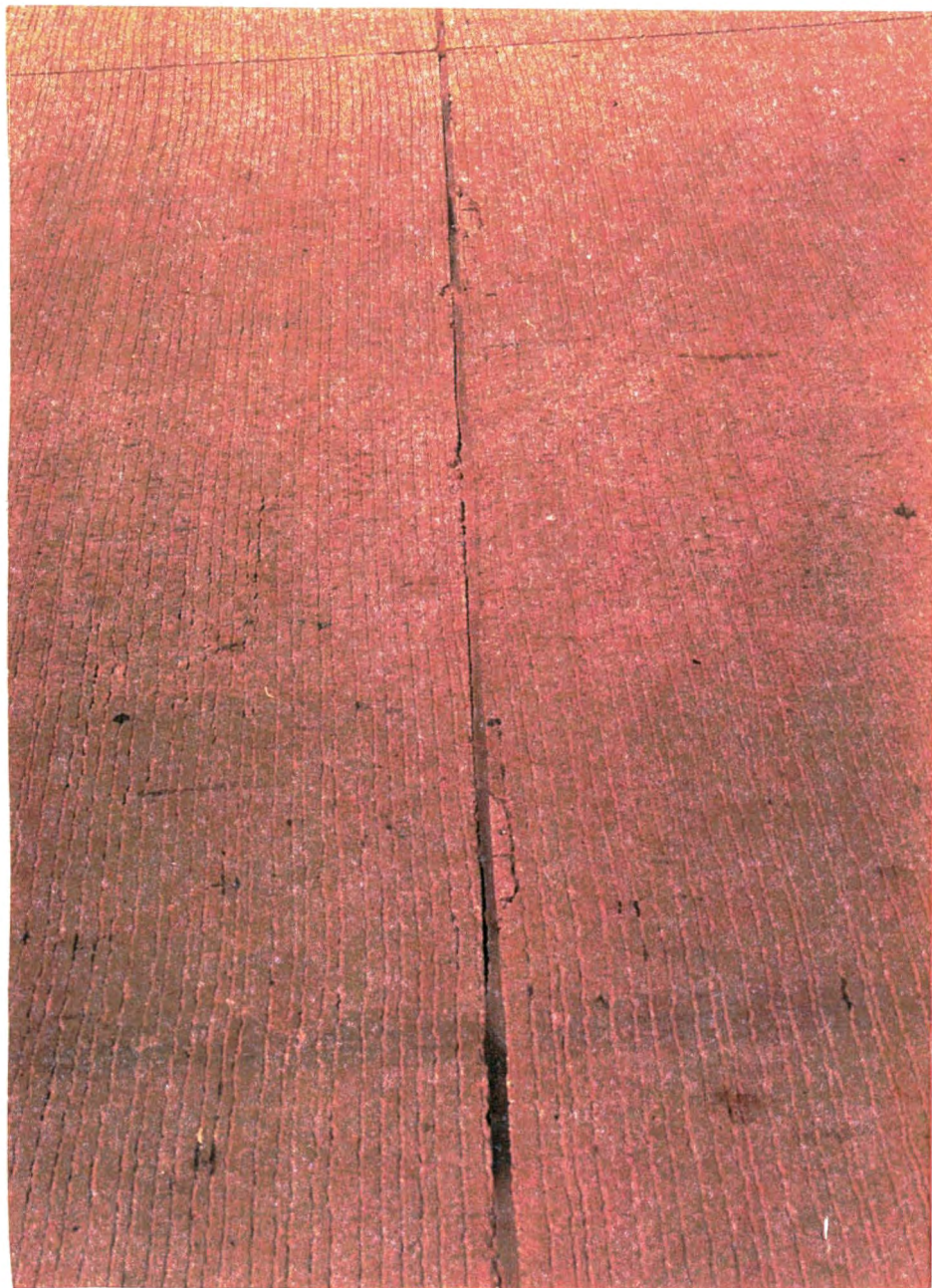
**Figure 2 Longitudinal Cracking**



**Figure 3 Longitudinal Cracking**



**Figure 4 Longitudinal Cracking**



**Figure 5 U - Shaped Cracks in Wheel Paths, Located at Tenth Joint From East End**



**Figure 6 Measuring Faults**

# APPENDIX "A"

## SURVEY DATA

<u>Data</u>	<u>Page</u>
FWD	A2
Cracking	A6
Faults	A7

R80 154010612CZECHALL36F20  
 7000 08002-057 701590  
 150 0 203 305 610 91412191829 5.9 0.0 8.0 12.0 24.0 36.0 48.0 72.0  
 C:\DYNATEST\DATA\ .FWD  
 washita county line north on us 183  
 S 155wb -0.0 100 86D51031 -0 100 86  
 S 52wb -17.8 38 30D51032 -0 100 86  
 1306403827213732NO NO  
 1015.0 3.5 6.0 5.015.0 2.0 8.0  
 Ld 101 1.007 86.1  
 D1 791 1.000 1.041  
 D2 792 0.999 1.106  
 D3 793 0.996 1.114  
 D4 794 1.003 1.078  
 D5 795 0.997 1.055  
 D6 796 0.999 1.116  
 D7 797 0.998 1.010  
 D\* 2890 1.000 1.000  
 D\* NO 1.000 1.000  
 D\* NO 1.000 1.000  
 System Operator  
 0000150010002 1 1  
 0 0.0 0 0.0

soils lab test  
 lab  
 000+0.0 000+0.0 St  
 300 0 0 0 0 0 0 0 11.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 13 104 12513 72533  
 Cffffgggg.....  
 Cffffgggg.....

JOINT STATIONS

\*  
 S 759wb -17.8 37 29D51001 -0 98 84  
 1009 176 157 150 126 105 86 50 16038 6.92 6.18 5.91 4.94 4.12 3.37 1.97  
 1009 176 156 150 126 105 86 50 16030 6.93 6.16 5.90 4.94 4.13 3.38 1.98  
 1010 176 156 150 125 105 86 50 16054 6.91 6.15 5.89 4.94 4.13 3.38 1.98  
 1011 176 157 150 126 105 86 51 16070 6.92 6.16 5.89 4.96 4.14 3.38 1.99  
 1011 176 156 150 126 105 86 50 16057 6.93 6.16 5.90 4.94 4.12 3.38 1.97  
 1012 176 157 150 126 105 86 51 16073 6.93 6.16 5.90 4.95 4.13 3.39 1.99  
 1010 177 157 151 126 105 87 51 16046 6.96 6.19 5.94 4.97 4.14 3.41 2.00  
 1013 176 157 150 126 105 86 50 16089 6.94 6.17 5.91 4.95 4.12 3.40 1.98  
 S 744wb -17.8 34 28D51003 -0 93 83  
 1005 191 171 162 135 112 91 51 15974 7.53 6.75 6.37 5.30 4.41 3.58 2.02  
 1007 191 171 162 135 113 91 52 16009 7.53 6.74 6.37 5.33 4.43 3.60 2.05  
 1007 191 171 162 135 113 91 52 16006 7.52 6.74 6.36 5.33 4.44 3.60 2.06  
 1008 193 173 163 137 114 93 54 16017 7.59 6.80 6.42 5.39 4.50 3.66 2.11  
 1008 191 171 162 135 113 92 52 16022 7.51 6.74 6.37 5.32 4.43 3.61 2.06  
 1007 191 172 162 135 113 92 52 15998 7.53 6.76 6.38 5.33 4.43 3.61 2.06  
 1005 191 170 162 136 113 92 52 15978 7.51 6.70 6.39 5.36 4.46 3.62 2.06  
 1006 190 171 162 136 115 92 53 15986 7.50 6.74 6.39 5.35 4.51 3.63 2.07

S 728wb -17.8 35 28D51006 -0 96 83  
 1017 164 148 141 120 100 80 45 16157 6.46 5.81 5.53 4.72 3.94 3.15 1.78  
 1015 164 147 140 120 100 80 45 16125 6.44 5.80 5.52 4.71 3.93 3.16 1.78  
 1016 164 148 141 120 100 81 46 16152 6.47 5.83 5.53 4.72 3.94 3.18 1.80  
 1015 164 148 140 120 100 80 45 16129 6.45 5.81 5.53 4.72 3.94 3.17 1.79  
 1017 164 148 141 120 100 80 45 16157 6.46 5.82 5.54 4.73 3.94 3.16 1.77  
 1014 164 148 141 120 100 81 46 16109 6.46 5.81 5.54 4.73 3.95 3.19 1.81  
 1015 165 148 141 120 100 81 46 16133 6.48 5.83 5.54 4.74 3.95 3.19 1.81  
 1016 164 148 141 120 100 80 45 16141 6.47 5.83 5.54 4.72 3.95 3.15 1.78  
 S 713wb -17.8 37 29D51008 -0 98 83  
 997 156 142 135 116 98 80 47 15847 6.15 5.59 5.33 4.57 3.85 3.14 1.86  
 999 155 142 135 117 98 81 48 15871 6.10 5.58 5.33 4.59 3.87 3.17 1.90  
 1001 155 142 136 117 98 81 48 15906 6.11 5.60 5.35 4.59 3.88 3.18 1.87  
 998 155 142 135 116 98 80 48 15850 6.09 5.58 5.32 4.57 3.87 3.15 1.89  
 1000 156 142 136 117 99 81 49 15890 6.15 5.60 5.35 4.61 3.89 3.18 1.91  
 997 156 142 136 117 99 81 48 15839 6.13 5.60 5.34 4.59 3.88 3.18 1.87  
 999 155 142 136 117 98 81 48 15882 6.11 5.59 5.35 4.60 3.88 3.18 1.91  
 1001 156 143 136 117 99 81 48 15903 6.13 5.61 5.35 4.59 3.90 3.18 1.89  
 S 698wb -17.8 37 29D51010 -0 99 85  
 1006 207 187 177 150 124 100 55 15982 8.15 7.36 6.96 5.89 4.89 3.94 2.17  
 1007 207 187 177 149 124 100 56 15998 8.15 7.35 6.95 5.88 4.88 3.94 2.19  
 1007 207 187 177 150 124 100 55 16001 8.14 7.36 6.97 5.90 4.89 3.94 2.17  
 1007 207 187 177 150 124 100 56 16009 8.16 7.37 6.98 5.90 4.90 3.95 2.19  
 1006 207 187 177 150 125 100 55 15990 8.15 7.36 6.98 5.91 4.91 3.95 2.17  
 1005 207 187 177 150 125 100 56 15970 8.15 7.37 6.98 5.91 4.91 3.95 2.20  
 1006 207 188 177 150 124 100 56 15982 8.15 7.39 6.98 5.90 4.89 3.94 2.21  
 1007 207 188 177 150 125 101 56 16001 8.15 7.38 6.97 5.93 4.92 3.96 2.20  
 S 515wb -17.8 38 29D51014 -0 101 85  
 999 178 167 160 141 121 102 64 15882 7.01 6.56 6.29 5.55 4.76 4.01 2.53  
 999 177 167 160 141 122 102 65 15882 6.98 6.56 6.30 5.56 4.78 4.02 2.54  
 998 177 166 159 141 121 102 65 15863 6.99 6.54 6.28 5.56 4.78 4.02 2.55  
 996 177 167 160 141 121 102 65 15831 6.98 6.56 6.29 5.56 4.78 4.02 2.54  
 994 178 166 159 141 121 102 64 15792 6.99 6.55 6.28 5.55 4.77 4.01 2.54  
 996 178 167 160 141 121 102 65 15819 7.00 6.56 6.28 5.56 4.77 4.02 2.54  
 996 178 167 160 141 121 102 64 15827 6.99 6.58 6.29 5.56 4.77 4.01 2.54  
 996 178 167 160 141 121 102 64 15819 7.00 6.56 6.29 5.56 4.77 4.02 2.52  
 S 500wb -17.8 37 29D51016 -0 99 85  
 1004 158 147 142 127 111 96 63 15962 6.21 5.77 5.57 4.99 4.39 3.78 2.48  
 1005 157 147 142 127 112 96 63 15966 6.19 5.78 5.59 5.00 4.42 3.77 2.48  
 1005 157 147 142 127 112 96 63 15966 6.16 5.80 5.59 4.99 4.41 3.77 2.50  
 1005 158 147 142 127 112 96 63 15966 6.22 5.79 5.59 5.00 4.41 3.77 2.48  
 1003 158 147 142 127 112 96 63 15943 6.24 5.79 5.59 5.00 4.42 3.79 2.50  
 1005 155 147 142 127 112 96 63 15970 6.11 5.80 5.60 5.00 4.42 3.78 2.50  
 1003 156 147 142 127 112 96 63 15938 6.16 5.78 5.59 4.99 4.40 3.76 2.47  
 1003 157 147 142 127 112 96 63 15943 6.19 5.80 5.60 5.01 4.43 3.78 2.49  
 S 486wb -17.8 38 29D51018 -0 99 85  
 1005 158 142 137 121 104 89 57 15974 6.23 5.61 5.39 4.75 4.09 3.50 2.26  
 1004 158 142 137 121 104 89 58 15950 6.24 5.61 5.39 4.76 4.08 3.49 2.27  
 1003 158 143 137 122 104 90 58 15935 6.20 5.63 5.41 4.78 4.11 3.52 2.30  
 1004 157 143 137 121 104 89 58 15950 6.18 5.62 5.39 4.76 4.11 3.50 2.27  
 1004 158 143 137 122 104 90 58 15954 6.20 5.65 5.41 4.78 4.11 3.52 2.27  
 1004 157 145 138 122 104 89 58 15950 6.19 5.71 5.43 4.81 4.08 3.51 2.30  
 1004 157 145 138 122 104 88 59 15959 6.20 5.71 5.44 4.82 4.09 3.46 2.32  
 1002 157 146 138 123 104 87 58 15922 6.19 5.74 5.45 4.82 4.08 3.41 2.30  
 S 471wb -17.8 38 29D51020 -0 100 85

1000 146 135 130 116 101 85 55 15890 5.73 5.31 5.13 4.57 3.96 3.36 2.17  
1001 146 136 131 117 101 86 56 15906 5.74 5.34 5.17 4.59 3.99 3.39 2.19  
1001 147 136 132 117 102 87 56 15906 5.77 5.36 5.18 4.61 4.02 3.41 2.22  
1001 146 136 132 117 102 87 56 15903 5.76 5.36 5.19 4.61 4.00 3.41 2.20  
1000 146 136 132 117 102 87 56 15890 5.75 5.37 5.18 4.61 4.02 3.41 2.21  
998 146 136 131 117 101 86 56 15863 5.74 5.35 5.17 4.59 3.99 3.40 2.20  
1000 146 136 132 117 101 86 56 15887 5.76 5.35 5.18 4.60 3.99 3.40 2.20  
996 145 136 131 117 102 86 56 15827 5.72 5.34 5.16 4.60 4.00 3.39 2.19  
S 202wb -17.8 38 30D51024 -0 99 85  
1003 159 133 113 89 76 64 38 15930 6.26 5.22 4.44 3.52 3.01 2.50 1.51  
1001 159 133 113 89 76 63 38 15906 6.27 5.22 4.43 3.51 3.00 2.48 1.50  
1002 159 132 113 89 76 63 38 15919 6.26 5.21 4.43 3.50 2.99 2.46 1.51  
1001 159 132 112 89 76 63 38 15906 6.27 5.20 4.43 3.50 2.98 2.47 1.50  
1000 159 132 113 89 76 63 38 15890 6.26 5.21 4.43 3.51 2.99 2.46 1.51  
1002 160 133 113 90 77 63 39 15919 6.30 5.24 4.46 3.54 3.02 2.50 1.53  
1000 159 133 113 89 76 63 38 15890 6.28 5.22 4.44 3.51 3.00 2.47 1.51  
1002 159 133 113 89 76 62 39 15927 6.24 5.22 4.44 3.51 2.99 2.46 1.52  
S 187wb -17.8 37 29D51025 -0 98 84  
1003 114 105 100 86 73 60 36 15930 4.49 4.11 3.93 3.40 2.88 2.35 1.43  
1004 114 105 100 87 73 60 37 15959 4.50 4.13 3.94 3.41 2.89 2.36 1.44  
1003 114 104 100 86 74 60 37 15943 4.49 4.11 3.93 3.40 2.90 2.37 1.44  
1004 114 105 100 87 74 59 36 15962 4.50 4.15 3.96 3.42 2.91 2.34 1.41  
1003 114 105 100 86 73 60 37 15930 4.49 4.12 3.94 3.40 2.89 2.37 1.46  
1002 114 105 100 87 74 60 37 15927 4.49 4.12 3.94 3.41 2.90 2.38 1.44  
1003 114 105 100 87 74 60 36 15943 4.49 4.12 3.94 3.41 2.90 2.37 1.43  
1003 115 104 100 87 73 61 37 15938 4.51 4.09 3.94 3.42 2.89 2.41 1.45  
S 171wb -17.8 37 29D51027 -0 99 85  
993 119 108 102 88 74 61 37 15776 4.68 4.24 4.03 3.45 2.92 2.40 1.44  
995 119 108 103 88 74 61 37 15816 4.69 4.26 4.05 3.48 2.93 2.39 1.44  
995 119 108 103 88 74 61 37 15807 4.69 4.26 4.04 3.47 2.93 2.41 1.45  
994 120 108 103 88 75 61 37 15792 4.71 4.26 4.04 3.46 2.94 2.40 1.46  
994 119 108 103 88 75 61 37 15803 4.70 4.26 4.06 3.47 2.94 2.41 1.45  
995 118 110 103 89 75 62 38 15807 4.67 4.32 4.06 3.50 2.94 2.44 1.50  
993 119 109 102 88 74 61 38 15776 4.68 4.30 4.03 3.47 2.92 2.41 1.48  
993 118 110 102 88 74 61 38 15784 4.65 4.35 4.01 3.44 2.91 2.41 1.49  
S 155wb -17.8 38 30D51031 -0 100 86  
993 123 112 107 92 77 62 37 15784 4.85 4.42 4.23 3.61 3.01 2.45 1.46  
996 122 112 108 92 77 62 38 15819 4.81 4.43 4.23 3.62 3.02 2.45 1.48  
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993 122 113 108 92 77 62 37 15779 4.82 4.43 4.24 3.62 3.02 2.45 1.46  
997 122 113 108 92 77 62 38 15839 4.81 4.44 4.24 3.62 3.02 2.45 1.48  
993 123 113 108 92 77 63 38 15787 4.82 4.43 4.23 3.63 3.04 2.48 1.48  
994 123 113 108 92 76 62 37 15803 4.83 4.43 4.25 3.62 3.01 2.44 1.47  
995 122 113 108 92 77 62 38 15816 4.79 4.43 4.23 3.64 3.02 2.45 1.49

EOF

## SUMMARY OF FWD TEST RESULTS

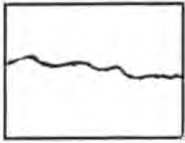
<b>Distance</b>	<b>D<sub>0</sub></b>	<b>D-12</b>	<b>LTE (%)</b>
759	6.96	6.19	88.9
744	7.51	6.70	89.2
728	6.48	5.83	90.0
713	6.11	5.59	91.5
698	8.15	7.39	90.7
515	6.99	6.58	94.1
500	6.16	5.78	93.8
486	6.20	5.71	92.1
471	5.76	5.35	92.9
202	6.28	5.22	83.1
187	4.49	4.12	91.8
171	4.68	4.30	91.9
155	4.83	4.43	91.7

# CRACKS LOCATED DURING JUNE 12, 2001 SURVEY

East ← → West



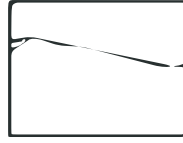
Slab No. 3



Slab No. 4



Slab No. 5



Slab No. 6



Slab No. 10



Slab No. 33



**Fault Measurements, June 12, 2001 Survey**

<b>Joint Number</b>	<b>Measurement</b>	<b>Joint Number</b>	<b>Measurement</b>	<b>Joint Number</b>	<b>Measurement</b>
1	0.10	23	0.05	45	0.02
2	0.05	24	0.08	46	0.00
3	0.00	25	0.03	47	0.00
4	0.00	26	0.05	48	0.00
5	0.10	27	0.04	49	0.00
6	0.05	28	0.05	50	0.00
7	0.08	29	0.05	51	0.00
8	0.00	30	0.03	52	0.00
9	0.05	31	0.01	53	0.03
10	0.05	32	0.03	54	0.02
11	0.02	33	0.00	55	0.02
12	0.10	34	0.00	56	0.00
13	0.00	35	0.04	57	0.01
14	0.05	36	0.02	58	0.03
15	0.05	37	0.05	59	0.00
16	0.05	38	0.00	60	0.02
17	0.05	39	0.00	61	0.10
18	0.08	40	0.03		
19	0.08	41	0.00		
20	0.00	42	0.07		
21	0.05	43	0.00		
22	0.05	44	0.02		

JOINT NUMBERING SYSTEM

