TM no. M-53-77-3

TECHNICAL MEMORANDUM

title: EVALUATION OF RUBBER-ASPHALT BINDER FOR SEAL COATING ASPHALTIC CONCRETE, NPTR EL CENTRO, CALIFORNIA, MARCH 1974 - JULY 1977

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date: AUGUST 1977

sponsor: WESTERN DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

program nos: 53-032

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INTRODUCTION

Engineering inspections have been made of the condition of rubber-asphalt seal coats at the National Parachute Test Range, El Centro, since March 1974 and have been previously reported (Reference 1). This report updates Reference 1 to include the results of inspections made on 1 February 1977 and 11 July 1977. Narrative descriptions of the pavement conditions are presented in this report, along with drawings of crack survey plots. Photographs of pavement conditions are also included. An analysis of the performance of the seal coat is provided.

EVALUATION PROGRAM

The effectiveness of the rubber-asphalt seal binder was evaluated by:

a. Determining the amount of reflective cracking appearing on the surface. Reflective cracking is defined as the upward migration of a subsurface cracking pattern into and through an overlying surface pavement layer.

b. Determining the aggregate retention characteristics by visual observation and by interviewing Operations and Public Works personnel.

Reflective cracking was evaluated by selecting 20 by 20 feet square test plots at NPTR El Centro and plotting all the cracks visible in these test plots prior to seal coat application. On subsequent visits to the station after construction of the seal coats, the test plots were inspected and all visible cracks were again plotted. The locations of test plots at NPTR El Centro are shown in Figure 1. As can be seen by looking at the crack plots in Figures 2 through 7, each location had differing magnitudes of cracking before and after the seal coat application. To gain a better perspective, the percent of each test area cracked after the seal coating was divided by the percent of that test area cracked before seal coating to arrive at a relative percent of reflective cracking:

$$\text{Relative Reflective Cracking (Percent)} = \frac{\text{Percent area cracked (after seal)}}{\text{Percent area cracked (before seal)}} \times 100$$

TEST RESULTS

Reflection Cracking

At NPTR El Centro, the majority of cracking was fatigue-type pattern cracking with a few longitudinal construction joint cracks. As shown in Table 1 and Figure 8, reflection cracks began to appear after the seal coats were 6-13 months old. The amount of reflection cracking has been cyclic, reaching a peak in mid-winter and then dropping dramatically during the summer until the July 1977 inspection. All test plots on Taxiway B and test plot 2 of Taxiway A showed increased reflection cracking in the summer of 1977. All of these areas exhibited substantial amounts of rutting and evidence of incipient load-related failures (Figures 9 and 10). Replacement of

these severely distressed areas is planned in the near future by NPTR El Centro. Test plot 1 of Taxiway A and test plot 1 of Taxiway D exhibited the "self-healing" effect noted in Reference 1, and this is shown graphically in Figure 8.

Aggregate Retention

Loose aggregate has not been as much of a problem on rubber-asphalt seal coats at NPTR El Centro as has been experienced at other installations (Reference 1). Some loose aggregate was noted on Taxiway B, where aircraft make a 90-degree turn to the warm-up area for Runway 8L-26R. During the July 1977 inspection, it was noted that the rubber-asphalt binder on Taxiway B was still resilient and when pieces of aggregate were pulled from the surface, the binder stuck tenaciously to the stone.

CONCLUSIONS

The test results and observations made during the period of this investigation lead to the following conclusions:

1. The rubber-asphalt seal coat is still functioning over fatigue-type cracking where the pavement has not begun to fail under the load. Deflections occurring under load on Taxiway B apparently cause higher tensile stresses than the rubber-asphalt binder can sustain.

2. At test plot 1 of Taxiway A and test plot 1 of Taxiway D, the seal coat was "self-healing", as shown in previous inspections (Reference 1).

RECOMMENDATIONS

It is recommended that semi-annual inspections continue at NPTR El Centro and that the scope of this investigation be expanded to include semi-annual visits to other rubber-asphalt seal coat installations at NAS Fallon, MCAS Yuma, MCAS Cherry Point, NAS Pensacola, and NAS Miramar. Two installations of rubber-asphalt seal coat are planned at MCAS Yuma for completion in the summer of 1977. These projects will make use of a revised method of blending the rubber and asphalt to yield a more consistent and stronger binder. These installations should be monitored to determine if the improved technique leads to any substantial improvement in the final product.

REFERENCES

1. Civil Engineering Laboratory, Technical Memorandum M53-76-5, Evaluation of Rubber-Asphalt Binder for Seal Coating Asphaltic Concrete, March 1974 - June 1976, by R.B. Brownie, Port Hueneme, California, August 1976.

Table 1. Reflection Cracking Analysis, NPTR El Centro, California

Location and Test Section		Cracking Before Seal Coat (percent)	Reflected Cracking* (percent)						
			Inspection Date						
			7 Nov 74	1 May 75	22 Jul 75	3 Feb 76	27 May 76	1 Feb 77	11 Jul 77
Taxiway A									
(Sealed 14-15 October 1975)	1	88.5	-	-	-	0.0	0.0	10.5	4.7
	2	70.2	-	-	-	26.1	2.5	29.6	33.2
Taxiway B									
(Sealed 25 March 1974)	1	89.5	0.0	2.6	2.6	53.1	15.3	59.5	95.0
	2	48.5	0.0	6.2	6.2	40.2	19.1	39.6	66.6
	3	52.3	0.0	10.5	10.5	20.4	15.9	22.0	58.3
Taxiway D									
(Sealed 20 October 1975)	1	56.3	-	-	-	17.4	7.6	34.2	11.2
	2	67.2	-	-	-	16.1	17.6	**	**
Taxiway E									
(Sealed 20 October 1975)	1	78.0	-	-	-	4.5	2.3	**	**
	2	87.0	-	-	-	7.2	6.3	**	**

* Reflected Cracking (percent) = $\frac{\text{Cracked area after seal coat (percent)}}{\text{Cracked area before seal coat (percent)}} \times 100$

** Test section removed during pavement reconstruction, July 1975.

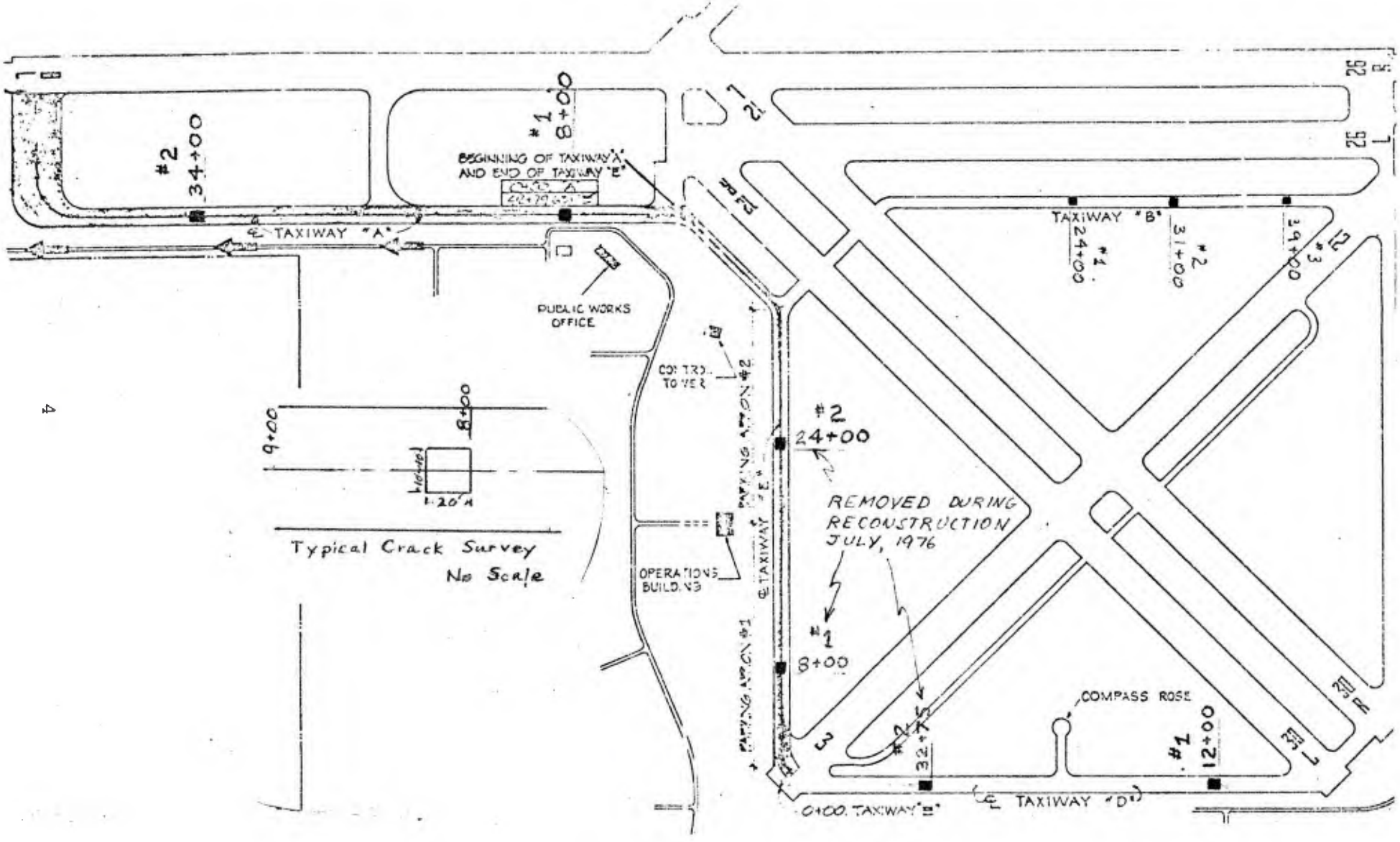
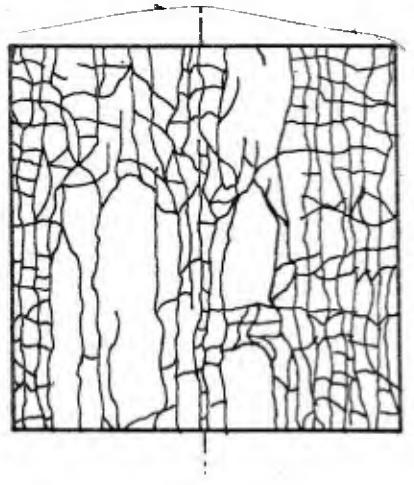


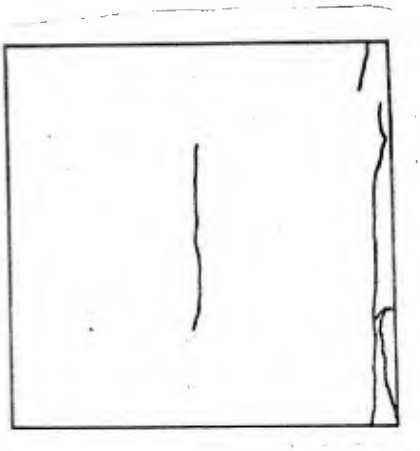
Figure 1. NPTR El Centro, CA Rubber-Asphalt Seal Coat Crack Survey Locations



22 July 1975
Pre-seal condition

3 February 1976

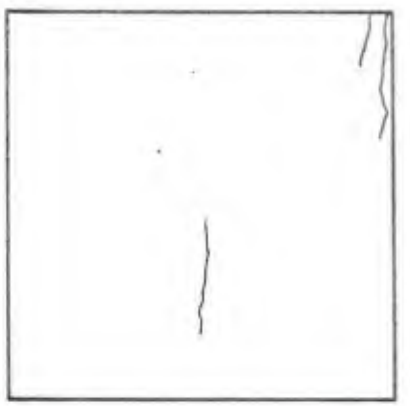
27 May 1976



1 February 1977

Plot 1
Taxiway A
Seal Coated 14-15 October 1975

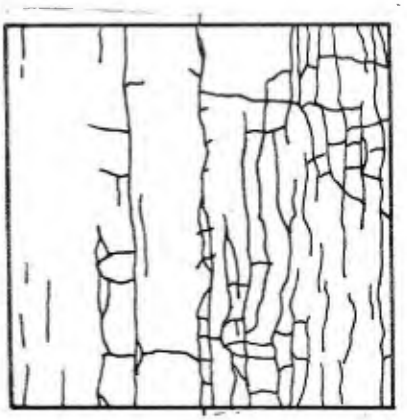
Figure 2. Crack Survey Plots, Taxiway A
NPTR El Centro, California



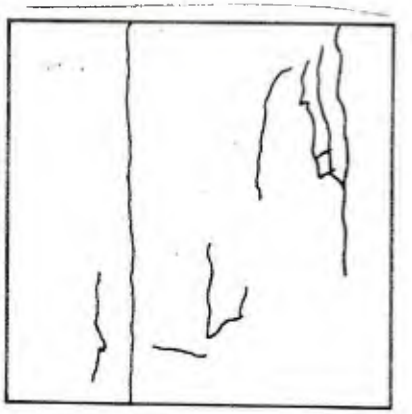
11 July 1977

Plot 1
Taxiway A
Seal Coated 14-15 October 1975

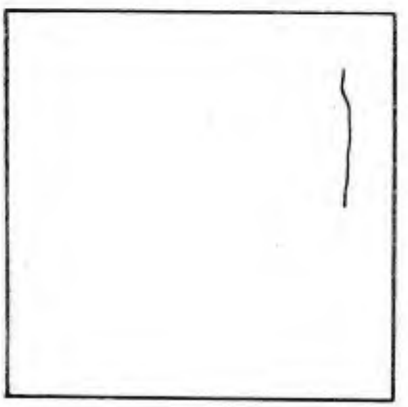
Figure 2a. Crack Survey Plots, Taxiway A
NPTR El Centro, California



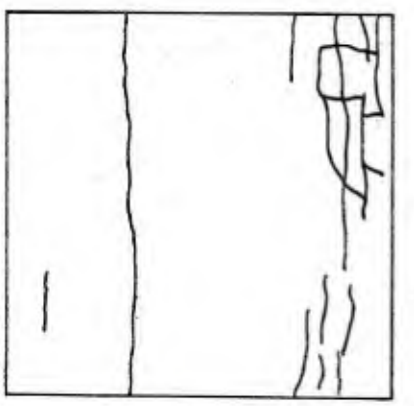
22 July 1975
Pre-seal condition



3 February 1976



27 May 1976



1 February 1977

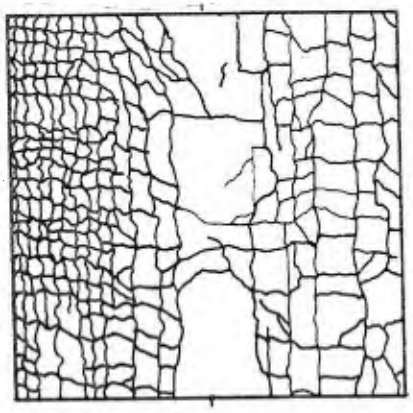
Plot 2
Taxiway A
Seal Coated 14-15 October 1975

Figure 3. Crack Survey Plots, Taxiway A
NPTR El Centro, California

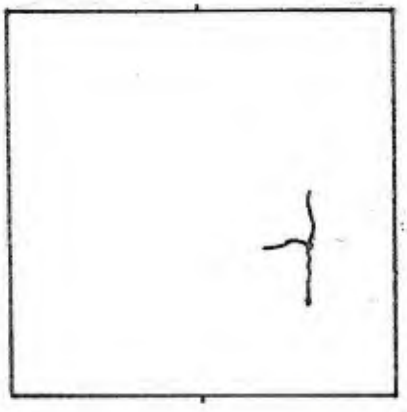
11 July 1977

Plot 2
Taxiway A
Seal Coated 14-15 October 1975

Figure 3a. Crack Survey Plots, Taxiway A
NPTR El Centro, California

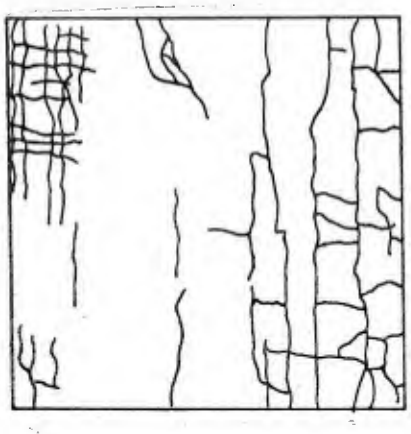


11 March 1974
Pre-seal condition

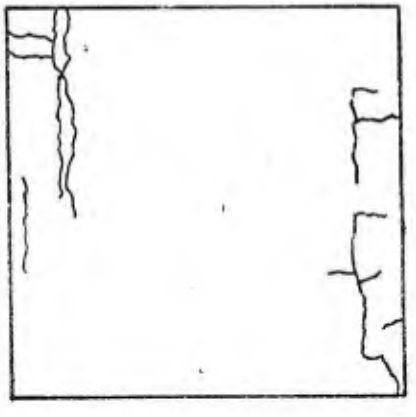


1 May 1975 and 22 July 1975

Note: No cracks visible on
7 November 1974



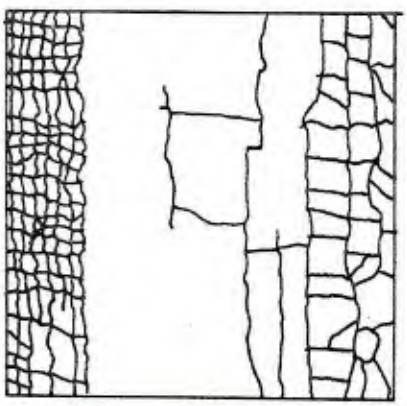
3 February 1976



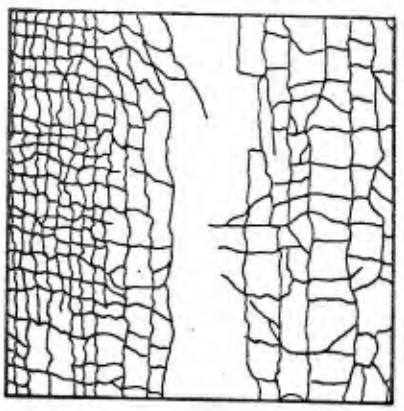
27 May 1976

Plot 1
Taxiway B
Seal Coated 25 March 1974

Figure 4. Crack Survey Plots, Taxiway B
NPTR El Centro, California



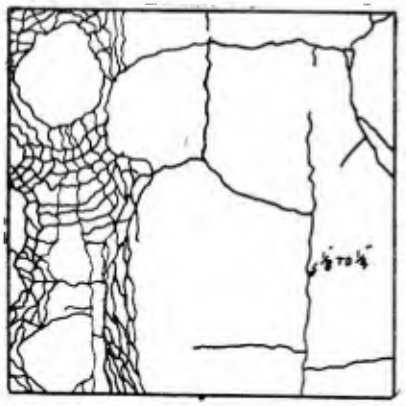
1 February 1977



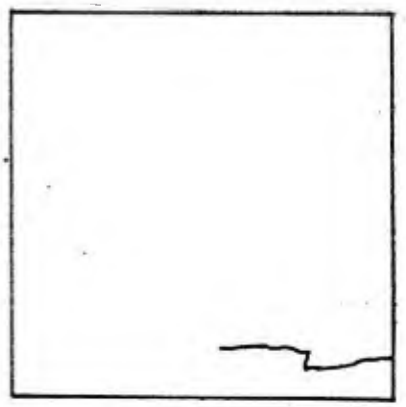
11 July 1977

Plot 1
Taxiway B
Seal Coated 25 March 1974

Figure 4a. Crack Survey Plots, Taxiway B
NPTR El Centro, California



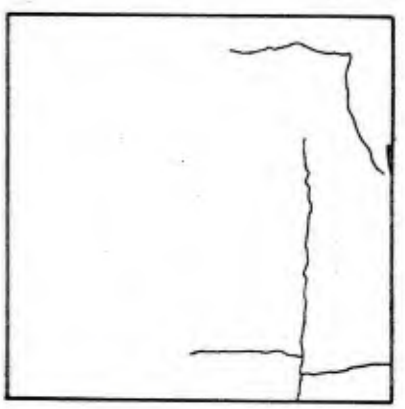
11 March 1974
Pre-seal condition



1 May 1975 and 22 July 1975

Note: No cracks visible on
7 November 1974

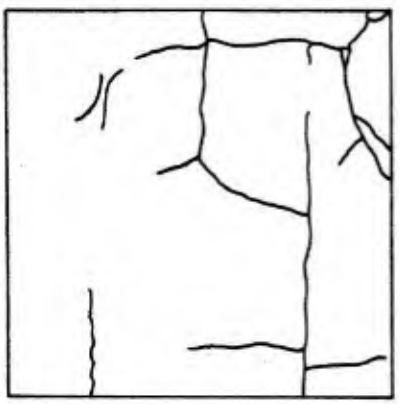
3 February 1976



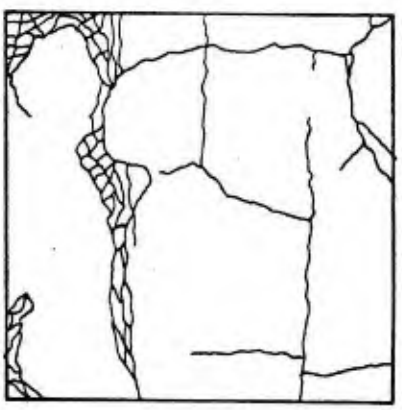
27 May 1976

Plot 2
Taxiway B
Seal Coated 25 March 1974

Figure 5. Crack Survey Plots, Taxiway B
NPTR El Centro, California



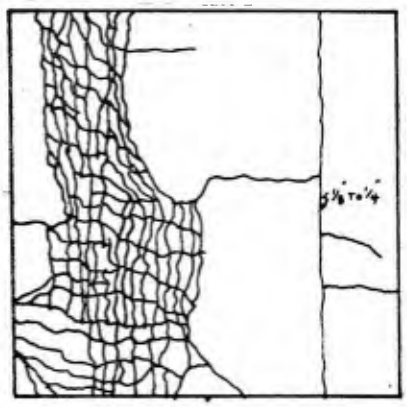
1 February 1977



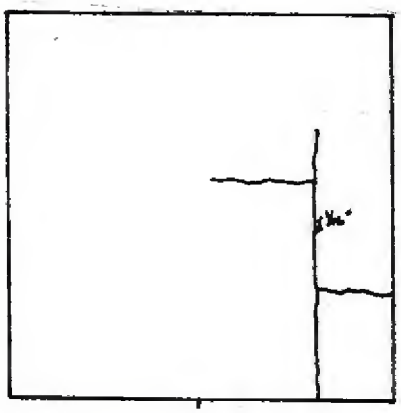
11 July 1977

Plot 2
Taxiway B
Seal Coated 25 March 1974

Figure 5a. Crack Survey Plots, Taxiway B
NPTR El Centro, California



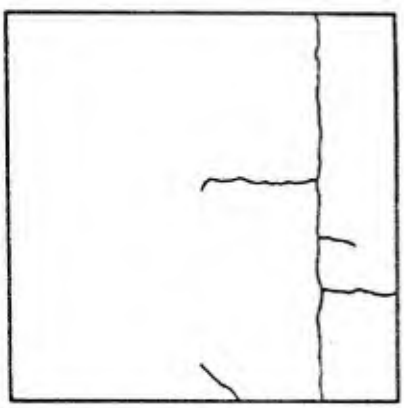
11 March 1974
Pre-seal condition



1 May 1975 and 22 July 1975

Note: No cracks visible on
7 November 1974

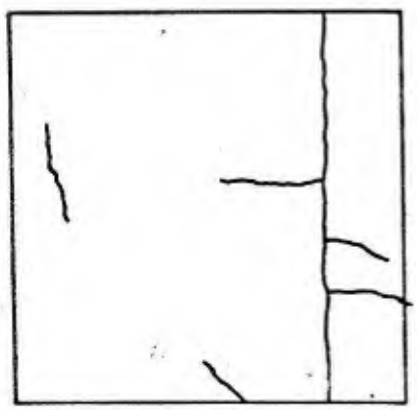
3 February 1976



27 May 1976

Plot 3
Taxiway B
Seal Coated 25 March 1974

Figure 6. Crack Survey Plots, Taxiway B
NPTR El Centro, California



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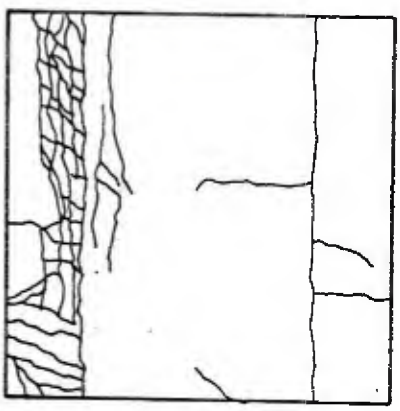
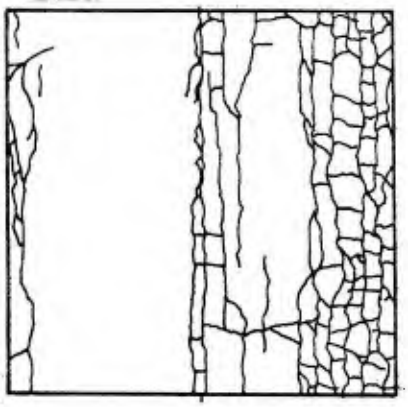


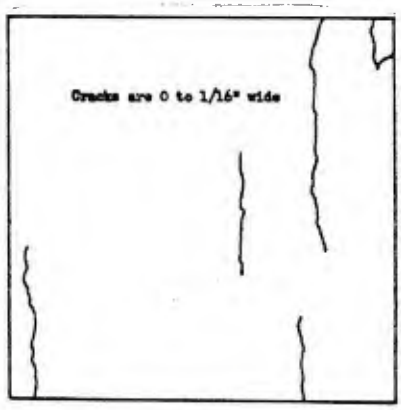
11 July 1977

Plot 3
Taxiway B
Seal Coated 25 March 1974

Figure 6a. Crack Survey Plots, Taxiway B
NPTR El Centro, California



22 July 1975



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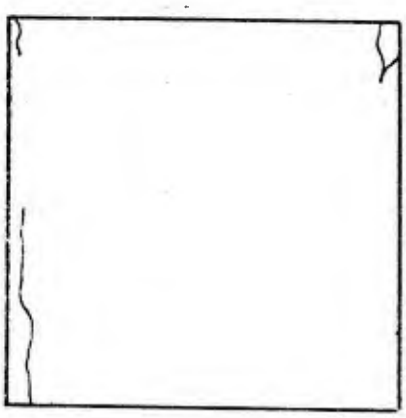
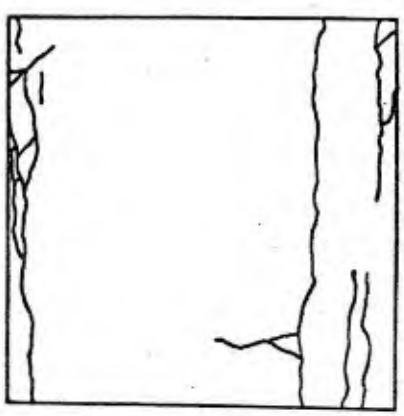


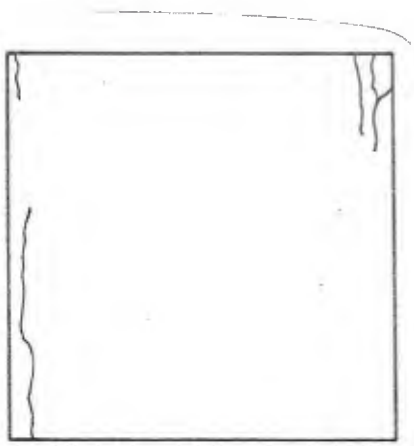
27 May 1976



1 February 1977

Plot 1
Taxiway D
Seal Coated 20 October 1975

Figure 7. Crack Survey Plots, Taxiway D
NPTR El Centro, California



11 July 1977

Plot 1
Taxiway D
Seal Coated 20 October 1975

Figure 7a. Crack Survey Plots, Taxiway D
NPTR El Centro, California

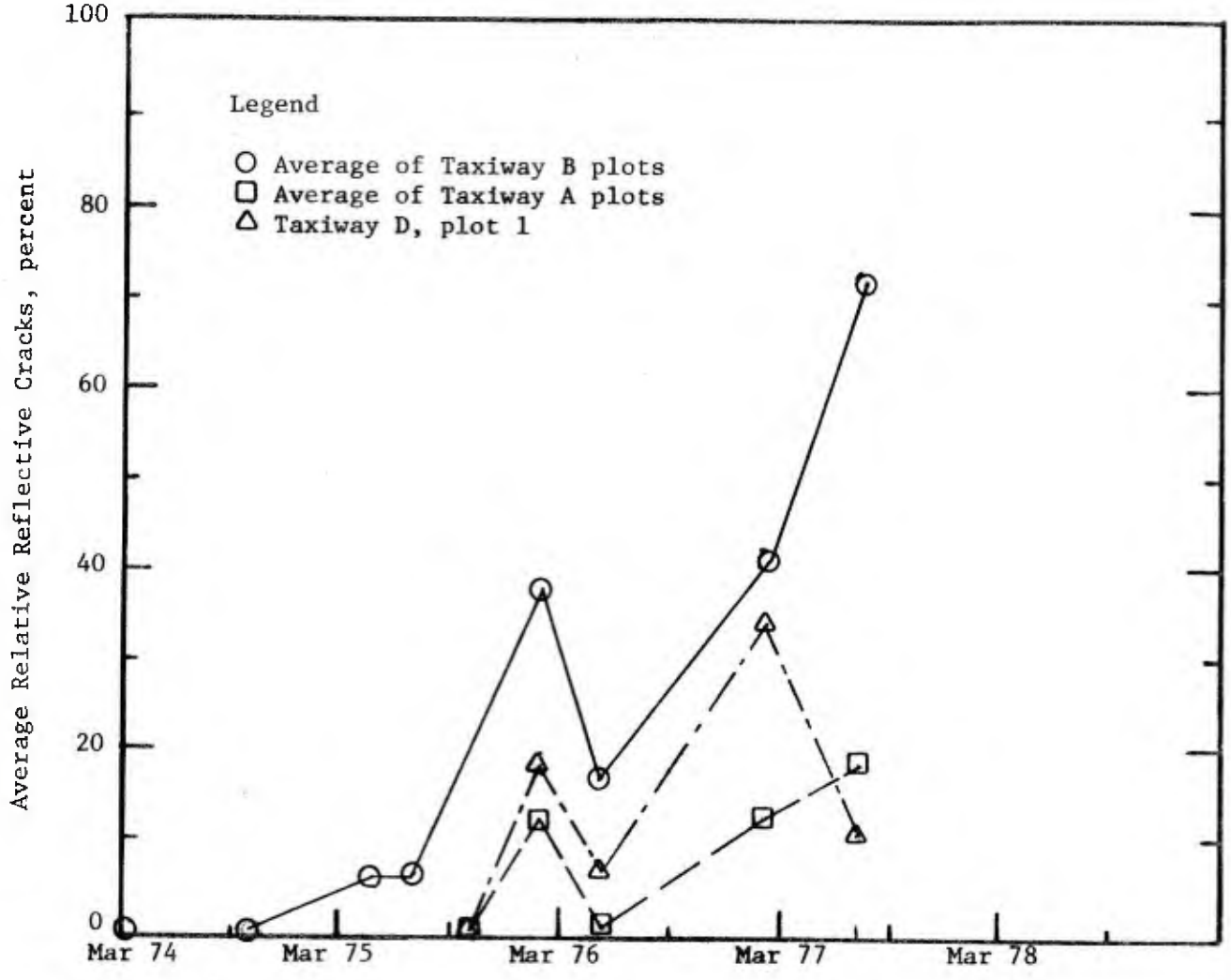


Figure 8. Average Relative Reflected Cracks versus Time, NPTR El Centro, California

Figure 9. One-inch deep rutting in wheelpath of Taxiway B.

Figure 10. Patched load failure and associated pattern cracking.