Technical Report Documentation Page

1. REPORT No.
643185

2. GOVERNMENT ACCESSION No.

3. RECIPIENT'S CATALOG No.

4. TITLE AND SUBTITLE
Experimental Asphalt Test Section Road 01-Men-1-E, Wlts.

5. REPORT DATE
February 1967

6. PERFORMING ORGANIZATION

7. AUTHOR(S)
John Skog

8. PERFORMING ORGANIZATION REPORT No.
643185

9. PERFORMING ORGANIZATION NAME AND ADDRESS
State of California
Highway Transportation Agency
Department of Public Works
Division of Highways
Materials and Research Department

10. WORK UNIT No.

11. CONTRACT OR GRANT No.

12. SPONSORING AGENCY NAME AND ADDRESS

13. TYPE OF REPORT & PERIOD COVERED

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Synopsis

Small amounts, 3.5 tons each, of three experimental asphalts were incorporated in the paving mixture placed on Contract 64 -1T13C4-P, Road I-Men-1-E, Wlts in August 1964. Each of these asphalts had a different California Rolling Thin Film residue viscosity at 140*F. The primary purpose of the study was to determine the "setting" qualities of these asphalts which have good durability properties. All of the experimental asphalts showed satisfactory "setting" properties in comparison with the Standard Specification asphalt test section.

Performance surveys have been completed after ten and twenty-two months of service life. There has been rapid densification in the wheel tracks of the travel lane for all of the test sections. The deflections are very low and there is little evidence of any surface distress, although the special asphalt test sections appear rather smooth because of the rapid decrease in air voids. All of the asphalts including the control are hardening at a slow rate in the lower parts of the surface course. However, the control asphalt is definitely hardening at the surface at a more rapid rate than any of the experimental asphalts.

17. KEYWORDS

18. No. OF PAGES:
22

19. DRI WEBSITE LINK
http://www.dot.ca.gov/hq/research/researchreports/1966-1967/67-17.pdf

20. FILE NAME
67-17.pdf

STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

EXPERIMENTAL ASPHALT TEST SECTION

ROAD 01-Men-1-E, Wlts.

67-17

[redacted]

FEBRUARY 1967

MATERIALS & RESEARCH DEPARTMENT

State of California
Department of Public Works
Division of Highways
Materials and Research Department

January 5, 1967

Lab. Auth. No. 643185

Mr. J. C. Womack
State Highway Engineer
Division of Highways
Sacramento, California

Dear Sir:

Submitted for your consideration is:

A

PROGRESS REPORT

ON

CONSTRUCTION AND SERVICE PERFORMANCE

OF THE

EXPERIMENTAL ASPHALT TEST SECTION NEAR

WILLITS, CALIFORNIA, ROAD I-MEN-1-E, WLTS.

Study made by .... Pavement Section
Under general direction of .... E. Zube
Work supervised by .... John Skog
Glenn Kemp
Report written by .... John Skog

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

TABLE OF CONTENTS

SYNOPSIS

Small amounts, 3.5 tons each, of three experimental asphalts were incorporated in the paving mixture placed on Contract 64-1T13C4-P, Road I-Men-1-E, Wlts in August 1964. Each of these asphalts had a different California Rolling Thin Film residue viscosity at 140°F. The primary purpose of the study was to determine the "setting" qualities of these asphalts which have good durability properties. All of the experimental asphalts showed satisfactory "setting" properties in comparison with the Standard Specification asphalt test section.

Performance surveys have been completed after ten and twenty-two months of service life. There has been rapid densification in the wheel tracks of the travel lane for all of the test sections. The deflections are very low and there is little evidence of any surface distress, although the special asphalt test sections appear rather smooth because of the rapid decrease in air voids. All of the asphalts including the control are hardening at a slow rate in the lower parts of the surface course. However, the control asphalt is definitely hardening at the surface at a more rapid rate than any of the experimental asphalts.

CONCLUSIONS

The field "setting" properties of the three experimental asphalts indicate that a viscosity requirement on the residue from the California Rolling Thin Film test may be used for controlling "set".

Tests on cores removed from the pavement after twenty-two months of service life indicate that the experimental asphalts are hardening at a slightly slower rate than the control Standard Specification asphalt. The greatest difference is in the top 1/2" of the surface course. The results appear to be significant since all asphalts are being weathered under equivalent pavement conditions in terms of void content, asphalt content and air permeability.

INTRODUCTION

The primary purpose of this project was to study the "setting" characteristics of a paving mixture prepared from asphalts having different California Rolling Thin Film test residue viscosities.

The Chevron Asphalt Co. furnished small quantities of three paving asphalts classified as medium, good and very fast "setting" materials. All three asphalts had satisfactory durability as measured by our tentative specification test.

The test sections were placed in part of the surface course on Contract 64-1T13C4-P, Road I-Men-1-E, Wlts., on August 17, 1964. The purpose of this progress report is to present field studies during construction together with laboratory work. Also presented are field and laboratory studies after ten and twenty-two months of service life.

CONSTRUCTION OF TEST SECTIONS

The three experimental asphalts were used in a standard specification Type B-3/4" maximum paving mixture specified for the contract. For identification purposes, the asphalts were labeled 3.5, 4.5 and 5.5. These figures are the average viscosity in kilopoises at 140°F after the California Rolling Thin Film test. According to Chevron Research Corporation special test results, the asphalts may also be classified in terms of "setting" rate as medium (3.5), fast (4.5) and very fast (5.5).

Paving operations, using the three experimental asphalts in the S.B. travel lane surface course, were performed and completed on August 17, 1964. A control section using the contract asphalt supply, (Union Oil Co., Oleum, Standard Specification 85-100 grade) was also placed on the same day. A map showing location of the test sections is shown in Figure 1.

The paving mixture was produced in a modern commercial batch plant located at Calpella approximately fifteen miles from the job site. Arrangements were made at the paving plant for using the individual truck loads of each special asphalt as a storage unit during mixing operations.

Paving operations with the experimental asphalt mixtures were the same as that used on the contract. A Barber Greene paver was used for paving, and rolling was performed in accordance with the Standard Specifications.

Average temperatures during mixing and laying are shown in the tables below.

Mixing and Laying Temperatures

Average Temperature °F							
Plant			Street				
			Test	To	Rolling		
Asph.	Agg.	Mix	Section	Paver	Break	Pneumatic	Finish
290	320	290	5.5	280	240	145	125
			4.5	265	250	155	150
			3.5	285	255	190	160
			Control	290	275	165	150

Air Temperatures

Time	Temp. °F
8 A.M.	60
9	70
$9^{\underline{45}}$	80
$10^{\underline{15}}$	90
$10^{\underline{45}}$	85
$11^{\underline{10}}$	92
$12^{\underline{00}}$	95
$12^{\underline{15}}$	90
$12^{\underline{40}}$	95

There did not appear to be any real differences in the "setting" rate of the experimental asphalts. This may be explained on the basis of the relatively low atmospheric temperatures during the morning when paving was performed. However, in general, the 5.5 asphalt appeared to "set" faster than the 3.5 and control asphalts. Traffic was permitted to travel over the sections immediately after final rolling. After twenty-four hours of traffic, all sections were in excellent condition with no indication of "scuffing" or softness associated with slow "setting" characteristics. However, atmospheric temperatures were not very high during the first twenty-four hours after paving.

Water and air permeabilities were performed four hours after final rolling. The average results are shown as follows:

Test Section	Water Permeability Ml./Min.			Air Permeability Ml./Min./sq.in. at 1/4" Vac.		
	Ave.	Range		Ave.	Range	
		Low	High		Low	High
5.5	162	75	255	82	29	147
4.5	107	60	215	60	24	116
3.5	180	55	400	76	19	167
Control	181	85	330	91	48	150

There is no significant difference in the various sections.

LABORATORY STUDIES ON SAMPLES OF ASPHALT AND PAVING MIXTURE OBTAINED DURING CONSTRUCTION

Standard tests on the paving mixture are shown below.

Test Section	Stability 140°F	Cohesion 140°F	Specific Gravity	%* Asph. Extracted	Grading 3/4	3/8	4	8	30	200
5.5	45	381	2.36	5.6	100	73	48	33	19	4
4.5	45	382	2.37	5.5	100	72	46	33	21	4
3.5	42	286	2.35	5.6	100	75	48	35	20	4
Control	43	252	2.37	5.5	100	76	51	36	21	5

* 5.6% was used in the paving mixture.

The tests indicate that the paving mixture in each test section is equivalent except for the cohesion value which appears to vary with the viscosity of the asphalt at 140°F.

Tests to determine any variation in resistance to water action through use of the experimental asphalts were performed. The results are shown below.

Test Section	Swell Test .001"	Surface Abrasion Test Loss-Gms.	Moisture Vapor Susceptibility Test		
			% Moisture	Stability 140°F	Cohesion 140°F
5.5	.004	0	0.4	35	574
4.5	.003	0	0.5	31	473
3.5	.002	0	0.6	36	522
Control	.001	0	0.5	33	556

There are no differences in resistance to water action between any of the experimental materials when compared with a Standard Specification paving asphalt.

Abson recoveries were performed on samples of paving mixture taken at the plant. The average results, shown below, indicate good retention of penetration during mixing. The standard ductility tests were somewhat erratic for all asphalts including the control.

Test Section	Recovered Asphalt Tests		
	Pen. 77°F	S.P. °F	Standard Ductility
5.5	66	131	3-100+ 1-77
4.5	66	132	2-100+ 2-52
3.5	70	129	3-100+ 1-66
Control	50	127	3-100+ 1-83

Samples of the three special asphalts and the control were obtained at the paving plant. Since this was the first production of small amounts of the new type asphalt, comprehensive testing of the samples was performed. The results are shown in Table A. The durability of all three experimental asphalts is very satisfactory. They have excellent retained penetrations after mixing, as noted above, and these results correlate well with the penetrations on the residues from the California Rolling Thin Film test. The service life durability test results indicate good resistance to hardening, but the micro-ductility results are slightly low. The low temperature viscosities of all three experimental asphalts are definitely better than the control, indicating a better resistance to fatigue.

SERVICE PERFORMANCE STUDIES

The first set of cores were removed from the test sections nine days after construction. It was decided to use only 4" cores for studying service life performance because of the short test sections. The cores were sectioned and the viscosity and micro-ductility was determined on the various layers. The results are shown in Table B. These results will be used as starting values for comparing with future core results.

The first performance survey was conducted on June 22, 1965, after ten months of service life. Deflection and rut depth measurements were obtained and a visual pavement condition survey was performed. The pavement was in excellent condition. Average deflection and rut depths are shown below.

Test Section (S.B. Travel Lane)	Age Mo.	Average Deflection .001"		Average Rut Depth Ft.	
Wheel Track		OWT	IWT	OWT	IWT
5.5	10	4	4	.003	.005
4.5	10	6	5	.002	.008
3.5	10	5	6	.003	.004
Control, 85-100 Union	10	6	6	.005	.007

The deflection and rut depth results are satisfactory.

The second performance survey was completed on June 1, 1966, after twenty-two months of service life. Deflection and rut depth measurements were obtained, and a visual pavement condition survey was performed. Also, 4" cores were taken from locations just adjacent from those obtained nine days after construction.

The visual survey showed a few minor isolated longitudinal and transverse cracks. There appeared to be a difference in surface texture between the control and the adjacent three experimental asphalt sections. The control was slightly more rough in comparison to the experimental asphalt sections. This finding will be mentioned in more detail under the discussion of results from the cores.

The average deflections and rut depths are shown below.

Test Section (S.B. Travel Lane)	Age Mo.	Average Deflection .001"		Average Rut Depth Ft.	
Wheel Track		OWT	IWT	OWT	IWT
5.5	22	2	1	.008	.010
4.5	22	2	2	.010	.012
3.5	22	3	3	.006	.007
Control, 85-100 Union	22	3	3	.005	.005

There is virtually no deflection in any of the sections after twenty-two months of service life. The rut depths have increased slightly in the experimental sections with no change in the control.

The test results on the twenty-two month cores are shown in Table C, and the results are compared with the initial cores below.

Test Section	Depth From Surface	Viscosity M.P. S.R.=.05 Sec^{-1}-77°F		Micro-Duct. mm at 77°F		% Voids Entire Core	
		Orig. Cores	22 Mo. Cores	Orig. Cores	22 Mo. Cores	Orig. Cores	22 Mo. Cores
5.5	Top 1/2"	3.12	6.2	31	18	5.2	1.2
	5/8"-1 1/8"	2.65	3.9	29	20		
	1 1/4"-1 3/4"	2.70	4.7	33	28		
4.5	Top 1/2"	3.20	4.9	41	26	5.1	1.7
	5/8"-1 1/8"	2.05	3.2	34	26		
	1 1/4"-1 3/4"	2.60	3.4	31	28		
3.5	Top 1/2"	2.32	4.0	40	23	6.7	1.7
	5/8"-1 1/8"	1.95	2.2	34	25		
	1 1/4"-1 3/4"	1.89	3.4	36	25		
Control	Top 1/2"	4.66	11.6	60	38	6.5	1.7
	5/8"-1 1/8"	2.88	4.6	55	48		
	1 1/4"-1 3/4"	3.17	5.5	55	52		

There has been some hardening at all core locations, however, it is relatively low. We note that the control asphalt is hardening at a slightly faster rate than any of the experimental materials. However, the control asphalt continues to have better ductile properties.

There has been a rapid drop in percentage of air voids during the twenty-two months of service life. This is confirmed by the low air permeability results. The rapid drop in air voids has caused the surface of the experimental sections to be somewhat smooth. However, the control section is somewhat rougher, Figure 2. The greater hardening rate of the upper 1/2" of the control section may account for the increased roughness of the surface. These test sections should provide future valuable information on the changes in surface texture because of difference in the weathering rates of the binder.

TABLE A

Original Asphalt Sample Tests
Special Asphalt Test Sections
Contract 61-1T13C4P-Road I-Men-1-E, Wlts.

Test	R4005 5.5 Stand.	R4006 4.5 Stand.	R4007 3.5 Stand.	R4008 Union 85-100
Flash P.M.C.T.	445	420	455	445
Penetration at 77°F	95	105	111	86
Penetration Ratio	43	42	43	40
Xylene Equivalent	0	0	0	-17
Viscosity S.F. at 275°F	189	173	155	176
Orig. Softening Point	116	116	112	115
Orig. Ductility, Stand.	100+	100+	100+	100+
Orig. Micro-Ductility	57	54	43	49
Orig. Stain No.	8	5	5	8
Orig. Asphaltene Content	20.6	21.5	20.7	26.2
Orig. Soluble in CCl_4	99.9	99.9	99.9	99.9
Orig. Viscosities	.05 Sec^{-1} .001 Sec^{-1}	.05 Sec^{-1} .001 Sec^{-1}	.05 Sec^{-1} .001 Sec^{-1}	.05 Sec^{-1} .001 Sec^{-1}
39.2°F - Megapoises	190 450	129 340	132 250	282 610
77°F - "	1.17 2.23	1.07 1.82	0.90 1.66	1.07 1.53
140°F - Poises	1760	1572	1353	1633
225°F - Centistokes	1608	1470	1335	1608
275°F - "	318	291	278	341
325°F - "	93	91	84	99
<u>Bureau Thin Film</u>				
Loss - %	0.16	0.21	0.22	0.19
% Orig. Pen.	58	55	56	62
Ductility, Standard	55	98	80	100+
<u>Rolling Thin Film</u>				
Penetration	57	66	68	53
Ductility, Standard	79	92	99	100+
Ductility, - Micro	17	22	24	53
Softening Point	131	130	126	128

TABLE A (Contd)

Original Asphalt Sample Tests
Special Asphalt Test Sections
Contract 61-1T13C4P-Road I-Men-1-E, Wlts.

Test	R4005 5.5 Stand.		R4006 4.5 Stand.		R4007 3.5 Stand.		R4008 Union 85-100	
Viscosities	.05 Sec^{-1}	.001 Sec^{-1}	.05 Sec^{-1}	.001 Sec^{-1}	.05 Sec^{-1}	.001 Sec^{-1}	.05 Sec^{-1}	.001 Sec^{-1}
39.2°F - Megapoises	255	900	217	935	179	480	420	1480
77°F - "	3.12	7.85	3.0	6.1	2.4	5.3	3.2	4.9
140°F - Poises	5452		5102		4062		3487	
275°F - Centistokes	552		648		528		471	
Rolling Thin Film - 375°F								
Penetration	46		46		48		38	
Ductility - Standard	32		34		31		100+	
Cohesiograph								
Original Rd.-Inches Ave. Br.	.95		.85		.78		.81	
Gain, 0-24 Hrs. " " "	.22		.15		.13		.14	
Durability Test								
Viscosity - .05 Sec^{-1}	13		13		12		29	
Megapoises - .001 Sec^{-1}	48		38		30		62	
Micro-Ductility	8		8		8		7	

NOTE - All samples taken at paving plant during preparation of the paving mixture.

TABLE B

Test Results on Cores Removed Nine Days After Construction

Test Section	Depth From Surface	Viscosity* M.P.-77°F		Micro-* Duct. 77°F	Average Visc. M.P.-77°F		Average Micro-Duct.
		.05 Sec^{-1}	.001 Sec^{-1}		.05 Sec^{-1}	.001 Sec^{-1}	
5.5	Top 1/2"	3.12	6.10	31			
	5/8"-1 1/8"	2.65	4.97	29			
	1 1/4"-1 3/4"	2.70	5.53	33	2.82	5.53	31
4.5	Top 1/2"	3.20	4.37	41			
	5/8"-1 1/8"	2.05	4.11	34			
	1 1/4"-1 3/4"	2.60	4.77	31	2.62	4.42	35
3.5	Top 1/2"	2.32	4.99	40			
	5/8"-1 1/8"	1.95	3.26	34			
	1 1/4"-1 3/4"	1.89	3.38	36	2.05	3.88	37
Control	Top 1/2"	4.66	7.28	60			
	5/8"-1 1/8"	2.88	3.88	55			
	1 1/4"-1 3/4"	3.17	4.19	55	3.57	5.12	57

* Results represent an average from three core locations in the outer wheel track of each test section.

Other core properties are shown below.

Test Section	Theo. Max. Spec. Grav.	Lab. Compacted Spec. Grav.	Average Core Results			
			Waxed Spec. Grav.	Wt. per Cu.Ft.	% Relative Comp.	% Air Voids
5.5	2.42	2.36	2.29	143	97.2	5.2
4.5	2.42	2.36	2.30	143.5	97.3	5.1
3.5	2.42	2.36	2.26	141	95.7	6.7
Control	2.42	2.36	2.26	141	95.9	6.5

TABLE C

Test Results on Cores Removed After
Twenty-Two Months of Service Life

Test Section	Depth From Surface	Viscosity* M.P.-77°F		Micro-* Duct. 77°F	Average Visc. M.P.-77°F		Av. Micro-Duct.	Air Perm. Mls/Min. at 1" Vac.	% Voids
		.05 Sec^{-1}	.001 Sec^{-1}		.05 Sec^{-1}	.001 Sec^{-1}			
5.5	Top 1/2" 5/8"-1 1/8" 1 1/4"-1 3/4"	6.2 3.9 4.7	13.6 10.0 9.4	18 20 28	4.93	11.0	22	8	1.2
4.5	Top 1/2" 5/8"-1 1/8" 1 1/4"-1 3/4"	4.9 3.2 3.4	8.9 7.0 5.5	26 26 28	3.83	7.1	27	7	1.7
3.5	Top 1/2" 5/8"-1 1/8" 1 1/4"-1 3/4"	4.0 2.2 3.4	9.6 6.6 6.7	23 25 25	3.20	7.6	24	9	1.7
Control	Top 1/2" 5/8"-1 1/8" 1 1/4"-1 3/4"	11.4 4.6 5.5	14.8 7.3 7.6	38 48 52	7.17	9.9	46	9	1.7

* Results represent an average from three core locations in the outer wheel track of each test section.

ASPHALT TEST SECTIONS - CONTRACT 64-1T13C4-P

ROAD 01-Men-1-E, Wlts

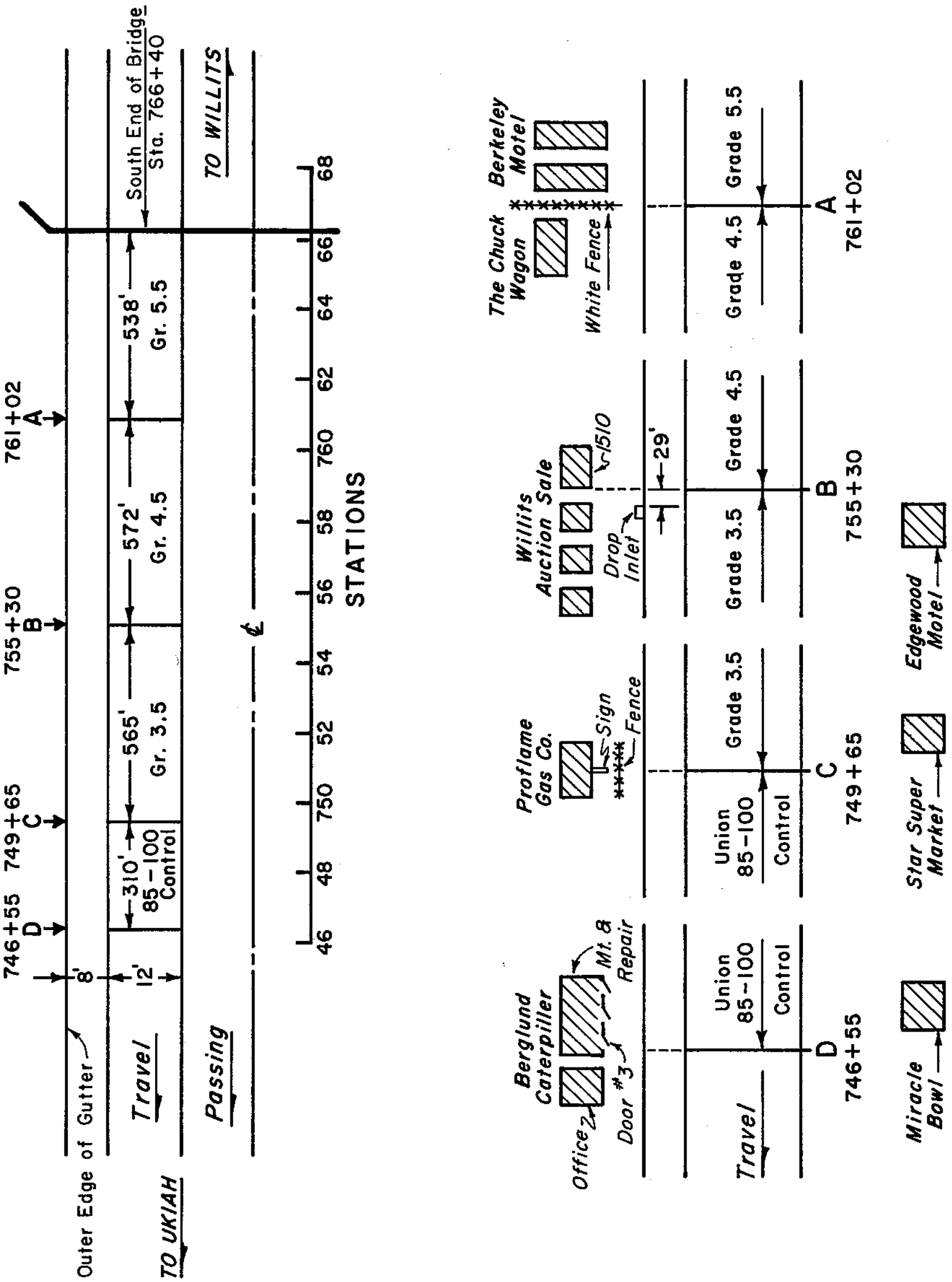
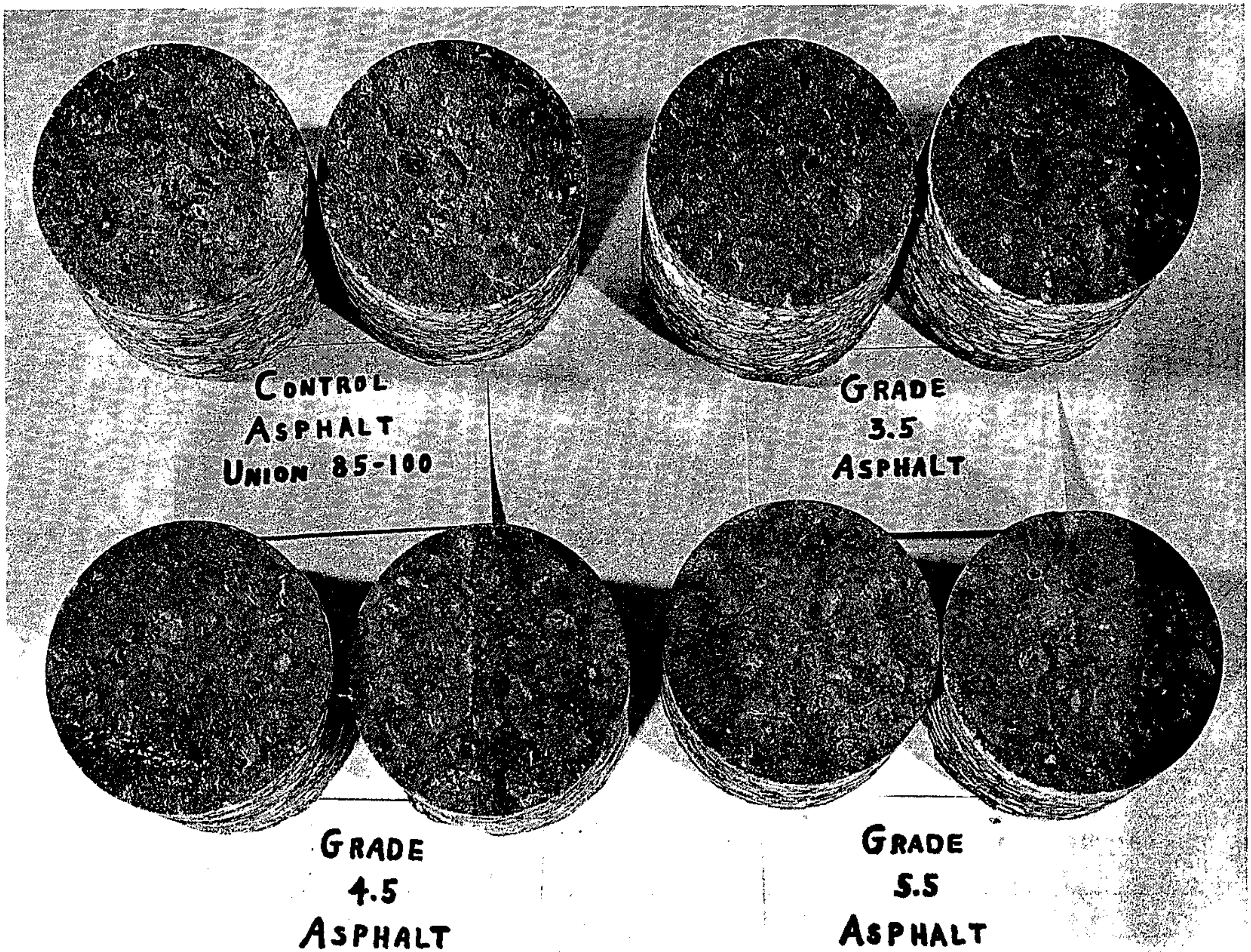


FIGURE 2



SURFACE CONDITION OF CORES
AFTER TWENTY-TWO MONTHS OF SERVICE LIFE