TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. FHWA/TX-82/07+524-2F	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle

Recycling Asphalt Concrete Pavement

5. Report Date
November 1981

6. Performing Organization Code

7. Author(s)

Charles H. Hughes

8. Performing Organization Report No.

DHT 1-9-76-524- 2F

9. Performing Organization Name and Address

State Department of Highways and Public Transportation
Materials and Tests Division
Austin, Texas 78703

10. Work Unit No.

11. Contract or Grant No.
DOT-FH-15-185

13. Type of Report and Period Covered

Final

12. Sponsoring Agency Name and Address

State Department of Highways and Public Transportation
11th and Brazos
Austin, Texas 78701

14. Sponsoring Agency Code

15. Supplementary Notes

Prepared in cooperation with the U. S. Department of Transportation
Federal Highway Administration

16. Abstract

The state of the art for recycling has progressed rapidly since the crude efforts reported earlier for this project in May of 1976. This pioneer project did provide useful information and test programs as well as tentative designs that are merely refined in our modern recycling methods. This report follows the change in properties of the recycled pavement, with three different recycling agents, over a four year period following construction. Stability, water susceptibility, indirect tension and properties of the extracted asphalt are reported for this pavement which is still serving as a satisfactory surface overlay at this time.

17. Key Words

Asphalt Concrete, Pavement, Recycling Agents, Water Susceptibility, Stability, Indirect Tension, Recycling

18. Distribution Statement

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 63	22. Price

Form DOT F 1700.7 (8-69)

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

AND

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
DEMONSTRATION PROJECTS DIVISION
REGION 15

DEMONSTRATION PROJECT 1-9-76-524

RECYCLING ASPHALT CONCRETE PAVEMENT

by

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DISCLAIMER STATEMENT

ACKNOWLEDGMENT

The author would like to acknowledge the assistance and express his appreciation to the following without whom this project and report would not have been possible.

District 21 of the State Department of Highways and Public Transportation in the Rio Grande Valley of Texas. Their help in monitoring and preserving the integrity of the test sections and obtaining cores was invaluable.

Demonstration Projects Division Region 15 FHWA for their funding and patience in developing the data and this report.

My secretary, Stella Rider, for her help in arranging and typing the interminable tables of data and this report.

The Research Section D-10R of the State Department of Highways and Public Transportation for their help in obtaining skid resistance, dynaflect and Mays meter data on the test sections. Also my special thanks to Rick Norwood for his help in drafting the figures for this report.

The Texas Transportation Institute who performed all of the laboratory tests reported herein and to Dr. Jon A. Epps who participated in the field evaluations, planning for the project and who has given me his advice and encouragement throughout the project.

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ABSTRACT

The state of the art for recycling has progressed rapidly since the crude efforts reported earlier for this project in May of 1976. This pioneer project did provide useful information and test programs as well as tentative designs that are merely refined in our modern recycling methods. This report follows the change in properties of the recycled pavement, with three different recycling agents, over a four year period following construction. Stability, water susceptibility, indirect tension and properties of the extracted asphalt are reported for this pavement which is still serving as a satisfactory surface overlay at this time.

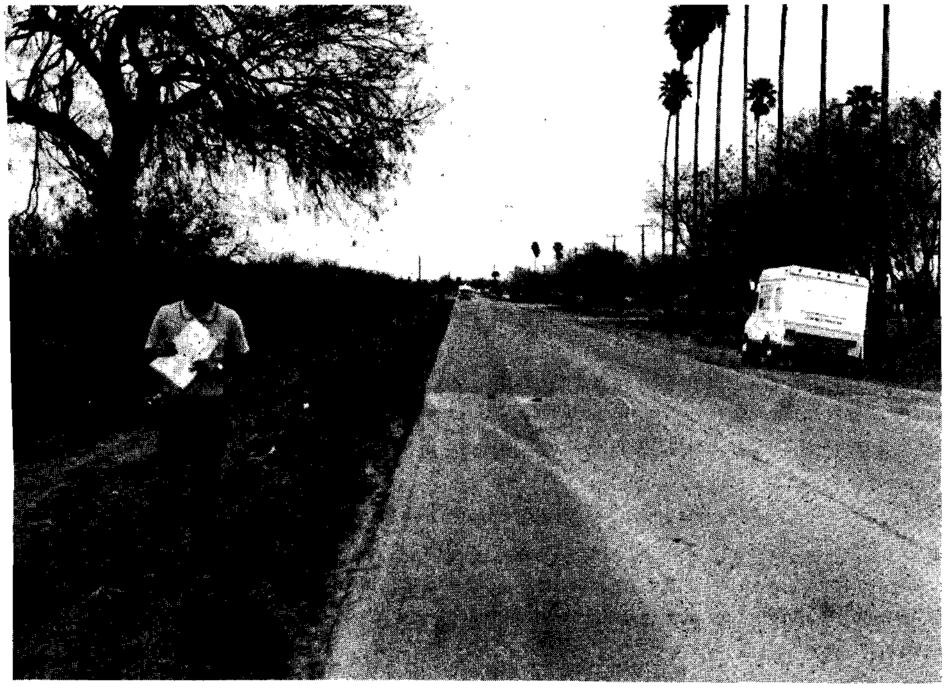


Photo taken in February of 1980 on the recycled pavement, used as a surface overlay, after 44 months of service.

INTRODUCTION

Constructed in the lower Rio Grande Valley of Texas in May of 1976 this project was one of the first in hot-recycling of asphalt concrete pavement. Although crude and subject to many production variables, many of the innovations in material design, plant modifications and material handling techniques are reflected in the state of the art today in hot-recycling of asphalt concrete pavements. The first report (3) on this project was written in August of 1977 and may be referred to for details on the plant, designs, materials and construction. This final report will present data showing the performance, asphalt properties and mixture properties for the test sections utilizing three different recycling agents. The laboratory testing was performed on cores taken from the same locations over a 44 month period after construction.

At the writing of this report the recycled pavement is still performing satisfactorily as a surface course nearly five and one-half years after construction.

TESTING AND EVALUATION

Test locations for future coring of the completed pavement were establsihed during construction. For each of the recycling agents used a section of foil paper was placed on top of the old pavement to allow separation of the recycled portion of future cores. Figure 1 shows the project test locations, type of recycling agent used in each test section and the location from which cores were taken at 21, 29 and 44 months after construction was completed. Figure 2 shows the test sequences that were utilized although some of these were omitted on some of the cores taken. In addition to these laboratory tests, other measurements were obtained by use of visual surveys, skid resistance measurements, roughness and deflection measurements. These techniques are described in Reference 4. Data sheets are included in the Appendix for these measurements.

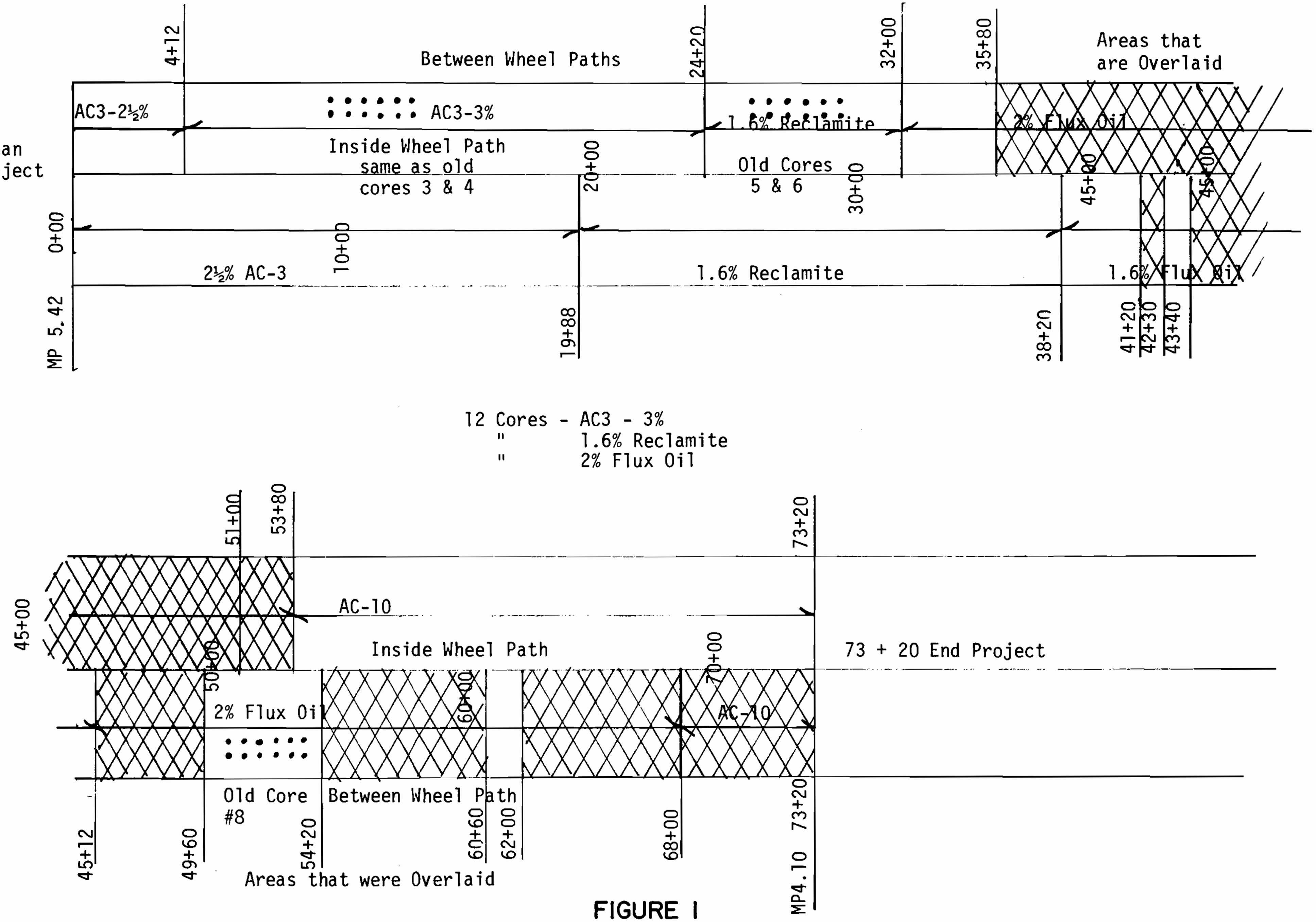


FIGURE I
CORE LOCATIONS
LOOP 374 HIDALGO COUNTY
DEMONSTRATION PROJECT I-9-76-524

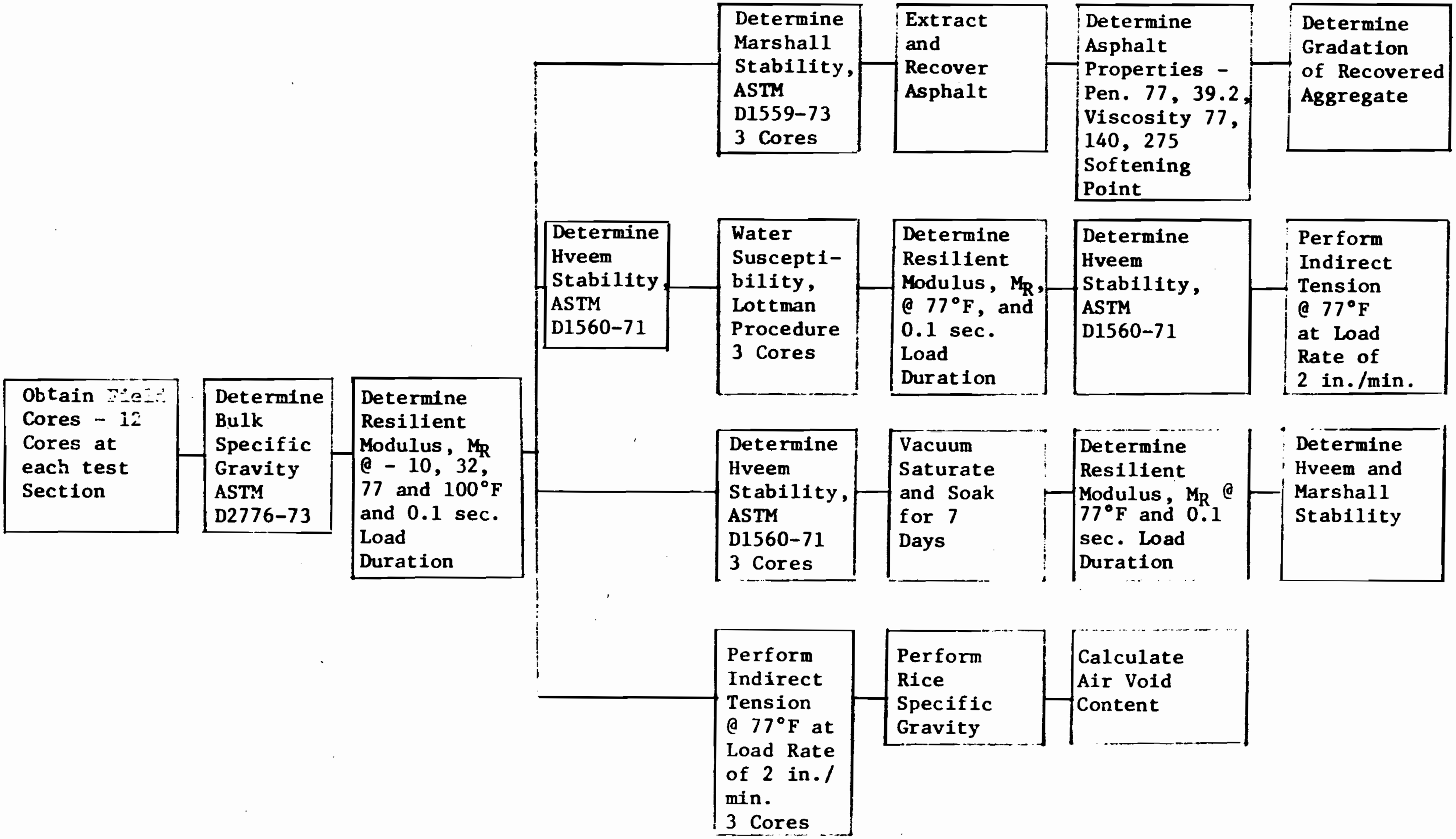


Figure 2: Suggested test sequence for field cores

DISCUSSION

Performance

The performance of the three test sections has been evaluated by use of visual surveys, Mays Meter (5) readings, Dynaflect and skid resistance measurements. The data sheets for these may be found in the Appendix. Based on these evaluations, the recycled pavement has functioned as a surface course for over five years without any major problems or maintenance. It should be noted that the favorable environmental conditions have contributed to this success since no freeze thaw cycles are experienced in the Rio Grande Valley of Texas. Minor raveling of the surface, particularly in the flux oil section, has been noted from the first week of service. This has been the primary indication that the flux oil is not as effective in improvement of the cohesive properties of the mixture as the other recycling agents used. The visual surveys in the Appendix show longitudinal and transverse crack development in all sections. The AC-3 section shows more cracking than the flux oil section while the Reclamite section shows the least cracking. Skid resistance was not improved in any section since no new aggregate was added to the recycled material. Flushing has not been noted during the life of the recycled section. Rutting has not been noted and the dynaflect measurements indicate no structural deterioration. The Mays Meter (5) records a satisfactory serviceability index.

Asphalt Properties

Table 1 and Figures 3 and 4 compare several properties of the asphalt extracted and recovered by the Abson method. Asphalt extracted from the laboratory and plant mixtures containing Reclamite Base Oil (RBO) had ductilities at 77°F in excess of 141 cms. Ductilities with the other recycling agents utilized in this project were too low to be considered acceptable. This, of course, was to be expected because the amount of these agents used was limited by other design considerations such as stability of the mixture. Ductility tests on asphalt extracted from cores taken almost four years after construction still show a ductility of 106 cms. Ring and Ball tests on asphalt extracted from cores in February 1978 and February 1980 show little change in the mixtures with AC-3 or Reclamite while the flux-oil mixtures show to be hardening at a faster rate.

TABLE 1 : ASPHALT PROPERTIES

	Penetration 77°F	Viscosity 140°F	Ring & Ball °F	Ductility 77°F (cm.)
Original Pavement	9	-	-	-
Laboratory Designs				
1) 2.5% AC-3	18			7.5
2) 1.6% RBO	43	7,732		141+
3) 1.6% Flux Oil	35	29,937		9
Plant Samples (May 1976)				
1) 2.5% AC-3	19	32,469		12
2) 3.0% AC-3	24	23,178		19
3) 1.6% RBO	49	4,760		141+
4) 1.6% RBO	37	7,571		141+
5) 1.6% Flux Oil	50	6,123		28
6) 2.0% Flux Oil	64	4,069		42
7) 2.0% Flux Oil	69	3,092		80
Cores (Feb. 1978)				
1) 3.0% AC-3	12	98,430	160	
2) 1.6% RBO	26	11,816	140	
3) 2.0% Flux Oil	53	4,166	131	
Cores (Feb. 1980)				
1) 3% AC-3	11	60,759	158	6
2) 1.6% RBO	34	8,075	137	106
3) 2.0% Flux Oil	23	33,315	151	6

Figure 3 compares the penetration on asphalt extracted from samples and cores from the three test sections. The penetration on asphalt extracted from the original pavement prior to recycling is also shown. These data indicate a faster rate of hardening of asphalt in the flux oil section than the Reclamite section. After 44 months the section with AC-3 has an asphalt penetration close to the original aged asphalt. The data, showing penetration of asphalt from the Reclamite section greater at 44 months than at 21 months, is probably in error due to sampling problems or residual solvent from the Abson recovery procedures.

Figure 4 compares the viscosity at 140°F for asphalt extracted from samples and cores from the test sections. The same trends noted in the other asphalt tests are followed in these tests. The flux oil test section seems to be hardening at a much faster rate than the Reclamite or the AC-3 sections.

Mixture Properties

Tables 2, 3 and 4 show various mixture properties measured on cores taken from the tests sections at 21 months, 2 years and 5 months and at 44 months. Air voids, Hveem and Marshall stabilities, indirect tension and the resilient modulus at -10F, 32F, 77F and 100F are reported in these tables. Figures 5, 6 and 7 show the comparisons of 3 resilient moduli at the four test temperatures for cores from the test sections at three different ages. Figure 6 also shows a range of resilient moduli measured on cores from conventional asphalt concrete pavements at the same age as cores from the recycled section. (These data were taken from ASTM STP 662.) One data point for each of the test sections (Rm at 68F) was available for cores taken in May 1976 immediately after construction. This is shown on all of the Figures for comparison purposes. It is interesting to note that these data show less hardening than the conventional ACP pavements although the temperature susceptibility reflected in the data on cores from the test sections follow the pattern of conventional pavements. Figure 8 is a different presentation of the data wich interpolated moduli at 68F graphed to show the comparison of resilient moduli over 44 months for the three modifiers. Figure 9 compares the Hveem stabilities on the laboratory designs, plant samples during construction, and cores from the test sections. In general the stabilities reflect a much lower value for the cores as compared to laboratory compacted specimens. This is usually explained by the higher air voids in the pavement and is probably the primary factor in this case since the measured air voids are consistently high in the cores from all test sections. The lack of stability has not seemed to be reflected by rutting problems however the traffic on this road is relatively light with a low percentage of trucks.

Tables 5, 6, 7 and 8 show the data before and after water susceptibility tests on cores from the test sections. The resilient moduli at 77F, Hveem and Marshall stabilities are reported before and after being subjected to either the 7-day soak or the Lottman water susceptibility procedures. Figure 10 compares the resilient moduli of cores from the test sections to show the trend of water susceptibility indicated by these tests. In each case the test indicate an improved resistance to moisture with age. While the flux oil cores continue to show a very susceptible pavement, the reclamite is approaching the level generally considered to be acceptable for resistance to water susceptibility tests. The AC-3 modified mixture also shows relatively good water susceptibility resistance at the older age.

As a closing note it has been somewhat amazing to the author that despite the many variables encountered during the production and construction of this early crude attempt at hot recycling, these tests reported over almost a four year period do seem to reliably compare the properties of the three test sections.

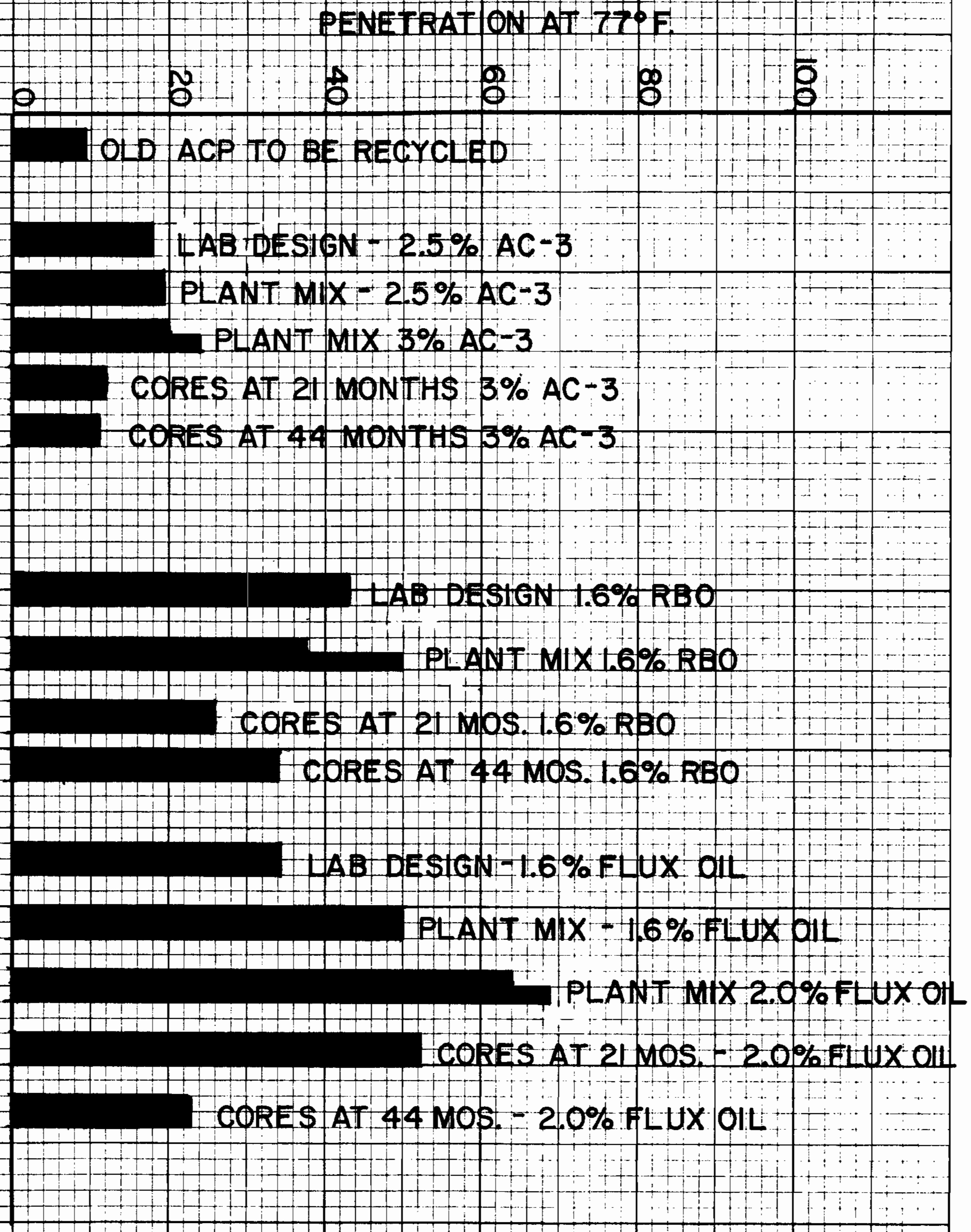


FIGURE 3 - SAMPLES OF EXTRACTED ASPHALT

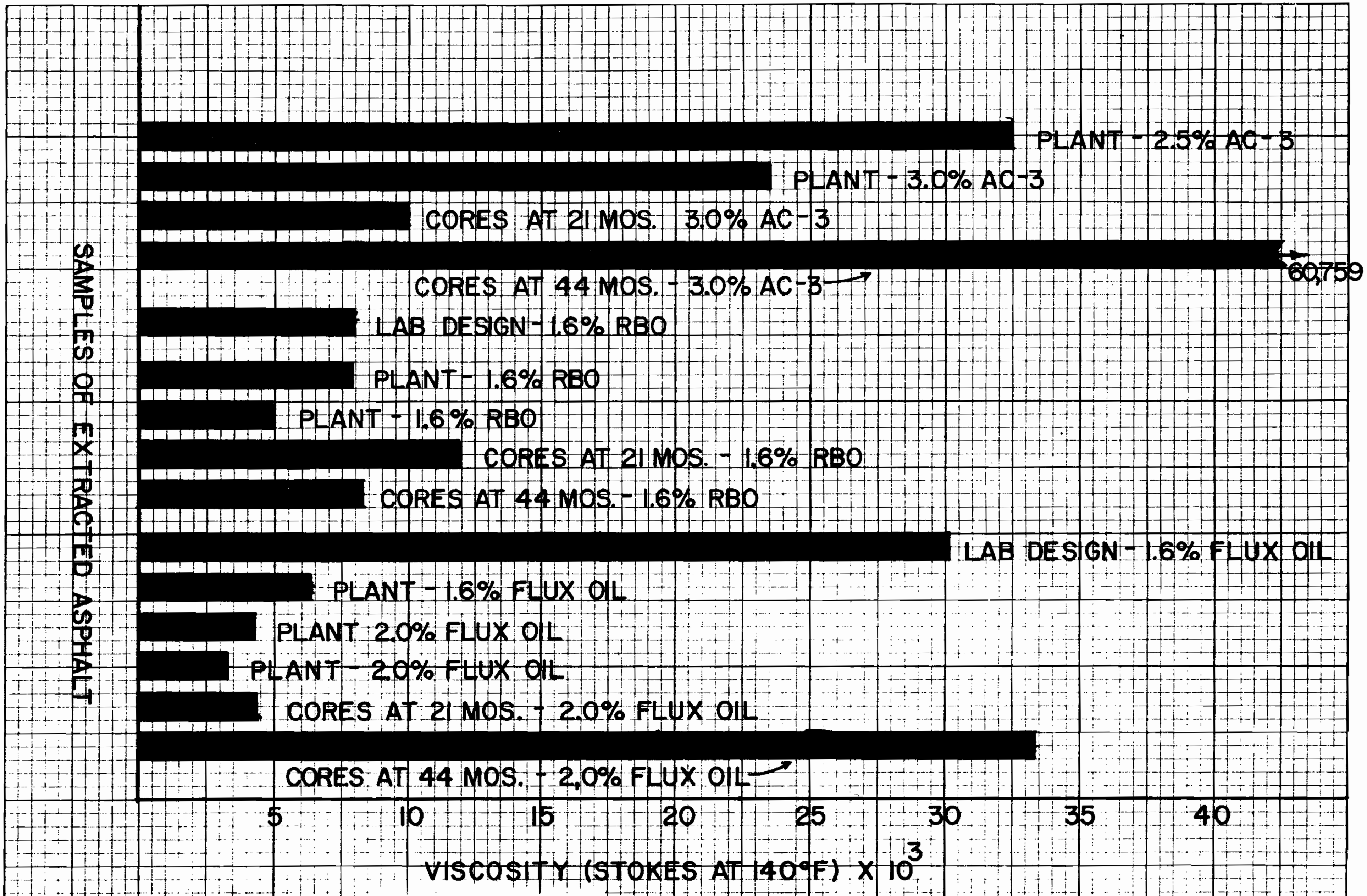

PLANT - 2.5% AC-3
PLANT - 3.0% AC-3
CORES AT 21 MOS. 3.0% AC-3
CORES AT 44 MOS. - 3.0% AC-3
60,759
LAB DESIGN - 1.6% RBO
PLANT - 1.6% RBO
PLANT - 1.6% RBO
CORES AT 21 MOS. - 1.6% RBO
CORES AT 44 MOS. - 1.6% RBO
LAB DESIGN - 1.6% FLUX OIL
PLANT - 1.6% FLUX OIL
PLANT 2.0% FLUX OIL
PLANT - 2.0% FLUX OIL
CORES AT 21 MOS. - 2.0% FLUX OIL
CORES AT 44 MOS. - 2.0% FLUX OIL
SAMPLES OF EXTRACTED ASPHALT
5
10
15
20
25
30
35
40
VISCOSITY (STOKES AT 140°F) X 10^3

FIGURE 4

Table 2: Mixture Properties of Cores Taken From
Loop 374 - Hidalgo County (Feb. 1978)
Section Recycled with 3.0% AC-3

Sample No.	Air Voids %	Resilient Modulus psi x 10^6						Marshall		Indirect Tension			Remarks
		-10°F	32°F	77°F	100°F		Hveem Stab.	Stab. lbs.	Flow 0.01 in	E psi	Stress psi	Strain in/in	
D-1	11.3	2.010	1.346	.626	.286								
D-2	11.6	2.268	1.382	.570	.262					114,454	125	.00109	
D-3	11.3	1.738	1.124	.539	.252			5500	12				
D-4	9.4	2.565	1.271	.440	.181		25						
D-5	9.5	2.412	1.192	.437	.215								
D-6	10.4	2.079	1.451	.483	.197					90,155	111	.001232	
D-7	13.0	1.854	1.592	.436	.219			2997	11				
D-8	12.6	2.142	1.214	.577	.251		24						
D-9	12.0	2.313	1.382	.553	.262					120,918	137	.00109	
D-10	11.7	2.114	1.151	.536	.242								
D-11	10.7	2.234	1.307	.612	.273			4466	13				
D-12	11.8	1.973	1.338	.577	.236		19						
Avg.	11.3	2.142	1.313	.532	.240		23	4321	12	108,509	123	.001137	

Table 2: Mixture Properties of Cores Taken From Loop 374 - Hidalgo County (Feb. 1978) Section Recycled with 1.6% RBO

Sample No.	Air Voids	Resilient Modulus x 10^6						Marshall		Indirect Tension			Remarks
		-10°F	32°F	77°F	100°F		Hveem Stab.	Stab.	Flow	E psi	Stress psi	Strain in/in	
D-13	6.2	2.954	1.619	.492	.177			2784	16				
D-14	9.1	2.529	1.032	.235	.070								
D-15	8.3	2.805	1.443	.533	.157		23						
D-16	8.6	2.356	1.680	.477	.159			4851	15				
D-17	6.0	2.586	1.149	.250	.070					38,242	112	.0029	
D-18	9.3	2.153	1.396	.427	.151					53,232	114	.0021	
D-19	5.8	1.791	1.623	.533	.148		22						
D-20	7.7	2.423	1.634	.520	.178								
D-21	3.6	2.738	1.501	.430	.098			3753	15				
D-22	4.2	2.937	1.664	.430	.131								
D-23	3.9	2.836	1.855	.484	.138					54,982	158	.0029	
D-24	3.5	3.004	1.537	.371	.094		29						
Avg.	6.4	2.593	1.509	.432	.1309		24	3796	15	48,818	128	.0026	

Table 2: Mixture Properties of Cores Taken From
Loop 374 - Hidalgo County (Feb. 1978)
Section Recycled with 2.0% Flux Oil

Sample No.	Air Voids	Resilient Modulus x 10^6						Marshall		Indirect Tension			Remarks
		-10°F	32°F	77°F	100°F		Hveem Stab.	Stab.	Flow	E psi	Stress psi	Strain in/in	
D-25	10.3	2.052	.999	.171	.073								
D-26	9.2	1.767	1.203	.172	.070		20						
D-27	9.3	2.098	.998	.197	.076								
D-28	9.5	2.035	.973	.192	.074					37,629	58	.0016	
D-29	9.1	1.892	1.049	.285	.133		24						
D-30	12.0	1.837	1.099	.275	.125			3125	12				
D-31	9.5	2.230	1.312	.225	.103								
D-32	9.4	2.393	1.208	.259	.133		25						
D-33	8.8	2.393	1.049	.173	.069			3836	8				
D-34	10.0	1.273	1.046	.202	.081					25,791	62	.0024	
D-35	9.6	2.342	1.233	.246	.116					64,301	70	.0011	
D-36	8.8	1.749	1.206	.177	.094			3868	9				
Avg.		2.005	1.100	.214	.096		23	3610	10	42,633	64	.0017	

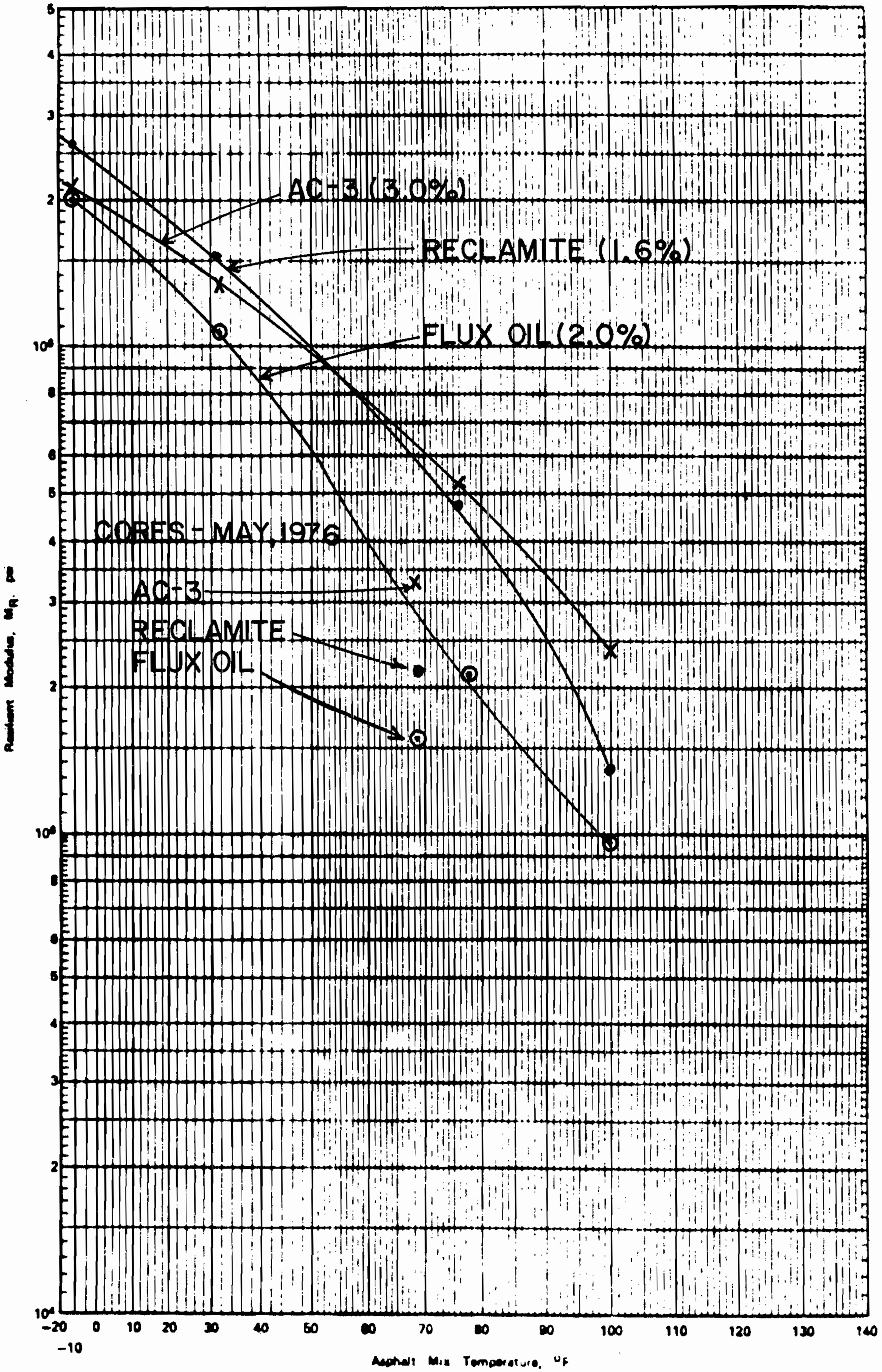


FIGURE 5- CORES TAKEN AT 21 MONTHS - FEB. 1978

Table 3 : Mixture Properties of Cores Taken From
Loop 374 - Hidalgo County (Oct. 1978)
Section Recycled with 3.0% AC-3

Sample No.	Air Voids %	Resilient Modulus x 10^6					Hveem	Marshall		Indirect Tension			Remarks
		-10°F	32°F	77°F	100°F		Stab.	Stab.	Flow	E psi	Stress psi	Strain in/in	
1-A	8.8	3.028	1.808	.751	.392			5625	14				
B	8.1	3.040	1.842	.593	.261								
C	8.1	3.060	1.859	.707	.349					102993	159	.0015	
D	11.2	2.308	1.412	.416	.209					75397	151	.0020	
E	10.3	2.770	1.672	.612	.311					77558	158	.0020	
F	9.0	2.863	1.945	.666	.267			5100	19				
G	6.8	3.459	1.804	.473	.179								
H	7.3	3.413	1.713	.452	.181			2695	18				
I	5.5	3.472	1.619	.576	.317		23						
J	5.9	3.419	1.977	.644	.291		21						
K	6.4	3.373	1.901	.593	.264		25						
L	6.8	3.889	1.895	.607	.253								
Avg.	7.9	3.175	1.787	.591	.273		23	4473	17	85316	156	.0019	

Table 3: Mixture Properties of Cores Taken From
Loop 374 - Hidalgo County (Oct. 1978)
Section Recycled with 1.6% RBO

Sample No.	Air Voids %	Resilient Modulus x 10^6					Hveem	Marshall		Indirect Tension			Remarks
			-10°F	32°F	77°F	100°F	Stab.	Stab.	Flow	E psi	Stress psi	Strain in/in	
2-A	4.3		3.451	2.096	.669	.274	20						
B	10.4		2.395	1.492	.468	.183		3966	13				
C	10.4		2.401	1.513	.527	.227				205923	146	.0007	
D	8.2		2.753	1.664	.547	.238							
E	10.8		2.546	1.550	.496	.211				147826	137	.0009	
F	8.7		2.966	1.783	.640	.274		2424	14				
G	14.3		2.499	.896	.429	.180				51038	99	.0020	
H	10.4		2.869	1.764	.545	.228	19						
I	10.0		2.929	1.534	.454	.197							
J	9.5		2.804	1.564	.448	.180							
K	9.1		3.010	1.716	.530	.221	20						
L	9.1		2.592	1.598	.527	.219		2675	15				
Avg.	9.6		2.768	1.597	.573	.220	20			134929	128	.0012	

Table 3 : Mixture Properties of Cores Taken From Loop 374 - Hidalgo County (Oct. 1978) Section Recycled with 2.0% Flux Oil

Sample	Air	Resilient Modulus x 10^6					Hveem	Marshall		Indirect Tension			Remarks
No.	Voids %	-10°F	32°F	77°F	100°F		Stab.	Stab.	Flow	E psi	Stress psi	Strain in/in	
3-A	13.0	2.157	1.218	.368	.132								
B	13.8	1.255	.516	.160	.084					74949	40	.0005	
C	13.4	1.927	.882	.267	.085			2571	11				
D	13.4	1.875	1.004	.307	.108					54686	58	.0011	
E	13.8	1.861	1.001	.291	.100								
F	13.0	2.074	1.129	.370	.120		31						
G	13.4	2.121	1.309	.408	.130		47						
H	16.0	1.713	.945	.289	.106			1540	10				
I	16.4	1.650	.863	.252	.081					24598	39	.0016	
J	16.0	1.578	1.020	.293	.103								
K	15.6	1.624	.872	.244	.089								
L	17.3	1.326	.603	.160	.122			1779	10				
Avg.	14.6	1.763	.948	.284	.105		39	2435	11	51401	48	.0011	

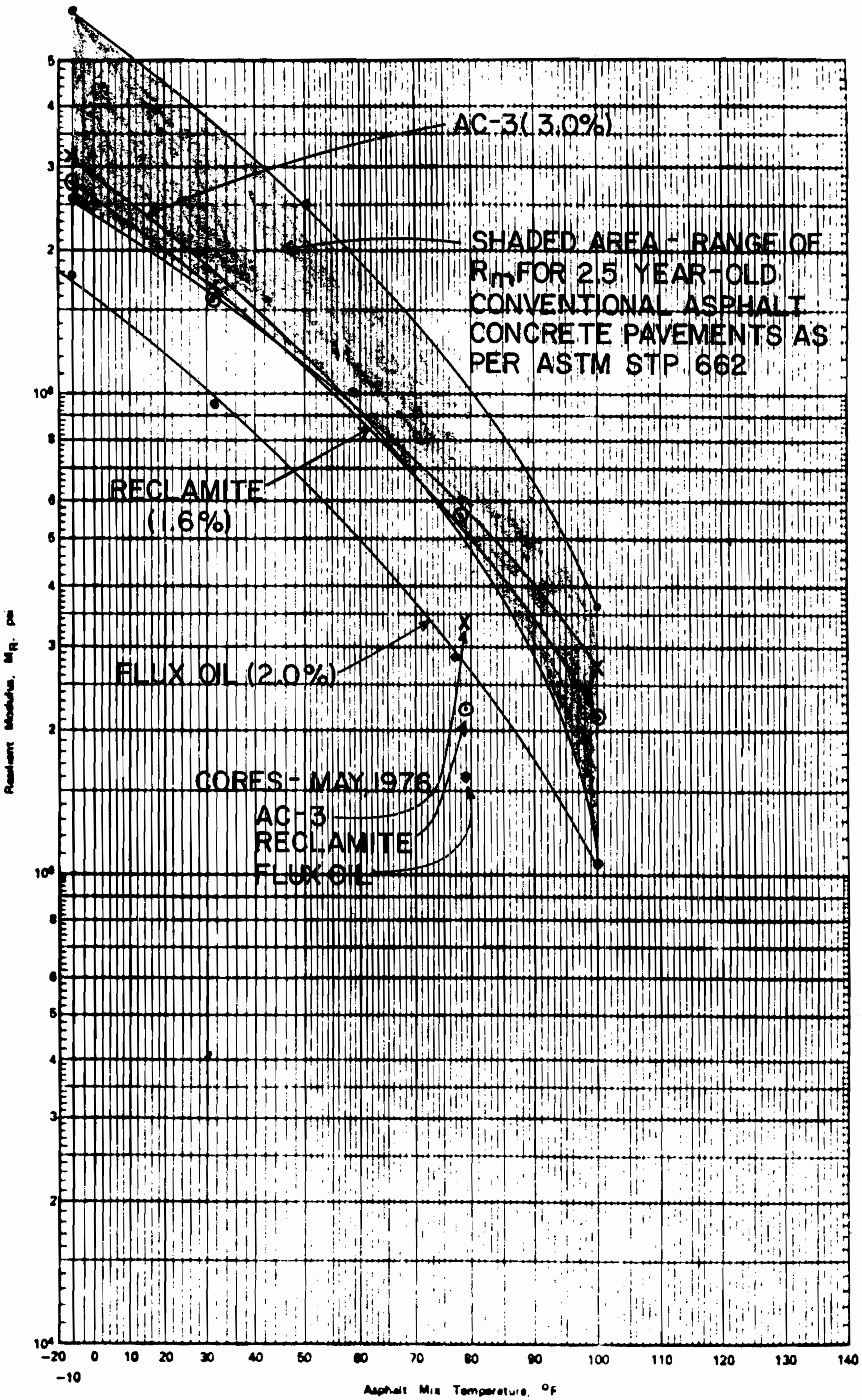


FIGURE 6 CORES TAKEN OCT. 1978 - AGE 2 YRS., 5 MOS.

RESILIENT MODULUS VS. TEMP.

Table 4 : Mixture Properties of Cores Taken From
Loop 374 - Hidalgo County (Feb. 1980)
Section Recycled with 3% AC-3

Sample No.	Air Voids %	Resilient Modulus x 10^6					Hveem Stab.	Marshall		Indirect Tension			Remarks
		-11°F	33°F	68°F	77°F	108°F		Stab.	Flow	E psi	Stress psi	Strain in/in	
A1	7.0	2.59	1.360	0.552	0.516	0.143							Inside
A2	9.3	2.67	1.558	0.648	0.467	0.164		*	12				Wheel
A3	6.8	2.34	1.039	0.428	0.335	0.098				249,000	83	0.0003	Path
A4	7.8	2.54	1.266	0.523	0.334	0.136				228,000	110	0.0005	
A5	7.6	2.34	1.457	0.498	0.381	0.111							
A6	7.6	3.04	1.599	0.542	0.346	0.115	12						
Avg.	6.68	2.59	1.38	0.53	0.396	0.127							
A7	7.2	2.93	2.122	0.946	0.766	0.260	28						Between
A8	7.4	2.35	1.668	0.817	0.679	0.228		4450	13				Wheel
A9	8.0	2.50	1.790	0.809	0.605	0.231	28						Paths
A10	7.9	3.09	1.905	0.933	0.727	0.274		4300	14				
A11	7.9	2.32	1.576	0.766	0.511	0.193							
A12	8.2	3.65	2.462	0.763	0.567	0.311				134,000	144	0.0011	
Avg.	7.77	2.81	1.92	0.839	0.65	0.250							

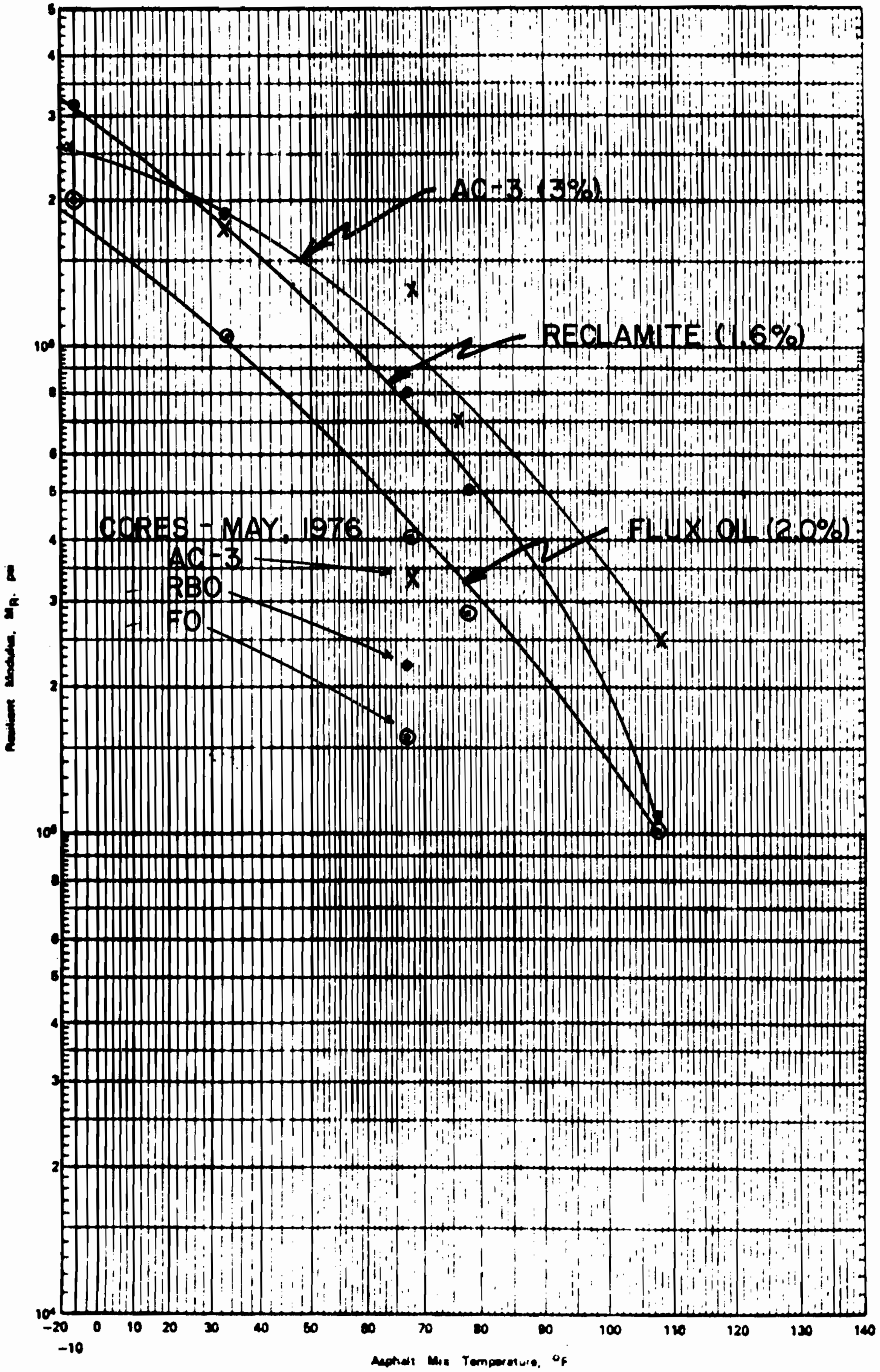
*Sample too thin to determine stability.

Table 4: Mixture Properties of Cores Taken From Loop 374 - Hidalgo County (Feb. 1980) Section Recycled with 1.6% Reclamite

Sample No.	Air Voids %	Resilient Modulus x 10^6					Hveem Stab.	Marshall		Indirect Tension			Remarks
		-11°F	33°F	68°F	77°F	108°F		Stab.	Flow	E psi	Stress psi	Strain in/in	
B1	5.0	3.42	1.852	0.623	0.453	0.143							
B2	4.9	3.22	1.788	0.702	0.483	0.155		4690	11				Inside
B3	3.3	3.11	1.867	0.596	0.400	0.127				69,000	141	0.0002	Wheel
B4	5.3	3.03	1.650	0.585	0.418	0.121				40,000	145	0.0004	Path
B5	4.7	3.21	1.667	0.548	0.428	0.109	22						
B6	5.0	2.94	1.827	0.677	0.520	0.146							
Avg.	4.7	3.16	1.775	0.622	0.450	0.134							
B7	4.9	3.27	2.002	0.712	0.477	0.131	17						Between
B8	3.9	3.84	1.865	0.682	0.445	0.122		3180	13				Wheel
B9	6.3	3.34	2.284	0.838	0.643	0.185	17						Paths
B10	4.1	3.56	2.018	0.771	0.551	0.159				62,000	152	0.0002	
B11	6.9	3.03	2.020	0.896	0.606	0.190							
B12	5.4	3.23	1.924	1.235	0.542	0.165							
Avg.	5.3	3.38	2.02	0.856	0.544	0.159							

Table 4 : Mixture Properties of Cores Taken From
Loop 374 - Hidalgo County (Feb. 1980)
Section Recycled with 2.0% Flux Oil

Sample No.	Air Voids %	Resilient Modulus x 10^6					Hveem Stab.	Marshall		Indirect Tension			Remarks
		-11°F	33°F	68°F	77°F	108°F		Stab.	Flow	E psi	Stress psi	Strain in/in	
C1	10.9	1.98	1.409	0.556	0.348	0.121							Inside
C2	11.4	1.92	1.216	0.494	0.348	0.129		2860	9				Wheel
C3	10.7	2.07	1.341	0.545	0.419	0.149							Path
C4	11.0	2.55	1.447	0.530	0.391	0.122				78,000	71	0.0009	
C5	10.6	4.38	1.302	0.485	0.358	0.126	22						
Avg.	10.9	2.58	1.343	0.522	0.373	0.129							
C6	14.1	1.28	0.808	0.331	0.259	0.095							Between
C7	14.2	1.40	0.708	0.254	0.183	0.060		1510	8				Wheel
C8	13.3	1.53	0.961	0.374	0.333	0.110	21						Paths
C9	13.3	1.35	0.717	0.248	0.168	0.053	22						
C10	12.0	1.66	0.924	0.364	0.251	0.078		2040	12				
Avg.	13.4	1.44	0.824	0.314	.205	0.079							



CORES TAKEN AT 44 MONTHS - FEB. 1980
FIGURE 7

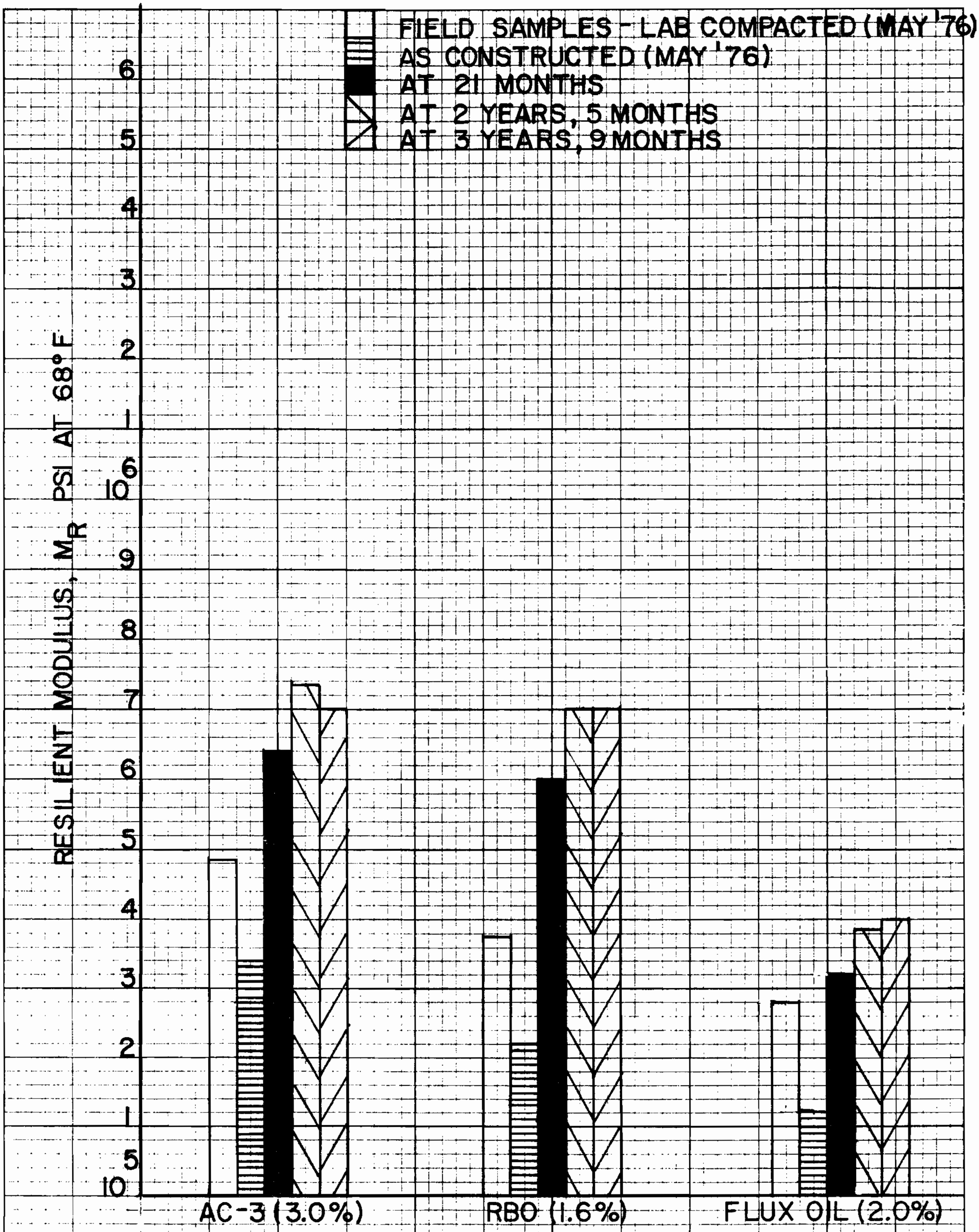


FIGURE 8

RESILIENT MODULUS DATA FROM LOOP 374

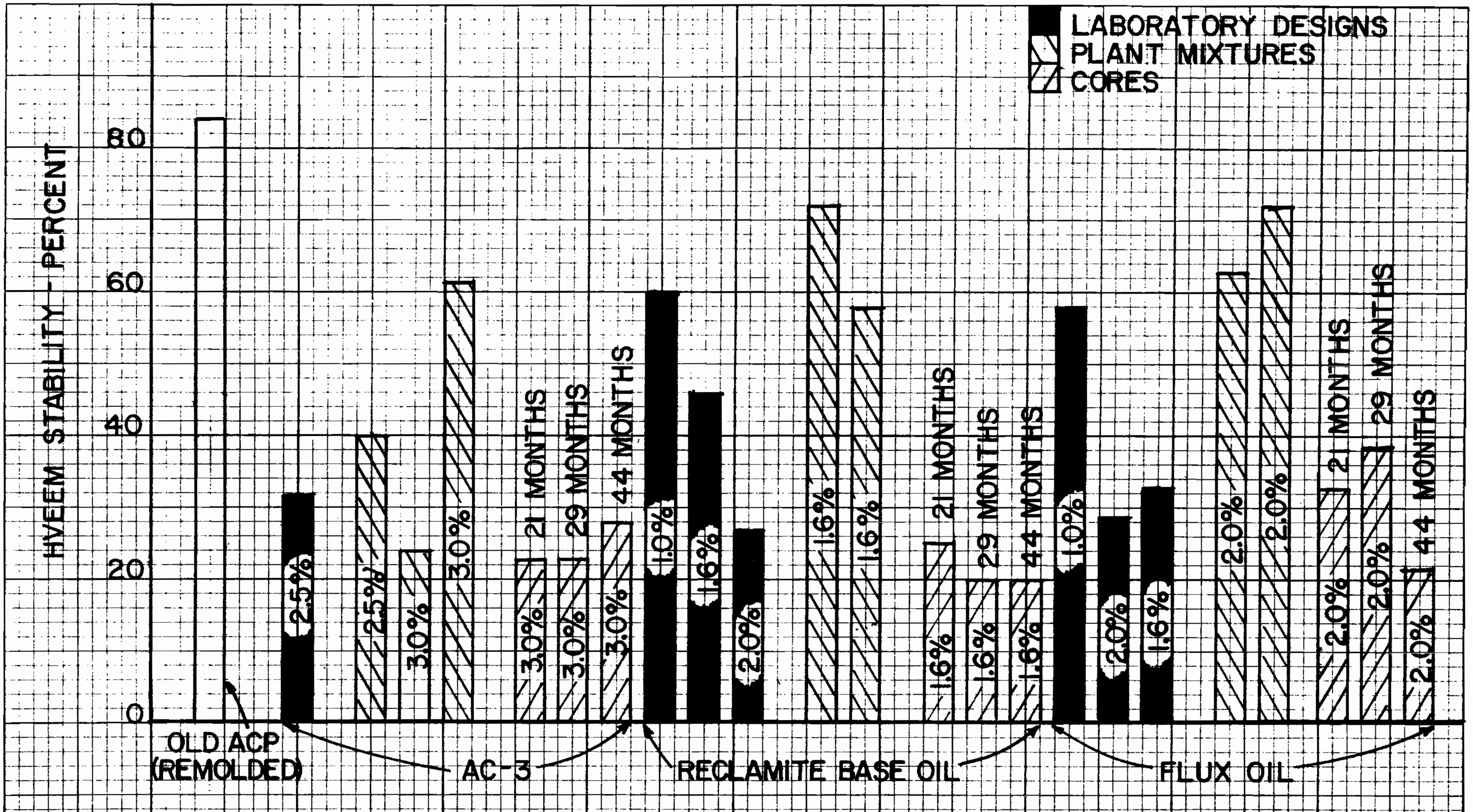


FIGURE 9

HVEEM STABILITIES FOR OLD PAVEMENT (REMOLDED), LABORATORY DESIGNS, PLANT MIXTURES, AND CORES AT 21, 29 AND 44 MONTHS

Table 5: Mixture Properties Before and After 7-Day Soak-Water Susceptibility Procedure (Feb. 1978)

Sample No.	Air Voids %	Resilient Modulus psi x 10^6 77°F	Hveem Stability	Marshall Stability		After 7-Day Soak Procedure				Remarks
				Stab.	Flow	Resilient Modulus 77°F	Hveem Stab.	Marshall Stab.		
								Stab.	Flow	
D-1	11.3	.626				.100				
D-3	11.3	.539		5500	12					
D-4	9.4	.440	25				6	818	22	3% AC-3
D-5	9.5	.437				.081				
D-7	13.0	.436		2997	11		0	866	25	
D-8	12.6	.578	24							
D-10	11.7	.536				.095				
D-11	10.7	.612		4466	13					
D-12	11.8	.577	19				4	1340	28	
Avg.			22	4321	12	.092	5	1008	25	

Table 5: Mixture Properties Before and After 7-Day Soak-Water Susceptibility Procedure (Feb. 1978)

Sample No.	Air Voids %	Resilient Modulus psi x 10^6 77°F	Hveem Stability	Marshall Stability		After 7-Day Soak Procedure				Remarks
				Stab.	Flow	Resilient Modulus 77°F	Hveem Stab.	Marshall Stab.		
								Stab.	Flow	
D-13	6.2	.492		2784	16					
D-14	9.1	.235				.076				1.6% Reclamite
D-15	8.3	.533	23				0	1166	32	Base Oil
D-16	8.6	.250		4851	15					
D-19	5.8	.533	22				1	1152	30	
D-20	7.7	.520				.1014				
D-21	3.6	.429		3753	15					
D-22	4.2	.429				.2523				
D-24	3.5	.372	29				3	2606	23	
Avg.			25	3796	15	.1432	1.5	1641	32	

Table 5 : Mixture Properties Before and After 7-Day Soak-Water Susceptibility Procedure (Feb. 1978)

Sample No.	Air Voids %	Resilient Modulus psi x 10^6 77°F	Hveem Stability	Marshall Stability		After 7-Day Soak Procedure				Remarks
				Stab.	Flow	Resilient Modulus 77°F	Hveem Stab.	Marshall Stab. Stab.	Marshall Stab. Flow	
D-25	10.3	.171	20				0	363	23	
D-26	9.2	.172				.0257				2% Flux Oil
D-28	9.5	.192	24				0	578	25	
D-29	9.1	.285		3125	12					
D-30	12.0	.275				.0233				
D-31	9.5	.225	25				54	578	16	
D-32	9.4	.259		3836	8					
D-33	8.8	.173				.0152				
D-36	8.8	.177		3868	9					

Table 6 : Mixture Properties Before and After 7-Day Soak-Water Susceptibility Procedure (Feb. 1980)

Sample No.	Air Voids %	Resilient Modulus psi x 10^6 77°F	Hveem Stability	Marshall Stability		After 7-Day Soak Procedure				Remarks
				Stab.	Flow	Resilient Modulus 77°F	Hveem Stab.	Marshall Stab.		
								Stab.	Flow	
A-2	9.3	0.467		*	12					Inside Wheel Path 3% AC-3
A-6	7.6	0.346	12			0.282	14	1590	27	
Avg.	8.5	.407								
A-7	7.2	0.766	28			0.419	26	3055	35	Between Wheel Paths 3% AC-3
A-8	7.4	0.679		4450	13					
A-9	8.0	0.605	28			0.404	21	2980	29	
A-10	7.9	0.727		4300	14					
Avg.	7.6	0.694	28	4375	13.5	0.412	23.5	3018	32	
B-2	4.9	0.483		4690	11					Inside Wheel Path 1.6% Reclamite
B-5	4.7	0.428	22			0.224	9	1970	28	
Avg.	4.8	0.456								
B-7	4.9	0.477	17			0.393	15	2150	32	Between Wheel Paths 1.6% Reclamite
B-8	3.8	0.445		3180	13					
B-9	6.3	0.643	17			0.456	18	2500	33	
Avg.	5.0	.522	17			0.425	16.5	2325	32.5	
Avg.	4.9	.489	19.5	3938	12	0.340	12.75	2148	30.25	

Table 6 : Mixture Properties Before and After 7-Day Soak Water Susceptibility Procedure (Feb. 1980)

Sample No.	Air Voids %	Resilient Modulus psi x 10^6 77°F	Hveem Stability	Marshall Stability		After 7-Day Soak Procedure				Remarks
						Resilient Modulus 77°F	Hveem Stab.	Marshall Stab.		
				Stab.	Flow			Stab.	Flow	
C-2	10.9	0.348		2860	9					Inside Wheel Path 2.0% Flux Oil
C-5	10.6	0.357	22			0.032	5	490	19	
Avg.	10.75	0.353								
C-7	14.2	0.183		1510	8					Between Wheel Paths 2.0% Flux Oil
C-8	13.3	0.333	21			0.014	8	500	24	
C-9	13.3	0.168	22			0.022	8	450	18	
C-10	12.0	0.251		2040	12					
Avg.	13.2	0.234	21.5	1775	10	.018	8	475	21	

Table 7: Mixture Properties Before and After the Lottman Water Susceptibility Procedure (Cores Taken Oct. 1978.)

Sample No.	Air Voids	Res. Mod. x 10^6 77°F	Indirect Tension 77°F			After Lottman Procedure					
						Resilient Modulus	Hveem Stab.	Indirect Tension 77°F			
	%		E psi	Stress	Strain	77°F		E (psi)	Stress	Strain	Remarks
2-A	4.3	.6686					21				
C	10.4	.5270	205923	146	.00071						
D	8.2	.5465				.0834		15693	83	.00531	
E	10.8	.4960	147826	137	.0009						
F	8.7	.6397				.1444		8515	64	.00757	
G	14.3	.4290	51038	99	.00198						
H	10.4	.5446					13				
J	9.5	.4484				.0657		8304	49	.00584	
K	9.1	.5303					11				
Avg.	9.5	.5367	134929	128	.0012		15	10837	65	.00624	

Table 7: Mixture Properties Before and After the Lottman Water Susceptibility Procedure (Cores Taken October 1978)

Sample No.	Air Voids	Res. Mod. x 10^6 77°F	Indirect Tension 77°F			After Lottman Procedure					
						Resilient Modulus	Hveem Stab.	Indirect Tension 77°F			
	%		E psi	Stress	Strain	77°F		E (psi)	Stress	Strain	Remarks
3-A	13.0	.3681				.0211		1736	6	.00317	
B	13.8	.1600	74949	39	.00053						
C	13.4	.2674									
D	13.4	.3067	54656	58	.00106						
E	13.8	.2909				.0203		17885	66	.00367	
F	13.0	.3702				.0849	9				
G	13.4	.4083					12				
I	16.4	.2516	24598	39	.00159						
J	16.0	.2933				.0138					
Avg.	14.0	.3018	51401	45	.00106	.0350	10	9811	36	.00342	

Table 7: Mixture Properties Before and After the Lottman Water Susceptibility Procedure (Cores taken Oct. 1978.)

Sample No.	Air Voids	Res. Mod. x 10^6 77°F	Indirect Tension 77°F			After Lottman Procedure					
						Resilient Modulus	Hveem Stab.	Indirect Tension 77°F			
	%		E psi	Stress	Strain	77°F		E (psi)	Stress	Strain	Remarks
1-B	8.1	.593				.138		12746	55	.0043	
C	8.1	.707	102993	159	.0016						
D	11.2	.416	75397	151	.0020	.286		102224	131	.0013	
E	10.3	.612	77558	157	.0020	.177		48621	133	.0027	
G	6.8	.473				.201		17039	85	.0050	
I	5.5	.576					22				
J	5.9	.644					19				
K	6.4	.593					15				
L	6.8	.607				.215					
Avg.	7.6	.580	85316	156	.0019	.2036	19	26163	111	.0043	

Table 8. Mixture Properties Before and After the Lottman Water Susceptibility Procedure (Cores Taken Feb. 1980)

Sample No.	Air Voids	Res. Mod. x 10^6 77°F	Indirect Tension 77°F			After Lottman Procedure					
						Resilient Modulus	Hveem. Stab.	Indirect Tension 77°F			
	%		E psi	Stress	Strain	77°F		E (psi)	Stress	Strain	Remarks
A1	7.0	0.516				0.135	5	11,000	49	0.0005	IWP*
A3	6.8	0.335	249,000	83	0.0003						3.0%
A4	7.8	0.334	228,000	110	0.0005						AC-3
A5	7.6	0.381				0.227	2	24,000	78	0.0003	
A11	7.9	0.511				0.209	18	31,000	63	0.0002	BWP**
A12	8.2	0.567	134,000	144	0.0001						3% AC-3
Avg.	7.55	0.441	203,000	112	0.0003	0.190	8.3	22,000	63	0.00033	
B1	5.0	0.453				0.234	8	17,000	76	0.0005	IWP*
B3	3.3	0.400	69,000	141	0.0002						1.6%
B4	5.3	0.418	40,000	145	0.0004						Reclamite
B6	5.0	0.520				0.216	3	18,000	65	0.0004	
B10	4.1	0.551	62,000	152	0.0002						BWP**
B11	6.9	0.606				0.267	8	30,000	78	0.0003	1.6%
Avg.	4.9	0.500	57,000	146	0.0003	0.241	6.33	21,600	73	0.0004	Reclamite

*Inside Wheel Path
**Between Wheel Paths

Table 8: Mixture Properties Before and After the Lottman Water Susceptibility Procedure (Cores Taken Feb. 1980)

Sample No.	Air Voids	Res. Mod. x 10^6 77°F	Indirect Tension 77°F			After Lottman Procedure					
						Resilient Modulus	Hveem. Stab.	Indirect Tension 77°F			
	%		E psi	Stress	Strain	77°F		E (psi)	Stress	Strain	Remarks
C1	10.9	0.348				0.040	5	10,000	20	0.0002	IWP*
C3	10.7	0.419	78,000	71	0.0009						2.0%
C4	11.0	0.391				0.045	10	8,000	19	0.0002	Flux Oil
Avg.	10.9	0.386				0.043	7.5	9,000	19.5	0.0002	
C6	14.1	0.259				0.035	***				BWP**
											2.0%
											Flux Oil

*Inside Wheel Path
**Between Wheel Paths
***Sample Failed During Test

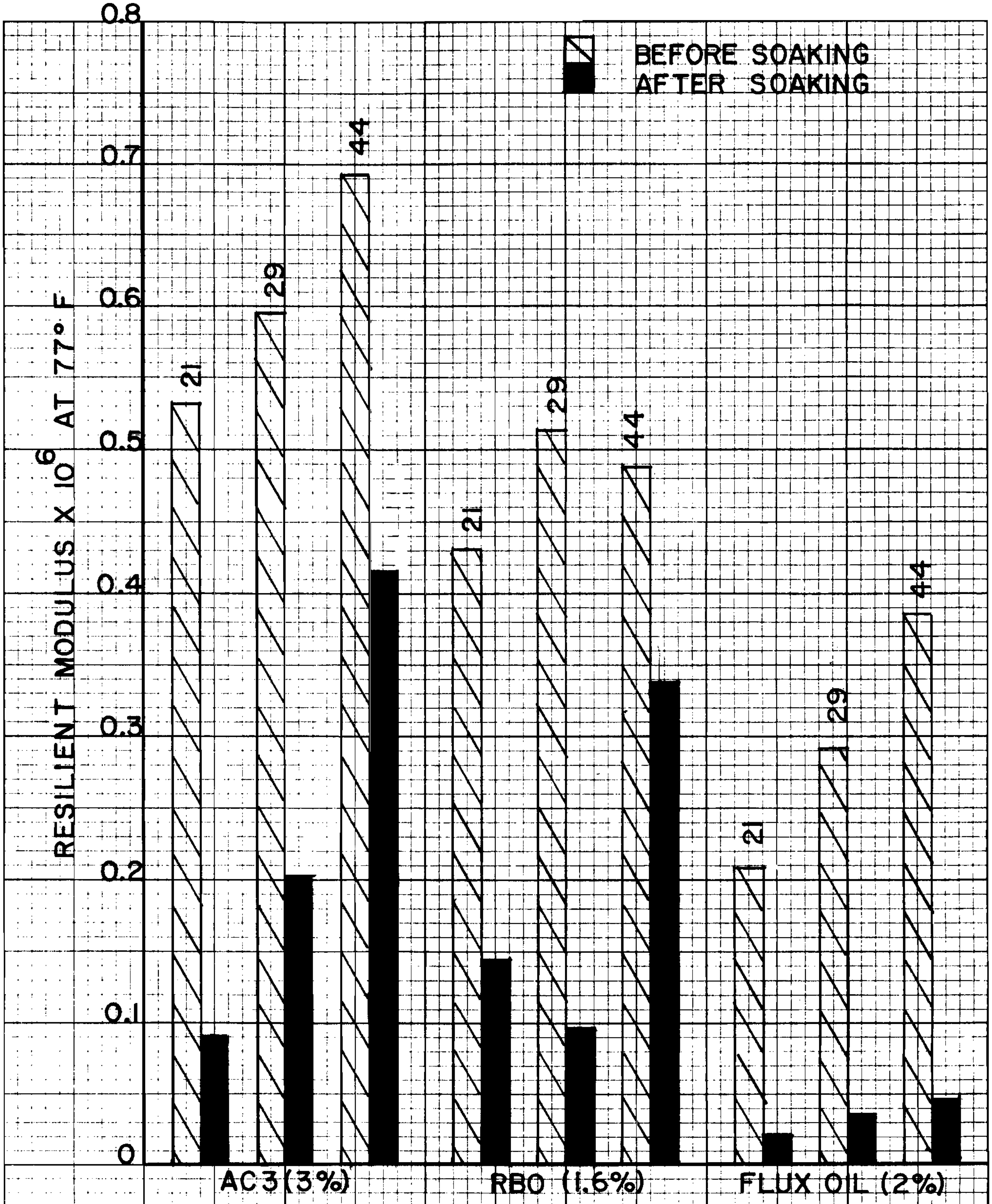


FIGURE 10

RESILIENT MODULUS OF CORES
TAKEN AT 21, 29, & 44 MONTHS
AFTER RECYCLING - BEFORE &
AFTER WATER SUSCEPTIBILITY

CONCLUSIONS

1. A properly designed mixture for a recycled asphalt concrete pavement performs as well as a conventional asphalt concrete pavement.

2. With a compatible asphalt modifier in sufficient quantity to rejuvenate the aged asphalt to its original properties, the aging process seems to follow that of a virgin asphalt in a conventional pavement.

3. To establish the most desirable properties in a recycled pavement and to achieve compliance with environmental standards it is necessary to add new aggregate to a recycled mixture.

REFERENCES

(1) NCHRP Report 224, 1980 Guidelines for Recycled Pavement Materials J. A. Epps, D. N. Little, R. J. Holmgrean, B. L. Terrel and W. B. Ledbetter.

(2) Lottmon, R. P., "Predicting Moisture - Induced Damage to Asphalt Concrete," NCHRP Report 192, 1978.

(3) C. H. Hughes, DHT 1-9-76-524-1-F, "Recycling Asphalt Concrete Pavement" August 1977.

(4) Epps, J.A., Meyer, A. H., Larrimore, I. E., and Jones, H. L., "Roadway Maintenance Evaluation User's Manual," Research Report 151-2, Texas Transportation Institute, 1974.

(5) Epps, J. A., Shaw, C. W., Harvey, G. G., Mahoney, J. P., and Scott, W. W., "Operational Characteristics of Mays Ride Meter," Research Report 151-3, Texas Transportation Institute, 1976.

APPENDIX

Chuck Hughes

CARD NO. 1 DIST 21 LP374 RECYCLING PROJECT

DISTRICT NO. 21

RATERS EPPS J A
HUGHES C H

DATE MONTH 02 DAY 10 YEAR 1978

CORES TO BE OBTAINED
EBL STA 4+12 to 29+20 AC-3
EBL STA 29+20 to 32+00 1.6% REC.
WBL STA 49+60 to 54+20 2% FLUX.

LOCATION / PAVEMENT

~~DISTRICT NO.~~ ~~SECTION NO.~~ STATION	COUNTY NO.	HIGHWAY NO. LANE	CONTROL	SECTION	FROM	TO MODIFIER	LANE	MAYS METER	RUTTING %AREA ①1-15 ②16-30 ③>30			RAVELING %AREA ①1-15 ②16-30 ③>30			FLUSHING %AREA ①1-15 ②16-20 ③>30			CORRUGATIONS %AREA ①1-15 ②16-20 ③>30			ALLIGATOR CRACKING %AREA ①1-5 ②6-25 ③>25			LONGITUDINAL CRACKING LIN FT PER STA/LN ①10-99 ②100-199 ③>200			TRANSVERSE CRACKING NO. PER STA ①1-4 ②5-9 ③>10			CRACKS (1) SEALED (2) PARTIALLY SEALED (3) NOT SEALED	PATCHING %AREA ①1-5 ②6-15 ③>16			FAILURES/MILE (1) 1-5 (2) 6-10 (3) >10	SHOULDER (1) YES (2) NO	SN			SURFACE TEXTURE			~~ADT PER LANE~~ PAVEMENT RATING SCORE
									SLIGHT	MODERATE	SEVERE	SLIGHT	MODERATE	SEVERE	SLIGHT	MODERATE	SEVERE	SLIGHT	MODERATE	SEVERE	SLIGHT	MODERATE	SEVERE	SLIGHT	MODERATE	SEVERE	SLIGHT	MODERATE	SEVERE		GOOD	FAIR	POOR			AVG	LOW	HIGH	IWP	BWP	OWP	
STA 24+60		EAST BOUND LANE				AC-3			0				2		0			0			0			0			1			3	0			0	2							85
STA 25+00		EAST BOUND LANE				1.6% Rec.			0				2		0			0			0			0			1			3	0			0	2							85
STA 26+00		WEST BOUND LANE				1.6% REC.			0			0			0			0			0			1				2		3	0			0	2							83
STA 31+00		EASTBOUND LANE				1.6% Rec.			0				2		0			0			0			0			1			3	0			0	2							85
STA 33+00		EASTBOUND LANE				2.0% FLUX.			0					3	0			0			0			1			1			3	0			0	2	POOR LAYDOWN						72
STA 51+00		WESTBOUND LANE				2.0% FLUX			0				2		0			0			0			2				3		3	0			0	2							63

Dist 21 LP374 Recycling Project I.

Maintenance Rating Form for Flexible Pavements

DISTRICT NO. 21

RATERS EPPS J A
HUGHES C H

DATE MONTH 12 DAY 6 YEAR 1980

LOCATION

FOREMAN NO.							
STATION HIGHWAY CLASS COUNTY NO.	24+60	25+00	[illegible]+00	31+00	33+00	51+00	1+00
LANE HIGHWAY NO. CONTROL	EAST BOUND LANE	EAST BOUND LANE	WESTBOUND LANE	EASTBOUND LANE	EASTBOUND LANE	WESTBOUND LANE	EASTBOUND LANE
SECTION							
FROM							
MODIFIER TO	AC-3	7.6% REC	16% REC	16% REC	20% RUM	20% RUM	AC-3
LANE							
MAYS METER							

PAVEMENT

RUTTING	%AREA ①1-15 ②16-30 ③>30	SLIGHT	0	0	0	0	0	0	0
		MODERATE							
		SEVERE							
RAVELING	%AREA ①1-15 ②16-30 ③>30	SLIGHT		1		1	2	2	1
		MODERATE	2		1	1			
		SEVERE							
FLUSHING	%AREA ①1-15 ②16-30 ③>30	SLIGHT	0	1	0	0	0	0	0
		MODERATE							
		SEVERE							
CORRUGATIONS	%AREA ①1-15 ②16-30 ③>30	SLIGHT	0	0	0	0	0	0	0
		MODERATE							
		SEVERE							
ALLIGATOR CRACKING	% AREA ①1-5 ②6-25 ③>25	SLIGHT	3	0	0	0	1	0	0
		MODERATE							
		SEVERE							
LONGITUDINAL CRACKING	LIN FT PER STA/LN ①10-99 ②100-199 ③>200	SLIGHT	0	0	1	0	2	2	1
		MODERATE							
		SEVERE							
TRANSVERSE CRACKING	NO. PER STA ①1-4 ②5-9 ③>10	SLIGHT	2	2	2	2	2	3	2
		MODERATE							
		SEVERE							
CRACKS (1)SEALED (2)PARTIALLY SEALED (3) NOT SEALED			3	3	3	3	3	3	3
PATCHING	%AREA ①1-5 ②6-15 ③>16	GOOD	0	0	0	0	0	0	0
		FAIR							
		POOR							
FAILURES / MILE	①1-5 ②6-10 ③>10		0	0	0	0	0	0	0

SHOULDER

PAVED	RIDE	
	CONTRAST	
	PAVEMENT EDGE	
	SHOULDER EDGE	
	CRACKS	
	RAVELING OR FLUSHING	
	VEGETATION	
UNPAVED	PAVEMENT EDGE	
	RUTTING, CORRUGATIONS, LOOSE ROCK	

ROADSIDE AND DRAINAGE	LITTER	
	MOWING	
	VEGETATION	
	SLOPE EROSION	
	CULVERTS	
	DITCHES, OUTFALL, CHANNELS	
	ROADSIDE DRAINAGE	
TRAFFIC SERVICE	GUARDRAILS	
	SIGNS	
	DELINEATORS	
	STRIPING	
	AUXILIARY MARKINGS	
OTHER		

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                         TEXAS HIGHWAY DEPARTMENT

                       DISTRICT 21 -DESIGN SECTION

          DYNAFLECT DEFLECTIONS AND CALCULATED  STIFFNESS COEFFICIENTS

                       THIS PROGRAM WAS RUN - 05-28-76

*****************************************************************************

                    PROJECT IDENTIFICATION

      COUNTY       CONT.  SECT.   PPSN     HIGHWAY      DATE     DYNAFLECT
   HIDALGO         0039    02   0002201   LOP-374    04-03-76

    REASONS FOR MEASUREMENTS AND COMMENTS        TOTAL PAV DEPTH
            -                                             0.0  INCHES

*****************************************************************************

                       EXISTING PAVEMENT

              MATERIAL TYPE          LAYER THICK.(IN)

          ASPHALT                            6.00

*****************************************************************************

                    GENERAL LOCATION INFORMATION

      DIRECTION OF TRAVEL IS              WITH   MILEPOINTS
      MEASUREMENTS ARE    FEET FROM THE RIGHT SIDE OF LANE

      DESCRIPTION OF LOCATION             ODOMETER READING  MILEPOINT
ROM-FM-1427 EAST
O-US-83

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DIST.      COUNTY         CONT.  SECT.   PPSN      HIGHWAY     DATE      DYNAFLECT
 21     HIDALGO           0039    02   0002201    LOP-374    04-03-76

                                DYNAFLECT DATA

ODOMETER   W1      W2      W3      W4      W5      SCI     AS2    AP2        REMARKS

25        1.530   0.990   0.600   0.360   0.250   0.540   0.29   0.29   M
30        1.620   0.490   0.600   0.420   0.310   0.630   0.29   0.29
35        1.260   0.960   0.690   0.430   0.330   0.300   0.29   0.29
40        1.620   1.200   0.810   0.600   0.370   0.420   0.26   0.28
45        1.290   1.020   0.690   0.490   0.370   0.270   0.29   0.29
50        1.680   1.110   0.690   0.460   0.340   0.570   0.28   0.28
55        2.190   1.470   0.930   0.690   0.470   0.720   0.26   0.26

AVERAGES  1.599   1.106   0.716   0.493   0.349   0.493   0.28   0.28
STANDARD DEVIATION                                0.169   0.01   0.01
NUMBER OF POINTS IN AVERAGE =    7


     W1-5   DEFLECTIONS AT GEOPHONES 1,2,3,4,&5
     SCI    SURFACE CURVATURE INDEX ( W1 MINUS W2)
     AS2    STIFFNESS COEFFICIENT OF THE SUBGRADE
     AP2    STIFFNESS COEFFICIENT OF THE PAVEMENT
```

Readings taken within the recycling project

```
 DIST    COUNTY      HIGHWAY   CONT-SEC    BMP     EMP    PPSN   LANE      DATE
  21   HIDALGO        LP-374      39-02     .       .               R     12-07-77
                    SERVICEABILITY INDEX
     0    0    1    1    2    2    3    3    4    4    5
     .    .    .    .    .    .    .    .    .    .    .                    JOB  5
     0    5    0    5    0    5    0    5    0    5    0      REMARKS
     ...................................................
    .                                  X
    .                                 X
    .                                      X
    .                                  X
D 01.                                 X
I   .                                X
```

```
TRIM---I            STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION      JOB  6  I---TRIM

                   SERVICEABILITY INDEX (SI) COMPUTED FROM THE MAYS RIDE METER

                              THIS PROGRAM WAS RUN - 01-17-78
       ***************************************************************************************

                                  PROJECT IDENTIFICATION

        DIST    COUNTY        HIGHWAY   CONT-SEC     BMP      EMP      PPSN   LANE      DATE
         21   HIDALGO         LP-374     39-02        .        .                L     12-07-77


        CALIBRATION CONSTANTS    TOTAL LENGTH    TOTAL COUNTER       ADT          MRM
          ALPHA        BETA       FOR SECTION     FOR SECTION      FOR PPSN      NUMBER
         9.89333     8.95751       1.389            698.                        21- 142-F
       ***************************************************************************************

                                  LOCATION INFORMATION


                             FROM - FM 2062 (RECYCLED PROJ)
                             TO - US 83 EXPWY (WBL)
       ***************************************************************************************
                                  MAYS RIDE METER DATA
                        MAYS METER
            LOCATION   (READING/0.2 MI)     SI    SPEED                REMARKS
         BEG. TO 0.2       136.0            3.0     50
                 0.4       101.0            3.5     50
                 0.6        87.0            3.7     50
                 0.8       102.0            3.5     50
                 1.0       113.0            3.3     50
                 1.2        95.0            3.6     50
                 1.389      59.0            4.1     50

       ***LOW SI = 3.0                  AVERAGE SI = 3.4                     HIGH SI = 3.7***
       *THE LOW,AVERAGE AND HIGH SI VALUES DO NOT INCLUDE THE SI AT THE END OF THE SECTION.*
```

```
                       DIST    COUNTY      HIGHWAY   CONT-SEC    BMP     EMP     PPSN   LANE     DATE
                        21  HIDALGO        LP-374      39-02     .       .               L     12-07-77
                                          SERVICEABILITY INDEX
                           0    0    1    1    2    2    3    3    4    4    5
                           .    .    .    .    .    .    .    .    .    .    .                    JOB  6
                           0    5    0    5    0    5    0    5    0    5    0      REMARKS
                           ...................................................
                          .                              X
                          .                                   X
                          .                                     X
                          .                                   X
                      D 01.                                 X
                      I   .                                    X
```

```
DISTRICT..21, CSN..0000001 - DETAIL TEST LISTING          SKID RESISTANCE REPORT 1          DATE 11/15/77          PAGE 46


+--------------------------------------------+---------------------------------------+------------------------------+----------------------------+

        ''STORAGE DESTRUCTION'' ERROR,
                                                                    RECYCLED PROJECT   LOOP 374
        CSN HEADER INFORMATION CANCELLED,
                                                                    From:US 83 Expwy.   To:  FM 2062    WESTBOUND LANE
        REASON - CONSTRUCTION SECTION NUMBER ILLEGAL OR NOT ON FILE

-----------------------------------------------+---------------------------------------+-------------------------------+
CONSTANTS THIS TEST -  (1) TESTED ON 10/20/77      (3) AIR TEMPERATURE AT TEST WAS  75 DEGREES F,              +
                       (2) USING TRUCK NO, 43      (4) TRAVELING *OPPOSITE* THE FROM/TO DESCRIPTION            +
                                                                                                               +
WARNING - THIS TEST ALONE IS INSUFFICIENT TO ESTABLISH THE SAFE FRICTION VALUE FOR A HIGHWAY                   +
-----------------------------------------------------------------------------------------------------------------------------------------------

-- GENERAL SKID TEST DATA ---***** SN BREAKDOWN BY LANE ****--------------------------- SN BREAKDOWN BY COMMENT ---------------------
 TEST & +       + CUMM, +      ***       +     +     +     + E &  ***           +          + INTER- + STRUC- +   R.R.   +          +  CITY  + DIST.
 LANE   + SPEED + MILES + SN  ***     A  +  B  +  C  +  D  + OVER *** FLUSH     + PATCH    + SECT.  +  TURE  +   XING   + CURVE    +  LIMIT + SELECT
-------+-------+-------+-----*****-------+-----+-----+-----+-----***-----------+----------+--------+--------+----------+----------+--------+-------
  1-A   +   40  +  0.1  + 24 ***   24 +     +     +     +      *** TEST #1 +STA 3+00+ AC-3      + 2.5%+              +          +        +  24
  2-A   +   39  +  0.2  + 28 ***   28 +     +     +     +      *** TEST #2 +STA.11+00+ AC-3     + 2.5%+              +          +        +  28
  3-A   +   39  +  0.6  + 26 ***   26 +     +     +     +      *** TEST #6 +STA.31+00+RECLAMITE+ 1.6%+              +          +        +  26
  4-A   +   39  +  0.8  + 28 ***   28 +     +     +     +      *** TEST #7 +STA 42+00+FLUX 1.6%+ AC-10   +OVERLAY   +          +        +  28
  5-A   +   39  +  1.0  + 29 ***   29 +     +     +     +      *** TEST #8 +STA. 53+00+FLUX 2.0%+        +          +          +        +  29
-------+-------+-------+-----*****-------+-----+-----+-----+-----***-----------+----------+--------+--------+----------+----------+--------+-------
     NUMBER OF TESTS....+  5 ***    5 +     +     +     +      ***            +          +        +        +          +          +        +   5
     SKID NUMBER - LO...+ 24 ***   24 +     +     +     +      ***            +          +        +        +          +          +        +  24
     SKID NUMBER - AVG..+ 27 ***   27 +     +     +     +      ***            +          +        +        +          +          +        +  27
     SKID NUMBER - HI...+ 29 ***   29 +     +     +     +      ***            +          +        +        +          +          +        +  29
-------+-------+-------+-----*****-------+-----+-----+-----+-----***-----------+----------+--------+--------+----------+----------+--------+-------
```

NOTE: DUE TO MALFUNCTION WITH EQUIPMENT THE DATA FOR THE EASTBOUND LANE WAS DESTROYED.

```
DISTRICT,,21, CSN,,0000000 - DETAIL TEST LISTING          SKID RESISTANCE REPORT 1          DATE 01/14/77          PAGE 76

Loop 374 test Section    W.B.L.

+---------------+-----------------------------+-----------------------------+-------------------+---------------------+

        !!STORAGE DESTRUCTION!! ERROR,

        CSN HEADER INFORMATION CANCELLED,

        REASON - CONSTRUCTION SECTION NUMBER ILLEGAL OR NOT ON FILE

----------------+-----------------------------+-----------------------------+-------------------+
CONSTANTS THIS TEST -   (1) TESTED ON  1/11/77      (3) AIR TEMPERATURE AT TEST WAS  45 DEGREES F,      +
                        (2) USING TRUCK NO, 43      (4) TRAVELING *OPPOSITE* THE FROM/TO DESCRIPTION    +
                                                                                                        +
WARNING - THIS TEST ALONE IS INSUFFICIENT TO ESTABLISH THE SAFE FRICTION VALUE FOR A HIGHWAY            +
------------------------------------------------------------------------------------------------------------------------

-- GENERAL SKID TEST DATA -------- SN BREAKDOWN BY LANE -----------------------------  SN BREAKDOWN BY COMMENT ---------------------
 TEST & +        + CUMM, +      ***      +     +     +     + E &  ***           +           + INTER- + STRUC- +  R,R,  +          +  CITY  + DIST,
 LANE   + SPEED  + MILES + SN  ***   A  +  B  +  C  +  D  + OVER ***  FLUSH     + PATCH     + SECT,  +  TURE  +  XING  +  CURVE   + LIMIT  + SELECT
--------+--------+-------+-----***------+-----+-----+-----+-----***-----------+-----------+--------+--------+--------+----------+--------+--------
   1-A  +   39   +  0,1  + 24  ***  24  +     +     +     +     ***  TEST #1   + STA. 3+00 + AC-3   + 2.5%   +        +          +        +
   2-A  +   40   +  0,2  + 21  ***  21  +     +     +     +     ***  TEST #2   + STA. 11+00+ AC-3   + 2.5%   +        +          +        +
   3-A  +   39   +  0,5  + 26  ***  26  +     +     +     +     ***  TEST #5   + STA. 28+00+ RECLAMITE + 1.6% +        +          +        +
   4-A  +   39   +  0,6  + 30  ***  30  +     +     +     +     ***  TEST #6   + STA. 31+00+ RECLAMITE + 1.6% +        +          +        +
   5-A  +   40   +  0,8  + 22  ***  22  +     +     +     +     ***  TEST #7   + STA. 42+00+ FLUX 1.6% + AC-10 + OVERLAY +         +        +
   6-A  +   39   +  1,0  + 24  ***  24  +     +     +     +     ***  TEST. #8  + STA. 53+00+ FLUX 2% +        +        +          +        +
--------+--------+-------+-----***------+-----+-----+-----+-----***-----------+-----------+--------+--------+--------+----------+--------+--------
     NUMBER OF TESTS,,,,+  6  ***   6  +     +     +     +     ***           +           +        +        +        +          +        +
     SKID NUMBER - LO,,,+ 21  ***  21  +     +     +     +     ***           +           +        +        +        +          +        +
     SKID NUMBER - AVG,,+ 25  ***  25  +     +     +     +     ***           +           +        +        +        +          +        +
     SKID NUMBER - HI,,,+ 30  ***  30  +     +     +     +     ***           +           +        +        +        +          +        +
--------+--------+-------+-----***------+-----+-----+-----+-----***-----------+-----------+--------+--------+--------+----------+--------+--------
```

Lp 374 test section E.B.L.

```
+---------------------------------------------------------------------------------------------------------------+

      ''STORAGE DESTRUCTION'' ERROR,

      CSN HEADER INFORMATION CANCELLED,

      REASON - CONSTRUCTION SECTION NUMBER ILLEGAL OR NOT ON FILE

-------------------------------------------------------------------------------------------+
CONSTANTS THIS TEST -  (1) TESTED ON  1/11/77     (3) AIR TEMPERATURE AT TEST WAS  45 DEGREES F.       +
                       (2) USING TRUCK NO. 43     (4) TRAVELING ***WITH*** THE FROM/TO DESCRIPTION     +
                                                                                                       +
WARNING - THIS TEST ALONE IS INSUFFICIENT TO ESTABLISH THE SAFE FRICTION VALUE FOR A HIGHWAY           +
-------------------------------------------------------------------------------------------------------------------

-- GENERAL SKID TEST DATA -------- SN BREAKDOWN BY LANE ---------------------------- SN BREAKDOWN BY COMMENT -----------------------
 TEST & +       + CUMM. +    ***     +     +     +     + E &  ***           +           + INTER- + STRUC- +  R.R.   +          +  CITY  + DIST.
 LANE  + SPEED + MILES + SN ***   A +  B  +  C  +  D  + OVER *** FLUSH    + PATCH     + SECT.  +  TURE  +  XING   + CURVE    +  LIMIT + SELECT
-------+-------+-------+---***-----+-----+-----+-----+-----***----------+-----------+--------+--------+---------+----------+--------+--------
   1-A  +   40  +  0.4  + 24 *** 24 +     +     +     +     ***   24     + TEST #9   + STA.-47+00+ FLUX 2% + AC-10 + OVERLAY +        +

***** PROCEDURE NOTATION - SKID TEST   2 DELETED ON RECEIPT OF OBSERVER INITIATED 'COMMENT 9' COMMAND.

   3-A  +   40  +  1.0  + 23 *** 23 +     +     +     +     ***          + TEST #4   + STA.-17+00+ AC-3   + 3%      +          +        +
   4-A  +   40  +  1.1  + 20 *** 20 +     +     +     +     ***          + TEST #3   + STA.-11+00+ AC-3   + 3%      +          +        +
-------+-------+-------+---***-----+-----+-----+-----+-----***----------+-----------+--------+--------+---------+----------+--------+--------
      NUMBER OF TESTS....+  3 ***  3 +     +     +     +     ***    1     +           +        +        +         +          +        +
      SKID NUMBER - LO...+ 20 *** 20 +     +     +     +     ***   24     +           +        +        +         +          +        +
      SKID NUMBER - AVG..+ 22 *** 22 +     +     +     +     ***   24     +           +        +        +         +          +        +
      SKID NUMBER - HI...+ 24 *** 24 +     +     +     +     ***   24     +           +        +        +         +          +        +
-------+-------+-------+---***-----+-----+-----+-----+-----***----------+-----------+--------+--------+---------+----------+--------+--------
```

```
TRIM---I                 STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION      JOB  5  I---TRIM

                     SERVICEABILITY INDEX (SI) COMPUTED FROM THE MAYS RIDE METER

                                   THIS PROGRAM WAS RUN - 01-17-78
          ******************************************************************************

                                      PROJECT IDENTIFICATION

            DIST    COUNTY       HIGHWAY   CONT-SEC     BMP      EMP      PPSN   LANE      DATE
             21   HIDALGO        LP-374      39-02       .        .               R      12-07-77

            CALIBRATION CONSTANTS     TOTAL LENGTH     TOTAL COUNTER       ADT          MRM
              ALPHA        BETA        FOR SECTION      FOR SECTION      FOR PPSN      NUMBER
             9.89333     8.95751          1.389            757.                       21- 142-F
          ******************************************************************************

                                       LOCATION INFORMATION

                                FROM - FM 2062 (RECYCLED PROJ.)
                                TO - US 83 EXPWY (EBL)
          ******************************************************************************
                                       MAYS RIDE METER DATA
                             MAYS METER
                LOCATION   (READING/0.2 MI)     SI    SPEED                REMARKS
             BEG. TO 0.2        106.0           3.4     50
                     0.4        110.0           3.3     50
                     0.6         80.0           3.8     50
                     0.8        108.0           3.4     50
                     1.0        111.0           3.3     50
                     1.2        122.0           3.2     50
                     1.389      117.0           3.2     50

          ***LOW SI = 3.2                    AVERAGE SI = 3.4                    HIGH SI = 3.8***
          *THE LOW,AVERAGE AND HIGH SI VALUES DO NOT INCLUDE THE SI AT THE END OF THE SECTION.*
```

Dist. 21 (Hidalgo Co.) Loop - 374 East Bound Lane

Recycle Proj.

```
+------------------------------------------+-------------------------------------+-----------------------------+-------------------------------+

        ''STORAGE DESTRUCTION'' ERROR.

        CSN HEADER INFORMATION CANCELLED.

        REASON - CONSTRUCTION SECTION NUMBER ILLEGAL OR NOT ON FILE

-------------------------------------------+-------------------------------------+-----------------------------+
CONSTANTS THIS TEST -  (1) TESTED ON  2/28/78      (3) AIR TEMPERATURE AT TEST WAS  79 DEGREES F.             +
                       (2) USING TRUCK NO. 40      (4) TRAVELING ***WITH*** THE FROM/TO DESCRIPTION           +
                                                                                                              +
WARNING - THIS TEST ALONE IS INSUFFICIENT TO ESTABLISH THE SAFE FRICTION VALUE FOR A HIGHWAY                  +
--------------------------------------------------------------------------------------------------------------+-------------------------------

-- GENERAL SKID TEST DATA ---***-- SN BREAKDOWN BY LANE --***---------------------- SN BREAKDOWN BY COMMENT ------------------------
 TEST & +       + CUMM. +     ***    +    +    +    + E &  ***         +         + INTER- + STRUC- + R.R.   +         +  CITY  + DIST.
  LANE  + SPEED + MILES + SN  ***  A +  B +  C +  D + OVER *** FLUSH   + PATCH   + SECT.  +  TURE  + XING   + CURVE   + LIMIT  + SELECT
--------+-------+-------+-----***----+----+----+----+------***---------+---------+--------+--------+--------+---------+--------+--------
   1-A  +   40  +  0.2  + 26  *** 26 +    +    +    +      ***         +         +        +        +        +         +        +
   2-A  +   40  +  0.8  + 23  *** 23 +    +    +    +      ***         +         +        +        +        +         +        +
   3-A  +   40  +  0.9  + 22  *** 22 +    +    +    +      ***         +         +        +        +        +         +        +
--------+-------+-------+-----***----+----+----+----+------***---------+---------+--------+--------+--------+---------+--------+--------
      NUMBER OF TESTS....+  3 ***  3 +    +    +    +      ***         +         +        +        +        +         +        +
      SKID NUMBER - LO...+ 22 *** 22 +    +    +    +      ***         +         +        +        +        +         +        +
      SKID NUMBER - AVG..+ 24 *** 24 +    +    +    +      ***         +         +        +        +        +         +        +
      SKID NUMBER - HI...+ 26 *** 26 +    +    +    +      ***         +         +        +        +        +         +        +
--------+-------+-------+-----***----+----+----+----+------***---------+---------+--------+--------+--------+---------+--------+--------
```

Dist. 21 (Hidalgo Co) Loop 374 West Bound Lane

Recycle Proj.

```
+--------------------------------------------+-----------------------------------+---------------------------+---------------------------+

       ''STORAGE DESTRUCTION'' ERROR.

       CSN HEADER INFCRMATION CANCELLED.

       REASON - CONSTRUCTION SECTION NUMBER ILLEGAL OR NOT ON FILE

--------------------------------------------+-----------------------------------+---------------------------+
CONSTANTS THIS TEST -  (1) TESTED ON  2/28/78      (3) AIR TEMPERATURE AT TEST WAS  79 DEGREES F.        +
                       (2) USING TRUCK NO. 40      (4) TRAVELING *OPPOSITE* THE FROM/TO DESCRIPTION      +
                                                                                                         +
WARNING - THIS TEST ALONE IS INSUFFICIENT TO ESTABLISH THE SAFE FRICTION VALUE FOR A HIGHWAY              +
---------------------------------------------------------------------------------------------------------+-----------------------------

-- GENERAL SKID TEST DATA ---***-- SN BREAKDOWN BY LANE --***----------------------- SN BREAKDOWN BY COMMENT ----------------------
 TEST & +       + CUMM. +     ***     +    +    +    + E &  ***         +        + INTER- + STRUC- +  R.R.  +        + CITY   + DIST.
  LANE  + SPEED + MILES + SN  ***   A +  B +  C +  D + OVER *** FLUSH   + PATCH  + SECT.  +  TURE  +  XING  + CURVE  + LIMIT  + SELECT
--------+-------+-------+-----***-----+----+----+----+------***---------+--------+--------+--------+--------+--------+--------+-------
   1-A  +   40  +  0.0  + 22 *** 22 +    +    +    +      ***         +        +        +        +        +        +        +
   2-A  +   41  +  0.2  + 24 *** 24 +    +    +    +      ***         +        +        +        +        +        +        +
   3-A  +   41  +  0.5  + 26 *** 26 +    +    +    +      ***         +        +        +        +        +        +        +
   4-A  +   40  +  0.6  + 23 *** 23 +    +    +    +      ***         +        +        +        +        +        +        +
   5-A  +   40  +  0.8  + 25 *** 25 +    +    +    +      ***         +        +        +        +        +        +        +
   6-A  +   41  +  1.0  + 26 *** 26 +    +    +    +      ***         +        +        +        +        +        +        +
--------+-------+-------+-----***-----+----+----+----+------***---------+--------+--------+--------+--------+--------+--------+-------
     NUMBER CF TESTS....+  6 ***  6 +    +    +    +      ***         +        +        +        +        +        +        +
     SKID NUMBER - LO...+ 22 *** 22 +    +    +    +      ***         +        +        +        +        +        +        +
     SKID NUMBER - AVG..+ 24 *** 24 +    +    +    +      ***         +        +        +        +        +        +        +
     SKID NUMBER - HI...+ 26 *** 26 +    +    +    +      ***         +        +        +        +        +        +        +
--------+-------+-------+-----***-----+----+----+----+------***---------+--------+--------+--------+--------+--------+--------+-------
```

```
                                TEXAS HIGHWAY DEPARTMENT

                              DISTRICT 21 -DESIGN SECTION

                  DYNAFLECT DEFLECTIONS AND CALCULATED  STIFFNESS COEFFICIENTS

                             THIS PROGRAM WAS RUN - 02-25-80

   ************************************************************************************

                           PRCJECT IDENTIFICATION

   DIST.      COUNTY      CONT.  SECT.   PPSN    HIGHWAY     DATE     DYNAFLECT
    21     HIDALGO          39    02             LP-374    02-05-80      29

           REASONS FOR MEASUREMENTS AND COMMENTS      TOTAL PAV DEPTH
                     - RECYCLED PROJECT                   15.50 INCHES

   ************************************************************************************

                              EXISTING PAVEMENT

                     MATERIAL TYPE        LAYER THICK.(IN)

                  HOT MIX                     7.50
                  BASE                        8.00

   ************************************************************************************

                        GENERAL LOCATION INFORMATION

              DIRECTION OF TRAVEL IS         OPPOSITE MILEPOINTS
              MEASUREMENTS ARE    FEET FROM THE RIGHT SIDE OF LANE

              DESCRIPTION OF LOCATION          ODOMETER READING  MILEPOINT
         FROM-1.7 MI E OF 1427 EAST
         TO-US 83 (WBL)

   ************************************************************************************
```

Dist. 21
T 2
D 9
D 10

#2 copy

```
DIST.      COUNTY       CONT.  SECT.   PPSN    HIGHWAY     DATE     DYNAFLECT
 21    HIDALGO           39     02             LP-374    02-05-80      29

                                 DYNAFLECT DATA

ODOMETER    W1      W2      W3      W4      W5     SCI    AS2    AP2        REMARKS

  3+00     1.170   1.020   0.780   0.690   0.430   0.150  0.20   0.77   WBL AC3 2.5%
 11+00     1.740   1.320   0.780   0.630   0.390   0.420  0.22   0.53   WBL AC3 2.5%
 28+00     1.620   1.350   0.990   0.840   0.630   0.270  0.20   0.66   WBL RECLAMITE 1.6%
 31+00     1.620   1.260   0.810   0.690   0.430   0.360  0.22   0.56   WBL RECLAMITE 1.6%
 42+00     1.500   1.170   0.780   0.600   0.400   0.330  0.22   0.57   WBL FLUX OIL 2%
 53+00     1.260   0.990   0.660   0.470   0.350   0.270  0.23   0.58   WBL FLUX OIL 2%

AVERAGES   1.485   1.185   0.800   0.653   0.438   0.300  0.21   0.61
STANDARD DEVIATION                                 0.093  0.01   0.09
NUMBER OF POINTS IN AVERAGE =    6

     W1-5   DEFLECTIONS AT GEOPHONES 1,2,3,4,&5
     SCI    SURFACE CURVATURE INDEX ( W1 MINUS W2)
     AS2    STIFFNESS COEFFICIENT OF THE SUBGRADE
     AP2    STIFFNESS COEFFICIENT OF THE PAVEMENT
```

```
                                 TEXAS HIGHWAY DEPARTMENT

                              DISTRICT 21 -DESIGN SECTION

               DYNAFLECT DEFLECTIONS AND CALCULATED  STIFFNESS COEFFICIENTS

                              THIS PROGRAM WAS RUN - 02-25-80

*************************************************************************************

                           PRCJECT IDENTIFICATION

DIST.      COUNTY      CONT.  SECT.   PPSN    HIGHWAY     DATE     DYNAFLECT
 21    HICALGO           39    02             LO 374    02-05-80      29

        REASONS FOR MEASUREMENTS AND COMMENTS      TOTAL PAV DEPTH
                  - RECYCLED PROJECT                   15.50 INCHES

*************************************************************************************

                              EXISTING PAVEMENT

                   MATERIAL TYPE        LAYER THICK.(IN)

                HOT MIX                      7.50
                BASE                         8.00

*************************************************************************************

                       GENERAL LOCATION INFORMATION

           DIRECTION OF TRAVEL IS            WITH   MILEPOINTS
           MEASUREMENTS ARE    FEET FROM THE RIGHT SIDE OF LANE

           DESCRIPTION OF LOCATION           ODOMETER READING  MILEPOINT
    FROM-1.7 MI E. OF 1427 EAST
    TO-US 83 (EBL)

*************************************************************************************
```

```
DIST.      COUNTY        CONT.  SECT.   PPSN    HIGHWAY     DATE     DYNAFLECT
 21     HIDALGO           39     02             LO 374    02-05-80      29

                             DYNAFLECT DATA

ODOMETER   W1      W2      W3      W4      W5      SCI     AS2    AP2       REMARKS

47+00     1.620   1.200   0.810   0.600   0.430   0.420   0.23   0.51   EBL FLUX OIL OVERLAY
17+00     1.380   1.170   0.810   0.690   0.460   0.210   0.20   0.70   EBL AC3 3%
11+00     1.650   1.320   0.870   0.720   0.480   0.330   0.21   0.59   EBL AC3 3%

AVERAGES  1.550   1.230   0.830   0.670   0.457   0.320   0.21   0.60
STANDARD DEVIATION                                0.105   0.01   0.09
NUMBER OF POINTS IN AVERAGE =   3

     W1-5   DEFLECTIONS AT GEOPHONES 1,2,3,4,&5
     SCI    SURFACE CURVATURE INDEX ( W1 MINUS W2)
     AS2    STIFFNESS COEFFICIENT OF THE SUBGRADE
     AP2    STIFFNESS COEFFICIENT OF THE PAVEMENT
```

```
                                 TEXAS HIGHWAY DEPARTMENT

                               DISTRICT 21 -DESIGN SECTION

               DYNAFLECT DEFLECTIONS AND CALCULATED  STIFFNESS COEFFICIENTS

                              THIS PROGRAM WAS RUN - 02-25-80

**************************************************************************************

                           PROJECT IDENTIFICATION

DIST.      COUNTY      CONT.  SECT.   PPSN    HIGHWAY     DATE    DYNAFLECT
 21    HIDALGO                                            - -        29

        REASONS FOR MEASUREMENTS AND COMMENTS       TOTAL PAV DEPTH
                  - US-281 ROADSIDE PARK                 9.00 INCHES

**************************************************************************************

                              EXISTING PAVEMENT

                   MATERIAL TYPE        LAYER THICK.(IN)

                HOT MIX                       1.00
                BASE                          8.00

**************************************************************************************

                        GENERAL LOCATION INFORMATION

           DIRECTION OF TRAVEL IS             WITH   MILEPOINTS
           MEASUREMENTS ARE     FEET FROM THE RIGHT SIDE OF LANE

           DESCRIPTION OF LOCATION            ODOMETER READING  MILEPOINT
    FROM-US 281
    TO-END OF RECYCLED MAT'L.

**************************************************************************************
```

```
  DIST.       COUNTY       CONT.  SECT.    PPSN    HIGHWAY      DATE     DYNAFLECT
   21    HIDALGO                                                - -          29

                                   DYNAFLECT DATA

  ODOMETER   W1      W2      W3      W4      W5      SCI     AS2    AP2       REMARKS

           1.410   0.900   0.470   0.380   0.290   0.510   0.26   0.57   50' FR US 281 HIWAY
           1.380   0.900   0.600   0.350   0.320   0.480   0.26   0.60   100' FR  HIGHWY
           0.550   0.500   0.430   0.360   0.310   0.050   0.23   1.55   150' FR  HIGHWY

  AVERAGES 1.113   0.767   0.500   0.363   0.307   0.347   0.25   0.91
  STANDARD DEVIATION                               0.257   0.02   0.55
  NUMBER OF POINTS IN AVERAGE =   3


      W1-5   DEFLECTIONS AT GEOPHONES 1,2,3,4,&5
      SCI    SURFACE CURVATURE INDEX ( W1 MINUS W2)
      AS2    STIFFNESS COEFFICIENT OF THE SUBGRADE
      AP2    STIFFNESS COEFFICIENT OF THE PAVEMENT
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