SURFACE RECYCLING ROUTE US 71

CONSTRUCTION AND INITIAL EVALUATION

By

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Conducted By
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METRIC CONVERSION FACTORS*

To Convert from	To	Multiply by
	Length	
foot	meter (m)	0.3048
inch	millimeter (mm)	25.4
yard	meter (m)	0.9144
mile (statute)	kilometer (km)	1.609
	Area	
square foot	square meter (m^2)	0.0929
square inch	square centimeter (cm^2)	6.451
square yard	square meter (m^2)	0.8361
	Volume (Capacity)	
cubic foot	cubic meter (m^3)	0.02832
gallon (U.S. liquid)**	cubic meter (m^3)	0.003785
gallon (Can. liquid)**	cubic meter (m^3)	0.004546
ounce (U.S. liquid)	cubic centimeter (cm^3)	29.57
	Mass	
ounce-mass (avdp)	gram (g)	28.35
pound-mass (avdp)	kilogram (kg)	0.4536
ton (metric)	kilogram (kg)	1000
ton (short, 2000 lbs)	kilogram (kg)	907.2
	Mass per Volume	
pound-mass/cubic foot	kilogram/cubic meter (kg/m^3)	16.02
pound-mass/cubic yard	kilogram/cubic meter (kg/m^3)	0.5933
pound-mass/gallon (U.S.)**	kilogram/cubic meter (kg/m^3)	119.8
pound-mass/gallon (Can.)**	kilogram/cubic meter (kg/m^3)	99.78
	Temperature	
deg Celsius (C)	kelvin (K)	$t_K=(t_C+273.15)$
deg Fahrenheit (F)	kelvin (K)	$t_K=(t_F+459.67)/1.8$
deg Fahrenheit (F)	deg Celsius (C)	$t_C=(t_F-32)/1.8$

*The reference source for information on SI units and more exact conversion factors is "Metric Practice Guide" ASTM E 380.

**One U.S. gallon equals 0.8327 Canadian gallon.

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INTRODUCTION

Background

Surface recycling for the purposes of this report was defined as the in-place recycling of an existing asphaltic concrete wearing surface by heating, scarifying or milling, applying a rejuvenating agent, thoroughly mixing and levelling the rejuvenated material and concurrently placing and compacting new asphaltic concrete in a single pass of the specialized recycling equipment. The process differs from other surface recycling which is limited to heating, scarifying, rejuvenating existing materials without the addition of new mix and a possible subsequent overlay. The surface recycling process examined herein was proposed by Cutler Repaving, Inc. as an alternate section design to cold milling followed by a thin overlay with which an economic savings could be realized. Surface recycling has been recommended as an alternate whenever rutting and/or surface deterioration is less than one inch in depth and there are no structural deficiencies.

Prior Louisiana Experience

Louisiana first examined surfaced recycling in 1966 on a 5.5 mile test section on US 61 bypass in Baton Rouge. The Cutler R-1000 Single Pass Repaver was used. This machine was a first generation recycler which had the capability of adding a minimum quantity of new mix to the in-place recycled materials so that deficiencies in existing materials could be corrected. For this project five different types of new mix were blended with the recycled asphaltic concrete to establish different test sections. The conclusions of that study indicated that: refinements were needed in the repaving equipment; additional scarification beyond the 3/4-inch specified was needed; some initial ravelling and rutting was observed; and, the heaters were found to oxidize the existing asphalt cement.

In 1980, Cutler Repaving was awarded a contract for another experimental project based on major equipment and processing changes. The new equipment was essentially the same as that utilized on the current test section in that it had the ability to heat and scarify to a depth of one inch, add and mix a rejuvenating agent, level and screed the recycled mix and add new hot-mix. The field trial was placed on a 3.6 mile curb and gutter section of Metairie Road in New Orleans in March and April 1980. The existing asphaltic concrete was scarified to a depth of one inch, emulsified asphalt (CSS-1) was added at the rate of 0.1 gallons per square yard and 90 pounds per square yard of new Type 3 wearing course mix was placed. Generally the construction proceeded smoothly and it was agreed that the recycling improved the surface condition of Metairie Road. However, tests on the existing asphaltic concrete, and on the recycled mix both after heating and after the addition of the emulsion indicated that the heaters oxidized the existing asphalt cement. Further, while the CSS-1 emulsion rejuvenated this oxidized asphalt, the rejuvenation was non-uniform. Within six months of construction several localized areas had ravelled between the outside wheelpath and the curb. As the typical section had a severe parabolic crown, this ravelling could be attributed to the feathering of mix in this area. To date the ravelling has extended longitudinally, down the roadway still being confined between the wheelpath and curb. The remainder of the roadway appears to be performing in a satisfactory manner.

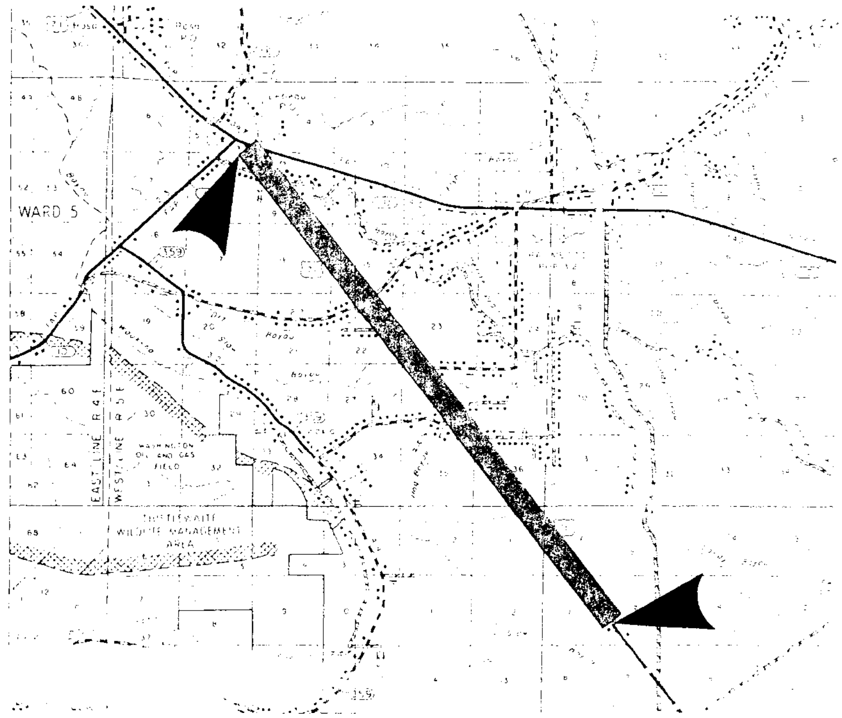
Recently in Louisiana due to monetary constraints, typical overlay section design has been modified from a levelling and wearing course (3.5 inches) to cold milling (average 2 inch depth) and 1.5-2.0 inches of wearing course. Due to the five years of satisfactory performance on Metairie Road, it was decided to once again examine surface recycling as an economic alternative. The U.S. 71 project was selected as a typical overlay project which could provide representative results. This report details the construction phase and initial evaluation of this surface recycling project.

FIELD EXPERIMENTAL PROJECT

Location and Section Design

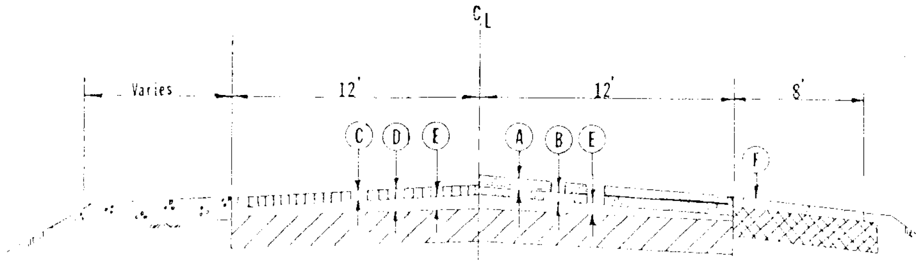
The surface recycling experimental section encompassed 7.1 miles of an 8.485 mile construction project no. 8-05-27 located on U.S. 71 from the junction of U.S. 190 to LeBeau (north section) in St. Landry Parish. Prairie Construction Company Inc, Mr. L. L. James, Present was the successful bidder for this contract. Cutler Repacing, Inc., Lawrence, Kansas was the sub-contractor for surface recycling portion. The Special Provisions governing the surface recycling work can be found in Appendix A. The general location for this project is provided in Figure 1.

The roadway was scheduled for cold planing (2 inch average, developing 0.025 ft/ft cross slope), followed by a 2-inch Type 3 binder course and a 1.5-inch Type 3 (high stability) wearing course. This typical section was constructed as a control section for one mile at the southern end of the project. Approximately 7.1 miles were surface recycled. A typical design section shown in Figure 2 for the experimental section included heating and scarifying to a one inch depth, addition of rejuvenator and concurrent placement of a 1.5 inch Type 3 wearing course. The existing section was composed of portland cement concrete which had been overlaid twice with asphaltic concrete, adding approximately 5.5 to 6 inches to the cross section. The ride of this existing composite pavement was poor due to wide spalling of the asphaltic concrete at the transverse joint locations.



Project Location

FIGURE 1



Typical Half Section for Surface Recycling

Typical Half Section for Proposed Roadway

(A) 1 1/2" Asphaltic Concrete (Wearing Course)

(B) 1" Surface Recycled Asphaltic Concrete

(C) Surface Recycling (Existing Asphaltic Concrete Overlay to be Heated, Scarified & Relaid)

(D) Existing Asphaltic Concrete Overlay

(E) Existing Asphaltic Concrete Overlay to remain

(F) 1 1/2" Asphaltic Concrete (Shoulder Mix)

Experimental Design Section

FIGURE 2

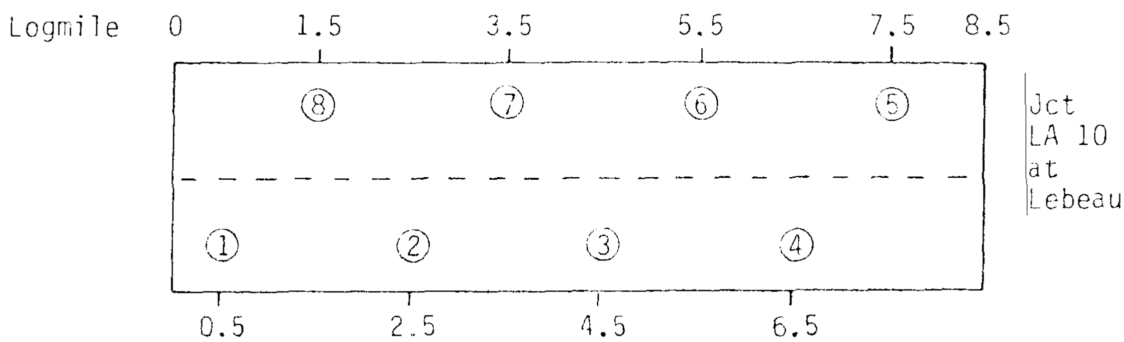
Recycle Mix Design

Prior to letting the contract, the department's research section sampled the existing roadway to determine the quantity and quality of the asphalt cement. Six inch cores were taken at eight locations on the project as indicated in Figure 3. The top one inch of each core was saw cut to provide material for extraction and recovery of the asphalt cement so that it would be representative of the material to be actually recycled. The asphalt cement was extracted and recovered by the Abson process. Binder content was calculated and absolute viscosity (140°F) was tested. Table 1 presents the results. Generally the asphalt cement was found to have viscosities greater than 200,000 poises. The mean asphalt content was 5.56 percent.

TABLE 1

RECLAIMED MATERIAL ASPHALT CONTENT AND VISCOSITY

Sample ID	Asphalt Content (%)	Viscosity (Poise)
1	6.0	65,816
2	5.4	200,000+
3	5.7	200,000+
4	5.4	200,000+
5	5.3	200,000+
6	5.8	200,000
7	5.5	185,484
8	5.4	200,000+



Sample Site Locations

FIGURE 3

A records search indicated that the original job mix for this hot mix called for a binder content range of 4.8-5.6 percent. As the existing binder content was found to be on the high side it was decided that a very low viscosity rejuvenator would be needed in order to soften the oxidized asphalt cement without adding too much binder to the mix. From past experience with recycled mixes (<u>Effects of Asphalt Cement Rejuvenating Agents</u>, Carey, D.E. and Paul, H.R., Louisiana Department etc., Research Report No. 146, 1980), the viscosity of a blend of an aged asphalt with a rejuvenator can be theoretically established by the relationship:

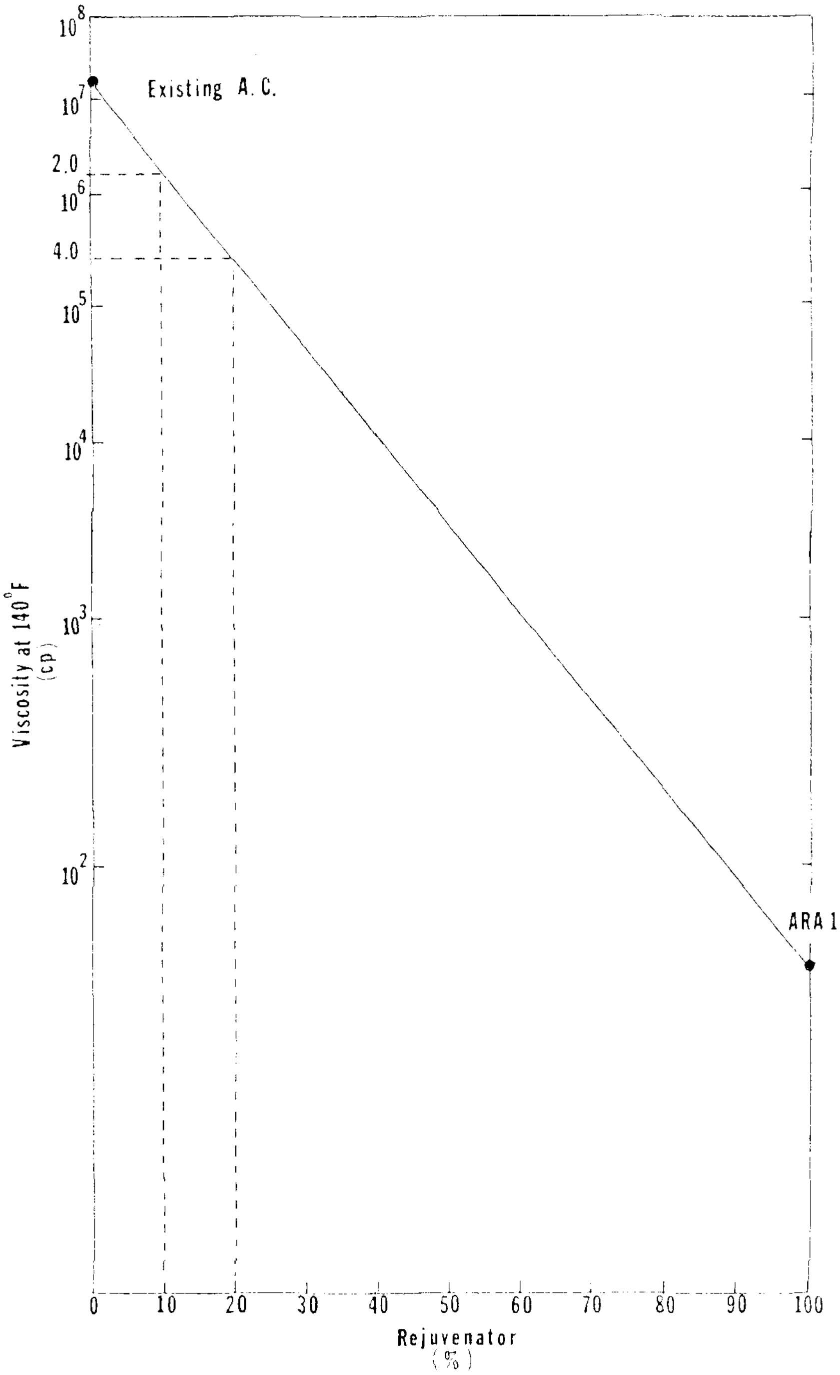
$$\text{Log Log } V = a + bp$$

Where : V = viscosity of the blend (centipoises at 140°F)

p = percent of rejuvenator (by volume)

a,b = constants (determined for each asphalt/rejuvenator blend)

This relationship is presented graphically in Figure 4. The existing asphalt cement (20,000,000 cp) and the rejuvenator (70 cp) are plotted as end points with the straight line relationship as indicated. Thus, a 10 percent rejuvenator proportion should provide a blended viscosity of 20,000 poises and a 20 percent proportion should result in a blended viscosity of 4,000 poises. Therefore an approximate blend of 15 percent rejuvenator should return the oxidized asphalt to 8,000 poises, a viscosity similar to new hot mix. However, because of the rather high existing binder content, consideration had to be given to the quantity of binder material added. Using the mean binder content found in the cores (5.56 percent), a 10 percent residual rejuvenator addition would provide an overall binder content of 6.17 percent. While this binder content was higher than that desired, it was decided that a compromise between the final blended binder viscosity and binder content had to be made. Thus, a 10 percent residual rejuvenator rate was set as a target value.



Theoretical Blended Viscosities

FIGURE 4

Plant Production

Prairie Construction Company utilized its dryer drum plant in Opelousas, Louisiana for mix production on this job. The plant was located approximately 22 miles from the construction site. There were no modifications to normal plant operations for the production of the Type 3 wearing course placed on the recycled mix.

Job mix formula (JMF) 60 was used for the binder or levelling course on the control section while JMF 61 defined the wearing course for both the control and recycled sections. Table 2 provides the pertinent mix design data. The source of coarse aggregate was a river gravel from Red Stick No. 1 (Bayville) while the source for the coarse and fine sands were Trinity (Longville) and Mamou Pit, respectively. Texaco supplied the AC-30 grade asphalt cement and Bitucote Products Company provided the ARA-1 rejuvenating agent.

In accordance with the Special Provisions the contractor produced a small amount of wearing course mix on December 6, 1986 so that the surface recycling subcontractor could demonstrate his equipment operation and establish forward speed for the required depth of cut. A one inch depth of scarification was determined as per the specifications during this trial. Several other equipment problems forced the subcontractor to shut down the recycling operation until after the Christmas holidays. In the meantime 1440 tons of Type 3 binder course were placed on the control section.

Recycling operations were restarted on January 21, 1986 and continued until February 6, 1986 with a total of 8365 tons of Type 3 wearing course placed through the repaver. The control section used 1253 tons of mix which was placed April 3, 1986 as lot no. 80. Daytime temperatures ranged from 60-70°F under

TABLE 2

PROJECT JOB MIX FORMULAS

Sequence No.	60	61
Mix Use	Binder	Wearin[illegible]
Recommended Formula (% Passing)		
U.S. Sieve Size		
1"	100	100
3/4"	99	99
1/2"	88	86
No. 4	57	56
No. 10	42	39
No. 40	25	24
No. 80	14	15
No. 200	7	6
% A.C.	5.1	5.0
% Crushed	80	90
Mix Temp.	300	300
Marshall Properties		
Specific Gravity	2.32	2.35
Theoretical Gravity	2.44	2.45
% Theoretical	95.5	95.9
% Air Voids	4.5	4.1
% V.F.A.	71.8	74.0
Marshall Stability	1610	1892
Flow	9	11

TABLE 3

PLANT PRODUCTION

Lot No.	Date	Mix Type	Tonnage	Temperature
71	12/6/85 - 1/22/86	Wearing	1440	294
72	12/9-10/85	Binder	1510	297
73	1/22-24/86	Wearing	1504	301
74	1/24-29/86	Wearing	1509	305
75	1/29-31/86	Wearing	1502	304
76	1/31-2/3/86	Wearing	1506	303
77	2/3-6/86	Wearing	904	301
80	4/3/86	Wearing	1253	-

clear to partly cloudy skies. For this project a lot size of 1500 tons was established. Because of reduced roadway production, most lots were placed over several days.

Construction

The heart of the surface recycling operation is the specialized recycling equipment, in this case, the Cutler Repaver III. This third generation repaver is depicted in Figure 5. As annotated in the Figure, a hopper is located on the front end

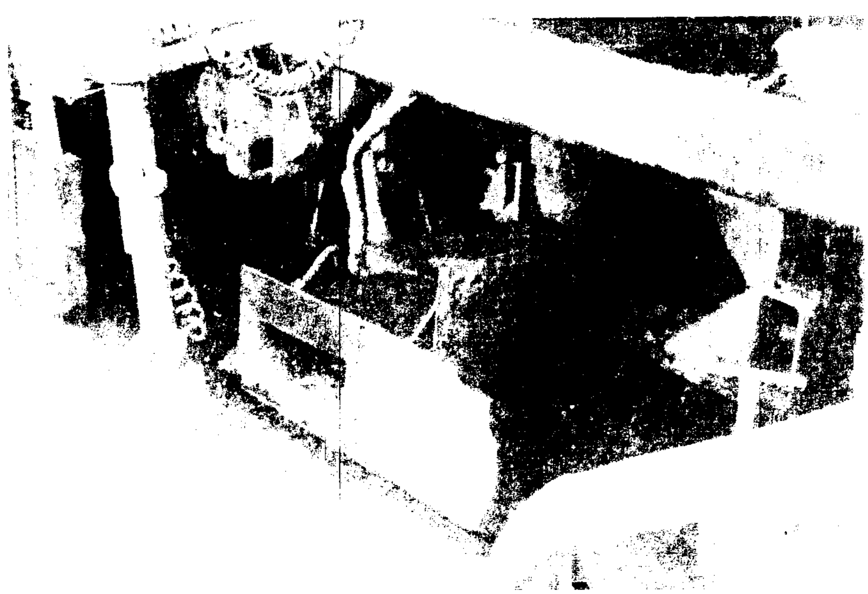
Cutler Repaver III

FIGURE 5

of the machine to accept the new hot-mix to be laid concurrent with the recycling operation. This new mix was lifted and carried the length of the machine above the recycling process on a dual, chain driven conveyor system from which it was deposited in front of a levelling auger and the final screed. Following the hopper were four banks of radiant heaters which softened the pavement for the several sets of air controlled carbide scarifiers (Figure 6). The rejuvenating agent was applied and then an auger redistributed and transversely levelled the scarified material prior to screeding (Figure 7). Finally, the new asphaltic concrete was dropped in front of a levelling auger and screeded.

Radiant Heaters and Scarifier Blades

FIGURE 6



Levelling and Screeding Recycled Material

FIGURE 7

Since this project was constructed over the winter months, the recycling contractor opted to use two additional heater-scarifiers which operated approximately 100-400 yards ahead of the main recycling machine. Each of these machines heated, scarified, added rejuvenator and screeded the material in order to retain as much heat as possible for the repaver. In such a manner the desired depth of scarification could be achieved.

In general, the recycling operation progressed according to the special provisions. There was only one major breakdown on the roadway when a leaking hydraulic line caught fire shutting down operations for about forty-five minutes. However, there were many minor breakdowns and stoppages. The daily roadway production ranged from 0.5 to 1.6 lane-miles. This limited production rate did cause some coordination problems with mix production at the plant.

The rejuvenating agent was applied to the roadway by both the preheater machines and the Repaver III. According to the pre-construction design a target rate of 0.14 gallons of rejuvenator emulsion per square yard was to be used in order to attain a residual rejuvenator content of 10 percent by volume. The actual measured rates are provided in Table 4. Overall the 13,056.9 gallons of ARA-1 rejuvenator utilized was very close to the design quantity of 13909.9 gallons (99,356.3 yd^2 x 0.14 gal/yd^2).

A possible problem with the recycling operation was noted with respect to mix temperature. Lower than normal mat temperatures were found behind the screed prior to breakdown rolling. The average temperatures at this location for the project was 215°F with a range of 150-265°F. Upon discovery of this problem temperatures were taken in the haul trucks, repaver hopper and just in front of the final screed. Truck temperatures averaged 275°F which was within JMF tolerance limits. On average, the

TABLE 4

REJUVENATOR ADDITION RATES
(Gallons/Square Yard)

Equipment	Preheater 1	Preheater 2	Repaver III	Total
Date				
1/21	.017	.069	.071	.165
1/22	.020	.081	.071	.172
1/23	.012	.057	.070	139
1/24	.010	.057	.067	.134
1/28	.013	.057	.073	.143
1/29	.010	.059	.056	.125
1/30	.010	.058	.055	.123
1/31	.013	.057	.053	.123
2/1	.010	.037	.063	.110
2/3	.011	.041	.065	.117
2/6	.016	.062	.069	.147

new mix was found to lose 20-40°F by the time it reached the final screed. The resultant rather low mat temperature for compaction may be related to the low densification found in the roadway core analysis.

One further issue, that of air polution, may be a problem with this process. The subcontractor was issued a notice of violation by the state's Office of Air Quality and Nuclear Energy. He was cited for non application of a certificate of approval (permit) for emissions prior to start-up. Since there were no actual tests taken to determine air quality, the question of air polution can not be addressed.

Quality Control

Marshall stability (75 blow design) was used for acceptance testing and other Marshall properties, while gradations and binder contents were used for mix control for the Type 3 binder and wearing courses. Table 5 presents all Marshall data for this project and Table 6 contains the gradations and asphalt cement content from extracted loose mix samples. The contractor received 100 percent payment for the Type 3 binder and wearing course mix.

Roadway density is used as an acceptance criteria in Louisiana with the contractor required to achieve 95 percent of the plant briquette density for 100 percent payment. Normally five roadway cores are randomly taken to represent each lot. For this project, because of the experimental nature, it was decided to cut three cores per station located transversely at the inside wheelpath, center of lane and outside wheelpath at each of the five sample sites.

Roadway compaction data from the first full day of production

TABLE 5

MARSHALL PROPERTIES

Lot No.	Stability (lbs)	Flow (0.01 in)	Specific Gravity	VFA (%)	Air Voids (%)
			Type 3 Binder Course		
72	1464	11	2.33	72	4.5
	1577	11	2.33	72	4.5
	1774	10	2.34	74	4.1
	1616	11	2.33	72	4.5
			Type 3 Wearing Course		
71	1439	9	2.33	70	4.9
	1872	10	2.35	74	4.1
	1911	10	2.34	72	4.5
	1794	12	2.34	72	4.5
73	1794	9	2.35	74	4.1
	1734	9	2.34	72	4.5
	1695	10	2.34	72	4.5
	1754	9	2.33	70	4.9
74	1655	12	2.33	70	4.9
	1760	11	2.34	72	4.5
	1703	12	2.34	72	4.5
	1852	10	2.34	72	4.5
75	1768	12	2.34	72	4.5
	1789	12	2.34	72	4.5
	1714	10	2.34	72	4.5
	1754	10	2.34	72	4.5
76	1809	10	2.34	72	4.5
	1754	11	2.34	72	4.5
	1810	11	2.34	72	4.5
	1774	12	2.34	72	4.5
77	1715	12	2.34	72	4.5
	1760	12	2.34	72	4.5
	1727	10	2.33	70	4.9
80	1695	-	2.33	70	4.9
	1774		2.34	72	4.5
	1728		2.34	72	4.5
	1703		2.34	72	4.5

TABLE 6

EXTRACTED GRADATION AND ASPHALT CEMENT CONTENT

Mix Type	B.C	W.C.						
Lot No.	72	71	73	74	75	76	77	80
Gradation (% Passing)								
1"	100	100	100	100	100	100	100	100
3/4"	100	99	100	100	98	100	98	99
1/2"	92	93	92	95	92	94	93	91
No. 4	60	58	54	55	54	52	52	57
No. 10	38	38	35	36	36	34	34	38
No. 40	22	21	21	22	21	20	21	20
No. 80	14	13	13	14	14	14	13	14
No. 200	7	7	7	7	7	8	8	9
% Asphalt	5.4	4.8	5.4	5.0	5.3	5.0	5.1	5.3

(Lot 71) is shown in Table 7. The contractor used a two roller operation with a vibratory roller for breakdown and a 3-wheel steel finish roller. A nuclear density gage was brought to the jobsite by department personnel on January 23 to assist the contractor in establishing an optimum roller pattern. While compactive effort increased as observed in lots 73 and 74 the desired density was still not attained. Upon request, the contractor added a pneumatic tire roller to the rolling train on January 31. The nuclear density gage was again used to establish an optimum rolling pattern. These actions resulted in the increased compactive effort observed in the Lot 76 core data. However, using the same rolling pattern, the last day's production once again fell below the 95 percent level.

Two possible explanations were proposed with respect to the reduced compaction. First, the daily coring operation posed a problem as most of the roadway cores broke within the recycled layer. In fact, only five of the eighty-six cores were removed intact, despite repeated drilling efforts. Figure 8 dipicts a typical extracted core, wherein, the compaction train could not densify the recycled materials into a cohesive, homogeneous layer. Another possible contribution to the low density achieved was the reduced mat temperature behind the screed caused by the 20-40°F temperature loss of the new hot-mix through the repaver machine. Certainly, breakdown rolling on a mat temperature of 190°F was not conducive to proper densification. It is noted that the contractor was able to achieve compaction of both the binder and wearing courses for the control section utilizing only two rollers so that the underlying PCC slab appeared to provide enough support.

Another concern about the surface recycling process which had been evident in all previous projects of this type was the additional oxidation of the existing asphalt cement followed by

TABLE 7

ROADWAY COMPACTION

Mix Type	B.C.	W.C.						
Lot No.	72	71	73	74	75	76	77	80
Specific Gravity	2.220	2.135	2.235	2.205	2.214	2.169	2.162	2.258
		2.161	2.230	2.186	2.189	2.229	2.225	
		2.196	2.225	2.212	2.191	2.187	2.186	
	2.209	2.175	2.203	2.183	2.192	2.258	-----	2.221
		2.149	2.234	2.223	2.111	2.227	2.176	
		2.124	2.250	2.218	2.215	2.247	2.142	
	2.220	2.233	2.173	2.231	2.257	2.293	2.217	2.230
		2.207	2.156	2.240	2.244	2.259	2.206	
		2.206	2.189	2.197	2.272	2.257	2.216	
	2.220	2.229	2.179	2.263	2.260	2.233	2.244	2.239
		2.189	2.150	2.231	2.217	2.235	2.262	
		2.186	2.174	2.255	2.250	2.184	2.256	
	2.239	2.256	2.236	2.205	2.209	2.216	2.173	2.209
		2.214	2.248	2.182	2.218	2.247	2.154	
		2.247	2.180	2.216	2.214	2.180		
Mean	2.222	2.194	2.204	2.216	2.217	2.228	2.202	2.231
% of Plant	95.3	93.8	94.2	94.7	94.7	95.2	94.1	95.3

Roadway Cores

FIGURE 8

rejuvenation in the recycling process. The 1980 Metairie Road project demonstrated that while the rejuvenating agent could return the asphalt cement to various viscosity levels, the radiant heaters did oxidize the asphalt cement. During the U.S 71 project, material was sampled at six of the eight locations for which preconstruction testing had been accomplished. At each location recycled mix was obtained at each of four places within the recycling operation: after heating and scarification by the second preheater; after rejuvenation by the second preheater; after heating and scarification by the repaver; and, after rejuvenation by the repaver. The results presented in Table 8 substantiates previous findings that the radiant heaters oxidize the existing asphalt; and, that oxidized material can be rejuvenated, but to a non uniform level.

TABLE 8

RECYCLED ASPHALT CEMENT PROPERTIES

Site	Preconstruction	Preheater 2 Before Rejuvenator	Preheater 2 After Rejuvenator	Repaver Before Rejuvenator	Repaver After Rejuvenator
Location					
2					
Viscosity (140°F)		Too Hard	49,970	3590	2681
Penetration (77°F)		12	26	68	96
Ductility (77°F)		-	-	-	150+
3					
Viscosity (140°F)	200,000+	85,003	12,766	200,000+	20,339
Penetration (77°F)		19	45	13	32
Ductility (77°F)		-	-	-	61
4					
Viscosity (140°F)	200,000+	170,269	10,250	31,764	36,735
Penetration (77°F)		16	45	30	27
Ductility (77°F)		-	-	-	36
5					
Viscosity (140°F)	200,000+	Too Hard	4196	200,000+	10,643
Penetration (77°F)		-	68	11	43
Ductility (77°F)		-	-	-	100
6					
Viscosity (140°F)	200,000+	200,000	200,000	Too Hard	56,697
Penetration (77°F)		10	10	-	24
Ductility (77°F)		-	-	-	31
8					
Viscosity (140°F)	200,000+	Too Hard	200,000+	41,894	3145
Penetration (77°F)		-	13	26	73
Ductility (77°F)		-	-	-	150+

INITIAL PERFORMANCE EVALUATION

The surface recycling and control asphaltic concrete sections were examined to evaluate structural performance characteristics and serviceability. Serviceability was monitored with a pavement condition rating (PCR) which incorporates Mays Ride Meter measurements for smoothness and different types of pavement distress such as bleeding, block cracking, transverse and longitudinal cracking, corrugations, patching, rutting and ravelling. Each distress type was evaluated and assigned weighted deduct points based on severity and intensity of the distress. The total of deduct points forms a pavement distress rating (PDR) by subtracting from 100 percent, weighting and then combining with a weighted Mays reading in PSI in the following manner to provide the pavement condition rating.

$$PCR = [(100 - \text{Deduct Total Points})/4] + (\text{Mays PSI}) \times 5$$

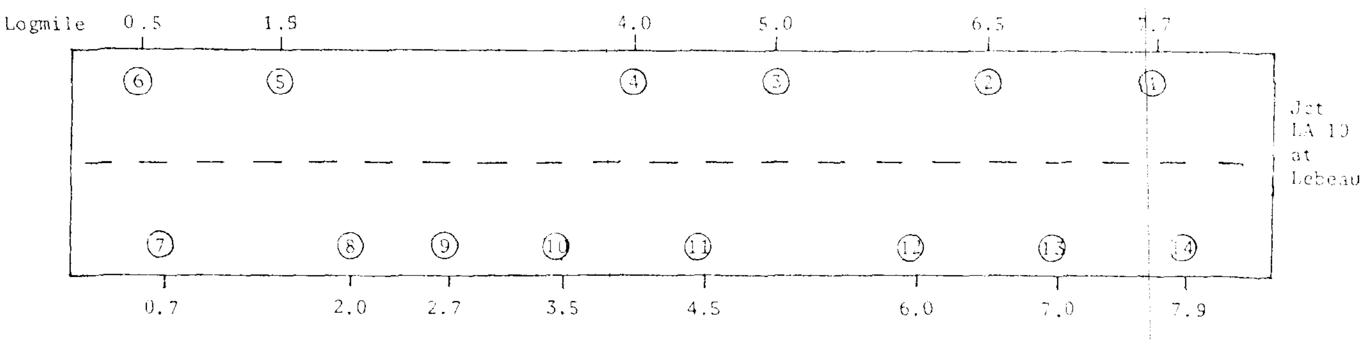
(A perfect pavement score would be 50)

The Dynamic Deflection Determination System (Dynaflect) was used to evaluate the relative strengths of both sections. Roadway cores were tested for further densification due to traffic.

The initial performance evaluation was conducted on April 24, 1986 approximately ten weeks after construction of the recycled section and three weeks after the control wearing course was placed. Figure 9 designates the site locations used in this evaluation. Additional evaluations will be conducted on a yearly basis.

Serviceability

The Pavement Condition Rating forms are provided in Appendix B and are summarized in Table 9. Mays Ride Meter and rutting measurements which are included in the PCR have also been



Performance Evaluation Sites

FIGURE 9

included for easy reference. Initially both sections appear to ride equally although it is noted that the recycled section has densified to a greater extent under traffic loading.

TABLE 9

PAVEMENT CONDITION RATING

Rating	Rutting (in)	Mays Ride Meter (SI)	PCR
Site ID			
1	0.16	3.7	42.75
3	0.15	3.5	41.75
5	0.14	3.6	42.25
6 *	0.07	3.7	42.75
7 *	0.09	3.6	42.25
8	0.18	3.3	40.75
11	0.17	3.7	42.75
13	0.19	3.8	43.25

* Control Sections

Roadway Cores

Roadway samples were cored such that each day's production would be represented by two cores. Of the fourteen cores eight were extracted intact. Similar to the experience during construction, six cores broke within the recycled layer. Each of the eight cores containing both the recycled mix and new mix were tested for density. The remaining cores were saw cut at the recycled/new mix interface. Specific gravities and percent of plant compaction are provided in Table 10. The new mix only has now reached a 95.1 percent mean compaction level while the mean for the recycled and new mix was 94.7. The control wearing course (6 and 7) averaged 94.8 percent compaction. This additional densification under traffic in the recycled section appears to be reflected in the rutting measured during the visual evaluation.

TABLE 10

ROADWAY CORE DENSIFICATION - INITIAL EVALUATION

Site	Specific Gravity	Percent Plant Compaction
	Recycled and New Hot Mix	
1	2.145	91.7
3	2.194	93.8
5	2.193	93.7
8	2.228	95.2
9	2.236	95.6
10	2.236	95.6
12	2.259	96.5
14	2.231	95.3
	New Mix Only	
4 *	2.208	94.3
6 *	2.204	94.2
7	2.237	95.6
11	2.236	95.6
13	2.230	95.3

*Control Sections

Structural Evaluation

The Dynamic Deflection Determination System (Dynaflect) was used to evaluate the relative strength of both sections. A temperature deflection adjustment procedure was applied to each set of data converting all deflections to their equivalent deflection at 60°F. Deflection data and corresponding structural number are included in Table 11. Generally, at this time both sections appear to be performing equally although there is a balancing effect due to the strength of the underlying PCC slab. Additional deflection analysis with time will be used as a performance indicator.

TABLE 11

STRUCTURAL ANALYSIS

Dynaflect Property	Corrected Max Deflection	Percent Spread	Surface Curvature Index	Subgrade Modulus Of Elast.	Structural Number
Section					
1	0.52	83	0.04	7,500	5.1
3	0.56	84	0.05	6,840	5.0
5	0.75	83	0.09	5,560	4.5
6	0.51	80	0.07	8,240	4.9
7	0.55	82	0.05	7,440	4.9
8	0.70	81	0.08	6,280	4.5
11	0.58	83	0.06	6,840	5.0
13	0.69	78	0.16	7,060	4.2

ECONOMIC ANALYSIS

The unit cost of the bid items for the recycled and control sections are reproduced as follows:

Item	Description	Unit	Cost
501(1)	Asphaltic Concrete	TON	28.50
736(01)	Cold Planing Asphaltic Pavement	SYD	0.70
S-001	Surface Recycling Asphaltic Pavement	SYD	1.50
S-002	Rejuvenating Agent	GAL	1.75

The cost of the surface recycled section would be $4.10 per square yard for the surface recycling, rejuvenating agent at 0.14 gallons/square yard and 1.5 inches of asphaltic concrete wearing course. The corresponding cost for the conventional section would be $6.19 per square yard based on cold planing (2 inch average cut), a 2 inch levelling and 1.5 inch wearing course, so that an approximate 33 percent savings was realized for this project assuming equivalent section performance.

According to the recycling contractor, his process would provide performance equivalent to 2.5-inches of new hot-mix. Assuming that 2.5-inches of new hot-mix would be sufficient for levelling, the cost would be $3.93 per square yard which is less than the $4.10 bid for the surface recycling on this project. It would seem though that these costs are close enough to provide competition for alternate designs subject to this recycling project demonstrating field performance.

CONCLUSIONS

1. An initial performance evaluation indicates that the surface recycled section is performing equivalent to the control section with respect to structural integrity and serviceability; the surface recycled section has, however, densified twice as much as the control in the wheelpaths.

2. The surface recycling heaters further oxidized the existing asphaltic concrete; the rejuvenating agent did not consistently soften the oxidized asphalt to a level commensurate with new hot mix.

3. Proper densification was not achieved on the recycled section.

4. There was a temperature loss of the new hot-mix of 20-40°F as it passed from the haul truck to the final screed which may have affected the compactive effort.

5. A savings due to the recycling operation was realized on this project.

APPENDIX A

ITEMS S- THRU S- , SURFACE RECYCLING OF EXISTING ASPHALTIC CONCRETE: These items consists of in-place recycling of existing asphaltic concrete surfacing by heating, scarifying or milling, applying a rejuvenating agent, mixing and levelling therejuvenated material, and concurrently placing and compacting new asphaltic concrete in a single pass of the equipment, all in accordance with plan details and the following requirements. Construction methods, equipment and required materials shall be approved by the Department prior to beginning work under this item.

(a) <u>Surfacing Preparation</u>: Any required patching, levelling or joint repair shall be completed prior to commencement of recycling operations. The pavement surface shall be cleaned of surface water, dirt and debris immediately prior to recycling operations.

(b) <u>Recycling Equipment:</u> This equipment shall consist of a self-contained, self-propelled, automated unit capable of heating scarifying or milling; applying a rejuvenating agent in a uniform manner and rate; mixing, redistributing and levelling the scarified and rejuvenated material; and placing new asphaltic concrete on the hot recycled mix in a continuous and synchronized operation. Additional heaters not an integral part of the recycling equipment, may be used, but shall be of sufficient number and type to heat the pavement whithout damage, burning, scrubbing, scouring or erosion, or failing to comply with air pollution laws. Heaters shall be capable of imparting sufficient temperature to the pavement to allow the recycled mix to be within 200 to 250°F at the time the new asphaltic concrete is placed. The heating mechanism shall be under an enclosed or shielded hood, providing uniform radiant heating such that at no time shall the pavement surfacing temperature exceed 425°F.

(c) <u>Materials</u>: The rejuvenating agent shall be ARA-1 as manufactured by Bituminous Materials Company, Inc. P. O. Box 1507, Terre Haute, IN 47808, (812) 232-0421, or approved equal, conforming to the following specifications.

Property	ASTM TEST METHOD	Requirements	
		Min.	Max.
Viscosity @ 25°C, SSF	D88	15	100
Miscibility	D244	No coagulation or separation	
Sieve test, %	D244	--	0.10
Residue*, %	D244	60	--
Particle charge	D244	Negative	
Tests on Residue from Evaporation			
Asphaltenes, %	D4124	--	1.0
Saturates, %	D4124	--	30
Flash point, COC, °F	D92	375	--
Thin-film oven test, weight change, %	D1754	--	4
Viscosity @ 60°C, cSt	D2170	75	250

*Determined by evaporation method in ASTM D244, except that sample shall be maintained at 300°F until foaming ceases, then cooled and weighed.

(d) Preconstruction Equipment Trial: Prior to commencing operations, the contractor, at his expense, shall verify his ability to heat and scarify the pavement to the depth shown on the plans in a trial section established by the engineer. The trial section shall be the width of 1 pass of the repaver, and not more than 500 feet long. No other operations shall be accomplished during the test.

The contractor shall operate the heaters and scarifiers at a speed and in a manner the same as his paving operations. Ambient weather conditions, spacing and speed of equipment, and operating conditions shall be documented.

Immediately after scarification, the engineer shall in 3 randomly selected locations determine, by means of a ring of known cross-sectional area, that the scarified material is at least 12 pounds per square foot of surface area. If after 2 successive tests the results are inconclusive or not in specifications, the contractor shall make necessary adjustments or modifications and notify the engineer, who shall conduct 1 additional test for conformance. If the results of this test are inconclusive or out of specifications, the equipment or process shall not be used.

When the equipment and processing have been approved, the contractor shall proceed with the surface recycling, operating his equipment under the same conditions as the successful field trial. No further testing for scarification depth shall be done unless the engineer deems that a change in conditions warrant new trial tests which shall be conducted as outlined above.

(e) Recycling Operations: The surface shall be uniformly heated by a radiant heating method that provides proper heat penetration without overheating, coking or sooting of the asphalt cement and aggregates. Flames shall be shielded to prevent blasting or scrubbing of the pavement. The temperature of the pavement shall be sufficient to allow the scarifiers to penetrate to the specified depth, but at no time shall the pavement temperature exceed 425°F.

Scarifying or milling shall be performed immediately after heating. Scarifiers shall be pressure-loaded having teeth spaced such that the entire surface is covered without leaving ridges. The scarifiers shall cut a level pattern through the surface conforming to the pavement profile. Scarified depth shall be as indicated on the plans.

Immediately following the scarifying process, the rejuvenating agent shall be applied to the scarified material at shall be synchronized with the machine's forward speed to maintain a tolerance within 5% of the required rate. The rejuvenated material shall be mixed thoroughly and uniformly distributed, restoring pavement profile.

Type 3 wearing course mix conforming to Section 501 of the Standard Specifications shall be placed within 1 minute of the heater-scarifier process on the leveled recycled mixture, which shall be at a temperature of 200° to 250°F.

The combination recycled and new asphaltic concrete mixture shall be screeded with a heated, vibratory screed and compacted according to Subsection 501.08. Density and surface tolerance shall be in accordance with Section 501.

The recycling equipment, including heaters, shall be capable of heating and cutting back at least 2" of the standing edges of the previous adjoining passes to produce a welded longitudinal joint.

Any tonnage of mix (recycled existing surface or new asphaltic concrete) not accepted due to a malfunction of the contractor's equipment shall be removed and replaced full depth with Type 3 asphaltic concrete wearing course at the contractor's expense.

Grade transitions at drives or turnouts shall be constructed with Type 3 asphaltic concrete wearing course. An asphaltic tack coat conforming to Section 504 shall be applied prior to placement of the asphaltic mixtures. Grade transitions shall be provided at each end of the project as directed.

(f) Measurement: Recycling existing asphaltic concrete will be measured by the square yard. The width for measurement will be that of the finished section and the length will be the centerline length. Measurement of irregular areas will be the area constructed, as determined by the engineer.

Rejuvenating agent will be measured by the gallon of 231 cubic inches, measured in its tank on the repaver. Measurement will be made at 60°F or converted to gallonage at 60°F in accordance with proper conversion tables.

Type 3 asphaltic concrete wearing course placed on the recycled mixture and at grade transitions will be measured by the ton (2000 pounds) according to Subsection 501.13.

(g) Payment: Recycling existing asphaltic concrete will be paid for at the contract unit price per square yard. The recycled mixture will be subject to the payment adjustment provisions of Section 501 for deficiencies in density and surface tolerance.

Rejuvenating agent will be paid for at the contract unit price per gallon.

Type 3 asphaltic concrete wearing course placed on the recycled mixtures and at grade transitions will be paid for at the contract unit price per ton in accordance with Subsection 501.14. No direct payment will be made for tack coat required at grade transitions.

Payment will be made under:

Item S-1, Surfacing Recycling Asphaltic Concrete, per square yard.

Item S-2, Rejuvenating Agent, per gallon.

Item S-3, Type 3 Asphaltic Concrete Wearing Course, per ton.

APPENDIX B

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT	03	PARISH	St. Landry
CONTROL	008-05	SECTION	SB
LENGTH	8.5	C.S. LOG MILE	0.8
DATE	24 Apr 86	RATED BY	

ROUTE	US 71
SUBSECTION	I
FUNCTIONAL CLASS	

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL LOW	MEDIUM	HIGH	EXTENT LEVEL OCC	FREQ	EXT	DEDUCT POINTS (CODE RANGE)
		WEIGHT FACTOR			WEIGHT FACTOR			
BLEEDING	5	N/A .8	AGG/BIT .8	FREE BIT 1.0	<10%A .6	10%-30% .9	>30% 1.0	0
BLOW-UP	5	<1/2" BUMP .4	1/2"-1" BUMP .6	>1" BUMP 1.0	1/MI .5	2-4/MI .8	>4/MI 1.0	0
LONGITUDINAL CRACKING	10	<1/8" .2	1/8"-1" .6	>1" 1.0	<50' STA .4	50-100' STA .8	>100' STA 1.0	0
PATCHING	10	SMALL .6	MEDIUM .8	LARGE 1.0	<10%L .6	10%-30% .8	>30% 1.0	0
PUMPING	10	STAIN .7	STAIN .7	FAULT 1.0	<10%L .3	10%-25% .7	>25% 1.0	0
RAVELING	10	AGGREGATE LOSS SLIGHT .3	MOD. .6	SEVERE 1.0	<20%A .5	20%-50% .8	>50% 1.0	0
RUTTING	10	<1/4"D .3	1/4"-3/4" .7	>3/4" 1.0	<20%L .6	20%-50% .8	>50% 1.0	3
SETTLEMENT	10	NOTIC. RIDE .4	DIS-COMFORT .7	DIP>6" 1.0	1/MI .6	2-4/MI .8	>4/MI 1.0	0
SHATTERED SLAB	10	TIGHT CRACKS .6	CRACKS >1/8"W .8	SLAB IN PIECES 1.0	> 2 AREAS .7	2-5 AREAS .9	> 5 AREAS 1.0	0
DE-BONDING	5	<1"D <1SY .3	<1"D & >1SY >1"D & <1SY .6	>1"D >1SY 1.0	<20%L .6	20%-50% .8	>50% 1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK .2	1/8"-1" .6	> 1" 1.0	<20%L .4	20%-50% .8	>50% 1.0	0

.15 .15 .20 .15 .15

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3

100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS -
PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25
MRR = (MAYS PSI) X 5 3.7 = 18.5

URBAN ROADS -
PDR = (100 - TOTAL DEDUCT POINTS) / 5 =
MRR = (MAYS PSI) X 4 =

PAVEMENT CONDITION RATING = PDR + RR = 42.75

REMARKS :

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT 03 PARISH St. Landry ROUTE US 71
CONTROL 8-05 SECTION SB SUBSECTION 3
LENGTH 8.5 C.S. LOG MILE 3.5 FUNCTIONAL CLASS
DATE 24 Apr 86 RATED BY

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL LOW	MEDIUM	HIGH	EXTENT LEVEL OCC	FREQ	EXT	DEDUCT POINTS (SEE BELOW)
		WEIGHT FACTOR			WEIGHT FACTOR			
BLEEDING	5	N/A	AGG/BIT	FREE BIT	<10%A	10%-30%	>30%	
		.8	.8	1.0	.6	.9	1.0	0
BLOW-UP	5	<1/2" BUMP	1/2"-1" BUMP	>1" BUMP	1/MI	2-4/MI	>4/MI	
		.4	.6	1.0	.5	.8	1.0	0
LONGITUDINAL CRACKING	10	<1/8"	1/8"-1"	>1"	<50' STA	50-100' STA	>100' STA	
		.2	.6	1.0	.4	.8	1.0	0
PATCHING	10	SMALL	MEDIUM	LARGE	<10%L	10%-30%	>30%	
		.6	.8	1.0	.6	.8	1.0	0
PUMPING	10	STAIN	STAIN	FAULT	<10%L	10%-25%	>25%	
		.7	.7	1.0	.3	.7	1.0	0
RAVELING	10	AGGREGATE LOSS SLIGHT	MOD.	SEVERE	<20%A	20%-50%	>50%	
		.3	.6	1.0	.5	.8	1.0	0
RUTTING	10	<1/4"D	1/4"-3/4"	>3/4"	<20%L	20%-50%	>50%	
.15 .20 .15 .10 .15		.3	.7	1.0	.6	.8	1.0	3
SETTLEMENT	10	NOTC. RIDE	DIS-COMFORT	DIP>6"	1/MI	2-4/MI	>4/MI	
		.4	.7	1.0	.6	.8	1.0	0
SHATTERED SLAB	10	TIGHT CRACKS	CRACKS >1/8"W	SLAB IN PIECES	> 2 AREAS	2-5 AREAS	> 5 AREAS	
		.6	.8	1.0	.7	.9	1.0	0
DE-BONDING	5	<1"D <1SY	<1"D & >1SY >1"D & <1SY	>1"D >1SY	<20%L	20%-50%	>50%	
		.3	.6	1.0	.6	.8	1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK	1/8"-1"	> 1"	<20%L	20%-50%	>50%	
		.2	.6	1.0	.4	.8	1.0	0

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3
100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25
MRR = (MAYS PSI) X 5 3.5 = 17.5

URBAN ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 5 =
MRR = (MAYS PSI) X 4 =

PAVEMENT CONDITION RATING = PDR + RR = 41.75

REMARKS :

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT	03	PARISH	St. Landry	ROUTE	US 71
CONTROL	8-05	SECTION	SB	SUBSECTION	5
LENGTH	8.5	C.S. LOG MILE	7.0	FUNCTIONAL CLASS	
DATE	24 Apr 86	RATED BY			

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL LOW	MEDIUM	HIGH	EXTENT LEVEL OCC	FREQ	EXT	DEDUCT POINTS (SEE BELOW)
		WEIGHT FACTOR			WEIGHT FACTOR			
BLEEDING	5	N/A .8	AGG/BIT .8	FREE BIT 1.0	<10%A .6	10%-30% .9	>30% 1.0	0
BLOW-UP	5	<1/2" BUMP .4	1/2"-1" BUMP .6	>1" BUMP 1.0	1/MI .5	2-4/MI .8	>4/MI 1.0	0
LONGITUDINAL CRACKING	10	<1/8" .2	1/8"-1" .6	>1" 1.0	<50' STA .4	50-100' STA .8	>100' STA 1.0	0
PATCHING	10	SMALL .6	MEDIUM .8	LARGE 1.0	<10%L .6	10%-30% .8	>30% 1.0	0
PUMPING	10	STAIN .7	STAIN .7	FAULT 1.0	<10%L .3	10%-25% .7	>25% 1.0	0
RAVELING	10	AGGREGATE LOSS SLIGHT .3	MOD. .6	SEVERE 1.0	<20%A .5	20%-50% .8	>50% 1.0	0
RUTTING .20 .10 .10 .15 .15	10	<1/4"D .3	1/4"-3/4" .7	>3.4" 1.0	<20%L .6	20%-50% .8	>50% 1.0	3
SETTLEMENT	10	NOTC. RIDE .4	DIS-COMFORT .7	DIP>6" 1.0	1/MI .6	2-4/MI .8	>4/MI 1.0	0
SHATTERED SLAB	10	TIGHT CRACKS .6	CRACKS >1/8"W .8	SLAB IN PIECES 1.0	> 2 AREAS .7	2-5 AREAS .9	> 5 AREAS 1.0	0
DE-BONDING	5	<1"D <1$Y .3	<1"D & >1SY >1"D & <1SY .6	>1"D >1SY 1.0	<20%L .6	20%-50% .8	>50% 1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK .2	1/8"-1" .6	> 1" 1.0	<20%L .4	20%-50% .8	>50% 1.0	0

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3

100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25

MRR = (MAYS PSI) X 5 3.6 = 18.0

URBAN ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 5 = ______

MRR = (MAYS PSI) X 4 = ______

PAVEMENT CONDITION RATING = PDR + RR = 42.25

REMARKS : ______________________________

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT	03	PARISH	St. Landry	ROUTE	US 71
CONTROL	8-05	SECTION		SUBSECTION	6
LENGTH	8.5	C.S. LOG MILE	8.0	FUNCTIONAL CLASS	
DATE	24 Apr 86	RATED BY			

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL LOW	MEDIUM	HIGH	EXTENT LEVEL OCC	FREQ	EXT	DEDUCT POINTS (See Below)
		WEIGHT FACTOR			WEIGHT FACTOR			
BLEEDING	5	N/A	AGG/BIT	FREE BIT	<10%A	10%-30%	>30%	
		.8	.8	1.0	.6	.9	1.0	0
BLOW-UP	5	<1/2" BUMP	1/2"-1" BUMP	>1" BUMP	1/MI	2-4/MI	>4/MI	
		.4	.6	1.0	.5	.8	1.0	0
LONGITUDINAL CRACKING	10	<1/8"	1/8"-1"	>1"	<50' STA	50-100' STA	>100' STA	
		.2	.6	1.0	.4	.8	1.0	0
PATCHING	10	SMALL	MEDIUM	LARGE	<10%L	10%-30%	>30%	
		.6	.8	1.0	.6	.8	1.0	0
PUMPING	10	STAIN	STAIN	FAULT	<10%L	10%-25%	>25%	
		.7	.7	1.0	.3	.7	1.0	0
RAVELING	10	AGGREGATE LOSS SLIGHT	MOD.	SEVERE	<20%A	20%-50%	>50%	
		.3	.6	1.0	.5	.8	1.0	0
RUTTING	10	<1/4"D	1/4"-3/4"	>3.4"	<20%L	20%-50%	>50%	
.05 .05 .10 .05 .10		.3	.7	1.0	.6	.8	1.0	3
SETTLEMENT	10	NOTC. RIDE	DIS-COMFORT	DIP>6"	1/MI	2-4/MI	>4/MI	
		.4	.7	1.0	.6	.8	1.0	0
SHATTERED SLAB	10	TIGHT CRACKS	CRACKS >1/8"W	SLAB IN PIECES	> 2 AREAS	2-5 AREAS	> 5 AREAS	
		.6	.8	1.0	.7	.9	1.0	0
DE-BONDING	5	<1"D <1SY	<1"D & >1SY >1"D & <1SY	>1"D >1SY	<20%L	20%-50%	>50%	
		.3	.6	1.0	.6	.8	1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK	1/8"-1"	> 1"	<20%L	20%-50%	>50%	
		.2	.6	1.0	.4	.8	1.0	0

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3

100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25

MRR = (MAYS PSI) X 5 3.7 = 18.5

URBAN ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 5 =

MRR = (MAYS PSI) X 4 =

PAVEMENT CONDITION RATING = PDR + RR = 42.75

REMARKS :

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT 03 PARISH St. Landry ROUTE US 71
CONTROL 8-05 SECTION NB SUBSECTION 7
LENGTH 8.5 C.S. LOG MILE 7.8 FUNCTIONAL CLASS
DATE 24 Apr 86 RATED BY

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL: LOW	MEDIUM	HIGH	EXTENT LEVEL: OCC	FREQ	EXT	DEDUCT POINTS (SEE BELOW)
		WEIGHT FACTOR			WEIGHT FACTOR			
BLEEDING	5	N/A	AGG/BIT	FREE BIT	<10%A	10%-30%	>30%	
		.8	.8	1.0	.6	.9	1.0	0
BLOW-UP	5	<1/2" BUMP	1/2"-1" BUMP	>1" BUMP	1/MI	2-4/MI	>4/MI	
		.4	.6	1.0	.5	.8	1.0	0
LONGITUDINAL CRACKING	10	<1/8"	1/8"-1"	>1"	<50' STA	50-100' STA	>100' STA	
		.2	.6	1.0	.4	.8	1.0	0
PATCHING	10	SMALL	MEDIUM	LARGE	<10%L	10%-30%	>30%	
		.6	.8	1.0	.6	.8	1.0	0
PUMPING	10	STAIN	STAIN	FAULT	<10%L	10%-25%	>25%	
		.7	.7	1.0	.3	.7	1.0	0
RAVELING	10	AGGREGATE LOSS: SLIGHT	MOD.	SEVERE	<20%A	20%-50%	>50%	
		.3	.6	1.0	.5	.8	1.0	0
RUTTING	10	<1/4"D	1/4"-3/4"	>3.4"	<20%L	20%-50%	>50%	
.05 .10 .10 .10 .10		.3	.7	1.0	.6	.8	1.0	3
SETTLEMENT	10	NOTC. RIDE	DIS-COMFORT	DIP>6"	1/MI	2-4/MI	>4/MI	
		.4	.7	1.0	.6	.8	1.0	0
SHATTERED SLAB	10	TIGHT CRACKS	CRACKS >1/8"W	SLAB IN PIECES	> 2 AREAS	2-5 AREAS	> 5 AREAS	
		.6	.8	1.0	.7	.9	1.0	0
DE-BONDING	5	<1"D <1SY	<1"D & >1SY / >1"D & <1SY	>1"D >1SY	<20%L	20%-50%	>50%	
		.3	.6	1.0	.6	.8	1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK	1/8"-1"	> 1"	<20%L	20%-50%	>50%	
		.2	.6	1.0	.4	.8	1.0	0

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3

100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25

MRR = (MAYS PSI) X 5 3.6 = ~~18.0~~

URBAN ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 5 = ____

MRR = (MAYS PSI) X 4 = ____

PAVEMENT CONDITION RATING = PDR + RR = 42.25

REMARKS :

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT	03	PARISH	St. Landry	ROUTE	US 71
CONTROL	8-05	SECTION	NB	SUBSECTION	8
LENGTH	8.5	C.S. LOG MILE	6.5	FUNCTIONAL CLASS	
DATE	24 Apr 86	RATED BY			

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL LOW	MEDIUM	HIGH	EXTENT LEVEL OCC	FREQ	EXT	DEDUCT POINTS (SEE BELOW)
BLEEDING	5	N/A .8	AGG/BIT .8	FREE BIT 1.0	<10%A .6	10%-30% .9	>30% 1.0	0
BLOW-UP	5	<1/2" BUMP .4	1/2"-1" BUMP .6	>1" BUMP 1.0	1/MI .5	2-4/MI .8	>4/MI 1.0	0
LONGITUDINAL CRACKING	10	<1/8" .2	1/8"-1" .6	>1" 1.0	<50' STA .4	50-100' STA .8	>100' STA 1.0	0
PATCHING	10	SMALL .6	MEDIUM .8	LARGE 1.0	<10%L .6	10%-30% .8	>30% 1.0	0
PUMPING	10	STAIN .7	STAIN .7	FAULT 1.0	<10%L .3	10%-25% .7	>25% 1.0	0
RAVELING	10	AGGREGATE LOSS SLIGHT .3	MOD. .6	SEVERE 1.0	<20%A .5	20%-50% .8	>50% 1.0	0
RUTTING .2 .2 ..20 .15 .15	10	<1/4"D .3	1/4"-3/4" .7	>3.4" 1.0	<20%L .6	20%-50% .8	>50% 1.0	3
SETTLEMENT	10	NOTC. RIDE .4	DIS-COMFORT .7	DIP>6" 1.0	1/MI .6	2-4/MI .8	>4/MI 1.0	0
SHATTERED SLAB	10	TIGHT CRACKS .6	CRACKS >1/8"W .8	SLAB IN PIECES 1.0	> 2 AREAS .7	2-5 AREAS .9	> 5 AREAS 1.0	0
DE-BONDING	5	<1"D <1SY .3	<1"D & >1SY >1"D & <1SY .6	>1SY >1"D >1SY 1.0	<20%L .6	20%-50% .8	>50% 1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK .2	1/8"-1" .6	> 1" 1.0	<20%L .4	20%-50% .8	>50% 1.0	0

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3

100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25

MRR = (MAYS PSI) X 5 3.3 = 16.5

URBAN ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 5 = ____

MRR = (MAYS PSI) X 4 = ____

PAVEMENT CONDITION RATING = PDR + RR = 40.75

REMARKS : ____

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT	03	PARISH	St. Landry	ROUTE	US 71
CONTROL	8-05	SECTION	NB	SUBSECTION	11
LENGTH	8.5	C.S. LOG MILE	4.00	FUNCTIONAL CLASS	
DATE	24 Apr 86	RATED BY			

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL LOW	MEDIUM	HIGH	EXTENT LEVEL OCC	FREQ	EXT	DEDUCT POINTS (ROUND BELOW)
		WEIGHT FACTOR			WEIGHT FACTOR			
BLEEDING	5	N/A	AGG/BIT	FREE BIT	<10%A	10%-30%	>30%	
		.3	.8	1.0	.6	.9	1.0	0
BLOW-UP	5	<1/2" BUMP	1/2"-1" BUMP	>1" BUMP	1/MI	2-4/MI	>4/MI	
		.4	.6	1.0	.5	.8	1.0	0
LONGITUDINAL CRACKING	10	<1/8"	1/8"-1"	>1"	<50' STA	50-100' STA	>100' STA	
		.2	.6	1.0	.4	.8	1.0	0
PATCHING	10	SMALL	MEDIUM	LARGE	<10%L	10%-30%	>30%	
		.6	.8	1.0	.6	.8	1.0	0
PUMPING	10	STAIN	STAIN	FAULT	<10%L	10%-25%	>25%	
		.7	.7	1.0	.3	.7	1.0	0
RAVELING	10	AGGREGATE LOSS SLIGHT	MOD.	SEVERE	<20%A	20%-50%	>50%	
		.3	.6	1.0	.5	.8	1.0	0
RUTTING	10	<1/4"D	1/4"-3/4"	>3/4"	<20%L	20%-50%	>50%	
.15 .20 .15 .15 .20		.3	.7	1.0	.6	.8	1.0	3
SETTLEMENT	10	NOTC. RIDE	DIS-COMFORT	DIP>6"	1/MI	2-4/MI	>4/MI	
		.4	.7	1.0	.6	.8	1.0	0
SHATTERED SLAB	10	TIGHT CRACKS	CRACKS >1/8"W	SLAB IN PIECES	> 2 AREAS	2-5 AREAS	> 5 AREAS	
		.6	.8	1.0	.7	.9	1.0	0
DE-BONDING	5	<1"D <1SY	<1"D & >1SY >1"D & <1SY	>1"D >1SY	<20%L	20%-50%	>50%	
		.3	.6	1.0	.6	.8	1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK	1/8"-1"	> 1"	<20%L	20%-50%	>50%	
		.2	.6	1.0	.4	.8	1.0	0

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3

100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS -

PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25

MRR = (MAYS PSI) X 5 3.7 = 18.5

URBAN ROADS -

PDR = (100 - TOTAL DEDUCT POINTS) / 5 =

MRR = (MAYS PSI) X 4 =

PAVEMENT CONDITION RATING = PDR + RR = 42.75

REMARKS :

PAVEMENT CONDITION RATING FORM FOR COMPOSITE PAVEMENT

DISTRICT	03	PARISH	St. Landry	ROUTE	US 71
CONTROL	8-05	SECTION	NB	SUBSECTION	13
LENGTH	8.5	C.S. LOG MILE	1.5	FUNCTIONAL CLASS	
DATE	24 Apr 86	RATED BY			

DISTRESS TYPE	WEIGHT FACTOR	SEVERITY LEVEL: LOW	MEDIUM	HIGH	EXTENT LEVEL: OCC	FREQ	EXT	DEDUCT POINTS (SEE BELOW)
		WEIGHT FACTOR			WEIGHT FACTOR			
BLEEDING	5	N/A	AGG/BIT	FREE BIT	<10%A	10%-30%	>30%	
		.8	.8	1.0	.6	.9	1.0	0
BLOW-UP	5	<1/2" BUMP	1/2"-1" BUMP	>1" BUMP	1/MI	2-4/MI	>4/MI	
		.4	.6	1.0	.5	.8	1.0	0
LONGITUDINAL CRACKING	10	<1/8"	1/8"-1"	>1"	<50' STA	50-100' STA	>100' STA	
		.2	.6	1.0	.4	.8	1.0	0
PATCHING	10	SMALL	MEDIUM	LARGE	<10%L	10%-30%	>30%	
		.6	.8	1.0	.6	.8	1.0	
PUMPING	10	STAIN	STAIN	FAULT	<10%L	10%-25%	>25%	
		.7	.7	1.0	.3	.7	1.0	0
RAVELING	10	AGGREGATE LOSS SLIGHT	MOD.	SEVERE	<20%A	20%-50%	>50%	
		.3	.6	1.0	.5	.8	1.0	0
RUTTING	10	<1/4"D	1/4"-3/4"	>3/4"	<20%L	20%-50%	>50%	
.25 .20 .15 .20 .15		.3	.7	1.0	.6	.8	1.0	3
SETTLEMENT	10	NOTC. RIDE	DIS-COMFORT	DIP>6"	1/MI	2-4/MI	>4/MI	
		.4	.7	1.0	.6	.8	1.0	0
SHATTERED SLAB	10	TIGHT CRACKS	CRACKS >1/8"W	SLAB IN PIECES	> 2 AREAS	2-5 AREAS	> 5 AREAS	
		.6	.8	1.0	.7	.9	1.0	0
DE-BONDING	5	<1"D <1SY	<1"D & >1SY >1"D & <1SY	>1"D >1SY	<20%L	20%-50%	>50%	
		.3	.6	1.0	.6	.8	1.0	0
TRANSVERSE CRACKING	(R) 10 (I) 5	<1/8" CRACK	1/8"-1"	> 1"	<20%L	20%-50%	>50%	
		.2	.6	1.0	.4	.8	1.0	0

DEDUCT POINTS = DISTRESS WEIGHT FACTOR X SEVERITY WEIGHT X EXTENT WEIGHT FACTOR

TOTAL DEDUCT POINTS = 3

100 - TOTAL DEDUCT POINTS = 97.0

RURAL ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 4 = 24.25

MRR = (MAYS PSI) X 5 3.8 = 19.0

URBAN ROADS - PDR = (100 - TOTAL DEDUCT POINTS) / 5 =

MRR = (MAYS PSI) X 4 =

PAVEMENT CONDITION RATING = PDR + RR = 43.25

REMARKS :