



TRC9205

**Guidelines for In-Place Recycling -  
Phase I**

Terry L. Hardison

Final Report

*Final Report - Phase I*  
*TRC - 9205*

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*April 1994*

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# *Guidelines for In-place Recycling*

*Planning and Research Division*  
*Arkansas State Highway and Transportation Department*

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*In cooperation with*

*Federal Highway Administration*  

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*U.S. Department of Transportation*



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| 16. Abstract<br><br><b>This interim report documents the construction and performance to date of all hot in-place recycling (HIR) projects in Arkansas. These projects are located in Texarkana, Magnolia, Arkadelphia, Newport and Vilonia. The HIR projects have different lengths of service ranging in age from three years to five years. The objective of this study is to gather all pertinent information relating to hot in-place recycling projects from the preconstruction phase to post construction monitoring. This information will be used to develop guidelines that will design recycled asphalt pavements more efficiently.</b> |  |   |  |  |           |
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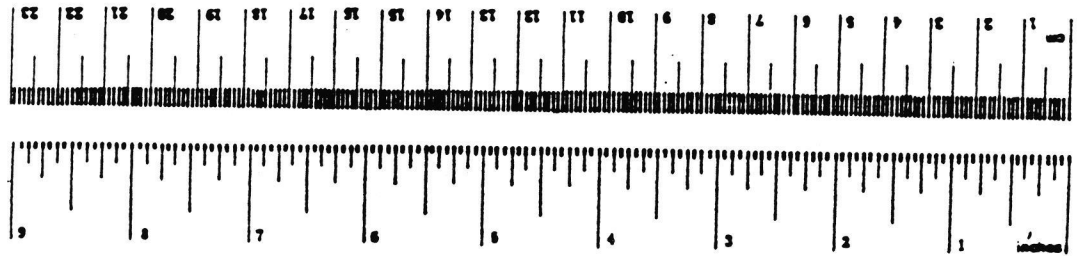
# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

| Symbol                     | When You Know          | Multiply by                | To Find             | Symbol          |
|----------------------------|------------------------|----------------------------|---------------------|-----------------|
| <b>LENGTH</b>              |                        |                            |                     |                 |
| in                         | inches                 | 2.5                        | centimeters         | cm              |
| ft                         | feet                   | 30                         | centimeters         | cm              |
| yd                         | yards                  | 0.9                        | meters              | m               |
| mi                         | miles                  | 1.6                        | kilometers          | km              |
| <b>AREA</b>                |                        |                            |                     |                 |
| in <sup>2</sup>            | square inches          | 6.5                        | square centimeters  | cm <sup>2</sup> |
| ft <sup>2</sup>            | square feet            | 0.09                       | square meters       | m <sup>2</sup>  |
| yd <sup>2</sup>            | square yards           | 0.8                        | square meters       | m <sup>2</sup>  |
| mi <sup>2</sup>            | square miles           | 2.6                        | square kilometers   | km <sup>2</sup> |
| acres                      | acres                  | 0.4                        | hectares            | ha              |
| <b>MASS (weight)</b>       |                        |                            |                     |                 |
| oz                         | ounces                 | 28                         | grams               | g               |
| lb                         | pounds                 | 0.45                       | kilograms           | kg              |
|                            | short tons (2000 lb)   | 0.9                        | tonnes              | t               |
| <b>VOLUME</b>              |                        |                            |                     |                 |
| teaspoons                  | teaspoons              | 5                          | milliliters         | ml              |
| tablespoons                | tablespoons            | 15                         | milliliters         | ml              |
| fluid ounces               | fluid ounces           | 30                         | milliliters         | ml              |
| cup                        | cup                    | 0.24                       | liters              | l               |
| pint                       | pint                   | 0.47                       | liters              | l               |
| quart                      | quart                  | 0.95                       | liters              | l               |
| gallon                     | gallon                 | 3.8                        | liters              | l               |
| cubic feet                 | cubic feet             | 0.03                       | cubic meters        | m <sup>3</sup>  |
| cubic yards                | cubic yards            | 0.76                       | cubic meters        | m <sup>3</sup>  |
| <b>TEMPERATURE (exact)</b> |                        |                            |                     |                 |
| °F                         | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C              |

## Approximate Conversions from Metric Measures

| Symbol                     | When You Know                     | Multiply by       | To Find                | Symbol          |
|----------------------------|-----------------------------------|-------------------|------------------------|-----------------|
| <b>LENGTH</b>              |                                   |                   |                        |                 |
| mm                         | millimeters                       | 0.04              | inches                 | in              |
| cm                         | centimeters                       | 0.4               | inches                 | in              |
| m                          | meters                            | 3.3               | feet                   | ft              |
| km                         | kilometers                        | 1.1               | yards                  | yd              |
|                            |                                   | 0.6               | miles                  | mi              |
| <b>AREA</b>                |                                   |                   |                        |                 |
| cm <sup>2</sup>            | square centimeters                | 0.16              | square inches          | in <sup>2</sup> |
| m <sup>2</sup>             | square meters                     | 1.2               | square yards           | yd <sup>2</sup> |
| km <sup>2</sup>            | square kilometers                 | 0.4               | square miles           | mi <sup>2</sup> |
| ha                         | hectares (10,000 m <sup>2</sup> ) | 2.5               | acres                  | acres           |
| <b>MASS (weight)</b>       |                                   |                   |                        |                 |
| g                          | grams                             | 0.035             | ounces                 | oz              |
| kg                         | kilograms                         | 2.2               | pounds                 | lb              |
| t                          | tonnes (1000 kg)                  | 1.1               | short tons             | short tons      |
| <b>VOLUME</b>              |                                   |                   |                        |                 |
| ml                         | milliliters                       | 0.03              | fluid ounces           | fl oz           |
| l                          | liters                            | 2.1               | pints                  | pt              |
| l                          | liters                            | 1.06              | quarts                 | qt              |
| m <sup>3</sup>             | cubic meters                      | 0.26              | gallons                | gal             |
| m <sup>3</sup>             | cubic meters                      | 36                | cubic feet             | ft <sup>3</sup> |
|                            |                                   | 1.3               | cubic yards            | yd <sup>3</sup> |
| <b>TEMPERATURE (exact)</b> |                                   |                   |                        |                 |
| °C                         | Celsius temperature               | 9/5 (then add 32) | Fahrenheit temperature | °F              |



\*1 in = 2.54 exactly. For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Length and Measure, Price \$2.25, SD Catalog No. C13.10-286.

# METRIC CONVERSION FACTORS

**GUIDELINES FOR IN-PLACE RECYCLING**

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The opinions, findings, and conclusions expressed in this publication are those of the author and not necessarily those of the Arkansas State Highway and Transportation Department or the Federal Highway Administration. The author is solely responsible for the accuracy in this report.



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## **INTRODUCTION**

The need to restore and rehabilitate asphalt pavements has never been greater. To continue to overlay existing pavements wastes our limited aggregate sources and costs the taxpayer additional dollars. The asphalt binder tends to deteriorate long before the aggregate does. Also, numerous overlays tend to raise the overall profile of the roadway. This can affect drainage, curb heights, and in extreme cases can lead to clearance problems for high vehicles passing under low bridges.

This project explores in-place recycling as a possible alternative to overlaying with 100% virgin asphalt mix. Data collected from five in-place recycling projects in Arkansas was analyzed and is contained in this report. From this information, the literature review, and interviewing various personnel in this field, guidelines were developed. These guidelines will enable the designer to do the following:

1. Determine if the properties of the existing roadway are conducive to a satisfactory in-place recycling job.
2. Formulate a mix design blending the existing roadway material and virgin asphalt hot mix in the proper percentages to produce a new surface that will perform satisfactorily.

## **REVIEW OF LITERATURE**

Hot in-place recycling has been used successfully in other countries for many years. For the purposes of this report only two methods are considered. These are the remix and the repave methods. The Arkansas State Highway and Transportation Department became interested in these processes when the Atlanta District of the Texas DOT began using them in 1984.

Texas used the remixing process later that year on a 130,000 sq. yd. project on U.S. 59 at Lufkin. Two additional projects followed in 1985 and 1986 totaling 240,000 sq. yd's.

Prior to this, other states were still uncertain about the method. However, at that time, remixing was an accepted process in Europe where highways were designed to be easier to remix at a later date.

Maryland DOT monitored Pennsylvania's Schuylkill County project in 1985. Three districts in Maryland were involved in hot in-place recycling where they added harder aggregates to increase skid resistance and also recycled open graded mixes. The original contract in Maryland's District 7 was doubled from 50,000 to 100,000 sq. yd's.

The Colorado DOT let it's largest and deepest (1.75 inches) hot in-place recycling



project in 1992. The main purpose of this project was to level the driving lanes and seal the cracks while reconditioning as many miles as possible with the funds available. The desired "more miles for the buck" made the recycling approach particularly attractive to Colorado.

It appears that city street and state DOTs across the United States have proven that hot in-place recycling can meet or exceed all specification requirements for virgin HMA.

## **DESCRIPTION OF PROJECTS AND RELATED INFORMATION**

In-place recycling of asphalt pavement is generally classified into two types: hot in-place and cold in-place recycling. This report will concentrate on hot in-place recycling (HIR). HIR is divided into the remix option and the repave option.

The five in-place recycling projects in Arkansas are listed in Table I. The Department currently allows both the remix and the repave options. Remixing involves heating the pavement then milling the heated pavement to a depth of 1 inch to 1 3/4 inches, adding virgin asphalt mix, mixing both together in a pugmill, and relaying all in one pass. Repaving consists of heater scarifying the pavement, relaying the pavement material, placing a new surface mat immediately after the recycled mat, and compacting them both at the same time. Each construction project is outlined below:

### **Newport**

Hwy. 67, Section 15, and Hwy. 367, Section 21 at Newport was the first project in Arkansas to be rehabilitated using the in-place recycling method. Remixer Contracting Co., Inc., of Austin, Texas, was awarded the contract for Job 5918 at Newport. Construction began in September, 1987. A preliminary rutting survey by AHTD Research personnel indicated the existing pavement was rutted 1/2" to 3/4" and as much as 1 1/2" in several locations. Remixer Contracting Co. scarified the existing Type 3 Surface Course 1 1/2" and remixed with 20 lbs./sq. yd. of virgin Type 2 Surface. No rejuvenating agent was added to the mix on this project.

### **Vilonia**

Preliminary testing was completed in August, 1988 for the rehabilitation of the existing asphalt surface on Hwy. 64, Section 9 at Vilonia. The pavement was found to be consistent enough in asphalt content and penetration values to be suitable for in-place recycling. Remixer Contracting Co., Inc. was awarded the contract for Job 8980 and began construction in June, 1989. The existing 1" of Hot Mix Seal Course and the underlying Type 2 Surface Course were scarified to a depth of 1 1/2" and remixed with 35 lbs./sq. yd. of virgin Type 2 Surface mix from Conway Asphalt at Conway, AR. Low penetration values of the existing material necessitated the addition of 0.10 gal./sq. yd. of

rejuvenator to the blended mix. The asphalt content of the blended mix averaged 5.2% and penetration values averaged 24. Core specimens taken after construction averaged 94.2% of the theoretical density or 143.2 pcf. The Special Provision Specifications for Job 8980 are in Appendix B.

#### **Arkadelphia**

Selected sections of Hwys. 51 and 67 at Arkadelphia were in need of surface rehabilitation in July, 1989. Samples of the existing asphalt material were taken and tested. The penetration values of the existing pavement ranged from 14 to 22. It was determined that in-place recycling would be the proper method for this project. Remixer Contracting Co., Inc. was awarded the contract for Job 70009. The existing pavement was scarified to a depth of 1 1/2". 50 lbs./sq. yd. of virgin Type 2 Surface asphalt material and 0.10 gal./sq. yd. of rejuvenator was remixed with the old pavement. Remixer Contracting Co., Inc. had set a target asphalt content of 5.8% and a target penetration value of 33 for the blended mix, with a minimum penetration value of 25. The proposed starting date was October 23, 1989. Quality control testing of the actual mix indicated a 6.0% asphalt content. The virgin Type 2 Surface had 4.9%-5.4% asphalt content. Penetration values of the blended mixture ranged from 39 to 57.

#### **Magnolia**

Selected sections of Hwys. 82 and 132 in Magnolia were included in a rehabilitation project that began in August, 1989. Materials and Research personnel were requested by the District Seven Engineer to obtain samples of the existing asphalt material. The existing pavement was sampled and tested and the results were given to Remixer Contracting Co., Inc., the low bidder on this project, Job 70010. The asphalt mix design with the remixer option was developed by Remixer Contracting Co., Inc. and construction began and was completed in the fall of 1989. The Special Provision Specifications for Job 70010 are in Appendix B.

#### **Texarkana**

Preliminary evaluation of this project initially indicated that the existing surface course was placed under two different jobs. The first job (the 8th. St. couplet of Hwy. 67, Section 1) was completed in 1978; the second job (the remainder of Hwy. 67, Section 1, and Hwy., 71, Section 2) was completed in 1980.

Two sets of roadway cores from both jobs were tested to show that approximately 1 1/2" of Type 2 Surface existed on both jobs. Extraction and Abson tests revealed that the Type 2 Surface on the first job had an asphalt content of 5.3% with a penetration value of 41, while the Type 2 Surface of the second job had an asphalt content of 5.1% and a penetration value of 40. These results indicated that the asphalt surface course was

consistent enough to be a good candidate for in-place recycling. The repave option with the addition of 0.05 gal./sq. yd. of rejuvenator was selected for this project. Cutler Repaving, Inc. of Lawrence, KS was low bidder and Job 30052 was constructed in the summer of 1990. The Special Provision Specifications for Job 30052 are in Appendix B.

#### **Site Performance Measurements**

These construction projects have been completed for up to five years and have different levels of performance. Initially, three test sections, good, medium, and poor were selected from each jobsite based on pavement performance at that time. Profilograph, rut measurement, and deflection data were accumulated at each jobsite. In addition, core pavement samples were taken for lab analysis. The projects are ranked in Table II by assigning equal importance to each of the following categories: rut depth, profile index, ride rating, skid number and cracking. Each project was assigned a numerical value based on their ranking in each category with a lower number denoting better performance. The numbers were totaled in each category and averaged to rank the projects by pavement condition. These results are plotted in Figure I.

To assign a numerical value for pavement performance, a system similar to that used to develop the pavement serviceability index (PSI) was used. The values reported in Table III should not be considered as an accurate PSI value expanded to a scale from 0 to 100, but an estimation of the Department's pavement serviceability rating used in our pavement management system.

Table III gives the ratings of the projects based on asphalt distress and ride rating and compares this with equivalent single axle load data. Asphalt distress is subdivided into cracking and rutting. Ride rating is comprised of profile index and Mays Ride Rating. The PSI is calculated by deducting points from 100 based on the site's performance in the above categories. Cracking in the particular site is ranked against the other sites from one to six with one being the site with the least cracking. This number is a straight deduct from 100. Rutting is also a straight deduct with points being deducted in increasing amounts based on any rut 8/32" or deeper (i.e., 8/32" and 9/32" = -1 pt.; 10/32" and 11/32" = -2 pts. and so on). The profile index is multiplied by two and added to 100 minus the ride rating. This number is divided by two and added to the total deducts for cracking and rutting. This number is then subtracted from 100 to arrive at the PI.

Figure II plots the pavement serviceability rating versus the ESALs for each location. These points fall either above or below a line which correlates measured performance. Two locations, Vilonia and Newport, are above the line indicating their performance is better based on the number of ESALs.

#### **COMPARISON OF TEST DATA**

Results of pavement and core data are listed in Table IV. Penetration and Absolute Viscosity @ 140 deg. F. values are incomplete at this time, but further testing is ongoing.



The Magnolia penetration values are in the 36 to 45 range after 4 1/2 years of service which appear indicative of a pavement binder that has not become too hard or brittle. Penetration values between 10 and 15 or lower indicate a hard binder that is not conducive to good pavement performance. This is the range that some of the penetrations fell within before in-place recycling and with the addition of rejuvenator, these values were raised to an acceptable level. Table V compares wheelpath and between wheelpath in situ air void, density, and tensile strength data for each of the three test sections of each jobsite. Tables VI, VII, and VIII present averages for each jobsite for the same wheelpath and between wheelpath data. It is interesting to note in Table VI that the lowest air voids (2.7%) were found at Newport which also had the highest average rut measurements (9/32") of the six projects. This same relationship was evident at Arkadelphia (Hwy. 51) with an average of 3.3% air voids and 8/32" rut measurements. As expected, with the exception of one project, the between the wheelpath air voids were slightly higher than the wheelpath data. Magnolia and Arkadelphia (Hwy. 51) have the most desirable air void numbers. Table VII is a comparison of density values. The lower numbers found at Arkadelphia (Hwy. 67) and Vilonia coincide with the higher air void percentages at these locations. As before, the between the wheelpath data indicates less compactive effort than the wheelpath data. Table VIII compares tensile strength values. Newport, with the highest tensile strengths, also had the lowest air void content. The density and tensile strength values appear to be in line with those of regular asphalt overlay mixes.

## **COST ANALYSIS**

The conservation of two nonrenewable resources, aggregates and crude oil, which in turn reduce energy consumption, must be considered when evaluating the cost effectiveness of asphalt pavement recycling. With the present equipment, recycling agents, know-how and technology, most aged asphalt pavement can be recycled and the final recycled mix will be structurally equal or near equal to that of virgin asphalt pavement. As a result, the required overlay thicknesses are reduced resulting in savings of money, resources, and energy.

Another way to look at savings that can result from recycling is to consider the amount of asphalt pavement that would need to be landfilled if it were not recycled. The Asphalt Recycling and Reclaiming Association (ARRA) surveyed its contractor members to determine the amount of recycling and reclaiming work performed in 1991. Only a small number, 39 contractors, responded to the survey. However, these 39 contractors kept 11,339,703 tons of asphalt pavement from being landfilled in 1991. According to ARRA

this resulted in a savings to taxpayers of \$664,184,838.50 in 1991.

To overlay the existing surface with one lift (1 1/2") of new pavement has been estimated to cost approximately \$63,625 a mile, compared to \$32,077 a mile for full depth heater recycling with added virgin asphalt mix.

U.S.D.O.T. Demonstration Project No. 39 found that the initial cost benefits of single pass asphalt recycling provides 35% more pavement repair for each maintenance dollar spent. In other words, 1.35 miles of highway could be paved with the single pass asphalt recycling method compared to 1.0 mile of highway with the conventional equivalent method.

A comparison can be made using a weighted average unit price for a ton of Type 2 Surface asphalt mix and a ton of in-place recycled asphalt mix. The weighted average unit price for a ton of Type 2 Surface was \$27 a ton in 1993, whereas a ton of in-place recycled asphalt mix would cost \$23.

## **CONCLUSION**

The research to date has focused on the following: (1) determining the performance of the five in-place recycling jobs to date, and (2) correlating mix properties to performance.

All five jobs that were monitored during this study have performed satisfactorily to date. The in-place recycling mixes have not continued to close up voids and rut as standard overlays often do. Rutting does not appear to be a problem with in-place recycling mixes. However, based on the data in Tables II and III, it appears that certain locations outperformed others. Age of the pavement and the number of ESALs play an important role in each location's performance.

Phase I of this project has demonstrated that in-place recycling is a realistic and cost effective alternative to conventional asphalt overlay. The savings associated with recycling asphalt pavement can be used to rehabilitate many additional miles for the same available funding.

Phase II will concern the pavement serviceability of standard asphalt overlays. Monitoring of these jobs will continue through Phase II.

APPENDIX A  
TABLES  
AND FIGURES



**TABLE I**  
**LOCATION OF IN-PLACE RECYCLING PROJECTS**

| Route | Section | Location    | Log Mile    | Lane Miles | Sq. Yds. |
|-------|---------|-------------|-------------|------------|----------|
| 64    | 9       | Vilonia*    | 12.0-18.62  | 13.24      | 92,929   |
| 67    | 15      | Newport*    | 0.10-2.60   | 12.5       | 80,668   |
| 367   | 21      | Newport*    | 7.30-8.90   | 8.0        | 51,627   |
| 132   | 1       | Magnolia*   | 24.55-25.10 | 1.1        | 7,745    |
| 82    | 3B      | Magnolia*   | 2.20-3.08   | 3.52       | 24,782   |
| 67    | 1       | Texarkana** | 0.0-0.95    | 3.8        | 26,753   |
| 71    | 2       | Texarkana** | 14.17-14.99 | 3.28       | 23,091   |
| 67    | 6       | Arkadelphia | 0.0-3.36    | 6.72       | 47,310   |
| 51    | 1       | Arkadelphia | 29.76-32.01 | 4.5        | 31,681   |

\* remix method

\*\* repave method

TABLE II

PAVEMENT CONDITION  
RANKED BY CATEGORY  
(1 = best, 6 = worst)

| LOCATION              | RUT DEPTH | PROFILE INDEX | RIDE RATING | SKID NUMBER | CRACKING | RANK |
|-----------------------|-----------|---------------|-------------|-------------|----------|------|
| TEXARKANA             | 1         | 5             | 3           | 2           | 2        | 1    |
| MAGNOLIA              | 2         | 6             | 6           | 5           | 2        | 5    |
| ARKADELPHIA (Hwy. 67) | 4         | 2             | 3           | 3           | 4        | 3    |
| ARKADELPHIA (Hwy. 51) | 5         | 3             | 5           | 4           | 1        | 4    |
| NEWPORT               | 6         | 4             | 1           | 6           | 5        | 6    |
| VILONIA               | 3         | 1             | 2           | 1           | 6        | 2    |

FIGURE I

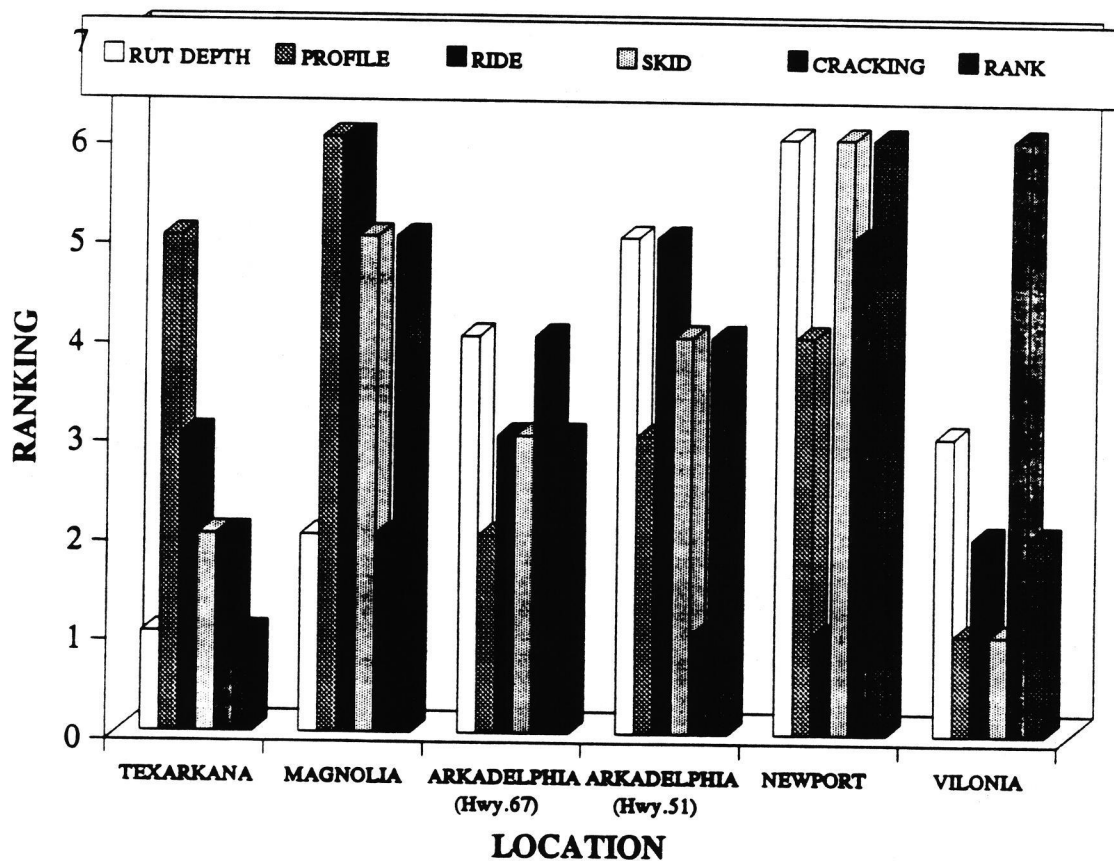
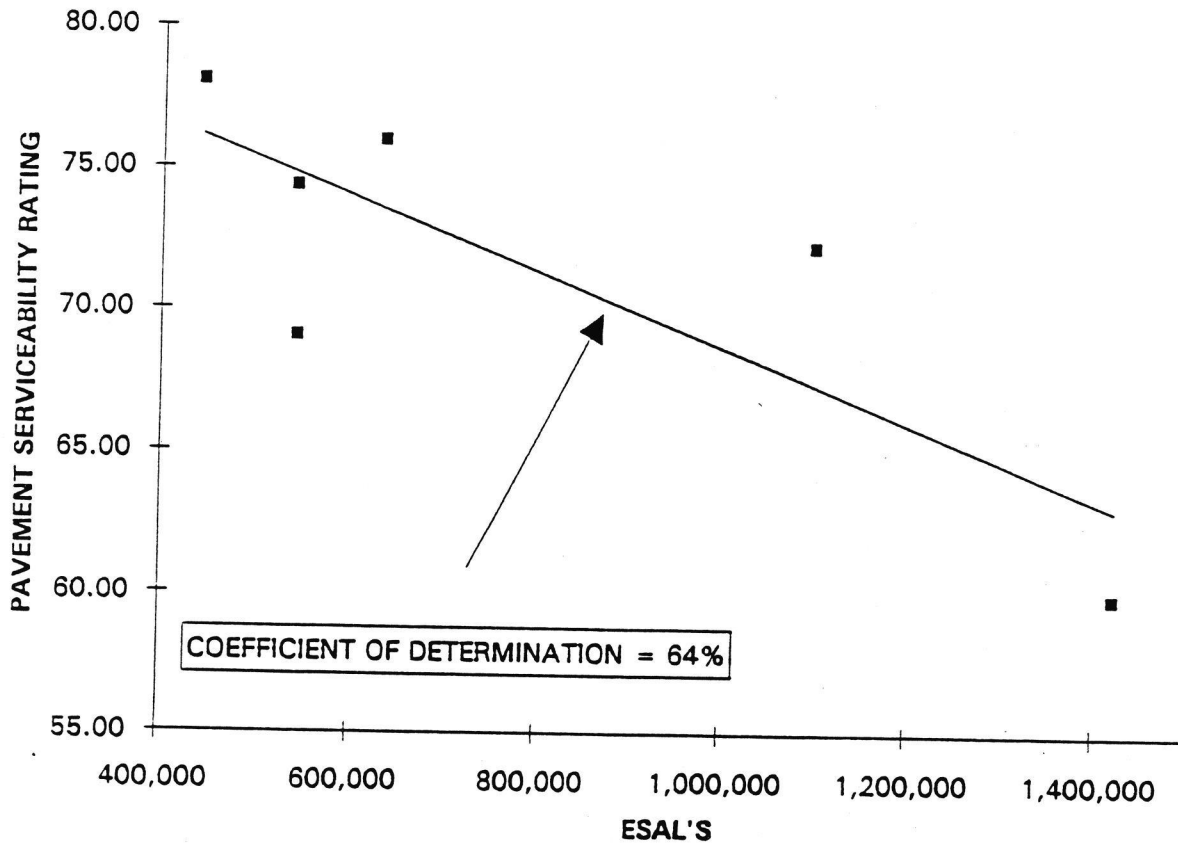


TABLE III

COMPARISON OF ESAL DATA  
VERSUS  
PAVEMENT SERVICEABILITY RATING

| LOCATION              | RATING | ESAL      |
|-----------------------|--------|-----------|
| TEXARKANA             | 69.07  | 542,520   |
| MAGNOLIA              | 59.92  | 1,421,366 |
| VILONIA               | 75.98  | 633,909   |
| ARKADELPHIA (Hwy. 67) | 74.39  | 541,044   |
| ARKADELPHIA (Hwy. 51) | 78.07  | 441,378   |
| NEWPORT               | 72.28  | 1,096,962 |

FIGURE II



**TABLE IV**  
**RESULTS OF PAVEMENT AND CORE DATA**

| JOB / LOCATION                  | SECTION | AGE / YEARS | PAVEMENT CONDITION |        |                |        |                  |               |             |                 |               |               |        | TENSILE STRENGTH (psi) | PEN VALUE | ABSOLUTE VISCOSITY @140 deg F |
|---------------------------------|---------|-------------|--------------------|--------|----------------|--------|------------------|---------------|-------------|-----------------|---------------|---------------|--------|------------------------|-----------|-------------------------------|
|                                 |         |             | AVG. RUT DEPTH     |        | MAX. RUT DEPTH |        | PROF IDX In/mile | RIDE RATE (%) | SKID NUMBER | CRACKING (0-10) | AIR VOIDS (%) | DENSITY (pcf) |        |                        |           |                               |
|                                 |         |             | OWP                | IWP    | OWP            | IWP    |                  |               |             |                 |               |               |        |                        |           |                               |
| 3000-1<br>30052<br>Texarkana    | GOOD    | 3.5         | 2/32"              | 3/32"  | 2/32"          | 10/32" | 13.85            | 75.72         | 44          | 1               | 5.2           | 144.6         | 169.28 |                        |           |                               |
|                                 | AVG.    | "           | 2/32"              | 3/32"  | 2/32"          | 4/32"  | 17.23            | 71.14         | 48          | 3               | 4.6           | 145.1         | 194.59 |                        |           |                               |
|                                 | POOR    | "           | 4/32"              | 2/32"  | 6/32"          | 4/32"  | 7.99             | 75.73         | 43          | 7               | 7.4           | 142.1         | 172.23 |                        |           |                               |
| 70010<br>Magnolia               | GOOD    | 4.5         | 5/32"              | 6/32"  | 6/32"          | 7/32"  | 7.50             | 70.81         | 32          | 3               | 3.9           | 141.1         | 198.91 | 45                     | 6010      |                               |
|                                 | AVG.    | "           | 5/32"              | 3/32"  | 6/32"          | 4/32"  | 9.30             | 69.77         | 34          | 3               | 4.8           | 143.2         | 193.65 | 36                     | 7951      |                               |
|                                 | POOR    | "           | 13/32"             | 4/32"  | 35/32"         | 6/32"  | 30.30            | 61.14         | 34          | 5               | 4.4           | 142.5         | 138.76 | 39                     | 5684      |                               |
| 70009<br>Arkadelphia<br>Hwy. 67 | GOOD    | 4.5         | 7/32"              | 6/32"  | 11/32"         | 7/32"  | 6.28             | 74.56         | 42          | 3               | 5.2           | 142.0         | 108.40 | 28                     | 25,323    |                               |
|                                 | AVG.    | "           | 8/32"              | 6/32"  | 8/32"          | 7/32"  | 8.58             | 73.44         | 42          | 5               | 4.3           | 143.1         | 120.98 |                        |           |                               |
|                                 | POOR    | "           | 6/32"              | 2/32"  | 8/32"          | 3/32"  | 5.32             | 74.56         | 43          | 9               | 8.5           | 137.3         | 106.95 | 16                     | NT        |                               |
| 70009<br>Arkadelphia<br>Hwy. 51 | GOOD    | 4.5         | 9/32"              | 5/32"  | 12/32"         | 5/32"  | 5.03             | 74.51         | 31          | 1               | 3.3           | 142.8         | 194.26 |                        |           |                               |
|                                 | AVG.    | "           | 7/32"              | 5/32"  | 11/32"         | 6/32"  | 8.60             | 73.53         | 35          | 1               | 4.2           | 143.3         | 171.66 |                        |           |                               |
|                                 | POOR    | "           | 9/32"              | 8/32"  | 11/32"         | 10/32" | 12.72            | 73.22         | 38          | 5               | 4.1           | 143.5         | 157.25 |                        |           |                               |
| 5918<br>Newport                 | GOOD    | 6.5         | 7/32"              | 12/32" | 8/32"          | 16/32" | 4.65             | 88.93         | 25          | 3               | 2.0           | 150.0         | 215.66 |                        |           |                               |
|                                 | AVG.    | "           | 8/32"              | 11/32" | 8/32"          | 15/32" | 10.69            | 82.24         | 26          | 5               | 2.9           | 149.3         | 261.19 |                        |           |                               |
|                                 | POOR    | "           | 5/32"              | 6/32"  | 8/32"          | 7/32"  | 17.50            | 82.22         | 25          | 7               | 3.9           | 148.0         | 217.79 |                        |           |                               |
| 8980<br>Vilonia                 | GOOD    | 5.0         | 4/32"              | 8/32"  | 5/32"          | 9/32"  | 6.65             | 78.23         | 54          | 4               | 7.5           | 142.2         | 133.22 |                        |           |                               |
|                                 | AVG.    | "           | 6/32"              | 4/32"  | 7/32"          | 5/32"  | 2.12             | 77.85         | 48          | 6               | 8.4           | 140.4         | 118.32 |                        |           |                               |
|                                 | POOR    | "           | 3/32"              | 6/32"  | 4/32"          | 10/32" | 5.17             | 75.72         | 48          | 9               | 4.8           | 146.1         | 248.77 |                        |           |                               |

**TABLE V**  
**COMPARISON OF WHEELPATH**  
**AND BETWEEN WHEELPATH DATA**

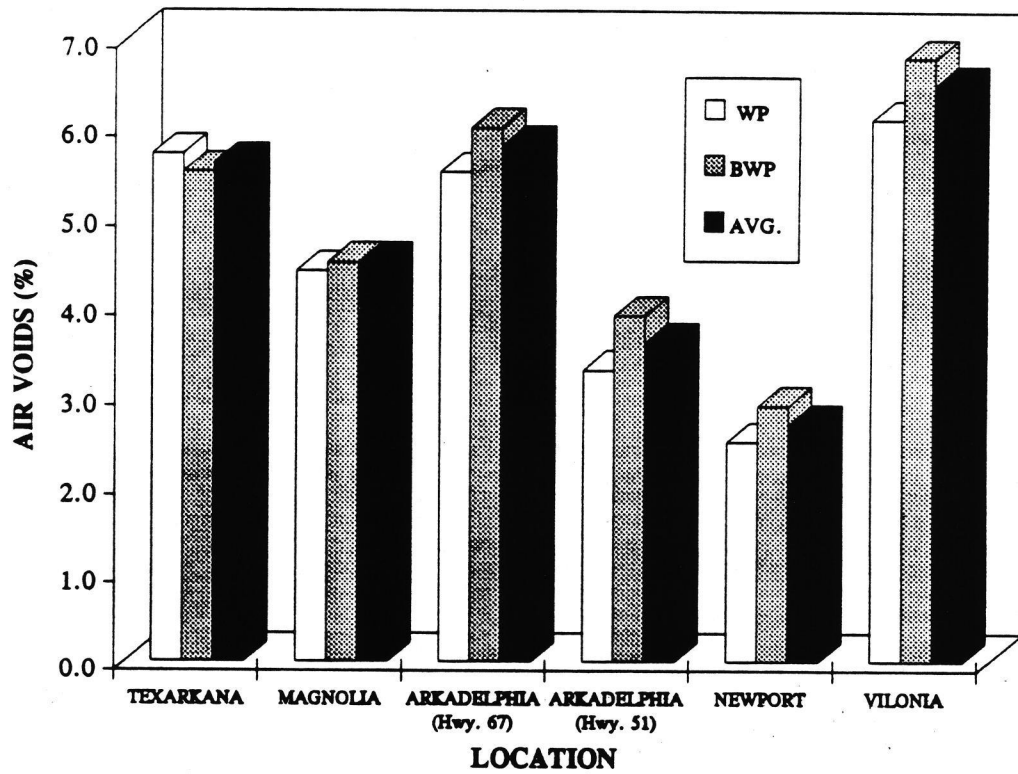
| JOB/<br>LOCATION                | SECTION | AIR VOIDS<br>(%) |     |     | DENSITY<br>(pcf) |       |       | TENSILE STRENGTH<br>(psi) |        |        |
|---------------------------------|---------|------------------|-----|-----|------------------|-------|-------|---------------------------|--------|--------|
|                                 |         | WP               | BWP | AVG | WP               | BWP   | AVG.  | WP                        | BWP    | AVG.   |
| 3000-1<br>30052<br>Texarkana    | GOOD    | 4.8              | 5.2 | 5.0 | 145.2            | 144.6 | 144.9 | 186.73                    | 169.28 | 178.01 |
|                                 | AVG.    | 4.6              | 4.6 | 4.6 | 145.1            | 145.1 | 145.1 | 185.60                    | 194.59 | 190.10 |
|                                 | POOR    | 7.2              | 7.4 | 7.3 | 142.5            | 142.1 | 142.3 | 195.86                    | 172.23 | 185.55 |
| 70010<br>Magnolia               | GOOD    | 4.4              | 3.9 | 4.2 | 140.4            | 141.1 | 140.8 | 200.53                    | 198.91 | 199.72 |
|                                 | AVG.    | 5.0              | 4.8 | 4.9 | 145.2            | 143.2 | 143.2 | 184.38                    | 193.65 | 189.02 |
|                                 | POOR    | 4.2              | 4.4 | 4.3 | 142.9            | 142.5 | 142.7 | 125.06                    | 138.76 | 131.91 |
| 70009<br>Arkadelphia<br>Hwy. 67 | GOOD    | 4.5              | 5.2 | 4.9 | 142.3            | 142.0 | 142.2 | 107.64                    | 108.40 | 108.02 |
|                                 | AVG.    | 4.0              | 4.3 | 4.2 | 143.7            | 143.1 | 143.4 | 101.86                    | 120.98 | 111.42 |
|                                 | POOR    | 7.9              | 8.5 | 8.2 | 138.2            | 137.3 | 137.8 | 106.29                    | 106.95 | 106.62 |
| 70009<br>Arkadelphia<br>Hwy. 51 | GOOD    | 2.8              | 3.3 | 3.1 | 143.6            | 142.8 | 143.2 | 193.40                    | 194.26 | 193.85 |
|                                 | AVG.    | 3.9              | 4.2 | 4.1 | 143.8            | 143.3 | 143.6 | 170.12                    | 171.66 | 170.89 |
|                                 | POOR    | 3.3              | 4.1 | 3.7 | 144.8            | 143.5 | 144.2 | 157.25                    | 157.25 | 157.25 |
| 5918<br>Newport                 | GOOD    | 1.8              | 2.0 | 1.9 | 150.4            | 150.0 | 150.2 | 219.35                    | 215.66 | 217.51 |
|                                 | AVG.    | 2.4              | 2.9 | 2.7 | 150.2            | 149.3 | 149.8 | 256.34                    | 261.19 | 258.77 |
|                                 | POOR    | 3.3              | 3.9 | 3.6 | 149.1            | 148.0 | 148.6 | 240.92                    | 217.79 | 229.36 |
| 8980<br>Vilonia                 | GOOD    | 7.1              | 7.5 | 7.3 | 142.8            | 142.2 | 142.5 | 146.10                    | 133.22 | 139.66 |
|                                 | AVG.    | 7.3              | 8.4 | 7.9 | 142.1            | 140.4 | 141.3 | 131.70                    | 118.32 | 125.01 |
|                                 | POOR    | 4.0              | 4.8 | 4.4 | 147.3            | 146.1 | 146.7 | 251.74                    | 248.77 | 250.26 |

TABLE VI

COMPARISON OF  
AIR VOID (%) VALUES

| LOCATION              | WP  | BWP | AVG. |
|-----------------------|-----|-----|------|
| TEXARKANA             | 5.7 | 5.5 | 5.6  |
| MAGNOLIA              | 4.4 | 4.5 | 4.5  |
| ARKADELPHIA (Hwy. 67) | 5.5 | 6.0 | 5.8  |
| ARKADELPHIA (Hwy. 51) | 3.3 | 3.9 | 3.6  |
| NEWPORT               | 2.5 | 2.9 | 2.7  |
| VILONIA               | 6.1 | 6.8 | 6.5  |

FIGURE III





**TABLE VII**  
**COMPARISON OF**  
**DENSITY (pcf) VALUES**

| LOCATION              | WP    | BWP   | AVG.  |
|-----------------------|-------|-------|-------|
| TEXARKANA             | 144.3 | 143.9 | 144.1 |
| MAGNOLIA              | 142.1 | 142.3 | 142.2 |
| ARKADELPHIA (Hwy. 67) | 141.4 | 140.8 | 141.1 |
| ARKADELPHIA (Hwy. 51) | 144.1 | 143.2 | 143.7 |
| NEWPORT               | 149.9 | 149.1 | 149.5 |
| VILONIA               | 144.1 | 142.9 | 143.5 |

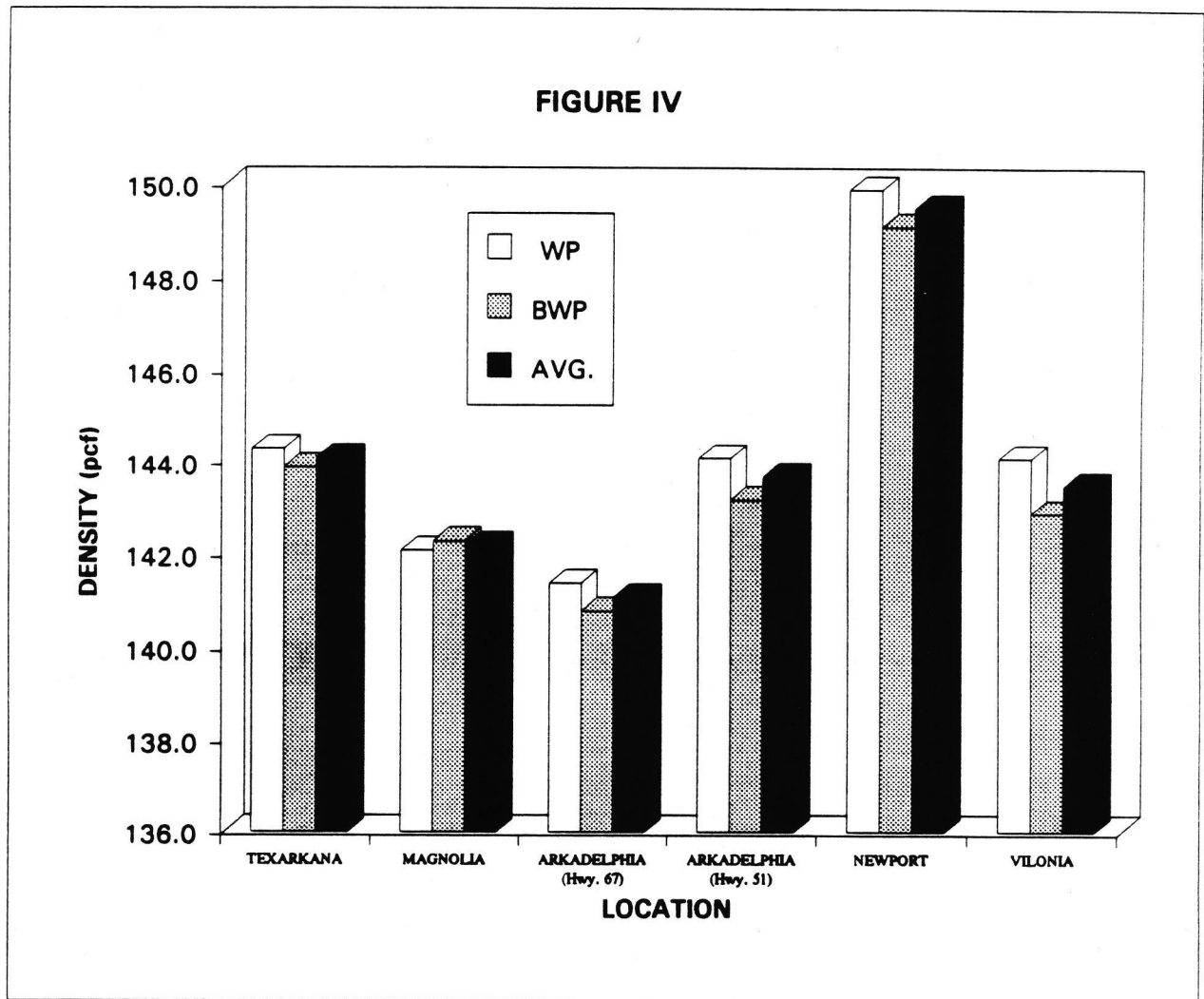
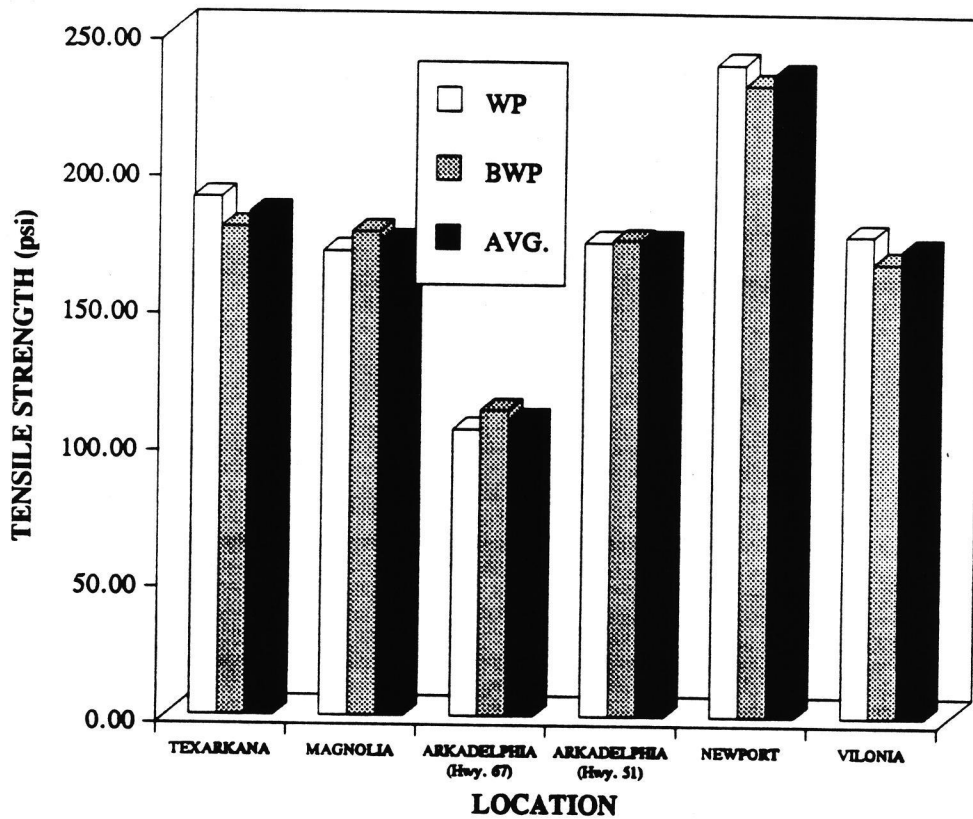


TABLE VIII

COMPARISON OF  
TENSILE (psi) STRENGTHS

| LOCATION              | WP     | BWP    | AVG.   |
|-----------------------|--------|--------|--------|
| TEXARKANA             | 189.40 | 178.70 | 184.05 |
| MAGNOLIA              | 169.99 | 177.11 | 173.55 |
| ARKADELPHIA (Hwy. 67) | 105.20 | 112.19 | 108.70 |
| ARKADELPHIA (Hwy. 51) | 173.59 | 174.39 | 173.99 |
| NEWPORT               | 239.07 | 231.55 | 235.31 |
| VILONIA               | 176.50 | 166.77 | 171.64 |

FIGURE V



**APPENDIX B**  
**SPECIAL PROVISIONS**

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 8980

ASPHALT CONCRETE SURFACE REHABILITATION

**DESCRIPTION.** This item shall consist of rehabilitation of the existing asphalt concrete surface by heating, scarifying and remixing in place material, mixing in new asphalt concrete hot mix surface course and relaying on the existing roadway, in conformity with the lines and grades shown on the plans or as designated by the Engineer.

Asphalt concrete hot mix surface course shall be in accordance with Section 406 of the Standard Specifications for Highway Construction, edition of 1988 except that construction methods specified herein shall govern for new hot mix asphalt concrete when remixed with recovered materials.

**MATERIALS.** Asphalt rejuvenating agent (if required) shall meet the following requirements:

| Property                         | Test Method   | Requirements |      |
|----------------------------------|---------------|--------------|------|
| Min. Max.                        |               |              |      |
| Viscosity at 77°F, (SF)          | AHTD Test 411 | 15           | 100  |
| Sieve test, (%)                  | AASHTO - T59  | --           | 0.10 |
| Residue, (%)                     | AASHTO - T59  | 60           | --   |
| Asphaltenes, (%)                 | ASTM D2006    | --           | 1.0  |
| Residue Tests (From Evaporation) |               |              |      |
| Viscosity at 140°F, (cSt)        | AHTD Test 415 | 75           | 250  |
| Flash Point, (°F)                | AHTD Test 403 | 375          | --   |

**MIX DESIGN** The Contractor shall submit a mix design to the Engineer. This design shall include target values for asphalt content of the recycled mix, penetration of the recovered asphalt cement, and asphalt content of the virgin mix. A minimum asphalt penetration of the recycled mix will be established by the Engineer based upon the results from the mix design. The work involved in furnishing a mix design, including all required revisions, will not be paid for directly but will be considered included in the price bid for Asphalt Concrete Surface Rehabilitation.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 8980

ASPHALT CONCRETE SURFACE REHABILITATION

QUALITY CONTROL The Contractor shall produce a recycled mixture that is not overasphalted or composed of asphalt of insufficient quality. The contractor as a minimum shall perform the following tests on at least one sample per day of the recycled mixture:

1. Determination of Asphalt Content of Bituminous Mixture (AHTD Test 450 or 451 or other approved method)
2. Determination of maximum specific gravity of Bituminous Paving Mixtures (AASHTO T209).
3. Recovery of Asphalt from Solution by Abson Method (AHTD Test Method 422).
4. Penetration of Bituminous Materials (AHTD Test Method 404)

The rejuvenating agent shall be added at a rate to produce a recycled asphalt penetration value above the predetermined minimum. If a daily sample fails to meet this requirement two (2) additional samples will be randomly taken at 2 other locations representing the failing days production. If any one of these tests fails, that days production may be subject to removal or acceptance at a reduced price. The penetration sample shall become the property of the Department after testing for verification.

The Contractor shall split all samples of asphalt mix taken for extraction and recovery, and for maximum specific gravity. One half of each sample shall be delivered to the Engineer. The Engineer will randomly test this portion of the samples for the purpose of checking the Contractor's procedures and results. All daily test results shall be made available to the Engineer. The Contractor shall also plot the test results, and make the plots available to the Engineer. All test results and plots shall be made available to the Engineer by 12:00 P.M. of the following working day.

The work involved in providing quality control will not be paid for directly but will be considered included in the price bid for Asphalt Concrete Surface Rehabilitation.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 8980

ASPHALT CONCRETE SURFACE REHABILITATION

EQUIPMENT

(a) Processing Equipment. The equipment for heating, scarifying, remixing, and repaving shall be as approved by the Engineer and shall consist of the following:

- (1) A heating mechanism capable of heating the asphalt concrete pavement to a temperature high enough to allow scarification of the material to the specified depth without breaking aggregate particles, without charring the existing asphalt, and without producing undesirable pollutants. The heating mechanism shall be so equipped that heat application shall be under an enclosed or shielded hood.
- (2) A leveling mechanism capable of gathering the heated and scarified material into a windrow or otherwise collecting for remixing.
- (3) A system for adding and uniformly blending new asphalt and/or rejuvenating agent with the reclaimed mix during the remixing and leveling operation. The application rate for the added material shall be synchronized with the machine speed to provide uniform application.
- (4) A system for uniformly mixing new asphalt concrete hot mix surface course with the scarified mixture to provide a homogeneous mix and distributing the blended mixture over the width being processed and finished so as to produce a uniform cross section and surface.

(b) Rollers. Rollers shall be in accordance with Section 409 of the Standard Specifications.

CONSTRUCTION METHODS

(a) General. The pavement surface to be rehabilitated shall be cleaned of all dirt and other objectional material by blading, brooming or other approved methods, prior to beginning heating and scarification operations.

(b) Heating, scarifying and placing. The pavement surface shall be evenly heated, scarified and reworked to the widths and depths shown on the plans. Heating shall be controlled shown on the plans. Heating shall be controlled to assure uniform heat penetration without causing differential softening of the sur-



ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 8980

ASPHALT CONCRETE SURFACE REHABILITATION

faces. Charring of the asphalt will not be permitted. The scarified material shall be gathered by the leveling device, remixed and relaid. Rejuvenating agent, if required, shall be applied uniformly to the scarified material prior to remixing and leveling unless otherwise approved by the Engineer. The rate of application shall be as determined by the Engineer based on laboratory tests on pavement samples.

The required amount of new asphalt concrete hot mix surface course shall be added, thoroughly mixed with the scarified material, laid and compacted.

The heated and scarified material shall have a temperature in a range between 200°F and 265°F as measured immediately behind the scarifier. The Engineer will select the temperature within these limitations, and the mixture shall not vary from this selected temperature by more than 25°F and shall remain within the above limits.

Care shall be taken to protect adjacent traffic from heat damage. There shall be no burning of trees, shrubs, or other landscaping adjacent to the pavement. It shall be the responsibility of the Contractor to protect the adjacent landscaping from heat damage. This protection may consist of individual shielding and/or water spray or other methods approved by the Engineer. The repair of any damage resulting from the Contractor operation shall be made at no cost to the State.

When a pass is made adjacent to a previously placed mat, the longitudinal joint shall extend at least two inches horizontally into the previously placed mat. Other methods approved by the Engineer may be used that insure a tight joint between the mats.

(c) Compaction. Compaction will begin before the mat temperature drops below 190°F. All rolling shall be completed before the mixture temperature drops below 175°F unless determined by the Engineer that a higher minimum compaction temperature is required for proper compaction.

Compaction of an inplace recycled mix is known to vary with the asphalt content of the recycled mix, the amount of rejuvenator required to soften the mix, and the asphalt content of the virgin mix. To avoid overasphalting and compaction to greater than 97% density, the Engineer may allow a reduction in the asphalt content of the virgin asphalt mix up to 0.4% from the target value provided the Contractor can show proof of improvement in the

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**

**SPECIAL PROVISION**

**JOB 8980**

**ASPHALT CONCRETE SURFACE REHABILITATION**

recycled mix from such an adjustment. No increase in asphalt content will be allowed to aid in meeting minimum density requirements.

**METHOD OF MEASUREMENT.** Asphalt Concrete Surface Rehabilitation will be measured by the square yard. Rejuvenating agent will be measured from a calibrated meter used to dispense the rejuvenator and checked by calculating application rate from amount of rejuvenator used and square yards treated. Asphalt concrete hot mix surface course shall be measured in accordance with Section 406.

**BASIS OF PAYMENT.** Work completed and accepted and measured as described above will be paid for as follows:

(a) Asphalt Concrete Surface Rehabilitation shall be paid for at the unit price bid per square yard for "Asphalt Concrete Surface Rehabilitation", which price shall be full compensation for cleaning existing pavement; for all heating and scarifying; for mixing of new and existing material and labor, tools, equipment and incidentals necessary to complete the work.

(b) Rejuvenating agent shall be paid for at the contract unit price bid per gallon for rejuvenating agent.

(c) Asphalt Concrete Hot Mix Surface Course shall be paid for in accordance with Section 406.

Payment will be made under:

| <b><u>Pay Item</u></b>                  | <b><u>Pay Unit</u></b> |
|---|------------------------|
| Asphalt Concrete Surface Rehabilitation | Square Yard            |
| Rejuvenating Agent                      | Gallon                 |

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 70010

ASPHALT CONCRETE SURFACE REHABILITATION

**DESCRIPTION.** This item shall consist of rehabilitation of the existing asphalt concrete surface by heating, scarifying and remixing in place material, mixing in new asphalt concrete hot mix surface course and relaying on the existing roadway, in conformity with the lines and grades shown on the plans or as designated by the Engineer.

Asphalt concrete hot mix surface course shall be in accordance with Section 406 of the Standard Specifications for Highway Construction, edition of 1988 except that construction methods specified herein shall govern for new hot mix asphalt concrete when remixed with recovered materials.

**MATERIALS.** Asphalt rejuvenating agent (if required) shall meet the following requirements:

| Property                         | Test Method   | Requirements |      |
|----------------------------------|---------------|--------------|------|
| Min. Max.                        |               |              |      |
| Viscosity at 77°F, (SF)          | AHTD Test 411 | 15           | 100  |
| Sieve test, (%)                  | AASHTO - T59  | --           | 0.10 |
| Residue, (%)                     | AASHTO - T59  | 60           | --   |
| Asphaltenes, (%)                 | ASTM D2006    | --           | 1.0  |
| Residue Tests (From Evaporation) |               |              |      |
| Viscosity at 140°F, (cSt)        | AHTD Test 415 | 75           | 250  |
| Flash Point, (°F)                | AHTD Test 403 | 375          | --   |

**MIX DESIGN** The Contractor shall submit a mix design to the Engineer. This design shall include target values for asphalt content of the recycled mix, penetration of the recovered asphalt cement, and asphalt content of the virgin mix. A minimum asphalt penetration of the recycled mix will be established by the Engineer based upon the results from the mix design. The work involved in furnishing a mix design, including all required revisions, will not be paid for directly but will be considered included in the price bid for Asphalt Concrete Surface Rehabilitation.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 70010

ASPHALT CONCRETE SURFACE REHABILITATION

QUALITY CONTROL The Contractor shall produce a recycled mixture that is not overasphalted or composed of asphalt of insufficient quality. The contractor as a minimum shall perform the following tests on at least one sample per day of the recycled mixture:

1. Determination of Asphalt Content of Bituminous Mixture (AHTD Test 450 or 451 or other approved method)
2. Determination of maximum specific gravity of Bituminous Paving Mixtures (AASHTO T209).
3. Recovery of Asphalt from Solution by Abson Method (AHTD Test Method 422).
4. Penetration of Bituminous Materials (AHTD Test Method 404)

The rejuvenating agent shall be added at a rate to produce a recycled asphalt penetration value above the predetermined minimum. If a daily sample fails to meet this requirement two (2) additional samples will be randomly taken at 2 other locations representing the failing days production. If any one of these tests fails, that days production may be subject to removal or acceptance at a reduced price. The penetration sample shall become the property of the Department after testing for verification.

The Contractor shall split all samples of asphalt mix taken for extraction and recovery, and for maximum specific gravity. One half of each sample shall be delivered to the Engineer. The Engineer will randomly test this portion of the samples for the purpose of checking the Contractor's procedures and results. All daily test results shall be made available to the Engineer. The Contractor shall also plot the test results, and make the plots available to the Engineer. All test results and plots shall be made available to the Engineer by 12:00 P.M. of the following working day.

The work involved in providing quality control will not be paid for directly but will be considered included in the price bid for Asphalt Concrete Surface Rehabilitation.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 70010

ASPHALT CONCRETE SURFACE REHABILITATION

EQUIPMENT

(a) Processing Equipment. The equipment for heating, scarifying, remixing, and repaving shall be as approved by the Engineer and shall consist of the following:

- (1) A heating mechanism capable of heating the asphalt concrete pavement to a temperature high enough to allow scarification of the material to the specified depth without breaking aggregate particles, without charring the existing asphalt, and without producing undesirable pollutants. The heating mechanism shall be so equipped that heat application shall be under an enclosed or shielded hood.
- (2) A leveling mechanism capable of gathering the heated and scarified material into a windrow or otherwise collecting for remixing.
- (3) A system for adding and uniformly blending new asphalt and/or rejuvenating agent with the reclaimed mix during the remixing and leveling operation. The application rate for the added material shall be synchronized with the machine speed to provide uniform application.
- (4) A system for uniformly mixing new asphalt concrete hot mix surface course with the scarified mixture to provide a homogeneous mix and distributing the blended mixture over the width being processed and finished so as to produce a uniform cross section and surface.

(b) Rollers. Rollers shall be in accordance with Section 409 of the Standard Specifications.

CONSTRUCTION METHODS

(a) General. The pavement surface to be rehabilitated shall be cleaned of all dirt and other objectional material by blading, brooming or other approved methods, prior to beginning heating and scarification operations.

(b) Heating, scarifying and placing. The pavement surface shall be evenly heated, scarified and reworked to the widths and depths shown on the plans. Heating shall be controlled shown on the plans. Heating shall be controlled to assure uniform heat penetration without causing differential softening of the sur-

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 70010

ASPHALT CONCRETE SURFACE REHABILITATION

faces. Charring of the asphalt will not be permitted. The scarified material shall be gathered by the leveling device, remixed and relaid. Rejuvenating agent, if required, shall be applied uniformly to the scarified material prior to remixing and leveling unless otherwise approved by the Engineer. The rate of application shall be as determined by the Engineer based on laboratory tests on pavement samples.

The required amount of new asphalt concrete hot mix surface course shall be added, thoroughly mixed with the scarified material, laid and compacted.

The heated and scarified material shall have a temperature in a range between 200°F and 265°F as measured immediately behind the scarifier. The Engineer will select the temperature within these limitations, and the mixture shall not vary from this selected temperature by more than 25°F and shall remain within the above limits.

Care shall be taken to protect adjacent traffic from heat damage. There shall be no burning of trees, shrubs, or other landscaping adjacent to the pavement. It shall be the responsibility of the Contractor to protect the adjacent landscaping from heat damage. This protection may consist of individual shielding and/or water spray or other methods approved by the Engineer. The repair of any damage resulting from the Contractor operation shall be made at no cost to the State.

When a pass is made adjacent to a previously placed mat, the longitudinal joint shall extend at least two inches horizontally into the previously placed mat. Other methods approved by the Engineer may be used that insure a tight joint between the mats.

(c) Compaction. Compaction will begin before the mat temperature drops below 190°F. All rolling shall be completed before the mixture temperature drops below 175°F unless determined by the Engineer that a higher minimum compaction temperature is required for proper compaction.

Compaction of an in-place recycled mix is known to vary with the asphalt content of the recycled mix, the amount of rejuvenator required to soften the mix, and the asphalt content of the virgin mix. To avoid overasphalting and compaction to greater than 97% density, the Engineer may allow a reduction in the asphalt content of the virgin asphalt mix up to 0.4% from the target value provided the Contractor can show proof of improvement in the



ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 70010

ASPHALT CONCRETE SURFACE REHABILITATION

recycled mix from such an adjustment. No increase in asphalt content will be allowed to aid in meeting minimum density requirements.

METHOD OF MEASUREMENT. Asphalt Concrete Surface Rehabilitation will be measured by the square yard. Rejuvenating agent will be measured from a calibrated meter used to dispense the rejuvenator and checked by calculating application rate from amount of rejuvenator used and square yards treated. Asphalt concrete hot mix surface course shall be measured in accordance with Section 406.

BASIS OF PAYMENT. Work completed and accepted and measured as described above will be paid for as follows:

(a) Asphalt Concrete Surface Rehabilitation shall be paid for at the unit price bid per square yard for "Asphalt Concrete Surface Rehabilitation", which price shall be full compensation for cleaning existing pavement; for all heating and scarifying; for mixing of new and existing material and labor, tools, equipment and incidentals necessary to complete the work.

(b) Rejuvenating agent shall be paid for at the contract unit price bid per gallon for rejuvenating agent.

(c) Asphalt Concrete Hot Mix Surface Course shall be paid for in accordance with Section 406.

Payment will be made under:

Pay Item

Pay Unit

Asphalt Concrete Surface Rehabilitation

Square Yard

Rejuvenating Agent

Gallon



ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 70010

ASPHALT CEMENT USED IN VIRGIN ASPHALT  
CONCRETE ADMIXTURE

Asphalt cement used to produce Asphalt Concrete Hot Mix Surface Course (Type 2) for mixing with the recycled asphalt pavement shall be in accordance with Section 409 of the Standard Specifications for Highway Construction, edition of 1988 except where modified herein.

The grade of asphalt cement shall be an AC-20 and have a minimum penetration value of 65 at 77°F.

The Type 2 Asphalt Concrete Surface Course made with this asphalt cement shall meet all the requirements of Sections 404 and 406. An approved mix design will be required.

While Type 2 Asphalt Concrete Surface Course is being supplied to this job, this mix will be acceptable for other jobs using Type 2 Asphalt Concrete Surface Course provided all the requirements of Division 400 are met.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 30052

ALTERNATE NO. 1

ASPHALT CONCRETE SURFACE REHABILITATION

EQUIPMENT

(a) Processing Equipment. The equipment for heating, scarifying, remixing, and repaving shall be as approved by the Engineer and shall consist of the following:

- (1) A heating mechanism capable of heating the asphalt concrete pavement to a temperature high enough to allow scarification of the material to the specified depth without breaking aggregate particles, without charring the existing asphalt, and without producing undesirable pollutants. The heating mechanism shall be so equipped that heat application shall be under an enclosed or shielded hood.
- (2) A leveling mechanism capable of gathering the heated and scarified material into a windrow or otherwise collecting for remixing.
- (3) A system for adding and uniformly blending new asphalt and/or rejuvenating agent with the reclaimed mix during the remixing and leveling operation. The application rate for the added material shall be synchronized with the machine speed to provide uniform application.
- (4) A system for uniformly mixing new asphalt concrete hot mix surface course with the scarified mixture to provide a homogeneous mix and distributing the blended mixture over the width being processed and finished so as to produce a uniform cross section and surface.
- (5) A positive method of determining depth scarified and total depth of blended mixture.

(b) Rollers. Rollers shall be in accordance with Section 409 of the Standard Specifications.

CONSTRUCTION METHODS

(a) General. The pavement surface to be rehabilitated shall be cleaned of all dirt and other objectionable material by blading, brooming or other approved methods, prior to beginning heating and scarification operations.

ARKANSAS HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 30052

ALTERNATE NO. 1

ASPHALT CONCRETE SURFACE REHABILITATION

(b) Heating, scarifying and placing. The pavement surface shall be evenly heated, scarified and reworked to the widths and depths shown on the plans. Heating shall be controlled as shown on the plans. Heating shall be controlled to assure uniform heat penetration without causing differential softening of the surfaces. Charring of the asphalt will not be permitted. The scarified material shall be gathered by the leveling device, remixed and relaid. Rejuvenating agent, if required, shall be applied uniformly to the scarified material prior to remixing and leveling unless otherwise approved by the Engineer. The rate of application shall be as determined by the Engineer based on laboratory tests on pavement samples.

The required amount of new asphalt concrete hot mix surface course shall be added, thoroughly mixed with the scarified material, laid and compacted.

The Engineer will establish a mixing temperature between 200°F and 265°F. The temperature of the heated and scarified material, measured immediately behind the scarifier, shall not vary more than 25°F from the mixing temperature and shall be between 200°F and 265°F.

Care shall be taken to protect adjacent traffic from heat damage. There shall be no burning of trees, shrubs, or other landscaping adjacent to the pavement. It shall be the responsibility of the contractor to protect the adjacent landscaping from heat damage. This protection may consist of individual shielding and/or water spray or other methods approved by the Engineer. The repair of any damage resulting from the contractor operation shall be made at no cost to the State.

When a pass is made adjacent to a previously placed mat, the longitudinal joint shall extend at least two inches horizontally into the previously placed mat. Other methods approved by the Engineer may be used that insure a tight joint between the mats.

(c) Compaction. Compaction will begin before mat temperature drops more than 10°F below the lower limit of the mixing temperature range. All rolling shall be completed before the mat temperature drops more than 25°F below the lower limit of the mixing temperature range.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT  
SPECIAL PROVISION

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ALTERNATE NO. 1

ASPHALT CONCRETE SURFACE REHABILITATION

Compaction of an in place recycled mix is known to vary with the asphalt content of the recycled mix, the amount of rejuvenator required to soften the mix, and the asphalt content of the virgin mix. To avoid overasphalting and compaction to greater than 97% density, the Engineer may allow a reduction in the asphalt content of the virgin asphalt mix up to 0.4% from the target value provided the contractor can show proof of improvement in the recycled mix from such an adjustment. No increase in asphalt content will be allowed to aid in meeting minimum density requirements.

METHOD OF MEASUREMENT. Asphalt Concrete Surface Rehabilitation will be measured by the square yard. Rejuvenating agent will be measured from a calibrated meter used to dispense the rejuvenator. Asphalt concrete hot mix surface course shall be measured in accordance with Section 406.

BASIS OF PAYMENT. Work completed and accepted and measured as described above will be paid for as follows:

Asphalt Concrete Surface Rehabilitation shall be paid for at the unit price bid per square yard for "Asphalt Concrete Surface Rehabilitation", which price shall be full compensation for cleaning existing pavement; for all heating and scarifying; for adding of new material and rejuvenating agent, for mixing of new and existing material and labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

| <u>Pay Item</u>                         | <u>Pay Unit</u> |
|---|-----------------|
| Asphalt Concrete Surface Rehabilitation | Square Yard     |

## ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

## SPECIAL PROVISION

JOB 30052

ALTERNATE NO. 1

## ASPHALT CONCRETE SURFACE REHABILITATION

DESCRIPTION. This item shall consist of rehabilitation of the existing asphalt concrete surface by heating, scarifying and remixing in place material, mixing in new asphalt concrete hot mix surface course and relaying on the existing roadway, in conformity with the lines and grades shown on the plans or as designated by the Engineer.

Asphalt concrete hot mix surface course shall be in accordance with Section 406 of the Standard Specifications for Highway Construction, edition of 1988 except that construction methods specified herein shall govern for new hot mix asphalt concrete when remixed with recovered materials.

MATERIALS. Asphalt rejuvenating agent (if required) shall meet the following requirements:

| Property                | Test Method   | Requirements |      |
|-------------------------|---------------|--------------|------|
|                         |               | Min.         | Max. |
| Viscosity at 77°F, (SF) | AHTD Test 411 | 15           | 100  |
| Sieve test, (%)         | AASHTO - T59  | --           | 0.10 |
| Residue, (%)            | AASHTO - T59  | 60           | --   |
| Asphaltenes, (%)        | ASTM D2006    | --           | 1.0  |

## Residue Tests (From Evaporation)

|                           |               |     |     |
|---------------------------|---------------|-----|-----|
| Viscosity at 140°F, (cSt) | AHTD Test 415 | 75  | 250 |
| Flash Point, (°F)         | AHTD Test 403 | 375 | --  |

MIX DESIGN. The contractor shall submit a mix design to the Engineer. This design shall include target values for asphalt content of the recycled mix, penetration of the recovered asphalt cement, and asphalt content of the virgin mix. A minimum asphalt penetration of the recycled mix will be established by the Engineer based upon the results from the mix design. The work involved in furnishing a mix design, including all required revisions, will not be paid for directly but will be considered included in the price bid for Asphalt Concrete Surface Rehabilitation.

## ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

## SPECIAL PROVISION

JOB NO. 30052

ALTERNATE NO. 2

## ASPHALT CONCRETE SURFACE REHABILITATION

QUALITY CONTROL. The Contractor shall produce a recycled mixture that is not overasphalted or composed of asphalt of insufficient quality. The contractor as a minimum shall perform the following tests on at least one sample per day of the recycled mixture:

1. Determination of Asphalt Content of Bituminous Mixture (AHTD Test 450 or 451 or other approved method).
2. Determination of maximum specific gravity of Bituminous Paving Mixtures (AASHTO T209).
3. Recovery of Asphalt from Solution by Abson Method (AHTD Test Method 422).
4. Penetration of Bituminous Materials (AHTD Test Method 404).

The rejuvenating agent shall be added at a rate to produce a recycled asphalt penetration value above the predetermined minimum. If a daily samplet fails to meet this requirement two(2) additional samples will be randomly taken at 2 other locations representing the failing day's production. If any one of these tests fails, that day's production will be subject to removal or acceptance at a reduced price. The penetration sample shall become the property of the Department after testing for verification.

The contractor shall split all samples of asphalt mix taken for extraction and recovery, and for maximum specific gravity. One half of each sample shall be delivered to the Engineer. The Engineer will randomly test this portion of the samples for the purpose of checking the contractor's procedures and results. All daily test results shall be made available to the Engineer. The contractor shall also plot the test results, and make the plots available to the Engineer. All test results and plots shall be made available to the Engineer by 12:00 P.M. of the following working day.

The work involved in providing quality control will not be paid for directly but will be considered included in the price bid for Asphalt Concrete Surface Rehabilitation.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB NO. 30052

ALTERNATE NO. 2

ASPHALT CONCRETE SURFACE REHABILITATION .

EQUIPMENT

(a) Processing Equipment. The equipment for heating, scarifying, remixing, and repaving shall be as approved by the Engineer and shall consist of the following:

- (1) A heating mechanism capable of heating the asphalt concrete pavement to a temperature high enough to allow scarification of the material to the specified depth without breaking aggregate particles, without charring the existing asphalt, and without producing undesirable pollutants. The heating mechanism shall be so equipped that heat application shall be under an enclosed or shielded hood.
- (2) A system for adding and uniformly blending new asphalt and/or rejuvenating agent with the reclaimed mix during the remixing and leveling operation. The application rate for the added material shall be synchronized with the machine speed to provide uniform application.
- (3) A positive method of determining depth scarified and total depth of reclaimed and new asphalt mix.

(b) Rollers. Rollers shall be in accordance with Section 409 of the Standard Specifications.

CONSTRUCTION METHODS

(a) General. The pavement surface to be rehabilitated shall be cleaned of all dirt and other objectionable material by blading, brooming or other approved methods, prior to beginning heating and scarification operations.

(b) Heating, scarifying and placing. The pavement surface shall be evenly heated, scarified and reworked to the widths and depths shown on the plans. Heating shall be controlled as shown on the plans. Heating shall be controlled to assure uniform heat penetration without causing differential softening of the surfaces. Charring of the asphalt will not be permitted. Rejuvenating agent, if required, shall be applied uniformly to the scarified material prior to remixing and leveling unless otherwise approved by the Engineer. The rate of application shall be as determined by the Engineer based on laboratory tests on pavement samples.



## ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

## SPECIAL PROVISION

JOB NO. 30052

ALTERNATE NO. 2

## ASPHALT CONCRETE SURFACE REHABILITATION

The required amount of new asphalt concrete hot mix surface course shall be added, laid and compacted.

The Engineer will establish a mixing temperature between 200°F and 265°F. The temperature of the heated and scarified material, measured immediately behind the scarifier, shall not vary more than 25°F from the mixing temperature and shall be between 200°F and 265°F.

Care shall be taken to protect adjacent traffic from heat damage. There shall be no burning of trees, shrubs, or other landscaping adjacent to the pavement. It shall be the responsibility of the contractor to protect the adjacent landscaping from heat damage. This protection may consist of individual shielding and/or water spray or other methods approved by the Engineer. The repair of any damage resulting from the contractor operation shall be made at no cost to the State.

When a pass is made adjacent to a previously placed mat, the longitudinal joint shall extend at least two inches horizontally into the previously placed mat. Other methods approved by the Engineer may be used that insure a tight joint between the mats.

(c) Compaction. Compaction will begin before the mat temperature drops more than 10°F below the lower limit of the mixing temperature range. All rolling shall be completed before the mat temperature drops more than 25°F below the lower limit of the mixing temperature range.

No increase in asphalt content will be allowed to aid in meeting minimum density requirements.

METHOD OF MEASUREMENT. Asphalt Concrete Surface Rehabilitation will be measured by the square yard. Rejuvenating agent will be measured from a calibrated meter used to dispense the rejuvenator. Asphalt concrete hot mix surface course shall be measured in accordance with Section 406:

BASIS OF PAYMENT. Work completed and accepted and measured as described above will be paid for as follows:

(a) Asphalt Concrete Surface Rehabilitation shall be paid for at the unit price bid per square yard for "Asphalt Concrete Surface Rehabilitation", which price shall be full compensation

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB NO. 30052

ALTERNATE NO. 2

ASPHALT CONCRETE SURFACE REHABILITATION

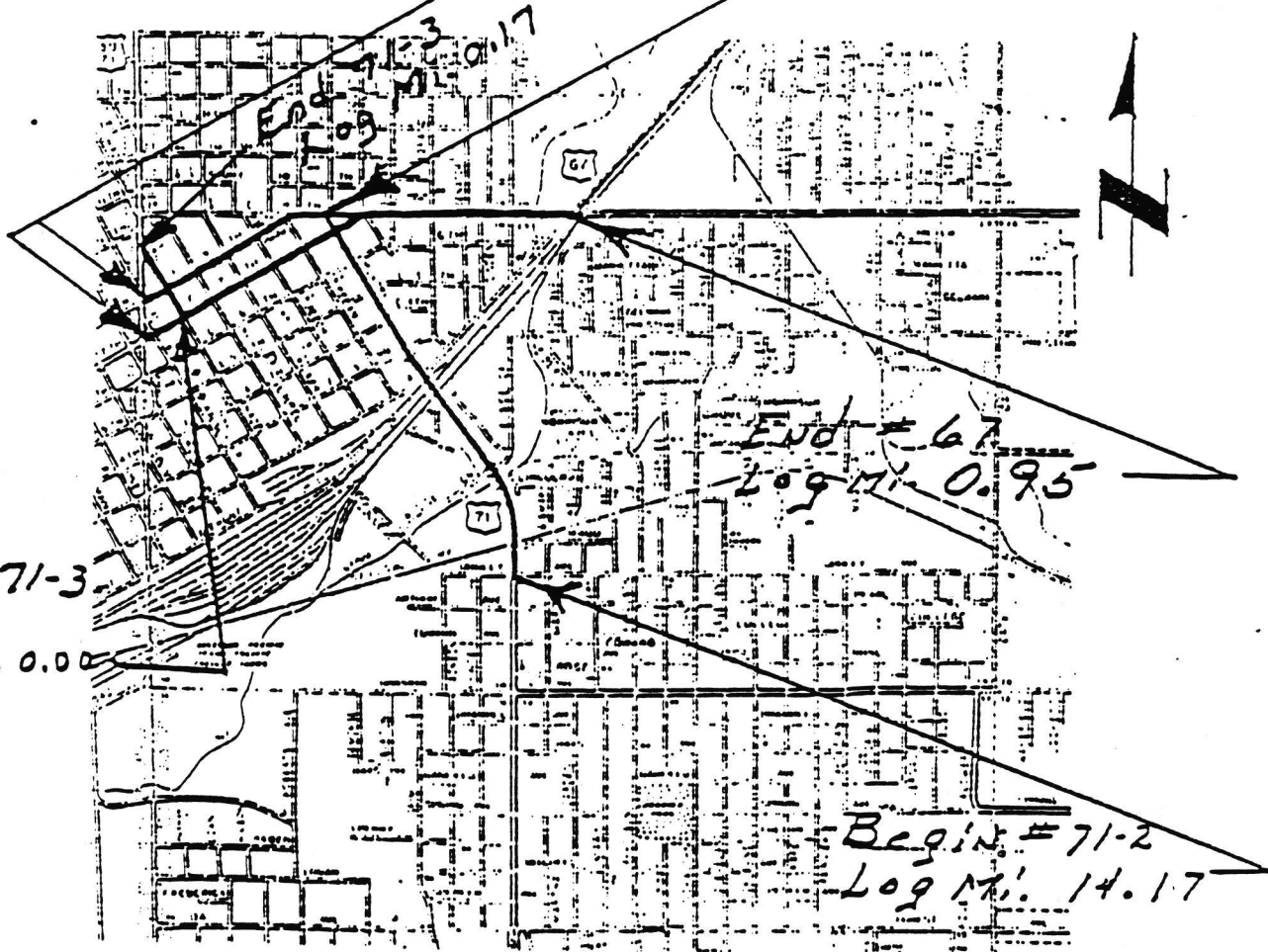
for cleaning existing pavement; for all heating and scarifying; for furnishing and placing rejuvenating agent and Asphalt Concrete Surface Course Type II, and labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

| <u>Pay Item</u>                         | <u>Pay Unit</u> |
|---|-----------------|
| Asphalt Concrete Surface Rehabilitation | Square Yard     |

Begin # 67  
Log Mi. 0.00

End # 71-2  
Log Mi. 14.99



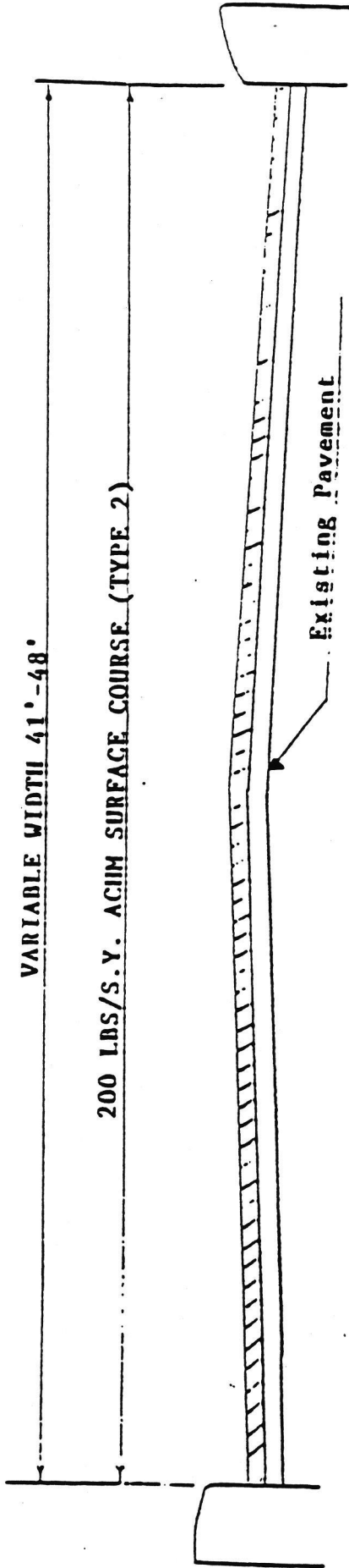
Job No. 30052  
HWYS. 67 & 71 REHABILITATION (SEL SECS.) (TEXARKANA)  
Route 67, section 1  
Route 71, section 2 & 3  
Miller County

TYPICAL SECTION

HWY. 71, S-3 LOG MILE 0.00-LOG MILE 0.17

VARIABLE WIDTH 41'-48"

200 LBS/S.Y. ACIM SURFACE COURSE (TYPE 2)



JOB NO. 30052

HWYS. 67 & 71 REHABILITATION (SEL. SECS.) (TEXARKANA)

Route 67, Sec. 1

Route 71, Sec. 2 & 3

Miller County

- Notes:
1. The contractor shall provide 2-way radio communication for flag persons.
  2. Stringline will be used to maintain a uniform horizontal alignment.
  3. The contractor shall furnish and maintain Std. W-8 "Dump" signs (30"x30") with black legend on orange background at all transverse joints exposed to traffic.
  4. Asphalt used for leveling shall be laid as directed by the Engineer.



ASPHALT REHABILITATION QUANTITIES  
ALTERNATE NO. 1 OR ALTERNATE NO. 2

| ROUTE   | SEC. | LOG MI. | LOG MI. | LENGTH<br>(Mile)         | WIDTH<br>(Ft.) | AREA<br>(Sq. Yd.) |
|---------|------|---------|---------|--------------------------|----------------|-------------------|
| 67      | 1    |         |         |                          |                |                   |
| 7th St. |      | 0.00    | 0.53    | 0.53                     | 40             | 14,925            |
| 8th St. |      | 0.00    | 0.48    | 0.48                     | 48             | 13,517            |
| 67      | 1    | 0.53    | 0.95    | 0.42                     | 48             | 11,827            |
|         |      |         |         | <u>TOTAL FOR #67</u>     | <u>1.43</u>    | <u>40,269</u>     |
| 71      | 2    | 14.17   | 14.99   | 0.82                     | 48             | 23,091            |
|         |      |         |         | <u>TOTAL FOR #71</u>     | <u>0.82</u>    | <u>23,091</u>     |
|         |      |         |         | <u>TOTAL FOR PROJECT</u> | <u>2.25</u>    | <u>63,360</u>     |

JOB NO. 30052

HWY 67 & 71 REHABILITATION (SEC. SECS.) (TEXARKANA)

ROUTE 67, SEC. 1

ROUTE 71, SEC. 2/3

Miller COUNTY

TEMPORARY PAVEMENT MARKING QUANTITIES

| ROUTE      | SECTION | LOG MILE | LENGTH | QUANTITY @4' in 40' | Unit     |
|------------|---------|----------|--------|---------------------|----------|
| 67         | 1       |          |        |                     |          |
| 7th Street |         | 0.00     | 0.53   | 840                 | Lin. Ft. |
| 8th Street |         | 0.00     | 0.48   | 760                 | Lin. Ft. |
| 67         | 1       | 0.53     | 0.42   | 887                 | Lin. Ft. |
| 71         | 2       | 14.17    | 0.82   | 1732                | Lin. Ft. |
| 71         | 3       | 0.00     | 0.13   | 137                 | Lin. Ft. |
| 71         | 3       | 0.13     | 0.04   | 63                  | Lin. Ft. |
| TOTAL      |         |          |        | 4419                | Lin. Ft. |

REMOVAL OF TEMPORARY PAVEMENT MARKING QUANTITIES

| ROUTE      | SECTION | LOG MILE | LENGTH | QUANTITY @4' in 40' | Unit     |
|------------|---------|----------|--------|---------------------|----------|
| 67         | 1       |          |        |                     |          |
| 7th Street |         | 0.00     | 0.53   | 840                 | Lin. Ft. |
| 8th Street |         | 0.00     | 0.48   | 760                 | Lin. Ft. |
| 67         | 1       | 0.53     | 0.42   | 887                 | Lin. Ft. |
| 71         | 2       | 14.17    | 0.88   | 1732                | Lin. Ft. |
| 71         | 3       | 0.00     | 0.13   | 137                 | Lin. Ft. |
| 71         | 3       | 0.13     | 0.04   | 63                  | Lin. Ft. |
| TOTAL      |         |          |        | 4419                | Lin. Ft. |

TOTAL

4419

Lin Ft.

JOB NO. 30052

HWYS. 67 & 71 REHABILITATION (SEL. SECS.) (MARKALAP)

IMV. 67, SECTION 1

IMV. 71, SECTION 2

IMV. 71, SECTION 3

Miller COUNTY





**APPENDIX C**  
**PHOTOGRAPHS**



View of In-Place Recycling Operation



Infra-red Panels Preheat Pavement





Infra-red Panels Heating Existing Pavement

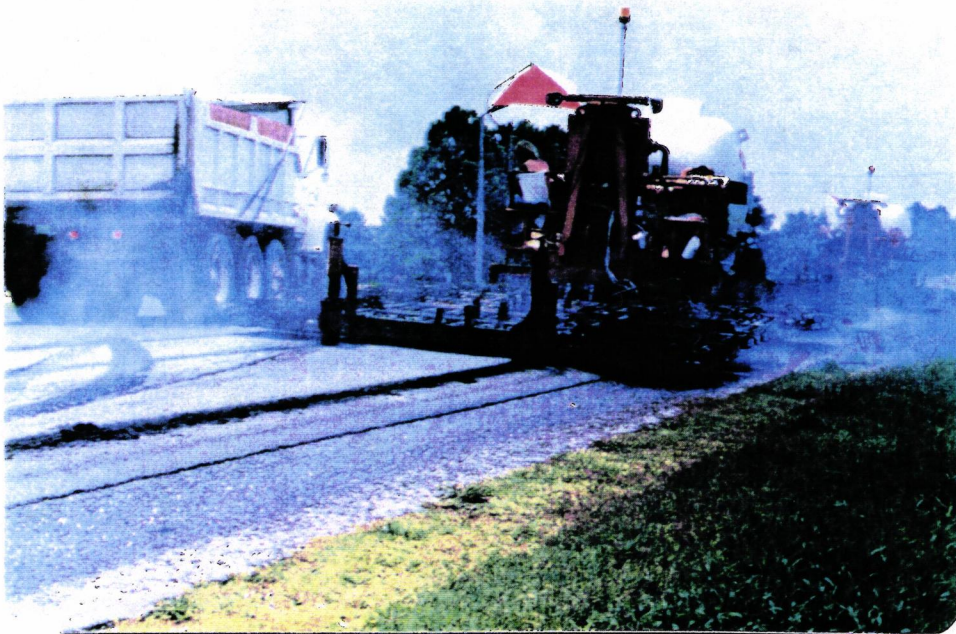


Paver Pauses as New Hot Mix is Delivered



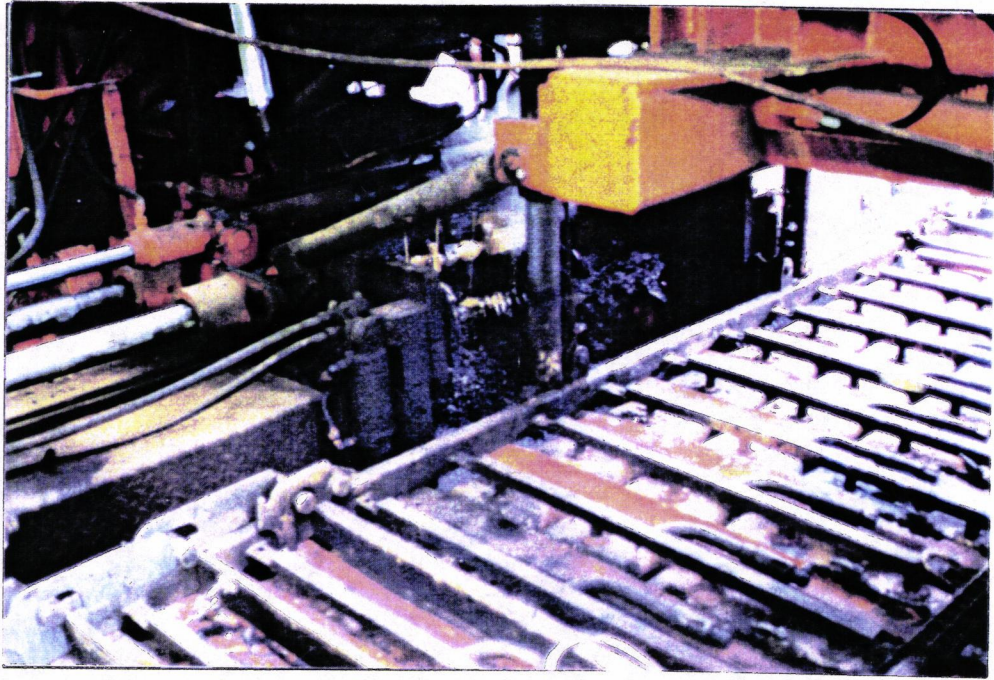


Virgin Hot Mix is Delivered to Receiving Hopper

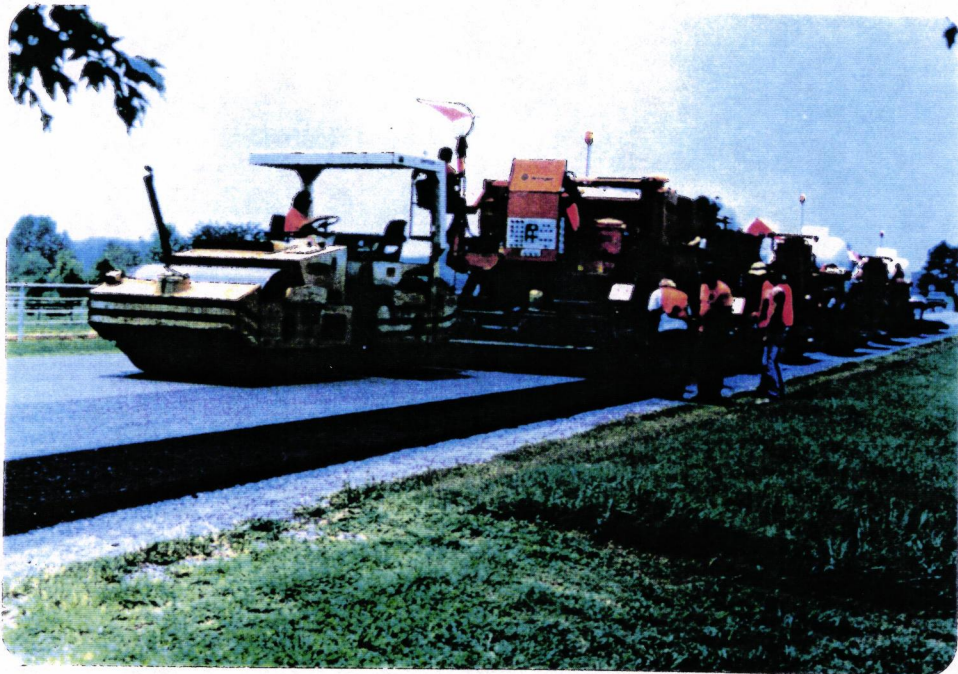


Truck Leaves Job After Unloading New Mix





Rejuvenating Agent is Added to Mix



Vibratory Steel-Wheeled Roller Compacts New Surface





View from Hopper Back to Heating Panels



View of New In-Place Recycled Surface





Checking Temperature of Recycled Mat



Vilonia Good Section (4 years after const.)





Newport Good Section (5 years after const.)

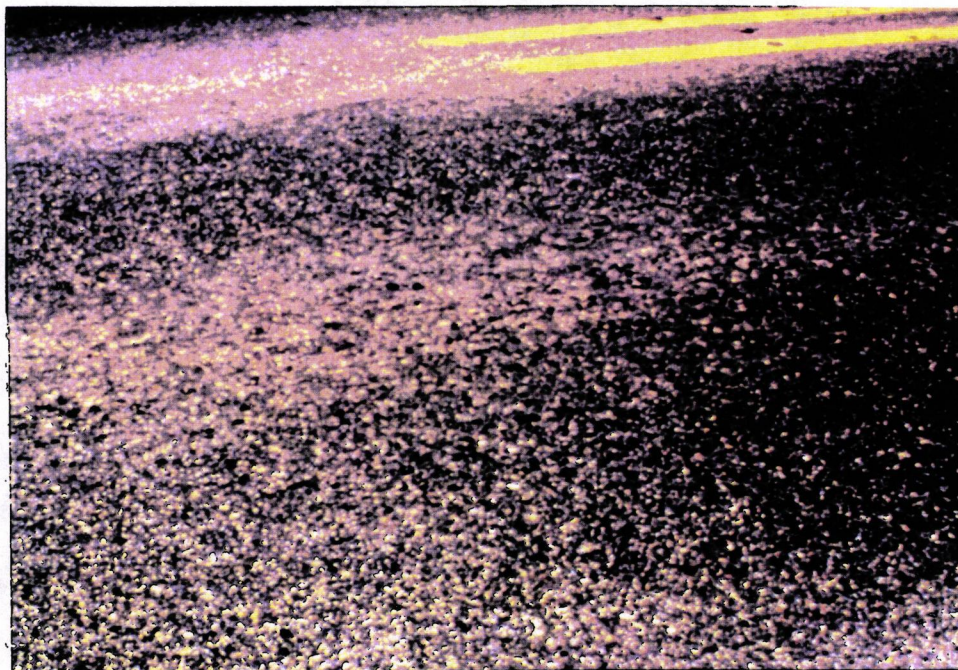


Magnolia Medium Test Section (4 years after const.)





Texarkana Bad Test Section (3 years after const.)



Arkadelphia Good Test Section (4 years after const.)





Profilograph Testing at Arkadelphia



Coring Operation at Magnolia





Falling Weight Deflectometer at Magnolia



Taking Rut Measurements at Texarkana

