

LTRC Contact:  
Harold "Skip" Paul, P.E.  
Phone: (504) 767-9131

## TECHNICAL SUMMARY

Summary of Report Number 216

## EVALUATION OF RECYCLED PROJECTS FOR PERFORMANCE

---

### INTRODUCTION

In 1978, Louisiana constructed two asphalt concrete recycling projects as part of a study to determine the construction feasibility and to evaluate recycled mix quality, economics and energy conservation. The technological feasibility of producing a recycled asphalt concrete in both a batch and a dryer drum plant was demonstrated. Material test results indicated that recycled mixes had properties similar to conventional mixes. Economic and conservation aspects were favorable.

The department let four recycling projects in 1981. The intent of these projects was twofold: (1) to promote the recycling concept among the state's contractors, and (2) to document the quality control aspects associated with recycling efforts on a broader data base. The variations found in the recycled mixtures for these four projects were similar to those of conventional hot mix for all control and acceptance testing including gradation, asphalt cement content, Marshall properties and roadway compaction. Analysis of the quality of the asphalt cement recovered from samples of the in-place recycled mixtures indicated that in order to meet specification limits for the maximum allowable viscosity of plant produced mix, constraints would have to be placed on the allowable reclaim/virgin ratio.

On the basis of these findings, supplemental specifications were approved permitting the use of reclaimed asphaltic concrete materials in any mix included in the asphalt concrete specifications, such that any mixtures incorporating reclaimed material would have to meet all control and acceptance requirements. Also, in order to achieve a desirable viscosity in the plant produced mix, restrictions were placed on the quantity of reclaimed material allowed and the consistency of the virgin asphalt cement. An AC-30 grade asphalt cement would be required for mixtures using up to 20 percent reclaimed material and an AC-10 grade asphalt cement would be required for reclaimed materials between 20 and 30 percent.

Within two years, 65 projects had been constructed using reclaimed asphalt concrete. In 1983 a study

was initiated to evaluate the performance of projects using reclaimed asphalt concrete. A combination of ten recycled and conventional pavements were chosen for evaluation over a five-year period. This report presents the findings of that evaluation.

### OBJECTIVE AND SCOPE

The objective of this project was to determine the performance of recycled asphaltic concrete pavements with respect to conventional asphalt pavement performance.

The scope was confined to a performance evaluation of five recycled and five conventional asphalt concrete pavements over a five-year period. At each of ten sites on each project, data were collected to determine serviceability, pavement distress and structural properties. Roadway cores were taken at five sites on each project to obtain mixture and binder properties such as density, gradation, asphalt content, viscosity, penetration and ductility.

### RESEARCH APPROACH

#### Project Selection Criteria

The first five projects constructed in Louisiana which used reclaimed asphalt concrete were selected for this study. Since these projects had been used for the earlier construction feasibility and quality control studies, data bases had already been established. In addition, the projects were distributed statewide and would, by the end of this study, provide performance data for service lives of six to nine years.

U.S. 84, constructed in 1978, had a control section included in the design for the purpose of comparing the recycled and conventional mixes. The next four projects constructed in the 1981-82 season, however, were initiated to examine the quality control of recycled mixes compared to the historical data base. As such, no control sections were included on those projects. In order to compare the relative performance of the recycled projects, it was decided to select four conventional projects which were constructed during this same time frame. Additional selection criteria for these

projects included the same contractor, if possible, and similar mix design, section design and traffic. In each case an attempt was made to choose a project to be paired with the recycled projects in the same geographical location.

### Performance Evaluations

Serviceability was examined with a pavement condition rating (PCR) which incorporates Mays Ridemeter measurements for smoothness and different types of pavement distress such as bleeding, block, transverse and longitudinal cracking, corrugations, patching, rutting and ravelling. The pavement serviceability index (PSI) derived from the Mays Ridemeter is based on a scale of 1 to 5 with 5 being a perfectly smooth ride. Pavement distress was monitored within a two hundred foot segment at each evaluation site. Each distress type was evaluated and assigned weighted deduct points based on severity and intensity of the distress. The total quantity of deduct points forms a pavement distress rating (PDR) by subtracting from 100 percent, weighting and then combining with a weighted Mays Ridemeter reading to form the PCR.

Pavement structural strength was evaluated with the Dynamic Deflection Determination System (Dynalect). Dynalect testing was accomplished at each test site with three deflection measurements taken in the outside wheelpath. These measurements were then averaged for each site and converted at 15.6°C to equivalent deflections. Parameters including subgrade modulus ( $E_s$ ), structural number (SN), surface curvature index (SCI), and corrected maximum deflection (CMD) expressing subgrade and upper pavement strengths were determined using established procedures.

In addition to roadway serviceability and structural testing, five 6-inch roadway cores were taken during each evaluation at each of the ten projects. Roadway cores were taken to the research laboratory where specific gravities were determined. Asphalt cement was extracted from the cores to determine the asphalt cement content and gradation testing was accomplished. The asphalt cement was then recovered from the extracted cores by the Abson process and tested for viscosity (60°C), penetration (25°C), and ductility (25°C).

### CONCLUSIONS

In general, this study found that recycled pavements containing reclaimed asphalt concrete materials in the range of 20 to 50 percent by weight of the mixture in both binder and wearing course mixes performed similarly to conventional pavements for six to nine years after construction. Specific findings are offered as follows:

- Performance as measured by a pavement condition rating indicates that there is no significant difference between the recycled and control pavements evaluated. The recycled pavements did

exhibit slightly more distress with respect to longitudinal cracking.

- Significant differences in maximum deflection between the recycled and control pavements (which are representative of overall section strength) were related to differences in subgrade support. No significant differences were found in the upper pavement strength or structural numbers.
- Roadway cores demonstrated additional compaction from traffic for the first several years of the study. Only three of the pavements achieved design air voids. Extraction results indicated no degradation of the mixtures. Generally, the recovered asphalt cement contents were lower than those measured during construction. This was attributed to incomplete extraction of the oxidized asphalt.
- There were no significant differences in recovered asphalt cement properties including viscosity, penetration and ductility.
- Those recycled pavements which exceeded the specification 12,000 poise viscosity limit for plant produced mix had a greater degree of cracking than the paired control pavements. These pavements experienced a moderate level of cracking.

### RECOMMENDATIONS

The findings of this study indicate that recycled pavements using up to 50 percent reclaimed asphalt concrete material in both wearing and binder course mixes perform similarly to pavements constructed with conventional materials. The department's more conservative approach in allowing a maximum of 30 percent reclaimed material should, therefore, continue to provide Louisiana with good performing pavement materials while taking advantage of the economics of a salvageable material.

The department has eliminated the use of reclaimed material in wearing course mixtures because of testing constraints; on short tonnage projects, the projects are usually completed prior to obtaining viscosity testing results. The results of this study show that the 12,000 poise limitation produces a mix which is less subject to cracking. If the test time constraint can be corrected, the department's original position of permitting 15 percent reclaimed material in the wearing course and requiring the 12,000 poise limitation should be reconsidered.

NOTICE: This technical summary is disseminated under the sponsorship of the Louisiana Department of Transportation and Development and the Federal Highway Administration in the interest of information exchange. The summary provides a synopsis of the project's final report. The summary does not establish policies or regulations, nor does it imply DOTD or FHWA endorsement of the conclusions or recommendations. These two agencies assume no liability for the contents or its use.