



The benefit/cost analysis
was performed in 2003



JTRP / INDOT RESEARCH PROGRAM

Research Pays Off

Use of Reclaimed Asphalt Pavement (RAP) Under Superpave Specifications—SPR 2143

States in the North Central region of the United States made extensive use of reclaimed asphalt pavement (RAP) prior to the implementation of Superpave. Though Superpave did not rule out the use of RAP, there are no clear guidelines on how to incorporate RAP in Superpave mixtures. In addition, the states and industry are learning the new system and adjusting to the new, frequently tighter Superpave specifications, so there is some reluctance to add another variable to the process.

Renewed interest in using RAP once the use of Superpave becomes routine is anticipated. For this reason, seven states in the North Central region initiated a pooled fund research project to address the use of RAP in Superpave mixtures with typical North Central materials. The seven states were Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri and Wisconsin. This regional pooled fund project was closely coordinated with National Cooperative Highway Research Project 9-12,

Incorporation of Reclaimed Asphalt Pavement in the Superpave System. Specifically, the regional study looked at typical materials for the North Central United States to determine if the findings of NCHRP 9-12 are valid for Midwestern materials and to expand the NCHRP findings to higher RAP contents.

The objectives were addressed by comparing mixtures produced in the laboratory with different proportions of RAP and virgin materials. Three RAP sources were investigated at RAP contents up to 50%. Indiana, Michigan and Missouri provided RAP and virgin materials for use in the study. For each RAP source, a laboratory mix was also compared to a plant-produced mix with the same RAP content. Binder and mixture tests were performed following protocols established in NCHRP 9-12.

Research Findings and Implementation

The research demonstrated that acceptable Superpave mixtures can be designed with up to 40 or 50% RAP. Aggregate quality and gradation in the RAP material may limit the amount of RAP that can be incorporated. The results support the concept of a tiered approach to RAP usage. Adding 20 to 25% RAP raised the high temperature grade of the plant-produced mixture by one increment. Under the recommended tiers, dropping the virgin binder grade by one increment will counteract the stiffening effect of the RAP binder. Low amounts of RAP (up to about 15%) could be used with no change in the virgin binder grade.

The results are generally consistent with the NCHRP 9-12 findings. This implies that the results and the recommendations of the national study can be implemented with confidence in the North Central region. States should consider allowing the use of RAP, if they do not already do

so, under the newly revised AASHTO provisional standards MP2, PP28 and TP2. Based on these results states should, at the very least, allow RAP at levels comparable to pre-Superpave levels and may consider increasing the allowable RAP contents.

The addition of RAP can help to offset the perceived higher costs of Superpave mixtures while still providing good performance for low volume roads. Mixtures designed for low volume roads should be designed for durability, so all mixtures need to be designed for appropriate traffic levels. Individual states should consider evaluating their own materials to assess typical RAP binder grades and aggregate gradations. These two factors can affect the resulting mixture properties and limit the amount of RAP that can be successfully incorporated.

Potential Benefits

Until 2003 RAP use was not permitted in surface mixtures. As identified in the study, an assessment of RAP use was obtained from the Asphalt Pavement Association of Indiana. The analysis was provided for 5,074,042 tons of materials for intermediate and base layers on INDOT projects mixed with RAP content. Savings per 1% addition of RAP content to virgin material (depends upon the grade of asphalt used) were calculated to be

\$0.13 per ton. The Benefit/Cost analysis is based on a usage of 5% RAP. Some mix designs allow up to 15%, so this is a conservative number.

**Cost of
Research
\$15,000**

Estimated Economic Value over 10 years at 5% Discount Rate

INDOT Material Tonnage [1]	Savings Per 1% RAP Content [2]	Annual Savings [3]	Total Discounted Savings Using (1%) RAP Content [4]	Benefit/Cost Ratio [5] = [4] / \$15,000
5,074,042	\$0.13	329,812	3,301,433	220

Assumptions

- That the tonnage for base and intermediate layers was 5,074,042 tons.
- That the average savings per 1% RAP is \$0.13/ton based upon standard costing of base and intermediate layer items.
- Annual savings generated by using 5% RAP at current quantities is \$329,812.
- A ten year pavement cycle is used.
- A 3% growth in tonnage is used.

References

- Rebecca M., Hamid S., and Ayesha S., "Use of Reclaimed Asphalt Pavement (RAP) Under Superpave Specifications: A Regional Pooled Fund Study," Joint Transportation Research Project FHWA/IN/JTRP-2002/6 Final Report, May 2002.
- Communication with Mr. Lloyd Bandy of Asphalt Pavement Association, Indiana.