Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-6092: Performance Evaluation and Mix Design for High RAP Mixtures

Background

The asphalt paving industry has always advocated recycling, including reclaimed asphalt pavement (RAP), recycled asphalt shingles (RAS), tires, etc. The earliest recycling asphalt pavement dates back to early last century. However, significant use of RAP in hot-mix asphalt (HMA) started in the mid-1970s due to extremely high asphalt binder prices as the result of the oil embargo. The RAP mixes, when properly designed and constructed, could have the same or similar performance as virgin HMA mixes. In addition to conserving energy and protecting the environment, the use of RAP can significantly reduce the cost of HMA paving. However, many states including Texas have upper limits on use of RAP in asphalt mixes due to different concerns: RAP variability, the impact of RAP on engineering properties of mixes and field performance (especially cracking resistance), and the lack of a rational RAP mix design method. To address these concerns, in 2008, the Texas Department of Transportation (TxDOT) initiated this research study at the Texas A&M Transportation Institute with objectives to:

- Define variability of processed RAP.
- Develop best practices for RAP processing and stockpile management.
- Identify the impact of RAP on engineering properties of mixes.
- Propose a balanced mix design and performance evaluation system for project-specific service conditions.
- Construct and monitor field test sections with RAP(/RAS).
- Devaluate approaches for improving cracking resistance of RAP(/RAS) mixes.

What the Researchers Did

To achieve the study objectives, researchers completed the following tasks:

- RAP sampling and laboratory characterization in terms of gradation and asphalt content.
- Development of best practices for RAP processing and stockpile management through visiting and surveying RAP mix producers around Texas.
- Laboratory evaluation of the influence of RAP contents on rutting/moisture damage and cracking resistance of mixes.
- Construction and monitoring of field test sections with RAP(/RAS) around Texas.
- Development of a balanced mix design and performance evaluation system for project-specific service conditions.
- Evaluation of approaches for improving cracking resistance of RAP(/RAS) mixes.

What They Found

From this study, researchers found the following:

- Both TxDOT and contractors' RAP materials, in terms of aggregate gradation and asphalt

Research Performed by:
Texas A&M Transportation Institute

Research Supervisor:
Fujie Zhou, TTI

Researchers:
Sheng Hu, TTI
Das Gautam, TTI
Tom Scullion, TTI

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content, are consistent and have low variability when the six-step RAP processing and stockpile management are used.

- RAP content influences the optimum asphalt content (OAC), rutting/moisture resistance, and cracking resistance. OAC generally increases with more RAP (/RAS) usage, but the increase in OAC is small when RAP content is below 20 percent. Furthermore, increasing RAP content always improves rutting/moisture resistance. Inversely, cracking resistance worsens with use of more RAP, especially when RAP content is 30 percent and above or when RAP/RAS combinations are used.
- RAP(/RAS) mixes, when properly designed and constructed, can have similar or better performance than virgin mixes.
- Use of softer virgin binder (i.e., PG xx-28 or PG xx-34) or design of mixes with higher density can improve the cracking resistance of RAP(/RAS) mixes.
- The balanced mix design and performance evaluation system for project-specific service conditions, as shown in Figure 1, is validated through field test sections.

What This Means

Based on the findings from this study, researchers recommend the following:

- Implement statewide the six-step RAP processing and stockpile management practices.
- Reduce the maximum allowable RAP/RAS binder replacement from 35 percent to 30 percent and below.
- Use soft binders (i.e., PG xx-28 or PG xx-34) or design the mix with 97.5 percent design density when RAP/RAS binder replacement is 20 percent and above.
- Implement the balanced mix design and performance evaluation system for project-specific service conditions for designing mixes containing RAP/RAS.

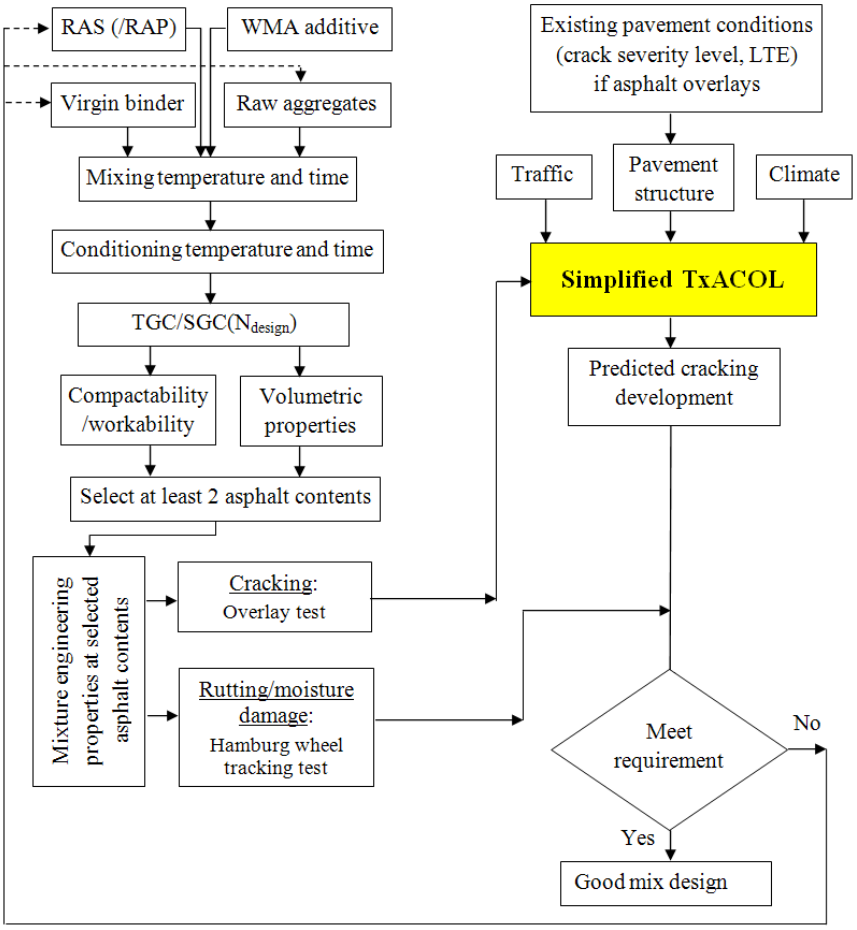

Figure 1. Balanced Mix Design and Performance Evaluation System for Project-Specific Service Conditions.

For More Information

Project Manager:
German Claros, TxDOT, (512) 416-4738

Research Supervisor:
Fujie Zhou, TTI, (979) 459-3965

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Research and Technology Implementation Office
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
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