

HOW DOTs CAN ENHANCE SUSTAINABILITY AND RESILIENCE IN ASPHALT PAVEMENTS USING RAP AND RAS

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INTRODUCTION

Sustainability in the context of pavements means the ability to achieve engineering and environmental goals through economical use of resources¹, while resilience indicates the ability of the pavement to withstand or recover rapidly from disruptions².

Reclaimed asphalt pavement (RAP) is the most recycled material in the United States, with 98.1 million tons used in asphalt mixtures in 2022³. The use of RAP in asphalt pavements contributes significantly to the sustainability and resilience of transportation infrastructure by conserving natural resources and can improve the performance characteristics of the pavement. Recycled asphalt shingles (RAS) can also be used to improve sustainability and resilience of asphalt pavements, but to a more limited extent.

The ability of RAP and RAS to increase sustainability and resilience without sacrificing performance of the pavement is readily achievable with proper processing, design, and construction of RAP and RAS mixtures.

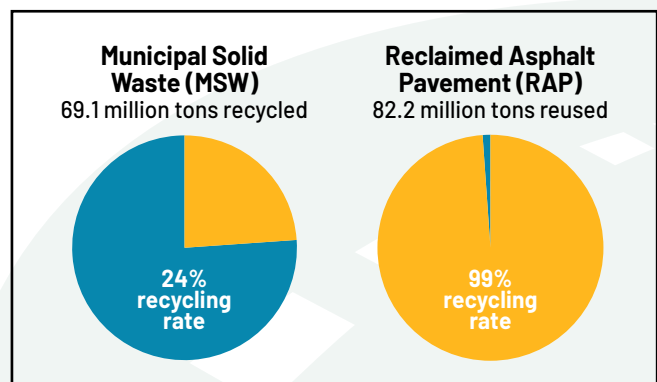


Figure 1: Comparison of common material recycling in the United States in 2018. Sources: EPA, NAPA/FHWA.

¹<https://www.fhwa.dot.gov/pavement/sustainability/start-here/>

²Statutory Definition of "Resilience" at 23 U.S.C. § 101(a)(24). Section 11103 of the Bipartisan Infrastructure Law, enacted as the Infrastructure Investment and Jobs Act, Pub. L. 117-58 (Nov. 15, 2021)

³Williams, B.A., J.R. Willis, & Shacat, J. (2024). Annual Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2022, 13th Annual Survey (IS 138). National Asphalt Pavement Association, Greenbelt, Maryland.

SUSTAINABILITY BENEFITS

RAP and RAS significantly contribute to environmentally sustainable practices in two primary ways. First, the recycling and reuse of asphalt pavement and asphalt shingle material reduces the need for raw materials, thereby conserving natural resources. Second, increasing RAP and RAS utilization considerably reduces greenhouse gas (GHG) emissions associated with the extraction and processing of virgin materials. In 2022, incorporating RAP and RAS into new pavements replaced 5 million tons of virgin asphalt binder and more than 93 million tons of virgin aggregate, reducing GHG emissions by more than 2.7 million metric tons CO₂e³.

Using RAP and RAS also contributes to economic sustainability by lowering initial material costs for construction, therefore allowing road owners and agencies to conduct more maintenance and construction activities within a given budget. In total, the use of RAP and RAS saved more than \$4.7 billion³ during the 2022 construction season compared to using only virgin materials.

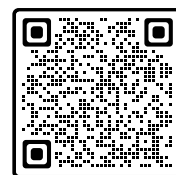
RESILIENCE BENEFITS

Pavements incorporating RAP and RAS have demonstrated equal or superior performance compared to those using virgin materials. This contributes to the longevity of the pavement and enhances overall resilience because a pavement in better condition is less vulnerable

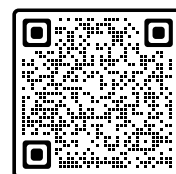
and can more readily withstand and recover from weather related disruptions. The key to successful performance of asphalt pavements with recycled materials is the appropriate processing, mixture design, structural design, and control during production and construction. For example, RAP has been successfully used in all layers of a pavement to improve the overall structural capacity and increase resistance to both cracking and rutting. The stiff, brittle, aged RAS binders are often a concern with respect to cracking and durability in surface layers but can provide significant benefits when used in structural pavement layers. To achieve high performance, the properties of the recycled materials need to be adequately characterized and the asphalt mixtures designed to meet the required performance properties for the location. Done responsibly, pavements containing RAP and RAS will provide increased resilience to both traffic and environmental loads.

CONCLUSION

The asphalt pavement industry is committed to promoting sustainability and resilience of asphalt pavements through innovative practices and materials such as RAP and RAS. When successfully engineered, designed, produced, and constructed, pavements incorporating RAP and RAS contribute to both economic and environmental sustainability while maintaining – or even enhancing – the performance and longevity of the pavement and overall resilience.



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