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New Jersey Department of Transportation  
Bureau of Research

## Technical Brief



### High Reclaimed Asphalt Pavement in Hot Mix Asphalt

*Currently, the New Jersey Department of Transportation allows a maximum of 15 % of reclaimed asphalt pavement (RAP) in the surface course. This leads to a significant amount of unused Reclaimed Asphalt Pavement (RAP) in the state. The purpose of this study is to develop recommendations to increase the percentages of RAP up to 35% in the surface mixes without adversely the long term performance of the roadways.*

### Background

New Jersey generates significantly more RAP than it uses. The material in the existing pavement has value; if utilized effectively it will not only reduce the overall cost of the pavement but also develop environmentally friendly and sustainable pavements. Currently, the contractors are provided incentives for using high percentage of RAP; however, appropriate procedures to ensure quality control are not-in-place. There is a need to assess the impact of lack of quality control procedures on the mechanical properties of the mixture and subsequently conduct a detailed sensitivity analysis to develop protocol that can be followed during construction. It is also required that the performance of roadways is not affected through the use of RAP.

### Research Objectives and Approach

The two main objectives of the study are: 1) to develop a thorough understanding of the properties of mixture and binder with higher percentages of RAP and 2) to explore the possibility of designing asphalt mixtures with high percentages of RAP approaching 35 percent without compromising performance. To complete these objectives, the following, three-part approach was conducted. The first part dealt with the variability of RAP. First, an assessment of RAP stockpiling practices as well as a variability study was conducted in order to better understand variability within local RAP stockpiles. The second part of the approach focused on the blending of RAP and virgin binder. This was accomplished through the use of extraction and recovery methods in order to determine the Degree of Blending (DOB) on test mixtures. The third part of the approach was performance. This was completed by conducting low-temperature testing on 25 percent and 35 percent RAP samples and comparing them to control samples with zero percent RAP.

### Findings

The following conclusions were made based off of results found in this report:

- Partial DOB occurs in mixtures with RAP and virgin materials and depends on both RAP and virgin binder selection. DOB is an important factor to consider when utilizing RAP percentages 25 or higher.
- The assumption of 100 percent DOB can lead to underasphalting of the mix. Variability could cause severe problems in obtaining acceptable value for mix designs when utilizing RAP percentages 35 percent or higher. Plants that practiced fractionation showed lower RAP variability.
- Using high percentages of RAP can negatively affect the fracture energy of a sample. The use of softer binders to compensate for higher percentages of RAP can raise the fracture energy of a given mixture with high percentages of RAP; however, it will decrease the stiffness of the mixture.
- The use of high percentages of RAP within the study did not show any negative effects towards moisture sensitivity. Using high percentages of RAP will lead to significant long-term cost savings.

## Recommendations

The following are the recommendations from the study:

- The revised NCHRP 9-33 sheet should be used for high RAP mixes (25% and above) especially if partial degree of blending is considered in the mixture design.
- The softer binder should be used with higher percentages of RAP (25% and above).
- The plants should be encouraged to fractionate the RAP stockpiles.
- The degree of blending prediction model should be used to estimate the DOB. The model is based on the RAP properties (RAP binder content, dust in RAP, RAP binder stiffness) and stiffness of virgin binder.
- A pilot section should be constructed with high RAP HMA project alongside a no-RAP project to compare the long term performance.

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A final report is available online at: <http://www.state.nj.us/transportation/refdata/research/>.  
If you would like a copy of the full report, send an e-mail to: [Research.Bureau@dot.state.nj.us](mailto:Research.Bureau@dot.state.nj.us).

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