Executive Summary and Research Readiness Level Assessment

Data Analysis of Nebraska Pavements Containing RAP

Research Objectives

Conduct a comprehensive data analysis of Nebraska pavements containing RAP materials. The research team and NDOT engineers worked together to select pavement sections in service for the last 5-10 years. A complete set of data was collected and used to perform data analyses. Further examination was conducted through laboratory testing of samples cored from the field sections and numerical simulation of relevant mixtures and pavement structures. The data analysis included typical statistical evaluation as well as the life cycle cost analysis, so that the practices for the last 13 years with RAP can be reviewed and improved for future projects.

Research Benefits

Data analysis results including the life cycle costs from various projects provided useful information to examine the state's RAP practices in pavements for the last decade and to develop any working plans for future projects. This research brings clear benefits in cost savings and sustainability by the use of recycling materials into our pavements in a more efficient and scientific manner.

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Background

For about the last 13 years, Nebraska has used reclaimed asphalt pavement (RAP) materials in mixes at approximately 20-50% to produce asphalt concrete (AC) mixtures for flexible pavements. The expanded use of RAP materials in the production of AC mixtures brought significant economic benefits and environmental advantages through the reduction of material costs and environmental impacts associated with production, transportation, and processing of the conventional asphalt materials. It has been reported that about $30-50 million were saved annually due to the use of RAP materials. This infers that more use of RAP materials in the mixes is favorable to reducing costs and environmental impacts.

Despite the immediate cost saving and environmental benefits attributed to the use of RAP, it has also been reported that using a higher percentage of RAP may reduce the resistance of asphalt mixtures to cracking. This in turn, can result in reduced pavement an increased amount of maintenance (or rehabilitation). As a result, to quantify the benefits on the use of increased RAP content mixes, a detailed lifecycle cost was used to evaluate the true economic benefits of using RAP materials in pavements. The approach needs to take into account not only the initial costs associated with materials and production, but also later-stage costs related to in-service maintenance costs of these pavements.

Conclusion

Nebraska has used reclaimed asphalt pavement (RAP) materials (in a range of 20-50%) over more than 10 years in pavement construction. Despite the immediate economic and environmental benefits, it has been reported that incorporating RAP may reduce pavement crack resistance. This study used NDOT's database to investigate the effect of RAP amounts on the overall behavior of pavement performance. To that end, we collected data of pavement performance, mixture design, traffic, and environmental conditions on a total of 254 pavement projects constructed between 2009 and 2012. Using the data, several analyses (such as descriptive, inferential, and life cycle cost) were conducted by interrelating field performance (for the last 10 years) with mixture design on varying RAP contents. Results showed that sections with high RAP content (up to 45%) presented no significant difference regarding IRI and rut depth when they were compared with low RAP content sections. The research found that projects constructed with 45% RAP in northern Nebraska reached the cracking limit (40%) and severity limit (0.4) after around 5-6 years in service. Projects constructed with 25-45% RAP in southern Nebraska showed good performance in both cracking and severity up to 8 years in service. The LCCA results showed that SPR (mix type) sections with RAP (up to 45 percent) could reduce costs by an additional 14% even with slightly more crack sealing costs. These savings can even be larger when compared to pavement sections constructed in southern Nebraska due to additional cost differences for aggregates in this area of Nebraska. To be noted, the test sections evaluated were collected from projects are with typical traffic levels of ADT less than 1600 and daily truck traffic of 200 or less.

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Interested in finding out more?
Final report is available at:
NDOT Research Website

NDOT Recommendations Based Off of Research Project

The Nebraska Department of Transportation has used reclaimed asphalt pavement (RAP) materials (in proportions of 20-50% of a mix design) for more than 13 years in pavement construction. RAP maximizes the use of removed or salvaged material, which minimizes the use of virgin material and prevents reclaimed materials from going to landfill. This research provided validation that NDOT mix designs using a high volume of reclaimed asphalt pavement performed and continue to perform well overall. The research collected 254 data points from projects constructed between 2009 and 2012. The research validated that the use of 45% RAP for the last decade provided not only substantial economic benefits, but a myriad of environmental benefits that need to be quantified to realize all of the benefits from raw material preservation to reduction of carbon footprint in a global scale. NDOT engineers estimated the financial savings on aggregates and petroleum binders alone has been nearly $500 Million since 2008 (13 years) since implementing high-volume RAP mix designs in paving construction.

As provided by Robert Rea and Bruce Barret, TAC Lead Members

Research Readiness Level (RRL) Assessment

Level: Standard Practice/Fully Understood

RRL 5

This brief summarizes Project SPR-P1 (20) M112
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