A New Generation of Dense-Graded Asphalt Mixtures with Superior Performance against Stripping and Moisture Damage

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21BLSU03

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Tran-SET

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$ 135,000

Developing Dense-Graded asphalt mixtures with superior performance

The presence of moisture in a pavement structure is a matter of great concerns as it is responsible for significant distresses such as stripping, fatigue cracking, rutting, and poor durability. Asphalt concrete (AC) stripping, which is a chronicle problem in flexible pavements in Louisiana and Arkansas, refers to the loss of bond between the aggregate and asphalt binder usually caused by the accumulation of moisture underneath the pavement surface. In Louisiana, shallow groundwater table (GWT) and heavy rainfall conditions (average annual rainfall of 60 in.) throughout the year make the pavement highly vulnerable to water entrapment and moisture damage. The effect of AC stripping is manifested in the roadway through poor durability of the mixes and shorter service life. These pavement distresses greatly affect user safety, pavement performance, and cost-effectiveness of maintenance and rehabilitation activities. The objective of this research is to develop a new generation of dense-graded asphalt mixtures that would provide superior performance against AC stripping and moisture damage. To develop this improved asphalt mixture, the current state of practice including aggregate type and gradation, and additives, will be reviewed and comprehensively evaluated.

Problem Statement

The presence of moisture beneath the pavement surface is a matter of great concerns, as it is responsible for significant distresses such as stripping, fatigue cracking, rutting, and poor durability of asphalt mixes. Asphalt concrete stripping, which is a chronicle problem for flexible pavements in Louisiana and in Arkansas, refers to the loss of bond between the aggregate and asphalt binder usually caused by the accumulation of moisture underneath the pavement surface. In Louisiana, shallow groundwater table (GWT) and heavy rainfall conditions (average annual rainfall of 60 in.) throughout the year make the pavements highly vulnerable to water entrapment and moisture damage. The effect of AC stripping is manifested in the roadway through poor durability of the mixes and shorter service life. These pavement distresses greatly affect user safety, pavement performance, and cost-effectiveness of maintenance and rehabilitation activities. Research results by the PI showed that overlaying extended pavement service life by 13 years when placed on non-stripped pavements but only performed adequately for 8.7 years when moisture damage was present in the underlying AC layers

Objectives

The objective of this research is to develop a new generation of dense-graded asphalt mixtures that would provide superior performance against AC stripping and moisture damage. To develop this improved asphalt mixture, the current state of practice including aggregate type and gradation, and additives, will be reviewed and comprehensively evaluated. Furthermore, innovative ideas will be evaluated in the laboratory including the use of hydrophobic nanomaterials and emerging anti-stripping agents such as Evotherm and vegetable-based oils, recycled products such as crumb-rubber, warm-mix asphalt technologies, and adhesion promotors. For all the evaluated technologies, the research team will ensure that the new generation of asphalt mixtures will be environmentally friendly and cost-effective by testing and evaluating different additive types, recycled products, and other additives such as nano-clay and super-fine hydrated lime.

Figure 1. AC Stripping Damage in Flexible Pavement in Louisiana

Intended Implementation of Research

Workforce Development, Education, and Outreach: This research project will provide partial funding to a graduate student at Louisiana State University. The student will be trained on laboratory testing methods, pavement construction practices, QA specifications, and asphalt mixes production. Results of this work will also be disseminated at national conferences and journal publications. In addition, this project will present the general knowledge related to this study such as asphalt mixes and pavement construction to K-12 students in Louisiana and in Arkansas. The research team will also prepare educational materials on AC stripping and antistripping additives, which can be incorporated in transportation courses at LSU and ASU and shared with other universities in Region 6. In addition, the research findings will be published online to disseminate the results to researchers all over the world.

Anticipated Impacts/Benefits of Implementation

The results of this research will be used to enhance and to optimize the use of asphalt pavements in Region 6 in order to maximize the use of available funds and to minimize premature failure of constructed pavements due to moisture damage and AC stripping. It will also allow state agencies to pro-actively address moisture damage prior to the occurrence of significant damage on the roadway. The study will have long-term benefits for road users as the proposed technologies will ease the repair and maintenance requirements due to AC stripping and associated distresses in Region 6.

Web links

- Tran-SET's website https://transet.lsu.edu/research-in-progress/

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.