

Research Summary

Optimizing of MassDOT's High Performance Asphalt Overlay (HPOL) Mixtures

Research Need

MassDOT and municipalities within Massachusetts are interested in utilizing new technologies that enhance the resiliency of their pavements because increased resiliency extends the service life of the road network. One method to enhance road resiliency is to use high performance asphalt overlays (HPOL) as a pavement preservation/rehabilitation strategy. Mixtures used in HPOL are generally required to meet enhanced performance characteristics compared to traditional dense graded hot mix asphalt (HMA).

To allow for innovation and healthy competition, MassDOT has been exploring the possibility of allowing contractors to choose between placing HPOLs either as an Asphalt Rubber Gap Graded (ARGG) mixture, a Superpave High Performance (HP) surface course mixture, or a stone matrix asphalt (SMA) mixture. These three are part of the FHWA EDC Thin Overlay Solutions (TOPS).

The main interest of MassDOT is to determine if using a HP or a SMA mixture will provide the same (or better) performance and life cycle costs/benefits as compared to the ARGG mixtures in which it has more experience. MassDOT also wishes to evaluate and modify its existing ARGG and HP specifications, when utilized for designing HPOL mixtures. These three overlays are part of the FHWA EDC Thin Overlay Solutions (TOPS).

Goals/Objectives

The objectives of this study were:

1. Evaluate current MassDOT ARGG and HP HPOL mixtures.
2. Design and evaluate the performance of ARGG, HP, and SMA mixtures for use as a HPOL.



3. Attempt to optimize materials or design parameters to improve on the current specifications for ARGG, HP, and SMA HPOL mixtures.
4. Compare the performance characteristics and life cycle costs of ARGG, HP, and SMA HPOL mixtures.
5. Establish which HPOL mixture is better for MassDOT.

Methodology

1. Conduct literature review to assess previous research related HPOL mixtures.
2. Design three 12.5-mm HPOL asphalt mixtures (ARGG, HP & SMA).
3. Evaluate the performance of the asphalt binders and HPOL mixtures.
4. Determine relative return on investment (ROI) when considering the possible HPOL alternatives.

Key Findings

- All HPOLs passed the mixture performance tests where the test had a MassDOT specified or preliminary criterion, and the results indicated that the three types can be used interchangeably.

-All HPOLs met the MassDOT's pilot specification criteria for rutting, moisture damage, and intermediate-temperature cracking. Tests for reflective cracking and raveling indicated that all HPOLs passed the criterion established by other state transportation agencies.

- AASHTOWare PMED predictive models for bottom-up fatigue cracking indicated that 2 in. of a HPOL placed on an existing in-service pavement can extend pavement service life between 11.2 and 14 years, depending on the type of HPOL and source of binder. Thus, the maximum difference between the six HPOL mixtures was slightly less than 3 years, although most of them were within 2 years of each other. Furthermore, none of the three HPOL types could be chosen as the best.

-Life cycle cost analysis indicated there was no significant difference in the net present value (NPV) of the three HPOLs, nevertheless, the binder source impacted the NPV.

- Statistical analysis indicated that both HPOL type and binder source had significant effects on the mixture performance tests except for one overlay test results where the binder source did not have a significant effect. Although there were significant effects, all TOPS passed the mixture performance tests where there was a MassDOT specified or preliminary criterion, and the AASHTOWare PMED predictive models did not show that any of the three HPOLs types would perform better or worse than the others based on bottom-up fatigue and thermal cracking. Overall, the data did not indicate one of the three HPOLs as superior to the others.

Project Information

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Key Words:

Asphalt Rubber Gap-Graded, ARGG, Stone Matrix Asphalt, SMA, High-Performance Asphalt Overlay, HPOL, Performance, Service Life, Cost

Recommendations

- To confirm the overall outcome of this research, which is that the three HPOLs can be used interchangeably, it is recommended that MassDOT select at least one pavement site to construct these three HPOLs adjacent to each other and observe their performances over time. It is important that these experiments have the same underlying layers, traffic, and climate.

-Perform life-cycle assessments (LCA) to quantify the environmental impacts of each of the three HPOLs.

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