Temperature Effect on Joint-Opening Movement within Composite Overlay Pavements
By: Courtney Beavan

Introduction/ Background
- Deteriorated Portland Cement Concrete Pavements (PCC) are often rehabilitated with hot mix-asphalt pavements (HMA).
- Joints exist between slabs of PCC pavement and are often locations of high-stress concentration in HMA overlays.
- Full scale test sections were constructed at MnROAD Test Facilities in 2017 on I-94 westbound.
  a) no hot-mix asphalt (HMA) overlay
  b) 1.5 in. HMA overlay
  c) 2.5 in. HMA overlay
  d) 4 in. HMA overlay
- Each test section is 500 feet in length

Objectives:
1) What is the impact of temperature variation (seasonal and daily) on joint opening movement of concrete slabs within composite pavements?
2) Determine if and how much of an insultation effect asphalt concrete overlays provide in reducing joint opening movement?

Methods
- Identified when first ‘cracks’ appeared on obtained survey crack maps from different test sections on different dates.
- Identified the survey periods before the first crack appeared.
- Finding single-day greatest change in air temperature over a four-year period for greatest thermal loading event.
- Extracted and analyzed joint-opening and air temperature data corresponding to greatest thermal loading event.

Results
2.5 Inch Overlay Joint Variation

Daily Variation Results

Greatest Change in Temperature in Winter

Greatest Change in Temperature in Summmer

72-hour Variation Results

Effect of Overlay Thickness on Joint-Opening

Summary and Conclusion
- Sudden temperature differences can greatly influence joint-movement.
- In cold weather joints contract and in warmer weather joints expand.
- Cell 983 (Control section with no HMA) had the greatest joint-opening movement with variations in temperature.
- The pavement joints reacted as expected based on asphalt thickness. In order from greatest variability to least variability:
  - 1) Control, no HMA layer (Cell 983)
  - 2) 1.5 in. HMA (Cell 986)
  - 3) 2.5 in. HMA (Cell 992)
  - 4) 4 in. HMA (Cell 989)
- There was approximately a 30% reduction in joint-opening movement with the addition of an HMA overlay.

Literature Cited
Pavement Interactive: https://pavementinteractive.org

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