South Carolina
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PROJECT SUMMARY

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South Carolina
Department of Transportation
Office of Materials and Research
1406 Shop Road
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# Field Evaluation of Temperature Differential in HMA Mixtures

## Overview

Temperature or thermal segregation refers to the situation in which there are cold spots in the hot mix asphalt (HMA) mat behind the paver during the rolling phase of construction. This segregation can be caused by several factors including poor construction techniques and environmental effects. Various research studies have shown that thermal segregation in HMA pavements leads to premature distress. This premature distress (known as temperature differential damage) is due to the additional effort needed to achieve adequate compaction on cooler pavements leading to lower densities obtained in these areas.

The purpose of this investigation was to gain insight on how thermal segregation during construction of HMA pavements affects their service life. This was done by identifying specific instances of thermal segregation during HMA construction by taking infrared pictures to measure and record mat temperatures behind the paver. These locations were monitored every six months to determine how well they performed in comparison to areas without thermal segregation. Also, a list of the causes of thermal segregation encountered and suggested strategies to reduce the number of occurrences or their severity was provided.

## Key Findings

During this investigation, 24 asphalt pavement segments containing thermal segregation were identified including most of the major asphalt mix types used in South Carolina. A total of 426 individual locations were noted. Of these locations, only nine displayed temperature differential damage. The most common type of thermal segregation encountered was end of load which was occasionally combined with segregation caused by dumping the wings of the paver. The second most common was from work stoppages. Most instances of thermal segregation were caused by contractor construction practices; however some were caused by environmental effects.

During the monitoring of these segments two types of pavement distress were noted. Simple deterioration is distress caused by factors other than thermal segregation, whereas temperature differential damage is distress caused by thermal segregation during construction.

The length of time segments were monitored ranged from six months to 48 months. As evidenced by these segments, with the severity of thermal segregation experienced during this investigation, simple deterioration can become apparent well before temperature differential damage. In several of the segments identified, reflective cracking occurred while no signs of temperature differential damage appeared.

No correlation became apparent between asphalt temperature at construction and the length of time until pavement deterioration appears. This is due to the fact that asphalt pavement life can be heavily affected by factors such as subsurface conditions, traffic levels, and rolling practices which change from one segment to another.

Based upon the monitoring of specific locations of thermal segregation, conventional asphalt pavements can be in service for three or more years without temperature differential damage becoming apparent. This length of time could be due to the increased material transfer vehicle (MTV) usage on coarser, higher volume asphalt mixes. This increased MTV usage seems to lessen the severity of thermal segregation as evidenced by the lack of temperature segregation combined with or leading to cyclical pavement surface texture changes as found in previous research.

**Severe Raveling on OGFC After 42 Months**

Open Graded Friction Course (OGFC) however, can be severely affected by thermal segregation, and damage can appear in as little as six months from the time of construction. The data does not indicate a specific correlation between temperature at construction and the time until temperature differential damage becomes apparent, however locations that are most susceptible to premature distress (in the form of severe raveling) are start-up areas after cold paving joints and areas adjacent to bridge decks. These areas are subject to greater cooling due to the extra hand working and roller delays necessary to achieve a smooth transition in these areas.

When using an infrared camera to monitor asphalt temperatures during construction, distance from the subject area, angle to the subject area and, and length of time after the paver has passed the subject area can all have a significant effect on the temperature data obtained. Consistent positioning with the camera is necessary to obtain consistent thermal segregation characterization.

**Key Recommendations**

Based upon its observed ability to reduce severity of end of load segregation, the SCDOT should strongly encourage the use of a MTV for all paving projects utilizing OGFC and Surfaces A, B, and CM.

To minimize thermal segregation for all mix types, the contractor should match the paver speed with the haul truck arrival rate to lessen the number of paver stoppages while waiting on trucks and to minimize the length of time the truck waits at the site with mix cooling in the bed. The contractor should also avoid dumping the wings of the paver between loads as this introduces cold mix into the asphalt mat. Hand working should be minimized, but when necessary, tossing of the mix should be avoided as it causes extra cooling.

When paving with OGFC from a construction joint, a bridge approach, or a bridge departure, the contractor should match the paver as close as possible to the previous paving to minimize the necessity of hand working of the mix in this area. When hand working is necessary, it should be done quickly to allow the rollers to roll the area quickly to minimize cooling of the mix before rolling. Also, as with other mix types, the contractor should not toss the mix.

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