Project Summary

Texas Department of Transportation

0-6435: CAM Mix Design with Local Materials in Texas

Background

Crack Attenuating Mixtures (CAM) are used by the Texas Department of Transportation (TxDOT) for retarding the reflective cracking in thin asphalt overlays without sacrificing rutting resistance. These mixtures are fine, designed using relatively small stone sized aggregates and screenings with high asphalt content. CAM are typically placed as an interlayer between an existing pavement and a surface layer of hot mix asphalt (HMA), although they are increasingly being placed as a thin surface course. As a surface course, CAM mixes must be designed to meet demanding structural and functional requirements. These requirements and the fact that CAM, being a fine mix, generally lacks surface macrotexture, suggest the use of high quality aggregates. The increasing cost of high quality aggregates and the depletion of natural high quality aggregate resources encourage the use of locally available aggregate sources, a cheaper and sustainable option.

What the Researchers Did

Laboratory testing of aggregates from 14 quarries in Texas was done to characterize the classification, aggregate imaging system (AIMS) and filler properties of aggregates. Current performance criteria in terms of Hamburg Wheel Tracker (HWT) using Tex-242-F and Overlay Tester (OT) using Tex-248-F were initially applied to assess current mix design procedures (based on TxDOT Special Specification 3165) and to develop minimum aggregate quality criteria. During the application of the research it became evident that the current HWT and OT requirements may be too stringent and eliminated most if not all of the local aggregates as potential candidates for use with CAM. For this reason, the researchers re-evaluated the HWT and OT requirements for CAM with local aggregates and relaxed these based on an overall assessment of the laboratory performance of the CAM tested as part of the study. Revised mix design and minimum aggregate quality criteria and guidelines were developed based on the relaxed performance requirements.

What They Found

The researchers were unable to satisfactorily design a CAM using local aggregates with acceptable rutting and OT performance as per the current specification. These mixtures are not only susceptible to rutting given the high asphalt contents used but also susceptible to moisture and stripping through the combined action of low air voids (designed at 2%) and the potential to mobilize high pore-water pressures in the HWT test. Shear failure of these mixes in the compactor as well as in HWT test was clearly demonstrated and related to the low voids in the mix becoming overfilled with asphalt.

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Project Completed: 8-31-11

OT cracking results are particularly sensitive to compaction level and as expected increase with an increase in design density. The HWT results on the other hand are not sensitive to compaction level although a slight decrease in the trend line is apparent with increased density as expected. A better measure of mixture stability as influenced by compaction level is the gyratory compaction shear strength. Shear failures during compaction were evident when the relative density of the mix exceeded about 97.5 percent. The optimum performance of the CAM mixtures in terms of HWT, OT and shear strength is obtained when the relative density of the mix is in the order of 97 percent at 50 gyrations. This therefore would appear to be the optimum density at which to select the optimum asphalt contents of CAM with local aggregates to optimize rutting and cracking performance and provides a measure of safety against the risk of overfilling the mix with asphalt, which could lead to shear failures.

It was clear that a compromise was necessary, hence the recommendation to design these mixtures for low traffic volumes with an acceptable HWT performance of 10,000 cycles regardless of asphalt grade used.

What This Means

This research produced recommendations for designing CAM using local aggregates as tabulated below:

Criterion	Level
Relative density at Ndes (50 gyrations)	= 97 %
Relative density at Nmax (75 gyrations)	<= 98 %
Minimum VMA	>= 18 %
No shear failure before Ndes	Check shear stress curve
Maximum VFA	<= 85 %
HWT (regardless of binder PG grade)	>= 10,000 cycles at 12.5 mm rut
OT	>= 750 cycles to 95 % stress reduction

The following aggregate guidelines and quality criteria are proposed:

- Micro-Deval testing of CAM aggregates is preferred over LA abrasion and the maximum abrasion loss in the micro-Deval should be restricted to 15 percent.
- The maximum magnesium sulfate soundness loss of CAM aggregates should not exceed 15 percent.
- Retain the current angularity and flakiness requirements for CAM aggregates but introduce an AIMS criterion to require a minimum fine aggregate angularity of 4,500.

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