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Crack Attenuating Mixtures (CAM) and Rich Bottom Layer (RBL) Mixtures

There is a high level of interest in using HMA mixtures, such as crack attenuating mixtures (CAM) and rich bottom layer (RBL) mixtures, that provide improved resistance to cracking. Understanding proper selection of CAM and RBL mixtures in pavement design has been somewhat confusing since their recent development in Texas.

Some people use CAM and RBL interchangeably, however they are very different mixes with different intended applications. Both mixes are fine graded and provide an integral contribution to the overall pavement design; however, they are designed to perform different functions to address different pavement conditions.

To provide a better understanding of these mixes and to utilize them more effectively in our pavements, an in depth description of CAM and RBL mixtures is provided below.

Crack Attenuating Mixture

The current statewide special specification for crack attenuating mixture (CAM) is SS 3165. A CAM is designed to reduce reflective cracking in hot mix overlays, but also exhibits high rut resistance. It is typically placed as an interlayer between an existing pavement and a surface layer of hot mix.

There have even been discussions about CAM mixes being placed as a surface course under the right conditions. A few CAM mixes have been placed as the final riding surface and are being monitored for performance. Keep in mind that this mix, being a fine graded mix, lacks macro-texture and vehicles may become more susceptible to loss of friction. While this may not be an issue on residential streets or roadways with lower posted speed limits (< 45mph); friction and surface texture are needed for higher posted speed limits.

CAM is designed to a lab density of 98% at Ndes = 50 gyrations using the Superpave Gyratory Compactor (SGC). The gradation used to design this mix is sometimes referred to as a screenings mix, and is shown in Figure 1. The minimum binder content is 7.0% (7.0 to 8.0% typical). Although not specified in the plans, a PG 76-22 binder is usually required to meet both the Hamburg Wheel Test and Overlay Test requirements outlined in the specification. Several mixes have been designed and successfully produced in the past with PG 70-22 and have performed well. Class A aggregate is not required unless used as a surface course and desired by the district; however, most contractors have found that Class A aggregates are needed to meet the Hamburg and Overlay requirements.

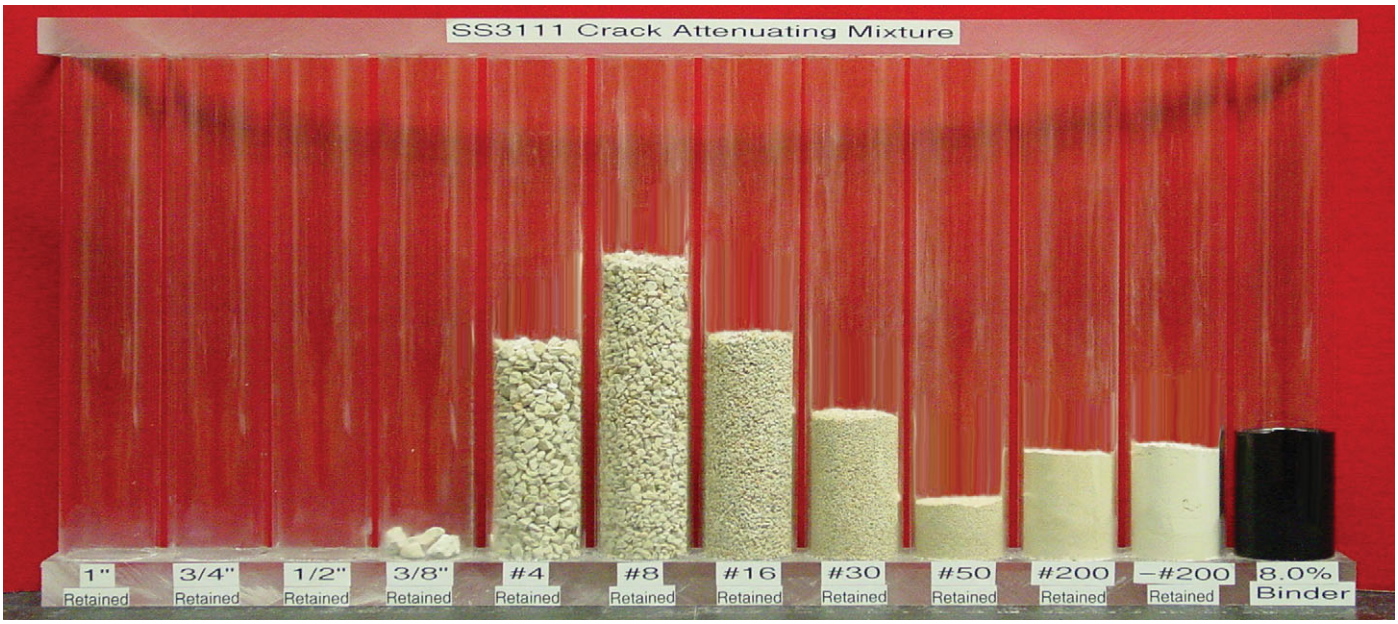

Figure 1. Typical gradation for crack attenuating mixtures (CAM)

Rich Bottom Layer

A rich bottom layer (RBL) mixture is designed as a fatigue resistant layer in a perpetual pavement design. It is placed as the "bottom" HMA layer of the perpetual pavement, as its name implies.

Some pavement design experts argue that RBL mixes are not necessary since the strain levels at the bottom of a perpetual pavement are very small. The main purpose of the RBL mixture is to provide relief of tensile stresses at the bottom of a pavement structure. It also serves as a relatively impermeable layer.

RBL is listed under and governed by Item 344, "Performance-Designed Mixtures." It is designed to a lab density of 98% at Ndes = 50 gyrations using the SGC, as outlined in Section 344.4.D.1. The gradation used to design an RBL mix is the SP-D Fine Mixture, but the specification prohibits the design gradation from passing below the reference zone. A typical gradation is shown in Figure 2.

Figure 2. Typical gradation for rich bottom layer mixtures (RBL)

RBL is designed to be placed at the bottom of the pavement structure where there is negligible concern about skid resistance or rutting resistance. Unless it is placed directly under traffic (i.e., during construction staging), there is no need to require Class A aggregate or the Hamburg Wheel Test.

RBL should theoretically provide improved resistance to fatigue cracking; however, there is no specification requirement for cracking resistance in Item 344. Several PG binder grades have been utilized, ranging from PG 64-22 to PG 76-22. PG 70-22 has commonly been specified on past projects. Because most RBL mixes are only exposed to construction traffic, PG 64-22 should be adequate.

Design and Mixture Properties

The average gradations of approved mix designs for both CAM and RBL projects are shown in Table 1 and a comparison of CAM and RBL mixture requirements are shown in Table 2.

Table 1. Average Gradations from Project Mix Designs

Sieve Size (% Passing)	CAM	RBL
3/4″	100	100
1/2″	100	99.9
3/8″	100	97.0
#4	80.4	77.5
#8	47.0	53.2
#16	30.6	39.2
#30	21.1	28.7
#50	16.0	19.2
#200	7.5	5.6
% AC	8.0	7.5

Table 2. Mixture Requirements

Parameter	CAM	RBL
Type of Compactor	SGC	SGC
Ndes gyrations	50	50
% Lab Molded Density	98.0	98.0
AC, % min	7.0	-
VMA, % min	17.0	16.0
Tensile Strength, psi	85-200	85-200
Hamburg	Yes	No
Overlay Test (cycles, min)	750	No

Conclusions and Recommendations

A CAM is designed to reduce reflective cracking in hot mix overlays. It is placed as an interlayer between an existing surface and a surface course of hot mix. The requirement of both Hamburg and Overlay tests makes the CAM an overall better choice in addressing rutting, fatigue and reflective cracking distresses. CAM may be used in lieu of RBL; however, using RBL in lieu of CAM is not recommended. The CAM special specification is now available for statewide use.

A RBL mixture is designed as a fatigue resistant layer at the bottom of a perpetual pavement design. Although RBL may offer some of the same characteristics as CAM, the properties of RBL are not validated with performance testing. Therefore, it is recommended that RBL be used only as the bottom layer in a perpetual pavement structure.

There continues to be a high level of interest in using CAM and RBL mixtures to provide improved resistance to cracking in pavements. Understanding the benefits and proper application of these mixes is important for engineers and designers.

Contact Information

If you have questions or need more information about this topic, please contact Robert Lee 512/506-5938 or Dale Rand 512/506-5836 of the Flexible Pavements Branch of the Construction Division.