Rationale for Revising AAHTO M 323 Table 2

The FHWA Mix ETG's RAP Task Group has proposed several revisions to AASHTO M 323 regarding the use of RAP in Superpave Mix Designs. Some of the most significant recommended changes have to do with the selection of the virgin binder grade for mixes containing RAP. The current guidance on this matter (Table 2 of M 323) is shown below.

Table 1—Binder Selection Guidelines for Reclaimed Asphalt Pavement (RAP) Mixtures

Recommended Virgin Asphalt Binder Grade	RAP Percentage
No change in binder selection	<15
Select virgin binder one grade softer than normal (e.g., select a PG 58-28 if a PG 64-22 would normally be used)	15 to 25
Follow recommendations from blending charts	>25

The current consensus of most asphalt paving technologies is that the virgin binder selection should be based on the properties of the RAP binder (i.e. its PG grade) and how much the RAP binder contributes to the mixture's total binder content. Some DOTs have simply altered Table 2 to base the three tiers on the RAP Binder Ratio (aka Binder Replacement) rather than RAP percentage by weight of mix.

In NCHRP Report 752, NCAT recommended removing the middle tier and using the blending equation to select the virgin binder grade when the RAP Binder Ratio is 0.25 and above. The reasoning behind this recommendation was twofold. First, removing the middle tier eliminated the practice of blindly dropping the virgin binder grade when it may not be necessary to do so (see examples below). Prior to NCHRP Report 752, some DOTs had already moved the step at which a softer grade for the virgin binder was required to a Binder Replacement of 20 or 25% (or RAP content of 20 or 25%) and had not reported any problems.

The second reason was motivated more by practicality. One of the commonly stated barriers to using higher RAP contents has been the requirement to use a softer virgin binder. In many areas of the country, softer binders have not been available. Even where softer binder grades are available, doing so would require the asphalt contractor to install an additional tank and associated controls and piping, expand the heating system, and expand the tank area containment. Therefore, setting a low step at which the virgin binder grade is decreased becomes a disincentive to RAP contents above that point.

Examples of Using RAP Binder Data to Determine Grade Steps

Indiana and Alabama are two states that have collected data on properties of recovered RAP binders from RAP stockpile samples taken across the respective states. The table below shows statistics for the critical temperatures (i.e. true grades) for RAP binders in Wisconsin and Alabama.

State	No. of Samples	$T_{critical}$ (°C)		
			Avg.	Std. Dev.
Indiana	33	High	90	5.0
		Low	-11	3.1
Alabama	34	High	92.3	5.7
		Low	-12.5	3.6

It can be assumed that the properties of the composite binder (blend of RAP and virgin binders) can be estimated from properties and relative proportions of the RAP binder and virgin binder. This is the fundamental basis of blending charts. The composite binder property can be estimated using the general equation:

$$Prop._{(composite)} = Prop._{(RAP\ binder)} \times (RAPBR) + Prop._{(virgin\ binder)} \times (1-(RAPBR)) \quad [1]$$

where *RAPBR* is the RAP binder ratio.

Therefore, if we are interested the low critical temperature,

$$Tc\text{-}low_{(composite)} = Tc\text{-}low_{(RAP\ binder)} \times (RAPBR) + Tc\text{-}low_{(virgin\ binder)} \times (1-(RAPBR)) \quad [2]$$

Solving for RAPBR

$$RAPBR = (Tc\text{-}low_{(composite)} - Tc\text{-}low_{(virgin\ binder)})/(Tc\text{-}low_{(RAP\ binder)} - Tc\text{-}low_{(virgin\ binder)}) \quad [3]$$

$Tc\text{-}low_{(composite)}$ can be based on the low temperature needed for a specific project or based on a representative value for a state or region. This can be obtained from LTPP Bind3.1. Tc-low for the RAP binder and virgin binder should be based on measured data.

In the case of Indiana, LTPP Bind3.1 data shows that at 98% reliability, the standard binder grade should be a PGXX-28, with a few locations requiring only a PGXX-22 grade. However, the standard grade is rounded down from the 98% reliability true grade. For the State of Indiana, the 98% reliability true grade is -23.7. The PGXX-28 binders supplied in Indiana have historically graded at a PGXX-28.7. Therefore, the maximum RAP Binder Ratio that can be used with the PGXX-28 binders and meet the true grade needed for Indiana is:

$$RAPBR = (-23.7 - (-28.7))/(-11.0 - (-28.7)) = 0.28$$

In the case of Alabama, LTPP Bind3.1 data shows that 81% of the state should use a PGXX-16, and 12% of the state should use a PGXX-10 at a reliability level of at least 98%. However, the standard grade required by ALDOT is a PG 67-22. If a conservative PGXX-16 is needed, and the virgin binders supplied in Alabama meet a PG XX-22 grade, then

$$RAPBR = (-16 - (-22.0))/(-12.5 - (-22.0)) = 0.36$$