2015 PAPA Regional Technical Meetings

High RAP/RAS Mix

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Main Source of Information for Changes

NCHRP Report 752, 2013, Transportation Research Board, National Research Council, Business Office, 500 Fifth Street N.W., Washington D.C. 20001.

This publication is also available on the Internet at

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_752.pdf

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Affected PennDOT Publications

- Bulletin 27 (Mix Design)
- Section 409 of Spec 408 (Construction Spec.)
- Publication 2 (POM)

RAP Mix Design

- Design Covered in Bulletin 27
- Details in Chapter H of Bulletin 27

RAP Mixes in PA

- Current Protocols
  - Tier 1 (Low RAP): Less than 15% RAP in Mix
  - Tier 2 (High RAP): More than 15% RAP in Mix

Notes:

- The above are based on RAP content in the mix.
- Move is taking place to consider RAP binder content rather than the RAP content in the mix.

New Definitions for RAP Usage

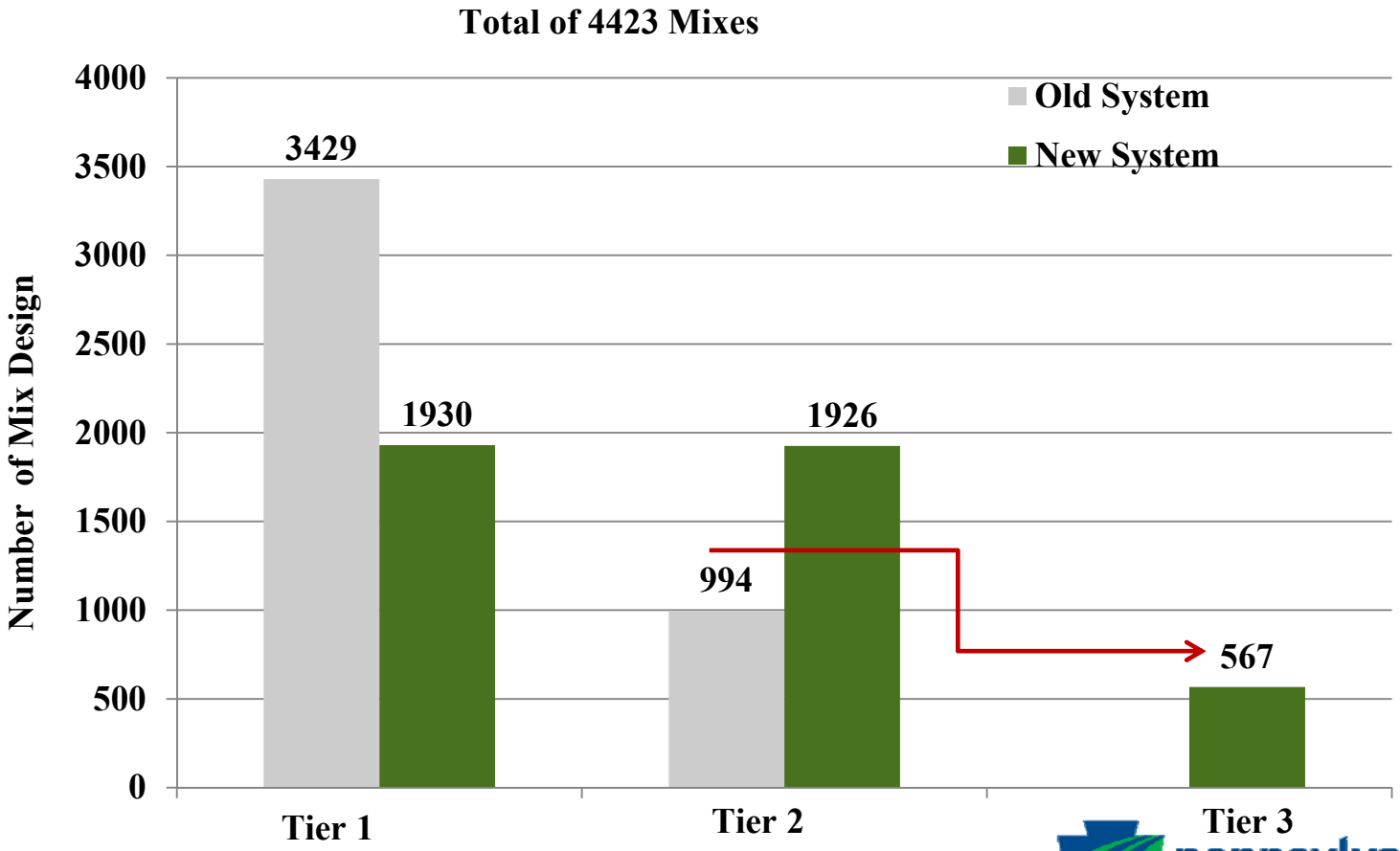
- New Term: Reclaimed Asphalt Binder Ratio: **RBR**

- Definition:
  - **RBR** is defined as the amount of RAP and RAS asphalt binder in the mixture divided by the total asphalt binder in the mixture.

Proposed Mix Design Tiers

Mix Design Tier	Pavement Course(s)	RBR
I	Wearing and Binder	≤ 0.20
	Base	≤ 0.25
II	Wearing and Binder	> 0.20 and < 0.25
	Base	> 0.25 and < 0.30
III	Wearing and Binder	≥ 0.25
	Base	≥ 0.30

How Does the Change Impact Existing Mix Designs?



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Concern about RAP Aggregate G_{sb}

- How Do We Find RAP Aggregate Sp. Gr. (Gsb)?
- Two Ways Are Proposed:
  - 1. Do solvent extraction and run AASHTO T84 and T 85
  - 2. Backcalculate Gsb using RAP Aggregate Effective Sp. Gr. and Binder Absorption

Concern about RAP Aggregate Binder Absorption

- How Do We Find RAP Aggregate Binder Absorption?
- Two Ways Are Proposed:
  - Assume absorption based on historical data
  - Use Lab Work

    1. Find Gsb of ignition oven extracted aggregate using T84 and T85.
    2. Blend aggregate from ignition oven with binder and find Gse
    3. Use results from steps 1 and 2 to find Gsb.

Equations to Consider

Effective Specific Gravity G_{se}

$$G_{se} = \frac{(100 - P_b)}{\left(\frac{100}{G_{mm}}\right) - \left(\frac{P_b}{G_b}\right)}$$

Equations to Consider

Percent Binder Absorbed into RAP Aggregate

P_{ba}

$$P_{ba} = 100 \times \frac{G_{se} - G_{sb}}{G_{se} \times G_{sb}} \times G_b$$

Equations to Consider

RAP Aggregate Bulk Specific Gravity G_{sb}

$$G_{sb} = \frac{G_{se}}{\frac{P_{ba} \times G_{se}}{100 \times G_b} + 1}$$

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Work under Proposed New Tiers

- **Tier 1**
  - Sampling
  - Gradation of RAP Aggregate
  - Asphalt Content
    - Ignition or Solvent Extraction
  - RAP Aggregate Sp. Gr.
    - Several Options Exist
      - Sp. Gr. on aggregate from solvent extraction
      - Using Gmm, Gse, and binder absorption

Work under Proposed New Tiers

- **Tier 2**
  - Sampling – Split Samples needed from Stockpile
  - Gradation of RAP Aggregate
  - Consensus Properties of RAP Aggregate
  - Asphalt Content
    - Only through Solvent Extraction
  - RAP Aggregate Sp. Gr.

Work under Proposed New Tiers

- **Tier 3**
  - Sampling – Three Split Samples needed
    - One Set for Testing in an Independent Laboratory.
    - One Set for Mix Design
    - One Set for LTS
  - Gradation of RAP Aggregate
  - Continuous Binder Grade by Independent Lab
  - Consensus Properties of RAP Aggregate
  - Asphalt Content
    - Only through Solvent Extraction
  - RAP Aggregate Sp. Gr.

Work under Proposed New Tiers

- **Tier 3**
  - Determine Required Binder Grade
  - Performance Testing (Hamburg Wheel Tracking)

Design ESALs (million)	Maximum Hamburg Rut Depth, (mm)
< 3	---
3 to <10	10
10 to <30	8
≥ 30	6

Proposed Table for Standard Deviation of RAP Asphalt Content and RAP Gradation

RAP Stockpile Parameter	Course	RBR ≤ 0.15	0.15 < RBR < 0.25	RBR ≥ 0.25
Asphalt Content	Wearing/Binder	0.60	0.5	0.4
	Base	0.70	0.60	0.5
Percent Passing the No. 200 Sieve	Wearing/Binder	2.50	2.00	1.50
	Base	3.00	2.50	2.00
Percent Passing all other Sieves	Wearing/Binder	5.0	4.0	3.0
	Base	6.0	5.0	4.0

Limits on RAS Content in the Mix

- RBR Contribution from RAS
  - ≤ 0.20 for wearing/binder courses
  - ≤ 0.25 for base course