WisDOT Pilot: High Recycle Mixes

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Agenda

- Projects
- Testing
- Successes
- Opportunities
- Next Steps

Background

- Desire to improve the way we work with recycled materials
- Industry looking for more economical ways to produce mixes
- Desire to use more than volumetrics as a means to accept pavements.

Department Goals

- Implement better practices for the use of recycled materials (from NCAT and other sources)
- More economical mixes without sacrificing pavement performance
- Develop performance testing protocols
- Develop protocols for verifying asphalt content
- Upgrading of standard specifications for the use of recycled materials

Pilot Project Specification Limits

MAXIMUM ALLOWABLE PERCENT BINDER REPLACEMENT

RECYCLED ASPHALTIC MATERIAL	LOWER LAYERS	UPPER LAYER
RAS if used alone	25	20[2]
Any blend of RAM [3] (from more than 1 source)	50[1]	40[1,2]

[1] When used in combination the RAS component cannot exceed 5 percent of the total weight of the aggregate blend.

[2] For RAS only and any combination RAM with a percent binder replacement greater than 25%, Virgin binder grades used to produce these mixes will be adjusted as follows:

Plan Specified Binder Grade	Supplied Virgin Binder Grade
PG 58-28	PG 52-34 or 46-34

This virgin binder grade adjustment may be waived if the contractor furnishes test results indicating that the resultant binder meets the grade of the contract originally specified as referenced in 460.2.7 of this SPV article

Pilot Projects in 2014 & 2015

- 2014 Projects
- STH 77, Ashland Co.
- STH 73, Dane Co.

- 2015 Projects
- STH 26, Fond du Lac Co.
- USH 141, Marinette Co.

Review - Project Selection

- Successes
  - A chance to evaluate standard mix and high recycle side by side
  - E3 (MT) & E1 mixes used
  - Upper and lower layers on most projects
- Opportunities
  - Availability of RAS/RAP in project locations
  - Quality of RAP needed for successful designs

RAS Stockpile Testing Requirements

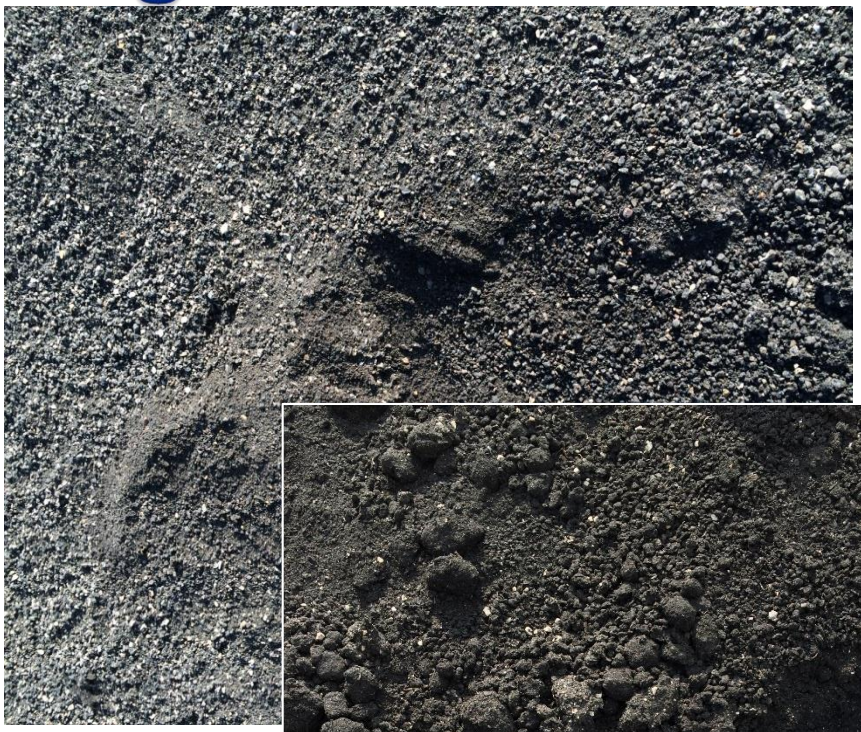
- One Test per 250 Tons during pile production
  - Gradation (Pilot)
    - 100 % Passing the 3/8” Sieve
    - 93% Passing the #4 Sieve
    - Less than 1% Deleterious on R4 Material
- Old specification
  - 100% Passing ½” Sieve

RAS Stockpile Testing Requirements (Con't)

- P200 must be within 2.0% of stockpile average
- Asphalt content must be within 2.0% of stockpile average
- All properties must be within described tolerances for 80% of the tests for stockpile to be accepted
- Minimum of 5 tests per stockpile

RAP Stockpile Testing Requirements

- One Test per 2000 Tons during pile production
  - P200 within 2% of stockpile average
  - Asphalt content within 0.75% of stockpile average
  - All properties within described tolerances for 80% of the tests
  - Minimum of 5 tests



Stockpile Testing Results

- Successes
  - New stockpile testing limits were achieved.
  - RAS Gradations were not a problem – implementable
- Opportunities
  - RAP had to be hauled in for design to work on one project
  - Use of project millings due to location prevented advanced stockpile testing
  - One project used true fractionation of RAP

Performance Testing

- Striping Resistance – Hamburg Wheel
  - AASHTO T324-11
- Fatigue Cracking – Semi Circular Bend Test (SCB)
  - AASHTO XXXX-XX – In Development (ASTM & AASHTO)
- Low Temperature Cracking – Disc Shaped Compact Test (DCT)
  - ASTM D 7313-07

Performance Test Intervals

- QC
  - Mix Design
  - Test Strip (Start up)
  - Once every 10,000 Tons of production
- QV
  - Test Strip (Start up)
  - Once every 10,000 Tons of production

Aging Requirements

- Long Term Aging Required (AASHTO R30)
  - 120 hours at 85C (5 Days)
  - Required for DCT, SCB Tests
  - Significant lead time needed to obtain results
  - Modified to 12 hours loose mix @ 135C in 2015

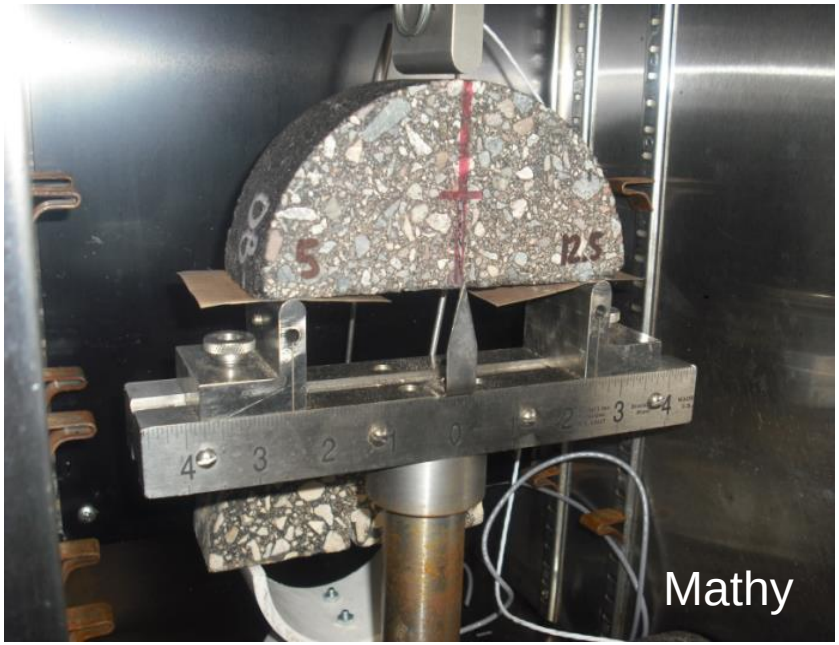
Hamburg Wheel Samples

- Moisture sensitivity and rutting potential
- Limits based on high temperature PG grade
- Less than 0.5” rut depth @ defined # of passes
  - PG 58 – 5,000 passes
  - PG 64 – 10,000 passes
- Stripping & Inflection Point (SIP) for mix stability

Hamburg Wheel Result

- Successes
  - 19mm mixes performed well
  - Good idea of moisture susceptibility
  - Developing a level of comfort with the test procedure
  - May prove viable to replace TSR Test
- Opportunities
  - 12.5mm mixes had problems, despite good performance
  - Test temperature (50C) too close to softening point of PG Binder?

Semi-Circular Bend Test



SCB Samples

- Wheel path fatigue cracking
- Following the Louisiana Procedure
- 3 different notch depths
  - 25.4, 31.8 and 38.1 mm
- No set limit, as specification is still in development

SCB Spec Limit

- Successes
  - Much national attention being paid to SCB
  - Debate as to which procedure is the best
  - Appears to be sensitive to aging
- Opportunities
  - Procedural and analysis inconsistencies
  - National need for consensus
  - Room temperature vs climate control

Disc Shaped Compact Test

DCT Samples

- Low temperature cracking
- 400 J/m^2 the desired minimum
- Run at 10C above the design required minimum
  - -34 C = -24 C Test temperature

DCT Results

- Successes
  - Repeatable results
  - Established procedure
  - Identified lower air void mixes as more crack resistant
- Opportunities
  - Trends not 100% predictable
  - Effect of aging on results not 100% consistent

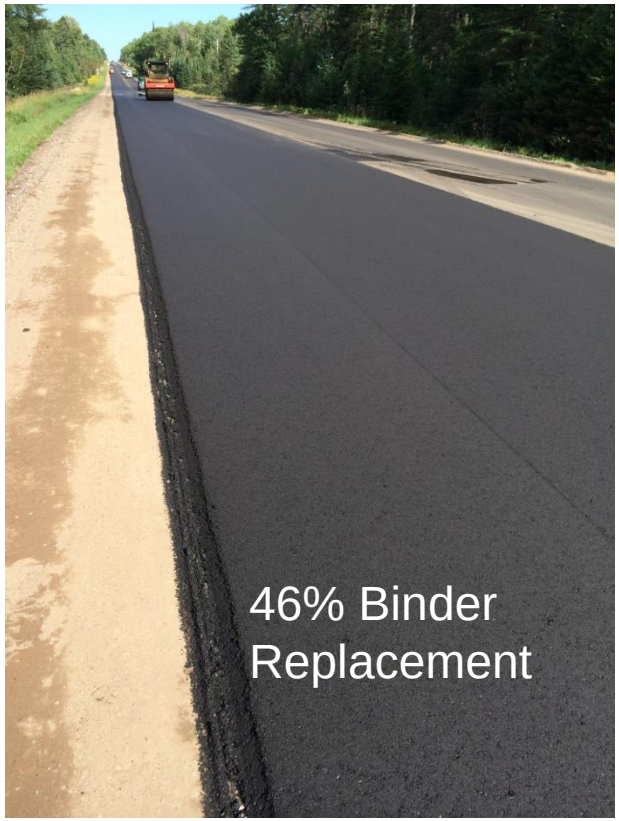
STH 77 – Clam Lake to STH 13

- High Recycle Mix Used on 19mm lower and 12.5mm upper layer of the mill & overlay project
  - Total Project Length – 13.69 miles
    - E3 – 29,000 Tons
  - High Recycle Length – 4.08 miles (West End)
    - E3 – 16,000 Tons
  - Resultant PG Grade Requirement PG 58-34

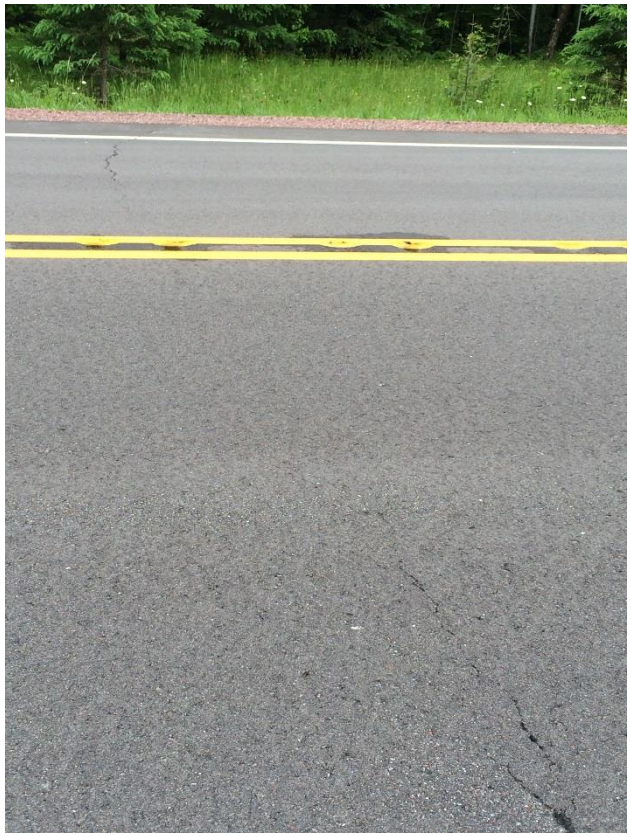
STH 77 Mix Designs

- All designs used RAP – Single Stockpile
  - RAP Obtained from STH 77 Millings
- 12.5 mm mix design
  - 36.7% binder replacement
- 19 mm mix design
  - 45.9% binder replacement

STH 77, Ashland County



STH 77: 1 Year Later



STH 77

- Successes
  - Meet every performance threshold
  - Monitoring pavement performance
- Opportunities
  - First project – identified language issues
  - Timeline issues – 5 day aging

STH 73, USH 12/14 to IH 90

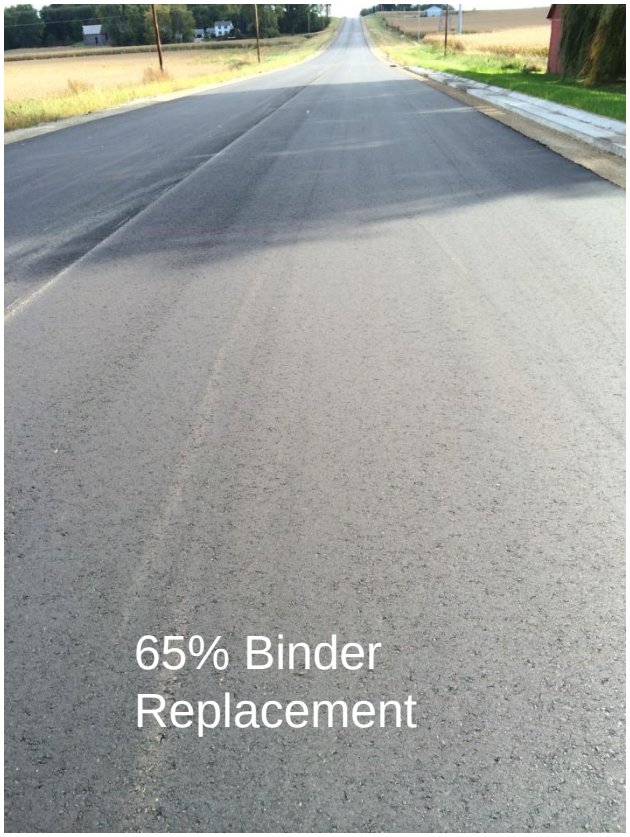
- Reconstruction project run as a research project with various levels of recycling used in both the lower and upper lifts.
- Total project length 9.623 miles
  - Lower layer – 3.5” 19 mm
  - Upper layer – 1.75” 12.5mm
- Target PG Binder Grade PG 58-28
- Total 66,153 Tons E 3 mix

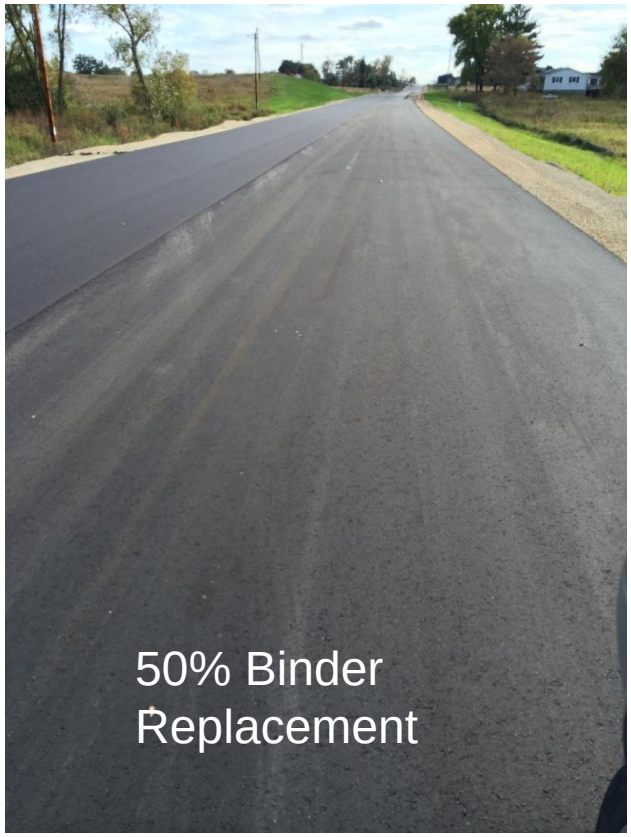
STH 73 Mix Designs

- Recycled asphalt from fractionated RAP (coarse & fine) and RAS

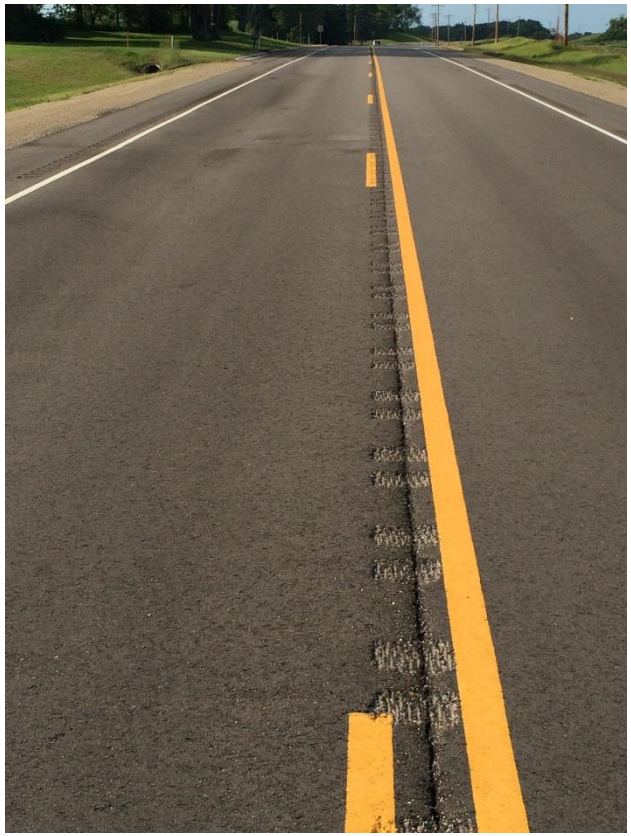
Mix Design	%RAP	%RAS	Total % Binder Replacement
276 (19mm)	14%	4.0%	34.6%
282 (19mm)	33%	4.0%	50.3%
282EX (19mm)	40%	6.0%	68.3%
277 (12.5mm)	13%	3.0%	24.6%
283 (12.5mm)	32%	5.0%	48.4%

STH 73, Dane County





STH 73: 1 Year Later



STH 73 Lessons Learned

- Successes
  - Tested recycling to extreme limits
  - Well organized tracking system
  - Contractor ownership
  - Will monitor for long term performance
  - FHWA lab trailer will provide many results
- Opportunities
  - Unable to pinpoint cause of early distress
  - Needed remedial action in year one

USH 141, Marinette County

- Moved to 2015 construction season
- Upper and lower layer recycle
  - All of lower layer mixes
  - 2 of the 5.3 miles in the upper layers
  - 28,000 Tons total
- Used lessons learned from previous projects
  - Mixture Aging
  - Hamburg Wheel concerns

USH 141 Construction

USH 141 Lessons Learned

- Successes
  - No major issues identified
  - Use of 12 hour aging vs 5 day at contractor's choice
- Opportunities
  - Identified the need for this to be a contractor choice (RAP)
  - Issues with Hamburg Wheel in 12.5mm mixes

STH 26, Fond du Lac County

- Only E-10 mix in program (12,000 Tons)
- Used on lower layer only
- No noted construction issues

Economics

- All projects were let with a Standard Specification & High Recycle Pilot mix
- Let savings of varied from 5 to 15% on HMA Items (including asphalt binder costs) for higher recycle mixes than standard E-mix.

Overall

- Higher RAM mixes had better performance test results than standard mix, within project
- Economic benefits seen
- Need for consistent definition of requirements
- Need to develop specification as contractor choice

Next Steps

- Updated specification and procedures with lessons learned for 2017 SS
- Monitor performance
- Use pilots to update standard specifications
  - Asphalt content testing
  - Recycled product specifications
  - Performance testing

Questions

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