Warm Mix Asphalt (WMA) and Recycled Asphalt Pavement (RAP)

Andrew Wrucke, M.S.C.E., E.I.
Design and Construction Engineer
Cass County, ND
Project SC-0910(062)

- Cass Highway 26 from State Highway 38 to Cass Highway 5 North
- Graded in 1993
- Originally surfaced in 1994 (planned first overlay)
- Planned 2.5” asphalt overlay (≈26,000 tons)
- Length: 8 Miles
- March 23, 2012 NDDOT bid opening
- Engineer’s estimate: $2,055,944.15
- Original low bid: $2,170,430.85
- First Superpave project in Cass County
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- Original road section: 2-12’ lanes, 6’ gravel shoulder
- Overlay to include 6’ shoulders to create 36’ asphalt road top
- Designed as a standard Hot Mix Asphalt (HMA) project
  - All PG 58-28 Asphalt
- NDDOT Specification 410
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Project SC-0910(062)
HOW WE GOT TO WMA/RAP
How we got to WMA/RAP

• Traditional bid process through NDDOT
  – Low bidder: Knife River Materials; Bemidji, MN

• First project with Knife River Materials
  – Had done several RAP/WMA projects in MN
  – Last HMA project was several years previous

• Had viewed KR project in Norman County, MN in 2010
  – Demonstration WMA/RAP project
How we got to WMA/RAP

- Pre-Construction Conference
  - May 30, 2012
  - Section 104.08 “Value Engineering”
    - Contractor allowed for use of WMA at bid price
    - Contractor suggested use of RAP (initial suggestion of 20% ± 5%) in mix
    - RAP source to be 1” milling of existing road
    - Re-quoted milling cost from subcontractor
    - Lowered gravel shoulders 1”
    - Estimated cost savings: $200,000
  - Completed NDDOT Change Order mid-July, 2012
How we got to WMA/RAP

• Minnesota specifications differ greatly from ND
  – Allows from oil from any source (RAP, RAS)
    • Allows for RAP to be from any source, not just existing road
  – Required to have 70% new oil in mix
    • Allows for 25-35% RAP in mix depending on RAP AC
    • Required on highly polymerized asphalts to lower RAP content (i.e. 20% max RAP on PG 58-34)
  – Do not pay for oil separate of mix
  – Mix tested off the road for AC content and gradation
    • Allows for on the fly adjustments to final product
CONSTRUCTION
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• Project started July 30, 2012
  – Initially widening gravel shoulders with class 5 aggregate
  – Existing road milled simultaneously
  – RAP stockpiled at asphalt plant/pit location in Sibley, ND
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- Paving started August 1, 2012
  - 1” Leveling course 26’ wide
  - 1.5” wear course with 2.5” shouldering 36’ wide
    - Started wear course August 2, 2012
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• Single extraction of RAP mix taken before project started by contractor for mix design
  – Cores taken from several locations to gather extraction and mix design samples

• Only additional test was single sieve analysis of RAP millings to verify nominal size

• Normal NDDOT Superpave specification testing followed
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• QA/QC Asphalt testing
  – Virgin aggregate testing conducted every day by both QA/QC
  – Additional worksheet filled out assure correct amount of RAP added to mixture
  – Asphalt samples removed behind paver for Rice and Gyratory testing
# ASPHALT CONTENT & VIRGIN AGGREGATE DETERMINATION

North Dakota Department of Transportation, Construction
SFN 18674 (Rev. 04-2000)

<table>
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<th>Test No.</th>
<th>TIME</th>
<th>(1) Aggr. Tons Rdg.</th>
<th>(2) Savx Blt. Tons Rdg.</th>
<th>% VIR. AGGR. = (1) / (1) + (2)</th>
<th>(3) BITUMEN Flow Meter Reading (Gal)</th>
<th>(4) Wt. Per Gal.</th>
<th>(5) AC TONS Tons Used = (3)x(4) /2000</th>
<th>(6) AC Percent Added = (5) / (1)+(2)+(5)</th>
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<th>CUTOFF REPORT COMPARISON</th>
<th>Totalizer Cutoff</th>
<th>Total Mix Produced =</th>
<th>Total Bitumen Used =</th>
<th>AVERAGE VIRGIN AGGR. %</th>
<th>SUM % NUMBER =</th>
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# REMARKS

DISTRIBUTION: Project Records

Project: O-0910(062)

Contractor: Knife River

Scheduled Hours: Target Ac Content: 4.7% Target Virgin Aggr: %

Date: 8-2-12

Inspector's Signature

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SC-0910(062)

• Lowered add AC% from 5.6 to 4.3
  – RAP had AC% of 6.3%
  – Target AC% of Mix Design at 5.6%
  – Resulted in 30% decrease in added AC%
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- Asphalt plant modifications
  - Asphalt foamer by Maxam
    - AQUABlack foamer installed on existing drum plants
    - Water only added to mix, no additional chemicals
  - RAP insertion point
    - RAP collar added to plant by manufacturer
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SC-0910(062)

- Paving operations completed August 9, 2012
- Project completed August 10, 2012
- Final Project cost: $1,872,680.43
- Savings from initial bid: $297,750.42
  - Total of 13.7% Savings
  - Biggest savings in PG 58-28 and Class 5
  - 66% and 72% original quantity
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Project Review

• WMA technology
  – Cores hit compaction requirements
    • NDDOT cores between 91-96%
  – Paving Ambient temperature 80F-90F
  – Lower WMA temperature allowed for better cooling
    • HMA project earlier in season had shoving and cooling issues in hot weather
    • WMA started at lower temperatures, less time required to reach workable temperatures
Project Review

• Foamer technology used for WMA
  – Water added to asphalt at plant to create asphalt emulsion
    • Water required to be potable and free of debris
  – Lower energy costs since less heating required to coat aggregate
  – Allows for lower temperatures of mixing and hauling
  – Lower temperatures results in better mixture with RAP with less reheating of aged bitumen
Project Review

• Excited by Possibilities of RAP
  – Costs savings of over 10% by using RAP
  – 1” milling removed damaged layer of asphalt from roadway
    • With 1” depth removal, structure of roadway not compromised
    • Removed rutting layer, equalized rate of application
  – Milling removed crack seal from roadway
    • Had problems with the crack seal activating in heat and causing cracks to reflect through on previous projects
Project Review

• RAP future savings
  – Average oil cost (2012 ND): $642/ton
  – AC savings from RAP: 30%
  – Savings of $8.35/ton of bituminous material
Project Review

• Road up for chip seal in 2013 or 2014, pending funds
  – County regularly chip seals 2 years after overlay to increase life of pavement
  – Chip seal after 2 years to add oil to RAP mixture and keep mix flexible
FUTURE USE OF WMA/RAP
Future Use of WMA/RAP

• New project bid by CCHD using RAP
  – Cass County Highway 4 bituminous surfacing
  – 40,000+ Tons of RAP in stockpile from removing existing road
  – Requiring use of stockpile to create 20% ± 5% RAP mixture for bituminous surfacing
  – Project bid opening on Feb 21, 2013.
    • Central Specialties low bid
    • $3,390,000 (46,000 ton project)
Future use of WMA/RAP
Future Use of WMA/RAP

- NDDOT Specification includes section on Recycled Pavements
  - NDDOT Specification Section 407
  - Built internal plan note referencing specification for use on future projects
Future Use of WMA/RAP

• Allowing use of WMA on future bituminous surfacing/overlay projects
  – Created note for county paving projects allowing use of WMA at Contractor’s discretion
  – Some contractors in area not retrofitted for WMA yet
Questions?