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Virginia DOT High RAP %'s in HMA

HMA RAP ETG

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- Acknowledgements: Rorrer, VDOT, Maupin, VTRC, others
- Why
- Approach Taken
- Project Characteristics
- HMA mix and binder results
- Remaining Questions

Why Higher RAP % in HMA

- 2006 – reduce HMA costs

Approach Taken to Assess Higher RAP %

- No new QC/process control requirements
- Conventional HMA quality: rutting, durability, production consistency
- VDOT QC/QA since mid-1980's
- Aggregate quality – friction?
- Binder selection based on 98th percentile design on the low end temperature of the grading system (-22 C) according to the LTPP Binder selection criteria. Low temp. crack experience - ?? Majority of Virginia -16 C falls above the 80th percentile.

Approach Taken to Assess Higher RAP % (cont)

2007 Maint. Overlay Contract Characteristics to Facilitate Assessment – Manage Risk:

- Competition – minimum of two bidders if possible
- Contractor experience with RAP
- Tonnage – minimum 10,000 tons
- Routes – suggest at least 50% of schedule has primary or high volume secondary roads with at least 10,000 ADT
- Overlays of 1.5” minimum
- Desire mill and overlay sections (milling on job may increase probability contractor will be interested in using high RAP mix)
- Not an interstate

Approach Taken to Assess Higher RAP % (cont)

HMA surface mix Binder type specified	New Spec: %RAP ≤ 20%	New Spec: 20%≤RAP≤30%	Standard Spec: 20.0%≤ %RAP
PG 64-22	PG 64-22	PG 64-22	PG 58-28
PG 70-22	PG 70-22	PG 64-22	PG 64-28
PG 76-22	PG 76-22	PG 70-28	PG 70-28

Approach Taken to Assess Higher RAP % (cont)

- Virginia DOT definition of high % RAP mixes = greater than 20% RAP in surface/intermediate mixes

Project Characteristics – Advertised

- Maintenance Overlay Type Projects bid for construction during 2007 construction season (VDOT has 9 Districts)
- Contractor option to use High RAP:
  - 1 District all contracts
  - 1 District a few contracts
  - 1 District 1 contract
- Contractor required to use high RAP in 2 contracts in 2 Districts
- All contracts have standard value engineering provisions

Project Characteristics – Bid and VE

Route(s)	Mix Type	% RAP	Tonnage
SR 40, CR 703	SM-12.5D	25	12,007
CR 611	SM-9.5D	25	3,169
I-664 ($85/ton)	SM-12.5D	30	7,092
SR 6	SM-12.5D	25	5,250
SR 6	IM-19.0D	30	2,584
US 58	SM-9.5D	30	10,042
US 221	SM-9.5D	30	7,544
US 29 ($52/ton)	SM-9.5D	25	24,898
SR 24, CR 691 ($52/ton)	SM-9.5D	25	24,841
US 29, SR 57, CR 729($47/ton)	SM-9.5D	21	31,940
Total			129,277

Project Characteristics – Bid and VE

- All high RAP mixes substituted PG 64-22 for the specified PG 70-22 binder
- Several high RAP optional contracts had PG 64-22 as the specified binder – no contractor elected to go high RAP
- High RAP mixes produced by 7 plants by 6 contractors in 4 Districts
- One contractor tried to use high RAP but high fines/asphalt ratio during mix design – elected not to pursue high RAP
- Three VE proposals to use high RAP submitted

Project Characteristics – Bid

Contract Bid Statistical Analysis:

- Impact of high RAP provision not statistically significant
- Statistically significant relationships between bid price and (1) the number of tons and (2) the number of bids received

Project Characteristics – VE

One VE proposal: change from 20% to 21% RAP resulted in binder change from PG 70-22 to PG 64-22

- Total savings of $2.16/ton which is split between DOT and contractor
  - Estimated that $1.75/ton of savings was for cost difference between binder grades

HMA Mix and Binder Results

Production observations and findings:

- Single processed RAP stockpile (contractors generally check AC content and gradation weekly, moisture daily)
- RAP sources - variable
- RAP moisture control maximum RAP % (>5% moisture)
- Production maximum controlled by RAP moisture
- Exhaust stack emissions control maximum RAP %
- HMA plant drum types: one-half, single, and double barrel counter flow, and parallel flow
- RAP hauling/processing - Contractor A $9.50/ton; Contractor B $5/ton

HMA Mix and Binder Results

- Conventional lab tests: AC content, gradation, voids,
- One project slight price adjustment on gradation, and another slight price adjustment on density. Not attributed to use of a high-RAP mix.
- Complex lab tests – High RAP % vs. conventional: fatigue, rutting, moisture susceptibility – no significant difference
  - Conventional: RAP contents ranging from 0-20%
- Recovered binder tests:
  - 12 samples from high RAP: seven PG 70-22, two PG 76-22, two PG 76-16, and one PG 64-22
  - Four samples from conventional HMA: two PG 70-22, one PG 76-16, and one PG 76-22

Specification for 2009

HMA surface mix Binder type specified	New Spec: %RAP ≤ 20%	New Spec: 20%≤RAP≤30%
PG 64-22	PG 64-22	PG 64-22
PG 70-22	PG 70-22	PG 64-22
PG 76-22	PG 76-22	PG 70-28

Remaining Questions

- Pavement in service performance
- Friction
- PG 70-22 with 19% RAP = PG 64-22 with 21% RAP?
- Low volume roads with pavements that deflect – need HMA that is flexible/not too stiff – limit RAP %
- Future RAP quality/sources
- Polymer modified binders
- Risk Allocation – Warranties?

VDOT High RAP %'s in HMA Documents

- http://vtrc.virginiadot.org/PubDetails.aspx?PubNo=08-R22
- http://www.virginiadot.org/business/resources/Materials/Hampton-Roads_District_High_RAP_Production_Placement-2008.pdf
- http://www.virginiadot.org/business/resources/Materials/LynchburgDist_High_RAP_Production_Placement-2008.pdf
- http://www.virginiadot.org/business/resources/Materials/Richmond-District_Dinwiddie_High_RAP_Production_Placement-2008.pdf
- http://www.virginiadot.org/business/resources/Materials/Richmond-District_Goochland_High_RAP_Production_Placement-2008.pdf
- http://www.virginiadot.org/business/resources/Materials/Salem_District_High_RAP_Production_and_Placement-2008.pdf

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Questions/Comments