REVIEW OF CONSORTIUM

DESIGN GUIDANCE
TASK E2

HYPOTHESIS
BINDER MODIFICATION (E2a)

- Modification impacts damage resistance properties
- Significant cost and handling consequences
- Understanding
  - polymer interaction
  - aging
  - and chemical modifiers
- Improve modifier selection process
- Reduce risk of construction impact
- Improve performance.

OBJECTIVE
BINDER MODIFICATION

- Identify modifiers and processes
- Develop modifier classification system
- Models to
  - Estimate level of modification
  - Cost of modification
- Manual for making modified binder
- Performance database
  - Use
  - Cost
  - Performance

OBJECTIVE?

- Become an asphalt binder manufacturer?
  - Effectiveness (on binder properties)
  - Cost
- Who will use the results?
  - State DOTs?
  - FHWA?
  - Binder manufacturers?

OBJECTIVE? Cont'd

- Seems not to be useful

- Think the main purpose is to ensure that the specification
  - Contains the "correct" properties
  - Specifies the "correct" criteria for the application
- Let market determine effectiveness and cost

Next Year Country

HYPOTHESIS
HIGH RAP MIX DESIGN (E2b)

- RAP beneficial
  - Economical
  - Long-term performance
- Needs
  - Appropriate testing
  - Analysis method

OBJECTIVE
HIGH RAP MIX DESIGN

- Develop testing and analysis procedures
- Evaluate RAP materials
  - Binder
  - Aggregate
- Develop mix design process
- Develop performance evaluation

HIGH RAP MIX DESIGN

- Binder
  - Amount
  - Properties
- Binder Properties
  - Develop environmentally friendly extraction / recovery test
  - Or
  - Develop a mortar separation method

Plan

HIGH RAP MIX DESIGN

- Evaluate voidless mortar (-#8)
  - All virgin binder
  - Virgin plus RAP
  - Use E* and Hirsch model to find binder stiffness

Plan

HIGH RAP MIX DESIGN

- Aggregate
  - Gradation
  - Specific gravity
- Simulated RAP
- Extraction
  - Reflux
  - Centrifuge
  - Ignition oven

Plan

Important Properties of Aggregates

- Gradation
- Specific gravity

- Question the evaluation of aggregate recovery method
  - lot of lab work
  - high likelihood that conclusion will be

- “Don’t use ignition oven”

Specific Gravity

- Can get Gse
- Can estimate Gsb based on typical absorption
  - using Gse is tolerable error at low (<15%) RAP
  - using estimated Gsb is tolerable up to 40% RAP

HIGH RAP MIX DESIGN

- Virgin and RAP Binder Compatibility
  - Develop new chemical test to evaluate
    - Do not use blend
    - Use blend cautiously
    - Use blend

Plan

Compatibility of RAP and Virgin Binders

- Measured using
  - Automatic Flocculating Titrimetry and
  - Atomic Force Microscopy

- What use will be made of this?

HIGH RAP MIX DESIGN

- Develop mix design procedure
  - Evaluate 15, 30 and 45% RAP
  - Process to evaluate binder properties
  - Process to measure aggregate gravity
  - Modify mixing/compaction temperature
  - Change gyrations

Plan

HIGH RAP MIX DESIGN

- Impact on Performance
  - E*
  - Moisture damage tests
  - Repeated load triaxial (rutting)
  - Beam fatigue (fatigue)
  - TSRT (low temperature cracking)
- Final Product
  - Database of results

Plan

RECYCLE IN MEPDG

- “agencies need to be able to input the fundamental properties of the RAP mixtures into the AASHTO MEPDG”

- Does this technology not exist today?

HIGH RAP MIX DESIGN

- Construct two sections in five locations
  - Use 40% RAP
    - No change to original binder
    - Adjust original binder grade
  - Develop RAP acceptance tests
    - Practical
    - Reliable
  - Monitor field performance
    - Fatigue
    - Rutting
    - Low temperature cracking

Plan

COMMENTS

- “a high variability is introduced in the RAP materials affecting the RAP properties and most likely resulting in a variable HMA mixture”
  - RAP processing not considered
  - Best practices available

RAP Stockpile Options

Isolate RAP Sources

Blend Multiple Sources

Processing RAP

Horizontal Impact Crusher

RAP Crushed and Screened to Two Sizes Split on ½ in.

RAP Size

Fine minus ½ in.

Coarse ½ to 1 in.

COMMENTS

- High RAP mix design
  - Unclear what technology is being developed?
  - What are the problems with existing technology?

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HYPOTHESIS
CRITICALLY DESIGNED MIXES (E2c)

- Critical conditions
  - Temperature
  - Load
- Assure performance by staying below critical conditions

OBJECTIVE
CRITICALLY DESIGNED MIXES

- Develop test method
  - Fundamental properties
  - Part of mix design
- Replacement for Repeated Load Triaxial Test

Computer Analysis

- 576 Combinations
  - HMA / granular thickness
  - Longitudinal grade
  - Speed / braking
  - Tire pressure
  - Binder grade
  - HMA temperature

Computer Analysis, cont'd

- ½" mix designs for PG 52, 58 and 64
- Measure the E* Master Curves
- Use in 3D-Move analyses
- Fixed modulus for the base and subgrade
- 18-wheeler truck at 125 psi pressure
- Calculate vertical displace, vertical and lateral stresses
  - at the surface
  - 1/2" depth increments for the top 2" of the HMA layer
  - at 1"increment thereafter
- Analyze
  - Time of loading throughout the HMA
  - Confining and deviator pressures

Computer Analysis, cont'd

- Measure repeated load triaxial test of the three mixtures.
- See if mix is stable

- How will the results be used?
  - Replacement for MEPDG?
- What if something is different?
  - Mix size
  - HMA thickness
  - FDAC? o r PCC overlay?

Develop Simple Test

- Develop simpler version of RLT test
  - Or
- Develop alternate test

- Comments
  - Some new work on aging seems appropriate
  - What about the existing evaluation and testing approaches?
    - Use with aging, temperature, etc from mountain states?

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HYPOTHESIS
THERMAL CRACKING
INTERMOUNTAIN STATES (E2d)

- Intermountain area has
  - Higher aging rates
  - Extreme temperature swings
  - High absorption aggregate

OBJECTIVE
CRITICALLY DESIGNED MIXES

- Develop evaluation and test system for intermountain conditions
  - Binder aging kinetics
  - Identify field sections
    - Find cause of cracking
  - Expansion coefficient
  - Low temperature strength
  - Carbonyl growth in binder
    - Lab study
  - Prediction software

Comments

- Some new work on aging seems appropriate
- What about the existing evaluation and testing approaches?
  - Do they not work?
  - Will this work any better?
- Can’t we use existing system with aging, temperature, etc from mountain states?

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SUMMARY

- Binder Modification
  - Recommend reconsideration
  - Of limited value, temporary
- High RAP Mixes
  - Aggregate work of limited value
  - Compatability work is theoretical and of limited practical value
  - Large lab program to produce a database of unclear use
  - RAP acceptance testing not on target

SUMMARY cont'd

- Critically Designed Mixes
  - Large computer analysis of unclear value
- Low Temp Cracking
  - Developing complete new system seems unwarranted
  - Suggest adopting existing system to intermountain state conditions

SUGGESTION 1

- Compaction of Hot Mix Asphalt
  - Effect on
    - Modulus
    - Rutting
  - Type of compaction
    - Gyratory vs road

SUGGESTION 2

- Tender mixes
  - Why are some mixes tender?
  - What is happening internally in tender mixes?

SUGGESTION 3

- Improve performance of HMA pavements in U.S.
  - Biggest bang for the buck?
  - Construction!!!
    - How can we effect the performance of pavements by construction methods?

DISCUSSION

THANKS