Industry, Agency, and University Partnerships

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March 1, 2017
Structural Design of Porous Asphalt Pavements

**Partners:** University of Maryland, National Asphalt Paving Association

High voids, large thickness of stone base: 
*Effect(s) on structural capacity?*

- Infiltration rate: 0.1 to 10 in/hr
- Drain Time: 12 to 72 hr
- Thickness: 4 to 8 in
- Thickness: 12 to 36 in

High voids, high saturation levels in subgrade: 
*Reduced bearing capacity?*
Challenges: Empirical AASHTO 93 Design

Defining traffic loads

Selecting structural layer coefficient ($a_1$)

Estimating structural contribution:
- Selecting structural layer coefficient ($a_2$)
- Determining ‘effective thickness’
- Selecting drainage coefficient ($m_2$)

Estimating appropriate resilient modulus
Modified Structural Section

6” Asphalt Surface
(a = 0.40)

Semi-Infinite “Subgrade”

Similar to
Stone Recharge Bed
(M_R = 20,000 psi)
(a = 0.10)

Total SN = 2.40

W_{18} = 2.3 MESAL

6” Asphalt Surface
(a = 0.40)

Choker Course

Stone Recharge Bed

Total Base: 36”
(a = 0.10)

Geotextile Separator

Uncompacted Subgrade
(M_R = 4000 psi)

Total SN = 6.00

W_{18} = 41.5 MESAL

6” Asphalt Surface
(a = 0.40)

Choker Course

Stone Recharge Bed

Total Structural Base: 17”
(a = 0.10)

‘Excess’ Base: 19”
(hydrologic only)

Geotextile Separator

Uncompacted Subgrade
(M_R = 4000 psi)

May be combined into “effective” subgrade M_R

for W_{18} = 2.3 MESAL
(over 4000 psi)

Total SN = 4.10
### Recommendations

<table>
<thead>
<tr>
<th>Layer</th>
<th>Recommended Property Value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porous asphalt</td>
<td>$a_1 = 0.40$</td>
<td></td>
</tr>
<tr>
<td>ATPB</td>
<td>$a_2 = 0.30 - 0.33$</td>
<td></td>
</tr>
<tr>
<td>Uncompacted subgrade</td>
<td></td>
<td>Compaction and high moisture content. Incorporate excess stone base thickness into effective subgrade modulus. Use geosynthetic separator layer between subgrade and coarse stone base.</td>
</tr>
</tbody>
</table>

**End Result:** Broader implementation of porous asphalt pavements!
H/WMA Level 1 Properties for MEPDG

Partners: University of Maryland, MD State Highway Administration

Benefit: More effective use of W/HMA mixtures in pavement structural design in Maryland!
Foamed Asphalt Stabilized Base

Partners:
- University of Maryland
- MD State Highway Administration
- P. Flanigan & Sons, Inc.
- Global Resource Recyclers, Inc.
Benefits:

- More rational and effective use of foamed asphalt stabilized base materials in Maryland
- Utilization of excess RAP and RC stockpiles
- More sustainable pavement solutions
CIR/CCPR/FDR Level 1 Properties for MEPDG

**Partners:** University of Maryland, Virginia Transportation Research Council (VDOT), Wirtgen America, Colas Solutions, NCHRP

**Benefits:**
- More effective and widespread use of asphalt stabilized cold recycled mixtures in pavement structural design
- Complements H/WMA structural wearing course
Infrared Asphalt Repair

**Partners**: University of Maryland (CEE Dept, MIPS Program); Pavement Corporation
Project Results:

• Improvements to patching process (e.g., heating process, rejuvenator application)
• Documentation of patch material quality (density, indirect tensile strength)
• Development of QA procedures
• Draft specification

Currently working with MD SHA to add to state specs.

Benefits:

• Improvement/confirmation of infrared asphalt repair as a superior all-weather maintenance strategy
• Economic development through increased revenues and numbers of employees
UMD Infrastructure Lab Renovation

Existing Dedicated Teaching Lab Space
Project Motivation: Program Needs

- Laboratory experiences are a critical part of a civil and environmental engineering curricula
- 100% of UMD CEE juniors (120+ students/year) take ENCE 300 Fundamentals of Engineering Materials
- 60% of UMD CEE seniors (75+ students/year) take ENCE 444 Experimental Methods in Geotechnical & Structural Engineering
- 10 – 20 students/year take ENCE 489 Special Problems in Civil Engineering
- With increasing enrollments, laboratory courses have become choke points in the curriculum
- Current lab facilities pose an accreditation risk
Renovated Lab Layout and Design

Teaching (Materials, Soils)

Teaching (Specimen Prep)

Teaching (Structures)
Current Status

Design/Construction under campus Facilities Management
Construction Documents 75+% complete
Construction Start: June 2017
Occupancy: Spring 2018 (partial), Fall 2018 (full)
**Benefit:** A state-of-the-art facility for training our next generations of engineers and construction leaders.

A special “thank you” to the Maryland Asphalt Association for its most generous contribution!

We are still actively fundraising and would like to talk to many you in the near future...

<table>
<thead>
<tr>
<th>Fundraiser</th>
<th>Amount</th>
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<tr>
<td>Whiting-Turner Contracting</td>
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<td>Scott Greenhaus ‘82, ‘86</td>
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<td>Maryland Asphalt Association</td>
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<td>Maryland Chapter ACI</td>
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<td>Whitman, Requardt Associates</td>
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<td>Wallace Montgomery</td>
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**TOTAL TO DATE** $1835K
Risk & Pay Factor Analysis for HMA

• Project Objectives:
  • Estimating risks of accepting lower quality (agency risk) or rejecting high quality (contractor risk) HMA
  • Relating risks of acceptance to HMA pay factors

• Partners:
  • University of Maryland
  • MD State Highway Administration
  • The many contractors who provided QA/QC data to the MD SHA database
Pay Factor Based on Predicted Performance

**Benefit:** More rational and equitable distribution of risk between agency and contractor
Hydraulic/Environmental Properties of RAP in Highway Shoulders

Objective: Evaluate heavy metal leaching from RAP

Methods:
• Constant Head Permeability
• Batch Water Leach Test
• Column Leach Test
• UMDSurf

Partners:
• UMD
• MD SHA
Benefits:

- **Documentation of environmentally benign use of RAP in highway shoulders**
- **Increased use of RAP stockpiles**
- **Enhance sustainability of pavement solutions**
ASPHALT MIXES

Open Graded

- Stable Mixes
- Waste Water Treatment Facilities
- PATB - Permeable Asphalt Treated Base
- Porous Pavements
  - Stormwater Management System
  - OGFC
ASPHALT MIXES

Gap Graded

- SMA – Stone Matrix Asphalt
ASPHALT MIXES

Dense Graded

• Cart Paths
• Driveways
• Minor Roadways
• Major Roadways
• Race Tracks
• Fish Rearing Ponds
• Reservoirs
• Airports
WE HAVE COME A LONG WAY
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MARYLAND ASPHALT ASSOCIATION

Since 1954