2016 Local Roads Workshop

Porous Asphalt Pavements
Porous Asphalt Pavements

Asphalt Pavement Association of Michigan

www.apa-mi.org
Presentation Outline

• Porous Asphalt Pavements
  – What is a Porous Pavement
  – Design and Construction
  – Example Projects
What are Porous Pavements?

Open-Graded HMA ~ 2 ½ - 4”

½” Agg. (#57) ~ 1 – 2” Thick

Clean Uniformly Graded 2”-3” Crushed Agg. (#2) – 40% Voids

Non-Woven Geotextile

Uncompacted Subgrade
HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Why are They Needed?

More Development

= More Impervious Surfaces

= More Runoff

How do local agencies handle this additional runoff?
RAINFALL 45"

EVAPOTRANSPIRATION 22"

FRACTURED BEDROCK

INfiltration

AQUIFER

RUNOFF 8"

BASEFLOW 15" or 1,120 gpd/acre

SMOOTH | DURABLE | SAFE | QUIET
HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
The Problem

- Run-off from impervious surfaces
- Detention basins and retention ponds require additional land
- Pollution
What We Usually Do…

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Porous Applications

- Parking Lots
- Roads
  - on a limited basis
- Recreational Facilities
  - playgrounds, tennis courts, paths, etc.
Typical Porous Pavement
Keys to Success – Site Conditions

- Soil permeability/infiltration rate
  - EPA recommends 0.5”/hour
  - 0.1”/hour still OK
- Depth to bedrock > 2’
- Depth to high water > 3’
- Fill – not recommended
- Frost
  - Pavement section should exceed frost depth
Soils Investigation

- Borings and/or test pits
  - Test permeability
  - Determine depth to high water table
  - Determine depth to bedrock
Keys to Success - Design

- Slope – limit surface slope to 5%
  - Terrace when necessary
  - Use conventional HMA for steeper slopes
- Avoid piping water long distances
- Spread infiltration over largest area possible
  - 5:1 Impervious: Infiltration
Keys to Success – HMA Design

• **Materials Selection**
  - Aggregates
    - Fine Aggregate Angularity
    - Fractured Faces
    - L.A. Abrasion
  - Binder
    - Stiffness
    - Polymer Modified
    - Fibers
Keys to Success – HMA Design

Gradation (APAM Guide)

<table>
<thead>
<tr>
<th>Aggregate Gradation:</th>
<th>Total Passing (% by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td></td>
</tr>
<tr>
<td>(3/4”) 19 mm</td>
<td>100</td>
</tr>
<tr>
<td>(1/2”) 12.5 mm</td>
<td>85-100</td>
</tr>
<tr>
<td>(3/8”) 9.5 mm</td>
<td>55-75</td>
</tr>
<tr>
<td>(#4) 4.75 mm</td>
<td>10-25</td>
</tr>
<tr>
<td>(#8) 2.36 mm</td>
<td>5-10</td>
</tr>
<tr>
<td>(#200) 75 µm</td>
<td>2-4</td>
</tr>
</tbody>
</table>
GUIDE SPECIFICATION
FOR
Porous HMA for Parking Lots

1 of 4

a. Description. This guide specification provides mixture design, quality control and acceptance testing requirements for use on Porous HMA mixture for parking lots.

b. Materials. The HMA and materials shall meet the following requirements:

1. Porous HMA. The Porous HMA mixture shall be composed of a mixture of aggregate, asphalt binder, and if required, mineral filler, as listed in Table 1.

   Table 1 – Porous HMA Mixture Requirements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Voids %</td>
<td>18.0</td>
</tr>
<tr>
<td>AC Content %</td>
<td>5.0-8.5</td>
</tr>
<tr>
<td>Denseflow % (max.), ASTM-D6990</td>
<td>0.3</td>
</tr>
<tr>
<td>TSR % (min.), AASHTO T283 *</td>
<td>80</td>
</tr>
<tr>
<td>* Do not compact specimen to 7.0% ± 0.3% Air Voids.</td>
<td></td>
</tr>
</tbody>
</table>

2. Aggregate Gradation and Physical Properties. The combined gradation of the aggregate portion of the mixture, including the mineral filler, shall be within the limits of Table 2. The physical properties of the combined aggregates shall meet the criteria of Table 3.

   Table 2 – Porous HMA Aggregate Gradation

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Total Passing Percent by Weight</th>
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<tbody>
<tr>
<td>3/4 inch</td>
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<tr>
<td>1/2 inch</td>
<td>85-100</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>55-75</td>
</tr>
<tr>
<td>No. 4</td>
<td>10-25</td>
</tr>
<tr>
<td>No. 8</td>
<td>5-10</td>
</tr>
<tr>
<td>No. 200</td>
<td>2-4</td>
</tr>
</tbody>
</table>

HMA – Your Best Value
Keys to Success – HMA Design

- Binder Content 5.0 - 6.5%
- Air Voids ≥ 18%
- Drain down ≤ 0.3%
- Evaluate for Moisture Susceptibility
  - TSR 80% minimum
- Mix Design is required!!!
Keys to Success – Construction

- Build porous pavement last
  - Protect from construction debris
  - Protect from soil laden runoff
- Protect site from heavy equipment
  - Don’t compact subgrade
- Excavate to subgrade (soft footprint)
- Place filter fabric
Keys to Success – Construction

- Place reservoir course 1.5 to 3 in. stone
- Place 1-2 in layer of ½ in stone to stabilize the surface of the reservoir course
- Place porous asphalt course (2 to 4 in.) usually compacted with 2-3 passes with 10 ton roller
Construction Guidelines

- Restrict traffic for 24 hrs.
- Protect porous pavement from contamination.
  - Runoff sediment
  - Construction debris
- Check Permeability
Construction Guidelines

Post Construction

- Inspect for design compliance during storm event.
- Confirm vegetation is established before removing temporary storm water measures.
- Do not sand for snow or ice, liquid de-icing compounds may be used.
- Sign for maintenance.
Educational Sign

Permeable Asphalt

The Parking Lot is Full of Holes
The asphalt covering this section of the parking lot is permeable, allowing water to drain through it. Some of the particles usually mixed into asphalt were left out, so that small holes remain in the asphalt pavement. Rain and melting snow drain through these holes down into a layer of gravel.

Why is it Better Than Regular Asphalt?
In a regular parking lot, rainwater runs off the pavement, empties into storm sewers, and ends up in creeks, carrying impurities along with it. Permeable asphalt allows that rainwater to drain directly below the parking lot. This filters particles and slows the flow of water, reducing the flooding of sewers and creeks. Another benefit of permeable asphalt is that it lessens the amount of standing water and ice on a parking lot, making it safer for drivers.

Cross Section

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Maintenance

- Inspect several times first few months & during storm events.
- Inspect annually thereafter.
- Pavement surface may be flushed or vacuumed.
- Damaged pavement can be repaired using dense hot mix (provided <10% area).
Morris Arboretum
Philadelphia, PA
1983
Diagram of infiltration bed at Morris Arboretum
Morris Arboretum

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Morris Arboretum
Ford Rouge Center
Dearborn, MI
2002
Strategy for Water Quality at Ford Rouge Center
Ford Rouge Center
Longacre House
Farmington Hills, MI
2007
Farmington Hills

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Farmington Hills

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Washtenaw Community College
Ypsilanti, MI
2007
Washtenaw Community College

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Washtenaw Community College
Washtenaw Community College

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET

2016
Michigan State University
East Lansing, MI
2009
Michigan State University

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Meijer Store
Manistee, MI
2014
Manistee Meijer

Project Location – Manistee

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Manistee Meijer

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Manistee Meijer

Design Focus: Stormwater Quality

- Porous paving
- Catch basin sediment sumps
- Mechanical sediment removal
- Infiltration basins
- Low-velocity discharge
- Maintenance plan

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Sylvan Avenue – Ann Arbor

2009

porous streets!!

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Sylvan Avenue – Ann Arbor

2016

Maintenance is Important!

HMA – Your Best Value

SMOOTH | DURABLE | SAFE | QUIET
Willard Street – Ann Arbor

2010

porous streets !!
Willard Street – Ann Arbor

2016 – 6 years old

HMA – Your Best Value
Conclusions

- Porous pavements offer good alternative to conventional storm water mitigation
- Site Conditions must be right
- Need to protect pavement from contamination during and after construction
- Properly designed constructed and maintained, will last more than 20 years
References

FHWA Tech Brief
April 2015

Porous Pavements

Questions?

Asphalt Pavement Association of Michigan
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