Porous Asphalt Pavements

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What are Porous Pavements?

Open-Graded HMA ~ 2 ½”
½” Agg. (#57) ~ 1 – 2” Thick
Clean Uniformly Graded 2”-3” Crushed Agg. (#2) – 40% Voids
Non-Woven Geotextile
Uncompacted Subgrade
Rainfall 45"/yr

Evaporative loss from impervious surfaces 2"

Reduced infiltration through regraded and compacted soils in grasses

0" of infiltration under impervious surfaces

Reduction in base flow by 15"/yr under impervious surfaces

43" runoff from impervious cover
Comparison of Detention vs. Infiltration Design Systems

![Graph comparing discharge rates over time for Predevelopment, Post Development, Post Development with Detention, and Post Development with Recharge](image-url)
Porous bituminous pavement

- Developed by the Franklin Institute – 1972
- Tested in pilot projects during 1970’s
- Development of geotextiles in 1979
- Current design since 1980
- CA has built over 150 projects since 1980
- Outstanding engineering project - 2000
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
Avoid piping long distances
Bottom Must Be Flat
Design

**Regulations**

- Rainfall
  - Typical designs for 6 month/24 hr storm
  - Conservative design for 20 year/24 hr storm range from 1.4 to 15 in./24 hr.

- Meet Local & State wastewater mitigation requirements.
Keys to Success – Design

Usage / Vehicle Loading

Lightly loaded areas

- Parking lots
- Low volume roads (limited truck use)
- Recreational Areas

- Meet structural requirements
- Roads?
What about roads?
It does rain in Arizona
18 Years Later
Roads

- Challenges
  - Cuts and fills
  - Slope
  - Variable soil conditions
  - Utilities
- Limited use
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 (if gravel source then 95% double fracture)

- 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 / seated with 2-3 passes with 10 ton roller.
Porous HMA Surface
Open-Graded HMA

- Binder Content 6.0-6.5%
- Should consider using stiffer asphalt
- Consider modified asphalt
- Consider fibers
- Thick OG HMA – 2 layers?
Construction Guidelines

Construction

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

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

- Inspect several times first few months during storm events.
- Inspect annually thereafter.
- Pavement surface may be flushed or jet washed.
- Damage pavement can be repaired using dense hot mix provided <10% area.
Cost

- Cost of pavement structure more
- May be offset by reducing drainage structure costs
Keys to Success

- Make sure site conditions are acceptable
  - Permeability
  - Depth to groundwater and/or bedrock
- Design
  - Bottom of infiltration bed level
  - Limit surface slope < 5%
  - Runoff from adjacent areas will not plug pavement
Keys to success

- **Construction**
  - Don’t compact subgrade
  - Protect pavement from contamination
    - Build porous pavement late
    - Stabilize adjacent areas before construction

- **Maintenance**
  - Do not sand, or ash pavements
  - Install signage to warn maintenance personnel
  - Can patch with conventional asphalt < 10%
Morris Arboretum
Philadelphia, PA
1984
Diagram of infiltration bed at Morris Arboretum
Shared Medical Systems
Malvern, PA
1982
Conclusions

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