Porous Asphalt Parking Lot

Technical Series on District Office Demonstration Features

Overall Goal:
Reduce Site Impact on Gervais Creek and Downstream Waters

Design Objectives
- Demonstrate and promote new technologies
- Infiltrate and store precipitation.
- Slow stormwater runoff
- Minimize impervious land coverage
- Improve water quality of runoff by binding heavy metals and toxins from precipitation before they get to waterways

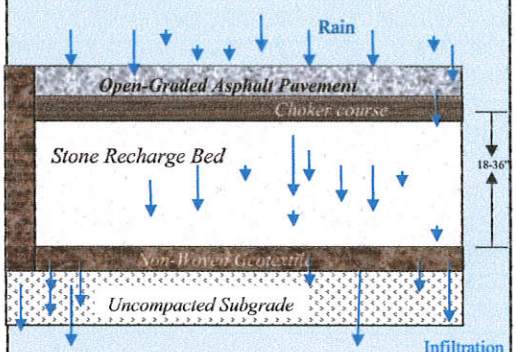
Layers of Porous Asphalt Pavement

Open-Graded Asphalt Pavement – The top layer of asphalt is similar to that of conventional asphalt except it excludes smaller aggregates and uses less tar in order to create this open-graded, porous layer. This allows stormwater to infiltrate through the asphalt and into a storage layer called the stone recharge bed.
Choker Course – This layer is composed of single size, ½-inch crushed granules and functions to stabilize the open-graded asphalt surface for paving.
Stone Recharge Bed – This is the water storage layer. It does not exist in conventional asphalt systems. It is composed of large, single sized crushed granite with a 40% void space to temporarily store stormwater and allow for gradual infiltration into the soil. While the depth of this layer usually varies from 18 to 36 inches, District office opted for a parking lot with an average 36 inch storage capacity.
Non-Woven Geotextile – This layer is a permeable fabric, that allows for infiltration of water while functioning as a barrier to keep soil from mixing with the recharge bed.
Uncompacted Subgrade – This is the lower-most layer. it is uncompacted native soil to allow optimal infiltration.

Note: The District also installed a sand trench on the building side of the parking lot to further improve infiltration capacity.

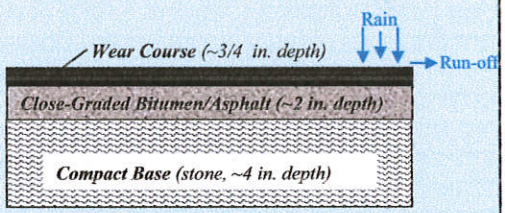
Parking Lot Square Footage: 7,000 sq. ft.

Porous Pavement System with Subsurface Recharge Bed



Cost: ~$9.50/sq ft for excavation, installation, materials, and labor.
Runoff Potential with Pervious Asphalt: The exact amount from this parking lot will be determined with monitoring. The parking lot was designed for 100% infiltration up to a 2-inch rainfall, therefore any rain event up to this amount will have 0 inches runoff.

Non-Porous/Traditional Asphalt Pavement System



Cost: ~$3.25 – 4.25/sq ft for excavation, installation materials and labor.
Runoff Potential with Impervious Asphalt: 3936 gallons of water from a 1" rainfall

How Porous Pavement Differs Structurally from Regular Pavement

The porous asphalt system requires very few materials that differ from standard asphalt systems. The difference is in the formula of the aggregate, the layer depths, and the composition of the stone recharge bed.

1. The top layer of aggregate mix in a porous system is made without 'fine' particles that would usually function to fill void space between the larger aggregates. Also, the amount of tar used is less than that used in non-porous systems. What results is a "black-top" looking surface similar to traditional pavement that is smooth enough to meet requirements of the Americans with Disabilities Act but that is also noticeably porous.
2. A less visible structural difference is the depth of the base material. The depth of the stone recharge bed is 3 feet allowing for a significant amount of water holding capacity. In the common instances of precipitation less than two inches, stormwater will be infiltrated slowly into the soil. In the less-frequent heavier rainfall event that overfills the carrying capacity of the storage layer, water will overflow into adjacent rain gardens on the premises. For reference, there were two rainfall events in 2005 that were 2 inches or greater according to the National Weather Service records.
3. Also unique about this stone recharge bed is that it required a non-traditional material be used. While traditional asphalt driveways use crushed limestone as a base layer, it could not be used for pervious asphalt systems due to its brittle nature. Chipping of the granule can clog the system over time making it impervious. For the District parking lot, contractors had to import crushed granite from St. Cloud to provide the required crushed, jagged base that is harder than limestone.

Costs

Because porous pavement systems are still a relatively new process to many contractors, it continues to be more expensive than installing impervious pavement. Including material and labor, the final cost breakdown for the District office site was approximately $9.50/sq. ft. While this figure is about two to three times the installation costs for standard asphalt, it takes into consideration three major factors:

1. **Deeper excavation.** Because the District parking lot allowed for a significant storage layer depth it was roughly 6 times deeper than a traditional parking lot. Because of this, excavation and grading costs were more.
2. **Material Costs - quantity issues.** The 36-inch storage layer (stone recharge bed) in a porous system lies below the surface layer and its stabilizing choker course layer. Traditional pavement does not have a storage layer.
3. **Material Costs - quality issues.** Porous systems cannot use a limestone base used in non-porous systems because limestone is too brittle - it will chip and clog the system over time. Crushed granite was used in place of limestone, and importing it from St. Cloud, added to the cost.

Construction of the Porous Asphalt Driveway

Figuring the Amount of Runoff Diverted

For a paved driveway of the same size:

$V = A^2 * R * 0.90 * 0.0833$ ft/in $* 7.5$ gal/ft^3

Where: V = volume of runoff (gal)
A^2 = paved surface area (square ft)
R = rainfall (inches)
0.90 = loss (usually through evaporation; unitless)
0.0833 = conversion factor (feet per inch)
7.5 = conversion factor (gallons per cubic foot)

So: $V = (7000) * 1$ inch $* 0.9 * 0.0833$ ft/in $* 7.5$ gal/ft^3
V = 3935.9 gallons water runoff in a 1-inch rainfall.

Rain storm: August 1, 2006

Monitoring

The porous asphalt parking lot at RWMWD is the first of its kind in Minnesota. The District will watch for surface clogging and structural integrity problems including any impacts of freeze-thaw cycles. Staff will also collect water quality data to monitor parking lot runoff.

Maintenance

The District parking lot will undergo vacuum sweeping once in the spring and again in the fall to remove particles that clog pore space. In winter months, it will *not* undergo any treatment for snow and ice other than early plowing. Sand cannot be used because it will wash into and clog up the pore spaces. Salt and other chemicals are not used in order to protect the soils and groundwater beneath the parking lot. With the proper maintenance practices, we can expect that the parking lot will last the estimated 15 to 20 years.

For More Information

Ramsey-Washington Metro Watershed District
Phone: 651-792-7950
Email: office@rwmwd.org

National Asphalt Pavement Association (NAPA).
www.hotmix.org

Minnesota Asphalt Pavement Association.
www.asphaltisbest.com

Pine Bend Paving, Inc.
Phone: (651) 437-2333

The Minnesota Stormwater Manual CD or Guidebook. November 2005.
Available through the PCA website:
www.pca.state.mn.us

Ramsey-Washington Metro Watershed District

2665 Noel Drive
Little Canada, MN 55117
Website: www.rwmwd.org

The RWMWD is a grouping of five smaller urban watersheds (Phalen Chain of Lakes, Beaver Lake, Battle Creek, Fish Creek, and East St. Paul) that drain to the Mississippi River just downstream of downtown St. Paul. We are a special purpose local unit of government with a mission to protect and improve water resources and water related environments within our jurisdiction.
For more information, you can visit our website at www.rwmwd.org, or call our office at 651-792-7950.

Come see this project and other green initiatives at our new office in Little Canada, MN

Publication RWM 811.sc6 (2006)