TERRA Transportation Engineering and Road Research Alliance
Partnering for Roadway Innovation

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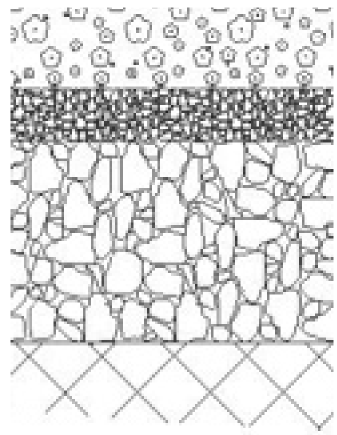
Porous Asphalt Reduces Storm Water Runoff

Porous asphalt pavements allow water to drain directly through the open-graded pavement structure into underlying layers. This plant-mix asphalt pavement contains a reduced amount of fine aggregate particles and higher interconnected air voids between particles.

Porous asphalt pavement technology was first developed in the United States more than 40 years ago. Porous pavement installations of different types are more common in Europe, but in the United States, porous asphalt primarily has been used in parking lots, recreational areas, and low-volume roadways. Today, porous asphalt is attracting attention as a tool in addressing environmental issues.

Porous asphalt structures typically contain four components. Water passes vertically through the permeable surface to the base below. At the top of the base, a filter or "choker" course of denser-graded aggregate material is often used to provide a uniform, stable construction platform. The heart of the porous asphalt pavement system is the aggregate reservoir base course with sufficient voids. It is used to temporarily store and help treat the storm water until it infiltrates the uncompacted subgrade soil. At the bottom, a geotextile provides separation and prevents the subgrade soil from migrating into the reservoir course.

Typical porous asphalt pavement structure



Porous Asphalt Mix

Filter "Choker" Course

Reservoir (Storage) Course
Thickness designed for water storage needs and/or frost penetration

Separation Geotextile

Uncompacted Subgrade
with sufficient permeability

MnROAD Research Project

In a project that began at MnROAD in December 2008, researchers studied the durability, maintenance requirements, hydrologic benefits, and environmental considerations of porous asphalt pavement construction on a low-volume roadway in a cold climate. MnROAD constructed three test sections—one porous asphalt section over a cohesive subgrade, one porous asphalt section over a sand subgrade, and one densely graded asphalt section over mixed materials as a control. The 220-foot-long sections received approximately 40,000 applied asphalt equivalent single-axle loads (ESALs), with a three-year testing and monitoring period.

Porous asphalt test cell on the MnROAD LVR

Porous test sections performed well in ride quality, permeability, stiffness modulus, strain response, safety, and quietness, according to the findings. Some rutting in the loaded lane and shallow surface raveling were noted, but there was no cracking or other significant distress in any of the three sections during the study period. Permeability tests confirmed that the porous asphalt pavement structure performed well in terms of water storage and infiltration. In addition, snow and ice was observed to melt faster on the porous pavements. The pavement also was quiet and provided significantly better skid resistance than dense-graded asphalt.

Case Study

In 2009, the city of Robbinsdale, Minnesota, began a field study to see if the use of porous asphalt pavement could help reduce the amount of chloride used as a deicer in the winter months. It constructed two short porous asphalt test sections on low-volume roadways—one on sandy subgrade and one on clay subgrade. Each test section is at an intersection and paired with a nearby traditionally constructed intersection.

During the winter, crews only cleared the test sections of the roadway and did not apply salt. The city noted that ice melted more quickly on the test sections during March and April when daylight was longer. In other seasons, the test sections allowed infiltration of the surface water. For maintenance, the city has used a vacuum truck to clear debris from the porous pavement sections. To date, the test sections are performing well. The city is continuing its evaluation and monitoring of the test sections.

Benefits

Because of its permeability, a porous asphalt pavement system helps reduce water runoff and offers other potential environmental, performance, and economic advantages for low-volume road applications.

- ***Environmental***—Interest in porous asphalt as a storm water mitigation solution has increased as environmental concerns about storm water runoff have grown. States such as Minnesota are looking to enhance storm water management by developing minimal impact design standards. The direct infiltration of storm water through a properly designed porous asphalt pavement system into the subgrade soils can reduce both the volume and the peak intensity of storm water runoff, which in turn can decrease the need for costly drainage structures, ditches, and the purchase of additional right-of-way for storm water mitigation. Porous asphalt pavement also helps reduce the temperature and chemical impact of storm surges on surface water sources and may improve the transfer of water and oxygen to nearby plant roots.
- ***Performance***—Porous asphalt pavement helps drivers by reducing hydroplaning, improving wet pavement friction, lowering splashing and spraying, and decreasing pavement surface glare, which leads to better visibility, especially in night conditions. The porous surface also reduces engine noise and tire-pavement interaction noise.
- ***Economic***—In certain situations, porous asphalt may offer an economically advantageous alternative to more expensive storm water mitigation solutions. Because water moves through the pavement, porous asphalt surfaces also may help reduce the use of sand and salt during winter. It is not recommended to sand a porous asphalt

Resources

The following reports and websites offer additional information about the use of porous asphalt:

- *Porous Asphalt Pavement Performance in Cold Regions* (Minnesota Department of Transportation, April 2012, 18.2 MB PDF) [technical summary, 1.1 MB PDF]
- *Synthesis of Current Practice on the Design, Construction, and Maintenance of Porous Friction* (Texas Transportation Institute, 2006, 778 KB PDF)
- *Porous Asphalt Pavement* (U.S. Environmental Protection Agency, 2009)
- *Guidance Specifications for Porous or Dense-Graded Asphalt Pavement Structures for Storm Water Management* [Draft] (Minnesota Asphalt Pavement Association, July 2012, 53 KB PDF)
- "Porous Asphalt Pavements in Minnesota" (*Hot Mix Asphalt Technology*, November 2010)
- National Asphalt Pavement Association (asphaltpavement.org)

Links to these resources are on the TERRA website at www.TerraRoadAlliance.org.

For More Information

For more information about the research in this fact sheet, please contact:

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Implementation Considerations

It is important to understand the optimal circumstances for use of porous asphalt and also weigh the benefits and challenges when considering implementation. Porous pavements usually have higher costs, and they may provide lower structural contribution, which makes them better candidates for low-volume facilities. Because they eventually can clog with dirt and debris, porous asphalt requires maintenance in the form of vacuuming and other cleaning methods, such as flushing with water. Toxic materials and deicing chemicals may reach groundwater more directly; however, spills would be confined on-site for treatment rather than transported by storm water pipes off-site.

The MnROAD research project helped demonstrate the effectiveness of porous asphalt in certain situations, and its results offer insights about the design and maintenance of porous asphalt pavements in cold climates.

About TERRA

The Transportation Engineering and Road Research Alliance, or TERRA, brings together government, industry, and academia in a dynamic partnership to advance innovations in road engineering and construction, including issues related to cold climates. More about TERRA is online at www.TerraRoadAlliance.org.

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