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New Jersey Department of Transportation
Bureau of Research

Technical Brief

The Use of Porous Concrete for Sidewalks

This project evaluated the use of porous concrete for sidewalks in New Jersey in terms of structural performance, hydrological performance, lifecycle costs, durability, maintenance, and energy performance.

Background

A porous concrete sidewalk typically consists of a porous concrete slab on top of an open graded stone reservoir layer. A filter fabric is placed between with underlying soil and the reservoir layer. One of the most important benefits of porous concrete is its effectiveness for stormwater management, improving water runoff quality, reducing stormwater runoff, and restoring groundwater supplies. However, there are concerns about its construction, cost, maintenance, and durability.

Research Objectives and Approach

The primary objective of this study is to evaluate the various factors that influence the performance of porous concrete in sidewalks. These include hydraulic performance to meet DEP regulation and structural performance to meet typical sidewalk strength requirements as well as life cycle cost and maintenance requirements. Several mix designs were tested to evaluate structural and hydrological performance and energy budget. A cost-benefit analysis comparing porous pavements for sidewalks to conventional concrete and asphalt alternatives, including environmental permitting, initial construction, and maintenance costs was performed. A guide document on the use of porous concrete and porous asphalt for sidewalks was provided.

Findings

The use of porous concrete for sidewalks can be effective in mitigating stormwater runoff. For soils with low permeability, an auxiliary subsurface drainage system may be needed. A porous sidewalk needs to be periodically maintained to avoid clogging resulting from debris and sediments. Porous sidewalks should be free from water especially in the winter to avoid failure due to freeze and thaw. Resistance to raveling is very important for the long term performance of pervious concrete. There is a need for research to evaluate raveling resistance and factors than can influence this resistance such as aggregate type, addition of sand, cement content and chemical additives. Other findings from this research include:

1. There is a need to establish vibration and compaction criteria for preparation of lab specimens for compression, flexure, tension and modulus testing. Construction of porous sidewalks requires skilled labor and is recommended to do test segments prior to construction of the actual sidewalks.
2. The addition of some sand to pervious concrete can improve its strength and may improve its resistance to raveling. There is a need to evaluate the effects of adding sand to mix and its effects on strength and porosity.
3. More data on field performance is needed. Tests of cores from field can provide information on the effect of periodic maintenance or lack there-of on void ratio, density, permeability and strength of in-situ sidewalks. It is recommended that a porous concrete and porous asphalt test sidewalks be constructed for short term and long term monitoring.
4. The initial construction cost of porous concrete is slightly greater than that of conventional concrete for sidewalks without subsurface drainage systems. The initial construction cost of porous asphalt sidewalks is much cheaper compared to conventional concrete. The literature review showed that the service life of porous concrete varies and it may be shorter than of conventional concrete. Although there are cost savings from storm water best management practices, the life cycle cost of porous concrete sidewalk may be still higher than that of conventional concrete sidewalk due to the shorter life.
5. Additional research should be considered for energy measurement additional pervious concrete mixes with different source aggregates of different color and size. Comparisons between conventional asphalt and concrete and pervious asphalt and pervious concrete should be conducted. Another approach to studying the energy budget of surface materials would be to experiment inside a controlled chamber to ensure the desired environmental conditions.

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A final report is available online at: http://www.state.nj.us/transportation/refdata/research/. If you would like a copy of the full report, send an e-mail to: Research.Bureau@dot.state.nj.us.

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