Use of Pervious Concrete as an Open Graded Drainage Layer in Pavement Structures

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Introduction

- Changing environmental conditions are causing storm events with larger volumes of precipitation than in the past.
- Drainage is a key factor in the performance of rigid and flexible pavement.
- Aspects of drainage:
  - Surface crossfall
  - Urban or rural cross-section and associated drainage systems
- Impermeable pavements typically have impermeable surface with < 8% voids, and base and subbase layers without excess fines.
- Open Graded Drainage Layers (OGDL) can be included between impermeable surface and granular base.

Open Graded Drainage Layer

- Open Graded Drainage Layer (OGDL) requires sufficient void content (25 to 50%), porosity and crossfall to drain through connected voids (pores).
- Applicable for municipal and provincial applications, urban or rural, various traffic levels.
- Current material alternatives for OGDL: Unbound granular material, asphalt stabilization, cement stabilization.
- OGDL is typically 100 mm thick (OPSD 207.041).

Objectives

- Drainage of water that infiltrates pavement surface layers.
- Support of pavement surface layers.

Challenges

- Outlets along edge of pavement must be well constructed and maintained.
- Portion of surface voids of OGDL are typically filled when a concrete pavement surface is used.
- Improperly designed, constructed, and maintained OGDL can trap moisture, reducing pavement performance.

Open Graded Drainage Layer Alternatives

Unbound Granular OGDL

- Poor construction platform due to lack of stability.
- Poor support capacity can cause pavement performance problems.
- Performs less consistently than stabilized OGDL (greater presence and fluctuation of moisture).

Asphalt Stabilized OGDL

- Contains 1.8 to 3% Asphalt Cement (AC).
- Can be a poor construction platform as surface may deform.
- Durability can be lost due to moisture damage.
- Development of deformation leads to inconsistent support and premature distresses.

Cement Stabilized OGDL

- Provides rigid surface for construction and even support for overlying pavement structure.
- Requires curing period for sufficient strength gain of cement (MTO requires a minimum of 48 hours).

Pervious Concrete

- High void content concrete material (15% to 25%).
- Surface layer over reservoir storage base layer.
- Pavement and stormwater infrastructure.
- Maintains natural water cycle in urban landscape.
- Low Impact Development.

Low Compaction Pervious Concrete (Hydromedia)

- Low Compaction Pervious Concrete (LCPC) addresses observed problems of earlier pervious concrete mix designs in Canada.
- High slump for easier placement.
- Meets current MTO permeability capacity standards for pervious concrete.
- Can meet MTO OGDL requirements for void content.

Future Work

- Evaluate extent of reduction in voids filled with surface concrete when size of voids is decreased.
- Evaluate potential to reduce pavement structure layer thicknesses when pervious concrete is used as OGDL.
- Cost comparison of OGDL alternatives including pervious concrete.

Summary

- OGDL can improve pavement performance with proper design and construction.
- Low compaction pervious concrete can address current challenges in using OGDL such as:
  - Consistency and ease of placement.
  - Effective construction platform.
  - Additional strength for pavement structure.

References

- OPSS 320 Construction Specification for Open Graded Drainage Layer.
- Low Compaction Pervious Concrete (Hydromedia).
- Characteristics similar to cement stabilized OGDL.
- Hydromedia can meet and exceed OGDL void content and drainage requirements in Ontario.
- In comparison to cement stabilized OGDL, Hydromedia offers increased strength and efficient construction.
- Increased strength by use of low compaction pervious concrete could reduce pavement structure thickness.
- OGDL with low compaction pervious concrete has potential benefits for overall pavement structure and may reduce thickness requirements of other layers.
- Voids sizes in low compaction pervious concrete can be altered by using different sized aggregate.
- With more small voids rather than few large voids, the tendency of surface concrete paste to fill the voids can be decreased.
- Reduced risk of poor OGDL performance compared to stabilized OGDL.

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