A STATE-OF-THE-ART REVIEW OF PERVIOUS CONCRETE TEST METHODS

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INTRODUCTION

- Investigating sustainable pavement alternatives has made pervious concrete an attractive solution for low-volume infrastructure.
  - Pervious concrete can act as both a pavement surface and stormwater management for a given site.
- Pervious concrete is a new technology limited information on cold-climate performance.
  - Lack of dedicated standards or a consensus approach is a clear barrier to implementation of pervious concrete.

Pervious Concrete Background

- Materials:
  - Single-sized aggregate, cementitious binder, admixtures as required (water reducing, set retarder, viscosity modifier, etc.).
  - Typically mixed for 15% air voids to allow for drainage through the structure.
- Structural Design:
  - Typically installed on a reservoir layer, dependent on location conditions.
- Sustainability Benefits:
  - Stormwater management, water filtration, heat control, noise control, and heavy metal removal.

OBJECTIVES

- Review the state-of-the-art in pervious concrete testing practices including:
  - Aggregate Testing and Sample Casting
  - Fresh Concrete Testing
  - Structural Performance Testing
  - Durability Performances Testing
- Identify and recommend test methods for work with a focus on Canadian application of pervious concrete

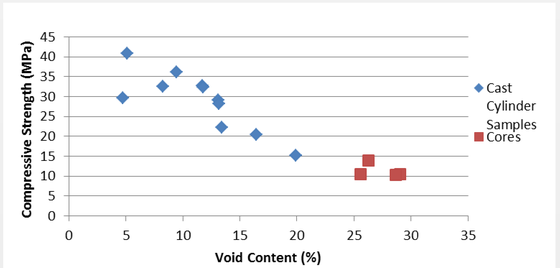
AGGREGATE TESTS AND CASTING

Aggregate Tests

- Main tests include:
  - Aggregate size analysis (ASTM C33)
  - Absorption and relative density (ASTM C127)
  - Bulk density (ASTM C29)
  - Abrasion Resistance (ASTM D6928)
- Specifically for abrasion, a Mico-Deval device is used
  - Testing only single-sized, large aggregate increases the probability of contact and artificially increases abrasion

Casting Samples

- Analysis has shown that cast samples, using standard rodding techniques, do not consistently replicate field compaction.



FRESH CONCRETE TESTS

Slump

- Performed following CSA A23.2-5C
- Typically shows '0' slump
  - Likely due to the structural differences between pervious and conventional concrete

Density and Void Content

- Performed following ASTM C1688, a dedicated standard for pervious concrete.
- Previously followed CSA A23.4-C and A23.3-6C for void content and density respectively
- New standard compacts the sample with a proctor hammer, which results in more realistic measured values

STRUCTURAL TESTS

Compressive Strength

- Testing usually follows CSA A23.2-9C or ASTM C39 methodologies.
- In Canada, CSA A23.2-3C describes sample preparation involving rodding of the sample; known to not be effective for pervious concrete.
- A new suggested methodology involves using the proctor hammer to compact specimens.

Flexural Strength

- Testing completed following ASTM C78, while sample preparation also follows CSA A23.2-3C.

Permeability

- Follows ASTM C1701, for pervious concrete pavements.
- Prior to this standard, other methods included:
  - Gibson permeameter
  - Falling head permeability

Density and Void Content

- ASTM C1754, another dedicated standard for pervious concrete.
- Uses a heating method to remove moisture from the samples until a constant weight is obtained, from which provided equations find the density and void content.
- Previous work used CoreLok vaccums or T-040R to determine these values.

DURABILITY TESTS

Freeze Thaw Resistance

- Testing usually follows ASTM C666 methodology, with adaptation.
- Testing method calls for the samples to be cyclically frozen and thawed while saturated. The porous nature of the material makes the value of this questionable.
- Testing has been completed at both a saturated state and at unsaturated, though in this case the samples were routinely soaked to add moisture to cause freezing damage.

Scaling Resistance

- Best standard available is ASTM C672, though this standard requires a pool of saline solution to be maintained on the surface.
  - This is not possible with a porous sample.
- Dedicated test methods for this is desperately needed in order to validate pervious concrete for the Canadian climate.

Surface Abrasion

- The most current standard followed is ASTM C1747, a dedicated standard calling for Los Angeles abrasion testing
- Previous work followed ASTM C944, which applied a rotary cutter to the surface of the specimen

CONCLUSIONS

- Clear benefits for establishing dedicated test methods for pervious concrete materials have been demonstrated. These methods are able to drive the consensus for research and allow practitioners to obtain reliable results for implementing the material
- Changes must be made to the compaction procedures for these tests as traditional rodding is not sufficient; the proctor hammer has demonstrated more reliable results
- Vast improvement and consensus is required for durability testing, particularly on freeze thaw and scaling resistance
  - This is of particular importance to Canadian practitioners

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