

# Strength and Permeability Characteristics of Porous Concrete Pavements

## Abstract:

The overall goal of this research is to characterize the strength, permeability, and overall performance of porous concrete pavements suitable for cold climates. Specific objectives of the research presented here were to:

- quantify the mechanical and hydraulic properties;
- evaluate the effects of winter surface applications (e.g. salt and sand) on hydraulic conductivity; and
- determine the effects of sample size on measured parameters.

## Mix Designs:

Mixes were created in general accordance with ASTM C192. To this point, three mix designs have been tested:

- Lab Mix #1: water-cement ratio = 0.25
- Lab Mix #2: water-cement ratio = 0.30
- Field Mix: porous concrete samples prepared during construction of porous concrete park and ride facility in Randolph, VT

All mixes were designed using locally available constituents, including a uniform coarse aggregate of 3/8" crushed ledge

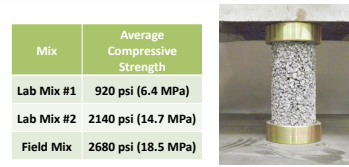
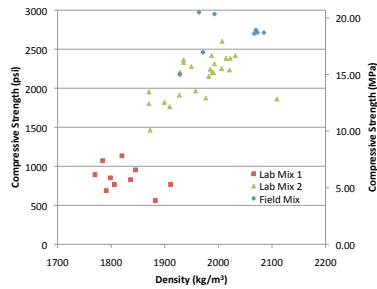
6" of Pervious Concrete
2" of AASHTO No. 57 Stone
34" min of AASHTO No. 2 Stone
Non-Woven Geotextile
Uncompacted Subgrade Soils

Porous concrete park and ride facility in Randolph, VT: during construction (left), typical cross-section (right), aerial view (below)



## Compressive Strength:

- Performed in general accordance with ASTM C39
- Samples cast with a 2:1 height to diameter ratio
- Failure was observed primarily through the cement-aggregate interface for Lab Mix #1, and primarily through the aggregate for Lab Mix #2 and the Field Mix



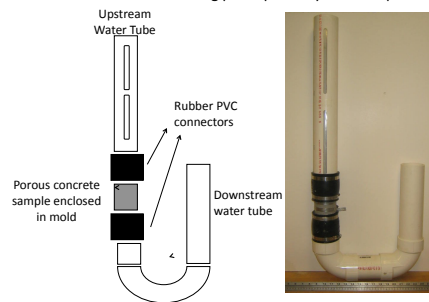
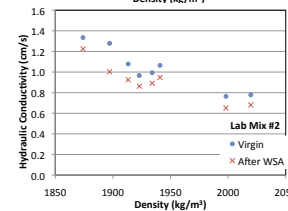
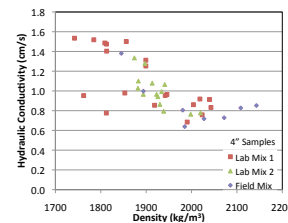
Porous concrete samples after compression testing: Lab Mix #1 (left), Lab Mix #2 (middle), Field Mix (right)

## Hydraulic Conductivity & Winter Surface Applications:

### Research Methods:

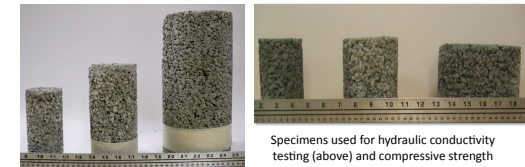
- Falling head permeameter was designed and used
- A constant downstream head maintained while the upstream head was allowed to fall from 30 cm to 10 cm (~12" to 4") – representative of site conditions
- Samples cast with a height of 15.24 cm (6") to represent a typical cross-section found in the field
- Rubber liner used in mold to prevent flow along the sides
- 2:1 Sand/salt mixture applied as typical for VT. Enough to coat surface and clog pore spaces by visual inspection

Mix Design	Average Hydraulic Conductivity	Hydraulic Conductivity after Winter Surface Applications	Reduction after Winter Surface Applications
Lab Mix #1	1.10 cm/s	0.95 cm/s	14.0%
Lab Mix #2	0.94 cm/s	0.81 cm/s	14.0%
Field Mix	0.87 cm/s	0.75 cm/s	13.5%

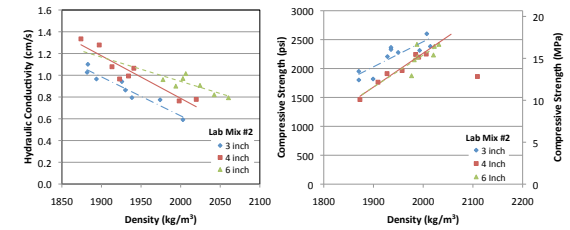


Falling head permeameter: photo (left), schematic (right)

## Size Effects:



Specimens used for hydraulic conductivity testing (above) and compressive strength testing (left)



## Conclusions:

- 10.16 cm (4") samples are recommended for laboratory testing based on size effect data
- Winter surface applications have an appreciable effect on the hydraulic conductivity of porous concrete, reducing capacity by ~14% after application of 0.12 g/cm<sup>2</sup> of material
- Hydraulic conductivity and compressive strength are influenced by density

## Ongoing Work:

Additional research underway:

- Freeze-thaw durability
- Effects of wear and tear (e.g. plowing) on porous concrete pavements
- Field verification to characterize differences between laboratory and field measurements
- Examination of more mix designs



## Acknowledgements:

This work was funded by the United States Department of Transportation through the University of Vermont Transportation Research Center along with the Vermont Agency of Transportation (VTrans). The authors are grateful to Jennifer Fitch, Jim Wild, Curtis Morrill and T. J. Davison for their assistance in sample preparation.