PERVIOUS CONCRETE
WHAT IS PERVERIOUS CONCRETE?

A CONCRETE SOLUTION
TO STORM-WATER MANAGEMENT
Most paving material in use today is fairly impervious.

That makes it difficult for precipitation to reach the soil under paved areas.
Also, all the pollution (motor oil, anti-freeze, etc.) that leaks out onto impervious pavement remains on the surface until it rains, when it's all washed into rivers and streams.

Joke's on you, though! Someday you're going to eat me!
Pervious concrete, on the other hand, is porous, allowing liquids to seep slowly through to the soil underneath.

Hurry up!
Pollutants cling to the vast surface area within this material, which gives microorganisms time to break them down into much less toxic chemicals before they enter the groundwater.

mmm...petroleum products...
And of course, it's much easier to grow trees in areas where water and air can reach the soil and roots below.

sooo... thirrstyyyy...
WHAT IS PERVIOUS CONCRETE?

• One of the hottest topics in land development today.

• As owners, architects, land developers, and concrete professionals become more familiar with its benefits, the interest in pervious concrete continues to grow.

• The use of Pervious Concrete pavements provides an environmental solution to storm-water runoff and puts rainwater back in the ground where it belongs!
WHAT IS PERVERIOUS CONCRETE?

- Pervious Concrete will typically contain 15-25% void space
- Will allow water to pass directly through it
- Typically used for exterior flatwork
- Reduces storm water runoff, and recharges groundwater
- Eliminates/reduces retention ponds
WHAT’S THE BASIC CONCEPT

- Pervious concrete pavement is a permeable pavement, often with an underlying stone reservoir, that captures rainfall and stores runoff before it infiltrates into the subsoil.

- This pervious surface replaces traditional pavement, allowing storm water to infiltrate directly, permitting a naturally occurring form of water treatment.
THIS IS NOT NORMAL CONCRETE!

If you treat it like normal concrete you will have trouble!

– Standard Equipment
– Standard Crews
– No Certification
– No Test Placement
– No Luck!

Oops! – We closed the surface!
RECOGNIZED AS AN EPA BMP

- For storm water pollution prevention
- Lower heat island effect
- Pervious concrete is eligible for one LEED credit point for the CaGBC (USGBC) Green Building Rating System.
SUSTAINABLE CONSTRUCTION

• LEED Canada-NC 1.0

Green Building Rating System

– Storm Water Management (Sustainable Sites Credit 6.1)
– Reducing Heat Island effects (Sustainable Sites Credit 7.1)
– Recycled Content (Materials and Resources Credit 4)
– Regional Materials (Materials and Resources Credit 5)
– Innovation in Design (Innovation and Design Process Credit 1)
APPLICATIONS

- Parking areas
- Roadways
- Walks
- Driveways
- Recreational areas
- Erosion Control
PARKING AREAS
Stamped Concrete & Pervious Concrete

Conventional Concrete & Pervious Concrete
No Joints!  Big Box Retailers
WALKWAYS
PERVIOUS CONCRETE CAN BE COLORED!
Golf Cart Paths

Nature Paths
RECREATION AREAS
ROADWAYS
Pervious Concrete has been used in the United States for low volume roadways.
WHY CONCRETE?

1. Made from abundant natural resources
2. Can use industrial byproducts like fly ash, slag, silica fume
3. Reduces the Heat Island Effect
4. High Albedo (Light Reflectance) reduces necessary lighting requirements or increases brightness of a given area with the same energy costs.
5. Durable surface
ENVIRONMENTAL BENEFITS

- Reduces storm water runoff
- Cleans storm water
- Replenishes aquifers
- Protects streams and lakes
- Allows water and oxygen to reach tree roots
- BMP for meeting EPA Phase II storm water regulations
- LEED recognition for reducing storm water runoff
- Meets LEED requirements for reducing urban heat islands
ECONOMIC BENEFITS

• Eliminates the need for detention ponds and other costly storm water management systems

• Allows for more efficient land development
Porous pavement pollutant removal mechanisms include absorption, straining, and microbiological decomposition in the soil. Studies indicate removal efficiencies of between 82 and 95 percent for sediment, 65 percent for total phosphorus, and between 80 and 85 percent of total nitrogen. It also indicated high removal rates for zinc, lead, and chemical oxygen demand.

Google: Natural Attenuation or Microbial Remediation

U.S. Geological Survey
LOWER HEAT ISLAND EFFECTS

- Light Color of Concrete Pavement absorbs LESS heat from Solar Radiation
- Open pore structure stores less heat
- Allows landscapers and architects to use more greenery around parking lots for shade to produce a cooling effect
- Reduces the HEAT UP of Stormwater
SAFETY BENEFITS

- Eliminates ponding during heavy rains
- Glare from wet pavement is virtually eliminated
- Risk of Hydroplaning and skidding is reduced
- Light color of concrete provides a safer, better lit area at night
ENGINEERING PROPERTIES

• **Fresh Properties**
  – Slump: (0mm – 20mm)
  – Unit Weight: 70% of conventional concrete
  – Working Time: 60 – 90 minutes

• **Hardened Properties**
  – Density: (1600-2000 kg/m³)
  – Permeability: (145 l/m²/min – 400 l/m²/min)
  – Compressive Strength: (4 MPa – 28 MPa)
  – Flexural Strength: (1 MPa – 4 MPa)
  – Shrinkage (Minimal)
MIX PROPORTIONING

Materials:
- Cementing Materials
- SCM
- Coarse Aggregate
- No or limited Fine Aggregates
WATER AND ADMIXTURES

- W/C ratio between 0.27 and 0.30 are common
- W/C ratio up to 0.40 have been used successfully
- Set retarding admixtures are common
- Air-entraining admixtures in freeze-thaw conditions
DESIGN

• Two factors determine design thickness:
  – Hydraulic properties such as permeability and volume of voids
  – Structural properties such as pavement tensile strength and sub-grade stiffness

• Select appropriate material properties and thickness for:
  – Hydrological requirements
  – Anticipated loading
  – Larger of two values governs design
HYDROLOGICAL DESIGN CONSIDERATIONS

• Select intensity of surface runoff that can be tolerated
• For no runoff, design pavement to capture and store all rainwater for a given storm
• Passive system: capture and store rain falling on pavement
• Active system: capture and store rain falling on buildings, adjacent pavements and landscaping
• Design curbs, gutters, drainage, and ground cover to avoid clogging
SELECT RAINFALL EVENT

• Select design rainfall event:
  – Expected rainfall in a given period
  – Distribution of rainfall over the same period
  – Two-year storm often used
  – Local requirements may differ

Example of two-year storm:

• 75 – 90 mm of rain in 24 hrs. every two years
• 50mm of rain in two-hour period
PAVEMENT PERMEABILITY

- Must consider permeability and storage capacity
- Pavement permeability rarely governs
- Flow rate through sub-grade often governs
SLOPED PAVEMENTS

• Flat pavement design
• Higher levels of slab will not provide storage capacity
• Example
  – 150 mm pavement
  – 1% slope
  – 30 m long
  – 300 mm difference in elevation
  – 25% storage capacity
• Add porous sub-base and drainage channels for additional storage
Pervious Concrete: Hydrological Design and Resources (CD-ROM): An important pervious concrete reference tool, filled with technical and promotional resources, including *Pervious Concrete Pavements*, an outstanding reference which covers pervious applications and engineering properties, environmental benefits, structural properties, and durability. The CD also includes an analysis tool on hydrological design, based on the *Pervious Concrete Hydrological Analysis Program*, which illustrates the behavior of pervious concrete systems in relatively simple situations.
CONSTRUCTION

• Not difficult to place
• Different from conventional concrete
• Stiff consistency and short setting time require special handling and placement
• Contractors use different techniques
JOINTING

• Control joints can prevent random cracking
• Spacing is larger than conventional pavement
• 6 m spacing if needed
• 13.5 m spacing has been used successfully
• Depth of joint = ¼ slab depth
• Use rolling joint tool
• Joint immediately after compaction
• Consider saw cutting
NO JOINTS

Many pavement are not jointed at all – random cracking is not considered a negative on the textured surface
CURING AND PROTECTION

- Curing is even more important with pervious concrete
- Fog misting the surface within 20 minutes of compaction
- Cover with plastic sheeting
- Leave plastic in place for 7 days
OPENING TO TRAFFIC

- Pavements opened after 7 days
- Cured continuously until opened to traffic
- Pervious concrete can be painted
MAINTENANCE

• Little maintenance required
• Prevent clogging with debris
• Design site to minimize flow of soil and leaves onto pavement
• Vacuum annually or more frequently
• Power blowing or pressure washing is another option
CREW EXPERIENCE

• Experienced crews require less time and labor than conventional concrete
PERVIOUS CONCRETE CERTIFICATION

- 1 Day certification
- Closed book exam
- 75% Required for a pass
- 120+ people in Ontario
PERVIOUS CONCRETE SPECIFICATIONS

New RMCAO Pervious Concrete Guideline
PERVIOUS CONCRETE TESTING & ACCEPTANCE

New Standard Test Method For Pervious Concrete

Technical Bulletin

Standard Test Method for Determining Plastic Density

Since pervious concrete is a relatively new concrete product that is used for stormwater management, there are currently a large number of potential test methods that can be used to evaluate this product. One of the key material evaluation methods is to determine the plastic density of the product during the pervious concrete trial placement, and to then compare that to the actual product density during the final project placement. A plastic density acceptance criterion of ± 8% is then used as the primary quality control acceptance and rejection tool on the job site for the pervious concrete placement.

Since there are multiple potential test methods available, it is important that a standardized test method be selected prior to the acceptance of the product. Currently, the process of finalizing a new test method for determining the density of pervious concrete materials is underway, and they have selected this method based upon conducting a round robin testing program and comparing the results of 5 different consolidation methods performed by 6 different concrete laboratories. The most repeatable method was then selected based upon the high level of repeatability and the ease of implementation of this test method on construction projects.

The newly developed and finalized pervious concrete density testing be conducted following this draft ASTM test method. As of today, this test method has not yet been formally introduced; therefore, we are unable to directly discuss its use on Canadian jobsites at this time. In the meantime, RMCAO has developed this basic pervious concrete testing protocol based directly upon the draft ASTM test method. Once the ASTM testing protocol has been formally published, this Technical Bulletin should be discarded and the appropriate ASTM testing protocol followed.

STANDARD PERVERSIOUS CONCRETE DENSITY TEST METHOD

Definition

Pervious concrete is rigid concrete pavement with large interconnected voids that allow rapid water flow through the pavement.

Testing Equipment

- Cylindrical container made from metal conforming to the requirements of CSA A23.2-9C with a capacity of 7.0 ± 0.0 L
- Balance or scale conforming to the requirements of CSA A23.2-9C
- Standard proctor hammer
- Strike off bar
- Small tools: scoops, rubber gloves, sponge, etc.