Roller-Compacted Concrete & Pervious Concrete Pavements

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National Ready Mixed Concrete Association

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Antitrust Policy Statement

The National Ready Mixed Concrete Association assigns the highest priority to full compliance with both the letter and the spirit of the antitrust laws. Agreements among competitors that unreasonably limit competition are unlawful under federal and state antitrust laws, and violators are subject to criminal fines and incarceration, civil fines and private treble-damage actions. Even the successful defense of antitrust litigation or an investigation can be very costly and disruptive. It is thus vital that all meetings and activities of the Association be conducted in a manner consistent with the Association's antitrust policy.

Examples of illegal competitor agreements are those that attempt to fix or stabilize prices, to allocate territories or customers, to limit production or sales, or to limit product quality and service competition. Accordingly, it is inherently risky and potentially illegal for competitors to discuss under Association auspices, or elsewhere, the subjects of prices, pricing policies, other terms and conditions of sale, individual company costs (including planned employee compensation), the commercial suitability of individual suppliers or customers, or other factors that might adversely affect competition.

It is important to bear in mind that those in attendance at Association meetings and activities may include competitors, as well as potential competitors. Any discussion of sensitive antitrust subjects with one's competitors should be avoided at all times before, during, and after any Association meeting or other activity. This is particularly important because a future adversary may assert that such discussions were circumstantial evidence of an illegal agreement, when viewed in light of subsequent marketplace developments, even though there was, in fact, no agreement at all.

If at any time during the course of a meeting or other activity, Association staff believes that a sensitive topic under the antitrust laws is being discussed, or is about to be discussed, they will so advise and halt further discussion for the protection of all participants. Member attendees at any meeting or activity should likewise not hesitate to voice any concerns or questions that they may have in this regard.

Adopted by the NRMCA Board of Directors
September 18, 2006.

Topics of Discussion

- What is Roller-Compacted Concrete?
- What is Pervious Concrete?
- Applications
- Benefits
- Construction
- Resources

What is Roller-Compacted Concrete Pavement?

Ingredients for RCC

Conventional PCC

143 pcf

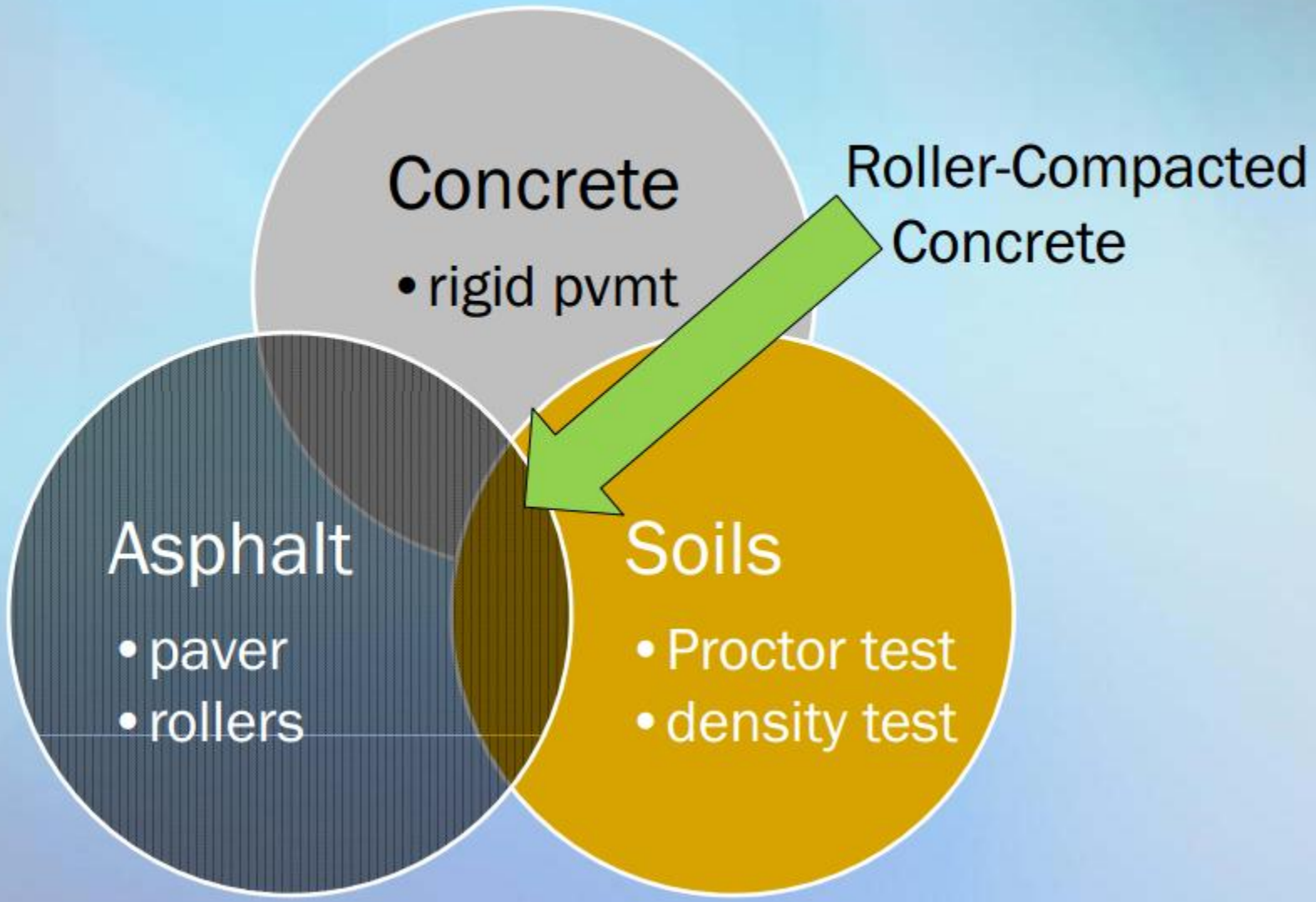
11% C.M. | 16% Water | 6% Air | 26% Fine Agg. | 41% Coarse Agg.

Roller-Compacted Concrete

153 pcf

10% C.M. | 13% Water | 1.5% Air | 35.0% Fine Agg. | 40.5% Coarse Agg.

Multiple Personalities



Slide courtesy of Wayne Adaska, PCA


RAPIDMIX 400 C


SMITH
012

Slide courtesy of Frank Lennox, Buzzi Unicem, Chattanooga, TN


SAVK
CAT
SAVK


96%

15-20 ft.

Durability

One-Pass Construction

Photo courtesy of Andale Ready Mix Central and Andale Paving, Inc.

Reflectivity

Heat Island Reduction


COSTS

Intermodal Yards

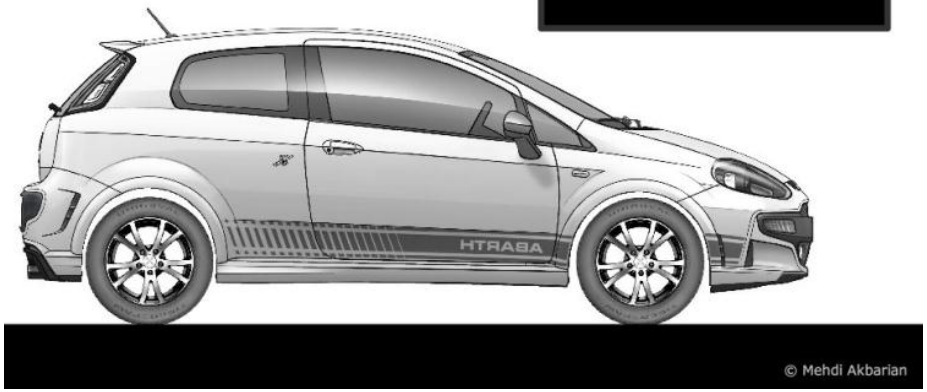

Mid-Size to Large Parking Lots


92.6%

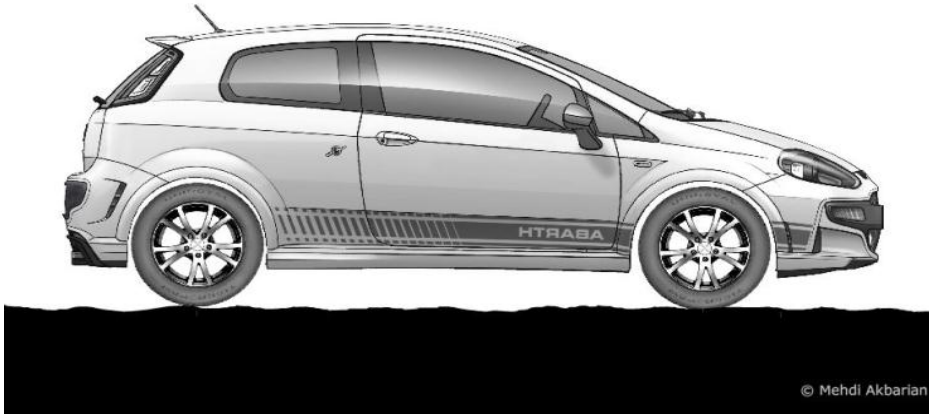

56%


Pavement
Vehicle
Interaction

Deflection



Roughness




3-17%


25-60%

National Concrete Pavement Technology Center

GUIDE FOR ROLLER-COMPACTED CONCRETE PAVEMENTS

AUGUST 2010

www.cptechcenter.org

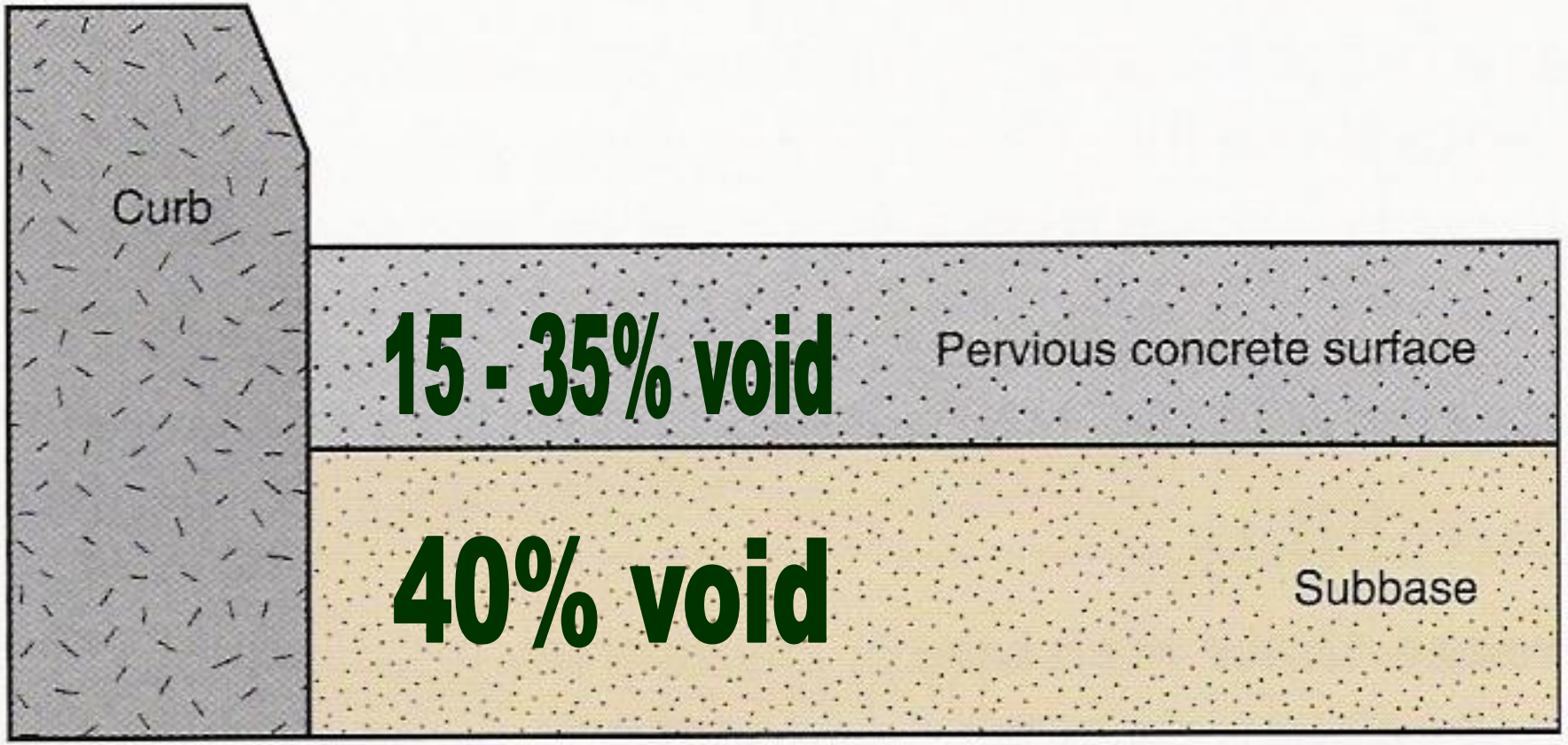
What is Pervious Concrete?

Typical Pervious Concrete Mix Design

- 450-550 lbs. Cementitious
  - Fly Ash / Slag Cement substitute acceptable at standard rates
- 27 ft^3 Coarse Aggregate
  - Aggregate size will affect drainage rate
- 0.25 – 0.37 W/C Ratio
  - Sufficient water to display a wet, metallic sheen on the aggregate
- High Range Water Reducer, Viscosity Modifier, Hydration Stabilizer

Pervious Concrete Properties

- 15% to 35% air void content
  - Field studies show 20-25% average
- 100 to 125 lbs/ft³ unit weight
- 2500 to 3500 psi strength*
  - Introduction of small amount of fine aggregate can increase strength to 4000 psi (+/-)
  - compressive strength typically *not* used as acceptance criteria. Air void structure and unit weight are used instead.

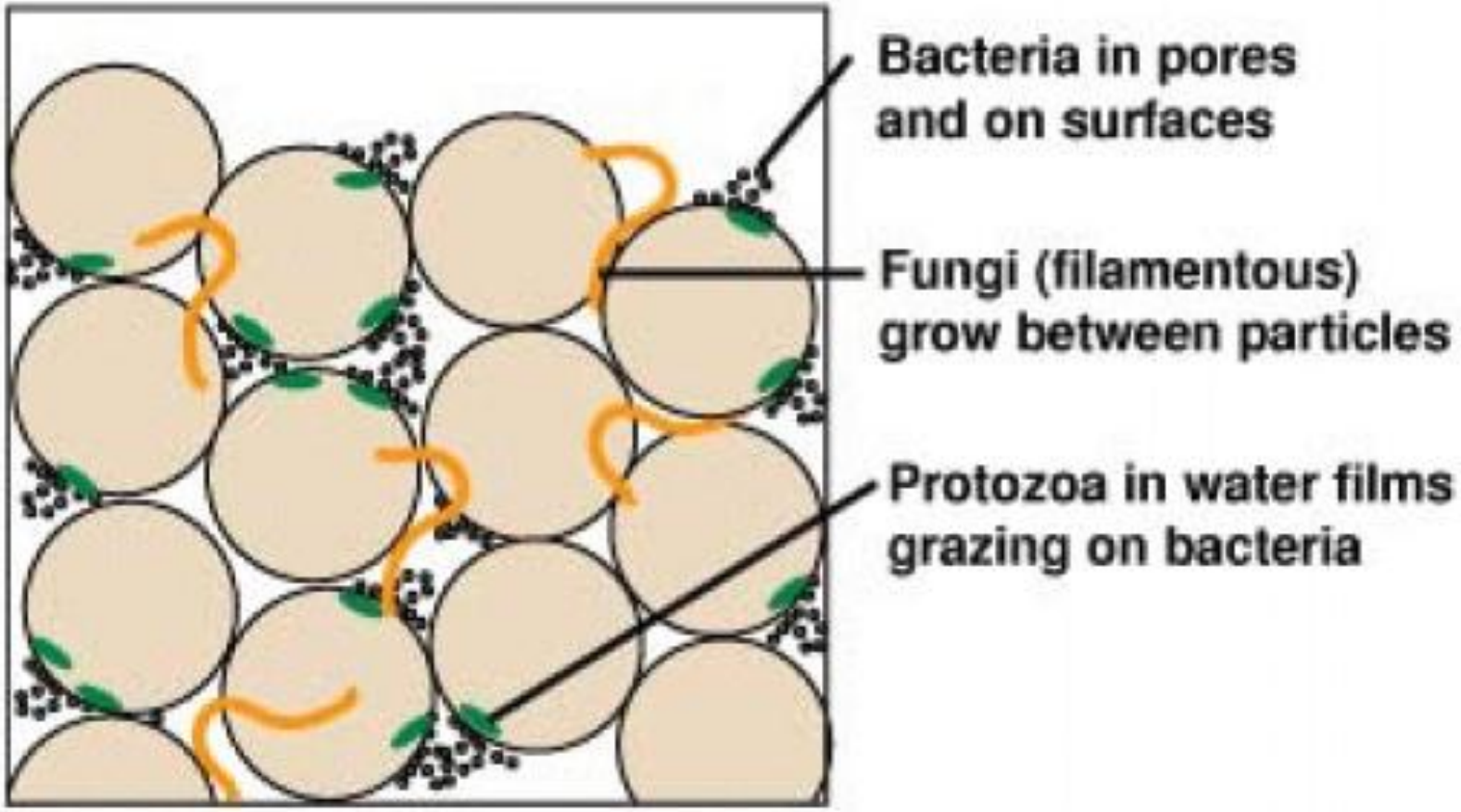

Curb
15 - 35% void
Pervious concrete surface
40% void
Subbase

275-450 in/hr

- Recharge Groundwater
- Flood Prevention / Management
- Improved Water Quality

Benefits of Pervious Concrete


First Flush


Bacteria in pores and on surfaces
Fungi (filamentous) grow between particles
Protozoa in water films grazing on bacteria


Waste Product


Resource

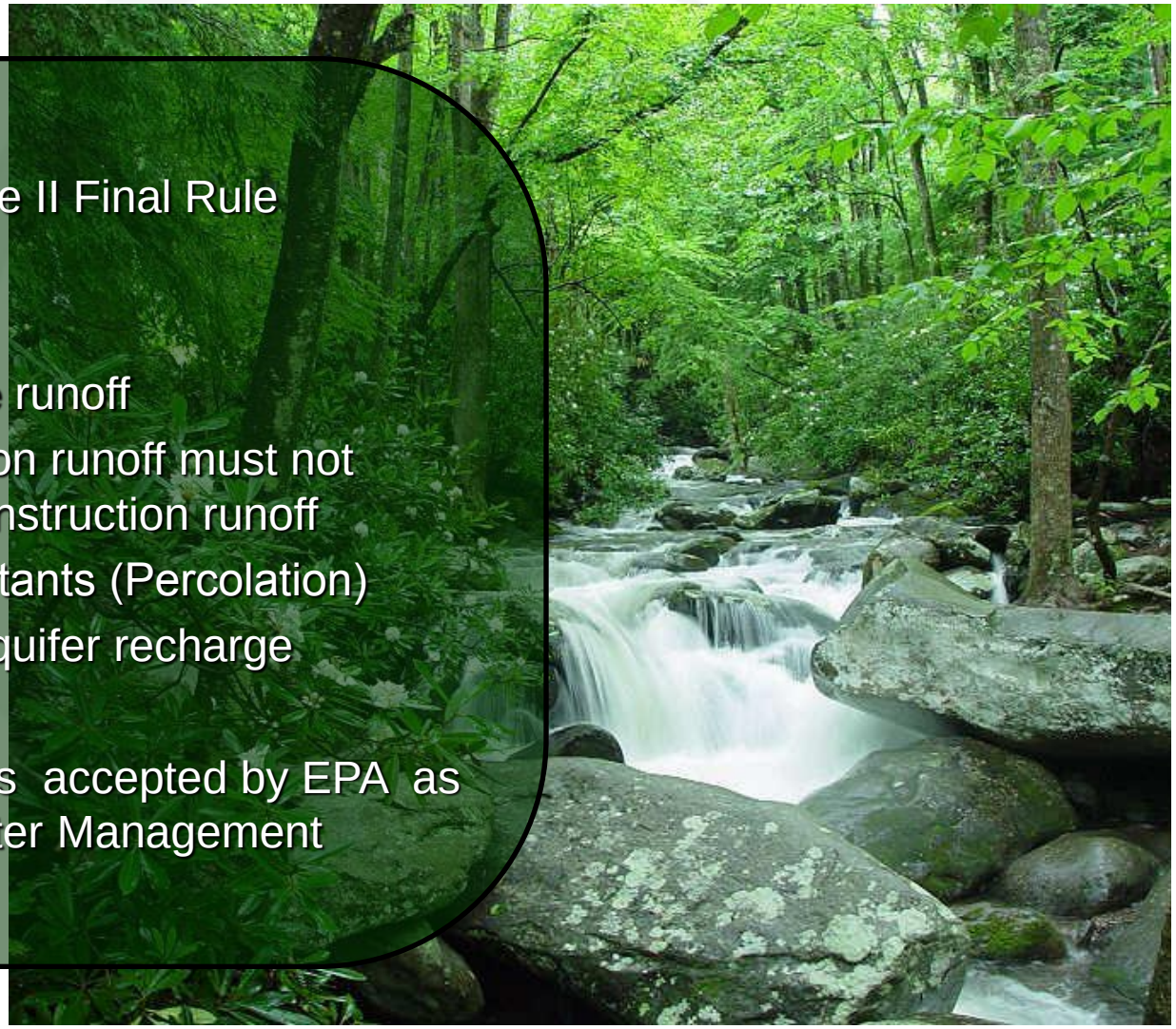
Applications for Pervious Concrete

Parking Lots
Streets / Local Roads
Nature Trails / Pathways

Erosion Control
Greenhouses / Nurseries
Environmentally Sensitive Developments

How Many Cars Can You Park On A Detention Pond?

US EPA - Clean Water Act



EPA Storm Water Phase II Final Rule (EPA 2000)

- Cities over 50,000
- Reduce or eliminate runoff
  - Post construction runoff must not exceed Pre-Construction runoff
- “Treatment” of Pollutants (Percolation)
- Groundwater and aquifer recharge
- Minimize Flooding
- Pervious Concrete is accepted by EPA as a BMP for Stormwater Management

Energy Independence and Security Act (EISA) 2007

- Section 438
  - **"Storm water runoff requirements for federal development projects.** The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

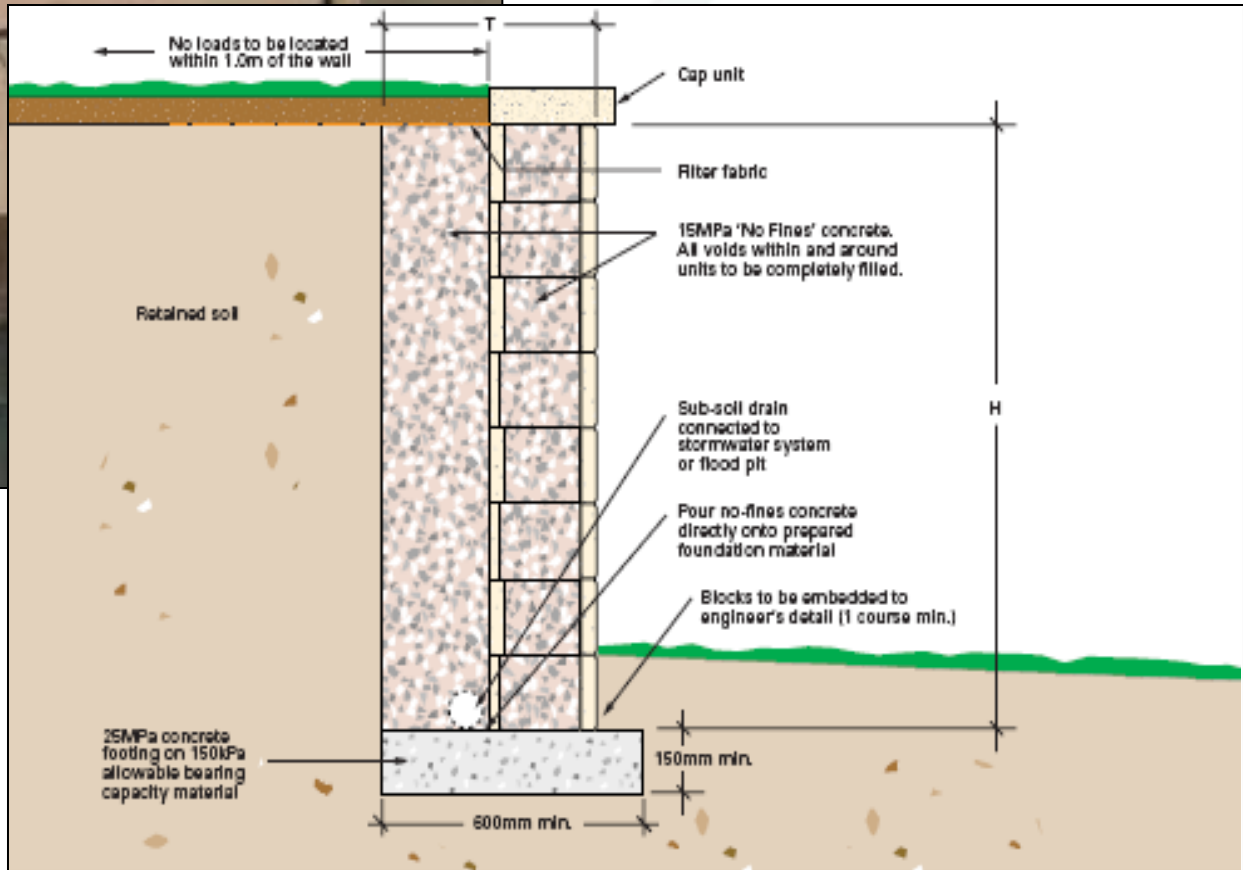
US Green Building Council

Green Building Rating System

For New Construction & Major Renovations

(LEED-NC)

Version 2.2


No loads to be located within 1.0m of the wall
T
Cap unit
Filter fabric
15MPa 'No Fines' concrete. All voids within and around units to be completely filled.
Retained soil
H
Sub-soil drain connected to stormwater system or flood pit
Pour no-fines concrete directly onto prepared foundation material
Blocks to be embedded to engineer's detail (1 course min.)
25MPa concrete footing on 150kPa allowable bearing capacity material
150mm min.
600mm min.

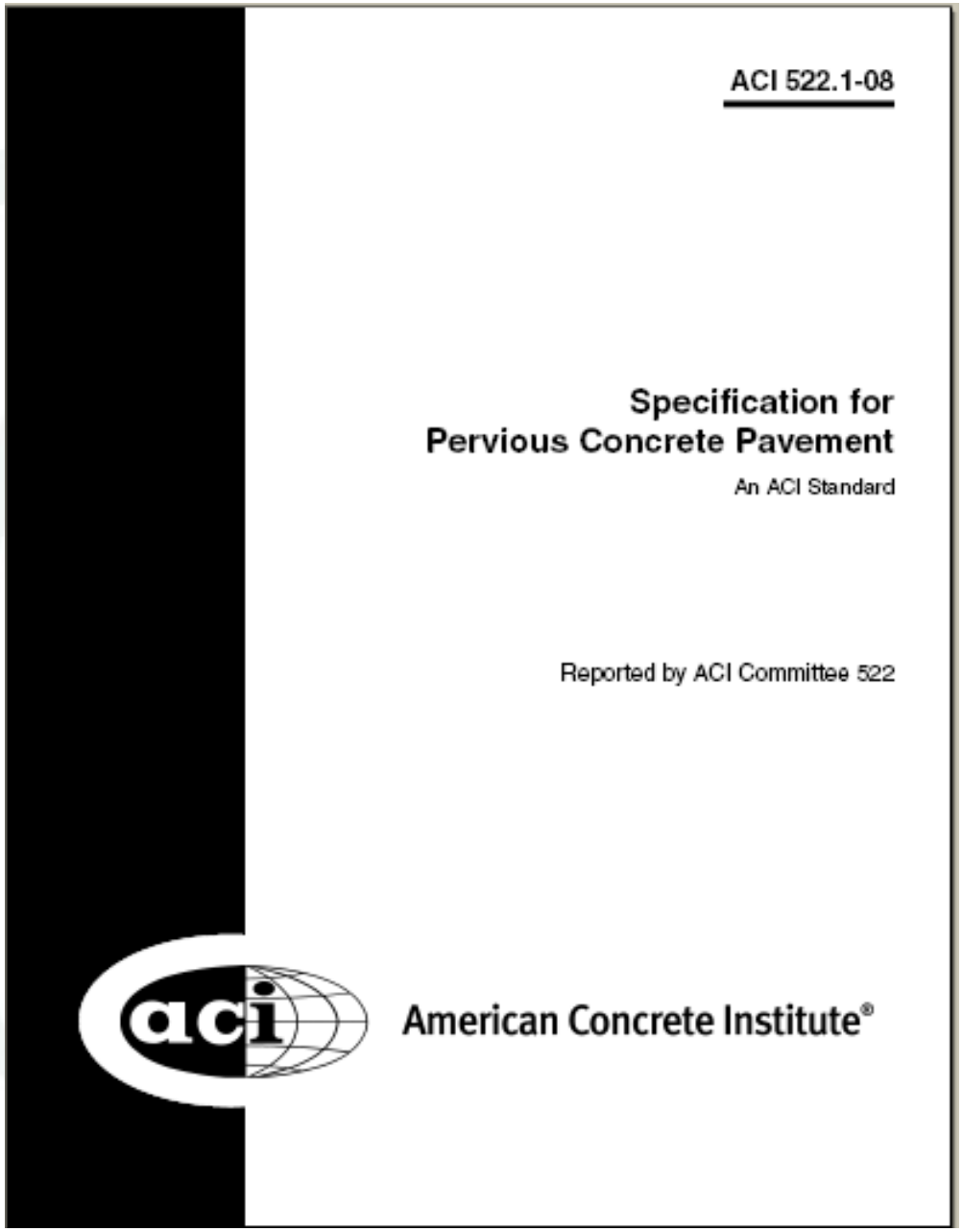

GREENHOUSE
Rt. 665
Aug. 18, 1976

ACI 522-R & 522.1

Available through

American Concrete Institute

www.concrete.org



Specification Recommendations

- *Target void content of 15% to 25% as measured by ASTM C1688**
- Fresh density of pervious concrete shall be within 5 lbs.+/- of the fresh density of the specified fresh density (approved mix design).

** Suggested text - Not taken from ACI 522.1-08*

ASTM Test Procedures

Fresh Concrete Density and Voids Content

- ASTM C1688-12: Standard Test Method for Density and Void Content of Freshly Mixed Pervious Concrete

Field Permeability (Infiltration Rate)

- ASTM C1701-09: Standard Test Method for Infiltration Rate of In-Place Pervious Concrete

Hardened Concrete Density and Porosity

- ASTM C1754-12: Density and Void Content of Hardened Pervious Concrete

NRMCA Pervious Concrete Contractor Certification Program

NRMCA Certified Craftsman

NRMCA Certified Installers

Other Concrete Sites

- Concrete Parking.org
- Green Concrete.info
- Concrete Buildings.org
- Flowable Fill.org
- Green Roof Tops.org
- Concrete Streets.org
- Self Consolidating Concrete.org
- Decorative Architectural Concrete

Help for Commercial Projects

- Concrete Answers Hub Site
- Project Assistance

Links

- Indu
- Publi
- Link

Pervious Concrete Pavement

An Overview

Pervious concrete pavement is a unique and effective means to address important environmental issues and support green, sustainable growth. By capturing stormwater and allowing it to seep into the ground, porous concrete is instrumental in recharging groundwater, reducing stormwater runoff, and meeting U.S. Environmental Protection Agency (EPA) stormwater regulations. In fact, the use of pervious concrete is among the Best Management Practices (BMPs) recommended by the EPA—and by other agencies and geotechnical engineers across the country—for the management of stormwater runoff on a regional and local basis. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other stormwater management devices. In doing so, pervious concrete has the ability to lower overall project costs on a first-cost basis.

or no sand, creating a substantial void content. Using sufficient paste to coat and bind the aggregate particles together creates a system of

➤ NRMCA Pervious Concrete Contractor Certification Program

The program is designed to be administered locally by local sponsoring groups in conjunction with planned training sessions or demonstrations of pervious concrete placement. NRMCA provides certification exams and

...more

➤ NRMCA Specifier Webinars

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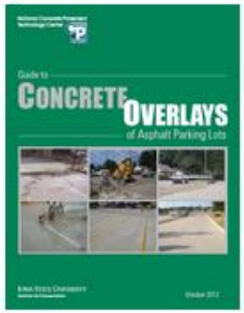
Welcome to the Ready Mixed Concrete (RMC) Research & Education Foundation Website

Now Available!

The new "Guide for Concrete Overlays of Asphalt Parking Lots". To download the Guide, please click here. Or, to order a hardcopy of the Guide, please contact NRMCA's Jacques Jenkins at jjenkins@nrmca.org or at 240-485-1165.



CSH concrete sustainability hub

Missed the MIT CSH webinar that took place on November 9? Click here to view it online. Or, click here to visit the Foundation's dedicated MIT CSH Resources Page.

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Bridge the Gap

Will you help to Bridge the Gap? The Foundation is embarking on a fundraising effort to "Bridge the Gap" in continuing to fund the MIT Concrete Sustainability Hub and other important industry resource development without eroding the endowment. Please click here to view more information, a list of current contributors to the effort and a pledge form. Or, please contact Foundation Executive Director Julie Garbini with questions.


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