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Inch-Pound Units

SI

International System of Units

# Pervious Concrete—Report

Reported by ACI Committee 522

ACI PRC 522-23



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## Pervious Concrete—Report

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# Pervious Concrete—Report

Reported by ACI Committee 522

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*This report provides technical information on pervious concrete's application, design methods, materials, properties, mixture proportioning, construction methods, testing, and inspection.*

*The term "pervious concrete" typically describes a near zero slump, open-graded material consisting of portland cement, coarse aggregate, little or no fine aggregate, admixtures, and water. The combination of these ingredients will produce a hardened material with connected pores, ranging in size from 0.075 to 0.32 in. (2 to 8 mm), that allow water to pass through easily. The void content can range from 15 to 35%, with typical compressive strengths of 400 to 4000 psi (2.8 to 28 MPa). The drainage rate of pervious concrete pavement will vary with aggregate size and density of the mixture but will generally fall into the range of 2 to 18 gal./min/ft<sup>2</sup> (81 to 730 L/min/m<sup>2</sup>). Pervious concrete is widely recognized as a sustainable building material, as it reduces stormwater runoff,*

*improves stormwater quality, may recharge groundwater supplies, and can reduce the impact of the urban heat island effect.*

**Keywords:** construction; design; drainage; green building; LEED® credit; permeability; pervious concrete pavement; stormwater; sustainability; testing.

## CONTENTS

- CHAPTER 1—INTRODUCTION AND SCOPE, p. 2**
  - 1.1—Introduction, p. 2
  - 1.2—Scope, p. 3
- CHAPTER 2—NOTATION AND DEFINITIONS, p. 3**
  - 2.1—Notation, p. 3
  - 2.2—Definitions, p. 3
- CHAPTER 3—APPLICATIONS, p. 4**
  - 3.1—General, p. 4
  - 3.2—Building applications: history, p. 4
  - 3.3—Pavement applications, p. 5
  - 3.4—Other applications, p. 7

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**CHAPTER 4—MATERIALS, p. 7**

- 4.1—General, p. 7
- 4.2—Aggregates for use in pervious concrete, p. 7
- 4.3—Cementitious materials, p. 8
- 4.4—Water, p. 8
- 4.5—Admixtures, p. 8

**CHAPTER 5—PROPERTIES, p. 8**

- 5.1—General, p. 8
- 5.2—Permeability, p. 8
- 5.3—Compressive strength, p. 10
- 5.4—Flexural strength, p. 11
- 5.5—Durability under freezing-and-thawing conditions, p. 12
- 5.6—Surface abrasion and raveling resistance, p. 13
- 5.7—Fracture toughness, p. 14
- 5.8—Acoustic absorption, p. 14
- 5.9—Slip and fall prevention, p. 14
- 5.10—Urban heat island mitigation, p. 15
- 5.11—Pollutant removal capacity, p. 15

**CHAPTER 6—PERVIOUS CONCRETE MIXTURE PROPORTIONING, p. 15**

- 6.1—General discussion of proportioning, p. 15
- 6.2—Proportioning criteria, p. 15
- 6.3—Proportioning process, p. 16
- 6.4—Mixture proportioning process examples, p. 17

**CHAPTER 7—PERVIOUS PAVEMENT DESIGN, p. 19**

- 7.1—Introduction, p. 19
- 7.2—Site design, p. 19
- 7.3—Structural design, p. 19
- 7.4—Stormwater management design, p. 21
- 7.5—Other considerations, p. 29

**CHAPTER 8—PERVIOUS PAVEMENT CONSTRUCTION, p. 30**

- 8.1—General construction principles, p. 30
- 8.2—Subgrade/subbase preparation, p. 30
- 8.3—Placing, p. 31
- 8.4—Compaction and finishing, p. 33
- 8.5—Jointing, p. 33
- 8.6—Curing and protection, p. 33
- 8.7—Cold weather protection, p. 35
- 8.8—Hot weather protection, p. 35

**CHAPTER 9—QUALITY CONTROL AND ASSURANCE, INSPECTION AND TESTING, p. 35**

- 9.1—General, p. 35
- 9.2—Preconstruction inspection and testing, p. 35
- 9.3—Inspection and testing during construction, p. 36
- 9.4—Postconstruction inspection and testing, p. 36

**CHAPTER 10—PERFORMANCE, p. 37**

- 10.1—General, p. 37
- 10.2—Changes in infiltration rates, p. 37
- 10.3—Structural distress, p. 38

- 10.4—Surface distress, p. 38
- 10.5—Resistance to freezing and thawing, p. 38
- 10.6—Resistance to deicers, p. 39
- 10.7—Repairing pervious concrete pavements, p. 39
- 10.8—Maintenance, p. 40
- 10.9—Pervious concrete overlay field durability and performance, p. 40

**CHAPTER 11—LIMITATIONS, POTENTIAL APPLICATIONS, AND RESEARCH NEEDS, p. 41**

- 11.1—Pervious concrete in cold climates, p. 41
- 11.2—Characterization of the material structure, p. 42
- 11.3—Strength and other testing needs and limitations, p. 42
- 11.4—Nondestructive determination of performance and properties, p. 43
- 11.5—Stormwater management, p. 43
- 11.6—Urban heat island effect, carbonation, and other thermal properties, p. 44
- 11.7—Construction, operation, and maintenance needs, p. 45
- 11.8—Other novel applications and uses, p. 45

**CHAPTER 12—THE ENVIRONMENT AND PERVIOUS CONCRETE, p. 46****CHAPTER 13—REFERENCES, p. 46**

- Author's documents, p. 47

**CHAPTER 1—INTRODUCTION AND SCOPE****1.1—Introduction**

The term “pervious concrete” typically refers to a hydraulic-cement concrete proportioned with sufficient, distributed, interconnected macroscopic voids that allow water to flow through the material under the action of gravity alone. The mixture often is composed of open-graded coarse aggregate, cementitious binder, little or no fine aggregate, admixtures, and water (Fig. 1.1a). The combination of these

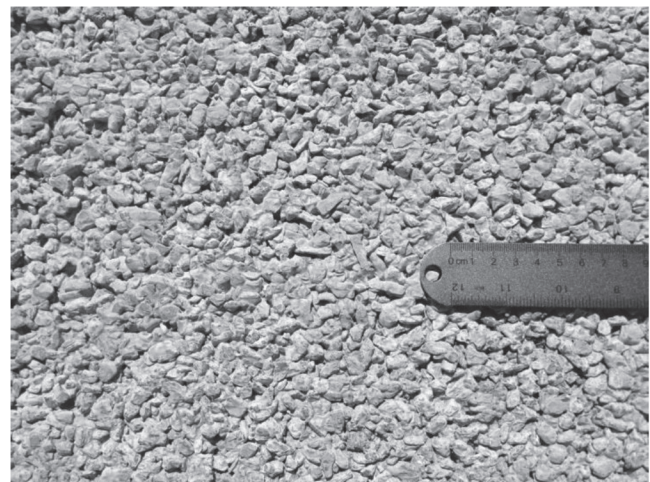


Fig 1.1a—Pervious concrete pavement (photo courtesy of M. Offenberger).



Fig 1.1b—Uniform porosity observed from a core sample (photo courtesy of J. Montgomery).

ingredients will produce a hardened material with voids (Fig. 1.1b), ranging in size from 0.08 to 0.32 in. (2 to 8 mm), that allow water to flow through easily. The void content can range from 15 to 35%. The infiltration rate of pervious concrete pavement will vary with aggregate size and porosity of the mixture but will generally fall into the range of 250 to 1700 in./h (0.17 to 1.20 cm/s).

## 1.2—Scope

The Environmental Protection Agency (EPA) recognizes that stormwater runoff is the single largest contributor to surface water impairment in the United States. Stormwater runoff also has the potential to pollute surface and groundwater supplies. Furthermore, as land is developed, stormwater runoff leaves the site in higher rates and volumes than predevelopment, leading to downstream flooding and bank erosion. Pervious concrete pavement reduces the impact of development by reducing the rate of or eliminating stormwater runoff and protecting water supplies. This report provides technical information on pervious concrete applications, design methods, materials, properties, mixture proportioning, construction methods, testing, and inspection.

## CHAPTER 2—NOTATION AND DEFINITIONS

### 2.1—Notation

$A_b$	=	area of the nonpervious area to be drained, ft <sup>2</sup> (m <sup>2</sup> )
$A_p$	=	area of the pervious pavement, ft <sup>2</sup> (m <sup>2</sup> )
$C$	=	runoff coefficient
$c$	=	cement content, lb (kg)

$D_a$	=	diameter between coarse aggregate particles
$D_c$	=	diameter between coarse aggregate particles coated with cement paste or mortar
$d_1$	=	thickness of the pavement, ft (m)
$d_2$	=	thickness of the subgrade, ft (m)
$f'_c$	=	specified compressive strength of concrete, psi (MPa)
$f_r$	=	modulus of rupture of concrete, psi (MPa)
$t$	=	time, s
$h_1$	=	initial head, in. (mm)
$h_2$	=	final head, in. (mm)
$h_c$	=	thickness of the pervious concrete layer, ft (m)
$h_{curb}$	=	height of curb to hold ponded water, ft (m)
$h_s$	=	thickness of the subbase or reservoir layer, ft (m)
$I$	=	rainfall intensity, ft (m)
$k$	=	permeability, in./s (mm/s)
$p_1$	=	percentage of void space in the pavement
$p_2$	=	percentage of void space in the subgrade
$R$	=	pressure reflection coefficient
$r_c$	=	porosity of the pervious concrete layer, %
$r_s$	=	porosity of the subbase or reservoir layer, %
$V$	=	total volume of water to be drained, ft <sup>3</sup> (m <sup>3</sup> )
$V_p$	=	available storage in pavement, ft <sup>3</sup> (m <sup>3</sup> )
$V_r$	=	required storage volume, ft <sup>3</sup> (m <sup>3</sup> )
$V_s$	=	available storage in subgrade, ft <sup>3</sup> (m <sup>3</sup> )
$w$	=	water content, lb (kg)

### 2.2—Definitions

ACI provides a comprehensive list of acceptable definitions through an online resource, ACI Concrete Terminology. Definitions provided herein complement that resource.

**exfiltration rate**—the design or measure rate at which water exits the pervious concrete system.

**hydraulic conductivity**—the ease of which fluids pass through concrete as a function of fluid density and viscosity and degree of saturation, also known as the coefficient of permeability when referring to water under saturated conditions.

**impervious area**—an area covered by a material that prevents precipitation from infiltrating soils and recharging groundwater supplies.

**infiltration rate**—the design or measured rate at which water enters the pervious concrete surface.

**percolation rate**—the rate, usually expressed as inches (millimeters) per hour or inches (millimeters) per day, at which water moves through pervious concrete.

**permeability**—the ability of pervious concrete to allow fluids (typically water) to pass through as a function of sample volume, fluid head, and fluid viscosity.

**pervious concrete**—hydraulic cement concrete proportioned with sufficient, distributed, interconnected macroscopic voids that allow water to flow through the material under the action of gravity alone.

**pervious pavement**—a pavement comprising material with sufficient continuous voids to allow water to pass from the surface to the underlying layers.