

IN-LB

Inch-Pound Units

SI

International System of Units

Pervious Concrete—Report

Reported by ACI Committee 522

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Pervious Concrete—Report

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Pervious Concrete—Report

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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 0.08 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/ft² (81 to 730 L/min/m²). 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.

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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 density 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 ² (m ²)
A_p	=	area of the pervious pavement, ft ² (m ²)
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 for the subbase or reservoir layer, %
V	=	total volume of water to be drained, ft ³ (m ³)
V_p	=	available storage in pavement, ft ³ (m ³)
V_r	=	required storage volume, ft ³ (m ³)
V_s	=	available storage in subgrade, ft ³ (m ³)
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.