

TB-0111 — Pervious Concrete Mix Proportioning Technical Bulletin

/ concrete / mix design

Pervious concrete is a high porosity concrete used for outdoor flatwork that allows water to pass through it. It is a low water/cement ratio, low-slump mix consisting of cement, narrowly graded coarse aggregate, little or no fine aggregate, water and admixtures. It is held together by cementitious paste at the coarse aggregate contact points since there is limited paste and fine aggregate to fill the voids between the coarse aggregate.

The actual mix proportions for pervious concrete varies depending on the application, mechanical properties required and materials used. Concrete producers should develop the mix proportions based on the project specifications. The table below provides some material ranges as well as more typical use.

The amount of cementitious material used per volume of pervious concrete varies, however a good starting point is about 600 lbs/yd³ (355 kg/m³). Water drainage rates (permeability or percolation) range from 2 to 18 gal/min/ft² (100 to 900 L/min/m²) of surface. As the void content increases, the water drainage rate through the concrete also increases.

If more strength is needed, a small amount of fine aggregate could be added to the mix, but this will reduce the void content and its permeability. Typical compressive strength ranges between 500 to 4,000 psi (3.5 to 28 MPa), although 2,500 psi (17 MPa) is common. Slump is usually less than 3/4 in. (20 mm). Chemical admixtures are used to affect the water/cementitious ratio, influence workability and setting times, and enhance mechanical properties and durability.

Standard methods for concrete mix proportioning and testing are employed. However air content tests are not applicable and slump testing provides limited information. Rather than air content test, a typical test method and acceptance criteria is unit weight (fresh density) as measured by ASTM C29, which also measures the void content. A more applicable test for consistency is a hand-squeeze test (see the next paragraph below).

Water

The amount of water used in a mix is critical. Too much water and the mix will segregate, too little water will lead to balling in the mixer and slow unloading times. The correct amount of water will impart a wet metallic appearance or sheen. Squeezing and releasing a handful of the mix should result in a mix that neither crumbles (too dry) or lose its structure as paste flows away from the aggregates (too wet). Too little water can also hinder curing of the concrete and could lead to premature raveling of the surface.

Admixtures

Retarders are often used to control the normal rapid setting of pervious concrete. RECOVER® is often the admixture of choice for pervious concrete. It is used to increase workability, allow concrete to easily move out of the mixer, and control the setting time so the mix may be placed correctly. The dosage rate of RECOVER® is often in the 3 to 6 oz/100 lbs (200 to 400 mL/100 kg) of cementitious material. Polycarboxylate high range water reducers (such as ADVA®) may be used to drive the water/cementitious ratio down to low levels in order to increase strength. Viscosity Modifying Admixtures (V-MAR®3) may also be used to hold the harsher, dryer mixes together. Air-Entraining Agents should be used where freeze-thaw damage is a concern.

	PROPORTION RANGE LBS/YD ³ (KG/M ³)	TYPICAL PROPORTIONS LBS/YD ³ (KG/M ³)
Cementitious material	450 to 700 (270 to 415)	550 to 675 (325 to 400)
Water/cementitious ratio	0.20 to 0.45	0.27 to 0.30
Coarse aggregate	2000 to 2700 (1190 to 1600)	2400 to 2600 (1400 to 1550)
Void content	15% to 35%	20% to 30%

Pervious concrete mix proportion examples used in various geographic areas:

PARKING LOT	FLORIDA	MASSACHUSETTS	COLORADO	ARIZONA	MARYLAND
Cementitious material	600 lbs/yd ³ (355 kg/m ³)	620 lbs/yd ³ (370 kg/m ³)	611 lbs/yd ³ (360 kg/m ³)	691 lbs/yd ³ (410 kg/m ³)	550 lbs/yd ³ (325 kg/m ³)
Water	125 to 150 lbs/yd ³ (75 to 90 kg/m ³)	174 lbs/yd ³ (105 kg/m ³)	135 lbs/yd ³ (80 kg/m ³)	210 lbs/yd ³ (125 kg/m ³)	190 lbs/yd ³ (112 kg/m ³)
Water/cementitious	0.21 to 0.25	0.28	0.22	0.30	0.35
Coarse aggregate	2600 lbs/yd ³ (38 in. to 332 in.) [1540 kg/m ³ (9.5 to 1.18 mm)]	2700 lbs/yd ³ [1600 kg/m ³]	2030 lbs/yd ³ (38 in.) [1200 kg/m ³ (9.5 mm)]	2600 lbs/yd ³ (12 in.) [1540 kg/m ³ (12.5 mm)]	2180 lbs/yd ³ (38 in.) [1290 kg/m ³ (9.5 mm)]
Void content	22% to 25%	18%	35%	15%	21%
RECOVER®	4 to 6 oz/cwt (260 to 400 mL/100 kg)	6.5 oz/cwt (425 mL/100 kg)	3 oz/cwt (195 mL/100 kg)	3.8 oz/cwt (250 mL/100 kg)	6 oz/cwt (400 mL/100 kg)
ADVA®			190 6 oz/cwt (400 mL/100 kg)		3 oz/cwt (195 mL/100 kg)
DARACEM® 55				5.7 oz/cwt (370 mL/100 kg)	
V-MAR® 3		3.2 oz/cwt (210 mL/100 kg)			4 oz/cwt (260 mL/100 kg)

DAREX® II/AT-30	3.5 oz/cwt	3.5 oz/cwt
AEA	(230 mL/100 kg)	(230 mL/100 kg)

Information for this Technical Bulletin on pervious concrete is based on field experience, and was obtained from ACI 522R-06 Pervious Concrete, Design and Control of Concrete Mixtures 2002 by PCA, Pervious Concrete Pavements 2004 by PCA and NRMCA Concrete in Practice CIP 38 Pervious Concrete 2004. For more detailed information please see these publications.

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