

PERMEABLE ARTICULATING CONCRETE BLOCK (P-ACB) SPECIFICATION FOR PARKING LOTS, DRIVEWAYS, ALLEYS AND ROADWAYS

PART 1: GENERAL

A. Definitions

Contract Documents – the Contract Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR’s Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, the General conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders, and ENGINEER’s written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop Drawings and the reports of subsurface and physical conditions are not Contract Documents. Only printed hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format, of text, data, graphics, and the like that may be furnished by OWNER to CONTRACTOR are not Contract Documents.

CONTRACTOR – The individual or entity with whom OWNER has entered into the Agreement.

Drawings – That part of the Contract Documents prepared or approved by the ENGINEER which graphically shows the scope, extent, and character of the Work to be performed by the CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

ENGINEER- The individual or entity named as such in the Agreement.

OWNER – The individual, entity, public body, or authority with whom the CONTRACTOR has entered into the Agreement and for whom the Work is to be performed.

Project – The total construction of which the Work to be performed under the Contract Documents may be the whole, or part as may be indicated elsewhere in the Contract Documents.

Resident Project Representative – The authorized representative of the ENGINEER who may be assigned to the Site or any part thereof.

Samples – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portions of the Work will be judged.

Shop Drawings – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled for the CONTRACTOR and submitted by the CONTRACTOR to illustrate some portion of the Work.

Site – Lands or areas indicated in the Contract Documents as being furnished by the OWNER upon which the Work is to be performed, including the rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of the CONTRACTOR.

Specifications – That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship applied to the Work and certain administrative details applicable there to.

Subcontractor – An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

Supplier – A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by the CONTRACTOR or Subcontractor.

Work- The entire completed construction of the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services and documentation necessary to produce such construction and furnishing, installing, and incorporating all materials and equipment into such construction, as required by the Contract Documents.

B. Samples

A Natural Gray full-sized P-ACB can be supplied upon request. Alternate color samples can be supplied in 4" x 4" coupons.

A minimum of 3 lbs. samples of proposed subbase and/or base aggregate materials must be supplied to the engineer of record for approval in accordance with Aggregate Subbase listed in Part 3 below.

C. Scope of Work

The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required and perform all operations in connection with the installation of the Permeable Articulating Concrete Block (P-ACB) in accordance with the lines, grades, design and dimensions shown on the Contract Drawings and as specified herein.

D. Submittal

The CONTRACTOR shall submit to the engineer all manufacturer's performance research results and calculations in support of the permeable articulating concrete blocks P-ACB system and geotextile proposed for use.

The CONTRACTOR shall furnish to the engineer all manufacturer's specifications, literature, and installation drawings of the P-ACB.

E. Preconstruction Conference

Within 2 weeks prior to the installation of the P-ACB, a conference attended by CONTRACTOR, ENGINEER, Supplier, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

PART 2: PRODUCTS

A. GENERAL

Permeable Articulating Concrete Blocks (P-ACB) shall be premanufactured of individual concrete blocks with specific stormwater runoff and storage capacities. Blocks shall be hand-placed or mechanically installed with the use of a clamping or suction lifting device.

Individual blocks in the P-ACB shall be staggered, beveled, and interlocked for enhanced stability. The blocks shall be constructed of closed cell blocks with an arched storage chamber for additional stormwater runoff as shown on the contract drawings. Each row of blocks shall be laterally offset by one-half block width from the adjacent row so that any given block is interlocked to four other blocks (two in the row above and two in the row below). Six adjacent blocks shall also surround each block.

Each block shall incorporate interlocking surfaces that prevent lateral displacement of the blocks. The interlocking surfaces shall not protrude beyond the perimeter of the blocks to such an extent that they reduce the flexibility or articulating capability of the system. Backfilling of the joints between the P-ACB with rock chips or sand is not required and shall not be done or included in the Work.

Infiltration Performance: The P-ACB will only be accepted when accompanied by documented third party infiltration performance characteristics based on ASTM C1701/C1701M-09, or C1781. The infiltration rate shall be no less than 1,000 inches per hour on an outdoor working surface, with typical base material utilized for the test.

Structural Performance: The design of the P-ACB shall be capable of supporting AASHTO H-25 and HS-25 truck loading. The blocks shall be analyzed as unreinforced concrete arches supporting a uniform truck tire load with impact per AASHTO standards. The subgrade soil, geosynthetic and base preparation for the P-ACB shall be properly designed by a Registered Professional Engineer and inspected by the ENGINEER or the Resident Project Representative during and following the installation of the Work.

B. Cellular Concrete Blocks

Materials

Cementitious Materials - Materials shall conform to the following applicable ASTM specifications:

Portland Cements - Specification C 150, for Portland Cement.

Blended Cements - Specification C 595, for Blended Hydraulic Cements.

Hydrated Lime Types - Specification C 207, for Hydrated Lime Types.

Pozzolans - Specifications C 618, for Fly Ash and Raw or Calcinated Natural Pozzolans for use in Portland Cement Concrete.

Aggregates shall conform to the following ASTM specifications.

Normal Weight - Specification C 33, for Concrete Aggregates.

Visual Inspection

All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection. Cracks exceeding 0.25 inches in width and/or 1.0 inch in depth shall be deemed grounds for rejection.

Physical Requirements

At the time of delivery to the work site, the units shall conform to the physical requirements prescribed in Table 1, Physical Characteristics.

TABLE 1: PHYSICAL CHARACTERISTICS

Item	Description	Values
Dimensions	Length x Width x Height	12" x 12" x 5.65" (+/- 1/8")
Compressive Strength	ASTM D-6684 / C-140	Avg. of Three: 4,000 psi min. Individual units: 3,500 psi min.
Block Weight		Arched Block: 45-50 lbs/sf Solid Block: 55-60 lbs/sf
Loading Capabilities	Truck Load Traffic Rating	AASHTO H-20, HS-20, HS-25
Joint Filler Between Blocks	Material Used	NONE Required
Percent Open Space		Surface: 7% Storage: 20%
Water Absorption (%) Density (lbs/cf)	ASTM D-6684 Table 1 / ASTM C-140	9.1% Avg. of Three, 11.7% Individual 130 Avg of Three, 125 Individual
Storage Capacity	Above Aggregate Within Arch	0.0833 cf/block
Post-Installation, Verified Surface Infiltration Rate	ASTM C1701/C1701M-09 ASTM C1781	Ave of three tests: 1,000 inches/hour/sf (MIN. 3 tests)

Sampling and Testing

The OWNER, ENGINEER or their authorized representative shall be accorded proper access to the manufacturer to inspect and obtain samples of the Permeable Articulating Concrete Blocks at the place of manufacture from lots ready for delivery.

Expense of Tests

Additional testing and associated costs, other than that provided by the manufacturer, shall be borne by the OWNER.

Manufacturer

The Permeable Articulating Concrete Blocks shall be PaveDrain® or pre-approved equal, as represented or distributed by:

LOCALLY

Bowman Construction

Supply-Denver

(303)696-8960

Bowman Construction

Supply-Longmont

(970)535-0863

Bowman Construction

Supply-Colorado Springs

(720)390-0203

NATIONAL

PaveDrain, LLC

PH. (888) 575-5339

info@pavedrain.com

www.pavedrain.com

"Or-Equal" Items: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. A proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

PART 3: FOUNDATION PREPARATION AND BLOCK INSTALLATION

A. Foundation and Preparation

General. Areas on which permeable articulating concrete blocks are to be placed shall be constructed to the lines and grades shown on the Drawings and to the tolerances specified in the Contract Documents. Any proposed changes shall be reviewed and approved by the ENGINEER.

References. *Insert the state specifications.* (Example; State Specifications: Standard Specifications for Highway and Structure Construction, State of "TBD" Department of Transportation.)

Subgrade. Unless required on the Drawings, compaction of underlying subgrade soil shall be avoided or minimized in order to encourage infiltration of stormwater. A Geotechnical Engineer should be consulted to determine the CBR values of the subgrade prior to the installation of the subbase materials and geotextile stabilizing fabrics and grids.

Geotextile Separator or Geogrid Stabilization. Monofilament or multifilament geotextile, that include Mirafi RS380i or its equivalent, or other geotextile material as shown on the Drawings shall be installed on the bottom and sides of the excavation to prevent in – situ soil contamination of the clean aggregate subbase. A geogrid may be required for sub base stabilization, but is not recommended on the sides of the aggregate sub base to separate the in-situ soils from the clean sub base aggregate.

Aggregate Subbase. If more than 6” of base aggregate is required, as shown on the Drawings, only the top 4-6” shall be AASHTO #57 aggregate; this is the leveling course directly beneath the P-ACB blocks. Additional aggregate depth shall consist of either AASHTO #2 or #3 or as shown on Drawings. All aggregate shall be clean, angular on all sides with no less than 90% fractured faces. Do not use rounded river gravel or fractured river gravel for any application.

ASTM No. 57 Base
Grading Requirements

<u>Sieve Size</u>	<u>Percent Passing</u>
37.5 mm (1 1/2 in.)	100
25 mm (1 in.)	95 to 100
12.5 mm (1/2 in.)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

ASTM No. 2 Subbase
Grading Requirements

<u>Sieve Size</u>	<u>Percent Passing</u>
75 mm (3 in.)	100
63 mm (2 1/2 in.)	90 to 100
50 mm (2 in.)	35 to 70
37.5 mm (1 1/2 in.)	0 to 15
19 mm (3/4 in.)	0 to 5

Crushed Aggregate Base Course: Follow State Specifications

Compaction: Standard compaction.

95 percent maximum density determined by Modified Proctor.

Allow ENGINEER to inspect prepared base course and to witness proof roll test by a fully loaded dump truck. Reconstruct where deflection is greater than ½ inch.

Allowable deviation from design grade: ½ inch.

The base course shall be firm and non-yielding, compacted until it does not creep or weave in front of the roller or compacting vehicle.

The aggregate bedding layer shall be compacted to a smooth plane surface to ensure intimate and positive contact is achieved between the legs of the permeable articulating concrete blocks and the compacted aggregate subbase layer and the Geogrid Separator.

AASHTO #2 or #3 subbase aggregate shall be compacted in 6-8" lifts with a roller-compactor. The AASHTO #57 aggregate leveling subbase shall be rolled and then compacted with a minimum 10,000 psi plate compactor in both the perpendicular and parallel directions in the area of coverage. The CONTRACTOR shall compact a 2" layer of the AASHTO #57 Aggregate into AASHTO #2 or #3 aggregate.

Geogrid Separator. Install Miragrid BXG110, Tensar BX-1100, (or equal) geogrid separator shall be directly on top of the compacted leveling course. The geogrid separator may be installed prior to the compaction of the leveling course. This will create a "snow shoe" effect and minimize damage from foot traffic prior to placement of the P-ACB.

Inspection. Immediately prior to placing the P-ACB the prepared area shall be inspected by the ENGINEER or Resident Project Representative, the OWNER's representative, and or by the manufacturer's representative. No blocks shall be placed thereon until that area has been approved by the ENGINEER.

B. Placement of Permeable Articulating Concrete Blocks

General. Permeable articulating concrete blocks shall be constructed within the specified lines and grades shown on the Drawings.

Placement. The P-ACB shall be placed on the geogrid separator so as to produce a smooth plane surface. No individual block within the plane of placed articulating concrete mats shall protrude more than one-quarter of an inch unless otherwise specified by the ENGINEER.

Consultation. The Supplier will provide design and construction advice during the design and installation phases of the project. The Supplier will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.

Finishing. The joints between the P-ACB shall not be backfilled with smaller aggregates or sand in order to function properly. The joints shall be left open. This includes following maintenance of the P-ACB. If the joints are filled with smaller aggregates or sand, the CONTRACTOR shall be responsible for the removal of the material and perform infiltration tests to assure that the P-ACB meets the minimum infiltration tests described in this specification.

Post Installation Certification. Upon completion of the P-ACB installation, the surface infiltration rate of the pavement shall be verified by ASTM C1701M-09 or ASTM C1781 to confirm the required infiltration rate of the pavement (per Table 1). If the system fails to perform as required in section Table 1 of this spec, it shall be removed and replaced at the supplier's cost.

C. Maintenance of Permeable Articulating Concrete Blocks

General. The maintainability of the permeable articulating concrete blocks shall be based on a maintenance study of at least 24 months conducted by an independent or third party representation.

- The study shall include multiple pre and post testing documentations in multiple locations of infiltration rates according to ASTM C1701 or a modified version of ASTM C1701 where the infiltration rate is recorded without a head pressure.
- Subsurface aggregate performance of pre and post testing shall also be documented over a 24 month period.
- The study shall show that following proper maintenance the original performance of the P-ACB can effectively be restored to at least 90% of its original performance.

Inspection & Maintenance. The manufacturer's representative of the P-ACB shall provide a minimum 36 month maintenance program; including a visual inspection report with photos and a recommended cleaning schedule with a Vacuum truck such as the Elgin® Whirlwind® or Megawind® or with the PaveDrain® Vac Head and associated combination sanitation vac truck. The visual inspection and recommended cleaning schedule shall be included with the price of the system.

Maintenance utilizing a combination sanitation vacuum truck with the PaveDrain vac head will be quoted and supplied by others based on the maintenance program.

Maintenance shall be required when either of the following are reached:

- a. The surface infiltration rates of more than 75% of the surface area fall below 10% of the rate required in Table 1.
- b. Surface ponding remains for 24 hours in an area larger than 10 square feet.