

# Enviro-Crete, Inc.

## Standard Specifications for Pervious Concrete



Pervious Concrete creates viable solutions for the storm water management and water quality standards that are readily becoming the norm for new and existing land development. This specification is presented as a recommended guide for horizontal applications implementing storm water management, ground water recharge, new water harvesting or a wear surface.

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Pervious Concrete Pavement

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sub-grade preparation
2. Installation of Portland Cement Pervious Pavement structures.

A. Related Sections:

- 1 Section 02050 – Soils
- 2 Section 02060 – Aggregate
- 3 Section 02230 - Site Clearing
- 4 Section 02311 – Rough Grading
- 5 Section 02315 – Excavation & Fill
- 6 Section 02374 – Erosion Control Devices
- 7 Section 02321 – Aggregate Base Course

## 1.2 REFERENCES

A. Annual Book of ASTM Standards, American Society for Testing and Materials (ASTM) Standards, Material References:

1. ASTM C 29 "Test for Unit Weight and Voids in Aggregate."
2. ASTM C 33 "Specification for Concrete Aggregates."
3. ASTM C 42 "Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete"
4. ASTM C 117 "Test Method for Material Finer than 75 mm (No. 200) Sieve in Mineral Aggregates by Washing."
5. ASTM C 138 "Test Method for Unit Weight, Yield, and Air Content (Gravimetric ) of Concrete."
6. ASTM C 150 "Specifications for Portland Cement" (Types I or II only).
7. ASTM C 172 "Practice for Sampling Fresh Concrete."
8. ASTM C 494 "Specification for Chemical Admixtures for Concrete."
9. ASTM C 618 "Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete."
10. ASTM C 989 "Specification for Ground Granulated Blast-Furnace Slag for use in Concrete and Mortars."
11. ASTM C 1077 "Practice for Laboratories Testing Concrete and concrete Aggregates for use in Construction and Criteria Laboratory Evaluation."
12. ASTM D 698 "Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5 Pound Rammer and 12-inch Drop."
13. ASTM E 329 "Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as used in Construction."
14. ASTM D1188 "Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples".

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SECTION 02755

1.3 SUBMITTALS

- A. Submit the following information in accordance with submittal procedures noted under provisions of Section 01330.
  - 1. Concrete mix components
  - 2. The supplier(s) from which the pervious concrete pavement materials are to be obtained, along with certificates, signed by the materials producer, stating that the materials meet or exceed the specified requirements.
  - 3. Repair, removal and replacement procedures to correct any work that does not meet criteria for pervious concrete pavement.
  - 4. Certification of the Installing Contractors qualifications as specified in Paragraph 1.5 of this Section
  - 5. Test results of all the test panels for review of workmanship and determination of Job Mix Formula (JMF).
  - 6. Test results for pervious pavement installations in accordance with this section.

1.4 NOTIFICATIONS

- A. Schedule and attend a pre-construction meeting with the Owner's Representative at least two weeks prior to the initiation of pervious concrete paving work, including subgrade preparation. Topics should include, but not limited to expectations and limitations.

1.5 QULAIFICATIONS

- A. The Pervious Portland Cement Concrete Installation Contractor shall meet, at the time of Bid Opening, one of the following criteria:
  - 1. The crew shall employ no less than one (1) NRMCA Certified Pervious Concrete Craftsman who must be onsite, overseeing each placement crew during all Pervious Concrete placement.
  - 2. The crew shall employ no less than three (3) NRMCA Certified Pervious Concrete Installers who must be onsite, working as members of the placement crew during all Pervious Concrete placement.
  - 3. The crew shall employ no less than three (3) NRMCA Certified Pervious Concrete Technicians and one (1) Pervious Concrete Installer, who shall be onsite, overseeing each placement crew during all Pervious Concrete placement.
  - 4. Submit with the original bid documents verification of current NRMCA certification requirements noted above.
- B. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.
- C. Submit with the original bid documents evidence of a minimum of 100,000 sf successful Pervious Concrete Pavement projects, the contact information and addresses for five of those jobs.
- D. Pour PPCC test panels in an isolated location designated by the Owner's representative. If the test panel is to be constructed in an area of permanent placement, the test panel must be protected throughout construction and meet the specifications noted in this Section. Remove and dispose of offsite, non-conforming test panel(s). Multiple test panel(s) will be required until the test for each pavement section meets the project specifications noted.
- E. Determine the placing equipment to be used for the "mock-up" placement for test panel(s) for the project.
- F. Submit jointing plan layout.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Pervious Portland Cement Concrete (PPCC) mix design criteria will meet the following requirements:
1. Cement: use Portland Cement type II conforming to ASTM C 150 or Portland Cement Type IP or ISM conforming to ASTM C 595. The cementous content, including pozzolans if used, shall be no less than 654 lbs per cubic yard, calculated as Portland cement.
  2. Aggregates: use crushed gravel, stone meeting No. 8 coarse aggregate (3/8 to No. 16) per ASTM C33. If other gradation of aggregates is to be used, submit data and test results (including in place test results) on the proposed material to the Owner's Representative for approval. Clean, Washed local materials should be used. Alterations to this gradation must be reviewed and approved by the owners representative.
  3. Addmixtures consist of:
    - a. Type D Water Reducing / Retarding – ASTM C 494
    - b. A hydration stabilizer that also meets the requirements of ASTM C 494 Type B Retarding or Type D Water Reducing / Retarding admixtures.
  4. Potable water added as necessary such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. Water cement ratios can range from 0.27 to 0.35.
  5. Verify the volume of aggregate, cement, water, and admixture per cubic yard is equal to 27 cubic feet, when calculated as a function of the unit weight determined in accordance with ASTM C 29 jigging procedure. Included in the total aggregate volume fine aggregate, if used, should not exceed three cubic feet. Use admixtures in accordance with the manufacturer's instructions and recommendations.
  6. The mix shall be designed and installed to have a total void content greater than 15 percent and less than 30 percent, in place, as constructed. Void content of the mix shall be determined from four (4) inch diameter cores from the finished Test Section using the following method:
    - a. Measure length of course for compacted thickness.
    - b. Trim the core to 4" from the top finish surface for the pedestrian pavement sections and 6" from the top finish for the vehicular pavement sections.
    - c. Determine the bulk specific gravity (Gb) of the core using the method described in ASTM D 1188.
    - d. Dry the core at a temperature not to exceed 65 C (150 F) until a constant mass (+/-0.1%) is obtained and allow to cool to ambient temperature.
    - e. Weigh the core and record the weight to the nearest 0.1g.

f. Use apparatus as described in ASTM D 2041.  
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- g. Place core in calibrated pycnometer and fasten it on a mechanical agitation device.
- h. Turn on the agitation device and slowly apply a vacuum to the pycnometer until the vacuum reaches 3.7+/-0.3kPa (27.5 +/-2.5 mm Hg). The vacuum should be reached in less than 2 minutes.
- i. After the vacuum is achieved, maintain vacuum and agitation for a period of 15 +/- 2 minutes.
- j. Slowly release the vacuum and determine the weight of the sample and pycnometer as described in paragraph 9.5.1 or paragraph 9.5.2 in ASTM 2041, as appropriate.
- k. If multiple procedures are run for separate pieces of the core, the average of all the runs will be the specific gravity (Gmm) of the core as a whole.
- l. The percentage of air voids will be calculated as:

$$\text{Voids} = \frac{\text{Gmm} - \text{Gb}}{\text{Gmm}} \times 100\%$$

Where:

V= Voids in the Sample (%)

Gmm= Specific Gravity of the Core Material Less Air Voids

Gb = Bulk Specific Gravity of the Core as determined by ASTM D 1188

7. Field infiltration rate: minimum of 100 inches per hour. See Part 3 for field infiltration test procedures.

B. Pervious Portland Cement Concrete (PPCC) mix design criteria will meet the following requirements:

- 1. Aggregate Discharge Subbase shall be ¾"-inch to 1"-inch washed, uniformly graded coarse aggregate or approved equivalent, with less than 0.8% passing the No. 200 sieve.

C. PPCC Geotextile: use Marafi 140N or an approved equivalent product.

D. Forms:

- 1. Made of steel, wood, or other material, provided the forms as constructed result in a pavement of specified thickness, cross section, grade and alignment as shown on the Drawings.
- 2. Clean and free of dirt, rust, debris and hardened concrete.
- 3. Sufficient strength and stability and be adequately supported to prevent deflection or movement and result in concrete pavement conforming to the requirements specified.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Verify installation conditions as satisfactory to receive work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

### 3.2 PREPERATION

- A. Verify existing dimensions and shapes. Allow for transitions to existing grades where applicable.
- B. Weather is to be considered. Do not place PPCC when ambient temperature is 40 degrees Fahrenheit or lower, or when ambient temperature is 80 degrees Fahrenheit or higher without an acceptable procedure or chemical additives are approved by the Project Engineer and the Owner's representative. Do not place PPCC when there is a 20% or greater chance of precipitation.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

### 3.3 INSTALLATION

- A. Test Panel: Install a Pervious Portland Concrete Cement Pavement Test Panel (test section) for the designed pavement section. The cost of said test panels shall be included in the overall cost of this scope of Work.
  - 1. Install a minimum 225 square foot complete Test Section of PPCC before proceeding with the rest of this Work. The width of the test section shall have a width no smaller than the greatest width to be used during the construction and installation of the PPCC onsite. Include the time to complete this work in the construction schedule.
  - 2. Notify the Owner's representative at least 10 working days before installing any test sections.
  - 3. Coordinate the location of the test section(s) with the Owner's representative.
  - 4. Install the test section(s) to the thickness specified on Drawings and demonstrate compliance with performance requirements in this Section.
  - 5. Notify the Owner's representative when the test section is ready for review.
  - 6. Remove, replace, and dispose of unsatisfactory portions of test section(s) as directed by the Owner's representative and at no additional cost to the Owner.

7. Contractor shall not proceed with non-test sections of the work until achieving a complete test section that fully complies with the specifications in accordance with this section and as follows:
  - a. Take three (3) cores from each test section after seven days of curing.
  - b. Compacted thickness shall be no less than  $\frac{1}{4}$ " of specified thickness using ASTM C 42.
  - c. Void Structure: conform to specifications per Paragraph 2.1 of this Section.
  - d. Average weight of the cores as determined by ASTM D1188 shall be within eight (8) pounds per cubic foot of the average of the three (3) cores from each test section.
  - e. Uniform finish for appearance with less than 5% of the test section surface area sealed.
  - f. Field Infiltration Rate: conform to specifications per Paragraph 2.1 using the following procedure:
    1. Place 18-inch diameter (17.6-inch inside diameter) PVC pipe 2-foot long, on end, over the pervious pavement section. Seal the bottom of the PVC pipe with a temporary plumbing putty to prohibit water from leaking out the bottom sides of the PVC pipe onto adjacent pavement.
    2. Pour 4 gallons of potable water into the PVC cylinder.
    3. Start the stop watch when all 4 gallons is discharged into the cylinder. The depth of the water in the cylinder above the pavement at the start is 3.8 inches when using a 17.6 inside diameter cylinder.
    4. When the depth of the water in the PVC pipe reaches 0, stop the watch.
    5. Determine the infiltration rate by: (3.8 inches)/time.
    6. To achieve a minimum of 100 inches per hour, water must draw down to zero (0) within 136 seconds.
8. The completed and acceptable test section will be used to validate the pervious concrete mix design and establish the Job Mix Formula for each application.

B. JOB MIX FORMULA

1. Once the Test Section is approved by the Owner's Representative, the mix design of the successful Test Section shall become the Job Mix Formula (JMF) and shall not be modified in any way. The JMF shall be determined from information submitted as noted in Section 2.1 of this specification and from results of the Test Panel as described in 3.3 of this specification. The JMF shall include the following:
  - a. Batch weights of all constituents
  - b. Portland cement type and brand
  - c. Pozzolan type and source
  - d. Microfiber brand (if used)
  - e. Admixtures type and brands (if used)
  - f. Aggregate source and gradation
  - g. Fresh density of the pervious concrete
  - h. Unit weight of the hardened pervious concrete

C. PERVIOUS PAVEMENT SUBGRADE PREPERATION

1. Construct grade to the specified lines and grades with a uniform appearance and in accordance with the soils engineers instruction, criteria and specifications.
2. Protect any native subgrade to remain. Keep traffic off the prepared subgrade during construction to the maximum extent practical to reduce additional compaction. Final 12" subgrade testing to be done at the time for placement of the geotextile subgrade infiltration barrier.
3. Place geotextile fabric in accordance with the manufacturer's standards and recommendations.
4. Overlap the adjacent strips of geotextile fabric a minimum of 16 inches.
5. Secure geotextile fabric at least two (2) feet outside of bed limits.
6. Place and lightly compact aggregate discharge subbase to the grades indicated on the Drawings in six (6) inch maximum lifts, keeping equipment movement over the aggregate discharge subbase to a minimum.

7. Fold the geotextile fabric back along bed edges (including at the edge interface with vaults, boxes, structures within the pavement section) to protect from sediment washout along edges after placing the aggregate discharge subbase. Place an edge strip at least two (2) feet wide along the beds to protect beds from adjacent bare soils.
  - a. Keep edge strip in place until contiguous bare soils are stabilized and vegetated.
  - b. Implement TESC and flow diversion measures at the toe of slopes adjacent to beds to prevent sediment from washing into PPCC excavation.
  - c. Trim excess filter fabric along bed edges (and at interfaces with vaults and structures) to gravel edge after the site is fully stabilized.

D. PERVIOUS PAVEMENT INSTALLATION

1. Forms: Set, align and brace forms so that pavement will meet the requirements specified in this Section and as shown on the Drawings.
  - a. The edge of previously placed concrete may be used as a form.
2. Moisten the subbase prior to placement of the PPCC by thoroughly wetting the subbase with water from 2 to 4 hours before the concrete is to be placed and maintain moist condition until the concrete is placed.
3. Mix, pour and place Pervious Pavement Concrete:
  - a. Transport or mix Portland Cement concrete onsite and use within one hour of the introduction of mix water, unless otherwise approved in writing by the Owner's Representative.
    1. Increase the one-hour requirement to ninety (90) minutes when utilizing the hydration stabilizer specified in this Section, as long as the temperature of the concrete does not exceed 90 degrees Fahrenheit.
    2. Do not retemper concrete after water adjustments have been made to concrete delivered to the jobsite.
    3. Moisten the aggregate discharge subbase to a wet condition prior to placing concrete.
    4. Do not allow trucks used to transport the Pervious Portland Cement Concrete to have no more than three (3) consecutive loads of material without hauling conventional concrete or rinsing.
  - b. Inspect each mixer truck for load appearance of concrete conformity. Add water to obtain the required mix consistency (if necessary), as

determined by the QC Representative of the concrete supplier, provided the design water to cement ratio is not exceeded.

- c. Place Concrete:
  - 1. Deposit concrete as close to its final position as practical and such that fresh concrete enters the mass of previously placed concrete.
  - 2. Discharge continuously and complete as quickly as possible.
  - 3. Do not place concrete on frozen subgrade or subbase.
- d. Concrete shall be placed in a single lift.
- e. Compact with full width roller or other means and finish the pervious concrete pavement to the required cross section depth and finish grade. Ensure finish grade of pavement does not deviate more than +/- 1/4"-inch in 10-feet from profile grade. In areas of ADA, grades shall not exceed maximum slope and grades specified on Plans.
  - 1. Install joints at specified spacing as noted in this Section.
  - 2. Cover the pavement surface with a minimum six (6) millimeter thick polyethylene sheet. Prior to covering, spray on a "fog" or light mist above the surface when required due to ambient conditions (high temperatures, high wind, and low humidity). Overlap exposed edges and secure cover (without using dirt or stone) to prevent dislocation.
- 4. Joints:
  - a. Place transverse contraction joints at fifteen (15) feet on center maximum with depth of 1/4 the thickness of pavement.
  - b. The larger horizontal dimension of a slab panel shall not exceed 125% of the smaller dimension.
  - c. Install transverse construction joints whenever placing is suspended a sufficient length of time that concrete may begin to harden.
  - d. Do not use isolation (expansion) joints except when pavement is abutting nonporous slabs or other adjoining structures.
  - e. If joints are not installed at the time of placement, sawcut joints in at spacing specified in this Section after the pavement has properly cured.
    - 1. Implement measures to collect dust and sawcut slurry during sawcutting operations in order to avoid sealing of the pores.
  - f. Allow sections of PPCC to cure for seven (7) calendar days minimum before allowing foot traffic on completed sections.

4.4 QUALITY ASSURANCE

A. Submit for review and approval by Engineer prior to placement.

1. Submit certificates, signed by the materials producer and the paving subcontractor, stating that materials meet or exceed the specified requirements.

2. Submit samples of coarse aggregates and filter fabric for review and approval by Project Engineer, Certified Contractor/Finisher or an Owner's Representative.

3. The mixing plant shall submit a current mix design with aggregate, cement, water, and admixture proportions for approval. In addition the mixing plant shall submit any available past strength test data.

B. Permanent installed sections will be reviewed for the following:

1. Grade, line and slope

2. Field Infiltration Rate

a. Test not to be taken sooner than seven (7) calendar days from placement.

3. Thickness

4. Unit weight, or void structure.

5. Appearance

5. MAINTENANCE

1. There shall be a maintenance plan submitted to the Owner's representative to prevent the clogging of the pavement, which will include periodic testing for infiltration and the methods to restore infiltration if the flow rate drops below 100-inches per square foot as described in this Section.

2. Acceptable methods to restore levels of infiltration are to vacuum, then flush the pervious concrete pavement with high volume, low pressure wash, or to spray organic materials on to the pervious concrete pavement during the wet season of the year, prior to the excessively low temperatures.

3. Hydrocarbon / oil pan drippings maybe remediated by the use of such products as S-200 Oilgone from International Environmental Products, LLC. They are located at Two Villanova Center, Villanova, PA 19085. Enviro-Crete, Inc. has no affiliation with this LLC, and can not warrant the results.

END OF SECTION      EVSS-01 Rev A