

HIGH POINT PHASE II – ABATEMENT, DEMOLITION, GRADING AND INFRASTRUCTURE
SEATTLE, WASHINGTON
SECTION 32 13 43
POROUS PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes but is not limited to:
1. Porous cement concrete sidewalks.

1.2 REFERENCES

A. Reference Standards:

COS 2005	2005 City of Seattle Standard Specifications for Road, Bridge and Municipal Construction and 2005 City of Seattle Standard Plans
ASTM	American Society of Testing & Materials, current edition.
AASHTO	American Association of State Highway and Transportation Officials, current edition
ASTM C 29	"Test for Unit Weight and Voids in Aggregate"
ASTM C 33	"Specification for Concrete Aggregates."
ASTM C 42	"Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete"
ASTM C 117	"Test Method for Material Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing."
ASTM C 138	"Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete"
ASTM C 140	"Methods of Sampling and Testing Concrete Masonry Units"
ASTM C 150	"Specifications for Portland Cement" (Types I or II only).
ASTM C 172	"Practice for Sampling Fresh Concrete."
ASTM C 494	"Specification for Chemical Admixtures for Concrete"
ASTM C 1077	"Practice for Laboratories Testing Concrete and concrete Aggregates for use in Construction and Criteria Laboratory Evaluation"
ASTM, D 2434-68	"Standard test method for permeability of granular soils (Constant head)"
ASTM D-1188	"Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Parrafin Coated Samples"

1.3 SUBMITTALS

- A. Submit the following information in accordance with Section 01 33 00:
1. Concrete mix components
 2. Concrete supplier's instructions, criteria and requirements for installation of porous concrete pavement.
 3. The supplier(s) from which the porous concrete walk pavement materials are to be obtained, along with certificates, signed by the materials producer and the paving subcontractor, stating that materials meet or exceed the specified requirements.
 4. Repair, removal and replacement procedures to correct for work that does not meet criteria for porous concrete pavement.
 5. Certification of the Installers' qualifications as specified in Paragraph 1.5 of this Section.

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1.4 NOTIFICATIONS

- A. Notify Owner's Representative at least two working days prior to aggregate discharge subbase and porous paving work, including subgrade preparation. Hold a preconstruction meeting with the Owner's Representative at least one week prior to the initiation of porous paving work, including subgrade preparation.

1.5 QUALIFICATIONS

- A. Porous Portland Cement Concrete Pavement installer shall meet the following criteria:
1. Successful completion of the National Ready Mix Concrete Association (NRMCA) Pervious Concrete "Technician" Certification written exam and NRMCA "mock-up" performance exam:
 - a. A minimum of three crew members per sidewalk installation crew employed by the Contractor shall pass NRMCA Pervious Concrete "Technician" Certification written exam, including successful installation of the NRMCA "mock-up" performance exam placement.
 - b. Contractor shall submit documentation verifying successful completion of the written exam and mock-up required for NRMCA pervious "Technician" certification.
 - c. Dependent upon the size of the placement, a minimum of 3 crew members who have completed requirements noted above (in subparagraphs a and b) must be on site, working as members of each porous cement concrete sidewalk placement crew, during all porous cement concrete placements.
 - d. The porous cement concrete sidewalk test panel installed at the project site may be utilized as the "mock up" placement required for NRMCA "mock-up" performance exam. If the "mock up" placement installed for NRMCA certification does not meet the project specifications, the "mock up" placement shall be removed at the Contractor's expense and new porous cement concrete sidewalk test panel(s) shall be installed, tested and submitted for review.
 - e. NRMCA Pervious Concrete "Technician" course for the written exam and mock-up performance exam may be obtained by contacting the Washington Aggregates & Concrete Association, 22223 7th Avenue South, Des Moines, WA, (206) 878-1622. All fees associated with attending the NRMCA course and successfully passing the written exam and mock-up are at the Contractor's expense.
 2. Pour Porous Portland Cement Concrete Pavement Sidewalk Test Panel in isolated location designated by the Owner's Representative. The test panel will be located in an area not for permanent placement. The test panel shall meet the specifications noted in Paragraph 3.3 and 2.1 of this Section. Contractor shall remove and dispose of off-site, non-conforming test panel(s). Multiple test panel(s) will be required until the test panel meets the project specifications noted in Paragraph 3.3 and 2.1.
 3. The Contractor is responsible for the proper placing equipment to be used for the "mock up" placement for NRMCA exam, Porous Portland Cement Concrete Pavement Sidewalk Test Panel(s) and porous Portland cement concrete pavement sidewalk installations for the project.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Porous Portland Cement Concrete (PPCC): 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. Minimum cementitious material shall not be less than 564 lbs per cubic yard of mix.
 2. Aggregates: use crushed gravel, stone meeting No 8 coarse aggregate (3/8 to No. 16) per ASTM C 33 or No. 89 coarse aggregate (3/8 to No. 50) per ASTM D 448. If other gradation of aggregate is to be used, submit data on proposed material to Owner's Representative for approval.

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3. Admixtures 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.
 - c. ½ -inch microfiber at 1.5 pounds per cubic yard. Microfiber shall be Grace MicroFiber or an approved equivalent product.
 - d. 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.
 - e. Verify the volume of aggregate, cement, water, and admixture per cu. yd. is equal to 27 cu. ft., 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 3 cu. ft. Use admixtures in accordance with the manufacturer’s instructions and recommendations.
4. Voids: 15% minimum to 25% maximum voids. Void structure shall be measured per ASTM D-1188.
5. Field infiltration rate: minimum of 200 in/hr. Field infiltration test shall be conducted by SPU Inspector. For field infiltration test, SPU to place 17.6-inch diameter cylinder over pavement temporarily. Seal bottom edge of cylinder to pavement and then fill cylinder with four (4) gallons of water within two seconds, then measure rate at which water draws down and infiltrates into pavement.
6. Joints:
 - a. Transverse contraction joints shall be spaced at fifteen feet on center with depth of 1/4 the thickness of pavement.
 - b. Transverse construction joints shall be spaced at contraction joint interval.
 - c. Transverse construction joints shall be installed whenever placing is suspended a sufficient length of time that concrete may begin to harden.
 - d. Brush, toil or spray a bonding agent suitable for bonding fresh concrete to the existing pavement surface edge in order to assure aggregate bond at construction joints.
 - e. Do not use isolation (expansion) joints except when pavement is abutting nonporous slabs or other adjoining structures.

B. Aggregate Discharge Subbase: use 3/8-inch to ¾-inch washed uniformly graded coarse crushed aggregate that meets AASHTO size number 57 grading per Table 4, AASHTO Specifications, Part I, 13th Ed., 1982 (p. 47) or COS 2005 Section 9-03.16 washed Mineral Aggregate Type 24 modified as follows:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
½"	100
¼"	50-90
US No. 10	0 – 10
US No. 40	0 – 5
US No. 200	0 – 0.8

C. PPCC Sidewalk Geotextile: use Mirafi 180N or an approved equivalent product.

D. Forms:

1. Forms shall be made of steel or wood or other material at the option of the Contractor, provided the forms as constructed result in a pavement of specified thickness, cross section, grade and alignment as shown on the Drawings.
2. Forms shall be clean and free of dirt, rust, debris and hardened concrete.
3. Forms shall be of sufficient strength and stability and be adequately supported to prevent deflection or movement and result in concrete pavement conforming with the requirements specified.

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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.
- B. See City Checklist in Section 01 41 50 for installation criteria and additional specifications.

3.2 PREPARATION

- A. Verify existing dimensions and shapes. Allow for transitions to existing grades where applicable.
- B. Prepare subgrade in accordance with COS 2005 Section 2-06 and Section 31 00 00. Compact subgrade to 92%, per Section 31 00 00, except scarify top 1/4" surface so subgrade is not sealed.
- C. Do not place Porous Portland Cement Concrete Pavement when ambient temperature is 40 degrees Fahrenheit or lower or when ambient temperature is 80 degrees Fahrenheit or higher.

3.3 INSTALLATION

- A. Obtain porous concrete pavement installation instructions, criteria and requirements from the manufacturer.
- B. Porous Pavement Sidewalk Test Panel:
 - 1. Install a 225 square foot (at five feet wide) complete PPCC sidewalk section of porous concrete before proceeding with the rest of this Work. Include the time to complete this work in the construction schedule.
 - a. Notify the Owner's Representative and SPU Inspector at least 10 working days before installing porous pavement sidewalk test panel(s) (test section).
 - b. Coordinate the location of the test section with the Owner's Representative.
 - c. Install the test section in accordance with the manufacturer's instructions, criteria and requirements, to the thickness specified on the drawings and demonstrate compliance with performance requirements noted in this Section.
 - d. Notify the Owner's Representative when test section is ready for review.
 - e. Remove, replace, and dispose of any unsatisfactory portions of test section(s) as directed by the Owner's Representative and at no additional cost to the Owner.
 - f. Failure to install acceptable test sections of porous concrete will indicate an unqualified installer.
 - g. Do not proceed with the non-test sections of this Work until achieving a complete test section that fully complies with the specifications and written approval issued by the City of Seattle. Proceeding with the non-test section Work without satisfactory completion of the test section will constitute non-compliance and subject to nonpayment.
 - h. Verify satisfactory performance of the porous pavement sidewalk test panels by:
 - 1) Compacted thickness no less than 1/4" of specified thickness using ASTM C 42;
 - 2) Void Structure: conform to specifications per Paragraph 2.1.A.4 of this Section;
 - 3) Unit weight plus or minus five pcf of the design unit weight using ASTM D-1188.
 - 4) Infiltration rate of pavement shall meet requirements specified in Paragraph 2.1.A.5 of this Section.
 - 2. Installation of Porous Portland Cement Concrete pavement for sidewalks shall meet the approved porous pavement sidewalk test panel.
 - 3. The City of Seattle approved porous pavement sidewalk test panel shall be protected throughout construction and not removed and disposed of until all remaining porous pavement sidewalks shown on Drawings have been constructed and approvals obtained from SPU Inspector.

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C. Porous Pavement Installation

1. Install TESC measures and flow diversion measures in order to divert runoff from flowing into construction area of porous sidewalk prior to excavation and subgrade preparation of sidewalk section. Maintain TESC measures and flow diversion measures until pavement is approved and adjacent areas are permanently stabilized
2. Construct porous pavement to the specified lines and grades with a uniform appearance and in accordance with the manufacturer's instruction, criteria and specifications.
3. Bring the subgrade of the aggregate discharge subbase to the line, grade, and elevations indicated on the Drawings. Restore subgrade to design subgrade where damaged by erosion and ponding before placing the aggregate discharge subbase at no additional expense to Owner. Coordinate SPU Inspector's review of subgrade before covering subgrade.
4. Set, align and brace forms so that pavement will meet the requirements specified in this Section and as shown on the Drawings.
 - a. Apply form release agent to inside face of forms before placing concrete.
 - b. The edge of previously placed concrete may be used as a form. Do not apply form release agent to previously placed concrete.
5. Place filter fabric after SPU Inspector has viewed subgrade preparation.
 - a. Maintain flow diversion measures to prevent runoff and sediment from entering the work limits.
 - b. Remove debris or sediment that has accumulated on the finished subgrade after viewing and before installing fabric at no additional cost to the Owner.
 - c. Place filter fabric in accordance with manufacturer's standards and recommendations.
 - d. Overlap adjacent strips of filter fabric a minimum of 16 inches.
 - e. Secure fabric at least 2 feet outside of bed limits.
6. Place and compact aggregate discharge subbase to the grades indicated on the Drawings in 6-inch maximum lifts, keeping equipment movement over the aggregate discharge subbase to a minimum. Subbase to be compacted to 92% per Section 31 00 00.
7. Fold the filter fabric back along bed edges (including at edge interface with vaults and structures within pavement section) to protect from sediment washout along edges after placing the aggregate discharge subbase. Place an edge strip at least 2 feet wide along the beds to protect beds from adjacent bare soil.
 - a. Keep edge strip in place until contiguous bare soils are stabilized and vegetated.
 - b. Place hay bales at the toe of slopes that may be adjacent to beds to prevent sediment from washing into beds during site development.
 - c. Trim excess filter fabric along bed edges (and at interfaces with vaults and structures) to gravel edge after the site is fully stabilized.
8. Moisten the subbase prior to placement of the PPCC in accordance with COS 2005 Section 2-06.3(2).
9. Mix, haul and place porous pavement concrete:
 - a. Operate truck mixers at the designated mixing speed by the manufacturer for 75 to 100 revolutions of the drum.
 - b. Transport or mix Portland Cement concrete on site 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 90 minutes when utilizing the hydration stabilizer specified in Paragraph 2.1.A.3.b of 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) Trucks used to transport the porous Portland cement concrete shall have no more than 3 consecutive loads of material without hauling conventional concrete or rinsing.

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- c. Inspect each mixer truck for appearance of concrete uniformity. Add water to obtain the required mix consistency, if necessary as determined by the QC representative of the concrete supplier.
 - 1) Require a minimum of 20 revolutions at the manufacturer's designated mixing speed following any addition of water to the mix.
- d. 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 discharge onto existing subgrade and do not pull or shovel to final placement.
 - 4) Do not place concrete on frozen subgrade or subbase.
- e. Strike-off concrete in accordance with NRMCA recommendations.
- f. Compact with full width roller in accordance with NRMCA recommendations and finish the porous concrete pavement to the required cross section depth and finish grade. Finish grade of pavement shall not deviate more than +/- 3/8 inch in 10 feet from profile grade.
 - 1) Install joints at spacing noted in paragraph 2.1 of this Section.
 - 2) After strike-off, compaction and installation of joints, do not perform other finishing operation.
 - 3) Cover the pavement surface with a minimum 6 mil thick polyethylene sheet or other approved equivalent covering material. Prior to covering, spray on a fog or light potable water mist above the surface when required due to ambient conditions (high temperature, high wind, and low humidity). Overlap exposed edges and secure cover (without using dirt or stone) to prevent dislocation.
- g. If joints are not installed during placement of concrete, sawcut in joints at spacing noted in Paragraph 2.1 of this Section.
 - 1) Begin procedure as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking (normally after curing) if saw cut. Immediately upon removing the polyethylene sheeting for sawing, begin wetting all exposed concrete surfaces. Keep all exposed surfaces of the concrete wet during sawing operations and until the polyethylene sheeting is replaced.
 - 2) Implement measures to collect dust and/or sawcut slurry during sawcutting operations in order to avoid sealing of the pores.
- h. Do not use acid based solutions to remove cement paste from surface of hardened porous concrete that has already been placed and cured.
- i. Allow all sections of PPCC to cure for 10 calendar days minimum before allowing foot traffic on completed sections.

3.4 QUALITY ASSURANCE

- A. Take and test three cores no sooner than 7 calendar days after placing porous Portland cement concrete. Coordinate core location with the SPU Inspector per the following:
 - 1. Take three sample cores per each day's sidewalk pour production for each construction crew, which will be considered a set.
 - 2. Label each core sample with a designated tracking number. Include core sample number, date pavement was placed, date core was taken and location (road stationing) where sample was cored.
 - 3. Measure each core for compacted thickness (ASTM C42). Use untrimmed, hardened core samples to measure placement thickness. The average of all production cores (within a set as noted in paragraph 3.4.A.1) shall not be less than the specified thickness with no individual core being more than 1/4 inch less than the specified thickness.
 - 4. Measure each core for void structure per ASTM noted paragraph 2.1.A.4. Each individual core shall be within specified void range.
 - 5. Measure each core for Unit Weight. Trim and measure the cores for unit weight per ASTM D-1188 after thickness determination. Each individual core shall be +/- 5 pcf of the design unit weight for ranges of satisfactory hardened unit weight values.

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6. Fill core holes with concrete meeting the porous mix design. Match adjacent pavement color texture and finish grade.
 - B. Submit test data of core samples to Owner's Representative for SPU review of thickness, void structure and unit weight. If requirements are not met, then perform additional core sampling and testing as required by SPU Inspector at no additional cost to the Owner.
 - C. If test results of core samples for thickness, void structure and unit weight are not met, then field infiltration test shall be conducted at the direction of the SPU Inspector as noted in the City Checklist in Section 01 41 50. Field Infiltration testing to be conducted by SPU.
 - D. Contractor to submit batch certification for deliveries in order to verify Paragraph 2.1.A.3.e.
 - E. If water is added to the mix, then Contractor to conduct unit weight test per ASTM C172 and ASTM C29 using the jiggling procedure noted in ASTM C29 and submit test results to Owner's Representative.
 - F. The testing of the freshly mixed concrete per ASTM C29 shall be done at a minimum frequency of one test per each day of placement and if more than 100 cy is placed in one day, then perform a minimum of one test per every 100 cy placed in accordance with COS specifications.
 - G. If any portions of the finished surface appear to be non-porous by visual inspection and/or do not infiltrate water and/or do not meet specification requirements noted in Paragraph 2.1, then remove and replace, or repair these areas at no additional cost to the Owner.
 - H. If any one core fails to meet specifications for void structure or unit weight and/or core samples do not meet specifications for compacted thickness, then additional coring will be required by SPU in the area represented by the failing core(s) at no additional cost to the Owner. Delineation for removal and replacement will be accomplished by a combination of additional coring, visual inspection and/or field infiltration testing by the SPU Inspectors. Repair and/or replace improperly constructed porous pavement or pavement identified as nonconforming to the specifications as directed by the Owner's Representative and at no additional cost to the Owner.
- 3.5 CLEANING
- A. Leave premises clean and free of residue of work of this Section in accordance with the requirements in Division 01 of this Project Manual.
- 3.6 WORK BY OTHERS
- A. Seattle Public Utilities to conduct destructive testing on the core samples taken for testing noted in Paragraph 3.4.A. SPU destructive testing to be used for SPU study purposes. Submit cores including core sample tracking number and core test data results to SPU Inspector, upon completion of testing noted in Paragraph 3.4.

END OF SECTION 32 13 43