CITY OF COLUMBUS
DEPARTMENT OF PUBLIC SERVICE
DIVISION OF DESIGN AND CONSTRUCTION
SPECIFICATION 1525 PERMEABLE PAVER PAVEMENT
05/29/2024

1525.01 Description. This work consists of constructing geotextile fabrics, aggregate base, pervious concrete, and concrete or clay permeable pavers.

1525.02 Materials. Furnish materials conforming to:

Subgrade Stabilization Geotextile, Type 'D'.....712.09
Aggregate Sub-base, No. 2 or 4 Stone ..... Table 703.01-1*
Aggregate Setting Bed, No. 8 Stone.....Table 703.01-1*
Pervious Concrete……..ACI PRC522-23
Concrete or Clay Pavers.....1524**

*Washed – aggregate

**Approved Producers and Suppliers List (APPL)

1525.03 Submittals.

A. Aggregates: Submit testing data to include the following:

a. Sieve analysis per ASTM C-136 with aggregates clean, washed, and free of fines with <2% passing the No. 200 sieve.

b. Resistance to Degradation of Small-Sized and Large-Sized Coarse Aggregates by Abrasion and Impact in the Los Angeles Machine per ASTMC-131 and ASTM C-535. Aggregates should be crushed with minimum 90% fractured faces and minimum Los Angeles abrasion loss of <40.

c. Percentage of angular and sub-angular particles per ASTM D-2488 greater than 90%.

B. Concrete:

a. Proposed previous concrete mixture proportions including all material weights, volumes, design density (unit weight), water-cementitious ratio, and design void content.

b. Aggregate type, source, grading, dry-rodded unit weight, percent passing number 4 sieve and void content.

a. Cement, supplementary cementitious materials, synthetic (polypropylene) or cellulose fibers and chemical admixture manufacturer certifications.

b. Density (unit weight) and void content of proposed freshly mixed pervious concrete mixture per ASTM C 1688[1].

C. Concrete Pavers and Clay Pavers: The City has an APPL list for concrete and clay pavers. Only products on that list shall be permitted on City projects.

a. At the request of the Engineer, Contractor shall submit for approval up to 20 full size samples of each Paver type/size/thickness/color/finish specified on the plans; the samples shall represent the range of shape, texture and color of the respective type for Engineer selection.

1525.04

[1] ASTM C 1688 currently has been withdrawn. Test methods shall be followed per the ASTM with disregard of status.

A. Construction Requirements:

a. Construct or fine grade the subgrade to within 1/2 inch of the plan grade as measured with a 10-foot straightedge applied to the surface parallel to the centerline of pavement.
b. Proof roll per CMSC 204.06. Where proof rolling is not achievable due to inaccessible locations, acceptance of subgrade associated with cohesive soils shall pass the 1-point compaction test per SS 1501.

B. Subgrade Stabilization Geotextile:

a. Place the Geotextile directly on prepared surface and on the sides as shown on the typical section. The Geotextile should be deployed flat and tight with no wrinkles or folds. The rolls should be oriented in the direction of traffic to ensure the principle strength direction of the material is placed in the correct orientation. Adjacent rolls should be overlapped by 18-inches. Prior to fill placement, the geotextile should be held in place using suitable means such as pins, soil, staples and sandbags to limit movement during fill placement.
b. The surface of the subgrade should be relatively smooth and level, and depressions or humps greater than 6-inch should be graded out.
c. Sudden braking, sudden starting and sharp turning should be avoided. Tracked construction equipment must not be operated directly upon the exposed Geotextile. A minimum aggregate fill thickness of 6 inches is required prior to operation of tracked equipment on the Geotextile.

C. Installation of underdrains and storm sewer.

a. At the specified elevation(s), install the underdrain pipes and storm sewer and associated backfill in accordance with the construction drawings.

D. Installation of Aggregate Sub-base

a. Moisten, spread and consolidate the No. 2 or 4 subbase in maximum 12 inch lifts. Remove standing water from geotextile prior to placing subbase aggregate.
b. For each lift, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (8 T) vibratory roller until there is no visible movement of the No. 2 or 4 stone. Do not crush aggregate with the roller.
c. Use a minimum 13,500 lbf (60kN) plate compactor with a compaction indicator to compact areas that cannot be reached by the vibratory roller. Do not crush the aggregate with the plate compactor. When using this plate compactor, maximum lift height is 6-inches.
d. The final surface tolerance of the compacted subbase shall be ±2 inches (±25mm) over a 10 foot (3 m) straight edge.
e. Use a Light Weight Deflectometer (LWD) to measure deflection on lifts of sub-base and base aggregates after construction of the first lift of the sub-base course of aggregate.
    i. The LWD test method shall comply with ASTM E-2835.
    ii. Conduct tests on a +/- 20-foot grid throughout the area being constructed
    iii. After three preloading drops, the maximum average deflection from three additional drops should be no greater than 1.0 mm for the No. 2, or 4 subbase layer. Areas with greater than 1.0 mm deflection should be rolled again and re-rested. If after subsequent rolling the deflection is still over 1.0 mm but has not changed by more than 5% from the previous test, the material may be approved by the Engineer at their discretion.
    iv. For all tests, record the average deflection, location of the test, the approximate total depth of aggregate below the plate and the type of aggregate tested.

E. Installation of Pervious Concrete:

a. Onsite Representative.
An onsite representative whom is an industry craftsperson shall be made for all concrete pours. The representatives shall provide a resume with three (3) projects containing similar complexity of the pervious concrete pour. By May 2025, the contractor shall have a National Ready Mix Concrete Association certified installer, craftsman and/or technician to guide the installation of pervious concrete. The onsite representative will advise the City and Contractor on the inspection and means of installation for the product.

b. Test Panel Mock-up.
Install a test panel of pervious concrete. The onsite representative for the pervious concrete shall dictate the representative size and location of the test panel. The test panel may be incorporated into the work. Test panel will be tested for all criteria including 1525.04.E.h. The concrete supplier shall be present during the mock-up panel for visual observation of the material.

c. Formwork.
Form materials are permitted to be of wood or steel and shall be the full depth of the pavement. Protect impermeable membranes from puncture or tear when placing forms and form pins. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation of plan profiles following spreading, strike-off and compaction operations. Spread, screed and

consolidate concrete using a screed compaction effort that delivers a vertical pressure of 10 psi to 30 psi on the concrete. Finish small areas that are not accessible by the screed with hand held equipment and plate compactors that exert a minimum of 10 psi of vertical pressure. Large scale mechanized placement of pervious concrete with slip form concrete paving machines, laser screeds or asphalt paving machines may preclude use of fixed forms.

d. Mixing and Hauling:
   i. Mixing: Mixtures shall be produced in central mixers or in transit (truck) mixers. When concrete is delivered in agitating or non-agitating units, the concrete shall be mixed in the central mixer for a minimum of 1 minute or until a homogenous mix is achieved. Concrete mixed in transit mixers shall be mixed at the speed designated as mixing speed by the manufacturer for 75 – 100 revolutions.
   ii. Transportation: The pervious concrete mixture may be transported or mixed on site and discharge of individual loads shall be completed within one (1) hour of the introduction of mix water to the cement. Delivery times may be extended to 90 minutes when a hydration stabilizer. Submit request to use hydration stabilizer.
   iii. Discharge: Each truckload shall be visually inspected for consistency of concrete mixture. Water addition shall be permitted at the point of discharge to obtain the required mix consistency, provided a measurable quantity is discharged, and provided no more than half of the batch amount has been discharged. A minimum of 30 revolutions at the manufacturer's designated mixing speed shall be counted following the addition of any water to the mix, prior to further discharge. Discharge shall be a continuous operation and shall be completed as quickly as possible. Concrete shall be deposited as close to its final position as practical and such that discharged concrete is incorporated into previously placed plastic concrete. If consolidation occurs during concrete discharge, placement shall be halted and wet concrete removed (this may happen towards the end of some loads).

e. Weather Limitations
   i. Pervious concrete shall be placed between ambient temperatures of 40 degrees F and 90 degrees F. Pervious concrete shall not be placed on frozen sub-base. Maintain concrete temperatures during the curing per CMSC 451.071.

f. Placing and Finishing:
   i. Prior to placing concrete, the surface of the aggregate detention layer (or recharge bed) shall be soaked and in a wet condition at time of placement. Failure to moisten the aggregate surface will result in a reduction in strength of the pavement.
   ii. Concrete may be deposited into the forms by mixer truck chute, conveyor or buggy.
   iii. Unless otherwise permitted, the Contractor shall utilize a mechanical vibratory screed to strike off the concrete ½ in. to ¾ in. (13 mm to 19 mm) above final height. Screed concrete with equipment capable of delivering 10 psi to 30 psi of vertical force to the concrete. In areas with limited access a small plate compactor capable of delivering 10 psi of pressure can be used.
   iv. Care must be taken to prevent closing the void structure of pervious concrete. After mechanical or other approved strike-off and compaction operation, no other finishing operation will be allowed. Internal vibration shall not be permitted. If surface applied vibration, is used, it shall be shut off immediately when forward progress is halted for any reason.
   v. Placed concrete shall not be disturbed while in the plastic state. Low spots after the screed operation shall be over-filled for surface repair and either tamped to desired elevation with hand tampers or passing the screed a second time to correct the elevation.
   vi. Hand tampers and an edging tool with ¼ in. (6 mm) radius shall be used to compact the concrete along the slab edges immediately adjacent to the forms. After compaction, inspection and surface repair, no further finishing shall be performed on the concrete. Surface curing shall begin immediately.
   vii. The pervious concrete pavement shall be compacted to the required cross-section and shall not deviate more than +/- 1/2 in. in 10 ft from profile grade.
   viii.

g. Jointing:
   i. Construction Joints per Item 451.09. Jointing plastic concrete form joints in with concrete tools at a depth of ¼ of the full depth of the slab. Jointing hardened concrete saw-cuts shall be made as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking. Sawdust or slurry shall be promptly removed to protect the pervious concrete pores. After sawing, the curing cover shall be securely replaced for the remainder of the curing cycle.

h. Curing:
   i. Curing procedures shall begin immediately, no later than 10 minutes, from the time the pervious concrete is discharged from the truck. Placing, finishing and tooled jointing and edging must be completed within the10-minute window from discharge. The pavement surface shall be covered with a moistened burlap and a minimum of 6 mil thick clear polyethylene sheet or other approved covering material.
   ii. Immediately after the screed operation, the surface shall be kept moist and evaporation prevented using a moistened burlap.
   iii. The curing cover shall remain securely in place for a minimum of 7 days, uninterrupted. No vehicular traffic shall be permitted on the pavement prior to completion of the paver installation. Light duty construction equipment may be permitted after the curing period. Heavy-duty construction equipment may be permitted on the section after 14 days.

Pedestrian traffic may be permitted on the curing concrete after 24 hours.

i. Pavement Evaluation.
   i. Pavement thickness shall be single-course placement 8 in. thick unless otherwise specified in the plans. Untrimmed hardened core samples shall be used to determine placement thickness. The average of all production cores when measured for length shall not be more than ½ in. (13 mm) less than the specified design thickness.
   ii. Concrete tests shall be performed for each 50 yd3 (38 m3) or fraction thereof with a minimum of one set of tests for each day's placement.
   iii. Sampling - Plastic concrete shall be sampled in accordance with ASTM C 172.
   iv. Density (unit weight) – Density (unit weight) of the plastic concrete shall be measured in accordance with ASTM C 1688[1]. The density (unit weight) of the delivered concrete shall be +/- 5 lb/ft3 (80 kg/m3) of the submitted fresh density (unit weight).
   v. Void content - Void content of the plastic concrete shall be calculated as per ASTM C 1688[1] and compared to the submitted fresh void content. Unless otherwise specified, void content shall be between 13% and 30%. After a minimum of seven (7) days, hardened concrete shall be tested at a rate of one set of three cores per 50 yd3 (38 m3) of concrete placed on one day or fraction thereof. Cores will be drilled in accordance with ASTM C 42. The cores will be measured for thickness, void structure and unit weight. Cores will be taken at minimum 2 ft (0.6 m) away from the edge of placement to ensure a representative sample.
   vi. After curing and before aggregate setting bed placement operation the average infiltration rate of three (3) locations of the in-place pervious concrete shall be greater than 100 in/hour as determined per ASTM C 1701. Any areas of insufficient surface porosity, as determined by the Architect/Engineer, shall be removed and replaced by the Contractor.

G. Aggregate Setting Bed

a. Moisten, spread, and screed the No. 8 stone bedding material using an approved mechanical spreader, screed rails, or board the No. 8 stone bedding material to a nominal 1 1/2 in. thickness. Fill and level voids left by removed screed rails with No. 8 stone. The surface tolerance of the No. 8 bedding layer shall be ±3/8 in. over a 10 foot straightedge.

H. Installation of Pavers

a. Install pavers in accordance with the plan specified shape, color, pattern, and treatments along edge restraints, manholes, catch basins, and other obstructions. Pavers shall be inspected for color distribution and all chipped, damaged or discolored pavers shall be replaced.
b. Paving units shall be installed from a minimum of three bundles for hand installations, 6 bundles for mechanical installations, simultaneously to ensure color blending.
c. Fill gaps at the edges of the paved area with cut pavers or edge units. Do not install cut pavers smaller than one-third of a whole paver along edges subject to vehicular traffic - trim two pavers to fit.
d. Cut pavers using masonry saw with dust collection equipment. Upon completion of cutting, the area must be swept clean of all debris to facilitate inspection and to ensure the pavers are not damaged during compaction.
e. Using a low amplitude plate compactor capable of at least 5,000 lbs. (22 kN) compaction at a frequency of 75 hz -90 hz, compact and seat the pavers into the bedding course. A urethane cover is recommended over the steel plate to reduce the damage to the surface of the pavers during this process.
f. The pavers shall be compacted to achieve consolidation of the bedding course and brought to level and profile by not less than three passes. Initial compaction should proceed as closely as possible following the installation of the paving units and prior to the acceptance of any traffic or application of permeable joint material.
g. The cumulative length of chips on the exposed face of a single unit shall not exceed 10% of the perimeter of the exposed face of the paver. Pavers that have the top surface crumble during compaction shall also be replaced.
h. Apply aggregate setting bed, No. 8 Stone, as the joint aggregate material to the surface and sweep into the joints and voids. Fill joints and voids, and then sweep off excess material before vibrating the material down into the joints using a plate compactor. This will require at least three passes with the compactor.
i. Do not compact within 6 feet of the unrestrained edges of the paving units.
j. Sweep off excess aggregate the completed surface shall be swept clean and washed down with water
k. The final surface tolerance of compacted pavers shall not deviate more than±1/4 under a 10 feet (3 m) long straightedge.
l. The surface elevation of the pavers shall be 1/8 to 1/4 inch (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
m. Bond lines for paver courses: ±½ inch (±15 mm) over a 50 feet (15 m) string line.
n. Paver lippage shall be no greater than 1/8 inch difference in height between adjacent pavers
o. The City will verify the surface infiltration at a minimum of 100 in/hour using test method in ASTM C 1781.

1525.05 Maintenance and Protection

All completed pervious pavement areas shall be protected from damage and contamination throughout the life of the project. At the conclusion of sediment creating activities including hauling material conduct a maintenance of the paver system including sediment removal of paver joints and replacement of the joint filler aggregate.

1525.06 Method of Measurement

a. The permeable pavers will be measured by the number of Square Yards completed and accepted in place. Square yardage will be measured at the surface of the pavement. This shall include all labor, equipment, materials, and incidentals necessary for the described Work.
b. The Subbase aggregate will be measured by the number of cubic yards completed and accepted in place. The width equals the pavement width shown on the typical cross-section and the height based on the profile plus any additional widening as directed by the Engineer. The City will field measure the length along the centerline of each installation. The City will determine the volume based on the above width, height and length. The City will measure the elevation at which the materials change from subbase to base aggregate and note any changes based on the typical section.
c. The subgrade stabilization geotextile will be measured by the width of the pavement shown on the typical cross-section and the height based on the profile plus any additional widening as directed by the Engineer.
d. The City will measure all LWD Testing on a lump sum basis
e. The City will measure pervious concrete by the number of square yards completed and accepted in place. The widths equals the pavement width shown on the typical cross-sections of the plans. The City will measure the length along the centerline of each roadway.

1525.07 Basis of Payment

Item	Unit	Description
1525	Square Yard	Subgrade Stabilization Geotextile
1525	Cubic Yard	Aggregate Sub-Base No. 2 or 4 stone
1525	Lump Sum	LWD Testing
1525	Square Yard	Permeable Paver Roadway
1525	Square Yard	Pervious Concrete