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UNIFIED FACILITIES GUIDE SPECIFICATIONS

SECTION 32 14 13

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NOTE: *This guide specification covers the requirements for constructing a permeable interlocking concrete pavement for pedestrian and vehicular uses such as parking lots, alleys and low-volume roads. This section includes construction of the paving surface which consists of solid concrete units with joints filled with permeable aggregate installed over a permeable aggregate bedding course. This section includes subbase and base reservoir materials and construction specific to permeable interlocking concrete pavement.*

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 REFERENCES

NOTE: *This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.*

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the published print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 301 (2010) Specifications for Structural Concrete

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 288 (2010) Geotextile Specification for Highway Applications

ASTM INTERNATIONAL (ASTM)

ASTM C 29 (2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C 117 (2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 131 (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C 140 (2013a) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

ASTM C 535 (2012) Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 936 (2013) Solid Concrete Interlocking Paving Units

ASTM C 979 (2010) Pigments for Integrally Colored Concrete

ASTM C 1260 (2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C 1567 (2013) Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

ASTM C 1781	(2013) Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems
ASTM D 75	(2009) Standard Practice for Sampling Aggregates
ASTM D 448	(2012) Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
ASTM D 5821	(2006) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM E 11	(2009) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

1.2 RELATED SECTIONS

NOTE: *Permeable interlocking concrete pavement systems can be designed with no drain pipes in the subbase to allow water to infiltrate into the soil subgrade. The systems can also be designed with perforated drain pipes to remove excess water in low infiltration soils, or with an impermeable liner and drain pipes in conditions where infiltration of water is not desired. Permeable interlocking concrete pavement contributes to the following LEED credits: SS6, SS7, WE1, MR4, and MR5.*

Permeable interlocking concrete pavement systems may use Section 32 11 16.16 [BASE COURSE FOR RIGID] [AND SUBBASE COURSE FOR FLEXIBLE] [SUBBASE COURSE FOR PERVIOUS] PAVING 32 11 24 GRADED CRUSHED AGGREGATE BASE COURSE FOR [PERVIOUS] [FLEXIBLE] PAVEMENT, in addition to this section. Specifications for subbase and base course aggregate materials, gradations, and construction in this Section supersede that in other Sections.

1.3 SUBMITTALS

NOTE: *Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.*

A “G” following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a “G”. Only delete an existing “G” if the submittal item is not complex and can be reviewed through the Contractor’s Quality Control system. Only add a “G” if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the “G” designation to indicate the approving authority.

Codes for Army projects using the Resident Management System (RMS) are: “AE” for Architect-Engineer; “DO” for District Office (Engineering Division or other organization in the District Office); “AO” for Area Office; “RO” for Resident Office; and “PO” for Project Office. Codes following the “G” typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a “G” designation; submittals not having a “G” designation are for [Contractor Quality Control approval.] [information only.] When used, a designation following the “G” designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33

SUBMITTAL PROCEDURES:

SD-03 PRODUCT DATA

[Local/Regional Materials; (LEED)]

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Albedo; (LEED)

Provide information identifying the reflectance of the pavement.]

SD-04 SAMPLES

Concrete Paving Units [G]

Five representative full-size samples of each paver type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation. Accepted samples become the standard of acceptance for the work of this Section. Also, as directed by Contracting Officer, provide a representative sample of 5 paving units from each lot of 2,500 square meters (25,000 square feet) or fraction thereof.

Permeable Jointing, Bedding, Base and Subbase Aggregates [G]

Minimum 2 kg (3 lb) samples of each

Geotextiles [G]

One sample each of fabrics used on the job, each between 0.015 and 0.09 square meters (25 and 155 square inches)

Field-Constructed Mockup [G]

SD-06 TEST REPORTS

Concrete Paving Units [G]

Laboratory test reports certifying compliance of the concrete pavers with ASTM C 936.

Permeable Jointing, Bedding, Base and Subbase Aggregates [G]

Sieve analysis per ASTM C 136 of each and test results for porosity and bulk density of the base and subbase aggregates per ASTM C 29. LA Abrasion per ASTM C 131 and C 535.

Surface Infiltration [G]

Test results per ASTM C 1781

SD-07 CERTIFICATES [G]

CMHA Concrete Paver Installer Certification for the paver installation supervisor including a Record of Completion from a PICP or Permeable Interlocking Concrete Pavement Installer Specialist Course.

Manufacturers' material safety data sheets for the safe handling of the specified paving materials and other products specified herein. Provide certification that the paving units have a minimum solar reflective index that meets LEED credit requirements for heat island effect - non-roof.

SD-10 OPERATIONS AND MAINTENANCE MANUAL

At the completion of the work provide O&M manual to the contracting officer that includes the following: (1) maintenance types, procedures, and schedule; (2) vicinity map showing the project site within the installation; (3) map of the project area showing the permeable pavement with respect to the project; (4) typical cross section of the permeable pavement structure; (5) project specifications for the permeable pavement; and (6) construction cost of the permeable pavement area.

SD-11 CLOSEOUT SUBMITTALS

[Local/Regional Materials; (LEED) [; G] [; G, [____]]

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.]

[Concrete Paving Units; (LEED)

Albedo; (LEED)

LEED documentation relative to heat island effect - non-roof credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.]

1.4 DELIVERY, STORAGE AND HANDLING

Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver bundle. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped bundles capable of transfer by forklift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the product or to existing construction.

Stockpile jointing, bedding, base and subbase aggregates such that they do not segregate within each pile. Keep all stockpiles free from standing water, free of any organic material or sediment, debris, and ready for placement. Store aggregates on paved surfaces. Do not store aggregates on exposed soil or grassed areas unless first covered with geotextile to keep the aggregates clean.

1.5 QUALITY ASSURANCE

1.5.1 PERMEABLE INTERLOCKING CONCRETE PAVEMENT RECORD OF COMPLETION

Utilize a paving unit installer field supervisor that holds a current Concrete Masonry & Hardscapes Association (CMHA) Concrete Paver Installer Certification. The same field supervisor shall have a record of completion from the CMHA Permeable Interlocking Concrete Pavement (PICP) Specialist Course.

1.5.2. PRE-CONSTRUCTION MEETING

Prior to starting work, hold a pre-construction meeting with representatives from the paving unit manufacturer, paver installation subcontractor, general contractor, and the contracting officer. Determine the following:

(1) Installation contractors' field supervisor personnel;(2) Delivery and storage locations for aggregates and concrete paving unit bundles;(3) Anticipated start date; (4) Starting point(s) and direction(s) of paving; (5) Methods for checking slopes and surface tolerances for smoothness and elevations; (6) Estimated daily production for installation of all aggregates, edge restraints and paving units; and (7) Recording and reporting actual daily paving production, including identifying the site location and recording the number of bundles installed each day.

For machine assisted installation of paving units, review; (1) Concrete unit manufacturer's written method that explains processes for controlling paver dimensional tolerances, and (2) contractor diagram(s) of the concrete paver laying pattern and how the paver layers or clusters will be joined together to provide a continuous pattern across the pavement surface.

NOTE: Mechanized installations may require a larger mock up area. Consult with the paver installation contractor on the size of the mock up.

1.5.3 WEATHER REQUIREMENTS

Do not install in rain or snow; do not install frozen jointing, bedding, base or subbase aggregates. Do not install aggregates on frozen soil subgrades.

1.5.4 FIELD-CONSTRUCTED MOCK UP

NOTE: Permeable interlocking concrete pavement is a permeable surface with an underlying open-graded aggregate reservoir to temporarily store surface runoff before it infiltrates into the soil subgrade. This permeable surface replaces traditional pavement, allowing stormwater to infiltrate directly and receive water quality treatment.

Install a minimum 3 x 3 m (10 x 10 feet) paver area to determine surcharge of the bedding layer, joint sizes, and lines, laying pattern, color and texture of the job. This area will be used as the standard by which the work will be judged. Subject to acceptance by contracting officer, mock-up may be retained as part of finished work. If mock-up is not retained, remove and properly dispose of mock-up outside of the installation boundary.

1.5.5 SURFACE INFILTRATION TESTING AND ACCEPTANCE

When the work is complete, test the surface infiltration of the permeable interlocking concrete pavement using ASTM C 1781. Any test results below 250 cm/hour (100 inches/hour) shall be rejected. Provide the test report to the contracting officer.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 LOCAL/REGIONAL MATERIALS

NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor. Using materials harvested and manufactured within a 500 mile radius from the project site contributes to the following LEED credit: MR5. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option if Contractor is choosing local materials in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. First option shall not be used for USACE projects. Army projects shall include second option only if pursuing this LEED credit.

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800] [] kilometer [500] [] mile radius from the project site, if available from a minimum of three sources.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Pavement materials may be locally available.]

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 GEOTEXTILE

Conforms to AASHTO M 288 Class 2, Subsurface Drainage requirements.

2.1.2 PERMEABLE JOINTING, BEDDING, BASE AND SUBBASE AGGREGATES

Aggregates shall conform to gradations per ASTM D 448 shown in Table 1 below. All materials shall be washed with less than 2% passing the No. 200 sieve; 90% fractured faces per ASTM D 5821; Maximum LA Abrasion loss < 40 per ASTM C 131 and ASTM C 535. Do not use uncrushed, rounded river gravel for vehicular applications. Minimum porosity for base and subbase materials shall be 0.30 per ASTM C 29.

Table 1. Jointing, Bedding, Base and Subbase Aggregate Gradations

ASTM E 11	ASTM D 448	ASTM D 448	ASTM D 448	ASTM D 448
Sieve Sizes	No. 8 Jointing	No. 8 Bedding	No. 57 Base	No. 2 Subbase
75 mm (3 inch)				100
63 mm (2½ inch)				90 – 100
50 mm (2 inch)				35 – 75
37.5 mm (1½ inch)			100	0 – 15
25 mm (1 inch)			95 – 100	
19 mm (¾ inch)				0 – 5
12.5 mm (½ inch)	85 – 100	85 – 100	25 – 60	
4.75 mm (No. 4)	10 – 30	10 – 30	0 – 10	
2.36 mm (No. 8)	0 – 10	0 – 10	0 – 5	
1.16 mm (No. 16)	0 – 5	0 – 5		

2.1.2.1 SUBSTITUTIONS FOR AGGREGATE GRADATIONS

NOTE: When gradations in Table 1 are not available from local quarries, check with them for alternative aggregate gradations. For subbases, these typically include ASTM No. 3 and 4 gradations. Alternative sizes for the base aggregate can be ASTM No. 67 gradation. Alternative sizes for bedding materials can be ASTM No. 87 gradations.

ASTM No. 89 or No. 9 gradations may be used for jointing aggregates if paving unit joints widths will not accept ASTM No. 8 size aggregate. Substitution of base and subbase gradations shown in Table 1 shall be approved in writing by the contracting officer.

2.1.3 EDGE RESTRAINTS

NOTE: Select precast concrete and/or cast-in-place concrete to comply with the drawings.

2.1.3.1 PRECAST CONCRETE

The edge restraints shall be precast Portland cement concrete elements with dimensions shown on the plans. The concrete shall have a compressive strength of not less than 24 MPa (3500 psi) at 28 days.

2.1.3.2 CAST-IN-PLACE CONCRETE

NOTE: Minimum compressive strength of cast-in-place concrete should be 24 MPa (3,500 psi) unless analysis requires a higher value. Entrained air content of the fresh concrete should be 6 percent plus or minus 1.5 percent in areas where freezing and thawing is a design consideration.

Delete this paragraph when this option is not retained. If the project is not located in a freeze-thaw environment, air entrainment is not required.

The edge restraint shall be Portland cement concrete placed with the dimensions shown in the plans. Concrete shall conform to the requirements of ACI 301, except that it shall have a compressive strength of not less than 24 MPa (3500 psi) at 28 days.

Aggregates to be used in all cast-in-place concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. The types of aggregates shall be evaluated in a combination which matches the contractors' proposed mix design (including Class F fly ash or GGBF slag), utilizing ASTM C 1567. Test results of the combination shall have a measured expansion of less than 0.08 percent at 8 days. Should the test data indicate an expansion of greater than 0.08%, the aggregate(s) shall be rejected and the contractor shall submit new aggregate sources for retesting or may submit additional test results incorporating Lithium Nitrate for consideration.

2.1.4 CONCRETE PAVING UNITS

NOTE: Concrete paving units have cement contents typically between 16 and 18 percent of the concrete by dry weight. Cement is more energy intensive than the other constituents. Use the minimum amount of cement required for a project to produce quality concrete that meets product specifications herein. Fly ash, silica fume or slag cement is sometimes used as a replacement in concrete paving units for Portland cement and they often enhance paving unit properties. ASTM standards for these are included in ASTM C 936.

Concrete and cement are EPA designated products for recycled content. See Section 01 62 35 RECYCLED/RECOVERED MATERIALS and include minimum recycled content options unless designer determines that justification for non-use exists. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying products meeting EPA minimum recycled content.

Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to the following LEED credit: MR4. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages).

Size: [Specify] mm (Specify inches) long x [Specify] mm [(Specify inches)] wide x [Specify] mm [(Specify inches)] thick.

Color [and finish]: [Specify color] [Specify finish].

Color Pigment Material Standard: Comply with ASTM C 979.

2.2 TESTS, INSPECTIONS AND VERIFICATIONS

2.2.1 CONCRETE PAVING UNITS

a. Paver type: The concrete pavers shall conform to ASTM C 936/C 936M. Pavers shall be 3-1/8 inch thick, [color], and with paver types, shapes, sizes, and paver solar reflectivity as specified on the plans. Pigmentation shall conform to ASTM C 979. Structural interlocking capability shall be achieved by a vertical joint profile exhibiting protruding spacer bars that interlock throughout the depth of the block when placed in pattern.

2.2.1.1 ALBEDO

NOTE: The urban heat island effect forms as vegetation is replaced by low reflectivity materials such as dark colored paving. These surfaces absorb - rather than reflect - the sun's heat, causing urban ambient temperatures to be 1 to 6 degrees C 2 to 10 degrees F hotter than surrounding rural areas. Using high-albedo materials contributes to the following LEED credit: SS7. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Army projects shall specify bracketed LEED option only if pursuing this LEED credit.

[Installed paving surface must meet the requirements of LEED heat island effect non-roof credit SS 7.1, having a Solar Reflectance Index (SRI) of at least 29.]

Conduct the tests prescribed by ASTM C 936 and conduct the following tests on lots each consisting of 2,500 square meters (25,000 square feet) coverage on paving units delivered to the site.

NOTE: For jobs of less than 1,000 square meters (10,000 square feet) or for pavements not exposed to vehicular traffic, a manufacturer's certificate which certifies that the paving units meet the requirements of ASTM C 936 can be accepted in lieu of sampling and testing the paving units from each lot.

2.2.1.2 DIMENSIONAL TOLERANCES

Sample and measure three paving units from each lot per ASTM C 140. The paving units in the sample shall not vary from the specified length and width by more than 1.6 mm (1/16 inch). The thickness of any paving unit in the sample shall not vary from the specified thickness by more than 3 mm (1/8 inch).

2.2.1.3 COMPRESSIVE STRENGTH

Test three paving units per ASTM C 140. The average minimum compressive strength shall not be less than 55 MPa (8,000 psi). Notify the Contracting Officer if any paving unit fails to meet the specified requirements. In case the shipment fails to conform to the specified requirements, the Contractor may sort it, and new specimens selected from the retained lot for retesting, as directed by the Contracting Officer. All concrete paving unit retests shall be performed at the expense of the Contractor. In case the second set of specimens fail to conform to the test requirements, the entire lot shall be rejected and removed from the site.

2.2.2 PERMEABLE JOINTING, BEDDING, BASE, AND SUBBASE AGGREGATES

Obtain a representative sample of each material type in accordance with ASTM D 75 from each 75 cubic meters (100 cubic yards) of aggregates to be used in the project. If the material fails to meet the gradation requirements the Contractor may take another sample and retest it at no cost to the Government. If this retest fails or if no second test is taken, the aggregate is rejected by the Government and shall be removed from the job site.

PART 3 EXECUTION

3.1 EXAMINATION

NOTE: The elevations and surface tolerance of the soil subgrade and drainage pipe determine the final surface elevations of concrete pavers. The paver installation contractor cannot correct deficiencies excavation and grading of the soil subgrade with additional base or bedding materials. Therefore, the surface elevations of the soil subgrade should be checked and accepted by the General Contractor or designated party, with written certification presented to the paver installation subcontractor prior to starting work.

3.1.1 VERIFICATION AND ACCEPTANCE OF SITE OF CONDITIONS:

Verify that subgrade preparation, density, permeability, and elevations conform to specified requirements. Any deficiencies shall be corrected prior to proceeding with the installation by the Contractor. Verify location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage pipes and inlets. Verify that the soil subgrade is free from standing water prior to starting work.

The Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.

3.2 INSTALLATION

3.2.1 GENERAL

Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the [geotextile and] subbase materials.

Keep the area where pavement is to be constructed free from sediment during entire job. All aggregates contaminated with sediment shall be removed and replaced with clean aggregates.

All drain pipes, observation wells, overflow pipes, and (if applicable) geotextiles, berms, baffles and impermeable liner shall be in place per the drawings prior to placement of the subbase and base. Locations shall be approved by the project engineer prior to commencing the work.

Do not damage drain pipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.

3.2.2 GEOTEXTILES

Place on [bottom and] sides of soil subgrade according to Section 31 05 19 GEOTEXTILE. Secure in place to prevent wrinkling from vehicle tires and tracks. Overlap a minimum of [0.3 m (12 inch)] [0.6 m (24 inch)] in the direction of drainage.

3.2.3 SUBBASE AGGREGATE

Moisten, spread and compact the ASTM No. 2 aggregate subbase in maximum m 200 mm (8 inch) lifts [without wrinkling or folding the geotextile. Place subbase to protect geotextile from wrinkling under equipment tires and tracks.] For each lift, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 8 T (10 ton) vibratory roller until there is no visible movement of the No. 2 stone. Do not crush aggregate with the roller. Use a minimum 60 kN (13,500 pound-force) vibratory plate compactor with a compaction indicator to compact aggregate that cannot be reached by the vibratory roller compactor. The surface tolerance of the compacted No. 2 subbase shall be ± 65 mm ($\pm 2\frac{1}{2}$ inch) over a 3 m (10 foot) straightedge.

3.2.4 EDGE RESTRAINTS

Install [precast concrete] [cast-in-place concrete] edge restraints per the drawings [at the indicated elevations] on the compacted subbase.

3.2.5 BASE AGGREGATE

Moisten, spread and compact the No. 57 base layer in one 100 mm (4 inch) thick lift. On this layer, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 8 T (10 ton) vibratory roller until there is no visible movement of the No. 57 stone. Do not crush aggregate with the roller. Use a minimum 60 kN (13,500 pound-force) vibratory plate compactor with a compaction indicator to compact aggregate that cannot be reached by the vibratory roller compactor. The surface tolerance of the compacted No. 57 base shall be ± 25 mm (± 1 inch) over a 3 m (10 foot) straightedge.

3.2.6 BEDDING LAYER AGGREGATE

Moisten, spread and screed the No. 8 stone bedding material. Fill voids left by removed screed rails with No. 8 stone. The surface tolerance of the screeded No. 8 bedding layer shall be ± 10 mm ($\pm 3/8$ inch) over a 3 m (10 foot) straightedge. Do not subject screeded bedding material to any pedestrian or vehicular traffic before paving unit installation begins.

3.2.7 CONCRETE PAVING UNITS

NOTE: Concrete paving units subject to vehicular traffic should be placed in herringbone pattern, and this pattern can be specified here.

Lay the paving units in the pattern(s) and joint widths shown on the drawings. Maintain straight joint lines. Fill gaps at the edges of the paved area with cut units. Cut pavers subject to tire traffic shall be no smaller than 1/3 of a whole unit. Cut pavers and place along the edges with a [double-bladed splitter or] masonry saw.

3.2.8 JOINTING AGGREGATE

Fill the openings and joints with [No. 8] stone.

NOTE: Some paver joint widths may not accept most of the No. 8 stone. Use joint material that will fill joints such as ASTM No. 89 or No. 9 stone.

Remove excess aggregate on the surface by sweeping pavers clean. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 30 kN (7,000 pound-force) centrifugal compaction force. This will require at least two passes with the plate compactor. Do not compact within 2 m (6 feet) of the unrestrained edges of the paving units.

Apply additional aggregate to the openings and joints if needed, filling them completely. Remove excess aggregate from the paving unit surface by sweeping, and then compact the pavers again. This will require at least two passes with the plate compactor. All pavers within 2 m (6 feet) of the laying face must be left fully compacted at the completion of each day.

3.2.9 CONSTRUCTION TRAFFIC

Construction traffic shall not be allowed on the surface until the jointing aggregate has been placed and vibrated into the joints and all debris and excess material has been swept off.

3.2.10 PROOF ROLLING

NOTE: This paragraph can be deleted for light load pavements such as driveways or pedestrian walkways.

The final finished concrete paving unit surface shall be rolled in static mode with four passes of rubber-tired roller with a static weight of not less than 4.5 T (5 tons). Remove and replace any cracked units and jointing aggregate, and make two additional passes over such areas.

3.3 SMOOTHNESS AND GRADE TOLERANCES

The final surface tolerance of compacted pavers shall not deviate more than ± 10 mm ($\pm 3/8$ inch) under a 3 m (10 foot) long straightedge. The surface elevation of pavers shall be 3 to 6 mm (1/8 to 1/4 inch) above adjacent drainage inlets, concrete collars or channels. Lippage among adjacent paver surfaces should not exceed 3 mm (1/8 inch).

3.3.1 REMEDIAL ACTION

Any area not meeting the smoothness, paver lippage, or grade tolerance shall be removed, adjustments made, and the paving units reinstated with new bedding and jointing aggregates.

3.4 PROTECTION

3.4.1 DURING CONSTRUCTION

Prevent sediment from entering the job area by providing multiple lines of best management practices upstream of the permeable pavement area. Install temporary soil stabilization on all upstream contributing drainage areas prior to beginning job.

Protect the job area from sediment due to construction materials and construction traffic. Completed area areas shall not be used as storage areas or for passage of construction traffic not related to the work.

3.4.2 AFTER INSTALLATION

Prevent sediment from entering the completed permeable pavement surface paver area. Do not remove multiple lines of stormwater best management practices until all upstream contributing drainage areas have been finally stabilized with at least 85% vegetative cover.

After work in this section is complete, the Contractor shall be responsible for protecting work from sediment deposition and damage due to subsequent construction activity and traffic on the site.

The installation contractor shall return to site after 6 months from the completion of the work and provide the following as required: fill paver joints with stones, replace broken or cracked pavers, and re-level settled pavers to initial elevations. Any additional work shall be considered part of original bid price and with no additional compensation.

3.5 CLEANUP

Sweep the entire pavement surface and remove all excess aggregate, paving units, and debris from the project area.

3.6 WASTE MANAGEMENT

NOTE: Diverting waste from the landfill contributes to the following LEED credit: MR2. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Designer shall verify that items are able to be disposed of as specified.

In accordance with the Waste Management Plan. [Protect excess material from contamination and return to manufacturer, or reuse on-site for walkways, patching, ditch beds, speed bumps, or curbs.]

3.7 MAINTENANCE

[3.7.1 O&M Training

Provide one 4-hour training session to DPW operation and maintenance division staff within 6 months of completion of the work. The training shall cover industry best practices on (a) surface infiltration testing, (b) surface cleaning, (c) removing broken pavers, replacing and re-leveling pavers. Contractor shall provide a minimum of two weeks notification prior to the training sessions.]

3.7.2 REPAIR MATERIALS

At the completion of work provide 1 bundle with a minimum of 280 paving units matching those used in the project to a Base location provided by the Contracting Officer. The delivered paving units shall be stacked on and secured to a shipping pallet.

— End of Section —

ABOUT CMHA

The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.

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