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PERMEABLE INTERLOCKING CONCRETE PAVEMENT ON STRUCTURAL SOILS

SECTION 32 14 13.19

Note: This guide specification for U.S. applications describes construction of permeable interlocking concrete pavers on a permeable, open-graded crushed stone bedding layer (typically ASTM No. 8 stone). The pavers and bedding layer are placed over geotextile-covered structural soil. This guide specification does not cover excavation, impermeable liners, perforated underdrain pipes, or structural soils. See [CU-Structural Soil® A Comprehensive Guide](#) for design and specification information. The application is for pedestrian use only. This pavement surface allows water to enter the soil thus benefiting trees and other vegetation planted in it while supporting pedestrian traffic. See detail drawing ICPI-83. Vehicular applications should be limited to automobiles and to intermittent, occasional use.

*Edit this specification term as necessary to identify the design professional in the General Conditions of the Contract. **The text must be edited by a qualified, licensed design professional to suit specific project requirements. ICPI makes no representations or warranties of any kind, expressed or implied, and disclaims any liability for damages resulting in the use of this guide construction specification.***

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Permeable interlocking concrete pavers.
2. Crushed stone bedding material.
3. Bedding and joint/opening filler materials.
4. Edge restraints.
5. Geotextiles.

B. Related Sections

1. Section [] - Structural soils.
2. Section [] - [Stabilized] aggregate base.
3. Section [] - Drainage pipes.
4. Section [] - Impermeable liner.
5. Section [] - Edge restraints.
6. Section [] - Drainage pipes and appurtenances.
7. Section [] - Earthworks/excavation/soil compaction.

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1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)**
 - 1. C29 Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate.
 - 2. C136 Method for Sieve Analysis for Fine and Coarse Aggregate.
 - 3. C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 4. C936 Standard Specification for Solid Interlocking Concrete Pavers.
 - 5. C979 Specification for Pigments for Integrally Colored Concrete.
 - 6. C1645 Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
 - 7. D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- B. American Association of State Highway and Transportation Officials (AASHTO)**
 - 1. M-288 Standard Specification for Geotextile Specification for Highway Applications.
- C. Interlocking Concrete Pavement Institute (ICPI)**
 - 1. Permeable Interlocking Concrete Pavement manual (5th edition)
 - 2. Permeable Design Pro software for hydrologic and structural design
- D. American Society of Civil Engineers (ASCE)**
 - 1. ASCE 68-18 Permeable Interlocking Concrete Pavements.

1.03 SUBMITTALS

- A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.**
- B. [Paver manufacturer’s] [Installation subcontractor’s] drawings and details: Indicate perimeter conditions, junction with other materials, expansion and control joints, paver [layout,] [patterns,] [color arrangement,] installation [and setting] details. Indicate layout, pattern and relationship of paving joints to fixtures, and project formed details.**
- C. Minimum 3 lb (2 kg) samples of the bedding and jointing aggregate materials.**
- D. Sieve analysis of aggregates for the bedding and jointing aggregates per ASTM C136.**
- E. Soils report indicating density test reports, classification, infiltration rate measured on-site [under compacted conditions], and suitability for the intended project.**
- F. Erosion and sediment control plan.**
- G. Permeable concrete pavers:**
 - 1. Paver manufacturer’s catalog sheets with product specifications.
 - 2. [Four] representative full-size samples of each paver type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation.
 - 3. Accepted samples become the standard of acceptance for the work of this Section.
 - 4. Laboratory test reports certifying compliance of the concrete pavers with ASTM C936.
 - 5. Manufacturers’ safety data sheets for the safe handling of the specified paving materials and other products specified herein.
 - 6. Paver manufacturer’s written quality control procedures including representative samples of production record keeping that ensure conformance of paving products to the product specifications.
- H. Paver Installation Subcontractor:**
 - 1. Demonstrate that job foremen on the project have a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program and a record of completion from the PIP Installer Course.

2. Job references from projects of a similar size and complexity. Provide Owner/ Client/General Contractor names, postal address, phone, fax, and email address.

1.04 QUALITY ASSURANCE

A. Paver Installation Subcontractor Qualifications:

1. Utilize an installer having successfully completed concrete paver installation similar in design, material and extent indicated on this project.
2. Utilize an installer with job foremen holding a certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.

B. Regulatory Requirements and Approvals: [Specify applicable licensing, bonding or other requirements of regulatory agencies].

C. Review the manufacturers' quality control plan, paver installation subcontractor's Method Statement and Quality Control Plan with a pre-construction meeting of representatives from the manufacturer, paver installation subcontractor, general contractor, engineer and/or owner's representative.

D. Mock-Ups:

1. Install a 10 ft x 10 ft (3 x 3 m) paver area.

Note: Mechanized installations may require a larger mock-up area to exemplify a quality installation. Consult with the paver installation contractor on the size of the mock-up.

2. Use this area to determine surcharge of the bedding layer and paver settlement after compaction, joint sizes, and lines, laying pattern, color and texture of the job.
3. This area will be used as the standard by which the work will be judged.
4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
5. If mock-up is not retained, remove and properly dispose of mock-up.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver bundle.

1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
2. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by forklift or clamp lift.
3. Unload pavers at job site in such a manner that no damage occurs to the product or existing construction

D. Storage and Protection: Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install in rain or snow.

B. Do not install frozen bedding materials.

1.07 MAINTENANCE

A. Extra materials: Provide [Specify area] [Specify percentage] additional material for use by owner for maintenance and repair.

- B. Pavers shall be from the same production run as installed materials.

PART 2 PRODUCTS

2.01 PAVING UNITS

- A. **Manufacturer:** [Specify ICPI member manufacturer name].
1. Contact: [Specify ICPI member manufacturer contact information].
- B. **Permeable Interlocking Concrete Paver Units:**
1. Paver Type: [Specify name of product group, family, series, etc.].
 - a. Material Standard: Comply with ASTM C936. Use -15° C as the lowest temperature for freeze-thaw durability testing while test specimens are immersed in a 3% saline solution per ASTM C1645 for projects subject to deicers.
 - b. Color [and finish]: [Specify color.] [Specify finish].
 - c. Color Pigment Material Standard: Comply with ASTM C979.

Note: Concrete pavers may have spacer bars on each unit. Spacer bars are recommended for mechanically installed pavers. Manually installed pavers may be installed with or without spacer bars. Overall dimensions should not include spacer bars.

- d. Size: [Specify] inches [mm] x [Specify] inches [mm] x [Specify] inches [mm] thick.

2.02 PRODUCT SUBSTITUTIONS

- A. **Substitutions: Permitted for gradations for crushed stone jointing and bedding, materials. Bedding materials shall have a minimum 0.2 porosity per ASTM C29. All substitutions shall be approved in writing by the project engineer.**

2.03 CRUSHED STONE FILLER AND BEDDING

- A. **Crushed stone with 90% fractured faces**
- B. **Do not use rounded river gravel.**
- C. **All stone materials shall be washed with less than 2% passing the No. 200 sieve.**
- D. **Joint/opening filler and bedding: conforming to ASTM D448 gradation as shown in Table 1 below:**

Note: No. 89 or No. 9 stone may be used to fill pavers with narrow joints.

Table 1

ASTM No. 8 Grading Requirements Bedding and Joint/Opening Filler	
Sieve Size	Percent Passing
12.5 mm (1/2 in mm)	100
9.5 mm (3/8 in.)	85 to 100
4.75 mm (No. 4)	10 to 30
2.36 mm (No. 8)	0 to 10
1.16 mm (No. 16)	0 to 5

2.04 ACCESSORIES

- A. **Provide accessory materials as follows:**

Note: Curbs will typically be cast-in-place concrete or precast set in concrete haunches. Concrete curbs may be specified in another Section.

1. Edge Restraints
 - a. Manufacturer: [Specify manufacturer].
 - b. Material: [Pre-cast concrete] [Cut stone] [Concrete].

- c. Material Standard: [Specify material standard.].

Note: Select geotextile using AASHTO M-288 for separation geotextiles.

- 2. Geotextile:
 - a. Material Type and Description: [Specify material type and description.].
 - b. Material Standard: [Specify material standard.].
 - c. Manufacturer: [Acceptable to interlocking concrete paver manufacturer]

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. [Specify acceptable paver installation subcontractors.].

3.02 EXAMINATION

Note: The elevations and surface tolerance of the soil subgrade determine the final surface elevations of concrete pavers. The paver installation contractor cannot correct deficiencies excavation and grading of the soil subgrade with additional 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.

- A. **Acceptance of Site Verification of Conditions:**
 - 1. General 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.
 - a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
 - b. Provide written density test results for structural soil to the Owner, General Contractor and paver installation subcontractor.
 - c. Verify location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage pipes and inlets.
 - 2. Do not proceed with installation of bedding and interlocking concrete pavers until structural soil conditions are corrected by the General Contractor or designated subcontractor.

3.03 PREPARATION

- A. **Verify that the installed structural soil subgrade is free from standing water.**
- B. **Stockpile joint/opening aggregates such that they are free from standing water, no visible segregation of aggregate sizes, free of any organic material or sediment, debris, and ready for placement.**
- C. **Edge Restraint Preparation:**
 - 1. Install edge restraints per the drawings [at the indicated elevations].

3.04 INSTALLATION

- A. **General**
 - 1. Keep area where pavement is to be constructed free from sediment during entire job. Structural soil, geotextiles and bedding materials contaminated with sediment shall be removed and replaced with clean materials.
 - 2. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.
- B. **Geotextiles**
 - 1. Place on structural soils and along sides of installation. Secure in place to prevent wrinkling from vehicle tires/tracks.

2. Overlap a minimum of [12 in. (0.3 m)] in the direction of drainage.

C. Bedding layer

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

D. Permeable interlocking concrete pavers and joint/opening fill material

1. Lay the paving units in the pattern(s) and joint widths shown on the drawings. Maintain straight pattern lines.
2. Fill gaps at the edges of the paved area with cut units. Cut pavers shall be no smaller than 1/3 of a whole unit.
3. Cut pavers and place along the edges with a [double-bladed splitter or] masonry saw.
4. Fill the openings and joints with [No. 8] stone.

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

5. Remove excess aggregate on the surface by sweeping pavers clean.
6. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 5,000 lbf (22 kN). This will require at least 4 passes with the plate compactor.
7. Do not compact within 6 ft (2 m) of the unrestrained edges of the paving units.
8. Apply additional aggregate to the openings and joints if needed, filling them completely and remove excess aggregate by sweeping then compact the pavers. This will require at least 2 passes with the plate compactor.
9. All pavers more than 6 ft (2 m) of the laying face must be left fully compacted at the completion of each day.
10. The final surface tolerance of compacted pavers shall not deviate more than $\pm 3/8$ (10 mm) under a 10 ft (3 m) long straightedge.
11. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

3.05 FIELD QUALITY CONTROL

- A. **After sweeping the surface clean, check final elevations for conformance to the drawings.**
- B. **Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.**

Note: The surface of the pavers may be 1/8 to 1/4 in. (3 to 6 mm) above the final elevations after compaction. This helps compensate for possible minor settling normal to pavements.

- C. **The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.**
- D. **Bond lines for paver courses: $\pm 1/2$ in. (± 15 mm) over a 50 ft (15 m) string line.**

3.06 PROTECTION

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

- B. PICP 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.**

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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