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# Eagle Bay Permeable Pavement – Construction Specification

**Specification Section 32 14 13.19 (1995 MasterFormat Section 02795)**

*[Note: This guide specification is for U.S. based construction of the Eagle Bay Permeable Pavement Systems and SWMpave. While this guide specification does not fully cover earthwork, miscellaneous concrete, geosynthetics, and storm drainage, references are provided as guidance on the integrated systems approach to stormwater management with this permeable pavement solution]*

*[This text is fully editable, and must be reviewed closely and modified to suit the site-specific project requirements. Particular attention should be paid to the underlying soil properties as it relates to the depth of stone sub-base and the rate of infiltration for a fully recovered (or dry) system in order to achieve optimal performance. This should be determined by a qualified civil or geotechnical engineer, or in some cases a landscape architect, who is in responsible-charge of the design as identified in the Contract Documents]*

## PART 1 – GENERAL

### 1.01 SUMMARY

- A. Provide labor, materials, tools and equipment to furnish and install an Eagle Bay permeable pavement system as indicated on the plans and as specified herein.
- B. Section Includes
  - a. Permeable Interlocking Concrete Pavers
  - b. Crushed Stone bedding material
  - c. Open-graded subbase aggregate
  - d. Open-graded base aggregate
  - e. Bedding and joint opening aggregate
  - f. Concrete edge restraints
  - g. Geosynthetics

### C. Related Sections

- a. Section \_\_\_\_\_ - Earthwork
- b. Section \_\_\_\_\_ - Miscellaneous Concrete
- c. Section \_\_\_\_\_ - Geosynthetics
- d. Section \_\_\_\_\_ - Storm Drainage

### 1.02 REFERENCES

#### A. American Society for Testing and Materials (ASTM)

- a. C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- b. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
- c. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- d. C 418, Standard Test Method for Abrasion Resistance of Concrete by Sandblasting
- e. C 936, Standard Specification for Solid Concrete Interlocking Paving Units.
- f. C 979, Standard Specification for Pigments for Integrally Colored Concrete.
- g. C 1701, Standard Test Method for Infiltration Rate of In Place Pervious Concrete
- h. C1781 Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems
- i. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- j. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
- k. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
- l. D 1883, Test Method for California Bearing Ratio of Laboratory-Compacted Soils.
- m. D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).

- n. D3385 Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer
- o. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

B. Interlocking Concrete Pavement Institute (ICPI)

- a. Permeable Interlocking Concrete Pavements Manual, latest edition.
- b. PICP Permeable Design Pro software, latest version

### 1.03 DEFINITIONS

*[Designers should specify one of three types of PICP design intent: Full Exfiltration requires high infiltration rates in the subgrade and therefore does not include an underdrain; Partial Exfiltration allows infiltration but also includes a pipe underdrain which is the most common type of design; or No Exfiltration which requires the use of an impermeable liner that prevents infiltration. Except as specified elsewhere testing of the subgrade should be provided.]*

- A. Base Course: Layer of open-graded aggregate beneath the bedding course layer, comprised of small- to medium- sized stone (typically 1/2" to 1"). Recommended depth of the base course shall be four inches (4").
- B. Bedding Course: Layer of open-graded aggregate directly beneath the permeable interlocking concrete pavers, comprised of small sized stone chips (typically 1/4" to 3/8") also commonly called the "setting bed". Recommended depth of the bedding course shall be two inches (2").
- C. Bundle: Several layers (or clusters) of unit pavers stacked vertically, packaged, and tagged for shipment. Also commonly called a "cube".
- D. Chamfer: A 45-degree beveled edge around the top of a unit paver, usually 1/8" to 1/4" wide. It helps collect runoff into the open voids between unit pavers, prevents edge chipping and unit paver displacement, and delineates the paving's individual units. It also prevents damage during snow removal.
- E. Cluster: The group of pavers forming a single layer from a bundle of pavers or the group of pavers held by the clamp of a unit paver laying machine.
- F. Flats: The portion of the side faces of a unit paver, other than the spacer bars.
- G. General Contractor: Responsible party to the Owner according to the construction contract who may or may not be the installer.

- H. Installer: Responsible party for the installation of the permeable pavement system including related quality assurance. May be a subcontractor to the general contractor.
- I. Laying Face: The working edge of the pavement installation where the laying of unit pavers is occurring.
- J. Manufacturer: Responsible party for the fabrication, fabrication related quality assurance and delivery of unit pavers and associated appurtenances.
- K. Mechanical Installation: The use of specialized machines to lift clusters of pavers from the bundles and place them on the bedding course. These specialized machines are designed specifically for the laying of unit pavers and to avoid hand placement of individual unit pavers, reducing production time.
- L. Method Statement: The unit paver installer's and manufacturer's combined plan for manufacturing, delivery, construction and quality control of the pavement system.
- M. PICP – Permeable Interlocking Concrete Pavers
- N. Spacer Bars: Small protrusions on each side of pavers which are used to keep them uniformly spaced while compacting the pavement system, minimizing chipping and spalling during the process. Mechanically installed pavers must have spacer bars.
- O. Sub-base Course: Layer of open-graded aggregate beneath the base course layer, comprised of large-sized stone (typically 2-1/2" to 3" fractured rock). Depth shall vary depending upon site conditions including anticipated vehicle loadings and stormwater storage requirements. Minimum depth of the sub-base course shall be six inches (6").
- P. Void Filler: Open-graded aggregate used to fill the openings between the unit pavers. The void filler should match the bedding course aggregate, or shall utilize smaller particle-sized stone chips (1/8" to 1/4") if available.
- Q. Wearing Course: The top surface of the unit paver, surrounded by a chamfer.

#### **1.04 SUBMITTALS**

Submit the following information in accordance with Division 1 requirements.

##### **A. Unit Pavers**

1. Manufacturer Pre-qualification Statement

- a. Manufacturer shall demonstrate that they have a minimum of 5 years successful experience in the manufacture of interlocking concrete block pavers, and that they have supplied permeable unit pavers for at least three (3) completed projects of a similar nature, with regard to installation and production capacity required for the project.
  - b. Manufacturer shall provide at references for each completed project for review. For each reference, provide Owner, Client, and General Contractor company names, point of contact, postal address, phone, fax, and e-mail address.
  - c. References shall be required to demonstrate that the Manufacturer has a proven record of sufficient production capacity and established quality control procedures to produce, store, and deliver the required number of unit pavers with the quality specified within the required time frame.
2. Product Information - The manufacturer's catalog cut sheets, drawings and details showing the type and dimensions of the proposed unit pavers including length, width, height, chamfers, spacer bars, junction with other materials, perimeter conditions, joints, laying pattern (or layout), style, color, special finishes and other details.
  3. Test Results – Unit paver reports certifying compliance with ASTM C 936 and C 1701.
  4. Material Samples - At least four (4) full size unit pavers, for each type, thickness, color and finish to be used on the project. Samples should indicate the range of color and other variations to be expected.
  5. Quality Control - A detailed description of the manufacturer's quality control procedures until delivery to the site including a certification of the concrete pavers by ICPI as having met applicable ASTM standards and record-keeping forms.

B. Aggregate and Stone Materials.

1. Product Information - Locally accepted and current certifications for the aggregate and stone products to be used in paving.
2. Test Results - Current sieve analysis, void ratio, and bulk density of each type of aggregate and stone certifying compliance with ASTM C 136.
3. Material Samples of at least three pounds (3 lb) weight for each type of aggregate and stone including void filler, bedding course, base course, sub-base course, and other types as specified.

4. Quality Control - A detailed description of the manufacturer's quality control procedures until delivery to the site, including a written certification that the stone and delivery trucks will be thoroughly washed prior to each delivery.

C. Installer Pre-Qualification Statement: Designate an experienced paver installer for the project, meeting the following requirements for approval.

1. Provide at least three (3) job references in writing from projects of a similar size and complexity. For each reference, provide Owner, Client, and General Contractor company names, point of contact, postal address, phone, fax, and e-mail address.
2. References shall be required to demonstrate that the installer and job foreman have suitably experienced personnel and a management capability sufficient to execute the work.
3. Designate and provide a job foreman on the project available at all times during the work with at least five (5) years of relevant experience, and holding a current certificate from the ICPI Concrete Paver Installer Certification program and a record of completion from the PICP Specialist Course, or
4. Submit written evidence that the Contractor shall provide a consultant who has the required certifications and will be onsite at all times during the unit paver installation, acting as the installer for the project.

D. Installer Pre-Qualification Statement: Owner will require an experienced Contractor for the project, meeting the following requirements for approval.

1. Provide at least three (3) job references in writing from projects of a similar size and complexity, total square footage to exceed the project quantities. For each reference, provide Owner, Client, and General Contractor company names, point of contact, postal address, phone, fax, and e-mail address.
2. References shall be required to demonstrate that the installer and job foreman have suitably experienced personnel and a management capability sufficient to execute the work.
3. Designate and provide a job foreman on the project available at all times during the work with at least five (5) years of relevant experience, and holding a current certificate from the ICPI Concrete Paver Installer Certification Program and a record of completion from the PICP Specialist Course, or

4. Submit written evidence that the Contractor shall obtain the service of a consultant who has the required certifications and will be onsite at all times during the unit paver installation, acting as the installer for the project.

E. Method Statement:

1. Provide a written Method Statement that includes at a minimum:
  - a. A description of the relationship of the paver installer to the Manufacturer, Suppliers, Owner and General Contractor;
  - b. A description of the anticipated production rate, mold life, rate and effect of mold wear on pavers produced, individual mold runs, and a mold rotation plan.
  - c. A description of the anticipated growth in cluster size due to mold wear and a plan for dealing with that growth or other dimensional variances
  - d. The manufacturer's supply data demonstrating experience on similar past projects.
  - e. A method of measuring the clusters at the factory and in the field.
  - f. The installer's intention to machine-lay or hand-lay the pavers and an explanation of qualifying experience to date for the appropriate method of proposed installation.
  - g. Material storage, delivery, and staging plans.
  - h. Clear diagrams showing the proposed starting point of the installation, the proposed direction of installation, scheduled progress and installation rates on a week-by-week basis, and the dimensional controls to be used to maintain specified joint width and straight joint lines.
  - i. A description of the personnel and equipment to be employed for each portion of the work including manufacture, installation and quality control.
  - j. A schedule for testing and inspections to be provided; name of the independent testing agency.
  - k. Examples of all reporting forms and documentation to be used on the project to ensure conformance to the project specifications.
  - l. A quality control plan (or by reference).

F. LEED Documentation [optional]:

- a. As required by other project specifications and requirements, the Contractor shall provide the documentation necessary for LEED certification, including any certifications, calculations or LEED letter templates as provided by the Owner.
- b. Possible LEED points are as follows:
  - i. Materials and Resources Credit 4, Recycled Content: Certification of the post-consumer recycled content value and the post-industrial recycled content value, as a percentage of the unit paver materials, by weight. Also include a statement indicating the costs for products with recycled content.
  - ii. Materials and Resources Credit 5, Regional Materials: Certification as to the amount of materials extracted, harvested or recovered, as well as manufactured regionally within a maximum radius of the project site.
  - iii. Sustainable Sites Credit 7.1, Heat Island Effect: Certification of a Solar Reflex Index of 29 or greater for the unit pavers, to reduce heat island affects on at least fifty percent of the site's non-roof impervious surfaces.
  - iv. Innovation and Design Process: In addition to the LEED credits noted above, the use of permeable pavement reduces impervious surfaces and improves water efficiency, possibly qualifying for up to 4 points in this category. The use of TX Active Photocatalytic Cement also has smog-reducing benefits, which might quality in this category. Not only does this improve air quality, but the chemical properties will keep the concrete clean and reflective longer, by interacting with the deleterious materials usually found on concrete surfaces over time. The Owner's design team should evaluate these additional benefits as described in the product literature submitted and decide if additional points are warranted for the use of this product.
  - v. Other Credits: As determined by the Owner.

## **1.05 QUALITY ASSURANCE**

### **A. Quality Control Plan**

1. The general contractor shall work with the manufacturer and installer to establish, submit and maintain a written, approved quality control plan throughout the project. The quality control plan shall provide reasonable assurances that all materials and construction work submitted for



acceptance will conform to the contract requirements. Although guidelines are established and certain requirements are specified, the general contractor shall assume full responsibility for meeting all requirements for quality and workmanship.

2. The plan shall contain at a minimum the manufacturer's quality control procedures including the following:
  - a. The manufacturer's production records showing the date of manufacture, a mix design designation, mold number, mold cycles, and sequential pallet numbers. Copies of such records shall be made available to the owner upon request.
  - b. A description of the anticipated production growth in the cluster size and a plan for managing the growth so as to not interfere with placement by paving machine(s), if mechanically installed, in accordance with the schedule.
  - c. An agreed upon method for measuring the clusters at the factory and again in the field.
3. The plan shall contain at a minimum the installer's quality control procedures including the following:
  - a. Dimensional control methods
  - b. Paving machine(s) head adjustment
  - c. Typical daily work schedule to insure that all pavers placed on any given day are adjusted as required, void filler completed, compacted and verified at the end of that each installation day.
  - d. Provisions for identifying and recording actual daily production and the bundle numbers of pavers used in each day's installation.

#### B. Unit Paver Mock-Ups

1. For every 200,000 unit pavers, install one (1) 10 foot x 10 foot unit paver mock-up, showing details for the work involved for installation using approved materials.
2. Use this mock-up to depict the surcharge of the bedding layer, joint sizes or spacing, laying pattern, color variation, and overall quality of the work involved.
3. Once approved by the Owner, the mock-up shall become the standard by which the work will be judged.

4. If approved by the Owner, the mock-up may also be retained as part of the finished work. If mock-up is not retained, remove and dispose of properly at the end of the related work.

#### C. Sampling and Testing

1. The manufacturer shall designate and employ an independent testing company, qualified to undertake tests in accordance with the applicable standards specified herein. Test results shall be provided to the installer and the owner, upon request.
2. Unit pavers shall be inspected and tested to verify dimensional variation, compressive strength (ASTM C140), density and absorption (ASTM C140) and abrasion resistance (ASTM C418).
3. The initial testing frequency shall be one set of tests for each 100,000 full-sized unit pavers delivered to the site or at any time a change in the manufacturing process, mix design, cement, aggregate or other material occurs.
4. The following number of full-sized unit pavers shall be randomly sampled, per test:
  - a. Five (5) for dimensional variation
  - b. Three (3) for compressive strength
  - c. Three (3) for density and absorption
  - d. Three (3) for abrasion resistance.
5. If all unit pavers tested pass all requirements for a contiguous sequence of 400,000 unit pavers the testing frequency may be relaxed to one set of tests for each 200,000 full-sized unit pavers. If any pavers fail any of the required tests, then the testing frequency shall revert to the initial testing frequency.
6. When any of the individual test results fail to meet the specified requirements, the cluster of pavers represented by that test sample shall be rejected. The manufacturer shall provide additional testing from both before and after the rejected test sample with test results that meet all requirements, to determine the sequence of the paver production run that is unacceptable.
7. Additional testing, as described above, shall be performed at no additional expense to the owner. The sequence of pavers found to be defective shall, if they have been delivered to the site, be removed from the site promptly at no additional expense to the owner.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Unit pavers shall be handled, delivered to the site, and stored with or without pallets, in such a way that no damage occurs to the product prior to installation.
- B. Unit pavers shall be delivered to the site in approximately the chronological order in which they were manufactured. They shall be staged on site, as per the method statement.
- C. Each bundle of pavers shall be marked with a weather-proof tag identifying at a minimum the manufacturer, the date of manufacture, the mold number, the project name and phase for which the pavers were manufactured and the sequential bundle number.
- D. Manufacturer's ordering instructions and lead-time requirements shall be part of the Method Statement so as to avoid construction delays. Close coordination between the general contractor, manufacturer and installer will be required for this project.

**1.07 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install in rain or snow, in standing water conditions, or in overly wet conditions as determined by the Owner or the independent testing agency.
- B. Do not install on frozen ground, or by using materials that are frozen, as determined by the Owner or the independent testing agency.

**1.08 MAINTENANCE**

- A. Extra materials: Contractor shall provide [Specify area size, percentage area, or number] additional unit pavers for use by the Owner for maintenance and repair work that may be necessary after project acceptance.
- B. Unit pavers shall be from the same production run as installed materials, and shall comply with the same product requirements as the installed work. The number of unit pavers shall be clearly identified prior to production.

**PART 2 – PRODUCTS**

**2.01 UNIT PAVERS**

- 1. Manufacturer: Eagle Bay USA, 1231 Willis Road, Richmond, Virginia 23237
  - a. Name: Bob Bridges
  - b. Phone: 540-494-7336

- c. Fax: 804-743-4392
- d. Website: www.eaglebayusa.com

2. Type: Aqua Bric Type 4 “L” Joint/Void System

- a. Material Standard: Comply with ASTM C 936.
- b. Size: “L” Shape, with a 250 mm (9.84”) x 125 mm (4.92”) plan area on both legs, and an 80mm (3.15”) thickness, not considering chamfers and joint details.
- c. Color [and finishes]: [specify color] [specify finishes].
- d. Pigment Standard: Comply with ASTM C 979.
- e. Type: Joint/Void System

3. Optional Finishes [Specify optional finished below or delete this section]

- a. \_\_\_\_\_ with TX Active Photo Catalytic Cement
- b. \_\_\_\_\_ with 20% Recycled Content
- c. \_\_\_\_\_ with a Solar Reflex Index of 29 or greater
- d. \_\_\_\_\_ with LEED Point(s) Documentation

4. Quality Assurance

- a. All unit pavers shall comply with the following material requirements:
  - i. Unit Pavers: Conform to ASTM C 936.
  - ii. Color(s): Selected from a standard range of colors and/or natural gray.
  - iii. Mold Life: No paver shall be used for this project which has been manufactured in a mold that exceeds the mold life specified in the Method Statement.
  - iv. Visual Inspection: All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Minor cracks incidental to the usual methods of manufacture, or minor chipping resulting from customary methods of handling in shipment, delivery and installation, shall not be deemed grounds for rejection.

- v. ADA Compliance: Joint widths shall not exceed 13 millimeters and all unit paver installations shall comply fully with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) upon installation.
- b. Unit Paver Materials
- i. Portland Cement: Conform to ASTM C 150.
  - ii. Aggregates: Conform to ASTM C 33 for normal weight concrete aggregate (no expanded shale or lightweight aggregate) except that grading requirements may not apply.
  - iii. Pigments: Conform to ASTM C979 and as specified in the Contract Documents.
  - iv. Water: Clean and free from any deleterious matter.
  - v. Other Constituents: Air-entraining admixtures, integral water repellents and finely ground silica shall have a proven record of performance and shall conform to the relevant ASTM standards.
- c. All unit pavers shall meet the following testing requirements:
- i. Compressive Strength: At the time of delivery, the average compressive strength of the pavers shall not be less than 8,000 psi, with no individual unit less than 7,200 psi. Testing procedures shall be in accordance with ASTM C 140.
  - ii. Dimensional Tolerances of a Paver: Pavers shall be prismatic in plan and formed with straight, uniform edges. The tolerance for the flat portions of the sides shall not exceed 1/16" as measured with a steel straight edge. "Slumped" pavers exceeding this tolerance will be rejected. The length, width and thickness of the unit pavers shall meet the allowable tolerances specified in ASTM C 936.
  - iii. Dimensional Tolerances of a Cluster: The measurement across a cluster for any mold shall not increase more than 1/2" for the entirety of the use of the mold for this project.
  - iv. Absorption: The average absorption shall not be greater than five percent (5%), with no individual unit result greater than seven percent (7%) per ASTM C 140.
  - v. Resistance to Freezing and Thawing: The specimens shall have no breakage and shall have no greater than one percent (1%) loss measured by dry weight of

any individual unit paver when subjected to 50 cycles of freezing and thawing per ASTM C 67.

- vi. Abrasion: The maximum volume loss shall be 0.92 cubic inches per 7.75 square inches with an average thickness loss of no more than 0.118 inches due to abrasion testing per ASTM C418.

5. Maintenance [optional]: The Americast Eagle Bay Division shall include at no additional cost the maintenance of the permeable pavement system for a period of one (1) year. Annual maintenance includes a maximum of two (2) scheduled visits. Each visit shall consist of the following:

- d. Visual Inspection
- e. Replace Damaged PICP Units, if required.
- f. Remove Foreign Debris, Silt and Trash with a regenerative air vacuum truck or similar, and Offsite Disposal of Collected Material
- g. Joint Material Replenishment and Compaction
- h. Maintenance Records Updated and Provided to Owner/Operator

Extended maintenance agreements can also be purchased from Eagle Bay on a case by case basis.

## 2.02 CRUSHED STONE AND AGGREGATE MATERIALS

1. Manufacturer: [specify based on local availability] or [Contractor to determine]

- a. Name: [name]
- b. Phone: [number]
- c. Fax: [number]
- d. Website: [website]

2. Types

- a. Bedding and Joint/Void Filler Aggregate: The bedding course and void filler aggregate shall be free of organics and soluble salts, or other contaminants likely to cause efflorescence. The grading requirement shall be in compliance with the following gradation chart and ASTM D448.

Table 1

ASTM No. 8 - Sieve Size Percent Passing (by weight)

1/2 inch	100
3/8 inch	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

- b. Optional Bedding and Joint/Void Filler Aggregate: For narrow joints, ASTM No. 89 or ASTM No. 9 stone may be used as a substitute for the No. 8 bedding aggregate.
- c. Base Course Aggregate: The base course aggregate shall consist of open-graded, angular, washed stone and meet the following gradation chart and ASTM D448.

Table 2

ASTM No. 57 - Sieve Size Percent Passing (by weight)

1-1/2 inch	100
1 inch	95 to 100
1/2 inch	25 to 60
No. 4	0 to 10
No. 8	0 to 5

- d. Sub-Base Course Aggregate: The sub-base course aggregate shall consist of open-graded, angular, washed stone and meet the following gradation chart and ASTM D448.

Table 3

ASTM No. 3 - Sieve Size Percent Passing (by weight)

3 inch	100
2-1/2 inch	90 to 100
2 inch	35 to 70
1-1/2 inch	0 to 10
3/4 inch	0 to 5

### 3. Quality Assurance

- a. All stone materials shall be washed at the plant with less than 1% passing the No. 200 sieve, if tested. Hauling shall be in washed truck beds.

- b. Stone shall also have:
  - i. 90% angular, fractured faces. Do not use rounded river gravel or stone for vehicular loading applications.
  - ii. LA Abrasion < 40 per ASTM C 131
  - iii. Minimum CBR of 80% per ASTM D 1883.
- c. Gradation variation between layers shall meet Dx requirements as described below. Dx is the particle size at which x percent of the particles are finer. For example, D15 is the particle size of the aggregate for which 15% of the particles are smaller and 85% are larger. Additional criteria are as follows:
  - i. D15 base stone / D15 bedding stone < 5.
  - ii. D50 base stone/ D50 bedding stone > 2.

### 2.03 ACCESSORIES

- 1. TX-5 Geogrid: Tensar International Corp., 2500 Northwinds Parkway, Suite 500, Alpharetta, GA, 30009
  - a. Name: Mark Wayne
  - b. Phone: 770-344-2164
  - c. Fax: 770-344-2084
  - d. Website: [www.tensarcorp.com](http://www.tensarcorp.com)
  - e. Material Specifications: Per Manufacturer
  - f. Quality Assurance: Per Manufacturer
- 2. Geotextile Fabric: **[specify based on local availability]**
  - a. Name: **[name]**
  - b. Phone: **[number]**
  - c. Fax: **[number]**
  - d. Website: **[website]**
  - e. Material Specifications: Per Manufacturer
  - f. Quality Assurance:



- i. Per manufacturer
  - ii. Provide certification as to complying with ICPI guidance on geotextile product selection based on site specific material properties of the adjoining soils and other factors.
- 3. Impermeable Liner: [specify based on local availability]
  - a. Name: [name]
  - b. Phone: [number]
  - c. Fax: [number]
  - d. Website: [website]
- 4. Material Specifications: Per Manufacturer
  - a. Quality Assurance:
    - i. Per manufacturer
    - ii. Provide certification as to complying with ICPI guidance on impermeable liner types, thicknesses and other details. Typically 30mil minimum thickness for PVC liners and 40mil minimum thickness for HDPE liners.
- 5. Precast or Manufactured Edge Restraints: [Does not include miscellaneous concrete structures or cast-in-place work covered by local or state design standards, such as VDOT's CG-2, CG-3, CG-6, CG-9, CG-11, CG-13, etc.]
  - a. Name: [name]
  - b. Phone: [number]
  - c. Fax: [number]
  - d. Website: [website]
  - e. Material Specifications: Per Manufacturer
  - f. Quality Assurance:
    - i. Per manufacturer
    - ii. Edge restraints shall typically be pre-cast or cast-in-place concrete structures with suitable foundations to accept the horizontal forces that are transferred

through the wearing surface due to vehicular loading applications. Do not use plastic or metal edging with steel spikes to restrain the unit pavers except by written agreement between the Owner, Designer and Manufacturer.

## **PART 3 – EXECUTION**

### **3.01 QUALIFIED INSTALLERS**

1. Installers shall prove that they meet all project requirements as described herein prior to being accepted for this project.
2. Pre-qualified installers already determined to meet project requirements are as follows:
  - a. [Specify acceptable paver installation subcontractors].
  - b. [Specify acceptable paver installation subcontractors].
  - c. [Specify acceptable paver installation subcontractors].

### **3.02 EXAMINATION**

1. Acceptance of Site Conditions:

*[The elevations and surface tolerance of the soil subgrade determine the final surface elevations of installed unit pavers for the most part. The installer cannot correct deficiencies in 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 and designated third party, with written certification presented to the unit paver installation subcontractor prior to starting that work.]*

- a. General Contractor shall inspect, accept and certify in writing that site conditions meet project requirements prior to the installation of unit pavers, aggregate and stone layers. This includes the following:
  - i. Verify location, type, elevation, and general conformance of the design for all edge restraints, utility structures, and drainage pipes and inlets.
  - ii. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
  - iii. Provide any required written test results for subgrade preparation to the Owner, General Contractor and paver installer.
  - iv. Address any deficiencies identified, and re-inspect and test any new work for conformance to the specified requirements.

- b. A designated third party shall verify that site conditions meet the project requirements as certified by the Contractor and shall provide any additional required testing for this verification.
  - c. The unit paver installer shall accept or reject the certification and verification in writing prior to starting work.
2. Copies of all examination reports will then be provided to the Owner for final review and acceptance prior to starting work on the bedding and unit paver installations.

### **3.03 PREPARATION**

1. Edge Restraints:
- a. Inspect edge restraints installed by others.
  - b. Install any additional edge restraints, per the drawings [at the indicated elevations and dimensions].
  - c. Inspect and test any additional edge restraints following the procedures for acceptance of site conditions as described above.
2. Verify that the soil subgrade is free from standing water or frozen conditions.
3. Stockpile joint / opening filler, base and subbase materials such that they are free from standing water and frozen conditions, uniformly graded, and free of any organic material, sediment, or debris, and ready for placement.

### **3.04 INSTALLATION**

1. General
- a. 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 geosynthetic and aggregate materials.
  - b. Keep area where pavement is to be constructed free from sediment during the entire job. Geosynthetics, subbase, base or bedding materials contaminated with sediment shall be removed and replaced with clean materials.
  - c. Protect drainage systems and appurtenances during installation. Report any damage immediately to the project engineer.

- d. Install sub-drains in the pavement design, as specified and based on soil conditions. Plan the work in combination with paving installation as described below.

## 2. Geosynthetics

*[Compaction of the subgrade is optional and should be determined by the designer. If the soil subgrade is poor, typical installations would recommend the use of a Tensar TX5 geogrid to bridge the poor soils. Another option would be to require compaction to a minimum of 95% standard Proctor density per ASTM C 698. Compacted soil density and moisture should be checked in the field with a nuclear density gauge or other test methods. Stabilization of the soil and/or base material may be necessary with weak or continually saturated soils, or when subject to high wheel loads. Compaction will however reduce the permeability of soils and reduced infiltration may require partial or no exfiltration design]*

- a. Place geogrid and/or geotextile fabric on the sides **[and bottom]** of soil subgrade as specified and in accordance with manufacturer's recommendations.
- b. Secure in place to prevent movement during construction in accordance with manufacturer's recommendations.
- c. Overlap a minimum of 12 inches at all joints and seams, in the direction of drainage on bottom slopes for most geosynthetics.
- d. For impermeable liners requiring a watertight joint, all seams should be sewn, taped or welded in accordance with manufacturer's recommendations instead of using overlapping joints.
- e. Retain excess material above grade during construction to cover adjacent disturbed soils and further protect the interface between the soils and washed aggregate and stone. Cut excess material to grade as adjacent disturbed areas are stabilized.

## 3. Subbase Layer

*[Sub-base thickness will depend on soil subgrade conditions, subgrade preparation requirements, and the anticipated traffic loadings. PICIP Permeable Design Pro software or similar pavement design calculations should be performed as part of any projects under vehicular traffic loadings. A minimum thickness of 6-inches is required, and 12 inches is recommended as the minimum in most applications.]*

- a. Thoroughly moisten, spread and compact the subbase layer (No. 2) in 6 inch lifts. Place subbase as required to protect geosynthetics at all times from wrinkling or damage under equipment tires and tracks.
- b. For each lift, make at least two consecutive passes in the vibratory mode and then at least two additional passes in the static mode with a 10-ton vibratory roller or a reversible vibratory plate compactor with a minimum 13,500 lbf (60 kN) centrifugal force, so that there

is no visible movement of the subbase during the last pass in static mode. Do not crush the aggregate with the compactive effort.

- c. The surface tolerance of the compacted subbase shall be 1-1/2 inch maximum measured at any point over a 10 foot straightedge. The straightedge shall be placed to identify and remedy any locations where surface irregularities appear to be a maximum for the installation.

#### 4. Base Layer

- a. Thoroughly moisten, spread and compact the base layer [#57] in a single 4 inch lift. On this layer, make at least two passes in the vibratory mode and then at least two additional passes in the static mode with a 10-ton vibratory roller or a reversible vibratory plate compactor with a minimum 13,500 lbf (60 kN) centrifugal force, so that there is no visible movement of the base during the last pass in static mode. Do not crush the aggregate with the roller.
- b. The surface tolerance of the compacted base shall be 1/2 inch maximum measured at any point over a 10 foot straightedge. The straightedge shall be placed to identify and remedy any locations where surface irregularities appear to be a maximum for the installation.

#### 5. Bedding Layer

- a. Thoroughly moisten, spread and screed the bedding material (No. 8) in a two (2) inch lift.
- b. Fill any voids left by removing the screed rails with No. 8 stone.
- c. The surface tolerance of the screeded bedding layer shall be  $\pm 3/8$  inch maximum measured at any point over a 10 foot straightedge. The straightedge shall be placed to identify and remedy any locations where surface irregularities appear to be a maximum for the installation.
- d. Do not subject the screeded bedding material to any pedestrian or vehicular traffic, or to compactive effort, before unit pavers are placed.

#### 6. Unit Pavers and joint/opening fill material

- a. Place the unit pavers in the locations, pattern(s) and joint widths shown on the drawings starting in a corner in accordance with the Method Statement. Maintain straight pattern lines and edges at all times.
- b. Chalk lines shall be used on the bedding course as required to maintain straight joint lines and uniform patterns.
- c. Fill gaps along the edges of the paved area with cut units. Cut pavers subject to vehicular loadings shall be no less than one-third (1/3) of a whole unit.
- d. Cut pavers with vertical faces to place in gaps along the edges of the pavement surface with a table-mounted masonry saw in accordance with manufacturer's recommendations. Dry cutting of the unit pavers shall be performed utilizing a dust collection system.
- e. Fill the openings and joints with fill material matching the bedding material for the project, or smaller if a narrow joint is used.
- f. Remove any excess and loose aggregate on the surface by sweeping.
- g. Compact and seat the unit pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 5,000 lbf (22 kN) centrifugal compaction force. This will require at least two passes with the plate compactor over the entire surface.
- h. Do not compact within 6 feet of any unrestrained edges of the paving units including the laying face which is temporarily unrestrained.
- i. Place additional aggregate into the openings and joints as needed, filling them completely to the finished grade or surface each time. Remove excess aggregate by sweeping, then compact the unit pavers again. This will require at least two passes with the plate compactor each time additional aggregate is added.
- j. All pavers except within 6 feet from the laying face must be fully compacted at the completion of each work day. No compactive effort should be attempted however within 6 feet of the laying face.
- k. The surface tolerance of the completed unit pavers shall be  $\pm 3/8$  inch maximum measured at any point over a 10 foot straightedge. The straightedge shall be placed to identify and remedy any locations where surface irregularities appear to be a maximum for the installation.

- I. The surface elevation of pavers shall be at least 1/4 inch and no more than 3/8 inch above adjacent edge restraints and drainage inlets, concrete collars, channels or other vertical concrete faces to account for any future settlement that may occur.

## 7. FIELD QUALITY CONTROL

- a. After completing the unit paver installation, sweep the entire surface clean and check the patterns, color variation and overall look for compliance.
- b. Remove from the site all surplus materials, equipment and debris resulting from these operations.
- c. Elevation: Check the final elevations for conformance to the drawings.
- d. Lippage: No greater than  $\pm 1/8$  in. difference in height shall be allowed between any two adjacent pavers in any direction.
- e. Bond lines for paver courses:  $\pm 1/2$  inch over a 50 foot string line.
- f. Infiltration Test [Optional test for Owner showcase or ribbon cutting events, no ASTM standard methods]: The permeability of the pavement surface shall be tested prior to final acceptance by application of clean water at a rate of at least 5 gallons per minute, using a hose or other water delivery system. Water used shall be clean, free of suspended solids or deleterious liquids. Applied water shall infiltrate directly without large puddles or surface runoff, and the testing shall be observed by the Engineer or independent testing agency and the Owner. A minimum infiltration rate of 60 inches per hour is required.

## 8. PROTECTION

- a. After work is complete, the General Contractor shall be responsible for protecting the work from sediment deposition and damage due to subsequent construction activity on the site at all times until project acceptance.
- b. Any sediment deposition shall be thoroughly cleaned to include restorative measures at the direction of the Owner at no additional cost to the project.
- c. Any damage shall be repaired as directed by the Owner, at no additional cost to the project.

**END OF SECTION**