



PERMEABLE INTERLOCKING CONCRETE PAVEMENT

*[NOTE TO SPECIFICATION WRITER: This guide specification for the use of permeable interlocking concrete pavers for pedestrian and vehicular traffic application was developed based on the use of an open-graded base and subbase structure. The porosity of the base and subbase structure allows runoff water to seep into the subgrade or to be retained in the base-subbase structure. **This guide specification must be edited to suit specific conditions of the project.** The selection of the type of paver, sizing and composition of a pavement structure depending on the type of traffic and the volume of water to be stored should be determined by a civil engineer in accordance with local procedures regarding the calculation of pavements and drainage systems, technical bulletins, construction details and the software developed by the INTERLOCKING CONCRETE PAVEMENT INSTITUTE (hereinafter ICPI). The calculation guidelines and requirements concerning permeable interlocking concrete pavers must be prepared from the manual entitled "Permeable Interlocking Concrete Pavements Design-Specifications-Construction-Maintenance" from the ICPI.]*

PART 1: GENERAL

1.1 Section includes

- .1 Requirements and procedures for installing permeable interlocking concrete pavers by hand or with mechanical equipment.

1.2 Related Sections

- .1 Section [01 33 00 – Submittal Procedures]
- .2 Section [01 45 00 – Quality Control]
- .3 Section [31 10 00 – Site Clearing]
- .4 Section [31 20 00 – Earth Moving]
- .5 Section [31 30 00 – Earthwork Methods]
- .6 Section [31 32 19.23 – Geotextiles]
- .7 Section [32 16 00 – Concrete Walks, Curbs and Gutters]
- .8 Section [33 40 00 – Storm Drainage Utilities]

1.3 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C29 / C29M-[09], Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
 - .2 ASTM C131-[06], Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - .3 ASTM C136-[06], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .4 ASTM C140-[12a], Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
 - .5 ASTM C936-[12], Standard Specification for Solid Concrete Interlocking Paving Units
 - .6 ASTM C979-[10], Standard Specification for Pigments for Integrally Colored Concrete
 - .7 ASTM D448-[08], Standard Classification for Sizes of Aggregates for Road and Bridge Construction
 - .8 ASTM D698-[12], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12400 ft-lbf/ft³ (600 kN-m/m³))
 - .9 ASTM D1557-[12], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56000 ft-lbf/ft³ (2700 kN-m/m³))
 - .10 ASTM D1883-[07e2], Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils



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- .11 ASTM D4254-[00(2006)e1], Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- .12 ASTM D6938-[10], Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 Shop drawings

- .1 Submit shop drawings in accordance with Section [01 33 00 – Submittal Procedures].
- .2 Shop drawings must indicate or show the layout, pattern and relationship of paver joints to fixed installations, as well as details specific to work performed.

[NOTE TO SPECIFICATION WRITER: Request shop drawings only if features, conditions or particular models require them.]

1.5 Submittals

- .1 Product Data
 - .1 Submit product data in accordance with Section [01 33 00 – Submittal Procedures].
 - .2 Submit testing data of the concrete pavers showing compliance with ASTM C936 standard.
 - .3 Submit technical data sheets with respect to sampling, testing, sourcing, sieve analysis, mineralogical nature and characteristics of the materials proposed for the subbase, base, bedding and joint material.
 - .4 Submit test results for void ratio and bulk density of the base and subbase aggregates.
 - .5 Submit technical data sheets for geotextiles indicating physical and mechanical features for each type used.
- .2 Samples
 - .1 Submit samples in accordance with Section [01 33 00 – Submittal Procedures].
 - .2 Submit a full-size sample of each type of paver proposed.
- .3 Manufacturer's instructions
 - .1 Submit manufacturer's installation instructions.

1.6 Quality assurance

- .1 Qualifications
 - .1 Installer: company or person specializing in permeable interlocking concrete pavement installations [with [5] years documented experience].
 - .2 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 PICP Specialist Course.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified physical characteristics.
- .3 Mock-ups



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- .1 Construct mock-up in accordance with Section [01 45 00 – Quality Control].
- .2 Install a [10 ft (3 m)] x [10 ft (3 m)] area mock-up.
- .3 Mock-up will be used:
 - .1 To determine the surcharge imposed by the bedding layer, joint sizes, [lines] [layout], color[s] and texture.
 - .2 When accepted by [the Consultant], mock-up will constitute the standard for determining job compliance. [Approved mock-up may [not] remain as part of finished work.] [Protect this sample for its integration into the finished work.] [Remove mock-up and dispose of materials when no longer required and when directed by [the Consultant].]

1.7 Delivery, storage, and handling

- .1 Unload pavers at job site in such a manner that no damage occurs to the product or existing construction.
- .2 Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.

1.8 Measurement procedures

- .1 Measure precast concrete pavers for payment in square [feet] [meters].
- .2 Fixed price contract: all work will be paid for according to the lump sum indicated on the bid form.
- .3 Unit price contract: all work will be paid for according to the unit price indicated on the bid form.

[NOTE TO SPECIFICATION WRITER: Retain paragraph(s) to suit the project.]

PART 2: PRODUCTS

2.1 Geotextile

- .1 Geotextile to comply with [Specify material standard].

[NOTE TO SPECIFICATION WRITER: The choice of geotextile should be determined according to the type of pavement performance required for the project.]

2.2 Subbase, base, bedding and filler

- .1 Crushed stone with 90% fractured faces, LA Abrasion < 40 per ASTM C131, minimum CBR of 80% per ASTM D1883.
- .2 Do not use rounded river gravel for vehicular applications.
- .3 Gradation: All stone materials shall have less than 2% passing the No. 200 (0.075 mm) sieve:
 - .1 The subbase material shall consist of granular clean stone material conforming to ASTM No. 2:



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Sieve Size	Percent passing
3 in. (75 mm)	100
2½ in. (63 mm)	90 to 100
2 in. (50 mm)	35 to 70
1½ in. (37.5 mm)	0 to 15
¾ in. (19 mm)	0 to 5

[NOTE TO SPECIFICATION WRITER: The thickness and composition of the subbase should be determined according to the type of pavement performance required for the project.]

- .2 The base material shall consist of granular clean stone conforming to ASTM No. 57:

Sieve Size	Percent passing
1½ in. (37.5 mm)	100
1 in. (25 mm)	95 to 100
½ in. (12.5 mm)	25 to 60
No. 4 (4.75 mm)	0 to 10
No. 8 (2.36 mm)	0 to 5

[NOTE TO SPECIFICATION WRITER: The thickness and composition of the base should be determined according to the type of pavement performance required for the project. A thickness of 4 in. (100 mm) is generally recommended for the base course.]

- .3 Material used for the bedding and joint filler:

- .1 The bedding [shall consist] [and the joint filler shall consist] of granular clean stone conforming to ASTM No. 8:

Sieve Size	Percent passing
½ in. (12.5 mm)	100
3/8 in. (9.5 mm)	85 to 100
No. 4 (4.75 mm)	10 to 30
No. 8 (2.36 mm)	0 to 10
No. 16 (1.18 mm)	0 to 5

- .2 The joint filler shall consist of granular clean stone conforming to ASTM No. 9:

Sieve Size	Percent passing
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	85 to 100
No. 8 (2.36 mm)	10 to 40
No. 16 (1.18 mm)	0 to 10
No. 50 (0.3 mm)	0 to 5

[NOTE TO SPECIFICATION WRITER: Retain paragraph(s) to suit the project. The choice of material for the bedding and joint filler should be determined depending on the use of concrete paver surfaces and the joint width. For Mista Random, Victorien 60 mm Permeable and Villagio Grande, ASTM No. 9 stone is recommended for filling joints.]



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2.3 Permeable interlocking concrete pavers

- .1 Permeable interlocking concrete pavers: compliant with the requirements of ASTM C936 standard and the following requirements.
 - .1 Paver type [INFLO] [MISTA RANDOM] [PERMEA] [VICTORIEN 60 mm PERMEABLE] [VILLAGIO] [VILLAGIO GRANDE] from Techo-Bloc.
 - .2 Compressive strength: 8000 psi (55 MPa) min.
 - .3 Durability to freeze-thaw cycles:
 - .1 Total mass loss after 50 cycles: 1% max.
 - .4 Water absorption: 5% max.
 - .5 Dimensions: [specify according to product].
 - .6 Dimensional tolerances
 - .1 Length and width: $\pm 1/16$ in. (1.6 mm)
 - .2 Height: $\pm 1/8$ in. (3.2 mm)
 - .7 Texture: [specify according to product].
 - .8 Color: [specify according to product].
- .2 Pigment in concrete pavers: compliant with ASTM C979 standard.

[NOTE TO SPECIFICATION WRITER: Check the annual price list to determine the full range of permeable interlocking concrete pavers. Verify the delivery dates to ensure the availability of the products required for the execution of work.]

2.4 Edge restraints

- .1 Precast concrete edge restraint type [AVIGNON] [BELGIK] [PIETRA] [TUNDRA] from Techo-Bloc.
Dimensions: [specify according to product].
Texture: [specify according to product].
Color: [specify according to product].
- .2 Concrete curb: according to the requirements of section [32 16 00].
- .3 Edge restraint shall be plastic.
Acceptable product: []
- .4 Aluminum edge restraint.
Acceptable product: []
- .5 [Galvanized or painted steel] [] edge restraint.

[NOTE TO SPECIFICATION WRITER: Retain paragraph(s) to suit the project.]



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PART 3: EXECUTION

3.1 Inspection

- .1 Notify [the Consultant] at the end of each of the following steps:
 - .1 Completion of grading.
 - .2 Installation of geotextile.
 - .3 Completion of subbase.
 - .4 Completion of base.
 - .5 Completion of bedding layer.
 - .6 Installation of permeable interlocking concrete pavers.
- .2 Have the work approved by [the Consultant] at the end of each step.

3.2 Excavation, backfill and grading

- .1 Complete the work in accordance with [Specify specification section].
- .2 Keep area where pavement is to be constructed free from sediment during the entire job.
- .3 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.
- .4 Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to [the Consultant].

[NOTE TO SPECIFICATION WRITER: Compaction will reduce the permeability of the soil subgrade. Reduced infiltration may require drain pipes within the subbase to conform to local storm drainage requirements. Compaction of the soil subgrade should be determined by a civil engineer.]

3.3 Geotextile

- .1 Complete the work in accordance with [Specify specification section].
- .2 Unroll the geotextile on the subgrade without folds and raise the edges to cover the sides of the soil subgrade. No equipment shall be operated on the geotextile.
- .3 Overlap joints a minimum of [12 in. (300 mm)] in the direction of drainage.

3.4 Subbase

- .1 [All drain pipes] [observations wells] [overflow pipes] [berms] should be in place per the drawings [prior to] [during] placement of the subbase and base.
- .2 Moisten, spread and compact the subbase material in lifts not to exceed [12 in. (300 mm)] without wrinkling or folding the geotextile.
- .3 Compact each lift with a minimum of [two (2)] passes in the vibratory mode then at least [two (2)] passes in the static mode with a minimum [10 tons (9 metric tons)] vibratory roller until there is no visible movement of the subbase material. Do not crush aggregate with the roller.



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- .4 Unless otherwise specified, the subbase and base should exceed the surface to be paved by at least one and a half times the sum of their own thicknesses.
- .5 Ensure that the surface of the compacted subbase does not deviate more than [$\pm 2 \frac{1}{2}$ in. (65 mm)] from the specified grade. In areas where this tolerance has been exceeded, correct its profile by adding or removing subbase material.
- .6 Have the final installation of the subbase approved by [the Consultant] before proceeding with the installation of the base.

3.5 Edge restraints

- .1 Install edge restraints in accordance with manufacturer's recommendations.
- .2 Ensure that edge restraints conform to elevations and alignments required for laying pavers. If discrepancies occur, notify [the Consultant] and do not commence work until instructed by [the Consultant].

3.6 Base

- .1 Moisten, spread and compact the base material in one [4 in. (100 mm)] thick lift.
- .2 Compact this layer with a minimum of [two (2)] passes in the vibratory mode then at least [two (2)] passes in the static mode with a minimum [10 tons (9 metric tons)] vibratory roller until there is no visible movement of the base material. Do not crush aggregate with the roller.
- .3 Ensure that the surface of the compacted base does not deviate more than [± 1 in. (25 mm)] from the specified grade. In areas where this tolerance has been exceeded, correct its profile by adding or removing base material.
- .4 Have the final installation of the base approved by [the Consultant] before proceeding with the installation of the bedding layer.

[NOTE TO SPECIFICATION WRITER: a control strip could be constructed for the determination of the number of passes in order to get the optimal degree of compaction of the subbase and base courses and avoid over compaction. The compaction of the subbase should be considered satisfactory and complete when no movement can be seen after the circulation of the specified equipment. For the base layer, the compaction should be considered satisfactory and complete when the difference between two density readings measured with a nuclear gauge, using the backscatter method, is less than 1.2 lb/ft³ (20 kg/m³). As an alternative test method, the compacted density should be 95% of the laboratory index density established for the base layer as per ASTM D4254. These test methods are appropriate for pavement subject to consistent vehicular traffic such as parking lots and roads. Generally, they are not needed for pedestrian areas and residential driveways.]

3.7 Bedding material

- .1 Ensure that the bedding material is not frozen and that no stagnant water has accumulated at all times until the installation is complete.
- .2 Spread, moisten and screed the bedding material on the base course in order to obtain a [2 in. (50 mm)] thick layer before compaction. Fill the voids left by the removed screed rails with bedding material.



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- .3 Ensure that the surface of the bedding layer does not deviate more than [$\pm 3/8$ in. (10 mm)] from the specified grade. In areas where this tolerance has been exceeded, correct its profile by adding or removing bedding material.
- .4 Keep the bedding material loose until pavers are installed. Areas of bedding material that have been compacted by whatever means must be scarified, loosened and restored in original conditions. Any traffic on the bedding material is prohibited.
- .5 Do not use bedding material to fill depressions in the base course.

3.8 Installation of concrete pavers

- .1 Lay pavers manually or mechanically according to levels, lines and patterns shown on the drawings. Joint width must be according to manufacturer's recommendations.
- .2 The alignment of horizontal joints must not deviate more than [$\pm 1/2$ in. (13 mm)] over a total length of [50 ft (15 m)].
- .3 Use appropriate end, angle and edge pavers along edges. Saw cut pavers to fit around obstructions and at abutting structures.
- .4 No less than one-third of a concrete paver shall be used in pavement subjected to vehicular traffic.
- .5 Place paver pallets and other materials to avoid exceeding the bearing capacity of the covered surface and to avoid damaging it in any other manner. Avoid all vehicular and equipment traffic on the surface of concrete pavers before they have been vibrated and their joints filled.
- .6 Inspect the installed pavers and replace those that are chipped, broken or otherwise damaged as directed by [the Consultant].
- .7 Spread and sweep the joint material into the joints. The paver surface must be clean before vibrating pavers with the plate compactor.
- .8 Vibrate the surface of the concrete pavers with a low amplitude vibrating plate compactor capable of at least [7000 lbf (31 kN)] centrifugal compaction force at a frequency of 75 to 90 Hz to settle pavers into the bedding layer. At least three passes with the plate compactor shall be made across the surface of the concrete pavers.
- .9 In order to protect the surface of the pavers and prevent spalling during vibration, cover the vibrating plate with a rubber mat.
- .10 Continue to spread the joint material and vibrating of pavers with the vibrating plate compactor until the joints are completely filled. At least two passes of a plate compactor shall be applied to the pavers. Do not vibrate within [6 ft (2 m)] of unrestrained edges of pavers.
- .11 Complete installation up to [6 ft (2m)] from the edge of the surface to be covered by filling the joints at completion of each work day.
- .12 Sweep off excess joint material when the installation is complete.
- .13 Continue filling the joints during the following days under worksite traffic to ensure settlement and additional tightening in the joints.



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- .14 Ensure that the final level of the paver surface does not deviate more than [\pm 3/8 in. (10 mm)] from the specified grade. Any irregularity or depression shall not exceed [\pm 3/8 in. (10 mm)] under a [10 ft (3 m)] long straightedge.
- .15 The level of the paver surface shall be [1/8 in. (3 mm)] to [3/16 in. (4 mm)] above adjacent drainage inlets, concrete collars or channels.
- .16 No paver shall be higher or lower than [1/8 in. (3mm)] compared to adjacent pavers.
- .17 Ensure conformance of the paver final elevations.

3.9 Cleaning

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.10 Protection

- .1 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.

END OF SECTION