

# GUIDE SPECIFICATIONS FOR THE CONSTRUCTION OF INTERLOCKING CONCRETE PAVEMENTS

## SECTION 32 14 13.13 INTERLOCKING CONCRETE PAVERS/ CONCRETE PAVING SLABS

### PART 1 GENERAL

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**Note:** This guide specification for manually installed concrete paver applications in North America should be edited to fit project conditions and location. Notes are given on the use of a compacted aggregate base under the bedding sand and pavers. Other base materials may be used. Brackets [ ] indicate text for editing. Notes are provided on the use of a compacted aggregate base under the bedding sand and pavers. Other bases can be used such as cement or asphalt-treated aggregate, concrete or asphalt, as well as other setting materials. This section includes the term "Architect." Edit this term as necessary to identify the design professional in the General Conditions of the Contract. Coordinate all Sections with the General Conditions as well.

#### 1.01 SUMMARY

- A. This Section includes the following:
1. Interlocking Concrete Paver Units (manually installed).
  2. Bedding and joint sand.
  3. Edge Restraint.
  4. [Cleaners, Sealers, and Joint Sand Stabilizers]
- B. Related Sections include the following:
1. Section: [ ]-Curbs and Drains.
  2. Section: [ ]-Aggregate Base.
  3. Section: [ ]-Cement Treated Base.
  4. Section: [ ]-Asphalt Treated Base.
  5. Section: [ ]-Pavements, Asphalt and Concrete.
  6. Section: [ ]-Roofing Materials.
  7. Section: [ ]-Geotextiles.

**Note:** Pavements subject to vehicles should be designed in consultation with a qualified civil engineer, in accordance with ASCE/T&DI/ICPI 58-10 *Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways*, ICPI Structural Design software, and in accordance with ICPI Tech Spec technical bulletins. See ICPI Tech Specs 11 and 15 for guidance on specifying machine installed bedding materials and concrete pavers. This specification should be edited by an engineer/architect/landscape architect to conform to project conditions. Edit ASTM and CSA references below and throughout this Section according to project location.

#### 1.02 REFERENCES

- A. American Society of Testing and Materials (ASTM):
1. C33/C33M, Standard Specification for Concrete Aggregates.
  2. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  3. C140/C140M, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
  4. C144, Standard Specification for Aggregate for Masonry Mortar.
  5. C936/C936M-15, Standard Specification for Solid Concrete Interlocking Paving Units.
  6. C979/C797M, Standard Specification for Pigments for Integrally Colored Concrete.

7. C1645/C1645M, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
8. D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
9. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
10. D2940, Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.

B. Canadian Standards Association (CSA):

1. CSA-A231.2-14/CSA-A231.1-14, Precast Concrete Pavers/Concrete Paving Slabs
2. CSA-A23.2A, Sieve Analysis of Fine and Coarse Aggregates.
3. CAN/CSA-A23.1-FA 1, Concrete Materials and Methods of Concrete Construction.
4. CAN/CSA-A179, Mortar and Grout for Unit Masonry.

### 1.03 SUBMITTALS

- A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Manufacturer's drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, [expansion and control joints,] concrete paver [layout,] [patterns,] [color arrangement,] installation [and setting] details.
- C. Sieve analysis per [ASTM C 136][CSA A23.2A] for grading of bedding and joint sand.
- D. Concrete pavers/Concrete HydraPressed Paving Slabs:
  1. [Four] representative full-size samples of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation. Color(s) selected by [Architect] [Engineer] [Landscape Architect] [Owner] from manufacturer's available colors.
  2. Accepted samples become the standard of acceptance for the work.
  3. Test results from an independent testing laboratory for compliance of paving unit requirements to [ASTM C 936/C 936M-09][CSA A231.2-14/A231.1-14].
  4. Manufacturer's catalog product data, installation instructions, and Safety Data Sheets for the safe handling of the specified materials and products.
- E. Paver Installation Subcontractor:
  1. A copy of Subcontractor's current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
  2. Job references from a minimum of 3 projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

**Note:** Paver pattern layout is critical in vehicular applications. Avoid patterns with long continuous lines: these may be subject to failure under vehicular traffic.

### 1.04 QUALITY ASSURANCE

- A. Paving Subcontractor Qualifications:
  1. Utilize an installer having successfully completed a minimum of 3 concrete paver installations similar in design, material, scope and extent indicated on this project.
  2. Utilize an installer holding a current 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. Mock-Ups:

**Note:** A site visit and approval by the owner's representative during the first day of paving may substitute for a mockup.

1. Install a 7 ft x 7 ft (2 m x 2 m) paver area.
2. Use this area to determine surcharge of the bedding sand layer, joint sizes, lines, laying pattern(s), color(s) and texture of the job.
3. Evaluate the need for protective pads when compacting paving units with architectural finishes.
4. This area will be used as the standard by which the work will be judged.
5. Subject to acceptance by owner, mock-up may be retained as part of finished work.
6. If mock-up is not retained, remove and properly dispose of mock-up.

### **1.05 DELIVERY, STORAGE & 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 to project site in manufacturer's original, unopened, undamaged packaging with identification labels intact. Confirm that the correct product has been delivered to the job site before commencing off loading.
  1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving area.
  2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by fork lift or clamp lift.
  3. Unload pavers at job site in such a manner that no damage occurs to the product.
- D. Storage and Protection: Store materials protected such that they are kept free from mud, dirt, and other foreign materials. [Store concrete paver cleaners and sealers per manufacturer's instructions.]
  1. Cover bedding sand and joint sand with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

### **1.06 PROJECT/SITE CONDITIONS**

- A. Environmental Limitations:
  1. Do not install sand or pavers during heavy rain or snowfall.
  2. Do not install sand and pavers over frozen base materials.
  3. Do not install frozen sand or saturated sand.
  4. Do not install concrete pavers on frozen or saturated sand.
  5. [Apply Cleaner and Sealers as per Manufacturers Directions]

### **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 the same production run as installed materials.

## **PART 2 PRODUCTS**

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### **2.01 INTERLOCKING CONCRETE PAVERS/HYDRAPRESSED PAVING SLABS**

**Note:** : In addition to ASTM and CSA conformance, ICPI recommends a maximum 3:1 aspect ratio (length ÷ thickness) and a minimum 3 1/8 in. (80 mm) thickness for vehicular applications. Residential driveways and pedestrian applications should use a minimum 2 3/8 in. (60 mm) thick units with a maximum 4:1 aspect ratio Therefore, HydraPressed Paving Slab are not designed for vehicular traffic. Concrete pavers may have spacer bars on each unit. They are highly recommended for mechanically installed pavers. Manually installed pavers may be installed with or without spacer bars.

A Supplied by:

**Abbotsford Concrete Products**

Toll Free: 1-800-663-4091 Fax: (604)852-4819

B. Product name(s)/shape(s), color(s), overall dimensions, and thickness:

[\_in./mm x\_in./mm x\_in./mm thick]

[\_in./mm x\_in./mm x\_in./mm thick]

[\_in./mm x\_in./mm x\_in./mm thick]

C. Meet the following requirements set forth in ASTM C 936/C 936M-09, Standard Specification for Interlocking Concrete Paving Units:

1. Average compressive strength of 8,000 psi (55 MPa) with no individual unit under 7,200 psi (50 MPa).
2. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C 140.
3. Resistance to 50 freeze-thaw cycles when tested according to ASTM C 67.

---OR---

D. Meet the following requirements set forth in CSA-A231.2-14, Precast Concrete Pavers:

1. Minimum average cube compressive strength of 7,250 psi (50 MPa) for laboratory cured specimens or 5,800 psi (40MPa) for unconditioned field samples.
2. Resistance to 50 freeze thaw cycles while immersed in a 3% saline solution with no greater mass loss than 225 g/m<sup>2</sup> of surface area after 28 cycles, or 500 g/m<sup>2</sup> after 49 cycles.

E. Pigment shall conform to ASTM C 979.

**Note:** If 3 1/8in. (80mm) thick pavers are specified, their compressive strength test results per ASTM C140 should be adjusted by multiplying by 1.18 to equate the results to that from 2 3/8 in. (60mm) thick pavers.

## 2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

## 2.03 BEDDING AND JOINT SAND

A. Provide bedding and joint sand as follows:

1. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
2. Do not use limestone screenings, or stone dust, or sand for the bedding sand material that does not conform to the grading requirements of [ASTM C 33][CSA A23.1-FA1].
3. Do not use mason sand, or sand conforming to [ASTM C 144][CSA A179] for the bedding sand.

**Note:** If the pavement will be exposed to heavy traffic with trucks, i.e., a major thoroughfare with greater than 1.5 million 18-Kip (80 kN) equivalent single axle loads, see ICPI Tech Spec 17 – Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications for test methods and criteria for assessing bedding sand durability.

4. Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.
5. Sieve according to [ASTM C 136][CSA A23.2A].
6. Bedding Sand Material Requirements: Conform to the grading requirements of [ASTM C 33][CSA A23.1-FA1] with modifications as shown in Table 1.

**Table 1**

<b>Grading Requirements for Bedding Sand</b>			
<b>ASTM C 33</b>		<b>CSA A23.1-FA1</b>	
Sieve Size	Percent Passing	Sieve Size	Percent Passing
3/8 in. (9.5 mm)	100	10. mm	100
No. 4 (4.75 mm)	95 to 100	5. mm	95 to 100
No. 8 (2.36 mm)	80 to 100	2.5 mm	80 to 100
No. 16 (1.18 mm)	50 to 85	1.25 mm	50 to 90
No. 30 (0.600 mm)	25 to 60	0.630 mm	25 to 65
No. 50 (0.300 mm)	10 to 30	0.315 mm	10 to 35
No. 100 (0.150 mm)	2 to 10	0.160 mm	0 to 1
Pan	0 to 1	0.075 mm	0

**Note:** Coarser sand than that specified in Table 2 below may be used for bedding sand including C 33 or A23.1 material as shown in Table 1. Use material where the largest sieve size easily enters the smallest joints. For example, if the smallest paver joints are 2 mm wide, use sand 2 mm and smaller in particle size. If C 33 or A23.1-FA1 sand is used for joint sand, extra effort may be required in sweeping material and compacting pavers in order to completely fill the joints.

7. Joint Sand Material Requirements: Conform to the grading requirements of [ASTM C 144][CSA-A179] as shown with modifications in Table 2 below:

**Table 2**

<b>Grading Requirements for Joint Sand</b>				
<b>ASTM C 144</b>			<b>CSA – A179</b>	
	Natural Sand	Manufactured Sand		
Sieve Size	Percent Passing	Percent Passing	Sieve Size	Percent Passing
No. 4 (4.75 mm)	100	100	5 mm	100
No. 8 (2.36 mm)	95 to 100	95 to 100	2.5 mm	90 to 100
No. 16 (1.18 mm)	70 to 100	70 to 100	1.25 mm	85 to 100
No. 30 (0.600 mm)	40 to 75	40 to 100	0.630 mm	65 to 95
No. 50 (0.300 mm)	10 to 35	20 to 40	0.315 mm	15 to 80
No. 100 (0.150 mm)	2 to 15	10 to 25	0.160 mm	0 to 35
Pan	0	0 to 2	0.075 mm	0

**Note:** Specify specific components of a system, manufactured unit or type of equipment. See ICPI Tech Spec 3 - Edge Restraints for Interlocking Concrete Pavements for guidance on selection and design of edge restraints.

## 2.04 EDGE RESTRAINTS

- A. Where not otherwise retained, provide edge restraints installed around the perimeter of all interlocking concrete paving unit areas as follows:
1. Manufacturer: [Specify manufacturer].
  2. Material: [Plastic] [Concrete] [Aluminum] [Steel] [Pre-cast concrete] [Cut stone].
  3. Material Standard: [Specify material standard].

## 2.05 ACCESSORIES

- A. Provide accessory materials as follows:

**Note:** Delete article below if geotextiles are not specified.

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

**Note:** Delete article below if cleaners, sealers, and/or joint sand stabilizers are not specified.

2. [Cleaners] [Sealers] [Joint sand stabilizers]
  - a. Material Type and Description: [Specify material type and description].
  - b. Material Standard: [Specify material standard].
  - c. Manufacturer: [Specify manufacturer].

## **PART 3 EXECUTION**

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### **3.01 ACCEPTABLE INSTALLERS**

- A. [Specify acceptable paving subcontractors].

### **3.02 EXAMINATION**

- 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.

**Note:** Compaction of the soil sub-grade is recommended to at least 98% standard Proctor density per ASTM D 698 for pedestrian areas and residential driveways. Compaction to at least 98% modified Proctor density per ASTM D 1557 is recommended for areas subject to heavy vehicular traffic. Stabilization of the sub-grade and/or base material may be necessary with weak or saturated sub-grade soils.

- a. Verify that sub-grade preparation, compacted density and elevations conform to specified requirements.
- b. Verify that geotextiles, if applicable, have been placed according to drawings and specifications.

**Note:** Local aggregate base materials typical to those used for highway flexible pavements are recommended, or those conforming to ASTM D 2940. Compaction of aggregate is recommended to not less than 98% Proctor density in accordance with ASTM D 698 is recommended for pedestrian areas and residential driveways. 98% modified Proctor density according to ASTM D 1557 is recommended for vehicular areas. Mechanical tampers are recommended for compaction of soil sub-grade and aggregate base in areas not accessible to large compaction equipment. Such areas can include that around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions.

**Note:** Prior to screeding the bedding sand, the recommended base surface tolerance should be  $\pm 3 / 8$  in. (10 mm) over a 10 ft. (3 m) straight edge. See ICPI Tech Spec 2, Construction of Interlocking Concrete Pavements for further guidance on construction practices.

**Note:** The elevations and surface tolerance of the base determine the final surface elevations of concrete pavers. The paver installation contractor cannot correct deficiencies in the base surface with additional bedding sand or by other means. Therefore, the surface elevations of the base should be checked and accepted by the General Contractor or designated party, with written certification to the paving subcontractor, prior to placing bedding sand and concrete pavers.

- c. Verify that [Aggregate] [Cement-treated] [Asphalt-treated] [Concrete] [Asphalt] base materials, thickness, [compacted density], surface tolerances and elevations conform to specified requirements.

- d. Provide written density test results for soil sub-grade, [aggregate] [cement-treated][asphalt-treated][asphalt] base materials to the Owner, General Contractor and paver installation subcontractor.
  - e. Verify location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage inlets.
2. Do not proceed with installation of bedding sand and interlocking concrete pavers until [sub-grade soil and] base conditions are corrected by the General Contractor or designated subcontractor.

### 3.03 PREPARATION

- A. Verify base is dry, certified by General Contractor as meeting material, installation and grade specifications.
- B. Verify that base [and geotextile] is ready to support sand, [edge restraints,] and, pavers and imposed loads.
- C. Edge Restraint Preparation:
  - 1. Install edge restraints per the drawings [and manufacturer's recommendations] [at the indicated elevations].

**Note:** Retain the following two subparagraphs if specifying edge restraints that are staked into the base with spikes.

- 2. Mount directly to finished base. Do not install on bedding sand.
- 3. The minimum distance from the outside edge of the base to the spikes shall be equal to the thickness of the base.

### 3.04 INSTALLATION

- A. Spread bedding sand evenly over the base course and screed to a nominal 1 in. (25 mm) thickness, not exceeding 1-1/2 in. (40 mm) thickness. Spread bedding sand evenly over the base course and screed rails, using the rails and/or edge restraints to produce a nominal 1 in. (25 mm) thickness, allowing for specified variation in the base surface.
  - 1. Do not disturb screeded sand.
  - 2. Screeded area shall not substantially exceed that which is covered by pavers in one day.
  - 3. Do not use bedding sand to fill depressions in the base surface.

**Note:** When initially placed on the bedding sand, manually installed pavers often touch each other, or their spacer bars if present. Joint widths and lines (bond lines) are straightened and aligned to specifications with rubber hammers and pry bars as paving proceeds.

- B. Lay pavers in pattern(s) shown on drawings. Place units hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers and pry bars as required.
- C. Provide joints between pavers between [1/16 in. and 3/16 in. (2 and 5 mm)] wide. No more than 5% of the joints shall exceed 1/4 in. (6 mm) wide to achieve straight bond lines.
- D. Joint (bond) lines shall not deviate more than  $\pm 1/2$  in. (15 mm) over 50 ft. (15 m) from string lines.
- E. Fill gaps at the edges of the paved area with cut pavers or edge units.
- F. Cut pavers to be placed along the edge with a [double blade paver splitter or] masonry saw.

**Note:** Specify requirements for edge treatment in paragraph below.

- G. [Adjust bond pattern at pavement edges such that cutting of edge pavers is minimized. All cut pavers exposed to vehicular tires shall be no smaller than one-third of a whole paver.] [Cut pavers at edges as indicated on the drawings.]
- H. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint sand.

- I. Use a low-amplitude plate compactor capable of at least minimum of 5,000 lbf (22 kN) at a frequency of 75 to 100 Hhz to vibrate the pavers into the sand. Remove any cracked or damaged pavers and replace with new units.
- J. Simultaneously spread, sweep and compact dry joint sand into joints continuously until full. This will require at least 4 to 6 passes with a plate compactor. Do not compact within 6 ft (2 m) of unrestrained edges of paving units.
- K. All work within 6 ft. (2 m) of the laying face shall be left fully compacted with sand-filled joints at the end of each day or compacted upon acceptance of the work. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint sand to prevent exposed bedding sand from becoming saturated from rainfall.
- L. Remove excess sand from surface when installation is complete.

**Note:** Excess joint sand can remain on surface of pavers to aid in protecting their surface especially when additional construction occurs after their installation. If this is the case, delete the article above and use the article below. Designate person responsible for directing timing of removal of excess joint sand.

- M. Allow excess joint sand to remain on surface to protect pavers from damage from other trades. Remove excess sand when directed by [Architect].
- N. Surface shall be broom clean after removal of excess joint sand.

### 3.05 FIELD QUALITY CONTROL

- A. The final surface tolerance from grade elevations shall not deviate more than  $\pm 3/8$  in. (10 mm) under a 10 ft (3 m) straightedge. Use a straightedge, flexible straightedge or transit depending on surface slope and contours.
- B. Check final surface elevations for conformance to drawings.

**Note:** For installations on a compacted aggregate base and soil sub-grade, the top 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 in. to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

**Note:** For pedestrian access routes maximum elevation should not exceed 1/4 in. (6 mm).

- D. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

**Note:** Cleaning and sealing may be required for some applications. See ICPI Tech Spec 5, Cleaning and Sealing Interlocking Concrete Pavements for guidance on when to clean and seal the paver surface, and when to stabilize joint sand. Delete article below if cleaners, sealers, and or joint sand stabilizers are not applied.

### 3.06 [CLEANING] [SEALING] [JOINT SAND STABILIZATION]

- A. [Clean] [Seal] [Apply joint sand stabilization materials between] concrete pavers in accordance with the manufacturer's written recommendations.

### 3.07 PROTECTION

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

### END OF SECTION

**WARNING:** The contents of this Specification are intended only as a guideline for the installation of Interlocking Concrete Pavers and Professional assistance should be sought with respect to the design, specifications, and construction of each project.