**INTERLOCKING CONCRETE PAVEMENT**

**Note: This guide specification is for interlocking concrete pavers and bedding sand over a compacted aggregate base for pedestrian and vehicular applications.**

**The text must be edited for project-specific requirements. The Interlocking Concrete Pavement Institute (ICPI) and the City and County Pavement Improvement Center make 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. Interlocking Concrete Paver Units (manually installed).

2. Bedding and Joint Sand.

1. Edge Restraints.
2. Aggregate base.
3. Excavation and Subgrade Preparation.
4. [Cleaners, Sealers, and Joint Sand Stabilizers].

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM), [www.astm.org](http://www.astm.org).

1. C33 Standard Specification for Concrete Aggregates.

2. C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

3. C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

4. C144 Standard Specification for Aggregate for Masonry Mortar.

5. C936 Standard Specification for Solid Concrete Interlocking Paving Units.

6. C979 Standard Specification for Pigments for Integrally Colored Concrete.

7. C1645 Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.

B. American Society of Civil Engineers (ASCE)

 1. ASCE 58-16 Structural Design of Interlocking Concrete Pavement for Municipal

Streets and Roadways, <https://ascelibrary.org/doi/book/10.1061/9780784414507>.

C. Caltrans Standard Specifications – 2018 Edition.

D. California Test Methods

1. CT 216 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates (June 2011).

 E. Standard Specifications for Public Works Construction(“Greenbook”) – 2021 Edition.

F. ICPI Technical Bulletins, <https://icpi.org/government-tech-specs>.

* 1. Tech Spec 2 Construction of Interlocking Concrete Pavements.
	2. Tech Spec 3 Edge Restraints for Interlocking Concrete Pavements.
	3. Tech Spec 4 Structural Design of Interlocking Concrete Pavements for Roads and Parking Lots.
	4. Tech Spec 11 Mechanical Installation of Interlocking Concrete Pavements.
	5. Tech Spec 15 A Guide for the Specification of Mechanically Installed Interlocking Concrete Pavements.

6. Tech Spec 17 Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications.

1.03 SUBMITTALS

A. Detail drawings: Indicating perimeter/edge restraint conditions, junction with adjoining materials, assemblies, and fixtures; concrete paver [layout,] [patterns,] [color arrangement,] and subbase installation details. Indicate layout, pattern and relationship of paving joints to fixtures and project-formed details.

B. Sieve analysis per ASTM C136 for grading of bedding and joint filler sand.

C. Concrete pavers:

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] [Agency/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 concrete pavers with ASTM C936.

4. Manufacturer’s catalog product data, installation instructions, and safety data sheets for the safe handling of the specified materials and products.

D. Paver Installation Contractor/Subcontractor:

1. Current certificates of completion from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program for job foremen on the project.

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

# PART 2 MATERIALS

2.01 CONCRETE PAVERS

A. Manufacturer: [Specify ICPI member manufacturer name].

1. Contact: [Specify ICPI member manufacturer contact information].

B. Concrete Pavers:

1. Paver Type: [Specify name of product group, family, series, etc.] or Agency-approved equal.

a. Material Standard: Comply with ASTM C936.

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

c. Color Pigment Material Standard: Comply with ASTM C979.

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

e. Average Compressive Strength (per ASTM C140): 8000 psi (55 MPa) with no individual unit under 7200 psi (50 MPa).

f. Average Water Absorption (per ASTM C140): 5% with no unit greater than 7%.

 g. Freeze/Thaw Resistance (per ASTM C1645): 28 freeze-thaw cycles

with no greater loss than 225 g/m2 of paver surface area or no greater loss than 500 g/m2 of paver surface area after 49 freeze-thaw cycles. Use the lowest freezing temperature (-15° C) in C1645 per the Appendix and zone map in C936 if pavers are subject to deicers. Freeze-thaw testing requirements shall be waived for applications not exposed to freezing temperatures and deicers.

 C. Maintenance:

1. Extra Materials: Provide [Specify area] [Specify percentage] additional pavers for use by the Agency/Owner for maintenance and repair.

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

2.03 BEDDING AND JOINT SAND

A. Bedding and joint sand shall conform to the following:

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, stone dust, or sand for the bedding sand material that does not conform to the grading requirements of ASTM C33.

3. Do not use masonry sand or sand conforming to ASTM C144.

4. Sieve according to ASTM C136.

 B. Bedding Sand Requirements:

1. Conform to the grading requirements of ASTM C33 as shown in Table 2.03-b with modification to the percent passing the No. 200 sieve.

Table 2.03-B

Grading Requirements for Bedding Sand

 ASTM C33

Sieve Size Percent Passing

3/8 inch (9.5 mm) 100

No. 4 (4.75 mm) 95 to 100

No. 8 (2.36 mm) 80 to 100

No. 16 (1.18 mm) 50 to 85

No. 30 (0.600 mm) 25 to 60

No. 50 (0.300 mm) 5 to 30

No. 100 (0.150 mm) 0 to 10

No. 200 (0.075 mm) 0 to 1

C. Joint Filler Sand Requirements:

1. Conform to the grading requirements of ASTM C144 as shown in Table 2.03-C with modification to the percent passing the No. 200 sieve.

Table 2.03-C

Grading Requirements for Joint Filler Sand

ASTM C144 ASTM C144

Natural Sand Manufactured Sand

Sieve Size Percent Passing Percent Passing

No. 4 (4.75 mm) 100 100

No. 8 (2.36 mm) 95 to 100 95 to 100

No. 16 (1.18 mm) 70 to 100 70 to 100

No. 30 (0.600 mm) 40 to 75 40 to 100

No. 50 (0.300 mm) 10 to 35 20 to 40

No. 100 (0.150 mm) 2 to 15 10 to 25

No. 200 (0.075 mm) 0 to 5 0 to 5

2.04 AGGREGATE BASE MATERIAL

A. Aggregate base material shall be [Crushed Miscellaneous Base, Fine, conforming to 200-2.4 of the Standard Specifications for Public Works Construction (“Greenbook”), 2021 edition] [Class 2 Aggregate Base, 3/4 inch maximum, conforming to Section 26 of the 2018 Caltrans Standard Specifications].

2.05 EDGE RESTRAINTS

A. Provide and install 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] [Concrete].

3. Material Standard: [Specify material standard].

Note: Delete article below if a geotextile is not specified.

2.06 GEOTEXTILE

A. Material Type and Description: [Specify]

B. Reference standard (e.g., AASHTO, ASTM): [Specify]

C. Acceptable producer(s), and respective product name(s): [Specify]

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

D. [Cleaners] [Sealers] [Joint sand stabilizers]

1. Material Type and Description: [Specify material type and description].

2. Material Standard: [Specify material standard].

3. Manufacturer: [Specify manufacturer].

2.07 DELIVERY, STORAGE & HANDLING

A. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers packaging with identification labels intact.

1. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.

2. Unload pavers at the job site in such a manner that no damage occurs to the product.

B. 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 filler sand with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

# PART 3 CONSTRUCTION

3.01 CONCRETE PAVER INSTALLER QUALIFICATIONS

A. Installer shall have successfully completed concrete paver installation similar in design, material, and extent indicated on this project.

B. Installer shall hold a current certificate of completion from the Interlocking Concrete Pavement Institute Certified Concrete Paver Installer Certification program.

C. Submit statement of qualifications per 1.03-D.

3.02 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Do not install sand or pavers during heavy rain or snowfall.

2. Do not install sand and pavers over frozen aggregate base materials.

3. Do not install frozen sand or saturated sand.

1. Do not install concrete pavers on frozen or saturated sand.

3.03 SUBGRADE PREPARATION AND AGGREGATE BASE MATERIAL PLACEMENT

A. Prepare subgrade per [301-1 of the Standard Specifications for Public Works Construction, 2021 Edition (“Greenbook”)] [Section 19 of the 2018 Caltrans Standard Specifications] [Compact the subgrade to 95 percent of relative density according to California Test 216. Report results to the Agency’s Project Engineer].

Note: When a geotextile is specified, add an article below addressing installation.

B. Spread base material per [301-2 of the Standard Specifications for Public Works Construction, 2021 Edition (“Greenbook”)] [Section 26 of the 2018 Caltrans Standard Specifications].

C. Edge restraints:

a. Install at locations and elevations shown on the plans [and per the manufacturer’s recommendations].

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

b. Install directly on the finished aggregate base material, not on bedding sand.

c. The minimum distance from the outside edge of the base to the spikes is at least equal to the thickness of the base to a maximum of 10 inches (250 mm).

3.04 BEDDING SAND

A. Spread bedding sand evenly over the base course and screed rails, using the rails and/or edge restraints to produce a nominal 1 inch (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.

3.05 CONCRETE PAVERS

A. Mock-Ups:

1. Install a 7 feet x 7 feet (2 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. 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.

B. Lay pavers in pattern(s) shown on the plans. Place hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers and pry bars as required.

C. Provide consistent joints between pavers between [1/16 inch and 3/16 inch (2 and 5 mm)] wide. No more than 5% of the joints shall exceed [1/4 inch (6 mm)] wide to achieve straight bond lines.

D. Joint (bond) lines shall not deviate more than ± 1/2 inch (±15 mm) over 50 feet (15 m) from taut 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 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 plans.]

H. Keep equipment off newly laid pavers that have not received initial compaction and joint filler sand.

I. Use a low-amplitude plate compactor capable of a minimum of 5,000 foot-pounds (22 kN) at a frequency of 75 to 100 Hz 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 filler sand into joints continuously until full. This requires at least 4 passes with a plate compactor. Do not compact within 6 feet (2 m) of unrestrained edges of paving units.

K. All work more than 6 feet (2 m) of the laying face shall be left 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 the 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 the Engineer. Do not allow joint fiiller sand mixed with a stabilizer to remain on the surface.

N. Surface shall be broom clean after removal of excess joint filler sand.

3.06 FIELD QUALITY CONTROL

A. The final surface tolerance from grade elevations shall not deviate more than ± 3/8-inch (± 10 mm) under a 10-foot (3 m) straightedge.

B. Check final surface elevations for conformance to the plans.

C. The surface elevation of pavers shall be 1/8 inch to 1/4 inch (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

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

3.07 [CLEANING] [SEALING] [JOINT SAND STABILIZATION]

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

3.08 PROTECTION

A. After work in this section is complete, and prior to acceptance by the Agency, protect the work from damage due to subsequent construction activity on the site.

# PART 4 MEASUREMENT AND PAYMENT

# 4.01 MEASUREMENT

A. Interlocking concrete pavement will be measured by the square yard, complete, in-place.

4.02 PAYMENT

A. Payment per square yard includes:

 a. Excavation.

 b. Subgrade preparation.

 c. Supply and install:

 1) Geotextile.

 2) Aggregate base material.

 3) Edge restraints.

 4) Bedding sand.

 5) Concrete pavers with jointing sand.

 d. All other work required not listed above.

END OF SECTION

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