

Provided By:



PAVERS ON CEMENT TREATED BASE SECTION 32 14 13

Note: This guide specification for the U.S. is for concrete pavers on a sand bed with geotextile over a cement treated base (CTB). This assembly is for vehicular applications. CTB is highly recommended for gas station, street, industrial, port and airport pavements. Some guidelines are provided on CTB. However, its specification, as well as excavation and preparation of soil subgrade and subgrade drainage, are generally covered in other Sections.

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

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes**
1. Concrete paver units.
 2. Bedding and joint sand.
 3. Geotextiles.
 4. Edge restraints.
 5. [Cleaners, Sealers and Joint Sand Stabilizers].
- B. Related Sections**
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.

Note: Pavements subject to vehicles should be designed in consultation with a qualified civil engineer, in accordance with established pavement design procedures, ASCE 58-16 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways, ICPI structural design software, and in accordance with the ICPI Tech Spec technical bulletins.

1.02 REFERENCES

Revised November 3, 2021

A. American Society of Testing and Materials (ASTM):

1. C33 Specification for Concrete Aggregates.
2. C140 Method of Sampling and Testing Concrete Masonry Units.
3. C144 Standard Specification for Aggregate for Masonry Mortar.
4. C150 Standard Specification for Portland Cement.
5. C936 Specification for Solid Interlocking Concrete Paving Units.
6. C979 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.
8. D698 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.
9. D558 Standard Test Methods of Moisture-Density Relations of Soil-Cement Mixtures.
10. D1557 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.
11. D1633 Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
12. D2940 Graded Aggregate Material for Bases or Sub-bases for Highways or Airports.
13. D7428 Standard Test Method for Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.

B. Interlocking Concrete Pavement Institute (ICPI) Technical Bulletins

1. Tech Spec 3 Edge Restraints for Interlocking Concrete Pavements.
2. Tech Spec 5 Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement.
3. Tech Spec 17 Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications.

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 C136 for grading of bedding and joint sand.****D. [Test results for sand durability.]****E. 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] [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 C936.
4. Manufacturer's catalog product data, installation instructions, and safety data sheets for the safe handling of the specified materials and products.

F. Paver Installation Subcontractor:

1. Current certificates from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program for job foremen on the project.
2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.04 QUALITY ASSURANCE

- A. Paving Subcontractor Qualifications:**
 1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
 2. Utilize an installer holding a current certificate of completion 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:**
 1. Install a 7 ft x 7 ft (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.

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 in manufacturer's original, unopened, undamaged containers packaging with identification labels intact.**
 1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
 2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.
 3. Unload pavers at job site in such a manner that no damage occurs to the product.
- 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 Requirements:**
 1. Do not install sand or pavers during heavy rain or snowfall.
 2. Do not install sand and pavers over frozen CTB.
 3. Do not install frozen sand or saturated sand.
 4. Do not install concrete pavers on frozen or saturated sand.

1.07 MAINTENANCE

- A. Extra Materials: Provide [Specify area] [Specify percentage.] additional material for use by owner for maintenance and repair.**
- B. Pavers shall be from the same production run as installed materials.**

PART 2 PRODUCTS

2.01 CONCRETE PAVERS

Note: Concrete pavers may have spacer bars on each unit. They are recommended for mechanically installed pavers. Manually installed pavers may be installed with or without spacer bars.

- A. Manufacturer: [Specify ICPI member manufacturer name].**
 - 1. Contact: [Specify ICPI member manufacturer contact information].
- B. Interlocking Concrete Pavers:**
 - 1. Paver Type: [Specify name of product group, family, series, etc.].
 - a. Material Standard: Comply with material standards in ASTM C936: Average compressive strength (C 140): 8000 psi (55 MPa) with no individual unit under 7200 psi (50 MPa); Average water absorption (ASTM C 140): 5% with no unit greater than 7%; Freeze-thaw resistance (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 when immersed in a 3% saline solution. Use -15° C as the lowest test temperature for applications subject to deicers. Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.
 - b. Size: [Specify] inches [mm] x [Specify] inches [mm] x [Specify] inches [mm] thick.
 - c. Color [and finish]: [Specify color] [Specify finish].
 - d. Color Pigment Material Standard: Comply with ASTM C979.

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, stone dust, or sand for the bedding sand material that do not conform to the grading requirements of ASTM C33.
 - 3. Do not use mason sand or sand conforming to ASTM C144 for the bedding sand.

Note: Bedding sand durability is important for crosswalks and other vehicular pavements exposed to high traffic, especially high truck traffic. ICPI Tech Spec 17 Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications recommends durability evaluation using the Micro-Deval degradation test per ASTM D7428. The maximum recommended loss is 8%. This test is recommended when pavers and sand will be placed over concrete, or asphalt, and subject to major thoroughfare traffic (over 1.5 million lifetime 18,000 lb (80 kN) equivalent single axle loads or ESALs). If high traffic loads are anticipated and suitable bedding sand cannot be specified, the designer may consider using bitumen-set (sand-asphalt) bedding layer under the pavers.

- 4. Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.
- 5. Sieve according to ASTM C136.
- 6. Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C33 with modifications as shown in Table 1.

Table 1

ASTM C33 Grading Requirements for Bedding Sand	
Sieve Size	Percent Passing
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 85

No. 16 (1.18 mm)	50 to 85
No. 30 (0.600 mm)	25 to 60
No. 50 (0.300 mm)	10 to 30
No. 100 (0.150 mm)	2 to 10
No. 200 (0.075 mm)	0 to 1

Note: ASTM C144 allows up to 10% passing the No. 200 (0.075 mm) sieve for manufactured sand. ICPI recommends reducing this to no more than 5% as a means to maintain interlock since material passing the No. 200 sieve can lubricate larger sand particles and thereby reduce interlock among paving units.

Note: Coarser sand than that specified in Table 2 below may be used for joint sand including ASTM C33 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 ASTM C33 sand is used for joint sand, extra effort may be required in sweeping material and compacting the pavers in order to completely fill the joints.

7. Joint Sand Material Requirements: Conform to the grading requirements of ASTM C144 as shown with modifications in Table 2 below:

Table 2

Sieve Size	ASTM C 144 Grading for Joint Sand	
	Natural Sand Percent Passing	Manufactured Sand 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

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. 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] [Concrete].
3. Material Standard: [Specify material standard].

2.05 ACCESSORIES

A. Provide accessory materials as follows:

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

Note: Sealer for the purposes of joint stabilization are recommended for gas station and airfield applications. 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].

Note: CTB is typically a mixture of portland cement Type I, ASTM C150 and crushed coarse and fine aggregate conforming to ASTM D2940. The material should achieve a minimum compressive strength of 4.5 MPa (650 psi) at seven days per ASTM D1633. Consult a qualified professional civil engineer for material, testing, and installation specifications for CTB.

PART 3 EXECUTION

Note: Subgrade preparation, drainage, and installation and/or rehabilitation of subbase and CTB materials may be specified under other Sections. Some minimum requirements follow and a qualified civil engineer should be consulted for guidance in developing specifications for those Sections. Soil under CTB or subbases should be free from deleterious material and compacted to a minimum of 98% Proctor density according to ASTM D698 or modified Proctor density per ASTM D1557 for heavily loaded street, industrial, port and airport pavements. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils. A minimum 4 to 6 in. (100 to 150 mm) thick compacted aggregate sub-base under CTB is sometimes used as a working platform and is recommended. Compact aggregate subbase to a minimum of 98% modified Proctor density per ASTM D1557. CTB is typically applied in 4 in. (100 mm) lifts and compacted to a minimum of 98% density per ASTM D558. Field measurements of density of soil subgrade, subbases, and CTB should be reported in writing to the Engineer/Architect.

Note: Mechanical tampers are recommended for compaction of soil subgrade, subbase and base around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions. In areas not accessible to roller compaction equipment, compact to specified density with mechanical tampers.

3.01 ACCEPTABLE INSTALLERS

A. [Specify acceptable paving subcontractors].

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.

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.
 - a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
 - b. Verify that geotextiles, if applicable, have been placed according to drawings and specifications.
 - c. Verify that [Aggregate] [Cement-treated] base materials, thickness, [compacted density], surface tolerances and elevations conform to specified requirements.
 - d. Provide written density test results for soil subgrade, [aggregate] [cement-treated] 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 holes and inlets.
2. Do not proceed with installation of bedding sand and interlocking concrete pavers until [subgrade soil and] base conditions are corrected by the General Contractor or designated subcontractor.

3.03 PREPARATION

- A. Verify base is clean and 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. **Verify location of weep holes at lowest elevations filled with washed pea gravel and covered with geotextile to prevent bedding sand loss.**
- D. **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 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 to a maximum of 10 in. (250 mm).

3.04 INSTALLATION

- A. **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 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 as required.**

Note: Contact manufacturer of interlocking concrete paver units for recommended joint widths.

- C. **Provide consistent joints widths between pavers of [1/16 in. and 3/16 in. (2 and 5 mm)]. 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 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 [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 with a minimum of 5,000 lbf (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 sand into joints continuously until full. This will require at least 4 passes with a plate compactor. Do not compact within 6 ft (2 m) of unrestrained edges of paving units.**
- K. **All work more than 6 ft. (2 m) of the laying face must 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

Note: Surface tolerances on flat slopes should be measured with a rigid straightedge. Tolerances on complex contoured slopes should be measured with a flexible straightedge capable of conforming to the complex curves on the pavement surface.

- 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.
- B. Check final surface elevations for conformance to drawings.

Note: For installations on a compacted aggregate base and soil subgrade, 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.
- 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, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement 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

ABOUT CMHA

The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.

Disclaimer:

The content of this CMHA Guide Spec is intended for use only as a guideline and is made available "as is." It is not intended for use or reliance upon as an industry standard, certification or as a specification. CMHA and those companies disseminating the technical information contained in the Guide Spec make no promises, representations or warranties of any kind, expressed or implied, as to the accuracy or completeness of content contained in the Guide Spec and disclaim any liability for damages or injuries resulting from the use or reliance upon the content of Guide Spec. Professional assistance should be sought with respect to the design, specifications, and construction of each project.