

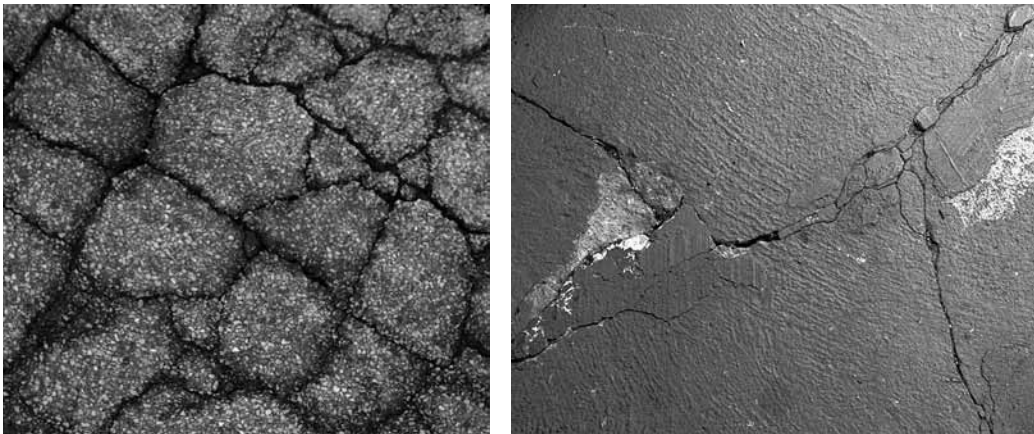
Section 5 Overlays and Inlays

An *overlay* is an application of concrete pavers and a bedding course (sand, bitumen or mortar) to an existing asphalt or concrete pavement. An *inlay* is when part or all of the existing asphalt or concrete surface is removed prior to installing pavers and a bedding course. The surface elevation of the pavers is the same or similar to the previous pavement surface. Paver overlays and inlays are methods for rehabilitating the pavement surface while increasing the pavement's ability to take more wheel loads.

Section 5 Part A: Assessing the Existing Pavement Condition

Prior to an overlay, the condition of pavement subject to vehicular traffic should be assessed for suitability for an overlay or inlay. This assessment should be by a pavement (civil) engineer, especially when the existing asphalt or concrete pavement has experienced some wear, cracking, or rutting. The engineer uses methods for surveying the condition of the pavement that identify distresses which may impair its performance. These distresses and survey methods are outside the scope of this course, but are well-described in references on conventional asphalt and concrete pavements. One key reference is ASTM D 6433 *Standard Practice for Roads and Parking Lot Condition Index Surveys*. This practice assesses the condition of asphalt and concrete pavements in terms of low, medium and high distresses as well as their severity. Any asphalt or concrete pavement that displays medium to high distress levels and severities of cracking, rutting, heaving or pumping is not suitable for interlocking concrete overlays.

A condition assessment by a civil engineer experienced with pavement surveys and rehabilitation is important to deciding on an overlay or inlay of concrete pavers. However, the paver installation contractor may encounter jobs where no such services have been provided by an engineer. These may include residential driveways and entrances to commercial properties where the expense of hiring an engineer is not justified.



Figures 5-1 and 5-2. Moderate or severely cracked asphalt and concrete with cracks and chipping as shown here don't qualify as a stable surface for an overlay of interlocking concrete pavement.

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The absence of a survey can place the paver installation contractor at risk, since the overlay or inlay may be on worn pavement. If this is the case, some signs of distress in the pavement can warn the contractor. Worn out asphalt pavement exhibits extensive cracking, loose pieces on the surfaces, and/or rutting that exceeds $\frac{3}{4}$ in. (20 mm). Figures 5-1 and 5-2 illustrate asphalt and concrete pavements that should receive an overlay of bedding sand and concrete pavers.

Worn cast-in-place concrete slabs can show extensive cracking, cracked corners, heaved or uneven slabs or pieces, or water pumping from between the slab joints. Slabs exhibiting these conditions should likely not be overlaid. If these signs are present on the existing pavements, the contractor should be very careful about engaging in the project or propose complete pavement replacement. In many cases worn, overlaid/inlayed pavement will continue to wear under the pavers. Rutting and cracking of the concrete or asphalt base will be reflected to the surface of the interlocking concrete pavement in a matter of weeks or months.

Section 5 Part B: Construction Aspects

Surface preparation—For overlays or inlays, existing asphalt and concrete pavements should not be uneven or heaving. The surface should be smooth with no bumps. Some cracks in the concrete or asphalt are acceptable, but if they are over $\frac{3}{8}$ in. (10 mm) wide, they should be patched. Sometimes wide cracks indicate the presence of expansive soils or heaving from water trapped under the existing pavement. An overlay of pavers will not solve these problems.

Use of geotextiles—Geotextiles should be used if there is potential for the loss of bedding sand. A layer of woven geotextile should be placed across the existing asphalt or concrete surface to prevent the loss of bedding sand into existing or future cracks. The geotextile is not essential if the asphalt is practically new and there are no cracks present. For new concrete, geotextile should be placed over expansion joints and control joints. The strips should be at least 12 in. (300 mm) wide. Woven geotextile is recommended as it has the highest resistance to abrasion from the bedding sand.

Edge restraints—Overlays on new or existing pavement should be constrained with edge restraints. *ICPI Tech Spec 3* and the Level I course address the different types of edge restraints and their applications. Precast concrete, plastic, steel or aluminum restraints can be fastened directly to the existing asphalt or concrete pavement. These edge restraints can be used on pavements with a limited amount of truck traffic. Expansion bolts are useful on concrete and spikes should be used in asphalt as expansion bolts often do not create a permanent connection. A 12 in. (300 mm) wide strip of geotextile should be placed along the edge restraint and turned up against it. This will contain the bedding sand and help prevent its loss.

For overlays on city streets, the existing concrete curbs often function as an edge restraint. In some cases the curb is angled or sloped away from the street. This creates an uneven, nonperpendicular surface against which the pavers are restrained. Therefore, it may be difficult to create a tight fit of the pavers against the curb. To create a tight fit, the sides of the pavers can be cut at an angle similar to that of the curb. This adds extra labor expense and should be accounted for when estimated. This approach, however, will not work against “rolled” or rounded concrete curbs, or those with slopes that allow tires to more easily ride over them.

Bedding Sand—The gradation of the bedding should conform to ICPI recommends no more than 1% passing the No. 200 (0.075 mm) sieve. Some projects may have heavy traffic, such as in a major thoroughfare, a bus station or a truck depot. In these situations, the hardness of the bedding sand should be assessed using the test method described in Section 4. Bedding sand can be used for joint sand.

Bedding sand thickness is typically 1 in. (25 mm). This allows the contractor to compensate for minor variations in the base and in the pavers. Bedding sand can be as thin as $\frac{1}{2}$ in. (13 mm) to adjust for slopes. However, the base will need to be very flat and smooth (no bumps) with consistent thicknesses among the pavers.

Elevations—Overlays and inlays on streets, parking lots and other pavements generally follow the contour and slope of the existing pavement under it. These

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should be marked on the construction drawings and verified on site with a transit level. Minor changes in slope can be made by varying the thickness of the bedding sand. However, the bedding sand should not exceed 1½ in. (40 mm) after compaction.

Most overlays and inlays on streets use 3⅛ in. (80 mm) thick pavers and 1 in. (25 mm) of bedding sand. Utility structures such as catch basins, manholes, pull boxes, gas, and water line valves will need to be raised about 4 in. (100 mm) prior to placing the pavers and bedding sand so that their elevations meet the new surface elevations created by the overlay. Raising utilities is typically done by the state, provincial or local municipality, or by other utility owners.

Inlays on Existing Asphalt and Concrete Parking Lot and Street Pavements

For inlays on asphalt, the existing pavement is often removed by another contractor with milling machines. The machines (Figures 5-3 and 5-4) can create accurate slopes and crowns while grinding a pavement. They grind the asphalt and convey it to a dump truck for disposal or recycling.

Caution must be used when deciding to grind existing concrete or asphalt. The removal of several inches (mm) of the surface can substantially weaken it, causing it to crack and eventually fail. Existing concrete pavements are seldom ground to a thinner cross section by milling machines and used as a base. When

they are milled, there is often a new layer of concrete or asphalt applied to strengthen the concrete base. An engineer's advice is essential in this situation.



Milling around catch basins, utility structures, gas and water valves, and in corners should be done with a small milling machine since the larger machines can't get close enough to remove the entire existing pavement around these protrusions. In some instances, the bits of pavement around the protrusions are removed with a small, powered hammer or chisel.



Figures 5-3 and 5-4. A milling machine can create a crown (or flatten one) in a street, thereby adjusting the grades for better drainage.

The result of milling and removal of the pavement around protrusions should create flush, clean vertical surfaces that are perpendicular to the pavement. This preparation and responsibility should be clearly defined in the drawings and specifica-

tions. Otherwise, it can become extra, labor-intensive work for the paver installation contractor. The paver installation contractor shouldn't be cleaning out bits of concrete or asphalt from around catch basins and manhole covers unless this work is identified in the contract or is in the contractor's estimate.

The depth of the milled material removed from grinding on asphalt streets is typically 4 in. (100 mm) in order to receive 3¹/₈ in. (80 mm) thick pavers and about 1 in. (25 mm) of bedding sand. Obviously, for pedestrian areas the depth of removed pavement material would be about 3¹/₄ in. (80 mm) assuming the use of 2³/₈ in. (60 mm) thick pavers and 1 in. (25 mm) of bedding sand.

In some instances, existing asphalt may be removed by grinding that is thicker than the depth of the pavers and bedding sand. The additional depth allows for a new layer of asphalt (usually 1.5 to 2 in. or 40 to 50 mm thick) to be placed before installing the bedding sand and pavers. Generally, compacted aggregate base material should not replace ground concrete or asphalt.

When building an overlay, transition areas are constructed that enable the surface of the overlay to align with the surface of adjacent pavement. The transition area is typically about 10 ft (3 m) long and requires removal and replacement of the base such that the pavers and adjacent surfaces meet to create a smooth transition.

Drainage and Installation

Drainage—Overlays and inlays require drainage of the bedding sand layer. While the joints between pavers seal or partially seal over time, water enters the joints and the bedding sand at the beginning of the life of the pavement. Therefore,

excess water must be removed from the bedding sand. This is done by two methods. The most common is to drill 2 in. (50 mm) diameter holes (or cast them if overlaying a new, cast-in-place concrete) at the lowest elevations of the existing pavement. See Figure 5-5. These can be located along a curb every 10 ft (3 m).



Figure 5-5. Drain holes placed at the lowest elevation in an asphalt pavement to be overlaid with concrete pavers.

This method of drainage is not recommended in areas where the water table is very close to the surface such as in soils close to the ocean or swamps. In these cases, drainage of the bedding sand should be accomplished by the second method which is drilling several 1 in. (25 mm) diameter holes in the sides of a catch basin (since they're at the lowest elevations). The bottom of the holes should align with the bottom of the sand layer (top of the concrete or asphalt base). The holes should be covered with geotextile prior to placing the bedding sand so it isn't lost through the drain holes. The drains

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will relieve the water in the bedding sand and help prevent loss of joint and bedding sand in low areas of the pavement.

Installing the Bedding Sand and Pavers—When geotextile is placed over the existing pavement, care should be taken to prevent wrinkling, especially when bedding sand is dumped and screeded on it. Dumping small quantities of bedding sand on the geotextile will help secure it and prevent wrinkling as a dump truck moves across it. Screed bars should be in place prior to spreading the sand with shovels. Screeding the bedding sand and paver installation proceeds as with any other interlocking concrete pavement. The pavers are compacted, sand spread and vibrated into the joints until the joints are full. Excess sand is removed.

Pool deck overlays—Concrete units having 1 to 1½ in. (25 to 40 mm) thicknesses have been used for overlays on commercial concrete pool decks and other concrete surfaces, especially in Florida and other nonfreezing regions. These thin, tile-like units should be applied only on a concrete base. Any cracks between ⅛ in. (3 mm) and ½ in. (13 mm) in the concrete deck should be patched with high strength mortar. Larger cracks may indicate additional problems with subgrade soil and/or the concrete and should be inspected by an engineer.

The thin units are often placed directly on the concrete deck with all edges cut and placed, but no compaction. Masonry sand (used to make mortar) is spread across the pavement and washed into the joints with a garden hose. The sand is repeatedly applied and washed into the joints until they are full. The pavement is left to completely dry, typically 24 hours. The pavers are sealed with an acrylic sealer which also stabilizes the joint sand. The sealer typically lasts from 2 to 4 years until it has to be reapplied. This method of rehabilitating a cracked but structurally stable pool deck is fast and effective for applications in places like Florida.

Estimating, Job Planning and Construction Checklist

Overlays

- Traffic control (plan)
- Condition of existing pavement
- Raising of utility structures
- Geotextiles
- Drainage of bedding sand
- Paving pattern
- Edge restraints—curbs or other

Inlays

- Traffic control
- Depth of removed pavement
- Grinding/milling around utility structures and curbs
- New asphalt or concrete base
- Geotextiles
- Drainage of bedding sand
- Edge restraints
- Paving pattern

Crosswalks

- Traffic control
- Base material
- Edge restraints—size and materials
- Drainage of bedding sand
- Tie existing pavement to edge restraints
- Paving pattern

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Guide Specification on Overlays

SECTION 32 14 13 INTERLOCKING CONCRETE PAVEMENT OVERLAY (1995 MasterFormat Section 02780)

Note: This guide specification for the U.S. is for the construction of a new or rehabilitative overlay of concrete pavers and bedding sand over existing asphalt, concrete, or aggregate base. Applications include pedestrian and vehicular areas. The text must be edited to suit specific project requirements. This Section includes the term "Architect." Edit this term as necessary to identify the design professional in the General Conditions of the Contract.

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 and Sealers]

B. Related Sections

1. Section: []- Curbs and Drains.
2. Section: []- Concrete Base.
3. Section: []- Pavements, Asphalt and Concrete.
4. Section: []- Geotextiles.

Note: Pavements subject to vehicles should be designed in consultation with a qualified civil engineer, in accordance with established pavement design procedures, ICPI Lockpave software, and in accordance with the ICPI Tech Spec technical bulletins. Use the current year reference.

1.02 REFERENCES

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

1. C 33, Specification for Concrete Aggregates.
2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
4. C 144, Standard Specification for Aggregate for Masonry Mortar.
5. C 936, Specification for Solid Interlocking Concrete Paving Units.
6. C 979, Standard Specification for Pigments for Integrally Colored Concrete.
7. C 1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.

B. Interlocking Concrete Pavement Institute (ICPI)

1. ICPI Tech Spec Technical Bulletins

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 for grading of bedding and joint sand.

- D. [Bedding sand durability test results.]
- 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 C 936.
 4. Manufacturer's certification of concrete pavers by ICPI as having met applicable ASTM standards.
 5. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.
- F. 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 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 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 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.]

NOTES

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 aggregate base materials.
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 highly 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 C 936.
 - b. Color [and finish]: [Specify color.] [Specify finish].
 - c. Color Pigment Material Standard: Comply with ASTM C 979.
 - d. Size: [Specify.] inches [({Specify.}mm)] x [Specify.] inches [({Specify.}mm)] x [Specify.] inches [({Specify.} mm)] thick.

Note: If 3 1/8 in. (80 mm) thick pavers are specified, their compressive strength test results per ASTM C 140 should be adjusted by multiplying by 1.18 to equate the results to that from 2 3/8 in. (60 mm) thick pavers.

- e. Average Compressive Strength (ASTM C 140): 8000 psi (55 MPa) with no individual unit under 7200 psi (50 MPa) per ASTM C 140.
- f. Average Water Absorption (ASTM C 140): 5% with no unit greater than 7%.
- g. Freeze/Thaw Resistance (ASTM C 67): Resistant to 50 freeze/thaw cycles with no greater than 1% loss of material. Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.

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, nonplastic, 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 C 33.
3. Do not use mason sand or sand conforming to ASTM C 144 for the bedding sand.

Note: Bedding sand durability is important for crosswalks and other vehicular pavements exposed to high traffic. The engineer/architect is advised to evaluate the hard-

ness of bedding sand with the following test method when the pavers and sand will be placed over concrete, or asphalt, and subject to major thoroughfare traffic (over 1.5 million ESALs). See ICPI Tech Spec 17 for guidance on bedding sand testing.

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.
6. Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C 33 with modifications as shown in Table 1.

| Table 1 ASTM C 33 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 100 |
| 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: Coarser sand than that specified in Table 2 below may be used for joint sand including C 33 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 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.

8. Joint Sand Material Requirements: Conform to the grading requirements of ASTM C 144 as shown with modifications in Table 2 below:

| Table 2 ASTM C 144 Grading for Joint Sand | | |
|--|---------------------|--------------------------|
| | 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 1 | 0 to 10 |

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 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

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] [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 subgrade, [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 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. 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. 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 as required.

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

- C. Provide joints between pavers between [$\frac{1}{16}$ in. and $\frac{3}{16}$ in. (2 and 5 mm)] wide. No more than 5% of the joints shall exceed [$\frac{1}{4}$ in. (6 mm)] wide to achieve straight bond lines.
- D. Joint (bond) lines shall not deviate more than $\pm\frac{1}{2}$ 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 4,000 lbf (18 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 to 6 passes with a plate compactor. Do not compact within 6 ft (2 m) of unrestrained edges of paving units.

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- K. All work within 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 straight-edge 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 $1/8$ in. 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 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