SECTION 521

PAVERS

I. GENERAL

1.1. DESCRIPTION OF WORK

This specification applies to clay and concrete brick pavers and concrete pavers with detectable warning surfaces. For composite detectable warning surface panels, refer to Section 502.

The Contractor shall furnish all labor, materials, equipment and supplies, and shall perform all Work necessary for the placement of pavers as shown on the Drawings or Special Provisions and as specified herein. Applications include pedestrian and vehicular areas. This specification is for the construction of new or rehabilitative overlay of pavers and bedding sand over an existing asphalt, concrete, or aggregate base.

1.2. MATERIALS

Materials shall be furnished by the Contractor in accordance with Section 200.

1.3. SUBMITTALS

A. Manufacturer's shop drawings shall indicate perimeter conditions, relationship to adjoining materials and assemblies, expansion and control joints, paver layout, patterns, color arrangement, installation and setting details.

B. Concrete base course shall meet or exceed 3,000 psi at 28 Days and shall be constructed in accordance with Section 502.

C. Sieve analysis shall be submitted for grading of bedding and joint sand.

D. Pavers

1. The Contractor shall provide four representative, full-size samples of each paver type, thickness, color, finish that indicates the range of color variation and texture expected in the finished installation. The colors provided must be acceptable to the Owner.

2. Accepted samples become the standard of acceptance for the Work.

3. Test results from an independent testing laboratory for compliance of pavers may be required as directed by the Owner. The Manufacturer must provide certification that the concrete pavers meet applicable standards as outlined in Section 200.

4. The Contractor must strictly adhere to the manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.

5. Sample Walk Strip

a. The Contractor shall construct a sample strip for each type of walk or paved roadway for approval and acceptance by the Owner no less than 14 calendar days prior to the start of the paver construction.

b. Minimum size of the sample strip(s) shall be 5 ft. x 8 ft.

c. Location of sample strip shall be as directed by the Owner.

d. The Owner shall approve the sample strip(s) prior to the start of the paver construction.

e. An acceptable sample strip may be used as part of the paver construction.

f. The Owner will use the sample strip(s) as a comparison standard to evaluate the completed Work

6. The Contractor shall provide 10% additional material for use by the Owner for maintenance and repair.

7. Sample Walk Strip Pavers and additional pavers (spare pavers) for maintenance and repair shall be from the same production run as installed materials.

II. EXECUTION

2.1. GENERAL

A. Sand or pavers shall not be installed during heavy rain or snowfall.

B. Sand and pavers shall not be installed over frozen aggregate base materials.

C. Frozen sand or saturated sand shall not be installed.

D. Pavers shall not be installed on frozen or saturated sand.

E. Contractor shall not proceed with paver construction until underground utility and wiring conduit construction is complete.

F. Contractor shall not proceed with paver construction until bench and trash receptacle foundations are set.

G. Contractor shall coordinate pedestrian light pole and street name sign pole locations with the Owner.

H. Installation in asphalt or concrete pavement: Contractor shall neatly saw cut along the edge of material to be removed.

I. Installation of pavers with detectable warning surfaces: Domes shall be aligned on a square grid, aligned in rows parallel and perpendicular to the predominant direction of travel. The domes must be not skewed diagonally to the direction of travel.

2.2. SUBGRADE PREPARATION

A. Any unsuitable material, such as organic material, large rocks, etc., shall be removed from the subgrade and replaced with suitable backfill. The subgrade shall be drained and protected against flooding and ground water by sub-soil drainage. The installation of pipes and sub-soil drainage shall be completed before initiating the base or subbase construction. The width of the subgrade shall be sufficient to extend to the back edge of the proposed edge restraint or abut existing structures.

B. The subgrade top surface shall be scarified and conditioned to the proper moisture content, and then to recompacted to established relative densities. Compaction of the soil shall be at least 98% standard Proctor density per ASTM D 698 for pedestrian areas and residential driveways and to at least 98% modified Proctor density per ASTM D 1557 for areas subject to heavy vehicular traffic.

2.3. SUBBASE COURSE

A. Geotextile fabric used to separate subgrade soil from aggregate subbase shall be placed without wrinkles and lapped at their edges.

B. The geotextile fabric shall be placed so that the material extends up the side of the excavated area a sufficient distance to cover the material. Geotextile fabric shall overlap a minimum of 36 in.

C. All subbase materials shall be compacted to a minimum of at least 95 percent of maximum density. The subbase should also extend at least one layer thickness past the edge of the overlying layer to enable adequate compaction at the edges of the pavement.

D. Compaction shall be completed as soon as possible after the material has been mixed and spread. The profiles should be such that water is channeled towards drainage facilities.

2.4. BASE COURSE

A. Base materials shall be laid in consistent, well packed layers (4in. max) that build up to a surface that will match the intended elevation. All base materials shall be compacted to a minimum of 95 percent maximum density. The base shall also extend at least 6 in. past the edge restraint if spikes are used to hold the restraint in place. The surface of the base shall be close-knit to prevent setting bed material from filtering downwards through the base.

B. Compaction shall be completed as soon as possible after the material has been spread. Mechanical tampers may be used for compaction of soil subgrade and aggregate base in areas not accessible to large compaction equipment. Such areas may include around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions.

C. Prior to screeding the bedding sand, the base surface tolerance shall be ± 3/8 in. over a 10 ft. straight edge.

D. Concrete Base Course Preparation

1. Install concrete base course in accordance with the Contract Documents.

2. Surfaces to receive masonry paving units shall be firm, free from frost, dirt, dust and foreign materials. Inspect surfaces prepared by other trades before starting Work and report to the Owner in writing any conditions which will prevent satisfactory execution of finished Work and have same corrected before starting Work. Application of materials in any given area indicates acceptance of surfaces provided and latter claims of defects to these surfaces provided will not relieve the applicator from responsibility to produce first class work.

3. Paver Setting Beds

   a. Verify sub grade is dry and meets material, installation and grade specifications.

   b. Place base course material on prepared sub grade, in 6 inch maximum lifts, to depth required to produce compacted thickness indicated. See Drawings and Special Provisions for required base and subgrade depth.

   c. Shape material, to sections and elevations indicated, with blade grader and compact with pneumatic tired rollers to 95 percent maximum dry density. Density test method shall conform to ASTM D 698-70.

   d. Proof roll base course with steel wheel roller or equivalent and correct irregularities.

4. Mortar Beds

   a. Do not install over when outside temperature is below 45° F.

   b. Completely remove all dirt, mortar and other foreign material from surface of concrete base prior to application of setting bed. This may require mechanical grinding and scarifying of the surface.

   c. Neutralize any trace of strong acid or alkali from the substrate prior to mortar application.

   d. If leveling of the concrete surface is necessary, apply latex Portland cement mortar surface leveling materials to the surface of the substrate to bring the surface to a true, even plane. Allow mortar-leveling materials to set prior to installation.

   e. Surface to receive mortar shall have a tolerance of ±1/4 in. over 10 ft for normal mortar setting bed applications and ±1/8 in. over 10 ft for thin set mortar setting bed applications.

E. Non-Concrete Base Course Preparation

1. Verify base is dry and meets material, installation and grade specifications.

2. Verify that base and geotextile is ready to support sand, edge restraints, and pavers and imposed loads.

2.5. EDGE RESTRAINTS

A. Install plastic, concrete, aluminum, steel, pre-cast concrete, cut stone, concrete edge restraints as indicated in the Drawings or Contract Documents around the perimeter of all interlocking paving unit areas.

B. Rigid edge restraints shall be installed prior to setting the paver bed and pavers. If the restraints consist of or include concrete, they shall be cured before pavers are laid.

C. Edge Restraint Preparation: Install edge restraints per the Drawings, Special Provisions and manufacturer's recommendations at the indicated elevations. For edge restraints that are staked into the base with spikes:

1. Mount directly to finished base. Do not install on bedding sand.

2. The minimum distance from the outside edge of the base to the spikes shall be equal to the thickness of the base.

3. Stakes: 12-inch long x 3/8-inch diameter steel spikes spaced 3 feet on center.

2.6. SITE VERIFICATION OF CONDITIONS

A. Verify that geotextiles, if applicable, have been placed according to Contract Documents.

B. Verify that aggregate, cement-treated, asphalt-treated, concrete, or asphalt base materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.

C. Provide written density test results for soil subgrade, aggregate, cement-treated, asphalt-treated, or asphalt base materials to the Owner.

D. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

E. The Contractor shall not proceed with the installation of bedding sand and interlocking concrete pavers until subgrade soil and base conditions are corrected.

2.7. PAVER SETTING BED

A. The bedding course shall follow the intended grade of the final wearing surface.

B. Sand or Sand/Cement Setting Bed Method

1. The setting bed shall not be used to fill in low spots or bring the pavement to the correct grade.

2. Spread bedding sand or sand/cement bedding mixture evenly over the base course and screed rails, using the rails and/or edge restraints to produce a nominal thickness as indicated on the Drawings or Special Provisions, allowing for specified variation in the base surface.

   a. Sand Setting Bed Depth: When not otherwise indicated in the Drawings or Special Provisions, the thickness of the sand setting bed shall be 1-inch with a tolerance of plus or minus 3/16-inch. Screeded area shall not substantially exceed that which is covered by pavers in one day.

   b. Sand/Cement Setting Bed Depth: When not otherwise indicated in the Drawings or Special Provisions, the thickness of the setting bed shall be ½-inch to ¾-inch. Do not place setting beds unless pavers are also ready to set. Any setting bed that becomes contaminated with dirt and/or debris must be removed and replaced prior to laying pavers.

3. Do not disturb screeded sand.

4. The setting bed sand shall not be spread too far in front of the laying face of the pavers to prevent disturbance. The sand shall be screeded without compaction to a level slightly higher than the final thickness of the layer. The sand shall be disturbed as little as possible since the final pavement surface will reflect any variation. The voids left by the screed rails shall be filled from the paver laying face as work progresses. Prepared areas shall not be left overnight unless they are properly protected from disturbance and moisture. The moisture content of the setting bed sand shall be as uniform as possible and the material should be moist without being saturated. Water shall not be added to screeded sand except as a very light misting. Stockpiled material shall be kept covered.

5. The screeded bedding sand is vulnerable to environmental disturbance from wind or rain. The Contractor shall ensure that water cannot drain back into the bedding sand when it is uncovered or covered with pavers but not vibrated.

C. Bituminous Setting Bed Method

1. A tack coat shall be applied over the base layer to achieve a level of bonding and moisture protection. The air and substrate temperature shall be above 50 degrees F. The material shall be at a temperature of about 80 degrees F or above when applied. A continuous, uniform coat shall be applied by spraying, squeegeeing or brushing the material. Typical application rates shall be 0.05 to 0.15 gallons per square yard, depending on surface texture and porosity. Work shall not be carried out in rainy conditions. The tack coat shall cure for 1/2 to 1 hour (until it turns black and is dry to the touch) before applying the bituminous setting bed.

2. Unless otherwise indicated on the Drawings or Special Provisions, the hot material shall be spread over the surface of the tack coat and screeded off to a nominal

thickness of 3/4 in. Care shall be taken to ensure that release agents applied to the screed rails and tools do not cause damage to the bituminous setting bed. The infilling of narrow slots where screed rails have been removed shall be minimized to prevent variable density and differential compaction. Screeding shall be undertaken while the material is still hot. Once the asphalt sand mixture has cooled to a suitable temperature, it shall be rolled to provide a smooth, uniform surface.

D. Mortar Setting Bed Method

1. Install cement mortar setting beds in areas indicated on the drawings. Place mortar, screen to required elevations and slopes.

2. Setting beds shall be a ½ - ¾" thickness unless noted otherwise on the drawings.

3. Do not place mortar setting beds so far in advance of paving that initial set of mortar takes place prior to installing the paving.

2.8. PAVER INSTALLATION

A. General

1. On site, brick pavers shall be stored off the ground. Base and bedding course materials shall be stored separately and covered with weighted plastic to maintain dryness and wind protection.

2. Installation shall not occur during rain or snowfall.

3. Work may start from an exact edge or from the centerline of the pavement. The pavers shall not be forced together. The pavers shall be laid in the desired bond pattern. For pavers without lugs, joint width shall be between 1/16 in. and 1/8 in. on all sides for heavy load applications and between 1/16 in. and 3/16 in. for pedestrian and other light loading applications, unless otherwise indicated on the Drawings or Special Provisions.

4. The pavers shall be laid straight with true bond lines to provide a uniform distribution of horizontal loads. Alignment shall be checked from time to time during the process, so that simple adjustments can be made to assure a clean, consistent bond pattern throughout. Joint widths and lines (bond lines) shall be straightened and aligned to specifications with rubber hammers and pry bars as paving proceeds.

5. All pavers shall be cut with a masonry saw to produce an accurate, clean cut. The minimum face dimension of the cut piece shall not be less than the paver thickness.

6. Back cut all pavers as required to accommodate Work of other trades located in the setting beds.

7. All pavers shall be laid hand tight.

8. 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.

9. Fill gaps at the edges of the paved area with cut pavers or edge units.

10. Tamp pavers to setting bed compacted thickness indicated, assuring solid bedding so pavers do not rock after laying.

11. Lay pavers true to grade allowing for positive drainage throughout. Under no circumstances shall the top of the curb exceed or extend beyond the top surface of the pavers.

12. Where pedestrian light poles and street name sign poles are to be installed, the contractor shall install a short section of PVC piping with the same outside diameter (O.D.) of the pole and neatly cut the pavers to fit a round the PVC piping. The actual locations of the poles shall be closely coordinated with the Owner. The contractor shall re-install concrete pavers (approximately 1 square yard per pole) after the poles are installed by others at no additional cost to the Owner.

13. 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.

14. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint sand.

15. Protection Prior to Completion

    a. 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.

    b. When using compact dry joint sand: Allow excess joint sand to remain on surface to protect pavers from damage from other trades. Remove excess sand when installation is complete.

    c. Protection when using compact dry joint sand/cement mixture: Apply dry joint sand to surface to protect pavers from damage from other trades. Remove excess sand when installation is complete.

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

B. Pavers on Sand Setting Bed

1. After the pavers have been placed on the sand setting bed, the brick pavement shall be vibrated by a mechanical plate vibrator/compactor. The compactor shall have a rubber pad to avoid damage to the pavers. The first pass shall be performed without jointing sand spread on the surface. Prior to subsequent passes of the compactor, jointing sand shall be spread across the surface before compaction. The jointing sand

shall be dry and spread on the pavement until the joints appear full. Obviously the initial vibration and placement of the jointing sand shall be accomplished as soon after placing the pavers as possible and before any traffic is permitted on the paving.

2. Compaction shall not occur within 6 feet of any unrestrained edge.

C. Pavers on Bituminous Setting Bed

1. The surface of the completed paving shall be rolled with a heavy rubber tire roller so that the adhesive does not penetrate into the setting bed and the quantity of adhesive can be better controlled. Pavers shall then be set close to their final position.

2. The adhesive shall be applied above 70 degrees F. It shall be applied at a coverage rate of 30 to 50 sq ft per gal by brush, squeegee or trowel, depending on its viscosity. The adhesive shall be spread at least two hours before setting the pavers.

3. The brick pavers shall be placed by hand onto the adhesive with joint widths of 0 to 1/16 in. and aligned as soon as possible to form straight lines. Wider joints shall not be permitted and the pavers shall be placed as close together as possible while maintaining the alignment. When the pavers have lugs, they may be placed in contact with each other to minimize creep.

4. Traffic shall not be permitted on the paving until the joints are filled with jointing sand that is stabilized. Sand stabilized by mixing cement with dry joint sand is not permitted

D. Pavers on Mortar Bed

1. Backcoat all pavers with mortar/bonding agent emulsion prior to setting.

2. Hand Tight Joints

All pavers shall be laid hand tight. Except in specified locations, brick shall be laid on the damp, leveling bed to the brick patterns shown on the drawings, using hand tight joints and shall be free from all movement and settlement.

3. Joint Fill

Immediately after the bricks are laid, broom colored mortar mix into all joints to form a tight surface. Leave excessive mix in place and tamp the surface with a hand tamper. Then cover the brick surface with dry mix and tamp again. Sweep any excess mix off the surface. The brick shall then be sprayed with a fine mist of water and maintained in a damp condition for three (3) Days. After three (3) Days, when the mix is dry, broom additional mix into all joints. No damaged or chipped brick shall be incorporated on the pavement. Colored mortar shall be washed directly off of bricks and curb to avoid staining. Stained areas will be rejected.

4. Curing

Cover all paving Work with a vapor barrier at the end of each day's Work to allow the mortar to cure and to protect from frost. Protect fresh mortar for seven (7) Days after installation from foot traffic or any other operation which could jar paving prior to curing of mortar.

5. Expansion-Contraction Joints

Expansion-contraction joints shall be constructed and located as indicated on the drawings, using materials as defined in Section 200 unless otherwise specified in the Drawings or Special Provisions. Expansion-contraction joints shall not extend through the mortar setting bed unless specifically noted otherwise.

6. Cleaning

After mortar setting beds and pointing have completely cured, clean all surfaces of dirt, mortar stains, and other defacements. Use an approved an approved masonry detergent at the recommended by the manufacturer. The used of acids and wire brushes shall be prohibited unless specifically approved by the Owner for each and every location requested.

E. Repairs

1. Excavation of Trenches

Proper compaction of the returned fill material is very important. If the area is too small for proper compaction, stabilized materials, such as concrete, may be used. The compacted fill shall be brought up to the proper level. One or two feet of pavers around the perimeter of the excavated area shall be removed so that accurate levels can be established from undisturbed Work. Vehicular traffic shall be kept at least 6 ft away from the work edges.

2. Non-Mortar Base Conditions

a. When starting repairs, a single brick shall be removed, preferably with a purpose-made tool. Adjacent pavers shall then be removed and stacked nearby to be used again if not damaged. The pavers shall be cleaned of adhering sand by brushing. Cleaning of asphaltic material is usually difficult, and it may be necessary to remove pavers set on bituminous setting beds from the site for cleaning with a solvent. Temporary edge restraints shall be placed at the perimeter of the removal area.

b. Setting bed material shall be screeded to the proper grade. The setting bed shall be compacted and a thin layer of sand screeded on top. Temporary edge restraints shall be removed and the pavers are then laid in the correct bond pattern. Jointing sand shall be spread over the top of the pavers and the system vibrated to the finished level with a plate compactor for a minimum of three passes and until the joints are filled.

3. Mortar Base Conditions

a. When starting repairs, a single brick shall be removed, preferably with a purpose-made tool. Adjacent damaged pavers shall then be removed and stacked nearby to be used again if not damaged. The removed pavers and the exposed pavers shall be cleaned of adhering mortar and grout. The mortar base shall be removed from the repair area. Any additional bricks that are damaged or loosed in the process shall also be removed and cleaned or replaced.

b. New mortar bed material shall be troweled to the proper grade. The installation of replaced pavers shall conform to the preparation and installation requirements outlined above and to the Field Quality Control Requirements outlined below. In small repair areas involving less than 4 pavers or 2 square feet, whichever area is greater, the pavers can be "buttered" with mortar for reinstallation.

2.9. FIELD QUALITY CONTROL

A. Joints between Pavers

1. Clay Pavers

Open joints above 1/8 in. shall not be permitted.

2. Concrete Pavers

Joints shall be between 1/16 in. and 3/16 in. wide. No more than 5% of the joints shall exceed 1/4 in.

B. Crosswalks, Roadways and Other Heavy Loading Areas: The final surface elevation shall be left slightly above adjacent pavement to allow for secondary compaction of the bedding layer under traffic.

C. The maximum variation in level shall be within ±1/4 in. in 10 ft.

D. Pavers adjacent to drainage inlets and channels shall be left slightly higher, but not more than 3/16 in. above them.

E. The edges of any two adjacent pavers shall not differ more than 1/8 in. if the pavers have chamfers, or 1/16 in. if they have square edges. Paver to paver tolerances shall be measured either chamfer to chamfer or top edge to top edge.

F. The bond line to which the paver pattern is laid shall be within ± 1/2 in. in 50 ft.

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

H. The final surface tolerance from grade elevations shall not deviate more than ± 3/8 in. under a 10 foot straightedge.

I. Check final surface elevations for conformance to Drawings.

J. Heavy Duty Traffic Loading Conditions

For installations on a compacted aggregate base and soil subgrade or on an asphalt base, the top surface of the pavers may be 1/8 to 1/4 in. above the final elevations after compaction to compensate for possible minor settling normal to pavements.

2.10. CLEANING, SEALING, JOINT SAND STABILIZATION

A. Clean, seal, apply joint sand stabilization materials between pavers in accordance with the manufacturer's written recommendations.

B. Remove and replace pavers that are loose, broken, stained or otherwise damaged. Provide new matching units, install as specified.

C. Clean walks not less than six Days after completion of Work, using clean water and stiff bristle brushes. Do not use wire brushes, acid type cleaning agents or other cleaning compounds with caustic or harsh fillers.

D. Upon completion of the Work, remove from site all excess materials, debris, tools, and equipment. Repair damage resulting from work operations.

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

2.11. WARRANTY

A. The Contractor shall guarantee the paving for a period of one year from the date of final approval. The guarantee shall cover all defects including settling, heaving, shifting, spalling, cracking and efflorescence.

B. The Contractor shall repair the paving section deemed unsatisfactory by the Owner within 14 Days of notification.

2.12. EXTRA STOCK

The Contractor shall provide no less than spare 100 brick units of each type and style of brick installed. Spare units shall be from the same lot as the units installed. The spare units shall be delivered to a storage site as directed by the Owner.

III. MEASUREMENT FOR PAYMENT

A. Pavers are to be measured in square feet and will be paid for at the unit price bid per square foot specified for each type of paver as indicated on the Bid form.

B. Payment per square foot for pavers shall include payment in full for all labor, materials, and

equipment necessary to furnish, install, and maintain the pavers and base and subgrade courses.

C. Pavers installed in curb cut ramps are incidental to the contract unit price for curb cut ramps and will not be measured separately. See Section 502 for additional information.

D. Separate pay items shall be made for concrete base courses and subgrade for concrete courses as defined in Section 502.

E. Extra Stock, as defined in Paragraph 2.12, shall not be paid for separately, but shall be considered incidental to the unit price of the pavers.

End of Section