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UNIFIED FACILITIES GUIDE SPECIFICATIONS SECTION 32 14 13

NOTE: This guide specification covers the requirements for constructing a concrete block pavement.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 PAYMENT PROCEDURES

NOTE: Delete this paragraph in fixed price contracts.

1.1.1 PAVEMENTS

The blocks, cut blocks, bedding sand, and jointing sand will be paid per square meter foot of satisfactorily installed block pavement surface.

1.1.2 EDGE RESTRAINTS

The edge restraints will be paid per lineal meter (foot) of satisfactorily installed edge restraint.

1.2 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 301	(2010; Errata 2011) Specifications for Structural Concrete
ACI 301M	(2010) Metric Specifications for Structural Concrete

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C936/C936M	(2013) Standard Specification for Solid Concrete Interlocking Paving Units
ASTM C979/C979M	(2010) Pigments for Integrally Colored Concrete
ASTM D75/D75M	(2013) Standard Practice for Sampling Aggregates
ASTM D1645	
ASTM D4318	(2010; E 2014) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D7428	(2008) Standard Test Method for Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
ASTM E11	(2013) Wire Cloth and Sieves for Testing Purposes

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a “G.” Generally, other submittal items can be reviewed by the Contractor’s Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the “G” designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: “AE” for Architect-Engineer; “DO” for District Office (Engineering Division or other organization in the District Office); “AO” for Area Office; “RO” for Resident Office; and “PO” for Project Office. Codes following the “G” typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a “G” designation; submittals not having a “G” designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the “G” designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 PRODUCT DATA

[Local/Regional Materials; (LEED)]

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Albedo; (LEED)]

Provide information identifying the solar reflectance of the pavement if required.]

SD-04 SAMPLES

Concrete Block Paving Units [G]

Five representative full-size samples of each paving block type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation. Accepted samples become the standard of acceptance for the work of this Section. Also, as directed by Contracting Officer, provide a representative sample of 5 paving units from each lot of 2,500 square meters (25,000 square feet) or fraction thereof.

Jointing and Bedding Sands [G]

Minimum 2 kg (3 lb) samples of each

Field-Constructed Mockup [G]

SD-06 TEST REPORTS

Concrete Paving Units [G]

Laboratory test reports certifying compliance of the concrete block pavers with ASTM C936/C936M.

Jointing and Bedding Sands [G]

Sieve analysis per ASTM C136 of each and L.A. Abrasion per ASTM C131.

SD-07 CERTIFICATES [G]

CMHA Concrete Paver Installer Certification for the paver installation supervisor.

Manufacturers' material safety data sheets for the safe handling of the specified paving materials and other products specified herein. Provide certification that the paving units have a minimum solar reflective index that meets LEED credit requirements for heat island effect - non-roof if required.

SD-10 OPERATIONS AND MAINTENANCE MANUAL

At the completion of the work provide O&M manual to the contracting officer that includes the following: (1) maintenance types, procedures, and schedule; (2) vicinity map showing the project site within the installation; (3) map of the project area showing the permeable pavement with respect to the project; (4) typical cross section of the pavement structure; (5) project specifications for the pavement; and (6) construction cost of the pavement area.

SD-11 CLOSEOUT SUBMITTALS

[Local/Regional Materials; (LEED) [; G] [; G, [_____]] if required.

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook if required.]

[Concrete Paving Units; (LEED)

Albedo if required; (LEED)

LEED documentation relative to heat island effect - non-roof credit in accordance with LEED Reference Guide if required. Include in LEED Documentation Notebook if required.]

1.4 MAINTENANCE

NOTE: This paragraph will be included only if the project has aesthetic considerations where future maintenance must exactly match the color of the block.

At the completion of work provide [_____] paving blocks matching those used in the project. These paving blocks shall be delivered stacked on pallets.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver paving blocks in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver block bundle. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving. Deliver concrete paving blocks to the site in steel banded, plastic banded, or plastic wrapped bundles capable of transfer by forklift or clamp lift. Unload blocks at job site in such a manner that no damage occurs to the product or to existing construction.

Stockpile jointing and bedding sand such that they do not segregate within each pile. Keep all stockpiles free from standing water, free of any organic material or sediment, debris, and ready for placement. Store aggregates on paved surfaces. Do not store sands on exposed soil or grassed areas unless first covered with geotextile to keep the sands clean.

1.6 QUALITY ASSURANCE

1.6.1 CERTIFIED INTERLOCKING CONCRETE PAVEMENT INSTALLER

Utilize a paving unit installer field supervisor that holds a current Concrete Masonry & Hardscapes Association (CMHA) Concrete Paver Installer Certification.

1.6.2 PRE-CONSTRUCTION MEETING

Prior to starting work, hold a pre-construction meeting with representatives from the paving unit manufacturer, paver installation subcontractor, general contractor, and the contracting officer. Determine the following:

(1) Installation contractors' field supervisor personnel;(2) Delivery and storage locations for aggregates and concrete paving unit bundles;(3) Anticipated start date; (4) Starting point(s) and direction(s) of paving; (5) Methods for checking slopes and surface tolerances for smoothness and elevations; (6) Estimated daily production for installation of all aggregates, edge restraints and paving units; and (7) Recording and reporting actual daily paving production, including identifying the site location and recording the number of bundles installed each day.

For machine installation contractor shall provide diagram(s) of the concrete block paver laying pattern and how the paver layers or clusters will be joined together to provide a continuous pattern across the pavement surface. For projects over 10,000 square meters (100,000 square feet), review concrete unit manufacturer's written method that explains processes for controlling paver dimensional tolerances.

NOTE: Mechanized installations may require a larger mock up area. Consult with the paver installation contractor on the size of the mock up.

1.6.3 WEATHER REQUIREMENTS

Do not install in rain or snow. Do not install frozen jointing or bedding sand. Do not install on frozen base materials.

1.6.4 FIELD-CONSTRUCTED MOCK UP

Install a minimum 3 x 3 m (10 x 10 feet) paving block area to determine surcharge of the bedding layer, joint sizes, and lines, laying pattern, color and texture of the job. This area will be used as the standard by which the work will be judged. Subject to acceptance by contracting officer, mock-up may be retained as part of finished work. If mock-up is not retained, remove and properly dispose of mock-up outside of the installation boundary.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 LOCAL/REGIONAL MATERIALS

NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor. Using materials harvested and manufactured within a 500 mile radius from the project site contributes to the following LEED credit: MR5. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option if Contractor is choosing local materials in accordance with Section 01 33 29 LEED(tm)

DOCUMENTATION. First option shall not be used for USACE projects. Army projects shall include second option only if pursuing this LEED credit.

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800] [_____] kilometer [500] [_____] mile radius from the project site, if available from a minimum of three sources.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Pavement materials may be locally available.]

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 BEDDING AND JOINTING SAND

NOTE: If the pavement is to be subjected to Design Index traffic of 7 or higher, both the bedding and jointing sands will consist of 100 percent crushed sand, if it is available in the construction locale.

Use two separate sand gradations for the bedding layer and in the block joints. Both sand gradations shall consist of crushed sand, natural sand, or a combination of crushed and natural sand. Both sand gradations shall have a minimum L.A. Abrasion of 40 percent when tested in accordance with ASTM C131. For pavement subject to a Design Traffic Index of 7 or higher, the bedding sand shall have a maximum loss of 8% when tested in accordance with ASTM D7428. Both sand gradations shall be non-plastic when tested in accordance with ASTM D4318 and shall be free of lumps, clay, vegetation, soft particles, sulphates, and other contaminants. The bedding and jointing sands shall conform to the following gradations, determined in accordance with ASTM C136 and ASTM C117, using ASTM E11 sieves.

Sieve (ASTM E11)	Percent Passing	
	Bedding Sand	Jointing Sand
9.5 mm	100	100
4.75 mm	95 to 100	100
2.36 mm	80 to 100	95 to 100
1.18 mm	50 to 85	70 to 100
0.600 mm	25 to 60	40 to 75
0.300 mm	5 to 30	10 to 35
0.150 mm	0 to 10	2 to 15
0.075 mm	0 to 1	0 to 5

Sieve (ASTM E11)	Percent Passing	
	Bedding Sand	Jointing Sand
3/8 in.	100	100
No. 4	95 to 100	100
No. 8	80 to 100	95 to 100
No. 16	50 to 85	70 to 100
No. 30	25 to 60	40 to 75
No. 50	5 to 30	10 to 35
No. 100	0 to 10	2 to 15
No. 200	0 to 1	0 to 5

2.1.2 CONCRETE PAVING BLOCK

NOTE: Color and shape of block may be specified. Check local availability of specific colors or shapes before specifying. Organic pigments should not be used, since they are unstable in the alkaline concrete environment and subject to weathering. Shape is generally rectangular or indented.

The concrete paving block shall conform to ASTM C936/C936M, and shall be [] thick, [] in color, and [] in shape. Pigmentation shall conform to ASTM C979/C979M.

2.1.3 EDGE RESTRAINTS

2.1.3.1 PRECAST CONCRETE

NOTE: Minimum compressive strength of precast concrete should be 21 MPa (3,000 psi) unless analysis requires some other value. Entrained air content of the fresh concrete should be 6 percent plus or minus 1.5 percent in areas where freezing and thawing coverage is a design consideration. Delete this paragraph when this option is not retained.

The edge restraint shall be precast portland cement concrete elements with the dimensions shown on the plans. The precast concrete shall have a compressive strength of not less than [] at 28 days and an entrained air content of not less than [].

2.1.3.2 CAST-IN-PLACE CONCRETE

NOTE: Minimum compressive strength of cast-in-place concrete should be 21 MPa (3,000 psi) unless analysis requires some other value. Entrained air content of the fresh concrete should be 6 percent plus or minus 1.5 percent in areas where freezing and thawing coverage is a design consideration. Delete this paragraph when this option is not retained.

The edge restraint shall be portland cement concrete placed with the dimensions shown in the plans. Concrete shall conform to the requirements of ACI 301 or ACI 301M, except that it shall have a compressive strength of not less than [] at 28 days and an entrained air content of not less than [].

2.1.3.3 PLASTIC OR METAL

NOTE: Plastic or metal edge restraints are typically fastened to a compacted aggregate base using large steel nails, typically 10 mm (3/8 inch) in diameter and 200 to 300 mm (8 to 12 inches) in length. Plastic or metal edge restraints are used in pedestrian applications and vehicular areas with limited automobile traffic. Delete this paragraph when this option is not retained.

Install according to manufacturer's instructions.

2.2 TESTS, INSPECTIONS AND VERIFICATIONS

Submit a written report within 7 calendar days after completion of the work, covering the testing required for each lot.

2.2.1 PAVING BLOCK

NOTE: Sampling of paving blocks prior to the start of the work for the purposes of verifying the color and shape of the blocks will only be required when these considerations are critical to the project aesthetics. For jobs of less than 2500 square meters (25,000 square feet) or for pavements not to be exposed to vehicular traffic, a manufacturer's certificate which certifies that the paving blocks meet the requirements of ASTM C936/C936M can be accepted in lieu of sampling and testing the blocks of each lot.

Conduct the tests prescribed by ASTM C936/C936M and the following tests on the remaining 13 blocks of each sample from each lot.

2.2.1.1 FREEZING AND THAWING

NOTE: The freezing and thawing test may be waived for climates not subject to freezing and thawing. For jobs of less than 1000 square meters (10,000 square feet), a manufacturer's certificate which certifies that the paving blocks meet the requirements of this paragraph may be accepted in lieu of sampling and testing the blocks of each lot.

Determine resistance to freezing and thawing in accordance with ASTM C1645 for five blocks. The blocks shall have no breakage and the average mass loss of all the blocks tested shall not be greater than 225 grams per square meter of block surface area when subject to 28 freeze-thaw cycles or no greater than 500 grams per square meter of block surface areas when subject to 49 freeze-thaw cycles.

2.2.1.2 DIMENSIONAL TOLERANCES

The length and width of each block in the sample shall not vary from the manufacturer's specified dimensions by more than 1.5 mm (1/16 inch). For machine installed projects that exceed 10,000 square meters (100,000 square feet) the length and width of each block in the sample shall not vary from manufacturer's specified dimensions by more than 1.0 mm (1/25 inch). The thickness of any block in the sample shall not vary from the manufacturer's specified dimensions by more than 3 mm (1/8 inch).

2.2.1.3 RETEST

Notify the Contracting Officer if any blocks fail to meet the specified requirements. In case the shipment fails to conform to the specified requirements, the Contractor may sort it, and new specimens selected from the retained lot for retesting, as directed by the Contracting Officer. All concrete paving block retests shall be performed at the expense of the Contractor. In case the second set of specimens fail to conform to the test requirements, the entire lot shall be rejected.

2.2.2 SAND SAMPLING

Obtain a representative sample in accordance with ASTM D75/D75M from each 75 cubic meters (100 cubic yards) of sand to be used in the project. If the sand fails to meet the gradation requirements the Contractor may take another sample and retest it at no cost to the Government. If this retest fails or if no second test is taken, the sand is rejected by the Government and shall be removed from the job site.

PART 3 EXECUTION

NOTE: The base course for the block pavement must be a dense graded or bound material to avoid loss of the sands from the bedding layer. It must also be properly graded and leveled. A smoothness of no more than 10 mm (3/8 inch) deviation from a 3 m (10 foot) straight edge is needed. The project specification for the pavement base course should be checked to ensure these requirements are met.

3.1 PREPARATION

3.1.1 EDGE RESTRAINT LOCATION

Install the edge restraint as shown in the drawings prior to placement of the blocks.

3.1.2 SAND BEDDING LAYER

The bedding sand shall be spread evenly over the area to be paved and shall be screeded to an uncompacted thickness of 25 mm (1 inch). This bedding sand shall not be used to fill low areas that exceed the specified surface tolerance for the base. The sand shall be left uncompacted and shall not be disturbed by any pedestrian or vehicle construction traffic.

3.2 BLOCK PLACEMENT

NOTE: Paving block to be subject to vehicular traffic should be placed in a herringbone pattern, and this pattern can be specified here.

The paving block shall be placed by hand or machine in the indicated pattern. Placement of paving block shall start from a corner or straight edge and proceed forward over the undisturbed sand bedding layer. The joints, excluding any chamfer between paving blocks, Provide 2 and 5 mm (1/16 and 3/16 inch) joints between paving blocks. No more than 5% of the joints shall exceed 6 mm (1/4 inch) to achieve straight bond lines. After seating with a plate compactor, the block surface shall be flush or up to 6 mm (1/4 inch) above the edge restraint.

3.2.1 UNFILLED GAPS

Cut paving blocks to fill gaps at the pavement edges. All cut paving blocks exposed to vehicular tires shall be no smaller than one-third of a whole unit. All other gaps between paving blocks and any edge restraint, drainage structures, or other edges with gaps that cannot be filled with a whole block shall be filled with a paving block cut to fit the gap with a minimum width of any cut block shall be 50 mm (2 inches). Cutting shall be done with a masonry saw or other device that accurately leaves a clean, vertical face without spalling. Any remaining gap between the block and adjoining edge restraint or structure greater than 6 mm (1/4 inch) will not be accepted; adjacent blocks shall be cut or rearranged to prevent this.

3.2.2 SEATING BLOCKS

The blocks shall be seated in the bedding sand by compacting them with a minimum of three passes of a vibratory plate compactor, having a minimum centrifugal compaction force of 22 kN (5,000 pound-force) at 75 to 90 cycles per second.

3.2.3 JOINTING SAND

The jointing sand shall be swept into joints and vibrated with a vibratory plate compactor. This process shall be continued until sweeping and vibrating have filled all joints with sand and further vibration cannot force additional sand into the joints. The coarser particles of the sand will not enter the joints and will remain on the surface. These particles and any excess sand shall be swept off the pavement.

3.2.4 TIMING OF OPERATIONS

Seating of blocks and placement of jointing sand can be done concurrently with block placement. However, seating of blocks and placement of jointing sand shall not be done within 1.5 m (5 feet) of any unfinished edge of the block pavement that is not supported by the edge restraint.

3.2.5 FINAL ROLLING

NOTE: This paragraph can be deleted for light load pavements such as driveways or pedestrian walkways.

For vehicular or emergency access lanes applications, the final finished paving block surface shall be rolled with four passes of a static rubber-tired roller with a static weight of not less than 4.5 metric tons (10,000 pounds).

3.2.6 CONSTRUCTION TRAFFIC

Construction traffic shall not be allowed on the paving block surface until the jointing sand has been placed and vibrated into the joints and all debris and excess sand has been swept off.

3.3 CLEANUP

Sweep the entire pavement surface and remove all excess sand, blocks and debris from the project area.

3.4 SMOOTHNESS AND GRADE TOLERANCES

3.4.1 SMOOTHNESS

No portion of the finished pavement surface shall deviate by more than 10 mm (3/8 inch) from a 3 m (10 foot) long metal straightedge placed on the pavement surface.

3.4.2 PAVING BLOCK HEIGHT

The finished block surface shall be 3 mm (1/8 inch) to 6 mm (1/4 inch) higher than all edge restraints or drainage structures. There shall be no greater than 3 mm (1/8 inch) difference in height between adjacent paving blocks.

3.4.3 GRADE

The finished pavement shall be within 12 mm (0.04) feet of planned grade shown on the plans.

3.4.4 REMEDIAL ACTION

Any area not meeting the smoothness, block height, or grade tolerance shall be taken up, adjustments made, and the blocks relaid.

— 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.

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