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SECTION 32 16 16

STONE PAVEMENTS
04/06

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

Comments and suggestions on this guide specification
are welcome and should be directed to the technical
proponent of the specification. A listing of
technical proponents, including their organization
designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as
a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer
choices or locations where text must be supplied by
the designer.

PART 1 GENERAL

1.1 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.

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.

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2024) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C150/C150M	(2024) Standard Specification for Portland Cement
ASTM C33/C33M	(2024a) Standard Specification for Concrete Aggregates
ASTM C920	(2018; R 2024) Standard Specification for Elastomeric Joint Sealants
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

KOREAN INDUSTRIAL STANDARDS (KS)

KS D 7017	(2023) Welded Wire Mash and Bar Fabrics
KS F 2527	(2024) Aggregates for Concrete
KS F 2538	(2021) Standard Specifications for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
KS L 5201	(2021) Portland Cement

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions
in Section 01 33 00 SUBMITTAL PROCEDURES and edit

the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Stone Pavement Layout

Shop drawings showing locations of installations, patterns of various shapes of flags, arrangement of surface finishes and colors, and installation details of each type of stone pavement.

SD-03 Product Data

Stone; G

Manufacturer's catalog cuts showing the quality of stones, textures, appearance, strength, laboratory test data, and previous installation records.

SD-04 Samples

Stone; G

Submit stone samples prior to delivery of any such material to the work site. The sample must show appearance of stone flag surfaces and color ranges.

SD-07 Certificates

Stone; G

Certify that stone flags submitted for use for landscaping pavement have been installed for the same purposes at other landscapes; and addresses and telephone number of the owners of facilities having stone pavement constructed with same stone flags.

1.3 TERMINOLOGY

1.3.1 Flags

Natural stones that are riven or cut into various shapes and thickness intended for use for ground pavement. There are two type of flags. One type is irregular shape having neutral rough cut edges with irregular thicknesses, and the other type is the machine cut regular shapes with uniform thicknesses. Irregular shape must have natural surface without finishing, and machine cut surface flags must be finished to various type of finishes at factory after cutting.

1.3.2 Warranty

The stone pavement work must be warranted against material and workmanship deficiencies for the period of one years. The warranty must state that any defects developed to stone pavement material and its workmanship during the warranty period caused from natural causes other than willful damage must be replaced with same material to the original condition at no cost to the Government but at Contractor's full expenses.

PART 2 PRODUCTS

2.1 BEDDING

Bedding material must consist of wire fabric reinforced concrete bedding or cement mortar between concrete base and flags as indicated on the drawings. Irregular shape stone must be laid on wire fabric reinforced concrete base before concrete starts setting. No other mortar material must be used. Bedding for machine cut stones must be cement mortar mixed in the mixing ratio of one part cement to two parts sand by volume. Flags must be laid on 20 mm thick mortar bed placed on wire fabric reinforced concrete base.

2.1.1 Portland Cement

ASTM C150/C150M Type I or KS L 5201 Class I.

2.1.2 Sand

Sand must conform to the quality and gradation requirements of ASTM C33/C33M or KS F 2527.

2.1.3 Setting Bed Mortar

Setting bed mortar must be mixture of one part of portland cement with two parts of damp setting bed sand by volume. Use water to dampen sand, if required, but do not add to the mix.

2.1.4 Joint Finish Mortar

Joint finish mortar must be same mixture as for the setting bed mortar above, except that natural inorganic carbon black colorant must be added to the mixture to make the mortar color black.

2.1.5 Concrete

The concrete base for stone pavement work must conform to Section[03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE] [03 30 00 CAST-IN-PLACE CONCRETE].

2.1.6 Welded Wire Fabric

Welded wire fabric must conform to ASTM A1064/A1064M or KS D 7017.

2.2 STONE

2.2.1 General

The stone flags to be used for the landscape pavement work must be of types of stones that are readily available from local sources or quarries. Those stone must have been in satisfactory use for pavement work in the past with no particular defects typical to the type of stone for use for exterior pavement work. Four types of stones designed for the landscaping pavement are listed below. The type of stone, commercial name, and color range are given for the guidance only. Other type of stones having similar appearance and colors to those indicted but having different commercial names, may be approved based on evidences of the past successful records in use for the pavement work, written certificate, and the Contractor's written warranty.

Types of Stone	Color	Cutting Type	Finish	Commercial Name
Orthoclase	Black	Irregular	Natural	Heuk-yo Stone
Granite	Black	Machine Cut	Polished	Ma-chun Stone
Granite	Pink	Machine Cut	Bush Hammered	Moon-kyung Stone
Granite	Gray	Machine Cut	Bush Hammered	Geo-chang Stone

2.2.2 Irregular Slabs

The irregular shape flags must be of assortment of stones having various face dimensions and thickness to form an aesthetical effects after laying as indicated on the drawing. The assorted sizes must range from the maximum size having its longest dimension not to exceed 500 mm down to small sizes that will fit into irregular spaces created between natural rough stone edges of big size flags. The thickness of the slab must be average 50 mm with tolerance of plus or minus 10 mm. The irregular stone surface must have clean natural faces obtained after stone has been riven into intended shape and thickness. No separate finish is required.

2.2.3 Machine Cut Stones

Machine cut stones must be cut at factory into various sizes and

thicknesses as indicated on the drawing with dimensional tolerance not to exceed 3 mm. After cutting, finish exposing surfaces of stone flags in two different finishes: polished finish for stones to be used for accent appearance, and bush hammered finish for the remaining area use.

2.3 STEEL TRANSITION

Steel transition must be of 2 mm thick sheet steel bent into angle shape to the dimensions indicated on the drawing and hot-dip galvanized after shaping.

2.4 EXPANSION JOINT FILLER, PREMOLDED

Expansion joint filler must be premolded material conforming to ASTM D1751 or KS F 2538; or ASTM D1752. Unless otherwise indicated, filler material must be 13 mm thick.

2.5 JOINT SEALANT

Joint sealant, cold-applied, must conform to ASTM C920 or ASTM D5893/D5893M.

PART 3 EXECUTION

3.1 GENERAL

Construct Stone pavement in accordance with construction details at locations as indicated on the drawings. The tolerance of irregular shape stone pavement must not exceed plus or minus 10 mm from the level surface, and machine cut stone pavement surface must be within the tolerance of 3 mm when tested with 3 meters long straightedge.

3.2 IRREGULAR SHAPE STONE PAVEMENT

3.2.1 Reinforced Concrete Bed

Excavate ground to the required depth, grade, and level areas for irregular shape stone pavement. Place and fix steel transition plate to prevent from tipping over all along joints between pavement area and adjacent ground and at other location where indicated. Install dividing forms to facilitate installation of separating medium consisting of premolded expansion joint filler at indicated locations. Place concrete on strips separated by form on the prepared surface within the boundary of steel transition plates to the indicated depth with reinforcing wire mesh embedded at an approximate level middle of the concrete depth, and screed surface. Install separation medium correctly without bending or tilting at indicated locations. Wait until water disappears from concrete surface but before concrete starts to set.

3.2.2 Irregular Shape Stone Flag Laying

Lay irregular stone flags on screeded surface of reinforced concrete base before concrete starts to set. Solidly set the underside irregularities of every flag into concrete without void. To ensure solid contact, lightly tap four corners of flag immediately after laying with wood hammer. Fill the space between irregular shape of stone edges with dry mix of joint finish mortar without smearing adjacent stone surface edges. The laying arrangements of various sizes of irregular shape flags and filling of joint spaces must be uniform all over the area without noticeable grouping of particular size of flags, and attain aesthetically

pleasing appearance. Protect the completed stone pavement from traffic for the period minimum 7 days.

3.3 MACHINE CUT STONE PAVEMENT

3.3.1 Reinforced Concrete Bed

Construct reinforced concrete bed in accordance with the same procedure as for the irregular shape stone pavement work as described above. Moist cure concrete for minimum 3 days before machine cut stone pavement tile work starts.

3.3.2 Machine Cut Stone Tile Laying

Lay machine cut stone flags on cured concrete bed using mortar. The bedding mortar must be stiff mixed, spread over the concrete base to form 20 mm thick uniform bed with level bedding surface. Lay machine cut stone flags with its finished surface exposing with 5 mm joints between all edges of flags. After laying, tap every piece of flag with wood hammer at four corners to ensure solid contact between underside of the flag and mortar bed without void. The flag laying pattern and color arrangement of different sizes and colors of flags must be in accordance with the approved shop drawings. All open joints between flags completely fill with dry mix of joint finish mortar by shoving and pointing. At indication joints locations, raked out mortar joint to the depth of 5 mm, and seal with approved joint sealant. After completion of joint mortar and sealing work, clean stone flag surfaces to remove any stain or irregular material remain on flag surfaces. After completion of work, protect machine cut stone pavement area from traffic minimum 7 days before open to the traffic.

-- End of Section --