UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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CONCRETE PAVEMENT FOR CONTAINMENT DIKES
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NOTE: This guide specification covers the requirements for concrete containment dikes and basins.

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 item(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 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 Reference Identifier (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.
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The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2017) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2019a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2020) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94/C94M	(2020) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2020) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1116/C1116M	(2010a; R 2015) Standard Specification for Fiber-Reinforced Concrete
ASTM C1240	(2020) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM D1751	(2004; E 2013; R 2013) 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

1.2 SUBMITTALS

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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 Contractor Quality Control approval.][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-03 Product Data

Aggregate Sources

SD-06 Test Reports

Independent Laboratory Test Results
Placing, Spreading And Vibrating; G[, [_____]].

SD-07 Certificates

Concrete Sampling and Testing; G[, [_____]].
Certified Test Results

1.3 CONCRETE SAMPLING AND TESTING

1.3.1 General

Provide certification of sampling and testing of all concrete and concrete materials, including design of concrete mixes, conforming to the requirements specified in ASTM C94/C94M Option A and submit to the Contracting Officer for approval. During actual concrete operations, no substitutions are allowed in the materials or proportions that were used in the mix design without additional testing unless specifically approved or directed by the Contracting Officer. In lieu of performing new concrete mix design studies, a concrete mix design from a current project at the military base may be used provided the required concrete strength is obtained and the materials proposed for use in this project are identical to those used in the concrete mix design. Perform quality control sampling and testing in accordance with Section [01 45 00.00 10 QUALITY CONTROL][01 45 00.00 20 QUALITY CONTROL][01 45 00.00 40 QUALITY CONTROL] and as specified herein. The Government may perform verification

tests as considered necessary.

1.3.2 Certification for Additional Pavement Materials

Prior to the use of materials not listed in ASTM C94/C94M, but listed in this section, submit Certified Test Results for each lot as directed by the Contracting Officer.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

2.1.1 General Requirements

Provide concrete and the equipment, workmanship, materials and quality control conforming to the applicable requirements of ASTM C94/C94M, except as otherwise specified herein. Use concrete composed of cement, supplementary cementitious materials (SCM), fine aggregate, coarse aggregate, water, and an air entraining mixture. State final mix proportions by weight and batch; cementitious materials by weight. Do not exceed a water-cementitious materials ratio (WCR) of 0.45. Maintain the air content of the concrete by volume at 6.0 percent plus or minus 1.0 percent. Do not exceed a concrete slump of 75 mm 3 inches for fixed form paving. Do not increase the slump of transit-mixed concrete because of the inadequacy of mixing, discharge, or placing equipment.

2.1.2 Strength Requirements

Provide concrete with the following average compressive strength:
Containment Dikes and Basin 30 MPa 4000 psi at 28 days

2.2 MATERIALS

2.2.1 Aggregate

2.2.1.1 Gradation

Provide coarse and fine aggregate conforming to ASTM C33/C33M with a maximum nominal size of 25 mm 1 inch.

2.2.1.2 Quality

Provide coarse and fine aggregate conforming to ASTM C33/C33M, Class 4.

2.2.1.3 Alkali-Silica Reactivity (ASR)

a. Evaluate and test fine and coarse aggregates to be used for alkali-aggregate reactivity. Evaluate fine and coarse aggregates separately, using ASTM C1260. Test results of the individual aggregates must show a measured expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Should the test data indicate an expansion of greater than 0.08 percent, reject the aggregate(s) or perform additional testing as follows: utilize the Contractor's proposed low alkali portland cement, blended cement, and/or SCM in combination with each individual aggregate and test in accordance with ASTM C1567. Determine the quantity that will meet all the requirements of these specifications and that will lower the expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Base the mixture proportioning on

the highest percentage of SCM required to mitigate ASR.

b. If any of the above options does not lower the expansion to less than 0.08 percent after 28 days of immersion in a 1N NaOH solution, reject the aggregate(s) and submit new aggregate sources for retesting. Submit the results of testing to the Contracting Officer for evaluation and acceptance.

2.2.2 Admixtures

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NOTE: High Range Water Reducing Admixtures are permitted only when using Silica Fume in OCONUS projects. Delete for all other projects
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a. Provide air-entraining admixture conforming to ASTM C260/C260M.

b. Use accelerating admixture conforming to ASTM C494/C494M, Type C, only when cold weather protection is required and only when approved in writing. Do not use admixtures containing the chlorine ion.

c. Provide water-reducing or retarding admixtures conforming to ASTM C494/C494M, Type A, B, or D.

d. When using Silica Fume, provide a high-range water-reducing admixture (HRWRA) meeting the requirements of ASTM C494/C494M, Type F or G. Provide the HRWRA that is a synthesized, sulfonated complex polymer type and free from chlorides and alkalies. Add the HRWRA to the concrete as a single component at the batch plant. Add the admixture to the concrete mixture only when its use is approved or directed, and only when it has been used in mixture proportioning studies to arrive at approved mixture proportions. Submit certified copies of the independent laboratory test results required for compliance with ASTM C494/C494M.

2.2.3 Cementitious Materials

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NOTE: Edit these paragraphs as appropriate for the particular project. Since the containment dike concrete is underlain by an impervious geomembrane, adverse reactions between the cement and subgrade soils are not anticipated. Only Type I or II cements are required.
****

Provide cementitious materials of portland cement, blended cement, or only portland cement in combination with supplementary cementitious materials (SCM), and conforming to appropriate specifications listed below. New submittals are required when the cementitious materials sources or types change.

2.2.3.1 Portland Cement

Provide portland cement conforming to ASTM C150/C150M, Type I or II, low alkali [including false set requirements]. Low alkali cement is required if the proposed aggregates are found to have greater than 0.04 percent expansion when tested in accordance with paragraph: Alkali-Silica Reactivity above.

2.2.3.2 Blended Cement

Provide blended cement conforming to ASTM C595/C595M, Type IP or IS, including the optional requirement for mortar expansion [and sulfate soundness]. Provide statement in writing from the manufacturer that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot to lot or within a lot. No change is allowed in the percentage and type of mineral admixture used in the blend from that submitted for the aggregate evaluation and mixture proportioning.

2.2.4 Supplementary Cementitious Materials (SCM)

2.2.4.1 Fly Ash

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NOTE: Use loss on ignition not exceeding 3 percent for frost areas to reduce carbon interference with air entraining admixture.

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Provide fly ash conforming to ASTM C618, Class F, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and not have a loss on ignition exceeding [3] [6] percent. For use in mitigating Alkali-Silica Reactivity, provide a Calcium Oxide (CaO) content of less than 13 percent and a total equivalent alkali content less than 3 percent.

2.2.4.2 Raw or Calcined Natural Pozzolan

Provide raw or calcined natural pozzolan conforming to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and not have a loss on ignition exceeding [3] [6] percent. Provide a Calcium Oxide (CaO) content of less than 13 percent and a total equivalent alkali content less than 3 percent for use in mitigating Alkali-Silica reactivity.

2.2.4.3 Ground Granulated Blast Furnace Slag (GGBFS)

Provide Ground Granulated Blast-Furnace Slag conforming to ASTM C989/C989M, Grade 100 or Grade 120.

2.2.4.4 Silica Fume

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NOTE: Silica Fume shall only be used for OCONUS projects where Class F fly ash and GGBF slag are not available. Delete this paragraph here and where encountered throughout the remainder of this section.

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Provide silica fume conforming to ASTM C1240, including the optional limits on reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as a slurry. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete

production and placement using silica fume.

2.2.4.5 Supplementary Cementitious Materials (SCM) Content

The Contractor may elect to use one of the SCMs listed below, unless the SCM is required to mitigate ASR. The use of SCMs is encouraged in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

TABLE 2 SUPPLEMENTARY CEMENTITIOUS MATERIALS CONTENT		
Supplementary Cementitious Material	Minimum, percent	Maximum Content, percent
Class N Pozzolan and Class F Fly Ash		
$SiO_2 + Al_2O_3 + Fe_2O_3 > 70$ percent	25	35
$SiO_2 + Al_2O_3 + Fe_2O_3 > 80$ percent	20	35
$SiO_2 + Al_2O_3 + Fe_2O_3 > 90$ percent	15	35
GGBFS	40	50
Silica Fume	7	10

2.2.5 Reinforcement Steel and Dowels

Provide reinforcement bars conforming to ASTM A615/A615M Grade 40 or 60. Provide welded steel wire fabric conforming to ASTM A1064/A1064M. Provide dowels that are plain (non-deformed) steel bars conforming to ASTM A615/A615M, Grade 40 or 60; ASTM A996/A996M, Grade 50 or 60. Provide epoxy coated dowel bars in conformance with ASTM A775/A775M. Use grout retention rings of fully circular metal or plastic devices capable of supporting the dowel until the epoxy hardens. Dowel sleeves or inserts are not permitted.

2.2.6 CURING MATERIALS

Only approved white pigmented membrane-forming curing compound materials conforming to the requirements specified in ASTM C309, Type 2, Class A or B may be used.

2.2.7 Joint Filler

For expansion joints use a preformed joint filler material conforming to ASTM D1751 or ASTM D1752.

2.2.8 SYNTHETIC FIBER REINFORCEMENT

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NOTE: Synthetic fibers may only be used in addition to conventional steel reinforcment to mitigate plastic shrinkage cracking. Do not use synthetic fibers as a replacement for reinforcing steel or mesh.

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ASTM C1116/C1116M. Use 100 percent virgin nylon or polypropylene fibers, 23 micron diameter, 19 mm 3/4 inch length with a minimum tensile strength of 482 MPa 70 ksi. Add fibers to the concrete mix at the batch plant at the rate of 0.89 kg/cubic meter 1.5 lbs/cubic yard.

PART 3 EXECUTION

3.1 GRADE CONTROL

Using bench-mark elevations furnished by the Contracting Officer, establish and maintain the lines and grades shown for the pavement by means of line and grade stakes placed at the jobsite. Construct pavements to the thicknesses and elevations indicated.

3.2 SUBGRADE, FORMS AND STRINGLINE

3.2.1 Underlying Material

3.2.1.1 General

Test the surface of the subgrade as to elevation and density in advance of setting forms. Keep the prepared surface free of foreign matter, waste concrete and/or cement, and debris at all times and thoroughly wet down sufficiently in advance to insure a firm, moist condition when the concrete is placed. In cold weather, prepare and protect the underlying material so that it will be entirely free from frost when the concrete is placed. The use of chemicals to eliminate frost in the underlying material will not be permitted.

3.2.2 Forms for Fixed-Form Paving

Use either steel or wood forms and forms subject to approval. Provide one-piece forms that are equal in depth to the edge thickness of the slab as shown on the drawings. Under no conditions are forms other than the depth of the pavement to be used and adjusted by filling or excavating under the forms to an elevation other than the bottom of the pavement slab. Do not vary the top surface of a form by more than 3 mm 1/8 inch in 3 m 10 feet from a true line and the face by more than 6 mm 1/4 inch in 3 m 10 feet from a true plane.

3.2.2.1 Steel Forms

Furnish steel forms in sections not less than 3 m 10 feet in length, except that on curves the sections are required to be flexible or curved to the proper radius. Provide each form section with form braces, pin sockets, and rigid joint locking devices.

3.2.2.2 Wood Forms

Furnish wood forms made of not less than 50 mm 2 inches nominal thickness, well-seasoned, surfaced plank or plywood, straight, and free from warp or bend. Use wood forms that have the strength and rigidity to resist the impact and vibrations of concrete placing, spreading and finishing without springing, weaving or settling.

3.2.2.3 Form Setting

Set the forms on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its

entire length and base width. Setting forms on blocks or on built-up spots of subgrade and then attempting to fill and compact under forms after they are in place will not be permitted under any condition. Lock the form sections tightly together. When tested by a 3 m 10-foot straightedge, provide the top of the form conforming to the requirements specified for the finished surface of the concrete, and do not vary the longitudinal axis of the upstanding leg by more than 6 mm 1/4 inch from the straightedge. Clean and oil the forms each time before concrete is placed. Do not place concrete until setting of forms has been approved. Do not drive form stakes in areas underlain by a geomemebrane. Anchoring of the forms in these areas is required to be approved by the Contracting Officer prior to installation.

3.3 PLACING, SPREADING AND VIBRATING

Submit a document detailing proposed concrete placement procedures. At a minimum, address form setting, protection of geomembrane, conveyance/pumping, construction joints, expansion joints, placement of reinforcement, curing and joint sealing procedures.

3.3.1 General

Place concrete between stationary forms. Deposit concrete between the forms within 90 minutes from the time all ingredients are charged into the mixing drum. Deposit concrete as close as possible to its final position in the pavement cross section. Place concrete at a continuous and uniform rate. Spread and vibrate concrete immediately after placement.

3.3.2 Paver Fixed-Form Method

Use a paver that is self-propelled and capable of spreading, consolidating and shaping the plastic concrete. Hand spreading will be permitted only when approved for odd widths or shapes of slabs. Equip pavers with a full-width mechanical spreader at the front which is capable of ready adjustment to provide a uniform cross section of concrete in front of the screed as necessary for proper operation. Use an auger, paddle or other approved type spreader. Hand spreading, where permitted, is to be done with shovels; rakes are not to be used. Where the concrete is delivered to the form in truck mixers, suitable chutes may be used, provided windrows cover essentially the entire area with-in the form. In no case is dumping of concrete in piles permitted.

3.3.3 Vibration

Consolidate concrete by properly designed vibrating screeds, internal vibrators, or other approved techniques immediately after spreading. Cease forward motion of the paver as soon as a vibrator becomes inoperable. Maintain additional vibrators at the site at all times.

3.3.3.1 Slabs 200 mm 8 Inches Thick

Consolidate concrete, greater than 200 mm 8 inches in thickness, with mechanical vibrating equipment immediately after spreading. Provide internal type mechanical vibrating equipment and the number of units and adequate power of each unit to properly consolidate all of the concrete. Automatically control the vibrators and/or tamping elements so that they will be stopped as forward motion ceases. Do not exceed vibrator unit spacing of 750 mm 30 inches, and provide a space from the outside unit and the edge of the slab of approximately 300 mm 1 foot. Insert vibrators

into the concrete to a depth that will provide the best consolidation, but not closer to the underlying material than 50 mm 2 inches. Change the depth and angle of vibrators whenever directed by the Contracting Officer.

3.3.3.2 Slabs Less Than 200 mm 8 Inches Thick

Consolidate concrete 200 mm 8 inches or less in thickness with properly designed and operating vibratory screeds immediately after spreading.

3.3.3.3 Hand Placement

Vibrate concrete in odd shaped slabs, or lanes 15 m 50 feet or less in length or in locations inaccessible to the above vibrating equipment with a hand-manipulated vibrator operated from a bridge spanning the concrete placement. Do not have workmen walk in the fresh concrete. Do not use vibrators to transport or spread the concrete in the forms. Do not operate vibrators in the concrete at one location for more than 20 seconds.

3.3.4 Placing Reinforcing Steel

Position reinforcement steel on suitable chairs prior to concrete placement or it may be installed by the strike-off method wherein the concrete is deposited on the underlying material, consolidated and struck to the indicated elevation of the steel reinforcement. When using the strike-off method, lay the reinforcement upon the prestruck surface, and place and finish the remaining concrete in the required manner. Remove and replace any portions of the bottom layer of concrete, that was placed more than 30 minutes without being covered with the top layer, with newly mixed concrete at no additional cost to the Government. Regardless of placement procedure, keep the reinforcing steel free from coatings which could impair bond between the steel and concrete and provide laps in the reinforcement as indicated.

3.3.5 Placing During Cold Weather

Place concrete in cold weather in accordance with ACI 306R. Do not place concrete on base course or subgrade containing frost or frozen material. Include provision to protect the concrete from freezing during the specified curing period. Remove and replace concrete damaged by freezing at no cost to the Government.

3.3.6 Placing During Warm Weather

Place concrete during warm weather in accordance with ACI 305R. During warm weather, produce concrete at the lowest temperature practicable under the existing conditions. Cool the mixing water and/or aggregates, if necessary, to maintain a satisfactory placing temperature. Place concrete continuously and rapidly at a rate of not less than 30 m 100 feet of paving lane per hour. Keep the finished surfaces of newly placed pavement damp by applying a waterfog or mist with approved spraying equipment until the pavement is covered by the curing medium.

3.4 FINISHING

Start finishing operations immediately after placing, spreading and vibrating of the concrete. Finish by the machine method except that, as specifically approved, the hand method may be used for lanes 15 m 50 feet or less in length, minor amounts of narrow slabs, irregular slab widths or shapes and separate, isolated slabs during removal and replacement type

repair operations. Maintain finishing equipment and tools clean and in an approved condition.

3.4.1 Machine Finishing - Fixed Forms

3.4.1.1 Equipment

Conform to applicable requirements specified in subparagraph: PAVER FIXED-FORM METHOD of paragraph: PLACING, SPREADING AND VIBRATING above. Check screed and float adjustments of these machines at the start of each day's paving operations and more often as required. When finishing machines ride the edge of a previously constructed slab, include provision to protect the surface of these slabs.

3.4.1.2 Transverse Finishing

As soon as placed, the concrete shall be accurately struck off and screeded to the crown and cross section shown and to such elevation that when consolidated and finished, the surface of the pavement will be free from porous places and will be at the required grade. Excessive manipulation that brings to the surface an excess of mortar and water will not be permitted. Keep the top of the form or pavement edge upon which the finishing machine travels clean.

3.4.1.3 Mechanical Floating

Operate the mechanical float to smooth and finish the pavement to grade and maintain surface contact at all times. Do not use rotating pipe or tube floats or finishers, such as: Clary screeds, rotating "bridge deck finishers" and similar equipment.

3.4.1.4 Other Types of Finishing Equipment

Except for rotating pipe or tube floats or finishers, concrete finishing equipment of types other than specified above may be used on a trial basis, when specifically approved. Replace equipment that fails to produce finished concrete of the required quality with the approved equipment before specified herein.

3.4.2 HAND FINISHING

3.4.2.1 Finishing and Floating

As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that, when consolidated and finished, the surface of the pavement will be at the required elevation. Tamp the entire surface. Continue the tamping operation until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, float the pavement longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, place and screed additional concrete, and the float operated until a satisfactory surface has been produced. Advance the floating operation to not more than half the length of the float, and the floating continued over the new and previously floated surfaces.

3.4.3 Surface Correction and Testing

After all other finishing is completed but while the concrete is still

plastic, eliminate minor irregularities and score marks in the pavement surface by means of straight-edges. Use straightedges 3 m 10 feet in length rigidly constructed to prevent deflection in any direction during use, and operate from the sides of the pavement and from bridges. After straight-edge finishing appears complete, test the entire surface for trueness with a 3 m 10 foot straightedge held in successive positions parallel and at right angles to the centerline of the pavement, and the whole area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one-half the length of the straightedge. Continue the straightedge testing and finishing until the entire surface of the concrete is free from observable departure from the straightedge and conforms to the surface requirements specified under subparagraph: SURFACE TESTS AND CORRECTIONS below.

3.4.4 Texturing

Before the surface sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a stiff broom finish.

3.4.5 Edging

After texturing has been completed, the edge of slabs along the forms, and at the joints, where indicated or directed, carefully finish with an edging tool to form a smooth rounded surface of the required radius. Eliminate tool marks, and the provide edges that are smooth and true to line.

3.5 FORM REMOVAL

Keep forms in place at least 12 hours after the concrete has been placed or for a longer period, if directed by the Contracting Officer. Remove forms without injuring the concrete. Repair any concrete found defective after form removal promptly, using approved procedures.

3.6 CURING

3.6.1 General

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days commencing immediately after finishing is complete. Protect unhardened concrete from rain and flowing water. Keep all equipment needed for adequate curing and protection of the concrete on hand and ready to use before actual concrete placement begins. If the curing materials and procedures used do not provide proper curing and protection against concrete cracking caused by temperature changes during the curing period, remove and replace the damaged pavement and employ another method of curing as directed.

3.6.2 Membrane Curing

Apply a uniform coating of white pigmented membrane curing compound to the entire exposed surface of the concrete as soon after finishing as free water has disappeared from the finished surface. Coat formed surfaces immediately after the forms are removed and in no case longer than 1 hour after removal of forms. Do not allow the concrete to dry before the application of the membrane. Apply the curing compound to the finished surfaces by means of an approved automatic spraying machine as soon as the free water has disappeared. Thoroughly and continuously agitate the

curing compound in the drum used for the spraying operation mechanically throughout the full depth of the drum during the application. Air agitation may be used only to supplement mechanical agitation. Apply the curing compound with an overlapping coverage that will give a two-coat application at a coverage of not more than 10 square meters/Liter 400 square feet/gallon for each coat. The application of curing compound by hand-operated pressure sprayers will be permitted only on odd widths or shapes of slabs where specifically approved, and on concrete surfaces exposed by the removal of forms. When application is made by hand-operated sprayers, apply the second coat in a direction approximately at right angles to the direction of the first coat. Respray curing compound that has pinholes, abrasions, or other discontinuities, that was subjected to heavy rainfall within 3 hours of application, or was damaged by subsequent construction operations by the method and at the coverage specified above. Take necessary precautions to insure that the concrete is properly cured at sawed joints, but that no curing compound enters the joints. Tightly seal the top of the joint opening and the joint groove at exposed edges by approved procedures using a temporary sealer or filler before the concrete in the region of the joint is resprayed with curing compound. Use the method for sealing the joint groove that prevents loss of moisture from the joint during the entire specified curing period. Provide approved standby facilities for curing concrete pavement at an accessible location at the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane curing compound at the proper time. Protect concrete surfaces to which membrane curing compounds have been applied adequately during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS AND TESTS

3.7.1 General

Provide pavements that are smooth and true to grade and cross section. When tested with a 3 m 10 foot straightedge on lines 1.5 m 5 feet apart parallel with and at right angles to the centerline of the pavement, the surface shall not vary more than 6 mm 1/4 inch from the testing edge of the straightedge.

3.7.2 Surface Tests And Corrections

Not later than 24 hours after concrete has been placed, test the surface of the pavement in the presence of the Contracting Officer using an approved straightedge or other approved device that will reveal all surface irregularities varying from the testing edge exceeding tolerances specified above for concrete pavements. Plainly mark high spots indicated by the testing edge in excess of applicable tolerances. Reduce high areas by approved methods or remove and replace the pavement at no cost to the Government.

3.8 TOLERANCES IN PAVEMENT THICKNESS

Provide pavements of the thicknesses indicated on the plans. Treat deficiencies in the thickness as described below.

3.8.1 Thickness Determination

Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section. When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm 1/4 inch, the deficient section will be removed, between regularly scheduled joints, and replaced at no cost to the Government.

3.9 FIELD TEST SPECIMENS

3.9.1 General

Except as modified hereinafter, perform tests to determine the slump, air content, and strength of the concrete in accordance with the requirements of ASTM C94/C94M. Complete tests for slump and air content each time cylinders are fabricated and at such other times as directed by the Contracting Officer.

3.9.2 Specimens for Strength Tests

Take compressive test cylinders not less than once a day nor less than once for each 190 cubic meters 250 cubic yards of concrete or fraction thereof. Take the samples of strength tests in accordance with ASTM C172/C172M. Mold and cure cylinders for acceptance tests in accordance with ASTM C31/C31M. Test cylinders in accordance with ASTM C39/C39M by an approved testing laboratory at no cost to the Government. Mold sufficient cylinders each time to provide two compressive-strength tests at each test age. Test ages are 7, 14, and 28 days.

3.10 JOINTS

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NOTE: A joint layout plan should be provided with a maximum just spacing of 3 m 10 feet. Panels should be as closed to square as possible.

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3.10.1 General

Provide joints conforming to the details indicated and that are perpendicular to the finished grade of the pavement. Provide transverse expansion and contraction joints that are straight and continuous from edge to edge of the pavement.

3.10.2 Construction Joints

Install transverse construction joints at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. Install transverse construction joints in the location of a planned joint.

3.10.3 Expansion Joints

Form expansion joints by means of a preformed filler material.

3.10.4 Contraction Joints

Provide transverse and longitudinal contraction joints of the

weakened-plane, and constructed as indicated hereinafter in subparagraph: SAWED JOINTS. Construct longitudinal contraction joints by sawing a groove in the hardened concrete with a power-driven saw in conformance with subparagraph: SAWED JOINTS below, unless otherwise approved.

3.10.4.1 Sawed Joints

Construct sawed joints by sawing a groove in the concrete with a 3 mm 1/8 inch blade to full depth as indicated, without chipping, spalling, or tearing the concrete adjacent to the joint. After expiration of the curing period, widen the upper portion of the groove by sawing to the width and depth indicated. Vary the time of sawing depending on existing and anticipated weather conditions, and such as to prevent uncontrolled cracking of the pavement. Saw the joints at the required spacing consecutively in the sequence of the concrete placement. Do not vary the saw cut by more than 13 mm 1/2 inch from the true joint alignment. Do not saw joints if a crack has occurred near the joint location and discontinue sawing when a crack develops ahead of the saw cut. Immediately after joint is sawed, thoroughly flush the saw cut and adjacent concrete surface with water until all waste from sawing is removed from the joint. Seal the top of the joint opening immediately as specified in subparagraph: MEMBRANE CURING. Provide an ample supply of saw blades and at least one standby sawing unit in good working order at the jobsite at all times during concrete paving operations.

3.10.4.2 Sealing Joints

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NOTE: In Section 32 01 19.61 SEALING OF JOINTS IN RIGID PAVEMENT, ASTM D5893/D5893M (Silicone) should be specified for all dikes and basins. Surfaces sloping 6h:1v or greater should be type NS (non-sag).

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Seal joints immediately following curing of the concrete, or as soon as weather conditions permit, as directed. Accomplish sawing of the reservoir or space for seals, immediately before sealing of the joints. Perform sawing by a multi-blade concrete saw. Perform sawing to the width specified and to the depth indicated in one pass. Readily adjust the cutting unit for width by the addition and removal of spacers or by other suitable means. Equip the machine with a mechanical guide which will keep the cutting unit aligned so as to cut equal widths from each side of the joint groove.

a. Sealing Dike Berms: Seal the joints in the concrete dike berms with a non-sag type fuel resistant sealant as specified in SECTION 32 01 19.61 SEALING OF JOINTS IN RIGID PAVEMENT.

b. Sealing Dike Basins: Seal joints in the concrete surface within the diked areas with fuel resistant sealant as specified in SECTION 32 01 19.61 SEALING OF JOINTS IN RIGID PAVEMENT.

3.11 PAVEMENT PROTECTION

Protect the pavement against all damage, prior to final acceptance of the work by the Government. No vehicular traffic will be allowed on the 100 mm 4 inch concrete pavement at any time.

3.12 REPAIR OF DAMAGED SLABS

Repair new pavement slabs that are broken, have spalled edges, or contain cracks as specified hereinafter at no cost to the Government.

3.12.1 Cracked Slabs

Rout and seal cracks in reinforced slabs in accordance with Section 32 01 19.61 SEALING OF JOINTS IN RIGID PAVEMENT. Do not epoxy inject these cracks.

3.12.2 Spalled Slabs

Where directed, repair spalls along joints of new slabs, along edges of adjacent existing concrete, and along parallel cracks by first making a vertical saw cut at least 25 mm 1 inch outside the spalled area and to a depth of at least 50 mm 2 inches. Provide straight line saw cuts forming rectangular areas. Chip out the concrete between the saw cut and the joint, or crack, to remove all unsound concrete and into at least 13 mm 1/2 inch of visually sound concrete. For patching materials and construction requirements, see Section 32 01 29.61 PARTIAL DEPTH PATCHING OF RIGID PAVING.

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