

2. AMENDMENT NO. 0001	3. EFFECTIVE DATE 24 OCT 2014	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. <i>(If applicable)</i>
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6. ISSUED BY CODE	7. ADMINISTERED BY <i>(If other than Item 6)</i> CODE
Naval Facilities Engineering Command Pacific (ACQ31) Building 62 4262 Radford Drive Honolulu HI 96818-3296	

8. NAME AND ADDRESS OF CONTRACTOR <i>(No., street, county, State and ZIP Code)</i>	9A. AMENDMENT OF SOLICITATION NO. <input checked="" type="checkbox"/> N62742-15-R-1301
	9B. DATED <i>(SEE ITEM 11)</i> 02 October 2014
	10A. MODIFICATION OF CONTRACT NO. <input type="checkbox"/>
	10B. DATED <i>(SEE ITEM 13)</i>
CODE	FACILITY CODE

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of offers is extended, is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:
(a) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or © By separate letter or telegram which includes a reference to the solicitation and amendment numbers. **FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER.** If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS, IT MODIFIES THE CONTRACT NO. AS DESCRIBED IN ITEM 14.

<input type="checkbox"/>	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: <i>(Specify authority)</i> THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT NO. IN ITEM 10A.
<input type="checkbox"/>	B. THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES <i>(such as changes in paying office, appropriation date, etc.)</i> SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
<input type="checkbox"/>	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
<input type="checkbox"/>	D. OTHER <i>(Specify type of modification and authority)</i>

E. IMPORTANT: Contractor is not, is required to sign this document and return ___ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*
N62742-15-R-1301, WON 1168070, FY14 MCON P-907 PARKING APRON AND INFRASTRUCTURE AND WON 1168073, FY14 MCON P-908 HANGAR, MARINE CORPS BASE HAWAII, KANEOHE, HAWAII

THE DATE AND TIME FOR RECEIPT OF PROPOSALS IS REVISED TO:
NOVEMBER 13, 2014 AT 2:00 P.M. (HST)

Facsimile and/or email submission will not be accepted.

See next page

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER <i>(Type or print)</i>	16A. NAME OF TITLE OF CONTRACTING OFFICER <i>(Type or print)</i>		
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
_____ <i>(Signature of person authorized to sign)</i>		BY _____ <i>(Signature of Contracting Officer)</i>	

FRONT END REVISIONS

1. Document 00100, first paragraph up to "SMALL BUSINESS SUBCONTRACTING PLAN/SUBCONTRACTING BREAKDOWN," is deleted in its entirety and replaced with the following:

"a. PRICE PROPOSAL (PAPER): An original paper and one (1) paper copy of the price proposal shall be submitted on **13 November 2014, 2:00 p.m., H.S.T.** in a sealed envelope and marked in the bottom right corner "PRICE PROPOSAL SUBMITTED UNDER RFP N62742-15-R-1301 - DO NOT OPEN IN MAILROOM."

SMALL BUSINESS SUBCONTRACTING PLAN/SUBCONTRACTING BREAKDOWN (PAPER): An original paper and one (1) paper copy of the Small Business Subcontracting Plan/Subcontracting Breakdown shall be submitted on **14 November 2014, 2:00 p.m. H.S.T.** in a sealed envelope and marked in the bottom right corner "SMALL BUSINESS SUBCONTRACTING PLAN/SUBCONTRACTING BREAKDOWN PROPOSAL SUBMITTED UNDER RFP N62742-15-R-1301 - DO NOT OPEN IN MAILROOM."

The Price Proposal shall include the following:

- (1) Signed and completed SF 1442 (Solicitation, Offer and Award)
- (2) Bid Guarantee
- (3) Representations and Certifications (See Section 00600)
- (4) Current VETS 100 Report Verification
- (5) Current company balance sheets (Will be used for responsibility determination)
- (6) Information required by paragraph 1.5, Pre-Award Survey/Responsibility Determination
- (7) Information required by paragraph 1.6, Joint Ventures (JV), Limited Liability Companies (LLC), Limited Partnerships (LP), etc., if applicable

The Small Business Subcontracting Plan/Subcontracting Breakdown shall be submitted as follows:"

2. Document 00202 is amended as follows:

a. Paragraph 2.2, Price Evaluation, subparagraph a., last sentence is deleted in its entirety and replaced with the following:

"For price evaluation purposes, the Government will add CLINs 0001, 0002, 0003, 0004 and 0005 to arrive at the total evaluated price."

b. Paragraph 2.3, Technical Evaluation Factors, Factor A-Experience, subparagraph (b), NOTES, Note 4, first sentence is revised to replace "should be" with "shall be"

SPECIFICATION REVISIONS

3. Section 27 05 29.00 10 PROTECTIVE DISTRIBUTION SYSTEM (PDS) FOR SIPRNET COMMUNICATION, is amended as follows:

a. Paragraph 1.2 REFERENCES: Delete "NSTISSAM TEMPEST/2-95 (1995; Am A 2000) RED/BLACK Installation Guidance NSTISSI-7003 (1996) Protective Distribution Systems (PDS)" and replace with "NSTISSAM TEMPEST/1-13 RED/BLACK Installation Guidance US Navy / US Marine Corps Information Assurance (IA) Publication Module 5239-22 Information Assurance Protected Distribution System (PDS) Publication"

b. Paragraph 1.3.4 PDS Design Technical Review: Delete "(see NSTISSI-7003, Appendix C)." Replace with "Coordinate with NEC/DOIM for documentation required."

c. Paragraph 1.4 SUBMITTALS, is amended as follows:

- (1) Add "; G" after PDS Hardened Carrier under SD-03 Product Data
- (2) Add "User Drop Box" under SD-04 Samples
- (3) Add "Provide PDS as-built drawings within 30 days of completing the PDS installation" under SD-11 Closeout Submittals

d. Paragraph 1.5.3 Equipment: Delete this paragraph in its entirety and replace with:

"PDS Hardened Carrier shall be approved for use by the U.S. Navy's and U.S. Marine Corps' Certified Tempest Technical Authority (CTTA) as defined by USN / USMC Information Assurance (IA) Publication Module 5239-22. Submit manufacturer's descriptive data."

e. Paragraph 2.1.1 Conduit Carrier: Delete this paragraph in its entirety and replace with:

"Provide electrical metallic tubing (EMT) manufactured from ferrous material that meets ANSI C80.3. Use compression fittings (couplers and connectors) manufactured from ferrous material. Use of EMT, fittings, couplers, and connectors construction from non-ferrous material is not acceptable. TIA-569 cable fill standards do apply."

f. Paragraph 2.1.1.1 Conduit: Delete this paragraph in its entirety and replace with:

"Use 3-inch EMT conduit for horizontal backbone or vertical riser runs; 1-inch EMT conduit for vertical runs from horizontal runs to secure user drop box. Use components (e.g. couplers, connectors, pull boxes, enclosures) constructed from ferrous metallic materials. Condulettes, elbows, and other fittings that allow cables to bend beyond the proper bend radius, are NOT to be used for telecommunication infrastructure. Use of components constructed from non-ferrous metallic material is not acceptable."

g. Paragraph 2.1.1.3 Fittings: Delete this paragraph in its entirety and replace with:

"PDS conduit carrier fittings include connectors and couplings for joining conduit sections. Use EMT conduit compression connectors and couplers to connect EMT conduit carrier sections, fittings, and components together. Use of set screw connectors and couplers is prohibited."

h. Paragraph 2.1.1.4 Through Wall Penetrating: Delete "a. Provide dielectric breaks when penetrating secure room wall partitions." and replace with "Not Used"

i. Paragraph 2.1.1.5 Pull Points: Delete "a. Size pull boxes according to the size of the conduit, not the number of cables or conduits that enter/exit the pull box. NFPA 70 conduit fill standards do not apply." And replace with "Not Used"

j. Paragraph 2.2 USER DROP BOX: Add to end of paragraph "UDBs must be approved by the Navy / USMC CTTA or must have been previously approved by the CTTA prior to installing it in this PDS. UDB will be pre-painted by the manufacturer to blend with the color of the wall that it will be mounted."

k. Paragraph 2.3 ENCLOSURES: Add to end of paragraph "Enclosures must be approved by the Navy / USMC CTTA or must have been previously approved by the CTTA prior to installing it in this PDS. Enclosures will be pre-painted by the manufacturer to blend with the color of the wall that it will be mounted."

l. Paragraph 3.2.1 General is amended as follows:

(1) Delete “a. Start the PDS horizontal backbone at the TR (SIPRNET TR or at IPS container location) with a single raceway or conduit sized accordingly (70 percent cable fill for secure raceway with removable top cover, 60 percent cable fill for EMT conduit and solid construction secure raceway) to contain CAT6 UTP, CAT6 STP, or fiber optic cable runs.” and replace with: “a. Start the PDS horizontal backbone at the TR (SIPRNET TR or at IPS container location) with a single raceway or conduit sized accordingly to contain CAT6 STP.”

(2) Delete “e. Maintain RED/BLACK cable separation in accordance with NSTISSAM TEMPEST/2-95.” and replace with “e. Maintain RED/BLACK cable separation in accordance with NSTISSAM TEMPEST 1-13 RED/BLACK installation Guidance.”

m. Paragraph 3.2.3 Mounting Location Considerations: Delete “e. Route PDS carrier to maximized cable fills in horizontal runs and reduce the number of horizontal runs within the same space.” and replace with “Not Used”

n. Paragraph 3.3.1 Mounting PDS Carrier: Delete “j. Do not paint or cover the PDS carrier with wallpaper or other covering unless the paint is applied by the carrier manufacturer.” and replace with “Paint the PDS carrier to blend with the color of the wall that it will be mounted, however do not paint areas that have been applied with epoxy sealant.”

o. Paragraph 3.3.3 Mechanical Security: Delete this paragraph in its entirety and replace with “Comply with site specific epoxy standards obtained from the installation NEC/DOIM. Apply a continuous and generous bead of epoxy on the threads of the compression fittings prior to tightening. Apply tape on the conduit approximately 3/4" from the fitting before applying epoxy to the conduit and the fitting. Apply tape on the UDB / Enclosure to create an equi-distance perimeter (circle) approximately 1/2" around the connector prior to generously applying epoxy on the connector and the surface of the UDB / Enclosure. Once the epoxy has dried to a tacky consistency, but before it is fully dried, remove the tape to create a clean and even epoxy edge. Epoxy must be opaque.”

4. Section 32 13 12 is deleted in its entirety and replaced with the attached Section 32 13 12.

P-907 DRAWING REVISIONS NARRATIVELY:

5. DWG G-001, General Notes and Requirements, Note 6 is deleted in its entirety and replaced with the following: “The entire existing parking apron, which includes Areas 6 and 7, must be available for flight operations during the period of July 01, 2016 to October 31, 2016. No work on the apron will be allowed during this time. If work on the apron is started before July 01, 2016, it must be completed, turned over and accepted by the Government before July 01, 2016. If the work cannot be completed and accepted prior to July 01, 2016, do not start work on the apron until after October 31, 2016.”

6. DWG G-005, BUILDING CODE ANALYSIS, Delete AREA TABULATION table and Notes 1 to 4.

7. DWG C-101 (SK-001, 002): Remove additional fire hydrant; additional keynote for removal of fire hydrant.

8. DWG C-105 (SK-003, 004): Remove additional fire hydrant and waterline; additional keynote for removal of fire hydrant and waterline.

9. DWG C-113 (SK-005, 006): Location of hazardous waste storage (Project P-908) added to site plan; additional keynote for hazardous waste storage.

10. DWG C-161 (SK-007): New reduced height fire hydrant added (Keynote 56). Keynote 121 was shifted and changed from flush hydrant to reduced height hydrant.

- 11.** DWG C-162 (SK-008, 009): Remove flush fire hydrant in the middle of the hangar door opening. Waterline rerouted. No longer runs plans north of hangar. Waterline rerouted. No longer runs plans north of hangar. Keynote 59 changed from flush fire hydrant to reduced height hydrant and shifted over reduced height hydrant (keynote 54) added.
- 12.** DWG C-163 (SK-010 to 012): Keynotes 50-67, 69-72, 74, 77, 80-83, 121 revised per new waterline routing.
- 13.** DWG C-201 (SK-013 to 016): Waterline "W-01" profile revised per new waterline routing.
- 14.** DWG C-202 (SK-017 to 019): Fire line "FP02" profile revised to show modified crossings.
- 15.** DWG C-212 (SK-020 to 022): Industrial waste line "IW01" profile revised to show modified crossings.
- 16.** DWG C-221 (SK-023 to 025): Storm drain line "SD02" profile revised to show modified crossings.
- 17.** DWG C-522 (SK-026): Detail C3 revised to show location of bollards and dimensions for reduced height versus standard fire hydrants.
- 18.** DWG C-523 (SK-027): Details C2/C-523, C3/C-523, C5/C-523, and A3/C-523 deleted.
- 19.** DWG E-501 (SK-028): Revised "T8" lamp to "T5"
- 20.** DWG ES-113 (SK-029): Added conduit and wire from fire pump room to HAZWASTE enclosure.

P-908 DRAWING REVISIONS NARRATIVELY:

- 21.** DWG G-005, BUILDING CODE ANALYSIS, Delete AREA TABULATION table and notes 1 to 4.
- 22.** DWG S-921 (SKS-001 to 004) ENTRY CANOPY/DETAILS: HAZWASTE Storage plans and details added.
- 23.** DWG A-152 (SKA-001): HAZWASTE Storage added.
- 24.** DWG FP-200 (SDFP-001) FIRE PUMP PLAN & FOAM EQUIPMENT PLAN (Detail b): Add location of foam test connection.
- 25.** DWG E-415 (SKE-001): HAZWASTE Enclosure drawings.
- 26.** DWG E-902 (SKE-002): HAZWASTE Enclosure drawings.

P-908 DRAWING REVISIONS BY REPLACEMENT:

- 27.** DWG T-105: Entire Sheet is replaced with the attached DWG T-105.
- 28.** DWG T-106: Entire Sheet is replaced with the attached DWG T-106.
- 29.** DWG T-301: Entire Sheet is replaced with the attached DWG T-301.
- 30.** DWG T-302: Entire Sheet is replaced with the attached DWG T-302.
- 31.** DWG T-303: Entire Sheet is replaced with the attached DWG T-303.
- 32.** All other terms and conditions remain unchanged.

SECTION 32 13 12

HIGH TEMPERATURE CONCRETE PAVEMENT FOR AIRFIELDS
11/12

PART 1 GENERAL

1.1 REFERENCES

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1 (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete

ACI 214R (2011) Evaluation of Strength Test Results of Concrete

ACI 305R (2010) Guide to Hot Weather Concreting

ACI 306R (2010) Guide to Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M (2013) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM A184/A184M (2006; E2011) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

ASTM A615/A615M (2013) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A775/A775M (2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars

ASTM A996/A996M (2014) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

ASTM C1017/C1017M (2013) Standard Specification for Chemical Admixtures for Use in Producing Flowing

Concrete

ASTM C1064/C1064M	(2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	(2013b) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1116/C1116M	(2010) Standard Specification for Fiber-Reinforced Concrete
ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123/C123M	(2012) Standard Test Method for Lightweight Particles in Aggregate
ASTM C1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
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 C138/C138M	(2013a) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142/C142M	(2010) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143/C143M	(2012) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C174/C174M	(2013) Standard Test Method for Measuring

Thickness of Concrete Elements Using
Drilled Concrete Cores

ASTM C192/C192M	(2013a) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C294	(2012) Standard Descriptive Nomenclature for Constituents of Concrete Aggregates
ASTM C295/C295M	(2012) Petrographic Examination of Aggregates for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C78/C78M	(2012; E 2013) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	(2013) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C881/C881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C94/C94M	(2014) Standard Specification for Ready-Mixed Concrete
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors

ASTM D3665	(2012) Random Sampling of Construction Materials
ASTM D4791	(2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates
ASTM E1274	(2003; R 2012) Standard Test Method for Measuring Pavement Roughness Using a Profilograph

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA QC 3	(2011) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
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STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CTM 526	(2002) Operation of California Profilograph and Evaluation of Profiles
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U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 130	(2001) Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 55	(1992) Test Method for Within-Batch Uniformity of Freshly Mixed Concrete
COE CRD-C 662	(2009) Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

1.2 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of high temperature concrete (HTC) pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

1.2.1 Surface Smoothness

Use the profilograph method for all longitudinal testing, except for paving lanes less than 200 feet in length. Use the straightedge method for transverse testing, for longitudinal testing where the length of each pavement lane is less than 200 feet, within 200 feet on both the approach and departure sides of an aircraft arresting gear, and at the ends of the

paving limits for the project. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.) or existing rough or high PI pavement, finish the surface to meet the approval of the Contracting Officer. Detailed notes shall be kept of the results of the testing and a copy furnished to the Government after each day's testing.

- a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the limits specified when checked with an approved 12 foot straightedge. Runway pavement within 200 feet on both the approach and departure sides of an aircraft arresting gear shall have a variation in the longitudinal direction from the specified straightedge not more than plus or minus 1/8 inch. All other airfield areas shall have a variation from a straight edge not greater than 1/4 inch in either the longitudinal or transverse direction.
- b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and each 0.1 mile segment of each pavement lot shall have a Profile Index not greater than specified when tested with an approved California-type profilograph. All other airfield areas shall have a Profile Index not greater than 9 inches per mile in the longitudinal direction.
- c. Bumps ("Must Grind" Areas): Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding in accordance with subparagraph "Diamond Grinding of PCC Surfaces" below until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding.
- d. Testing Method: After the concrete has hardened sufficiently to permit walking thereon, but not later than 48 hours after placement, test the entire surface of the pavement in each lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after diamond grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane shown on the drawings, regardless of whether the Contractor is allowed to pave two lanes at a time, and at the 1/8th point in from each side of the lane. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints. Transverse testing lines for pilot lanes shall be carried to construction joint lines and for fill-in lanes shall be carried 24 inches across construction joints, and the readings in this area applied to the fill-in lane. Straightedge testing of the longitudinal edges of slipformed pilot lanes shall also be performed before paving fill-in lanes as specified below.
 - (1) Straightedge Testing: The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and measuring the maximum gap between the straightedge and the pavement surface. Measurements shall be determined along the entire length of the straight edge.

(2) Profilograph Testing: Perform profilograph testing using approved California profilograph and procedures described in ASTM E1274. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 mile segment of the pavement lot. Grade breaks on aprons shall be accommodated by breaking the profile segment into short sections and repositioning the blanking band on each section. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph testing of the last 30 feet of a paving lane in the longitudinal direction from each day's paving operation shall be counted on the following day's continuation lane. The profile index shall be computed for each pass of the profilograph (3 per lane) in each 0.1 mile segment. The profile index for each segment shall be the average of the profile indices for each pass in each segment. Profilographs of unequal lengths shall be scaled and proportioned to an equivalent 0.1 mile as outlined in the CTM 526. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

1.2.2 Edge Slump and Joint Face Deformation

- a. Edge Slump: When slip-form paving is used, not more than 15.0 percent of the total free edge of each pavement panel shall have an edge slump exceeding 1/4 inch and none of the free edge of the pavement lot shall have an edge slump exceeding 3/8 inch. (A pavement panel is defined as a lane width by the length between two adjacent transverse contraction joints. The total free edge of the pavement will be considered to be the cumulative total linear measurement of pavement panel edge originally constructed as non-adjacent to any existing pavement; i.e., 100 feet of pilot lane originally constructed as a separate lane, will have 200 feet of free edge; 100 feet of fill-in lane will have no free edge, etc.,). The area affected by the downward movement of the concrete along the pavement edge shall not exceed 18 inches back from the edge.

- b. Joint Face Deformation: In addition to the edge slump limits specified above, the vertical joint face shall have a surface within the maximum limits shown below:

Offset from Straightedge Applied Longitudinally to Pavement Surface	Offset from Straightedge Applied Longitudinally to Vertical Face	Offset from Straightedge Applied Top to Bottom Against the Joint Face	Abrupt Offset in Any Direction	Offset of Joint Face from True Vertical
Airfield Pavement				
1/8 inch	1/4 inch	3/8 inch	1/8 inch	1 inch/12 inches
All Other Pavement				
1/4 inch	All other items same as airfield pavement			

- c. Slump Determination: Immediately after the concrete has hardened

sufficiently to permit walking thereon, the pavement surface of each lot shall be tested by the Contractor. Testing shall be performed with a minimum 12 foot straightedge to reveal irregularities exceeding the edge slump tolerance specified above. The vertical edge slump shall be determined at each free edge of each slipformed paving lane constructed. The straightedge shall be placed transverse to the direction of paving and the end of the straightedge located at the edge of the paving lane. Measurements shall be made at 5 to 15 foot spacings, as directed, commencing at the header where paving was started. Initially measurements shall be made at 5 foot intervals in each lane. When no deficiencies are present, the Contracting Officer may approve an increase in the interval. When any deficiencies exist, the interval will be returned to 5 feet. In no case shall the interval exceed 15 feet. In addition to the transverse edge slump determination above, the Contractor, at the same time, shall check the longitudinal surface smoothness of the joint on a continuous line 1 inch back from the joint line using the 12 foot straightedge advanced one-half its length for each reading. Other tests of the exposed joint face shall be made to ensure that a uniform, true vertical joint face is attained. The measurements shall be made by the Contractor, shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Contracting Officer within 24 hours after measurement is made. The report shall also identify areas requiring replacement.

- d. Excessive Edge Slump: When edge slump exceeding the limits specified above is encountered on either side of the paving lane, additional straightedge measurements shall be made, if required, to define the linear limits of the excessive slump. The concrete slabs having excessive edge slump or joint deformation shall be removed and replaced to the next transverse joint in conformance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Use of slip-form paving equipment and procedures that fail to consistently provide edges within the specified tolerances on edge slump and joint face deformation shall be discontinued and the pavements shall be constructed by means of standard paving procedures using fixed forms.

1.2.3 Plan Grade

Within 5 days after paving of each lot, the finished surface of the pavement area shall be tested, by running lines of levels at intervals corresponding with every longitudinal and transverse joint to determine the elevation at each joint intersection. The results of this survey shall be recorded and a copy given to the Government at the completion of the survey of each lot. The finished surfaces of airfield runway, taxiway, and apron pavements shall vary not more than 1/2 inch above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 3/4 inch. The above deviations from the approved grade line and elevation will not be permitted in areas where closer conformance with the planned grade and elevation is required for the proper functioning of appurtenant structures. The finished surfaces of new abutting pavements shall coincide at their juncture.

1.2.4 Flexural Strength

Submit certified copies of laboratory test reports and sources for cement, supplementary cementitious materials (SCM), aggregates, admixtures, curing compound, epoxy, and proprietary patching materials proposed for use on this project. All aggregate tests shall have been performed no earlier

than 6 months prior to contract award. Each lot of pavement will be evaluated for acceptance in accordance with the following procedures.

- a. Sampling and Testing: For acceptance, one composite sample of concrete from each subplot shall be obtained in accordance with ASTM C172/C172M from one batch or truckload. Test beams 6 x 6 inches shall be fabricated and cured in accordance with ASTM C31/C31M; and tested in accordance with ASTM C78/C78M. Test two test cylinders per subplot (8 per lot) at 14 days.
- b. Computations: Average the eight 14-day strength tests for the lot. The average strength shall be used in accordance with paragraph "Concrete Strength for Final Acceptance" in PART 2.

1.2.5 Thickness

Each lot of pavement will be evaluated for acceptance and payment adjustment in accordance with the following procedure. Two cores, between 4 and 6 inches in diameter, shall be drilled from the pavement, per subplot (8 per lot). The Contractor is responsible for drilling the cores within 3 days after lot placement, filling the core holes with an approved non-shrink concrete, respraying the cored areas with curing compound, and for measuring the cores. Each core shall be inspected for voids, thickness of paste on the surface, and depth of reinforcement (if required). Provide the results with the thickness measurement data. Eight measurements of thickness shall be made around the circumference of each core and one in the center, in accordance with ASTM C174/C174M, using calibrated calipers for specimens longer than 10 inches. The pavement thickness from the 8 cores for the lot shall be averaged and shall be evaluated as described below.

1.2.6 Diamond Grinding of PCC Surfaces

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with an approved diamond grinding machine after the concrete is 14 days or more old. Grinding shall be accomplished by sawing with an industrial diamond abrasive which is impregnated in the saw blades. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the concrete pavement or joint faces. The saw blades shall be 1/8-inch wide and there shall be a minimum of 55 to 60 blades per 12 inches of cutting head width depending on the hardness of the aggregate. Each machine shall be capable of cutting a path 3 to 4 ft 3 to 4 ft wide. Grinding equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The area corrected by grinding the surface of the hardened concrete shall not exceed 10 percent of the total area of any subplot. The depth of diamond grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, shall be removed and replaced in conformance with paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. All areas in which diamond grinding has been performed will be subject to the thickness tolerances specified in paragraph: Thickness, above.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
Proposed Techniques; G
Dowels; G
Dowel Bar Assemblies; G
Surface Sealer; G

SD-05 Design Data

Proportioning Studies; G

SD-06 Test Reports

Sampling and Testing; G

SD-07 Certificates

Contractor Quality Control Staff; G
Laboratory Accreditation; G
NRMCA Certificate of Conformance; G
Commercial Laboratory; G

1.4 QUALITY ASSURANCE

1.4.1 Contractor Quality Control Staff

Submit American Concrete Institute certification for Contractor Quality Control staff. Qualifications and resumes for petrographer, surveyor, concrete batch plant operator, and profilograph operator. All Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) certified in the following grade (or shall have written evidence acceptable to the Contracting Officer's representative of having completed similar qualification programs):

- a. CQC personnel responsible for inspection of concrete paving operations: ACI Concrete Transportation Inspector.
- b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews: ACI Concrete Flatwork Technician/Finisher.
- c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.
- d. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.

1.4.2 Other Staff

Submit for approval, the qualifications and resumes for the following staff:

- a. Petrographer: Bachelor of Science degree in geology or petrography, trained in petrographic examination of concrete aggregate according to ASTM C294 and ASTM C295/C295M and trained in identification of the specific deleterious materials and tests identified in this specification. Resume shall detail the education, training and experience related to the project-specific test methods and deleterious materials and shall be submitted at least 20 days before petrographic and deleterious materials examination is to commence.
- b. Licensed Surveyor: All survey work shall be performed under the supervision of a Licensed Surveyor.
- c. Concrete Batch Plant Operator: National Ready Mix Concrete Association (NRMCA) Plant Manager certification at the Plant Operator level.
- d. Profilograph Operator: Certification by equipment manufacturer or a state Department of Transportation.

1.4.3 Laboratory Accreditation

Laboratory and testing facilities shall be provided by and at the expense of the Contractor. Submit accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM C1077, including all applicable test procedures. The laboratories performing the tests shall be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation shall be current and shall include the required and optional test methods, as specified throughout this Section. Onsite temperature-controlled concrete curing facilities shall be provided.

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies shall be performed by a commercial laboratory.
- b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Steel molds shall be used for molding the beam specimens. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M. Flexural loading equipment shall be in accordance with ASTM C78/C78M.
- c. Contractor Quality Control: All sampling and testing shall be performed by an approved, onsite, independent, commercial laboratory, or for cementitious materials and admixtures, the manufacturer's laboratory.
- d. Laboratory Inspection: The Government will inspect the laboratory equipment and test procedures prior to the start of concreting operations for conformance to ASTM C1077. The laboratory shall maintain this certification for the duration of the project.

1.4.4 Preconstruction Testing of Materials

All sampling and testing shall be performed by, and at the expense of, the Contractor. Use an approved commercial laboratory or, for cementitious materials and chemical admixtures, a laboratory maintained by the manufacturer of the material. No material shall be used until notice of

acceptance has been given. The Contractor will not be entitled to any additional payment or extension of time due to failure of any material to meet project requirements, or for any additional sampling or testing required. Additional tests may be performed by the Government at the discretion of the Contracting Officer; such Government testing will not relieve the Contractor of any testing responsibilities.

1.4.4.1 Aggregates

Aggregates shall be sampled in the presence of a Government Representative. Samples shall be obtained in accordance with ASTM D75/D75M and shall be representative of the materials to be used for the project. Test results shall be submitted 7 days before commencing mixture proportioning studies.

1.4.4.2 Chemical Admixtures, Curing Compounds and Epoxies

At least 30 days before the material is used, submit certified copies of test results for the specific lots or batches to be used on the project. Test results shall be not more than 6 months old prior to use in the work. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing will be retested at the expense of the Contractor and will be rejected if test results are not satisfactory.

1.4.4.3 Cementitious Materials

Cement, ground granulated blast furnace (GGBF) slag, and pozzolan will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. Mill test reports shall be no more than 1 month old, prior to use in the work. No cementitious material shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious material may be subjected to testing by the Government from samples obtained at the mill, at transfer points, or at the project site. If tests prove that a cementitious material that has been delivered is unsatisfactory, it shall be promptly removed from the site of the work. Cementitious material that has not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory.

1.4.4.4 Multifilament Polypropylene Fibers

Multifilament polypropylene fibers will be accepted on the basis of the manufacturer's certification of compliance, accompanied by test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. Test reports shall be no older than 6 months, prior to use in the work. Fibers may be subjected to check testing by the Government from samples obtained at the manufacturer site, at transfer points, or at the project site. If tests prove that fibers that have been delivered are unsatisfactory, they shall be promptly removed from the work site. Fibers that have not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory.

1.4.5 Testing During Construction

During construction, the Contractor is responsible for sampling and

testing aggregates, cementitious materials, and concrete as specified herein. The Government will sample and test concrete and ingredient materials as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Testing by the Government will in no way relieve the Contractor of the specified testing requirements.

1.4.6 Test Section

Up to 10 days, but not more than 60 days, prior to construction of the concrete pavement, construct a test section as part of the production paving area at an outer edge. Use the test section to develop and demonstrate to the satisfaction of the Contracting Officer the proposed techniques of mixing, hauling, placing, consolidating, finishing, curing, initial saw cutting, start-up procedures, testing methods, plant operations, and the preparation of the construction joints. Variations in mixture proportions, other than water, shall be made if directed. Vary the water content, as necessary, to arrive at the appropriate content. The mixing plant shall be operated and calibrated prior to start of placing the test section. Use the same equipment, materials, and construction techniques on the test section as will be used in all subsequent work. Base course preparation, concrete production, placing, consolidating, curing, construction of joints, and all testing shall be in accordance with applicable provisions of this specification. Three days after completion of the test section, provide eight cores at least 6 inch diameter by full depth cut from points selected in the test section by the Government. The cores will be evaluated for homogeneity, consolidation and segregation. Construct the test section meeting all specification requirements and being acceptable to the Contracting Officer in all aspects, including surface texture. Failure to construct an acceptable test section will necessitate construction of additional test sections at no additional cost to the Government. Test sections allowed to be constructed as part of the production paving which do not meet specification requirements shall be removed at the Contractor's expense. If the Contractor proposes to use slipform paving and is unable to construct an acceptable test section, the slipform paving equipment shall be removed from the job and the construction completed using stationary side forms and equipment compatible with them. Production paving shall not commence until the results on aggregates and concrete, including evaluation of the cores, and all pavement measurements for edge slump, joint face deformation, actual plan grade, surface smoothness and thickness have been submitted and approved by the Contracting Officer. Pavement accepted as a production lot will be evaluated and paid in accordance with Paragraph: ACCEPTABILITY OF WORK below.

1.4.6.1 Pilot Lane

The test section shall consist of one paving lane at least 400 feet long and shall be constructed to the same thickness as the thickest portion of pavement shown on the Drawings. The lane width shall be the same as that required for use in the project. The test section shall contain at least one transverse construction joint. If doweled longitudinal construction joints are required in any of the production pavements, they shall be installed full length along one side of the test strip throughout the test section. Two separate days shall be used for construction of the test section.

1.4.6.2 Fill-In Lane

The first 400 feet of the initial production fill-in lane shall be considered a fill-in lane test section for purposes of testing and evaluation. All requirements for the test section are applicable, as appropriate. Obtain cores from the fill-lane side of the longitudinal construction joint with the pilot lane. The cores will be evaluated for homogeneity, consolidation, and segregation.

1.4.7 Acceptability of Work

The materials and the pavement itself will be accepted on the basis of tests made by the Contractor. The Government may make check tests to validate the results of the Contractor's testing. If the results of the Contractor tests vary by less than 2.0 percent of the Government's test results, the results of the Contractor's tests will be used. If the results of the Government and Contractor tests vary by 2.0 percent, but less than 4.0 percent, the average of the two will be considered the value to be used. If these vary by 4.0 percent or more, each sampling and testing procedure shall be carefully evaluated and both the Government and the Contractor shall take another series of tests on duplicate samples of material. If these vary by 4.0 percent or more, the results of the tests made by the Government shall be used and the Government will continue check testing of this item on a continuous basis until the two sets of tests agree within less than 4.0 percent on a regular basis. Testing performed by the Government will in no way at any time relieve the Contractor from the specified testing requirements.

1.4.8 Acceptance Requirements

1.4.8.1 Pavement Lots

A lot will be that quantity of construction that will be evaluated for acceptance with specification requirements. A lot will be equal to one shift of production not to exceed 1000 cubic yards. In order to evaluate thickness, each lot will be divided into four equal sublots. Grade determinations will be made on the lot as a whole. Surface smoothness determinations will be made on every 0.1 mile segment in each lot. Location of all samples shall be selected on a random basis in accordance with ASTM D3665. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, the following procedure shall be used to adjust the lot size and number of tests for the lot. Where three sublots have been completed, they shall constitute a lot. Where one or two sublots have been completed, they shall be incorporated into the next lot (except for the last lot), and the total number of sublots shall be used and acceptance criteria adjusted accordingly.

1.4.8.2 Evaluation

Provide all sampling and testing required for acceptance and payment adjustment at the Contractor's expense. Individuals performing sampling, testing and inspection duties shall meet the required Qualifications. The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. Testing in these areas will be in addition to the subplot or lot testing, and the requirements for these areas will be the same as those for a subplot or lot. Provide facilities for and, where directed, personnel to assist in obtaining samples for any Government testing.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Bulk Cementitious Materials

Furnish all cementitious material in bulk. The temperature of the cementitious material, as delivered to storage at the site, shall not exceed 150 degrees F. Sufficient cementitious materials shall be in storage to sustain continuous operation of the concrete mixing plant while the pavement is being placed. Provide separate facilities to prevent any intermixing during unloading, transporting, storing, and handling of each type of cementitious material.

1.5.2 Aggregate Materials

Store aggregate at the site of the batching and mixing plant avoiding breakage, segregation, intermixing or contamination by foreign materials. Each size of aggregate from each source shall be stored separately in free-draining stockpiles. Aggregate stored on ground shall have a minimum 24 inch thick sacrificial layer left undisturbed. Fine aggregate and the smallest size coarse aggregate shall remain in free-draining storage for at least 24 hours immediately prior to use. Sufficient aggregate shall be maintained at the site at all times to permit continuous uninterrupted operation of the mixing plant at the time concrete pavement is being placed. Tracked equipment shall not be allowed on coarse aggregate stockpiles.

1.5.3 Multifilament Polypropylene Fibers

Furnish all fibers in bulk or water soluble bags added at the plant. Fibers shall be stored in a dry and protected location and protected from damage.

1.5.4 Other Materials

Store reinforcing bars and accessories above the ground on supports. All materials shall be stored avoiding contamination and deterioration.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement or only portland cement in combination with supplementary cementitious materials (SCM), and shall conform to appropriate specifications listed below. New submittals are required when the cementitious materials sources or types change.

2.1.1 Portland Cement

Provide portland cement conforming to ASTM C150/C150M, Type II, low alkali including false set requirements.

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2.1.2 Pozzolan

2.1.2.1 Fly Ash

Fly ash shall conform to ASTM C618, Class F, including the optional

requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity shall have a total equivalent alkali content less than 3 percent. Do not use ultra fine fly ash, ground granulated blast furnace slag or silica fume, as these are detrimental to high temperature concrete performance.

2.1.3 DELETED

2.1.4 Supplementary Cementitious Materials (SCM) Content

The concrete mix shall always contain one of the SCMs listed in Table 2 within the range specified therein, whether or not the aggregates are found to be reactive in accordance with paragraph Alkali Silica Reactivity.

TABLE 2 SUPPLEMENTARY CEMENTITIOUS MATERIALS CONTENT		
Supplementary Cementitious Material	Minimum Content (percent)	Maximum Content (percent)
Class F Fly Ash		
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ > 70 percent	25	35
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ > 80 percent	20	35
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ > 90 percent	15	35

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2.2 AGGREGATES

2.2.1 Aggregate Sources

Conforming sources of aggregate include the following:

NOV-Ameron
 Kapaa Quarry
 Tel: 808-226-2647

Hawaiian Cement
 Halawa Quarry
 Tel: 808-443-3382

2.2.1.1 Durability

Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for durability in accordance with ASTM C88. Results shall not show more than 18 percent loss when subjected to 5 cycles using Magnesium Sulfate. If Sodium Sulfate is used, results shall not show more than 12 percent loss when subjected to 5 cycles.

2.2.1.2 Alkali-Silica Reactivity

Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for alkali-aggregate reactivity. Both coarse aggregate size groups shall be tested.

- a. The fine and coarse aggregates shall be evaluated separately, using ASTM C1260. Test results of the individual aggregates shall have 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, the aggregate(s) shall be rejected or additional testing shall be performed as follows: utilize the Contractor's proposed low alkali portland cement, blended cement, and/or SCM, and/or Lithium Nitrate in combination with each individual aggregate. If only SCMs are being evaluated, the testing shall be in accordance with ASTM C1567. If Lithium Nitrate is being evaluated, with or without SCMs, the testing shall be in accordance with COE CRD-C 662. 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. Mixture proportioning shall be based on the highest percentage of SCM required to mitigate ASR-reactivity
- 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.

2.2.1.3 Combined Aggregate Gradation

In addition to the grading requirements specified for coarse aggregate and for fine aggregate, the combined aggregate grading shall meet the following requirements:

- a. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.
- b. The Coarseness Factor (CF) shall be determined from the following equation:
$$CF = (\text{cumulative percent retained on the } 3/8 \text{ in. sieve})(100)/(\text{cumulative percent retained on the No. 8 sieve})$$
- c. The Workability Factor WF is defined as the percent passing the No. 8 sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds of cementitious material per cubic yard greater than 564 pounds per cubic yard.
- d. A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.)

2.2.2 Coarse Aggregate

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2.2.2.1 Material Composition

Coarse aggregate shall be basalt or other approved low-silica content aggregate which will not cause thermal distress from heat blast. Aggregates, as delivered to the mixers, shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C33/C33M except as specified herein. Coarse aggregate shall be washed. Washing shall be sufficient to remove dust and other coatings. Coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131. The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium sulfate soundness loss shall not exceed 18 percent after five cycles when tested in accordance with ASTM C88.

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2.2.2.2 Particle Shape Characteristics

Particles of the coarse aggregate shall be generally spherical or cubical in shape. The quantity of flat and elongated particles in any size group coarser than the 3/8 inch sieve shall not exceed 20 percent by weight as determined by the Flat Particle Test and the Elongated Particle Test of ASTM D4791. A flat particle is defined as one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.

2.2.2.3 Size and Grading

The nominal maximum size of the coarse aggregate shall be 0.75 inch. Grade and furnish the individual aggregates in two size groups to meet the coarseness and workability factor criteria for the contractor-proposed combined gradation. A third aggregate size group may be required to meet the above mentioned coarseness and workability criteria of paragraph COMBINED AGGREGATE GRADATION.

2.2.2.4 Deleterious Materials - Airfield Pavements

The amount of deleterious material in each size group of coarse aggregate shall not exceed the limits shown in Table 5 below, determined in accordance with the test methods shown.

TABLE 5	
LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE FOR AIRFIELD PAVEMENTS	
Percentage by Mass	
Materials (h)	Negligible Weather
Clay lumps and friable particles (ASTM C142/C142M)	1.0
Shale (a) (ASTM C295/C295M)	--
Material finer than No. 200 sieve (b) (ASTM C117)	1.0

TABLE 5	
LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE FOR AIRFIELD PAVEMENTS	
Percentage by Mass	
Materials (h)	Negligible Weather
Lightweight particles (c) (ASTM C123/C123M)	1.0
Clay ironstone (d) (ASTM C295/C295M)	--
Chert and cherty stone (less than 2.40 Sp. Gr.) (e) (ASTM C123/C123M and ASTM C295/C295M)	--
Claystone, mudstone, and siltstone (f) (ASTM C295/C295M)	--
Shaly and argillaceous limestone (g) (ASTM C295/C295M)	--
Other soft particles (COE CRD-C 130)	1.0
Total of all deleterious substances exclusive of material finer than No. 200 sieve	3.0
(a) Shale is defined as a fine-grained, thinly laminated or fissile sedimentary rock. It is commonly composed of clay or silt or both. It has been indurated by compaction or by cementation, but not so much as to have become slate.	
(b) Limit for material finer than No. 200 sieve will be increased to 1.5 percent for crushed aggregates if the fine material consists of crusher dust that is essentially free from clay or shale.	
(c) The separation medium shall have a density of Sp. Gr. of 2.0. This limit does not apply to coarse aggregate manufactured from blast-furnace slag unless contamination is evident.	
(d) Clay ironstone is defined as an impure variety of iron carbonate, iron oxide, hydrous iron oxide, or combinations thereof, commonly mixed with clay, silt, or sand. It commonly occurs as dull, earthy particles, homogeneous concretionary masses, or hard-shell particles with soft interiors. Other names commonly used for clay ironstone are "chocolate bars" and limonite concretions.	
(e) Chert is defined as a rock composed of quartz, chalcedony or opal, or any mixture of these forms of silica. It is variable in color. The texture is so fine that the individual mineral grains are too small to be distinguished by the unaided eye. Its hardness is such that it scratches glass but is not scratched by a knife blade. It may contain impurities such as clay, carbonates, iron oxides, and other minerals. Cherty stone is defined as any type of rock (generally limestone) that contains chert as lenses and nodules, or irregular masses partially or completely replacing the original stone.	

TABLE 5	
LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE FOR AIRFIELD PAVEMENTS	
Percentage by Mass	
Materials (h)	Negligible Weather
(f) Claystone, mudstone, or siltstone, is defined as a massive fine-grained sedimentary rock that consists predominantly of indurated clay or silt without laminations or fissility. It may be indurated either by compaction or by cementation.	
(g) Shaly limestone is defined as limestone in which shale occurs as one or more thin beds or laminae. These laminae may be regular or very irregular and may be spaced from a few inches down to minute fractions of an inch. Argillaceous limestone is defined as a limestone in which clay minerals occur disseminated in the stone in the amount of 10 to 50 percent by weight of the rock; when these make up from 50 to 90 percent, the rock is known as calcareous (or dolomitic) shale (or claystone, mudstone, or siltstone).	
(h) Perform testing in accordance with the referenced test methods, except that the minimum sample size shall be as specified below.	

2.2.2.5 Testing Sequence/Deleterious Materials in Coarse Aggregate - Airfields Only

The Contractor will not be entitled to any extension of time or additional payment due to any delays caused by the testing, evaluation, or personnel requirements. Sample sizes shall be in accordance with the referenced test methods.

2.2.3 Fine Aggregate

2.2.3.1 Composition

Fine aggregate shall consist of the same high temperature material as the coarse aggregate, and shall be composed of clean, hard, durable particles meeting the requirements of ASTM C33/C33M. Each type of fine aggregate shall be stockpiled and batched separately. Particles of the fine aggregate shall be generally spherical or cubical in shape.

2.2.3.2 Grading

Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33/C33M and shall have a fineness modulus of not less than 2.50 nor more than 3.40.

2.2.3.3 Deleterious Material

The amount of deleterious material in the fine aggregate shall not exceed the following limits by mass:

Material	Percentage by Mass
Clay lumps and friable particles ASTM C142/C142M	1.0
Material finer than No. 200 sieve ASTM C117	3.0
Lightweight particles ASTM C123/C123M using a medium with a density of Sp. Gr. of 2.0	0.5
Total of all above	3.0

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2.3 CHEMICAL ADMIXTURES

2.3.1 General Requirements

Chemical admixtures may only be used when the specific admixture type and manufacturer is the same material used in the mixture proportioning studies. The air-entraining admixture shall conform to ASTM C260/C260M. An accelerator conforming to ASTM C494/C494M, Type C, may be used only when specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES below and shall not be used to reduce the amount of cementitious material used. Calcium chloride and admixtures containing calcium chloride shall not be used. Retarding or water-reducing admixture shall meet the requirements of ASTM C494/C494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived. ASTM C494/C494M, Type F and G high range water reducing admixtures are allowable, but shall be added as separate admixtures from the ASTM C494/C494M Type A, B or D admixtures. Type S admixtures and ASTM C1017/C1017M flowable admixtures shall not be used.

2.4 MULTIFILAMENT POLYPROPYLENE FIBERS

Multifilament polypropylene fibers shall have a length between 0.375 and 0.75 inches and either a maximum diameter of 0.00157 inches or maximum average 10 denier weight. Test results have shown that 3 lb per cubic yard are needed in a concrete mixture to prevent spalling. The fibers shall be added to the concrete mixture at the batch plant. Submit certified copies of the laboratory test results showing length, and diameter or denier. Fibers shall follow ASTM C1116/C1116M.

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2.5 MEMBRANE FORMING CURING COMPOUND

Membrane forming curing compound shall conform to ASTM C309, white-pigmented Type 2, Class B.

2.6 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water, or water from concrete production operations, may be used if it meets the requirements of ASTM C1602/C1602M.

2.7 JOINT MATERIALS

Amdt. 0001*****

2.7.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to ASTM D1752 Type II or Type III. Expansion joint filler shall be 3/4 inch thick, unless otherwise indicated, and shall be furnished in a single full depth piece.

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2.7.2 Slip Joint Material

Slip joint material shall be 1/4 inch thick expansion joint filler, unless otherwise indicated, conforming to paragraph: Expansion Joint Material.

2.8 REINFORCING

All reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete. Removal of thin powdery rust and tight rust is not required. However, reinforcing steel which is rusted to the extent that it does not conform to the required dimensions or mechanical properties shall not be used.

2.8.1 Reinforcing Bars and Bar Mats

Reinforcing bars shall conform to ASTM A615/A615M, billet-steel or ASTM A996/A996M, rail and axle steel, Grade 60. Bar mats shall conform to ASTM A184/A184M. The bar members may be billet rail or axle steel.

2.8.2 Welded Wire Reinforcement

Welded Wire Reinforcement shall be deformed or smooth, conforming to ASTM A1064/A1064M, and shall be furnished in flat sheets.

2.9 DOWELS

2.9.1 Dowels

Dowels shall be single piece bars fabricated or cut to length at the shop or mill before delivery to the site. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and does not extend more than 0.04 inch from the end of the dowel. Dowels shall be plain (non-deformed) steel bars conforming to ASTM A615/A615M, Grade 40 or 60; ASTM A996/A996M, Grade 50 or 60. Dowel bars shall be epoxy coated in conformance with ASTM A775/A775M. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the epoxy hardens. Dowel sleeves or inserts are not permitted.

2.9.2 Dowel Bar Assemblies

Dowel bar assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels throughout the paving operation, with a minimum of four continuous bars or wires extending along the joint line. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from rising, sliding out, or becoming distorted during paving operations.

2.10 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881/C881M, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

- a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.
- b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.
- c. Material for use for injecting cracks shall be Type IV, Grade 1.
- d. Material for bonding freshly mixed portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

2.11 EQUIPMENT

All plant, equipment, tools, and machines used in the work shall be maintained in satisfactory working conditions at all times. Submit the following:

- a. Details and data on the batching and mixing plant prior to plant assembly including manufacturer's literature showing that the equipment meets all requirements specified herein.
- b. Obtain National Ready Mixed Concrete Association (NRMCA) certification of the concrete plant. The concrete plant shall be inspected by an engineer approved by the NRMCA. A list of NRMCA approved engineers is available on the NRMCA website at <http://www.nrmca.org>. All fees and costs associated with this inspection shall be paid by the Contractor. Submit a copy of the NRMCA QC Manual Section 3 Concrete Plant Certification Checklist, NRMCA Certificate of Conformance, and Calibration documentation on all measuring and weighing devices prior to uniformity testing.
- c. A description of the equipment proposed for transporting concrete mixture from the central mixing plant to the paving equipment.
- d. A description of the equipment proposed for the machine and hand placing, consolidating and curing of the concrete mixture. Manufacturer's literature on the paver and finisher, together with the manufacturer's written instructions on adjustments and operating procedures necessary to assure a tight, smooth surface on the concrete pavement. The literature shall show that the equipment meets all details of these specifications. Detailed information on automatic laser controlled systems shall be submitted if proposed for use.

2.11.1 Batching and Mixing Plant

- a. Location: The batching and mixing plant shall be located off Government premises no more than 15 minutes haul time from the placing site. There shall be operable telephonic or radio communication between the plant and the placing site at all times concreting is taking place.

b. Type and Capacity: The batching and mixing plant shall be a stationary-type central mix plant, including permanent installations or portable/relocatable plants installed on stable foundations. The plant shall be designed and operated to produce concrete within the specified tolerances, and shall have a capacity of at least 250 cubic yards per hour. The batching and mixing plant shall conform to the requirements of NRMCA QC 3 including provisions addressing:

1. Material Storage and Handling
2. Batching Equipment
3. Central Mixer
4. Ticketing System
5. Delivery System

c. Tolerances: The following tolerances shall apply.

Materials	Percentage of Required Mass
Cementitious Materials	plus or minus 1
Aggregate	plus or minus 2
Water	plus or minus 1
Admixture	plus or minus 3
Polypropylene Fibers	plus or minus 2

For volumetric batching equipment for water and admixtures, the above numeric tolerances shall apply to the required volume of material being batched. Concentrated admixtures shall be uniformly diluted, if necessary, to provide sufficient volume per batch to ensure that the batchers will consistently operate within the above tolerance.

d. Moisture Control: The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates and to change the quantities of the materials being batched.

2.11.2 Concrete Mixers

a. General: Mixers shall be stationary or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Mixer blades or paddles shall be replaced when worn down more than 10 percent of their depth when compared with the manufacturer's dimension for new blades or paddles.

b. Stationary: Stationary mixers shall be drum or pan mixers. Mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed.

c. Mixing Time and Uniformity for Stationary Mixers: For stationary

mixers, before uniformity data are available, the mixing time for each batch after all solid materials are in the mixer, provided that all of the mixing water is introduced before one-fourth of the mixing time has elapsed, shall be 1 minute for mixers having a capacity of 1 cubic yard. For mixers of greater capacity, this minimum time shall be increased 20 seconds for each additional 1.33 cubic yard or fraction thereof. After results of uniformity tests are available, the mixing time may be reduced to the minimum time required to meet uniformity requirements; but if uniformity requirements are not being met, the mixing time shall be increased as directed. The mixing time for full batch production shall be a minimum of 75 seconds. Mixer performance tests at new mixing times shall be performed immediately after any change in mixing time. The Regular Test sequence shall be conducted for initial determination of the mixing time or as directed. When regular testing is performed, the concrete shall meet the limits of any five of the six uniformity requirements listed in Table 1 below.

- d. The Abbreviated Test sequence shall be conducted for production concrete verification at the frequency specified in Table 6. When abbreviated testing is performed, the concrete shall meet only those requirements listed for abbreviated testing. The concrete proportions used for uniformity tests shall be as used on the project. Regular testing shall consist of performing all six tests on three batches of concrete. The range for regular testing shall be the average of the ranges of the three batches. Abbreviated testing shall consist of performing the three required tests on a single batch of concrete. The range for abbreviated testing shall be the range for one batch. If more than one mixer is used and all are identical in terms of make, type, capacity, condition, speed of rotation, etc., the results of tests on one of the mixers shall apply to the others, subject to the approval of the Contracting Officer. All mixer performance (uniformity) testing shall be performed in accordance with COE CRD-C 55 and with paragraph titled TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3.

TABLE 1 UNIFORMITY REQUIREMENTS--STATIONARY MIXERS		
Parameter	Regular Tests Allowable Maximum Range for Average of 3 Batches	Abbreviated Tests Allowable Maximum Range for 1 Batch
Unit weight of air-free mortar	2.0 lbs/cubic ft	2.0 lbs/cubic ft
Air content	1.0 percent	--
Slump	1.0 inch	1.0 inch
Coarse aggregate	6.0 percent	6.0 percent
Compressive strength at 7 days	10.0 percent	10.0 percent
Water content	1.5 percent	

- e. Truck: Truck mixers shall not be used for mixing or transporting slipformed paving concrete. The only truck mixers used for mixing or transporting paving concrete shall be those designed with extra large

blading and rear opening specifically for low-slump paving concrete. Truck mixers, the mixing of concrete therein, and concrete uniformity and testing thereof shall conform to the requirements of ASTM C94/C94M. The number of revolutions between 70 to 100 for truck-mixed concrete and the number of revolutions for shrink-mixed concrete shall be determined by uniformity tests as specified in ASTM C94/C94M and in requirements for mixer performance stated in paragraph TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3. If requirements for the uniformity of concrete are not met with 100 revolutions of mixing after all ingredients including water are in the truck mixer drum, the mixer shall not be used until the condition is corrected. Water shall not be added after the initial introduction of mixing water except, when on arrival at the job site, the slump is less than specified and the water-cement ratio is less than that given as a maximum in the approved mixture. Additional water may be added to bring the slump within the specified range provided the approved water-cement ratio is not exceeded. Water shall be injected into the head of the mixer (end opposite the discharge opening) drum under pressure, and the drum or blades shall be turned a minimum of 30 additional revolutions at mixing speed. Water shall not be added to the batch at any later time.

2.11.3 Transporting Equipment

Slipform concrete shall be transported to the paving site in nonagitating equipment conforming to ASTM C94/C94M or in approved agitators. Fixed form concrete shall be transported in approved truck mixers designed with extra large blading and rear opening specifically for low slump concrete. All transporting equipment shall be designed and operated to deliver and discharge the required concrete mixture completely without segregation.

2.11.4 Paver-Finisher

The following items a through e apply to both fixed-form and slip-form paver-finishers. Item f is applicable to fixed-form paver-finishers and item g is applicable to slip-form paver-finishers.

- a. General: The paver-finisher shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality pavement. The paver-finisher shall weigh at least 2200 lb/foot of lane width, and shall be powered by an engine having at least 6.0 horsepower/foot of lane width. The paver-finisher shall spread, consolidate, and shape the plastic concrete to the desired cross section in one pass. The mechanisms for forming the pavement shall be easily adjustable in width and thickness and for required crown. In addition to other spreaders required by paragraph above, the paver-finisher shall be equipped with a full width knock-down auger or paddle mechanism, capable of operating in both directions, which will evenly spread the fresh concrete in front of the screed or extrusion plate.
- b. Vibrators: Immersion vibrators shall be gang mounted at the front of the paver on a frame equipped with suitable controls so that all vibrators can be operated at any desired depth within the slab or completely withdrawn from the concrete, as required. The vibrators shall be automatically controlled so that they will be immediately stopped as forward motion of the paver ceases. The paver-finisher shall be equipped with an electronic vibrator monitoring device displaying the operating frequency of each individual internal

vibrator. The monitoring device shall have a readout display visible to the paver operator. It shall operate continuously while paving, and shall display all vibrator frequencies with manual or automatic sequencing among all individual vibrators. The spacing of the immersion vibrators across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between vibrators shall not exceed 30 inches. The outside vibrators shall not be more than 12 inches from the lane edge. Spud vibrators shall operate at a frequency of not less than 8000 impulses/minute and an amplitude of not less than 0.03 inch, as determined by COE CRD-C 521.

- c. **Screed or Extrusion Plate:** The paver-finisher shall be equipped with a transversely oscillating screed or an extrusion plate to shape, compact, and smooth the surface and shall so finish the surface that no significant amount of hand finishing, except use of cutting straightedges, is required. The screed or extrusion plate shall be constructed to provide adjustment for crown in the pavement. The entire machine shall provide adjustment for variation in lane width or thickness and to prevent more than 8 inches of the screed or extrusion plate extending over previously placed concrete on either end when paving fill-in lanes. Machines that cause displacement of properly installed forms or cause ruts or indentations in the prepared underlying materials and machines that cause frequent delays due to mechanical failures shall be replaced as directed.
- d. **Longitudinal Mechanical Float:** A longitudinal mechanical float may be used. If used, the float shall be specially designed and manufactured to smooth and finish the pavement surface without working excess paste to the surface. It shall be rigidly attached to the rear of the paver-finisher or to a separate self-propelled frame spanning the paving lane. The float plate shall be at least 5 feet long by 8 inches wide and shall automatically be oscillated in the longitudinal direction while slowly moving from edge to edge of the paving lane, with the float plate in contact with the surface at all times.
- e. **Other Types of Finishing Equipment:** Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Contracting Officer's approval. Bridge deck finishers shall have a minimum operating weight of 7500 pounds and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.
- f. **Fixed Forms:** The paver-finisher shall be equipped with wheels designed to ride the forms, keep it aligned with the forms, and spread the load so as to prevent deformation of the forms. Paver-finishers traveling on guide rails located outside the paving lane shall be equipped with wheels when traveling on new or existing concrete to remain.
- g. **Slipform:** The slipform paver-finisher shall be automatically controlled and crawler mounted with padded tracks so as to be completely stable under all operating conditions. The paver-finisher shall finish the surface and edges so that no edge slump beyond allowable tolerance occurs. Suitable moving side forms shall be provided that are adjustable and will produce smooth, even edges, perpendicular to the top surface and meeting specification

requirements for alignment and freedom from edge slump.

2.11.5 Curing Equipment

Equipment for applying membrane-forming curing compound shall be mounted on a self-propelled frame that spans the paving lane. The reservoir for curing compound shall be constantly mechanically (not air) agitated during operation and shall contain means for completely draining the reservoir. The spraying system shall consist of a mechanically powered pump which will maintain constant pressure during operation, an operable pressure gauge, and either a series of spray nozzles evenly spaced across the lane to give uniformly overlapping coverage or a single spray nozzle which is mounted on a carriage which automatically traverses the lane width at a speed correlated with the forward movement of the overall frame. All spray nozzles shall be protected with wind screens. Calibrate the spraying system in accordance with ASTM D2995, Method A, for the rate of application required in paragraph: Membrane Curing. Any hand-operated sprayers allowed by that paragraph shall be compressed air supplied by a mechanical air compressor. If the curing equipment fails to apply an even coating of compound at the specified rate, it shall immediately be replaced.

2.11.6 Texturing Equipment

- a. General: Texturing equipment shall be as specified below. Before use, the texturing equipment shall be demonstrated on a test section, and the equipment shall be modified as necessary to produce the texture directed.
- b. Burlap Drag: A burlap drag shall be securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. Length of the material shall provide 24 to 36 inches dragging flat on the pavement surface. Width shall be at least equal to the width of the slab. The material shall be clean, reasonably new burlap, completely saturated with water before attachment to the frame, always resaturated before start of use, and kept clean and saturated during use. Burlap shall conform to AASHTO M 182, Class 3 or 4.

2.11.7 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-type concrete saws mounted on a wheeled chassis which can be easily guided to follow the required alignment. Blades shall be diamond tipped. If demonstrated to operate properly, abrasive blades may be used. Provide spares as required to maintain the required sawing rate.

All saws shall be capable of sawing to the full depth required. Early-entry saws may be used, subject to demonstration and approval of the Contracting Officer. No change to the initial sawcut depth shall be permitted.

2.11.8 Straightedge

Furnish and maintain at the job site, in good condition, one 12 foot straightedge for each paving train for testing the hardened portland cement concrete surfaces. These straightedges shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the

pavement.

2.12 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

2.12.1 Specified Flexural Strength

Specified flexural strength, R, for concrete is 650 psi at 90 days, as determined by tests made in accordance with ASTM C78/C78M of beams fabricated and cured in accordance with ASTM C192/C192M. Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus SCM by the mass equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 4 plus or minus 1.5 percentage points, at the point of placement. Air content shall be determined in accordance with ASTM C231/C231M. The maximum allowable slump of the concrete at the point of placement shall be 2 inches for pavement constructed with fixed forms. For slipformed pavement, at the start of the project, select a maximum allowable slump which will produce in-place pavement meeting the specified tolerances for control of edge slump. The selected slump shall be applicable to both pilot and fill-in lanes.

2.12.2 Concrete Temperature

The temperature of the concrete as delivered shall conform to the requirements of paragraphs, Paving in Hot Weather and Paving in Cold Weather, in PART 3. Temperature of concrete shall be determined in accordance with ASTM C1064/C1064M.

2.12.3 Concrete Strength for Final Acceptance

The strength of the concrete will be considered acceptable when the average equivalent 90-day flexural strengths for each lot are above the 'Specified Flexural Strength' as determined by correlation with 14-day compressive strength tests specified in paragraph: "Mixture Proportioning for Flexural Strength" below, and no individual set (2 specimens per subplot) in the lot are 25 psi or more below the equivalent 'Specified Flexural Strength'. If any lot or subplot, respectively, fails to meet the above criteria, the lot or subplot shall be removed and replaced at no additional cost to the Government. This is in addition to and does not replace the average strength required for day-to-day CQC operations as specified in paragraph: Average CQC Flexural Strength Required for Mixtures, below.

2.13 MIXTURE PROPORTIONS

2.13.1 Composition

Concrete shall be composed of cementitious material, water, fine and coarse aggregates, fibrillated polypropylen fibers and admixtures. Supplementary Cementitious Materials (SCM) choice and usage shall be in accordance with paragraph: Supplementary Cementitious Materials (SCM) Content. The total cementitious material content shall be at least 517 lb./cu. yd.. Admixtures shall consist of air entraining admixture and may also include, as approved, retarder and water-reducing admixture.

2.13.2 Proportioning Studies

Trial design batches, mixture proportioning studies, and testing requirements are the responsibility of the Contractor. Submit the results of the mixture proportioning studies signed and stamped by the registered professional engineer having technical responsibility for the mix design study, and submitted at least 30 days prior to commencing concrete placing operations. The results shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The recommended mixture proportions shall be accompanied by test results demonstrating that the proportions selected will produce concrete of the qualities indicated. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1, modified as necessary to accommodate flexural strength. Submit test results including:

- a. Coarse and fine aggregate gradations and plots.
- b. Combined aggregate gradation and coarseness/workability plots.
- c. Coarse aggregate quality test results, include deleterious materials.
- d. Fine aggregate quality test results.
- e. Mill certificates for cement and supplemental cementitious materials.
- f. Certified test results for air entraining, water reducing, retarding, non-chloride accelerating admixtures.
- g. Specified flexural strength, slump, and air content.
- h. Documentation of required average CQC flexural strength, Ra.
- i. Recommended proportions/volumes for proposed mixture and each of three trial water-cementitious materials ratios.
- j. Individual beam breaks.
- k. Flexural strength summaries and plots.
- l. Correlation ratios for acceptance testing and CQC testing.
- m. Historical record of test results, documenting production standard deviation (if available).

2.13.2.1 Water-Cement Ratio

At least three different water-cement ratios, which will produce a range of strength encompassing that required on the project, shall be used. The maximum allowable water-cement ratio required in paragraph: Specified Flexural Strength, above will be the equivalent water-cement ratio. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content.

2.13.2.2 Trial Mixture Studies

Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for each placing method (slip form, fixed form, or hand placement) proposed. The temperature of concrete in each trial batch shall be reported. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

2.13.2.3 Mixture Proportioning for Flexural Strength

The following step by step procedure shall be followed:

- a. Fabricate all beams for each mixture from the same batch or blend of batches. Fabricate and cure all beams in accordance with ASTM C192/C192M, using 6 x 6 inch steel beam forms.
- b. Cure test beams from each mixture for 3, 7, 14, and 90-day flexural tests; 6 beams to be tested per age.
- c. Test beams in accordance with ASTM C78/C78M.
- d. Using the average strength for each w/c at each age, plot all results from each of the three mixtures on separate graphs for w/c versus:
 - 3-day flexural strength
 - 7-day flexural strength
 - 14-day flexural strength
 - 90-day flexural strength
- e. From these graphs select a w/c that will produce a mixture giving a 90-day flexural strength equal to the required strength determined in accordance with the next paragraph.
- f. Using the above selected w/c, select from the graphs the expected 3, 7 and 14-day flexural strengths.
- g. From the above expected strengths for the selected mixture, determine the Ratio of the 7-day flexural strength of the selected mixture to the 90-day flexural strength of the mixture (for CQC control).
- h. From the above expected strengths for the selected mixture, determine the Ratio of the 14-day flexural strength of the selected mixture to the 90-day flexural strength of the mixture (for acceptance).
- i. If there is a change in materials, additional mixture design studies shall be made using the new materials and new Correlation Ratios shall be determined.
- j. No concrete pavement shall be placed until the Contracting Officer has approved the Contractor's mixture proportions. The approved water-cementitious materials ratio shall not exceed the maximum value specified in paragraph: Specified Flexural Strength, above and shall not be increased without the Contracting Officer's written approval.

2.13.3 Average CQC Flexural Strength Required for Mixtures

In order to ensure meeting the strength requirements specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES above, during production, the mixture proportions selected during mixture proportioning studies and used during construction shall produce a required average CQC flexural strength exceeding the specified strength, R, by the amount indicated below. This required average CQC flexural strength, R_a , will be used only for CQC operations as specified in paragraph: TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3 and as specified in the previous paragraph. During production, the required R_a shall be adjusted, as appropriate and as approved, based on the standard deviation of average 90-day strengths being attained during paving.

- a. From Previous Test Records: Where a concrete production facility has previous test records current to within 18 months, a standard deviation shall be established in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified flexural strength or strengths within 150 psi of the 90-day flexural strength specified for the proposed work, and shall consist of at least 30 consecutive tests. Perform verification testing, as directed by the Contracting Officer, to document the current strength. A strength test shall be the average of the strengths of two specimens made from the same sample of concrete and tested at 90 days. Required average CQC flexural strength, R_a , used as the basis for selection of concrete proportions shall be the value from the equation that follows, using the standard deviation as determined above:

$$R_a = R + 1.34S$$

Where: S = standard deviation
 R = specified flexural strength
 R_a = required average flexural strength

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

- b. Without Previous Test Records: When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength, R_a , shall be determined by adding 15 percent to the specified flexural strength, R .

2.14 Surface Sealer

Surface sealer shall be a low viscosity, colorless, aqueous solution of at least 9 percent sodium silicate developed as a penetrating sealer that will not produce a vapor barrier nor change the concrete surface appearance or "skid resistance" characteristics of pedestrian or vehicular traffic.

PART 3 EXECUTION

3.1 PREPARATION FOR PAVING

Before commencing paving, perform the following. If used, forms shall be

in place, cleaned, coated, and adequately supported. Any reinforcing steel needed shall be at the paving site. All transporting and transfer equipment shall be ready for use, clean, and free of hardened concrete and foreign material. Equipment for spreading, consolidating, screeding, finishing, and texturing concrete shall be at the paving site, clean and in proper working order. All equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the paving site, in proper working condition, and in sufficient amount for the entire placement.

3.1.1 Weather Precaution

When windy conditions during paving appear probable, equipment and material shall be at the paving site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.2 Proposed Techniques

Submit placing and protection methods; paving sequence; jointing pattern; data on curing equipment and profilographs; demolition of existing pavements, as specified; pavement diamond grinding equipment and procedures. Submit for approval the following items:

- a. A description of the placing and protection methods proposed when concrete is to be placed in or exposed to hot, cold, or rainy weather conditions.
- b. A detailed paving sequence plan and proposed paving pattern showing all planned construction joints; transverse and longitudinal dowel bar spacing; and identifying pilot lanes and hand placement areas. No deviation from the jointing pattern shown on the drawings shall be made without written approval of the Contracting Officer.
- c. Plan and equipment proposed to control alignment of sawn joints within the specified tolerances.
- d. Data on the curing equipment, media and methods to be used.
- e. Data on profilograph and methods to measure pavement smoothness.
- f. Pavement demolition work plan, presenting the proposed methods and equipment to remove existing pavement and protect pavement to remain in place.

3.2 CONDITIONING OF UNDERLYING MATERIAL

3.2.1 General Procedures

Underlying material, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. Prior to setting forms or placement of concrete, the underlying material shall be well drained and shall have been satisfactorily graded by string-line controlled, automated, trimmer/fine grader and uniformly compacted in accordance with the applicable Section of these specifications. The surface of the underlying material shall be tested as to crown, elevation, and density in advance of setting forms or of concrete placement using slip-form techniques. High areas shall be trimmed to proper elevation. Low areas shall be filled and

compacted to a condition similar to that of surrounding grade, or filled with concrete monolithically with the pavement. Low areas filled with concrete shall not be cored for thickness to avoid biasing the average thickness used for evaluation and payment adjustment. Any underlying material disturbed by construction operations shall be reworked and recompacted to specified density immediately in front of the paver. If a slipform paver is used, the same underlying material under the paving lane shall be continued beyond the edge of the lane a sufficient distance and shall be thoroughly compacted and true to grade to provide a suitable trackline for the slipform paver and firm support for the edge of the paving lane.

3.2.2 Traffic on Underlying Material

After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon. Subject to specific approval, crossing of the prepared underlying material at specified intervals for construction purposes may be permitted, provided rutting or indentations do not occur. The surface shall be reworked and reprepared to the satisfaction of the Contracting Officer before concrete is placed. No transporting equipment shall be allowed to operate on the prepared and compacted underlying material in front of the paver-finisher.

3.3 WEATHER LIMITATIONS

3.3.1 Placement and Protection During Inclement Weather

Do not commence placing operations when heavy rain or other damaging weather conditions appear imminent. At all times when placing concrete, maintain on-site sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Suspend placement of concrete whenever rain, high winds, or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete, or changes the water content of the surface concrete. All unhardened concrete shall be immediately covered and protected from the rain or other damaging weather. Any slab damaged by rain or other weather shall be completely removed full depth, by full slab width, to the nearest original joint, and replaced at the Contractor's expense as specified in paragraph: REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS below.

3.3.2 Paving in Hot Weather

When the ambient temperature during paving is expected to exceed 90 degrees F, the concrete shall be properly placed and finished in accordance with procedures previously submitted, approved, and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C1064/C1064M. Cooling of the mixing water or aggregates or placing in the cooler part of the day may be required to obtain an adequate placing temperature. Steel forms and reinforcing shall be cooled as needed to maintain steel temperatures below 120 degrees F. Transporting and placing equipment shall be cooled or protected if necessary to maintain proper concrete placing temperature. The finished surfaces of the newly laid pavement shall be kept damp by applying a fog spray (mist) with approved spraying equipment until the pavement is covered by the curing medium.

Maximum Allowable Concrete Placing Temperature	
Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature in Degrees F
Greater than 60	95
40-60	85
Less than 40	80

3.3.3 Prevention of Plastic Shrinkage Cracking

During weather with low humidity, and particularly with high temperature and appreciable wind, develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, halt further placement of concrete until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 4.2 of ACI 305R. In addition to the protective measures specified in the previous paragraph, the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. Apply monomolecular films after finishing is complete, do not use in the finishing process. When such water treatment is stopped, curing procedures shall be immediately commenced. Plastic shrinkage cracks that occur shall be repaired in accordance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.3.4 Paving in Cold Weather

Cold weather paving shall conform to ACI 306R. Special protection measures, as specified herein, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Placement of concrete shall not begin unless the ambient temperature is at least 35 degrees F and rising. Thereafter, placement of concrete shall be halted whenever the ambient temperature drops below 40 degrees F. When the ambient temperature is less than 50 degrees F, the temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. If allowed under paragraph: MIXTURE PROPORTIONS in PART 2, an accelerating admixture may be used when the ambient temperature is below 50 degrees F. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Remove pavement slabs damaged by freezing or falling below freezing temperature to full depth, by full slab width, to the nearest original joint, and replace at the Contractor's expense as specified in paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS.

3.4 CONCRETE PRODUCTION

Batching, mixing, and transporting equipment shall have a capacity sufficient to maintain a continuous, uniform forward movement of the paver

of not less than 2.5 feet per minute. Concrete transported in non-agitating equipment shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above 90 degrees F, the time shall be reduced to 30 minutes. Concrete transported in truck mixers shall be deposited in front of the paver within 90 minutes from the time cement has been charged into the mixer drum of the plant or truck mixer. If the ambient temperature is above 90 degrees F, the time shall be reduced to 60 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall be on approved forms and shall show at least the mass, or volume, of all ingredients in each batch delivered, and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government weekly, or as directed by the Contracting Officer.

3.4.1 Batching and Mixing Concrete

Scale pivots and bearings shall be kept clean and free of rust. Any equipment which fails to perform as specified shall immediately be removed from use until properly repaired and adjusted, or replaced.

3.4.2 Transporting and Transfer - Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. Concrete shall be deposited as close as possible to its final position in the paving lane. All equipment shall be operated to discharge and transfer concrete without segregation. In no case shall dumping of concrete in discrete piles be permitted. No transfer or spreading operation which requires the use of front-end loaders, dozers, or similar equipment to distribute the concrete will be permitted.

3.5 PAVING

3.5.1 General Requirements

Pavement shall be constructed with paving and finishing equipment utilizing rigid fixed forms or by use of slipform paving equipment. Paving and finishing equipment and procedures shall be capable of constructing paving lanes of the required width at a rate of at least 2.5 feet of paving lane per minute on a routine basis. Paving equipment and its operation shall be controlled, and coordinated with all other operations, such that the paver-finisher has a continuous forward movement, at a reasonably uniform speed, from beginning to end of each paving lane, except for inadvertent equipment breakdown. Backing the paver and refinishing a lane is not permitted. Remove and replace concrete refinished in this manner. Failure to achieve a continuous forward motion requires halting operations, regrouping, and modifying operations to achieve this requirement. Workmen with foreign material on their footwear or construction equipment that might deposit foreign material shall not be permitted to walk or operate in the plastic concrete. Where an open-graded granular base is required under the concrete, select paving equipment and procedures which will operate properly on the base course without causing displacement or other damage.

3.5.2 Consolidation

Concrete shall be consolidated with the specified type of lane-spanning,

gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches. Excessive vibration shall not be permitted. If the vibrators cause visible tracking in the paving lane, the paving operation shall be stopped and equipment and operations modified to prevent it. Concrete in small, odd-shaped slabs or in isolated locations inaccessible to the gang-mounted vibration equipment shall be vibrated with an approved hand-operated immersion vibrator operated from a bridge spanning the area. Vibrators shall not be used to transport or spread the concrete. Hand-operated vibrators shall not be operated in the concrete at one location for more than 20 seconds. Insertion locations for hand-operated vibrators shall be between 6 to 15 inches on centers. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) shall require the immediate stopping of the paving operation and approved adjustment of the equipment or procedures.

3.5.3 Operation

When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to provide a roll of concrete which will spill over the header. The amount of extra concrete shall be sufficient to prevent any slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. The spud vibrators in front of the paver shall be brought as close to the header as possible before they are lifted. Additional consolidation shall be provided adjacent to the headers by hand-manipulated vibrators. When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement. Screeds or extrusion plates shall be electronically controlled from the previously placed pavement so as to prevent them from applying pressure to the existing pavement and to prevent abrasion of the pavement surface. The overlapping area of existing pavement surface shall at all times be kept completely free of any loose or bonded foreign material as the paver-finisher operates across it. When the paver travels on existing pavement, approved provisions shall be made to prevent damage to the existing pavement. Pavers using transversely oscillating screeds shall not be used to form fill-in lanes that have widths less than a full width for which the paver was designed or adjusted.

3.5.4 Required Results

The paver-finisher, and its gang-mounted vibrators, together with its operating procedures shall be adjusted and operated and coordinated with the concrete mixture being used to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. The paver-finisher shall make only one pass across the pavement; multiple passes will not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing other than the use of cutting straightedges, except in very infrequent instances. If any equipment or operation fails to produce the above results, the paving

shall be stopped, the equipment shall be replaced or properly adjusted, the operation shall be appropriately modified, or the mixture proportions modified, in order to produce the required results before recommencing paving. No water, other than fog sprays (mist) as specified in paragraph: Prevention of Plastic Shrinkage Cracking above, shall be applied to the concrete or the concrete surface during paving and finishing.

3.5.5 Fixed Form Paving

Paving equipment for fixed-form paving and the operation thereof shall conform to the requirements of paragraph EQUIPMENT, and all requirements specified herein.

3.5.5.1 Forms for Fixed-Form Paving

- a. Straight forms shall be made of steel and shall be furnished in sections not less than 10 feet in length. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Wood forms for curves and fillets shall be made of well-seasoned, surfaced plank or plywood, straight, and free from warp or bend. Wood forms shall be adequate in strength and rigidly braced. Forms shall have a depth equal to the pavement thickness at the edge. Where the project requires several different slab thicknesses, forms may be built up by bolting or welding a tubular metal section or by bolting wood planks to the bottom of the form to completely cover the underside of the base of the form and provide an increase in depth of not more than 25 percent. The base width of the one-piece or built-up form shall be not less than eight-tenths of the vertical height of the form, except than forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Maximum vertical deviation of top of any side form, including joints, shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch.
- b. Form sections shall be tightly locked and shall be free from play or movement in any direction. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.
- c. Set forms for full bearing on foundation for entire length and width and in alignment with edge of finished pavement. Support forms during entire operation of placing, compaction, and finishing so that forms will not deviate vertically more than 0.01 foot from required grade and elevations indicated. Conformity to the alignment and grade elevations shown on the drawings shall be checked and necessary corrections shall be made immediately prior to placing the concrete. The forms shall be cleaned and oiled each time before concrete is placed. No concrete shall be placed until setting of forms has been checked and approved by the CQC team.
- d. Do not anchor guide rails for fixed form pavers into new concrete or existing concrete to remain.

3.5.5.2 Form Removal

Keep forms in place at least 12 hours after the concrete has been placed. When conditions are such that the early strength gain of the concrete is delayed, leave the forms in place for a longer time, as directed. Remove

forms by procedures that do not injure the concrete. Bars or heavy metal tools shall not be used directly against the concrete in removing the forms. Any concrete found to be defective after form removal shall be repaired promptly, using procedures specified or as directed.

3.5.6 Slipform Paving

3.5.6.1 General

Paving equipment for slipform paving and the operation thereof shall conform to the requirement of paragraph EQUIPMENT, and all requirements specified herein. The slipform paver shall shape the concrete to the specified and indicated cross section, meeting all tolerances, in one pass. The slipform paver shall finish the surface and edges so that only a very minimum isolated amount of hand finishing is required. If the paving operation does not meet the above requirements and the specified tolerances, immediately stop the operation, and regroup and replace or modify any equipment as necessary, modify paving procedures or modify the concrete mix, in order to resolve the problem. The slipform paver shall be automatically electronically controlled from a taut wire guideline for horizontal alignment and on both sides from a taut wire guideline for vertical alignment, except that electronic control from a ski operating on a previously constructed adjoining lane shall be used where applicable for either or both sides. Automatic, electronic controls for vertical alignment shall always be used on both sides of the lane. Control from a slope-adjustment control or control operating from the underlying material shall never be used. Side forms on slipform pavers shall be properly adjusted so that the finished edge of the paving lane meets all specified tolerances. Dowels in longitudinal construction joints shall be installed as specified below. The installation of these dowels by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete shall not be permitted.

3.5.6.2 Guideline for Slipform Paving

Accurately and securely install guidelines well in advance of concrete placement. Provide supports at necessary intervals to eliminate all sag in the guideline when properly tightened. The guideline shall be high strength wire set with sufficient tension to remove all sag between supports. Supports shall be securely staked to the underlying material or other provisions made to ensure that the supports will not be displaced when the guideline is tightened or when the guideline or supports are accidentally touched by workmen or equipment during construction. The appliances for attaching the guideline to the supports shall be capable of easy adjustment in both the horizontal and vertical directions. When it is necessary to leave gaps in the guideline to permit equipment to use or cross underlying material, provisions shall be made for quickly and accurately replacing the guideline without any delay to the forward progress of the paver. Supports on either side of the gap shall be secured in such a manner as to avoid disturbing the remainder of the guideline when the portion across the gap is positioned and tightened. The guideline across the gap and adjacent to the gap for a distance of 200 feet shall be checked for horizontal and vertical alignment after the guideline across the gap is tightened. Vertical and horizontal positioning of the guideline shall be such that the finished pavement shall conform to the alignment and grade elevations shown on the drawings within the specified tolerances for grade and smoothness. The specified tolerances are intended to cover only the normal deviations in the finished pavement that may occur under good supervision and do not apply

to setting of the guideline. The guideline shall be set true to line and grade.

3.5.6.3 Laser Controls

If the Contractor proposes to use any type of automatic laser controls, submit a detailed description of the system and perform a trial field demonstration in the presence of the Contracting Officer at least one week prior to start of paving. Approval of the control system will be based on the results of the demonstration and on continuing satisfactory operation during paving.

3.5.7 Placing Reinforcing Steel

The type and amount of steel reinforcement shall be as shown on the drawings.

3.5.7.1 Pavement Thickness Greater Than 12 Inches

For pavement thickness of 12 inches or more, the reinforcement steel shall be installed by the strike-off method wherein a layer of concrete is deposited on the underlying material, consolidated, and struck to the indicated elevation of the steel reinforcement. The reinforcement shall be laid upon the prestruck surface, and the remaining concrete shall then be placed and finished in the required manner. When placement of the second lift causes the steel to be displaced horizontally from its original position, provisions shall be made for increasing the thickness of the first lift and depressing the reinforcement into the unhardened concrete to the required elevation. The increase in thickness shall be only as necessary to permit correct horizontal alignment to be maintained. Any portions of the bottom layer of concrete that have been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with newly mixed concrete without additional cost to the Government.

3.5.7.2 Pavement Thickness Less Than 12 Inches

For pavements less than 12 inches thick, the reinforcement shall be positioned on suitable chairs or continuous mesh support devices securely fastened to the subgrade prior to concrete placement. Concrete shall be vibrated after the steel has been placed. Regardless of placement procedure, the reinforcing steel shall be free from coatings which could impair bond between the steel and concrete, and laps in the reinforcement shall be as indicated. Regardless of the equipment or procedures used for installing reinforcement, ensure that the entire depth of concrete is adequately consolidated.

3.5.8 Placing Dowels

The method used in installing and holding dowels in position shall ensure that the error in alignment of any dowel from its required horizontal and vertical alignment after the pavement has been completed will not be greater than 1/8 in. per ft. Except as otherwise specified below, horizontal spacing of dowels shall be within a tolerance of plus or minus 5/8 inch. The vertical location on the face of the slab shall be within a tolerance of plus or minus 1/2 inch). The vertical alignment of the dowels shall be measured parallel to the designated top surface of the pavement, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a

level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The horizontal alignment shall be checked with a framing square. Dowels shall not be placed closer than 0.6 times the dowel bar length to the planned joint line. If the last regularly spaced longitudinal dowel is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar length, but not closer than 6 inches to its nearest neighbor. Dowel interference at a transverse joint-longitudinal joint intersection shall be resolved by deleting the closest transverse dowel. Dowels shall be installed as specified in the following subparagraphs.

3.5.8.1 Contraction Joints

Dowels in longitudinal and transverse contraction joints within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires. At the Contractor's option, in lieu of the above, dowels in contraction joints shall be installed near the front of the paver by insertion into the plastic concrete using approved equipment and procedures. Approval will be based on the results of a preconstruction demonstration, showing that the dowels are installed within specified tolerances.

3.5.8.2 Construction Joints-Fixed Form Paving

Install dowels by the bonded-in-place method or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms. The spacing of dowels in construction joints shall be as indicated, except that, where the planned spacing cannot be maintained because of form length or interference with form braces, closer spacing with additional dowels shall be used.

3.5.8.3 Dowels Installed in Hardened Concrete

Install dowels in hardened concrete by bonding the dowels into holes drilled into the hardened concrete. The concrete shall have cured for 7 days or reached a minimum flexural strength of 450 psi before drilling commences. Holes 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur to the concrete joint face. Continuing damage shall require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of plus/minus 1/2 inch of the dimension shown on the drawings. Upon completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic grout retention ring fitted around the dowel. Dowels required to be installed in any joints between new and existing concrete shall be grouted in holes drilled in the existing concrete, all as

specified above.

3.5.8.4 Lubricating Dowel Bars

The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed.

3.6 FINISHING

Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Any operations which produce more than 1/8 inch of mortar-rich surface (defined as deficient in plus U.S. No. 4 sieve size aggregate) shall be halted immediately and the equipment, mixture, or procedures modified as necessary. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way, except for fog (mist) sprays specified to prevent plastic shrinkage cracking.

3.6.1 Machine Finishing With Fixed Forms

The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

3.6.2 Machine Finishing with Slipform Pavers

The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled nonrotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. If there is concrete slurry or fluid paste on the surface that runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such slurry. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry,

concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

3.6.3 Surface Correction and Testing

After all other finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of cutting straightedges. Such straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated with an internal vibrator, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straightedge and conforms to the surface requirements specified in paragraph: ACCEPTABILITY OF WORK in PART 1. This straightedging shall not be used as a replacement for the straightedge testing of paragraph: Surface Smoothness in PART 1. Long-handled, flat bull floats shall be used very sparingly and only as necessary to correct minor, scattered surface defects. If frequent use of bull floats is necessary, the paving operation shall be stopped and the equipment, mixture or procedures adjusted to eliminate the surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Extreme care shall be taken to prevent overfinishing joints and edges. The surface finish of the pavement shall be produced essentially by the finishing machine and not by subsequent hand finishing operations. All hand finishing operations shall be subject to approval and shall be modified when directed.

3.6.4 Hand Finishing

Use hand finishing operations only as specified below.

3.6.4.1 Equipment and Template

In addition to approved mechanical internal vibrators for consolidating the concrete, provide a strike-off and tamping template and a longitudinal float for hand finishing. The template shall be at least 1 foot longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom. Grate tampers (jitterbugs) shall not be used.

3.6.4.2 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. In addition to previously specified complete

coverage with handheld immersion vibrators, the entire surface shall be tamped with the strike-off and tamping template, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed, consolidated and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

3.6.5 Texturing

Before the surface sheen has disappeared and before the concrete hardens or curing compound is applied, the surface of the pavement shall be given a texture as described herein. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris.

3.6.5.1 Burlap Drag Surface

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with an approved burlap drag. The drag shall be operated with the fabric moist, and the fabric shall be cleaned or changed as required to keep clean. The dragging shall be done so as to produce a uniform finished surface having a fine sandy texture without disfiguring marks.

3.6.6 Edging

After texturing has been completed, the edge of the slabs along the forms, along the edges of slipformed lanes, and at the joints shall be carefully finished with an edging tool to form a smooth rounded surface of 1/8 inch radius. Tool marks shall be eliminated, and the edges shall be smooth and true to line. No water shall be added to the surface during edging. Extreme care shall be taken to prevent overworking the concrete.

3.6.7 Outlets in Pavement

Recesses for the tie-down anchors, lighting fixtures, and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area that will be within the requirements for plan grade and surface smoothness.

3.7 CURING AND SEALING

3.7.1 Protection of Concrete

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. If any selected method of curing does not afford the proper curing and protection against concrete cracking, the damaged pavement shall be removed and replaced, and another method of curing shall be employed as directed. Curing shall be accomplished by one of the following methods.

3.7.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, or until curing compound is applied, commencing immediately after finishing. If forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. Lap sheets to provide full coverage. Provide an approved work system to ensure that moist curing is continuous 24 hours per day and that the entire surface is wet.

3.7.3 Final Sealing

The concrete surface shall be sealed with a sodium silicate solution applied no earlier than 70 days after the pavement has been placed, but the joints must be properly sealed. The sodium silicate shall be applied prior to application of paint markings. Apply when ambient temperature is expected to be above 40 degrees F and the relative humidity is expected to be below 75% both during and for 24 hours application. Surface preparation, cleaning, and coat applications shall be in accordance with manufacturer's recommendations. However, as a minimum, the surface shall be cleaned by dry brooming, vacuuming, then wet brooming and thoroughly vacuuming and allowed to dry 24 hours prior to the initial application. Apply three coats using low pressure airless spray equipment that can insure uniform coverage. Each coat shall be applied to not cover more than 200 square feet per gallon. Excessive application can result in efflorescence and excess material shall be rinsed off with water and the area treated again once the area has dried. The second coat shall not be applied until the first has dried. Prior to and after each application evaluate the surface, with the Contracting Officer present, for proper coverage. After the last coat has dried for 24 hours, evaluate the surface for any excess silicate, indicated by residue or a "dusting" appearance. Remove any excess silicate by pressure wash, as it may affect adherence of subsequent paint markings. Protect treated areas from pedestrian traffic until dry and vehicular traffic for a minimum of 8 hours.

3.8 JOINTS

3.8.1 General Requirements for Joints

Joints shall conform to the locations and details indicated and shall be perpendicular to the finished grade of the pavement. All joints shall be straight and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch. Where any joint fails to meet these tolerances, the slabs adjacent to the joint shall be removed and replaced at no additional cost to the Government. No change from the jointing pattern shown on the drawings shall be made without written approval of the Contracting Officer. Joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 32 13 73 COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS.

3.8.2 Longitudinal Construction Joints

Dowels shall be installed in the longitudinal construction joints, or the

edges shall be thickened as indicated. Dowels shall be installed as specified above. After the end of the curing period, longitudinal construction joints shall be sawed to provide a groove at the top for sealant conforming to the details and dimensions indicated.

3.8.3 Transverse Construction Joints

Transverse construction joints shall be installed 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. The transverse construction joint shall be installed at a planned transverse joint. Transverse construction joints shall be constructed by utilizing headers or by paving through the joint, then full-depth sawcutting the excess concrete. Pavement shall be constructed with the paver as close to the header as possible, and the paver shall be run out completely past the header. Transverse construction joints installed at a planned transverse joint shall be constructed as shown or, if not shown otherwise, shall be dowelled in accordance with paragraph: Dowels Installed in Hardened Concrete, or paragraph: Fixed Form Paving above.

3.8.4 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using joint filler of the type, thickness, and width indicated, and shall be installed to form a complete, uniform separation between the structure and the pavement. The filler shall be attached to the original concrete placement with adhesive or other fasteners and shall extend the full slab depth. After placement and curing of the adjacent slab, sawcut the sealant reservoir depth from the filler. Adjacent sections of filler shall be fitted tightly together, and the filler shall extend across the full width of the paving lane or other complete distance in order to prevent entrance of concrete into the expansion space. Edges of the concrete at the joint face shall be finished with an edger with a radius of 1/8 inch.

3.8.5 Contraction Joints

Construct transverse and longitudinal contraction joints by sawing an initial groove in the concrete with a 1/8 inch blade to the indicated depth. During sawing of joints, and again 24 hours later, the CQC team shall inspect all exposed lane edges for development of cracks below the saw cut, and shall immediately report results to the Contracting Officer. If the Contracting Officer determines that there are more uncracked joints than desired, the Contractor will be directed to saw succeeding joints 25 percent deeper than originally indicated at no additional cost to the Government. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to the early sawing, and sawing shall be delayed if undercutting is sufficiently deep to cause structural weakness or excessive roughness in the joint. The sawing operation shall be carried on as required during both day and night regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Adequate lighting shall be provided for night work. Illumination using vehicle headlights will not be permitted. A chalk line or other suitable guide

shall be used to mark the alignment of the joint. Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred near the planned joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water and vacuumed until all waste from sawing is removed from the joint and adjacent concrete surface. The surface shall be resprayed with curing compound as soon as free water disappears. Necessary precautions shall be taken to insure that the concrete is properly protected from damage and cured at sawed joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord backer rod before the concrete in the region of the joint is resprayed with curing compound, and shall be maintained until removed immediately before sawing the joint sealant reservoir. The exposed saw cuts on the faces of pilot lanes shall be sealed with bituminous mastic or masking tape. After expiration of the curing period, the upper portion of the groove shall be widened by sawing with ganged diamond saw blades to the width and depth indicated for the joint sealer. The reservoir shall be centered over the initial sawcut.

3.8.6 Thickened Edge Joints

Construct thickened edge joints as indicated on the drawings. Underlying material in the transition area shall be graded as shown and shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

3.9 REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS

3.9.1 General Criteria

New pavement slabs that are broken, have spalled edges, or contain cracks shall be removed and replaced or repaired, as specified at no cost to the Government. Removal of partial slabs is not permitted. Prior to fill-in lane placement, pilot lane slabs with spalls, regardless of spall size, shall be sawn full depth to remove the spalled face. All other slabs shall be removed, as directed. The Contracting Officer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be at least 6 inch diameter, and shall be drilled and backfilled with an approved non-shrink concrete. Perform drilling of cores and refilling holes at no expense to the Government.

3.9.2 Slabs with Cracks

Clean cracks that do not exceed 2 inches in depth; then pressure injected full depth with epoxy resin, Type IV, Grade 1. Remove slabs containing cracks deeper than 2 inches.

3.9.3 Removal and Replacement of Full Slabs

Where it is necessary to remove full slabs, removal shall be in accordance with paragraph: Removal of Existing Pavement Slab below. Removal and replacement shall be full depth, by full width of the slab, and the limit of removal shall be normal to the paving lane and extend to each original joint. Dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified in paragraph PLACING DOWELS above. Original damaged dowels shall be cut off

flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four edges of the new slab shall thus contain dowels. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material shall be recompact and shaped as specified in the appropriate section of these specifications, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

3.9.4 Repairing Spalls Along Joints

Where directed, spalls along joints of new slabs, along edges of adjacent existing concrete, and along parallel cracks shall be repaired by first making a vertical saw cut at least 1 inch outside the spalled area and to a depth of at least 2 inches. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and into at least 1/2 inch of visually sound concrete. Spalls along joints to be sealed with compression seals shall be sawn, chipped out, and repaired to a depth to restore the full joint-face support. The cavity thus formed shall be thoroughly cleaned with high pressure water jets supplemented with oil-free compressed air to remove all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The prepared cavity shall be filled with: Portland cement concrete or latex modified mortar for larger cavities, those more than 1/3 cu. ft. in size after removal operations; Portland cement mortar for cavities between 0.03 cu. ft. and 1/3 cu. ft.; and epoxy resin mortar or epoxy resin or latex modified mortar for those cavities less than 0.03 cu. ft. in size. Portland cement concretes and mortars shall be very low slump mixtures, 1/2 inch slump or less, proportioned, mixed, placed, consolidated by tamping, and cured, all as directed. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the Contracting Officer. Proprietary patching materials may be used, subject to approval by the Contracting Officer. The epoxy resin materials shall be placed in the cavity in layers not over 2 inches thick. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin material does not exceed 140 degrees F at any time during hardening. Mechanical vibrators and hand tampers shall be used to consolidate the concrete or mortar. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints. The reservoir shall be thoroughly cleaned and then sealed with the sealer specified for the joints. In lieu of sawing, spalls not adjacent to joints and popouts, both less than 6 inches in maximum dimension, may be prepared by drilling a core 2 inches in diameter greater than the size of the defect, centered over the defect, and 2 inches deep or 1/2 inch into sound concrete, whichever is greater. The core hole shall be repaired as specified above for other spalls.

3.9.5 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Diamond grind slabs containing weak surfaces less than 1/4 inch thick to remove the weak surface. Diamond grinding shall be in accordance with paragraph DIAMOND GRINDING OF PCC SURFACES in PART 1. All ground areas shall meet the thickness, smoothness and grade criteria of paragraph ACCEPTANCE REQUIREMENTS in PART 1. Remove and replace slabs containing weak surfaces greater than 1/4 inch thick.

3.9.6 Repair of Pilot Lane Vertical Faces

Excessive edge slump and joint face deformation shall be repaired in accordance with paragraph EDGE SLUMP AND JOINT FACE DEFORMATION in PART 1. Inadequate consolidation (honeycombing or air voids) shall be repaired by saw cutting the face full depth along the entire lane length with a diamond blade. Obtain cores, as directed, to determine the depth of removal.

3.10 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

Existing concrete pavement shall be removed at locations indicated on the drawings. Prior to commencing pavement removal operations, inventory the pavement distresses (cracks, spalls, and corner breaks) along the pavement edge to remain. After pavement removal, the remaining edge shall again be surveyed to quantify any damage caused by Contractor's removal operations. Perform both surveys in the presence of the Contracting Officer. Repairs shall be made as indicated and as specified herein. All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface, forming rectangular areas.

3.10.1 Removal of Existing Pavement Slab

When existing concrete pavement is to be removed and adjacent concrete is to be left in place, the joint between the removal area and adjoining pavement to stay in place shall first be cut full depth with a standard diamond-type concrete saw. Next, a full depth saw cut shall be made parallel to the joint at least 24 inches from the joint and at least 6 inches from the end of any dowels. This saw cut shall be made with a diamond saw as specified in paragraph: Sawing Equipment. All pavement to be removed beyond this last saw cut shall be removed in accordance with the approved demolition work plan. All pavement between this last saw cut and the joint line shall be removed by carefully pulling pieces and blocks away from the joint face with suitable equipment and then picking them up for removal. In lieu of this method, this strip of concrete may be carefully broken up and removed using hand-held jackhammers, 30 lb or less, or other approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to remain in place. In lieu of the above specified removal method, the slab may be sawcut full depth to divide it into several pieces and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and safe lifting devices used for attachment to the slab.

3.10.2 Edge Repair

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Slabs which are damaged during construction shall be removed and replaced as directed by the Contracting Officer at no cost to the Government. Repair of previously existing damage areas will be considered a subsidiary part of concrete pavement construction.

3.10.2.1 Spall Repair

Unless otherwise directed by the Contracting Officer, damaged slabs with spalls, regardless of spall size, shall be sawn full depth on the exposed face to remove the spalled face. Repair materials and procedures shall be as previously specified in paragraph: Repairing Spalls Along Joints.

3.10.2.2 Underbreak and Underlying Material

All underbreak shall be repaired by removal and replacement of the damaged slabs in accordance with paragraph: Removal and Replacement of Full Slabs above. The underlying material adjacent to the edge of and under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient underlying material shall be kept in place outside the joint line to completely prevent disturbance of material under the pavement which is to remain in place. Any material under the portion of the concrete pavement to remain in place which is disturbed or loses its compaction shall be carefully removed and replaced with concrete.

3.11 PAVEMENT PROTECTION

Protect the pavement against all damage prior to final acceptance of the work by the Government. Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least 14 days old, or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected, the concrete has attained a minimum field cured flexural strength of 550 psi. and approved means are furnished to prevent damage to the slab edge. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately upon occurrence. Special care shall be used where Contractor's traffic uses or crosses active airfield pavement. Power broom other existing pavements at least daily when traffic operates. For fill-in lanes, equipment shall be used that will not damage or spall the edges or joints of the previously constructed pavement.

3.12 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

3.12.1 Testing and Inspection by Contractor

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials (cement, GGBF and pozzolan), and concrete to determine compliance with the specifications. Provide

facilities and labor as may be necessary for procurement of representative test samples. Furnish sampling platforms and belt templates to obtain representative samples of aggregates from charging belts at the concrete plant. Samples of concrete shall be obtained at the point of delivery to the paver. Testing by the Government will in no way relieve the Contractor of the specified testing requirements. Perform the inspection and tests described below, and based upon the results of these inspections and tests, take the action required and submit reports as required. This testing shall be performed regardless of any other testing performed by the Government, either for pay adjustment purposes or for any other reason.

3.12.2 Testing and Inspection Requirements

Contractor CQC sampling, testing, inspection and reporting shall be in accordance with the following Table.

TABLE 6 CONTRACTOR TESTING AND INSPECTION REQUIREMENTS			
Frequency	Test Method	Control Limit	Corrective Action
Fine Aggregate Gradation and Fineness Modulus			
2 per lot	ASTM C136 sample at belt	9 of 10 tests vary <0.15 from average	
		Outside limits on any sieve	Retest
		2nd failure	Stop, repair, retest
Coarse Aggregate Gradation			
2 per lot	ASTM C136 sample at belt	Outside limits on any sieve	Retest
		2nd failure	report to COR, correct
		2 consecutive avgs of 5 tests out	report to COR, stop ops, repair, retest
Workability Factor and Coarseness Factor Computation			
Same as C.A. and F.A.	see paragraph AGGREGATES	Use individual C.A. and F.A. gradations. Combine using batch ticket percentages. Tolerances: +/- 3 points on WF; +/- 5 points on CF from approved mix design values	Check batching tolerances, recalibrate scales
Aggregate Deleterious, Quality, and ASR Tests			

TABLE 6 CONTRACTOR TESTING AND INSPECTION REQUIREMENTS			
Frequency	Test Method	Control Limit	Corrective Action
Every 30 days	see paragraph AGGREGATES		Stop production, retest, replace aggregate. Increase testing interval to 90 days if previous 2 tests pass
Plant - Scales, Weighing Accuracy			
Monthly	NRMCA QC 3		Stop plant ops, repair, recalibrate
Plant - Batching and Recording Accuracy			
Weekly	Record/Report	Record required/recorded/actual batch mass	Stop plant ops, repair, recalibrate
Plant - Batch Plant Control			
Every lot	Record/Report		Record type/amt of each material per lot
Plant - Mixer Uniformity - Stationary Mixers			
Every 4 months during paving	COE CRD-C 55	After initial approval, use abbreviated method	Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest
Plant - Mixer Uniformity - Truck Mixers			
Every 4 months during paving	ASTM C94/C94M	Random selection of truck.	Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest
Concrete Mixture - Air Content			
When test specimens prepared + 2 random	ASTM C231/C231M sample at paving site	Individual test control chart: Warning +/-1.0	Adjust AEA, retest
		Individual test control chart: Action +/-1.5	Halt operations, repair, retest
		Range between 2 consecutive tests: Warning +2.0	Recalibrate AEA dispenser
		Range between 2 consecutive tests: Action +3.0	Halt operations, repair, retest

TABLE 6 CONTRACTOR TESTING AND INSPECTION REQUIREMENTS			
Frequency	Test Method	Control Limit	Corrective Action
Concrete Mixture - Unit Weight and Yield			
Same as Air Content	ASTM C138/C138M sample at paving site	Individual test basis: Warning Yield -0/+1 percent	Check batching tolerances
		Individual test basis: Action Yield -0/+5 percent	Halt operations
Concrete Mixture - Slump			
When test specimens prepared + 4 random	ASTM C143/C143M sample at paving site	Individual test control chart: Upper Warning - 1/2 inch below max	Adjust batch masses within max W/C ratio
		Individual test control chart: Upper Action - maximum allowable slump	Stop operations, adjust, retest
		Range between each consecutive test: 1-1/2 inches	Stop operations, repair, retest
Concrete Mixture - Temperature			
When test specimens prepared	ASTM C1064/C1064M sample at paving site	See paragraph WEATHER LIMITATIONS	
Concrete Mixture - Strength			
8 per lot	ASTM C31/C31M sample at paving station	See paragraph CONCRETE STRENGTH TESTING for CQC	
Paving - Inspection Before Paving			
Prior to each paving operation	Report	Inspect underlying materials, construction joint faces, forms, reinforcing, dowels, and embedded items	
Paving - Inspection During Paving			
During paving operation		Monitor and control paving operation, including placement, consolidation, finishing, texturing, curing, and joint sawing.	

TABLE 6 CONTRACTOR TESTING AND INSPECTION REQUIREMENTS			
Frequency	Test Method	Control Limit	Corrective Action
Paving - Vibrators			
Weekly during paving	COE CRD-C 521	Test frequency (in concrete), and amplitude (in air), measure at tip/head and average.	Repair or replace defective vibrators.
Moist Curing			
2 per lot, min 4 per day	Visual		Repair defects, extend curing by 1 day
Membrane Compound Curing			
Daily	Visual	Calculate coverage based on quantity/area	Respray areas where coverage defective. Recalibrate equipment
Cold Weather Protection			
Once per day	Visual		Repair defects, report conditions to COR

3.12.3 Concrete Strength Testing for Contractor CQC

Contractor Quality Control operations for concrete strength shall consist of the following steps:

- a. Take samples for strength tests at the paving site. Fabricate and cure test beams in accordance with ASTM C31/C31M; test them in accordance with ASTM C78/C78M.
- b. Fabricate and cure 2 test beams per subplot from the same batch or truckload and at the same time acceptance beams are fabricated and test them for flexural strength at 7-day age.
- c. Average all 8 flexural tests per lot. Convert this average 7-day flexural strength per lot to equivalent 90-day flexural strength using the Correlation Ratio determined during mixture proportioning studies.
- d. Compare the equivalent 90-day flexural strength from the conversion to the Average Flexural Strength Required for Mixtures from paragraph of same title.
- e. If the equivalent average 90-day strength for the lot is below the Average Flexural Strength Required for Mixtures by 69 psi flexural strength or more, at any time, adjust the mixture to increase the strength, as approved.
- f. The Contractor's CQC testing agency shall maintain up-to-date control charts for strength, showing the 7-day CQC flexural strength and the 90-day flexural strength (from acceptance tests) of each of these for

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each lot.

3.12.4 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. Prepare a weekly report for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, make daily reports of pertinent temperatures. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

-- End of Section --