
USACE / NAVFAC / AFCEA UFGS-02983 (August 2004)

Preparing Activity: NAVFAC Superseding
UFGS-02983N (February 2003)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMLR dated 22 December 2004

Latest change indicated by CHG tags.

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SECTION 02983

PARTIAL DEPTH PATCHING OF RIGID PAVEMENT
08/04

NOTE: This guide specification covers the requirements for repair of spalls, popouts, and other partial depth patching of portland cement concrete airfield and vehicular pavements with portland cement concrete.

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

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

Use of electronic communication is encouraged.

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

NOTE: This specification is not intended for repair of heat resistant concrete pavements, or for rapid repair of PCC that must be returned to service in a short time. See second note in paragraph entitled "Cement." For full depth repairs of PCC pavements, use Section 02752 PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES.

NOTE: INSTRUCTIONS TO VIEW/PRINT GRAPHICS

FROM CCB DISKS OR WEBSITE:

1. Put in Disk A and go to CCB Program, or go to www.ccb.org and sign in.

2. Choose Browse CCB Libraries.
3. Choose Specifications Library.
4. Choose NAVFAC Specifications.
5. Choose NAVFAC Specifications graphics.
6. Choose Navy Graphics Table of Contents and then go to the specified Guide Spec and click on the needed graphic/table.

NOTE: The following information should be shown on the drawings:

1. Plans showing layout and identification of each joint and joint type. Include identification of joints with dowels and with tie-bars. Identify pavements or slabs that are reinforced and the reinforcement. Include location of each random crack where repairs are needed.

2. Show approximate location, length and width of each spall and location and size (usually average diameter) of each popout. Dimensions of spalls and popouts need not be to scale. Identify by legend and symbol whether spall repair needed is approximately rectangular or pentagonal (triangular spall). Any special or unusual shapes or partial depth repairs should be specifically detailed to suit.

3. If required spall repairs are extensive, a schedule showing scope of work and quantities for bid purposes should be provided in addition to the location plans. Schedule should identify feature areas where spalls or groups of spalls are located, area of spall repairs in square meter square feet, location and number or area of popouts, and other PCC pavement repairs which may be a part of the contract.

4. Provide details of spall and popout repairs. See three attached sketches for suggested details to be included on project drawings. Note that these sketches include the required 50 mm 2 inch minimum horizontal clearance of unsound concrete in the length and width dimensions shown.

5. In conducting field surveys to locate and size spalls needing repair, each suspect area must be sounded to determine extent of damage. Sounding may be done with a steel hammer, steel rod, or other suitable means for locating hollows. It is not unusual for delamination in a spall area to extend well beyond that visually obvious. Each previous partial depth patch should also be sounded for present condition.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in
project specifications need not be more current than
provided by the latest guide specification. Use of
SpecsIntact automated reference checking is
recommended for projects based on older guide
specifications.

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 (1991; R 2000) Burlap Cloth Made from Jute or Kenaf

ASTM INTERNATIONAL (ASTM)

ASTM C 131 (2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (2004) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 143 (1998) Slump of Hydraulic Cement Concrete

ASTM C 150 (2004a) Portland Cement

ASTM C 171 (2003) Sheet Materials for Curing Concrete

ASTM C 173 (1994a) Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C 231 (2004) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 260 (2001) Air-Entraining Admixtures for Concrete

ASTM C 309 (2003) Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 31/C 31M (2003a) Making and Curing Concrete Test Specimens in the Field

ASTM C 33 (2003) Concrete Aggregates

ASTM C 39 (1993a) Compressive Strength of Cylindrical Concrete Specimens

ASTM C 494 (1992) Chemical Admixtures for Concrete

ASTM C 94	(1994) Ready-Mixed Concrete
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.2 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Absorbent curing material

Joint filler
[Joint sealant]
SD-05 Design Data
Concrete Mix Design
SD-06 Test Reports
Laboratory Test Results
Aggregates gradation
Cement
Concrete slump
Concrete air content
Concrete strength (cylinder)
SD-07 Certificates
Cement
Aggregates
Admixtures
Absorbent curing material
Liquid membrane-forming compound
Sheet curing material
Joint filler
[Joint sealant]

Manufacturer's certifications may be submitted rather than laboratory test results for the materials listed. Certify compliance with the appropriate specification referenced herein. Place no materials without prior approval from the Contracting Officer.

1.3 DELIVERY AND STORAGE

1.3.1 Cement

Furnish in bulk or in suitable bags used for packing cements. Store and protect in a weathertight manner to prevent absorption of moisture.

1.3.2 Aggregates

Handle and store aggregates in a manner to avoid breakage, segregation, or contamination by foreign materials. Do not mix or store aggregates from different sources in same stockpile nor use alternatively in same concrete

mix.

1.4 SITE CONDITIONS

1.4.1 Weather Limitations

Do not place concrete when weather conditions detrimentally affect the quality of the finished product. Do not place any repair materials when the repair surface is wet or moist. Do not place concrete when the air temperature is below 10 degrees C 50 degrees F in the shade. When air temperature is likely to exceed 32 degrees C 90 degrees F the concrete shall have a temperature not exceeding 32 degrees C 90 degrees F when deposited, and the finished surface of such placed concrete shall be kept damp with a water fog until the approved curing medium is applied.

1.4.2 Bid Quantity

The approximate location and size [and total area] of spalls [and popouts] to be repaired are shown on the drawings. Determine and mark in the field the exact location and size. If location or size determined by the Contractor differs from that shown on the drawings, notify the Contracting Officer. The actual location and size shall be approved by the Contracting Officer before the repair work is started. Base bids on the repair quantities shown [by schedule] on the drawings.

1.5 QUALITY ASSURANCE

1.5.1 Required Data

Submit proposed concrete mix design at least 30 days prior to placement. The mix design shall be evaluated and certified by an approved engineering testing laboratory, and shall indicate the weight of each ingredient of the mixture, aggregate gradation, slump, air content, water-cement ratio, and 7-day and 28-day compressive strength test results. Include a complete list of materials including admixtures and applicable reference specifications. Place no concrete prior to approval of the proposed mix design. No deviation from the approved mix design will be permitted without prior approval.

1.5.2 Required Test Results

Within 24 hours of physical completion of laboratory testing, submit copies of test results for approval.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cement

NOTE: Specify type of portland cement to suit project requirement and location. Specify Type III cement only when pavements are expected to be returned to active service in less than 7 calendar days. Specify type of cement, including low-alkali, to suit local aggregate conditions. Types of cements other than those bracketed may be specified provided the designer knows that they have a

satisfactory service record in partial depth repairs.

NOTE: In addition to portland cement, there are many types of cements, polymers, blends and modifications thereto, and other cementitious materials available for patching PCC. Some have performed very well in some cases but failed in others. Many are unusually sensitive to moisture tolerances, temperature conditions, mixing criteria, curing techniques, quality of workmanship, or other critical processes. Some are suitable for use during cold weather. Many will develop a superfluous level of strength in excess of that needed for patching PCC pavements. Many are not as durable as PCC. Some have been introduced fairly recently and do not have a long term performance record. For patching PCC, most are less compatible, and more expensive than portland cement. Use of any of these materials will depend on the knowledge of the design engineer as well as project requirements, and may necessitate significant modifications to this guide specification and attached details.

ASTM C 150 Type [I or II.] [III.]

2.1.2 Water

Clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Water approved by Public Health authorities for domestic consumption may be accepted for use without being tested. Water that is of questionable quality shall be subject to the acceptance criteria of Table 1 of ASTM C 94.

2.1.3 Aggregates

NOTE: Do not allow types of aggregate at locations where they have an unsatisfactory performance record. Specify aggregates to be washed in areas where deleterious substances or organic impurities are a problem.

NOTE: The 19 mm 3/4 inch nominal maximum dimension for coarse aggregate specified below may be excessive for shallow spalls. If the project contains numerous shallow depth 50 mm 2 inch spalls, the designer should specify a suitable gradation based on locally available aggregate.

2.1.3.1 Coarse Aggregate

Crushed stone [or crushed gravel] conforming to ASTM C 33, except as otherwise modified herein. [Crushed or uncrushed gravel shall not be

permitted.] Aggregate shall be clean, hard, unweathered, uncoated, and non-reactive. [Coarse aggregate shall be washed before use.] Requirements of Table 3 of ASTM C 33 shall apply, except the abrasion loss shall not exceed 40 percent when tested in accordance with ASTM C 131, and the maximum allowable percentage for clay lumps and friable particles shall be [1.5] [_____] percent. Coarse aggregate when tested, in accordance with ASTM C 136, shall conform to the following gradation:

Sieve designation U.S. Standard Square Mesh	Percentage by weight passing Individual Sieves	
25.0 mm	[100	[_____]
19.0 mm	90-100	_____
9.5 mm	20-55	_____
4.75 mm	0-10	_____
2.38 mm	0-5]	_____]

Sieve designation U.S. Standard Square Mesh	Percentage by weight passing Individual Sieves	
1 inch	[100	[_____]
3/4 inch	90-100	_____
3/8 inch	20-55	_____
No. 4	0-10	_____
No. 8	0-5]	_____]

2.1.1.3.2 Fine Aggregate

Natural sand, manufactured sand, or a combination thereof, conforming to ASTM C 33, including provisions therein for other gradations. [Wash fine aggregate before use.]

2.1.1.4 Admixtures

2.1.1.4.1 Air-Entraining Admixture

ASTM C 260.

2.1.1.4.2 Chemical Admixtures

ASTM C 494. Where not shown or specified, the use of admixtures is subject to written approval of the Contracting Officer.

2.1.1.5 Curing

2.1.1.5.1 Burlap

AASHTO M 182.

2.1.1.5.2 Liquid Membrane-Forming Compound

ASTM C 309, Type 2, Class B.

2.1.1.5.3 Sheet Materials

ASTM C 171, type optional, color white.

2.1.6 Joint Sealant

Shall be as [indicated on the drawings.] [specified in Section 02982 RESEALING OF JOINTS IN RIGID PAVEMENT.]

2.1.7 Joint Filler

ASTM D 1751 or ASTM D 1752, Type II[or 100% recycled material meeting ASTM D 1752, subparagraphs 5.1 to 5.4].

2.2 EQUIPMENT

Assemble dependable and sufficient equipment before the start of repairs to permit thorough inspection, calibration of weighing and measuring devices, adjustment of parts, and the making of any repairs that may be required. Maintain the equipment in good working condition.

2.3 MIXES

2.3.1 Portland Cement Concrete

Design the concrete mixture to produce a minimum compressive strength of [35] [_____] MPa [5,000] [_____] psi at 28 days of age, determined in conformance with ASTM C 39 and to provide an air content by volume of [5] [_____] percent, plus or minus 1 1/2 percent, based on measurements made on concrete immediately after discharge from the mixer in conformance with ASTM C 231. The range of slump shall be 13 to 50 mm 1/2 to 2 inches when tested in accordance with ASTM C 143 except that maximum slump may be increased to 100 mm 4 inches when the Contractor has included an approved water-reducing, high range, admixture conforming to ASTM C 494 in the mix design. To minimize drying shrinkage, the maximum water-cement ratio by weight shall be 0.45.

NOTE: Specify type of portland cement to suit project requirement and location. Specify Type III cement only when pavements are expected to be returned to active service in less than 7 calendar days. Specify type of cement, including low-alkali, to suit local aggregate conditions. Types of cements other than those bracketed may be specified provided the designer knows that they have a satisfactory service record in partial depth repairs. Applicable to paragraphs "Sand-Cement Grout Bonding" and "Sand-Cement Mortar for Filling Small Popouts."

2.3.2 Sand-Cement Grout Bonding Course

Shall consist of equal parts of Type [I or II], [III] portland cement and sand by dry weight, thoroughly mixed with water to yield a thick, creamy mixture. The water-cement ratio shall not be greater than 0.62 by weight. The sand shall meet the requirements of the fine aggregate specified herein, except 100 percent shall pass a 2.36 mm No. 8 sieve.

2.3.3 Sand-Cement Mortar for Filling Small Popouts

Shall consist of one part Type [I or II], [III] portland cement and two

parts sand by dry weight, thoroughly mixed with water to yield a thick, suitable mix. The water-cement ratio shall not be greater than 0.45 by weight. The sand shall meet the requirements of the fine aggregate specified herein.

PART 3 EXECUTION

3.1 PREPARATION

NOTE: Specify minimum depth of removal of existing PCC. A 50 mm 2 inch minimum depth is usually satisfactory and should be specified, except where local conditions indicate 50 mm 2 inchthick shallow patches have an unsatisfactory service record. When required depth of repair is known or reasonably expected to exceed one-half the pavement thickness, full depth repairs should be required as specified in Section 02752 PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES.

3.1.1 Preparation of Existing Surfaces

In the area to be patched, [except popouts,] remove existing concrete to a minimum depth of [50] [_____] mm [2] [_____] inches below the pavement surface adjacent to spalls and to such additional depth where necessary to expose a surface of sound, unweathered concrete that is uncontaminated by sealants, oils, greases, or deicing salts or solutions. Make a vertical saw cut at least 50 mm 2 inches deep and 50 mm 2 inches outside of the area needing repair. Accomplish concrete removal in spalled areas with light, hand-held, high-frequency chipping hammers weighing not more than 14 kg 30 pounds or other approved hand tools. Do not use jack hammers weighing more than 14 kg 30 pounds and do not use pavement breaker devices mounted on or pulled by mobile equipment. Clean the cavity surface by sandblasting, blowing with compressed air, sweeping, and vacuums. Use sandblasting to remove all traces of sealer, oils, grease, rust, and other contaminants.

3.1.2 Dowels, Tie Bars, and Reinforcement

Cut and remove to minimum dimensions indicated existing dowels and tie bars exposed in joints adjacent to the spall cavity. Cutting shall be done by saws, torch, or other approved means; do not allow torch or other cutting methods to damage concrete to remain. Clean to bare metal by sandblasting any existing reinforcement or dowels remaining exposed in the repair area. Remove any reinforcement that cannot be properly re-embedded in the new repair concrete. Cut and remove at the joint not less than 13 mm 1/2 inch of existing exposed reinforcement that is continuous through the repair area and is embedded in the adjacent slab.

3.1.3 Preparation of Joints Adjacent to Spalls

Remove existing joint sealing and joint filler materials. Saw as indicated and install insert, cut to appropriate dimensions, to prevent contact between new patch material and existing concrete at existing joints. At the option of the Contractor, a bead of approved caulking material may be installed to preclude new patching material from getting around insert. Clean up any caulking material accidentally deposited on the prepared spall surface.

3.1.4 Bonding Course

Immediately prior to placing concrete, clean the previously prepared surfaces with a high pressure air jet, brushing, or vacuum to remove all loose and foreign material. Coat the clean and dry surface including sawed faces with an approximate 2 mm 1/16 inch thick coat of sand-cement grout. Place the grout just prior to concrete placement and scrub with stiff bristle brushes to fill all voids and crevices in the spall cavity surface. Apply additional brush coats as needed to obtain the required thickness. The concrete patch material must be placed before the grout dries or sets. Remove dried or hardened grout by sandblasting and re-coat the cavity with fresh grout before placing concrete patch material.

3.1.5 Popout Repair

**NOTE: Delete this paragraph if no popout repairs
are included in the project. Note the first
sentence for definition of popouts.**

Popouts, as used herein, are pavement surface defects caused by deterioration of unsatisfactory coarse aggregate, decaying of organic material such as wood or roots, mechanical accidents, or other reasons. Most popouts are indicated on the drawings by average diameter but the actual surface configuration will vary from circular to polygonal. Repair popouts as indicated using sand-cement mortar for small popouts (less than 50 mm 2 inches in width or depth) and portland cement concrete for large popouts. Popout cavities shall be cleaned of all dirt and contaminants prior to filling. As indicated on drawings, prepare popout areas by chipping the concrete to eliminate feather edging of the mortar or concrete repair material. After preparing large popout cavities, coat with sand-cement grout bonding course immediately prior to filling with concrete.

3.2 APPLICATION

3.2.1 Batching, Mixing, and Proportioning

3.2.1.1 Equipment

Provide facilities for the accurate measurement and control of each of the materials entering the concrete, mortar, or grout. The Contracting Officer shall have free access to the batching and mixing plant at all times. Mixing equipment shall be capable of combining the aggregate, cement, admixture, and water into a uniform mixture and discharging this mixture without segregation.

3.2.1.2 Conveying

Convey concrete from mixer to repair area as rapidly as practicable by methods that will prevent segregation or loss of ingredients.

3.2.1.3 Facilities for Sampling

Provide facilities for readily obtaining representative samples of aggregate and concrete for test purposes. Furnish necessary platforms, tools, and equipment for obtaining samples.

3.2.1.4 Mix Proportions

The proportions of materials entering into the concrete mixture shall be in accordance with the approved mix design. Revise the mix design whenever necessary to maintain the workability, strength, and standard of quality required, and to meet the varying conditions encountered during the construction; however, no changes shall be made without prior approval.

3.2.1.5 Measurement

Provide equipment necessary to measure and control the amount of each material in each batch of concrete. Weigh bulk cement. Cement in unopened bags as packed by the manufacturer may be used without weighing. One bag of portland cement shall be considered as weighing 42.64 kg 94 pounds. Measure mixing water and air-entraining admixtures by volume or by weight. Consider one liter one gallon of water as weighing 1 kg 8.33 pounds.

3.2.1.6 Workability

Maintain the slump of the concrete at the lowest practicable value, not exceeding the specified value.

3.2.2 Placing, Consolidating, and Finishing

NOTE: Specify placing time to suit concrete materials and environmental conditions. For most projects, 90 minutes is adequate.

Place concrete within [45] [90] minutes after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates, and before the concrete has obtained its initial set, and before the sand-cement grout bonding course has dried or obtained its initial set. The temperature of the concrete, as deposited in the repair area, shall be not less than 10 degrees C 50 degrees F nor more than 32 degrees C 90 degrees F. Deposit concrete as to require a minimum of re-handling and in such a manner so as to least disturb the sand-cement grout. Place concrete as indicated to maintain existing joints [and working cracks]; new repair material shall not infiltrate or span existing joints [and cracks] indicated to remain. Place concrete continuously in each spall area. Workmen shall not walk on the bonding course surface or in the concrete during placing and finishing operations. Consolidate the concrete by small spud vibrators not greater than 25 mm one inch in diameter, except that repair areas less than 100 mm 4 inches deep or 0.093 square meter one square foot in area may be consolidated by hand tamping or other approved means. To avoid pulling material away from patch edge and to maximize bond strength, work the finishing screed from the center of the patch out to the patch boundary. Fill all saw kerfs extending beyond the repair area with grout. Start finishing operations immediately after placement of the concrete. The finished surface grade of patched areas shall match the existing surface grade of the adjacent undisturbed pavement. Screeding, floating, or trowelling of patch material onto adjacent pavements shall be kept to a minimum; remove loose or poorly bonded patch material from adjacent surfaces. Before the concrete becomes non-plastic, finish the surface with a [broom] [burlap drag] [_____] to approximately match the surface finish of existing adjacent concrete pavement.

3.2.2.1 Joints

Construct new joints as detailed on the drawings and align with existing joints. After curing of the concrete, seal new joints as indicated [and specified].

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

3.3.1.1 Aggregates

ASTM C 136.

3.3.1.2 Cement

Test as prescribed in the referenced specification under which it is furnished. Cement may be accepted on the basis of mill tests and the manufacturer's certification of compliance with the specification, provided the cement is the product of a mill with a record for the production of high-quality cement for the past 3 years.

3.3.1.3 Concrete

Sample concrete in the field and test to determine the slump, air content, and strength of the concrete. Perform slump and air content tests at the beginning of a concrete placement each day, at the time test cylinders are made, and at other intervals to insure that the specification requirements are met. Make test cylinders for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed in service. Determine the air content and slump in conformance with ASTM C 173 and ASTM C 143, respectively. Mold and cure test cylinders in conformance with ASTM C 31/C 31M and as specified below. The Contractor shall furnish all materials, labor, and facilities required for molding, curing, and protecting test cylinders at the site. Curing facilities shall include furnishing and operating water tanks equipped with temperature-control devices that will automatically maintain the temperature of the water at 23 degrees C 73 degrees F plus or minus 2.8 degrees C 5 degrees F. The Contractor shall also furnish and maintain at the site, boxes or other facilities suitable for storing the specimens while in the mold at a temperature of 23 degrees C 73 degrees F plus or minus 5.5 degrees C 10 degrees F. Make compressive test cylinders each shift that concrete is placed. Mold each group of test cylinders from the same batch of concrete to consist of a sufficient number of specimens to provide two compressive strength tests at each test age of 7 days and 28 days. Make one group of specimens during the first half of each shift, and a second group during the last portion of the shift; however, at the start of paving repair operations and each time the aggregate source, aggregate characteristics, or mix design is changed, make one additional group of test cylinders. Test cylinders in accordance with ASTM C 39.

3.4 ADJUSTING

3.4.1 Test Results

Remove concrete not meeting strength, consistency, and air content requirements and provide new acceptable concrete. The removal and replacement method or methods shall be subject to approval of the

Contracting Officer.

3.4.2 Acceptance

Reject any spall repair material that cracks, or delaminates, or loses bond partly or completely, or causes spalling of adjacent portland cement concrete, or is not separated properly from adjacent slabs at joints, or fails to cure uniformly and completely, or is otherwise defective. Remove such unacceptable repairs, including new damaged areas adjacent to new spall patches, and provide new repairs meeting the specifications.

3.5 PROTECTION

3.5.1 Curing

**NOTE: Specify 7 days curing for Types I and II
cements; 3 days for Type III cement.**

Cure concrete by protection against loss of moisture and rapid temperature changes for a period of not less than [3] [7] days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. The Contractor shall have all equipment needed for adequate curing and protection of the concrete on hand and ready to install before actual concrete placement begins. Failure to comply with curing requirements shall be cause for immediate suspension of concreting operations.

3.5.1.1 Water Curing With Absorbent Curing Material

Immediately after the finishing operations have been completed and the concrete has set sufficiently to prevent marring the surface, cover the entire surface of the new concrete with wetted burlap, cotton mats, or rugs that shall be kept continuously wet for a period of not less than 24 hours.

Keep the surface of the new concrete moist until the absorbent coverings are in place. Hold the coverings in place by weights or other approved means. Continue curing of the concrete for the duration of the required curing period by this method or one of the methods specified below:

- a. Waterproof-Paper Blankets or Impermeable Sheets: Immediately after removing the covering used for initial curing, moisten the exposed concrete surfaces with a fine spray of water and then cover with waterproof-paper blankets, polyethylene-coated-burlap blankets, or impermeable sheets. Saturate burlap of polyethylene-coated burlap with water before placing. Place sheets with the light-colored side up. Sheets shall overlap not less than 300 mm 12 inches with edges taped or secured to form a completely closed joint. Weigh down coverings to prevent displacement or billowing from winds or prop and jet blast. Repair tears or holes appearing during the curing period by patching.
- b. Membrane-Forming Curing Compound: Apply immediately to exposed concrete surfaces after removing absorbent coverings. Apply the curing compound with an overlapping coverage that will give a two-coat application at a coverage of not more than 5 square meters per liter 200 square feet per gallon for both coats. Cure concrete at joints, but no curing compound shall enter joints that are to be sealed with joint sealants. The compound shall form a

uniform, continuous, cohesive film that will not check, crack, or peel, and that shall be free from pinholes and other imperfections. Re-spray at the coverage specified concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied. Curing compound damaged by pedestrian or vehicular traffic or by subsequent construction operations within the specified curing period shall also be re-sprayed.

3.5.2 Traffic Control

Protect the patched areas against damage prior to final acceptance of the work by the Government. Exclude traffic from the patched areas by erecting and maintaining barricades and signs until completion of the curing period of the concrete. Anchor traffic control devices to prevent displacement by jet or prop blasts.

-- End of Section --