Preparing Activity: NAVFAC Superseding
UFGS-32 11 36.13 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 11 36.13

LEAN CONCRETE BASE COURSE

11/19

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 DELIVERY
1.4 STORAGE
1.4.1 Cement, Aggregate, and Admixture Materials
1.4.2 Curing Compounds and Bond Breaker
1.5 QUALITY ASSURANCE
1.5.1 Required Information
1.5.2 Required Review
1.6 SAFETY

PART 2 PRODUCTS

2.1 MIX DESIGN
2.2 MATERIALS
2.2.1 Cement
2.2.2 Water
2.2.3 Aggregates
2.2.3.1 Gradation
2.2.3.2 Deleterious Substances
2.2.4 Admixtures
2.2.4.1 Air-Entraining Admixtures
2.2.4.2 Retarding Admixtures
2.2.4.3 Water-Reducing Admixtures
2.2.4.4 Accelerating Admixtures
2.2.4.5 Pozzolans
2.2.4.6 Ground Granulated Blast-Furnace Slag
2.2.5 Curing Materials
2.2.5.1 Waterproof Paper
2.2.5.2 Polyethylene Sheeting
2.2.5.3 Polyethylene-Coated Burlap
2.2.5.4 Liquid Membrane-Forming Compound

2.2.6 Bond Breaker

PART 3 EXECUTION

3.1 PREPARATION
3.2 FIXED FORMS
3.3 JOINTS
3.4 MEASURING, MIXING, AND TRANSPORTING LEAN CONCRETE
3.5 PLACING LEAN CONCRETE
3.5.1 General
3.5.2 Lean Concrete Placement
3.5.3 Consolidation
3.5.4 Cold Weather
3.5.5 Hot Weather
3.5.6 Protection Against Rain
3.6 FINISHING
3.6.1 Surface Correction and Testing
3.6.2 Surface Finish
3.7 CURING AND PROTECTION
3.7.1 Moist Curing
3.7.2 Liquid Membrane-Forming Compound Curing
3.7.3 Protection of Treated Surfaces
3.8 BOND BREAKER
3.9 FIELD QUALITY CONTROL
3.9.1 Sampling
3.9.1.1 Aggregates
3.9.1.2 Lean Concrete
3.9.2 Testing
3.9.2.1 Aggregate Testing
3.9.2.2 Lean Concrete Testing
3.9.3 Acceptance

-- End of Section Table of Contents --

****

USACE / NAVFAC / AFCEC / NASA	**UFGS-32 11 36.13 (November 2019)**

Preparing Activity: NAVFAC	**Superseding**
	UFGS-32 11 36.13 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

****

SECTION 32 11 36.13

LEAN CONCRETE BASE COURSE
11/19

****

NOTE: This guide specification covers the requirements for lean concrete base course for portland cement concrete pavement.

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

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

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

****

****

NOTE: Lean concrete is composed of a lean concrete mix and is not recommended for use in flexible pavement structures. Some paragraphs may need to be supplemented or modified to meet the project requirements. The extent of the work to be accomplished should be indicated on the project drawings or included in the project specifications.

****

****

NOTE: On the drawings, show:

1. Paving Plan, showing horizontal dimensions; locations with respect to existing structures; and new and existing ground contours.

2. Sections of pavement structures showing thicknesses and details.

3. Location and character of all joints.

****

PART 1 GENERAL

1.1 REFERENCES

****

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

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

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

****

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM C31/C31M	(2022) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams

	of Concrete
ASTM C94/C94M	(2022a) Standard Specification for Ready-Mixed Concrete
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138/C138M	(2017a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174/C174M	(2017) Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C192/C192M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2022) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494/C494M	(2019; E 2022) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2021) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2023; E 2023) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2022) Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM C1260	(2021) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1602/C1602M	(2022) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D3665	(2012; R 2017) Standard Practice for Random Sampling of Construction Materials

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 81-123	(1981) Occupational Health Guideline for Chemical Hazards, (Vols. I, II, and III)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.1153	Respirable Crystalline Silica

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

Choose the first bracketed item for Navy, Air Force,

and NASA projects, or choose the second bracketed item for Army projects.
****

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

SD-05 Design Data

Mix Design

At least 30 days prior to mixing and placing lean concrete, submit the design mix for approval. Provide a complete list of materials including type, brand, source and amount of cement, pozzolan, ground granulated blast-furnace slag, admixtures, reference specifications, and results of 28-day compressive strength test of the lean concrete. Prepare compressive strength test specimens in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M.

SD-06 Test Reports

Mix Design Review

Aggregate Testing

Slump

Air Content

Concrete Temperature

Yield

Surface

Base Course Thickness

Compressive Strength

Submit testing results as required in paragraph entitled "Field Quality Control."

SD-07 Certificates

Ready-mix Concrete Plant Identification

Batch Ticket Information

Cement

Aggregates

Admixtures

Curing Materials

1.3 DELIVERY

Do not deliver lean concrete until ready for placement.

1.4 STORAGE

1.4.1 Cement, Aggregate, and Admixture Materials

Store in accordance with recommendations of ACI 304R.

1.4.2 Curing Compounds and Bond Breaker

Inspect materials for contamination and damage. Unload and store with a minimum of handling.

1.5 QUALITY ASSURANCE

1.5.1 Required Information

Submit name and location of the ready-mix concrete plant. Submit batch ticket information as specified in ASTM C94/C94M.

1.5.2 Required Review

Before lean concrete is placed at the job site, submit a mix design review accomplished by a Government-approved independent commercial engineering testing laboratory. Include cement factor, standard deviation of compressive strength used in the design of the mix, water-cement ratio (by weight), percentage of fine aggregate to total aggregate by weight, weight in kg lbs of saturated surface-dry aggregates (fine and coarse) per sack of cement, volume of admixtures and yield for 1 cubic m 1 cubic yd of concrete.

1.6 SAFETY

In addition to Safety Requirements contained in the Contract Clauses; prevent employee respiratory, eye or skin contact with Portland cement and silica dust in accordance with 29 CFR 1926.1153 during wet or dry mixing. Provide and require employees to use and dispose or clean the following in accordance with the pertinent provisions of NIOSH 81-123:

a. Impervious clothing, boots and gloves.

b. Splash-proof safety googles and face shields.

c. Respiratory protection equipment.

PART 2 PRODUCTS

2.1 MIX DESIGN

Specify the mix design under paragraph SUBMITTALS and conform to the following specifications.

****

NOTE: Specify an upper limit on compressive strength when reflective cracking is a concern.

****

a. 28-day compressive strength MPa psi: 8 1200 minimum.

b. Cement factor kg per cubic m lbs. per cubic yd: 120 200 minimum.

The minimum cement factor indicated is for concrete durability only; increase to meet minimum compressive strength requirements.

****

NOTE: Specify 7 percent minimum air content when lean concrete is exposed to freeze-thaw cycle.

****

c. Air content (percent by volume): [4] [7] minimum.

d. Water-cement ratio: [0.6] [_____] maximum.

e. Slump: 25 mm 1 in minimum to 75 mm 3 in maximum for fixed form; 38 mm 1-1/2 in maximum for slip-forming.

****

NOTE: In locations subject to freeze-thaw cycles, insert the following, "Do not allow the freeze-thaw weight loss to exceed 14 percent when testing in accordance with AASHTO T 136."

****

2.2 MATERIALS

2.2.1 Cement

****

NOTE: Allowable types of cement are:

ASTM C150/C150M Portland	**ASTM C595/C595M Blended**	**Use**
Type I	**Type IP or IS**	**For general use in construction.**
Type II	**Type IP (MS) or Type IS (MS)**	**For general use in construction where concrete is exposed to moderate sulfate action or where moderate heat of hydration is required. ASTM C595/C595M (blended hydraulic cements): add the suffix MS or MH where either moderate sulfate resistance moderate heat of hydration, respectively, is required.**
Type III		**For use when high early strength is required.**

ASTM C150/C150M Portland	ASTM C595/C595M Blended	Use
Type IV		For use when low heat of hydration is required.
Type V		For use when high sulfate resistances is required.
Require cement to meet low alkali requirements of ASTM C150/C150M, Table 1A, when using potential alkali-reactive aggregates.		

NOTE: Do not use ASTM C595/C595M blended hydraulic cements on WESTNAVFACENGCOM airfield pavement projects without consulting WESTNAVFACENGCOM Code 411.

****

ASTM C150/C150M, Type(s) [I] [II] [I or II] [Type III, for high early strength concrete] [_____]. [ASTM C595/C595M, Type IS or IP.]

2.2.2 Water

Use water in accordance with ASTM C1602/C1602M. Do not use hot water.

2.2.3 Aggregates

Use stone or gravel, crushed or uncrushed[, or crushed Portland cement concrete pavement]. Use fine aggregate that is naturally contained in the aggregate material or sand. Use aggregates consisting of hard, durable particles, free from objectionable matter.

2.2.3.1 Gradation

Use aggregate in compliance with one of the gradations shown in Table 1 when tested in accordance with ASTM C136/C136M. Allow the gradation to be modified to suit [locally available aggregate] [recycled Portland cement concrete pavement], provided the strength requirements are met.

TABLE 1 - AGGREGATE GRADATION - LEAN CONCRETE BASE COURSE

	Percentage by Weight Passing Sieves		
Sieve Sizes	A	B	C
50 mm 2 in.	100	---	---
37.5 mm 1 1/2 in.	---	100	---
25.0 mm 1 in.	55-85	70-95	100
19.0 mm 3/4 in.	50-80	55-85	70-100

TABLE 1 - AGGREGATE GRADATION - LEAN CONCRETE BASE COURSE			
	Percentage by Weight Passing Sieves		
Sieve Sizes	A	B	C
4.75 mm No. 4	30-60	30-60	35-65
425 micrometers No. 40	10-30	10-30	15-30
75 micrometers No. 200	0-15	0-15	0-15

2.2.3.2 Deleterious Substances

Do not permit aggregates to contain substances which are deleteriously reactive with the alkalies in the cement, except as permitted in ASTM C33/C33M using the test methods in ASTM C1260.

2.2.4 Admixtures

****

NOTE: Admixtures are used in concrete to improve the concrete or to provide sound concrete under conditions where it would be burdensome to do so without use of an admixture.

1. Air entraining agents. Specify air entrainment for all concrete, particularly that exposed to freezing and thawing and sulfates and for seawater exposed concrete. Air entrainment improves the workability of plastic concrete.

2. Retarders. Retarding admixtures act to slow the hardening of concrete in hot weather. Permit use of approved retarders.

3. Water reducers. Water reducing admixtures are used to improve the quality of concrete, obtain specified strength at lower water-cement ratios or to increase the slump of a given mixture without increase in water content. Permit use of approved water reducing admixtures.

4. Accelerators. Calcium chloride and non-calcium chloride types are available. When added to the concrete acts to accelerate the hardening of concrete in cold weather. Do not permit calcium chloride accelerators for seawater exposed concrete, reinforced concrete and in concrete in contact with aluminum or other non-ferrous materials.

5. Pozzolans. Due to EPA guidelines, allow the use of fly ash, either in blended cements or as an admixture, as an optional material unless it can be shown that use of fly ash is technically inappropriate. Pozzolans are used to replace or augment cement in concrete mixes. In general, it

allows less cement to be used to achieve the required strength although the time required to reach the required strength may be longer than for a totally Portland cement concrete mix. Use Class F for sulfate resistant concrete. Do not use fly ash as a substitute for Portland cement on WESTNAVFACENGCOM airfield pavement projects without consulting WESTNAVFACENGCOM Code 411.
****

Where not shown or specified, allow admixtures to be used subject to written approval.

2.2.4.1 Air-Entraining Admixtures

ASTM C260/C260M.

2.2.4.2 Retarding Admixtures

ASTM C494/C494M, Type B or D.

2.2.4.3 Water-Reducing Admixtures

ASTM C494/C494M, Type A, D, E, F, or G.

2.2.4.4 Accelerating Admixtures

ASTM C494/C494M, Type C.

2.2.4.5 Pozzolans

Class N, F, or C ASTM C618, except that the maximum allowable loss on ignition is 6 percent for Classes N and F.

2.2.4.6 Ground Granulated Blast-Furnace Slag

ASTM C989/C989M, Grade 120.

2.2.5 Curing Materials

2.2.5.1 Waterproof Paper

ASTM C171, white color.

2.2.5.2 Polyethylene Sheeting

ASTM C171, white color.

2.2.5.3 Polyethylene-Coated Burlap

ASTM C171.

2.2.5.4 Liquid Membrane-Forming Compound

ASTM C309, white-pigmented Type 2, Class B, or clear or translucent Type 1-D, Class B with white fugitive dye.

2.2.6 Bond Breaker

Liquid membrane-forming curing compound as specified.

PART 3 EXECUTION

3.1 PREPARATION

Before placing lean concrete, compact underlying surface to within 13 mm 1/2in of finish grade and elevations shown in drawings. Wet underlying material in advance of placing lean concrete to ensure a firm, moist condition at time lean concrete is placed. Do not permit equipment, other than lean concrete delivery or paving equipment on prepared underlying material. In cold weather, protect underlying material from frost. Do not use chemicals to eliminate frost.

3.2 FIXED FORMS

Set forms for full bearing on foundation for entire length and width and in alignment with edge of base course. Support forms during entire operation of placing, consolidation, and finishing. Do not allow the maximum vertical and horizontal deviation of forms, including joints, to exceed 6 mm 1/4 in from a 3.7 m 12 ft straightedge. Provide stake sockets and interlocking devices to prevent movement of the forms.

3.3 JOINTS

Locate joints as required to provide a minimum of 150 mm 6 in from joints in overlying surface course.

3.4 MEASURING, MIXING, AND TRANSPORTING LEAN CONCRETE

****
NOTE: Include bracketed sentence except for projects at MCB Camp Pendleton.
****

Use ASTM C94/C94M, except as modified. Provide batch ticket information for each load of lean concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place lean concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 29.5 degrees C 85 degrees F.[Reduce placement time to 60 minutes if the air temperature is greater than 29.5 degrees C 85 degrees F.] Permit additional water to be added, provided that both the specified maximum slump and water-cement ratio are not exceeded.

3.5 PLACING LEAN CONCRETE

3.5.1 General

Do not permit lean concrete placement when weather conditions prevent proper placement and consolidation. Maintain drainage ditches, gutters and side drains to drain the subgrade during the construction of the base. Place lean concrete in one continuous operation for the full width and depth of the section between transverse joints with slip or fixed form equipment.

3.5.2 Lean Concrete Placement

Deposit lean concrete in its final location within the time limits specified and before initial set. Deposit the lean concrete in a manner that requires a minimum of re-handling. Complete work incidental to handling and placing of lean concrete in a manner that does not damage the underlying surface. Place lean concrete continuously at a uniform rate without unscheduled stops except for equipment failure or other emergencies. Avoid contamination of lean concrete with foreign material on construction equipment or workman's footwear. Use shovels to spread lean concrete by hand not with rakes.

3.5.3 Consolidation

Consolidate immediately after spreading with internal vibrating equipment. Limit duration of vibration to produce consolidation of concrete. Do not permit excessive vibration.

3.5.4 Cold Weather

Do not permit lean concrete temperature to fall below 10 degrees C 50 degrees F. Do not place lean concrete when the ambient temperature is below 4.5 degrees C 40 degrees F. Cover lean concrete and provide with a source of heat sufficient to maintain 10 degrees C 50 degrees F minimum while curing. Adhere to practices recommended in ACI 306R.

3.5.5 Hot Weather

Do not permit lean concrete temperature to exceed 32 degrees C 90 degrees F starting at time of batching and extending for a period of seven days. Cool ingredients before mixing, or substitute chip ice for part of required mixing water or use other suitable means to control lean concrete temperature to prevent rapid drying of newly placed lean concrete. Shade the fresh lean concrete and start curing as soon as the surface is sufficiently hard to permit curing without damage. Adhere to practices recommended in ACI 305R.

3.5.6 Protection Against Rain

Halt mixing and batching operations and cover unhardened lean concrete surface when rain is falling in the locale where the lean concrete is being placed. Extend the length of base to be protected back to a point where rain is not indenting base surface.[When slipform construction is used, install side forms in areas of base where edge cannot otherwise be protected to prevent edge erosion.] After rain ceases, install side forms as required to prevent excessive edge slump, and remove protective covering without delay. Remove remaining water without using cement. Refinish or replace areas damaged by rain at no additional cost to the Government.

3.6 FINISHING

Start lean concrete finishing operations immediately after consolidation. Use finishing machine. Permit hand finishing to be used in emergencies and for lean concrete in inaccessible locations or of such shapes that machine finishing is impracticable. Finish base surface on both sides of a joint to the same grade. Make as many finish trips over each area of base and at such intervals as necessary to retain coarse aggregate near finished surface, and produce a smooth surface true to grade and crown.

Do not permit excessive operation over an area, which results in an excess of mortar and water being brought to the surface.

3.6.1 Surface Correction and Testing

After finishing is completed but while lean concrete is still plastic, use straightedges to eliminate minor irregularities and score marks. Use straightedges 3 m 10 ft in length and operated from sides of base and from bridges. Check surface for trueness with straightedge held in successive positions parallel and at right angles to centerline of pavement. Advance straightedge along pavement in successive stages of not more than one-half the length of the straightedge. Immediately fill depressions with freshly mixed lean concrete, strike off, consolidate, and refinish. Strike off and refinish projections above required elevation. Continue straightedge testing and finishing until entire surface of lean concrete is free of defects and meets specified requirements.

3.6.2 Surface Finish

Apply a uniform, smooth surface finish to lean concrete base. Do not allow textured surface.

3.7 CURING AND PROTECTION

Protect lean concrete from injurious action by sun, rain, flowing water, frost, or mechanical injury. At completion of finishing and at the time lean concrete surface has hardened enough to prevent the surface being marred by the curing material, cure by one or more of the following methods. Use fresh water for curing. Keep base moist and at a temperature above 0 degree C 32 degrees F, for a full curing period of 7 days. Protect lean concrete base from damage during removal of form work and from injury resulting from storage or transportation of materials and equipment during construction. Protect exposed vertical faces of lean concrete with curing compound or by other suitable means.

3.7.1 Moist Curing

Wet lean concrete surface with a fine spray of water and cover with waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Saturate polyethylene-coated burlap with water before placing. Select size of sheets that are at least 300 mm 1 ft longer than necessary to cover the entire width and edges of base. Place sheets with light-colored side up. Overlap adjacent sheets not less than 300 mm 1 ft with the lapped edges securely weighted down or the sheets lapped 150 mm 6 in and cemented or tapered to form a continuous cover and a closed joint. Weight cover down to prevent displacement or billowing from winds. Fold coverings down over the exposed edges and secure with a continuous bank of earth or other approved means. Use covers in good condition when placed and immediately repair tears and holes that occur during the 7-day curing period.

3.7.2 Liquid Membrane-Forming Compound Curing

Apply compound immediately after surface loses its water sheen and has a dull appearance. Mechanically agitate curing compound during use. Apply at a maximum rate of 5.0 square m/L 200 square ft/gal of compound. If compound lacks a uniform continuous, coherent films, or exhibits checks, cracks, peels, or pinholes, apply an additional coat of compound to areas where film is defective. Have readily available impervious sheet curing

for use to protect freshly placed lean concrete in the event conditions occur to prevent correct application of compound at the proper time. Re-spray surfaces with curing compound after rainfall. Apply at same rate required above.

3.7.3 Protection of Treated Surfaces

Protect lean concrete surfaces from foot and vehicular traffic and other sources of abrasion for a minimum of 72 hours. Maintain continuity of applied curing method for the entire curing period.

3.8 BOND BREAKER

Prior to placement of overlying Portland cement concrete layer, coat the surface of the lean concrete base with a bond breaker to prevent bonding between the two layers. Use a bond breaker consisting of a double application of liquid membrane-forming curing compound. Use the rates specified for curing for each application . Allow the first application to be the lean concrete curing application. Place the second application no more than 24 hours prior to placement of the overlying surface course.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

3.9.1.1 Aggregates

Sample aggregates prior to delivery to the batch plant. During lean concrete placement sample aggregates for each [500] [_____] metric tons [500] [_____] tons. Use sampling methods in accordance with ASTM D75/D75M. Identify each sample for conformance tests. When test results indicate that the aggregates consistently meet the specified gradation requirements, allow the rate of sampling to be reduced if approved.

3.9.1.2 Lean Concrete

Obtain random samples of plastic lean concrete in accordance with ASTM C172/C172M. Permit quality control samples to be taken at the lean concrete batch plant; however, obtain samples for verification of lean concrete slump and air content for submittal to the Government at the point of discharge. From each sample obtained, mold one set of compressive strength test specimens for laboratory testing in accordance with ASTM C39/C39M. Supplier may obtain samples of the lean concrete for quality control purposes; however, obtain random samples of the lean concrete at the point of discharge for field testing and report results to the Government in writing. Cast one set of concrete compressive strength test specimens for each random sample obtained. Determine sampling location (or timing) in accordance with ASTM D3665.

3.9.2 Testing

3.9.2.1 Aggregate Testing

Perform aggregate gradation testing on random samples obtained during the batching process. Perform additional aggregate and cement sampling and testing whenever there is a change of source or material deficiency.

3.9.2.2 Lean Concrete Testing

Perform laboratory testing on aggregates and cement samples from the materials to be used in the project prior to the start of construction. During construction perform additional laboratory testing at no cost to the Government if concrete strength deficiency or other material defect is reported. Adjust the concrete mix as necessary to obtain specified concrete compressive strength.

a. Slump: Measure the cement water ratio of lean concrete in accordance with ASTM C143/C143M. Determine slump of lean concrete at the start of each day's placement, on each random sample obtained, and for each set of concrete compressive strength test specimens cast.

b. Air content: Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. Determine air content at the start of each day's lean concrete placement, on each random sample obtained, and for each set of concrete compressive strength test specimens. Report results in writing to the Government.

c. Concrete Temperature: Determine temperature of plastic lean concrete hourly at the point of discharge. During hot and cold weather periods, increase frequency of measurement as necessary to ensure concrete is placed within temperature specifications in ACI 305R.

d. Yield: Measure the yield in accordance with ASTM C138/C138M, twice for each day's production of lean concrete, and whenever materials or mix proportions are changed.

e. Surface: After curing, test the surface of the pavement with a straightedge or device to identify irregularities, if any. For a portion of the pavement containing irregularities greater than 0.6 mm in 3 m 1/4 in in 10 ft in a longitudinal or transverse direction, remove and replace the lean concrete, mechanically grind the lean concrete surface, or correct the surface using an approved method.

f. Base course thickness: Obtain 100 mm 4 in diameter core samples to determine the in place thickness of the lean concrete base course. Obtain cores in accordance with ASTM C42/C42M. Repair the core holes with non-shrink grout. The tolerance for any one core in a test section is 13 mm 1/2 in. The average of all core lengths within a test section must be the specified base material thickness indicated on the approved project drawings. When determining the average, assign cores with a length of more than 13 mm 1/2 in greater than the specified base thickness a length of the specified thickness plus 13 mm 1/2 in. If the measured base course thickness is less than that shown on the drawings by more than 13 mm 1/2 in, remove the deficient areas and replace with lean concrete of the specified strength, quality and thickness at no additional cost to the Government. When a core indicates unsatisfactory thickness, determine the limits of the base course to be removed and replaced as follows: Take one core 4.5 m 15 ft of the deficient location in both directions from the unsatisfactory core until satisfactory thickness is indicated; remove and replace base course for the full width of the lane where a core indicated unsatisfactory thickness. Determine length of cores in accordance with ASTM C174/C174M. Submit copies of each of the coring reports , in triplicate, and include the following information:

(1) Date lean concrete represented by core was placed.

(2) Date core was taken.

(3) Location of core - lane number, station number.

(4) Length of core.

(5) Condition of core - appearance, concrete texture, honeycombed.

(6) Disposition of core - In Contracting Officer or Contractor possession.

g. Compressive strength: ASTM C39/C39M. Fabricate four compressive strength test specimens per set in accordance with ASTM C31/C31M. Test one specimen at 7 days and three at 28 days. If the testing agency elects to cast 150 mm x 300 mm 6 in x 12 in test specimens only two specimens are required to be tested at 28 days; therefore, the set size may be reduced to three specimens. Sample lean concrete delivered to the jobsite, perform the prescribed field tests, and fabricate one set of compressive strength test specimens for every [380] cubic yds [500] cubic yds of lean concrete placed but not less than once for each day's placement. For evaluation purposes, use the average of all 28-day compressive strength test results for each set of specimens. If the average of the 28-day compressive strength test results for a set, or multiple sets, of specimens is below the specified minimum compressive strength by more than 690 kPa 100 psi, take a minimum of three ASTM C42/C42M core samples from the in-place work represented by the low test results and perform compressive strength tests. Consider the lean concrete test section represented by the core samples as acceptable if the average of the compressive strengths is at least the minimum specified compressive strength on the contract documents and that no core is more than 690 kPa 100 psi below the specified minimum compressive strength Retest locations represented by irregular core tests. Removed and replace at no cost to the Government the lean concrete sections failing to meet the specified minimum compressive strength after additional testing. Use additional coring and compressive strength testing as necessary at no additional cost to the Government to delineate areas requiring removal and replacement or remove the entire portion represented by the deficient set of specimens of subsequent test cores. Repair core holes with non shrink grout.

3.9.3 Acceptance

Base acceptance of lean concrete on compressive strength, thickness, grade and surface tolerance, as described in the previous section.

-- End of Section --