

Preparing Activity: USACE

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2011

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DIVISION 03 - CONCRETE

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CONCRETE FINISHING

11/10

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 03 35 00.00 10

CONCRETE FINISHING

11/10

NOTE: This guide specification covers the requirements for cast-in-place concrete finishing.

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 items(s) or insert appropriate information.

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

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

PART 1 GENERAL

NOTE: This specification covers concrete work primarily for buildings, but may also be used for other applications such as wharves, docks, drainage structures, warehouse type slabs, and driveways. The following guide specifications are relative to this section and will be included to the extent applicable in projects where this section is used:

Section 03 11 13.00 10 CONCRETE FORMING
Section 03 20 00.00 10 CONCRETE REINFORCING
Section 03 15 00.00 10 CONCRETE ACCESSORIES
Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE
Section 03 31 01.00 10 STRUCTURAL CONCRETE FOR CIVIL WORKS
Section 07 92 00 JOINT SEALANTS

Specifications on concrete for bridge construction

should be in a separate section and should be essentially in agreement with concrete construction requirements in the American Association of State Highway and Transportation Officials, "Standard Specifications for Highway Bridges". Requirements for deck slabs, curbs, gutters, and sidewalks forming an integral part of the bridge should be included in the section concerning concrete for bridge construction.

In addition to specified requirements the following information will be shown on project drawings:

1. Details which require a depressed structural slab for tile, terrazzo, or other floor finishes in order to provide finished surfaces at the same elevations.

2. When exposed concrete surfaces are specified, the locations in the finished structure should be indicated. If other than cast finish is required, the type and location must be indicated.

1.1 REFERENCES

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

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

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

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117 (2010) Specifications for Tolerances for Concrete Construction and Materials and Commentary

ACI 303R (2004) Guide to Cast-In-Place

Architectural Concrete Practice

ACI 305R

(2010) Specification for Hot Weather
Concreting

ASTM INTERNATIONAL (ASTM)

ASTM C 1059/C 1059M

(1999; R 2008) Standard Specification for
Latex Agents for Bonding Fresh to Hardened
Concrete

ASTM C 309

(2007) Standard Specification for Liquid
Membrane-Forming Compounds for Curing
Concrete

ASTM C 881/C 881M

(2010) Standard Specification for
Epoxy-Resin-Base Bonding Systems for
Concrete

ASTM C 940

(2010a) Expansion and Bleeding of Freshly
Mixed Grouts for Preplaced-Aggregate
Concrete in the Laboratory

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions
in Section 01 33 00 SUBMITTAL PROCEDURES and edit
the following list to reflect only the submittals
required for the project. Submittals should be kept
to the minimum required for adequate quality control.

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,
Air Force, and NASA projects.

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

SD-03 Product Data

Recycled Content Products; (LEED)
Latex Bonding Compound
Epoxy Resin

SD-05 Design Data

Dry Shake Finish

1.3 QUALITY ASSURANCE

1.3.1 Field Test Panels

NOTE: Edit these paragraphs as appropriate.
Specify location for all field test panels. Add
requirements for mock-ups if applicable. Add
requirements for slab panels if exposed aggregate
slab finish is required or if superflat slab finish
is required.

Construct field test panels prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Contracting Officer, and, if not judged satisfactory, construct additional panels until approval is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the approved field example.

1.3.1.1 Sample Wall Panels

One sample panel at least 1220 mm 4 feet by 1525 mm 5 feet and 150 mm 6 inches thick shall be constructed to demonstrate Class A formed finish and a similar one for Class B formed finish. Panels shall be located [____]. Each panel shall include a full length and full width joint line and shall have at least two voids each at least 300 mm 12 inches by 300 mm 12 inches by 75 mm 3 inches deep either impressed in the concrete as placed or chipped in the hardened concrete. After the concrete is 7 days old, the voids shall be patched to demonstrate the effectiveness and the appearance of the Contractor's repair procedures.

1.3.1.2 Slab Panels

A slab panel at least 1220 mm 4 feet by 1525 mm 5 feet and 100 mm 4 inches thick shall be constructed to demonstrate exposed aggregate slab finish and a similar panel for extra high class slab finish. Panels shall be located [____]. Each panel shall have a full length joint line.

PART 2 PRODUCTS

NOTE: Edit this PART to include only those products
which are locally available, are required by the
project, and are acceptable to the designer.

In accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS submit documentation indicating: distance between manufacturing facility and the project site, distance of raw material origin from the project site, percentage of post-industrial and post-consumer recycled content per unit of product and relative dollar value of recycled content products to total dollar value of products included in project. Submittals shall be as specified in the subject Section.

2.1 DRY SHAKE FLOOR TOPPING MATERIAL

NOTE: Edit and supplement this paragraph for light
reflective, spark resistant, static disseminating
floors as applicable to the project.

Dry shake floor topping material shall be a premixed ready-to-use dry shake. It shall be proportioned, mixed and packaged at the factory, and delivered to the jobsite in sealed, moisture resistant bags, ready to apply, finish and cure. The manufacturer of the dry shake material shall have at least 10 years experience in the manufacture of such material. Any material from a manufacturer who makes any disclaimer of the materials performance shall not be used.

2.2 LATEX BONDING COMPOUND

Latex bonding compound agents for bonding fresh to hardened concrete shall conform to ASTM C 1059/C 1059M. Submit samples as required.

2.3 EPOXY RESIN

Epoxy resin for use in repairs shall conform to ASTM C 881/C 881M, Type III, Grade I or II. Submit samples as required.

PART 3 EXECUTION

3.1 FINISHING FORMED SURFACES

NOTE: Formwork, form materials and form
construction are specified in Section 03 11 13.00 10
STRUCTURAL CAST-IN-PLACE CONCRETE FORMING. Classes
of finish to be used for various formed surfaces of
the structure must be indicated on the drawings or
clearly specified herein. Criteria to use in
choosing class of finish are as follows:

Class A Finish. This finish is for surfaces
permanently exposed to public view that require
excellent appearance at close range. Examples:
Exterior walls of office and residential buildings,

of warehouse/industrial type buildings where frequent public access occurs, and of other similar exposed structures; and interior walls, columns or beams of these same structures where no other finish treatment is to be added.

Class B Finish. This finish is for surfaces exposed to public view that do not require the excellent appearance of Class A. Exterior walls of warehouse/industrial buildings where public access is infrequent, structures on combat training ranges, and other similar exposed structures; interior exposed surfaces of such structures, and interior surfaces of liquid containers.

Class C Finish. This finish is for concealed surfaces not exposed to view and for all surfaces not covered by Class A, B, or D finish. Examples: Interior surfaces that will be covered by dry wall or other applied surfaces, surfaces of mechanical rooms and elevator shafts.

Class D Finish. This finish is for surfaces where roughness and irregularities are not objectionable. Examples: Walls and foundation surfaces against which backfill will be placed, exterior surfaces permanently submerged in water where no coating is to be applied.

When a Class A or B Finish is specified, add to paragraph FIELD TEST PANELS in PART 1 requirements for the Contractor to construct a sample panel for approval before start of construction. Finishes for surfaces to be exposed to high velocity flow of water (above 40 ft per sec) will be designed and constructed in accordance with Civil Works criteria.

Forms, form materials, and form construction are specified in Section 03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. [Other finishes shall be applied to the following structures or portions of structures:]

TYPES OF FINISH	STRUCTURE OR PORTION OF STRUCTURE
[Grout-cleaned]	[_____]
[Textured]	[_____]
[Exposed aggregate]	[_____]
[Sand-blast]	[_____]

TYPES OF FINISH	STRUCTURE OR PORTION OF STRUCTURE
[Tooled]	[_____]

Maintain uniform color of the concrete by use of only one mixture without changes in materials or proportions for any structure or portion of structure [that requires a Class A or B finish] [that is exposed to view or on which a special finish is required]. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features. [The finished surface of sand-blasted, textured, tooled, and exposed aggregate finishes shall duplicate the preapproved sample panel.]Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.

3.1.1 Class A Finish and Class B Finish

Class A finish is required [where indicated on the drawings.] [in the following areas, [_____].] Class B finish is required [where indicated on the drawings] [in the following areas, [_____].] Remove fins, ravelings, and loose material, all surface defects over 12 mm 1/2 inch in diameter or more than 12 mm 1/2 inch deep, shall be repaired and, except as otherwise indicated or as specified in Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm 1/2 inch in diameter shall be cut back to sound concrete, but in all cases at least 25 mm 1 inch deep. Prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained. Metal tools shall not be used to finish repairs in Class A surfaces.

3.1.2 Class C and Class D Finish

Class C finish is required [where indicated on the drawings.] [in the following areas, [_____].] Class D finish is required [where indicated on the drawings.] [in the following areas, [_____].] Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm 1/2 inch deep or more than 50 mm 2 inches in diameter shall be repaired. Defects more than 50 mm 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 25 mm 1 inch deep.

3.1.3 Architectural and Special Finishes

NOTE: The specification writer must ensure that any areas to receive architectural and special finishes are indicated on the drawings or specified in Section 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE or herein. Where these paragraphs require a finish to match a sample panel on display during the bidding period, the specification writer must ensure that such panel is fabricated and displayed. When considered appropriate, require a test panel to be fabricated for approval before start of construction.

Architectural concrete finishes are specified in Section 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE. Special finishes shall conform to the requirements specified herein.

3.1.3.1 Smooth Finish

After other concrete construction is complete in each overall separate contiguous area of the structure, apply smooth finish to [the areas indicated on the drawings] [the following areas, [_____]]. Use a mortar mix consisting of one part portland cement and two parts well-graded sand passing a 0.6 mm No. 30 sieve, with water added to give the consistency of thick paint. Where the finished surface will not receive other applied surface, use white cement to replace part of the job cement to produce an approved color, which shall be uniform throughout the surfaces of the structure. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Scrape off excess grout with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads having on their surface the same sand-cement mix specified above but without any mixing water, until all of the visible grout film is removed. The burlap pads used for this operation shall be stretched tightly around a board to prevent dishing the mortar in the voids. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours commencing immediately after finishing operations in each area. The temperature of the air adjacent to the surface shall be not less than 10 degrees C 50 degrees F for 24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas or at night, and shall never be applied when there is significant hot, dry wind.

[3.1.3.2 Grout-Cleaned Finish

NOTE: See the appropriate DM and EM 1110-2-2000 for surfaces to receive a grout-cleaned finish. Be sure this is shown in the drawings.

The surfaces of [_____] shall be given a grout-cleaned finish as described, as approved by the Contracting Officer and after all required curing, cleaning, and repairs have been completed. Surfaces to be grout-cleaned shall be moist cured for the required period of time before application of the grout-cleaned finish. Grout-cleaning shall be delayed until near the end of construction on all surfaces not to be painted in order to achieve uniformity of appearance and reduce the chance of discoloring caused by subsequent construction operations. The temperature of the air adjacent to the surface shall be not less than 5 degrees C 40 degrees F for 24 hours prior to and 72 hours following the application of the finish. The finish for any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the finished surface. The surface to receive grout-cleaned finish shall be thoroughly wetted to prevent absorption of water from the grout but shall have no free water present. The surface shall then be coated with grout. The grout shall be applied as soon as the surface of the concrete approaches surface dryness and shall be vigorously and thoroughly rubbed over the area with clean

burlap pads, cork floats or stones, so as to fill all voids. The grout shall be composed of one part portland cement as used on the project, to two parts by volume of well-graded sand passing a 600-µm (No. 30) sieve mixed with water to the consistency of thick paint. White portland cement shall be used for all or part of the cement as approved by the Contracting Officer to give the desired finish color. The applied coating shall be uniform, completely filling all pits, air bubbles, and surface voids. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, burlap pad, or other means. Then, after the surface whitens from drying (about 30 minutes at normal temperature) rub vigorously with clean burlap pads. Immediately after rubbing is completed, the finished surface shall be continuously moist cured for 72 hours. Burlap pads used for this operation shall be burlap stretched tightly around a board to prevent dishing the mortar in the voids.

] [3.1.3.3 Textured Finish

This type of finish shall be applied where specified to conform to details shown in the drawings by use of approved textured form liners. Liner panels shall be secured in the forms by methods recommended by the manufacturer but not by methods that will permit impressions of nail heads, screw heads, washers, or the like to be imparted to the surface of the concrete. Edges of textured panels shall be sealed to each other to prevent grout leakage. The sealant used shall be nonstaining to the surface. The finish shall be similar to and shall closely match the finish on the sample panel.

] 3.1.3.4 Exposed Coarse-Aggregate Finish

Coarse aggregate shall consist of [_____] material, shall meet the specified quality requirements, and shall have a grading as follows: [_____]. Expose coarse aggregate by an approved method. The finish shall be similar to and shall closely match the finish on the sample panel put on display during the bidding period, and the finish on the approved preconstruction test panel fabricated by the Contractor.

3.1.3.5 Sandblast Finish

Blast the concrete surface at an approved age with approved wet sandblasting procedures to obtain a [brush] [light] [medium] [heavy] finish which will match the descriptive photographs in [ACI 303R](#). The finish shall be similar to and shall closely match the finish on the approved preconstruction test panel fabricated by the Contractor.

3.1.3.6 Tooled Finish

The thoroughly cured concrete shall be dressed at an approved age with approved electric, air, or hand tools to a uniform texture with a [hand-tooled] [rough] [fine-pointed] [crandalled] [or] [bush-hammered] surface texture. The finish shall be similar to and shall closely match the finish on the approved preconstruction test panel fabricated by the Contractor.

3.2 REPAIRS

Except for major defects, as defined hereinafter, repair surface defects as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of [ACI 117](#). These

tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair below. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects below. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.2.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects, whose depth is at least as great as their surface diameter but not over 100 mm 4 inches, shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm No. 16 mesh sieve, and minimum amount of water. Use only sufficient water to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.2.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm 1/2 inch deep or, for Class A and B finishes, more than 12 mm 1/2 inch in diameter and, for Class C and D finishes, more than 50 mm 2 inches in diameter. Also included are any defects of any kind whose depth is over 100 mm 4 inches or whose surface diameter is greater than their depth. Repair major defects as specified below.

3.2.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Use approved equipment and procedures which will not cause cracking or microcracking of the sound concrete. If reinforcement is encountered, remove concrete so as to expose the reinforcement for at least 50 mm 2 inches on all sides. All such defective areas greater than 7800 square mm 12 square inches shall be outlined by saw cuts at least 25 mm 1 inch deep. Defective areas less than 7800 square mm 12 square inches shall be outlined by a 25 mm 1 inch deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing

to remove all loose material. Keep surfaces continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, as an option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, test each repair area for drumminess by firm tapping with a hammer and inspecting for cracks, both in the presence of the Contracting Officer, immediately before completion of the contract, and replacing any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Keep burlap continually wet.

3.2.2.2 Repair of Deep and Large Defects

**NOTE: Use this paragraph only for areas where the
designer considers this degree of repair acceptable;
otherwise require removal and replacement of
concrete containing these types of defects.**

Deep and large defects will be those that are more than 150 mm 6 inches deep and also have an average diameter at the surface more than 450 mm 18 inches or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Repair deep and large defects by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; design the paste portion of such concrete mixture to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. Provide a full width "chimney" at the top of the form on the placing side to ensure filling to the top of the opening. Use a pressure cap on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. Remove the form after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.2.3 Resinous and Latex Material Repair

NOTE: The portland cement type repairs specified above are considered appropriate for usual repairs. The designer should use the materials specified herein only if there is a record of previous successful use or if the use has been discussed in detail with the Waterways Experiment Station (CEWES-SL-EP). Additional requirements for their use must be added. Color match may be a problem with this type of repair.

In lieu of the portland cement [bonding coats specified above, an epoxy resin or a latex bonding agent may be used.] [based mortars specified above, an epoxy resin mortar based on epoxy resin or a mortar based on latex bonding agent may be used in the following specific locations [____].] The following additional requirements shall be met in the use of these materials [____].

3.3 FORMED SURFACE REPAIR

NOTE: Remove paragraph REPAIRS and its subparagraphs above if the project is Civil Works.

Refer to EM 1110-2-2000 for direction on class of finish. Please note that definitions for class of finish have been changed recently. Class of finish shall also be shown in the drawings. The section on formwork presents materials for each class.

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

3.3.1 Classes A, AHV, & B Finishes

Surfaces listed in Section 03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING and as shown to have classes A, AHV, and B finishes shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 10 000 square mm 16 square inches in area and less than 13 mm 1/2 inch deep and bug holes exceeding 13 mm 1/2 inch in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of tie rods shall be reamed and filled with dry-packed mortar as specified in paragraph MATERIAL AND PROCEDURE FOR REPAIRS below. Defective and unsound concrete areas larger than described shall be defined by 13 mm 1/2 inch deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN in PART 2, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND in PART 2, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS below.

3.3.2 Class C Finish

Surfaces listed in Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK and as shown shall have defects repaired as follows: defective areas, voids, and honeycombs smaller than 15 000 square mm 24 square inches and less than 50 mm 2 inches deep; bug holes exceeding 38 mm 1-1/2 inches in diameter shall be chipped and filled with dry-packed mortar; and holes left by removal of the tie rods shall be chipped and filled with dry-packed mortar. Defective and unsound concrete areas larger than 15 000 square mm 24 square inches and deeper than 38 mm 1-1/2 inches shall be defined by 13 mm 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN in PART 2, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND in PART 2, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS below.

3.3.3 Class D Finish

Surfaces listed in Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK and as shown to have class D finish shall have surface defects repaired as follows: defective areas, voids, and honeycombs greater than 30 000 square mm 48 square inches in area or more than 50 mm 2 inches deep shall be defined by 13 mm 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN in PART 2, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND in PART 2, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete as specified below.

3.3.4 Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Contracting Officer. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. Metal tools shall not be used to finish permanently exposed surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 5 degrees C 40 degrees F during placement, finishing, and curing. Other methods and

materials for repair may be used only when approved in writing by the Contracting Officer. Repairs of the so called "plaster-type" will not be permitted.

3.4 FINISHING UNFORMED SURFACES

NOTE: Type of finish of unformed surfaces should be indicated on the drawings. If not on the drawings, it must be specified here. Correlate this paragraph with paragraph Tolerances in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE or 03 31 01.00 10 STRUCTURAL CONCRETE FOR CIVIL WORKS.

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in [Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE] [03 31 01.00 10 STRUCTURAL CONCRETE FOR CIVIL WORKS], when tested as specified herein.

3.4.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than[10 degrees C 50 degrees F] [5 degrees C 40 degrees F]. In hot weather all requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking above shall be met. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 1.0 kg/square meter 0.2 pounds per square foot per hour. Make provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.4.2 Rough Slab Finish

NOTE: Rough-slab finish alone is used when a bonded surface course for heavy use industrial floor is specified, or where roof fill or thick mortar setting bed is used. If the drawings do not indicate the slabs to receive only a rough slab finish, they must be specified here. Rough slab finish must be retained as the first operation for all subsequent finishing.

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. [Areas indicated on the drawings] [The following areas [____]] shall receive only a rough slab finish. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.4.3 Floated Finish

NOTE: If the drawings do not indicate the areas to receive a floated finish, they must be specified here.

Slabs to receive more than a rough slab finish shall next be given a wood float finish. [Areas as indicated on the drawings] [The following areas [____]] shall be given only a float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. No water, cement, or mortar shall be added to the surface during the finishing operation. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 6 mm 1/4 inch and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Perform floating by use of suitable hand floats or power driven equipment. Use sufficient pressure on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.4.4 Troweled Finish

NOTE: If the drawings do not indicate the areas to receive a trowel finish, they must be specified here. Edit accordingly. A troweled finish will be specified for most wearing surfaces and where a smooth dense surface finish is required. Edit bracketed items as desired by designer. Delete this paragraph when no troweled finish or subsequent finish is required.

[Areas as indicated on the drawings] [The following areas [____]] shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled [2] [3] [4] times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.4.5 Superflat Finish

NOTE: If the drawings do not indicate the areas to receive a superflat surface, they must be specified here. Correlate this paragraph with the "Tolerances" paragraph in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE or 03 31 01.00 10 STRUCTURAL CONCRETE FOR CIVIL WORKS. Primary locations where superflat floors are required are warehouse aisles where very high lift forklifts and other type stackers operate. Delete this paragraph when superflat finish is not required.

[Areas as indicated on the drawings] [The following areas [____]] shall be constructed as superflat floors. Extreme care shall be taken to meet specified tolerances. If necessary, use special heavy duty, laser guided machines built especially for this work and experienced, factory-trained operators. Finishing operations shall include use of long-handled 3 meter 10 foot "highway type" cutting straightedges plus any other tools necessary to meet the surface tolerance requirements. Surface finish shall conform to paragraph [Troweled Finish] [____].

3.4.6 Non-Slip Finish

NOTE: If drawings do not indicate the areas to receive non-slip finish, they must be specified here. Broom finish is usually used for exterior slabs and abrasive aggregate for interior slabs, but such policy is not definite. Edit bracketed items as appropriate. Delete these paragraphs when Non-Slip Finish is not required.

Construct non-slip floors in accordance with the following subparagraphs.

3.4.6.1 Broomed

[Areas as indicated on the drawings] [The following areas [____]] shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a [hair] [coarse fiber] push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.4.6.2 Abrasive Aggregate

[Areas as indicated on the drawings] [The following areas [____]] shall be given an abrasive aggregate finish. The concrete surface shall be given a float finish. Abrasive aggregate shall then immediately be uniformly sprinkled over the floated surface at a total rate of not less than **1.25 kg per square meter 0.25 psf** spread in two applications at right angles to each other. The surface shall then be troweled to a smooth, even finish that is uniform in texture and appearance and free from blemishes including trowel marks. Immediately after curing, cement paste and laitance covering the abrasive aggregate shall be removed by steel brushing, rubbing with abrasive stone, or sandblasting to expose the abrasive particles.

3.4.7 Dry Shake Finish

NOTE: If the drawings do not indicate the areas to receive a dry shake finish, they must be specified here. When dry shake finish is required, add to paragraph Technical Service for Specialized Concrete in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE, a requirement that a manufacturer's representative be present during use of dry shake finish.

Construct [areas as indicated on the drawings] [the following areas [____]] with a dry shake finish. Use [dry shake floor armoring topping] [dry shake conductive and spark resistant floor topping] [dry shake non-metallic, light reflective floor topping] to surface the floor. Construct the base slab and apply the dry shake material in accordance with the manufacturer's written instructions, furnished by the Contractor. Submit manufacturer's written instructions on application of dry shake material 15 days prior to start of construction. Apply the dry shake material in a two-stage application. Total application shall be at the rate recommended by the manufacturer but at a rate not less than **7.5 kg per square meter 1.5 psf**.

- a. The first application shall be at the rate of two-thirds of the total and shall be applied immediately following floating of total area. The dry shake material shall first be applied to the floated concrete adjacent to forms, entryways, columns, and walls where moisture will be lost first. Dry shake material shall be distributed evenly using an approved mechanical spreader. The material shall not be hand thrown on the surface. Use finishing machines with float shoes as soon as dry shake has absorbed moisture (indicated by darkening of surface); do the floating just sufficiently to bring moisture from base slab through the shake.
- b. Immediately following floating of the first shake, the remaining

one-third of the total specified shake shall be applied in the same manner and machine floated. Surface shall be further compacted by a third mechanical floating if time and setting characteristics will allow. At no time shall water be added to the surface.

- c. As surface further stiffens, indicated by loss of sheen, hand or mechanically trowel the surface with blades relatively flat. Remove all marks and pinholes in the final raised trowel operation.
- d. Cure floors finished with dry shake material using a curing compound recommended by the manufacturer of the dry shake material. Apply membrane curing compound immediately after the floor surface has hardened sufficiently so surface will not be marred by the application. Apply the compound uniformly over the entire surface at a coverage which will provide moisture retention in excess of the requirements of **ASTM C 309**. When dry, protect the coating from droppings of plaster, paint, dirt, and other debris by a covering of scuffproof, non-staining building paper.
- e. Floor shall remain covered and be kept free of traffic and loads for at least 10 days after completion. Adequate provision shall be made for maintaining the concrete temperature at **10 degrees C 50 degrees F** or above during the curing period. The curing compound shall remain in place for not less than 30 days. Remove the curing compound by a manufacturer recommended method prior to turning the facility over to the Government.

3.5 SPECIALTY FLOORS

3.5.1 Heavy Duty Floors

NOTE: Heavy duty floors are to be used only for floors that will receive major traffic of tracked vehicles or steel wheeled equipment when the designer is concerned about wear. Moderate amounts of such traffic can be accommodated by ordinary concrete floors. If drawings do not indicate areas to receive heavy duty finish, they must be specified here. Delete this subparagraph if not required. Edit bracketed items. Add to and strengthen this subparagraph as needed but do not delete any of the listed requirements.

Place concrete as nearly as practicable in final position, in a uniform layer. The overlay shall be placed and screeded slightly above the required finished grade, compacted by rolling with rollers weighing not less than **4.5 kg/linear 25 mm 10 pounds/linear inch** of roller width or by approved tamping equipment and finish screeded to established grade. Grid type tampers shall not be used. The concrete, while still green but sufficiently hardened to bear a person's weight without deep imprint, shall be floated to a true even plane with no coarse aggregate visible. Floating shall be performed with an approved disc-type mechanical float which has integral impact mechanism. The surface of the overlay shall then be left undisturbed until the concrete has hardened enough to prevent excess fines from being worked to the top. Form joints to match those in the base slab.

3.5.2 Bonded Two-Course Floor Construction

NOTE: Where it is anticipated that the surface of a floor slab may be damaged during construction operations, a two-course floor may be specified with the second course applied late in the contract. If the drawings do not indicate areas to receive two-course floor construction, they must be specified here. Delete this subparagraph when two-course floor is not required. Edit bracketed items.

[Areas as indicated on the drawings] [The following areas [____]] shall have floors constructed with two-course construction. Construct a bonded two-course floor by placing a bonded topping on the thoroughly hardened concrete slab left a distance below final grade as shown in the drawings. The floor topping mixture shall have a specified compressive strength of 41.4 MPa 6,000 psi at 28 days, a 50 mm 2 inch maximum slump, 13 mm 1/2 inch maximum-size coarse aggregate and shall be proportioned to obtain required finishability. The surface of the base slab shall be thoroughly cleaned by sandblasting or high pressure water jet in accordance with paragraph PREPARATION FOR PLACING in Section [03 30 00.00 10 CAST-IN-PLACE CONCRETE] [03 31 01.00 10 STRUCTURAL CONCRETE FOR CIVIL WORKS]. The base slab shall be kept continuously wet for the first 12 hours during the 24-hour period immediately prior to placing the finished floor. After all free water has evaporated or has been removed from the surface, a grout shall be scrubbed in. The grout shall be a 1:1 mixture of portland cement and sand passing the 2.36 mm No. 8 sieve mixed to a creamlike consistency. The grout shall be applied just ahead of the concrete-placing operation. While the grout is still damp, the top course shall be spread and screeded. The surface shall then be floated with a disc power float or equivalent, followed by a minimum of two power trowelings. Trowel marks left by the machine shall be removed by final, hard steel troweling by hand. The finished floor shall be moist cured in accordance with Section 03 39 00.00 10 CONCRETE CURING. Form joints to match those in the base slab.

3.5.3 Unbonded Two-Course Floor

Construct an unbonded two-course floor by placing a bond-breaker on the thoroughly hardened concrete slab left a distance below final grade as shown in the drawings. The floor topping mixture shall have a specified compressive strength of 41.4 MPa 6,000 psi 28 days, a 50 mm 2 inch maximum slump, 13 mm 1/2 inch nominal maximum-size coarse aggregate, and shall be proportioned to obtain required finishability. The base (bottom) course shall be screeded and bull-floated. The bond-breaker shall consist of plastic sheeting, felt paper, a bond-breaking compound or a sand cushion. The topping shall be floated with a disc power float or equivalent, followed by a minimum of two power trowelings. Trowel marks left by the machine shall be removed by final, hard steel troweling by hand. The finished floor shall be moist cured in accordance with Section 03 39 00.00 10 CONCRETE CURING.

3.6 EXTERIOR SLAB AND RELATED ITEMS

NOTE: Edit bracketed statements and use these paragraphs only when minor amounts of specified

items are required in the project. Remove affected paragraph when pertinent Section (Ex: 32 13 11 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS, 32 16 13 CONCRETE SIDEWALKS AND CURBS AND GUTTERS) is included in the contract.

3.6.1 Pavements

Immediately following the final consolidation 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 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. After finishing is completed but while the concrete is still plastic, eliminate minor irregularities and score marks in the pavement surface by means of long-handled cutting straightedges. Straightedges shall be 3.75 m 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 1 m 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 3.75 12 foot 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, and refinished. Projections above the required elevation shall also be struck off and refinished. Continue the straightedge testing and finishing until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by [belting with approved "belt" and procedures] [use of a burlap drag. A strip of clean, wet burlap from 1.0 to 1.5 m 3 to 5 feet wide and 0.7 m 2 feet longer than the pavement width shall be carefully pulled across the surface]. Round edges and joints with an edger having a radius of 3 mm 1/8 inch.

3.6.2 Sidewalks

Apply a lightly broomed finish.

3.6.3 Curbs and Gutters

Finish exposed surfaces using a stiff bristled brush.

-- End of Section --