



د افغانستان اسلامي امارت
د کابل ښاروالۍ



Islamic Emirate of Afghanistan Kabul Municipality

Planning & Urban Development Deputy Mayor

ریاست طرح و تطبیق پلانهای شهری

آمریت تعمیرات

CONSTRUCTION SPECIFICATION

For Blocks # 1 and 2 (D15-4)

LOCATION: District 15, Kabul

Afghanistan

SECTION 03 33
00

CAST-IN-PLACE ARCHITECTURAL

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 301	(2010; ERTA 2015) Specifications for Structural Concrete
ACI 301M	(2010; ERTA 2015) Metric Specifications for Structural Concrete
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(2014) Building Code Requirements for Structural Concrete & Commentary
ACI 347 to	(2004; Errata 2008; Errata 2012) Guide Formwork for Concrete
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M Carbon	(2014) Standard Specification for Structural Steel
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1.2 SYSTEM DESCRIPTION

All materials, procedures, and requirements specified in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE shall fully apply to cast-in-place Architectural concrete, except as otherwise specified.

1.2.1 Concrete Mix Design

Design the concrete mix in accordance with ACI 211.1 and ACI 21

Including consideration of the finishes required.

1.2.2 Formwork Design

Design formwork conforming to ACI 301M ACI 301 and ACI 347

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the

Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail

Drawings. SD-04

Samples

Materials
Panels

1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit detail drawings conforming to ACI SP-66 and ACI 318M ACI 318. Detail drawings shall show location of cast-in-place elements in the work, building elevations, formwork fabrication details, reinforcements, embedments, dimensions, concrete strength, interface with adjacent materials, and special placing instructions, in sufficient detail to cover fabrication, placement, stripping, and finishing.

PART 2 PRODUCTS

2.1 MATERIALS

Submit samples of materials listed below, indicating sizes, shapes, finishes, color, and pertinent accessories:

2.1.1 Aggregates

Aggregates shall conform to mix design.

2.1.2 Reinforcing Steel

Reinforcing steel shall be galvanized if clearance to an exterior face

is
25 mm 1 inch or less

2.1.3 Tie Wire

Tie wire shall be soft monel or 18-8 stainless steel.

2.1.4 Plates, Angles, Anchors, and Embedments

Plates, angles, anchors, and embedments shall conform to ASTM A36/A36M, and shall be prime painted with inorganic zinc primer.

2.1.5 Formwork

Formwork for special effects shall be as approved.

2.1.6 Form Release Agents

Form release agents shall be manufacturer's standard, nonstaining, nonpetroleum based, compatible with surface sealer finish coating.

2.1.7 Surface Sealer

Surface sealer shall be methyl methacrylate polymer acrylic emulsion, clear color.

PART 3 EXECUTION

3.1 FORMWORK ERECTION

Erect formwork in accordance with the detail drawings to ensure that the finished concrete members conform accurately to the indicated dimensions, lines, elevations, and finishes. Deflection shall not exceed 1/360th of each component span or distance between adjacent supports. Deflections And tolerance shall not be cumulative. Install form lines as necessary to provide the required finish. Forms shall be coated with form release agents before reinforcement is placed. Formwork shall conform to ACI 301M ACI 301 and ACI 347.

3.2 CONCRETE FINISHES

Concrete finishes shall conform to the approved finishes. Finishing shall be accomplished at the time of concrete placement or immediately after formwork removal, as follows:

- a. Smooth finish: (1) As cast using flat smooth nonporous forms. (2) As cast using fluted, sculptured, board finish or textured form liners.
- b. Textured finish: (1) Textured form liners applied to inside of forms. (2) Distress finish by breaking off portion of face of raised portion of unit.
- c. Exposed aggregate finish: (1) Finish obtained by applying even coat of retardant to face of form, removing forms after concrete hardens, and exposing coarse aggregate to a depth of [5] mm inches by

Washing and brushing or lightly sandblasting away surface mortar.
(2) Finish obtained by treating surface of unit with brushes which have been immersed in acid solution.

Cast-in-place concrete elements which are to have a finish other than the surface produced from standard formwork, shall be accomplished by using the following procedures:

3.3 JOINT SEALING

Joint sealing shall be as specified in Section 07 92 00 JOINT SEALANTS.

3.4 CLEANING

No sooner than 72 hours after joints are sealed, faces and other exposed surfaces of cast-in-place concrete shall be washed down, cleaned with soap and water applied with a soft bristle brush, then washed down again with clean water, or by other approved procedures. Discolorations which cannot be removed by these procedures, shall be considered defective work. Cleaning work shall be done when temperature and humidity conditions are such that surfaces dry rapidly. Care shall be taken during cleaning operations to protect adjacent surfaces from damage.

3.5 SURFACE SEALING

After cleaning, exterior exposed architectural concrete surfaces indicated shall be given one coat of surface sealer, spray applied unless otherwise approved. Adjacent surfaces shall be protected to prevent damage from the surface sealer.

3.6 PROTECTION OF WORK

Work shall be protected against damage from subsequent operations.

3.7 DEFECTIVE WORK

Defective work shall be repaired or replaced, as directed, using approved procedures.

-- End of Section --

SECTION 03 35 00.00
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CONCRETE
FINISHING

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PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

- | | |
|----------|---|
| ACI 301 | (2010; ERTA 2015) Specifications for Structural Concrete |
| ACI 301M | (2010; ERTA 2015) Metric Specifications for Structural Concrete |
| ACI 303R | (2012) Guide to Cast-In-Place Architectural Concrete Practice |
| ACI 305R | (2010) Guide to Hot Weather Concreting |

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------|---|
| ASTM C309 | (2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete |
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1.2 SUBMITTALS

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

1.3 QUALITY ASSURANCE

PART 2 PRODUCTS

In accordance with Section 01 33 29 SUSTAINABILITY REPORTING 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.

Provide submittals as specified in the subject Section.

2.1 DRY SHAKE FLOOR TOPPING MATERIAL

Premixed ready-to-use dry shake 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 must have at least 10 years experience in the manufacture of such material. Do not use any material from a manufacturer who makes any disclaimer of the materials performance.

PART 3 EXECUTION

3.1 FINISHING FORMED SURFACES

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

3.1.4 Architectural and Special Finishes

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

3.1.4.1 Smooth Finish

After other concrete construction is complete in each overall separate contiguous area of the structure, apply smooth finish to [the areas indicated] [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 must be uniform throughout the surfaces of the structure. After the surface has been thoroughly wetted and allowed to approach surface dryness, vigorously apply the mortar 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, rub the area 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. Tightly stretch the burlap pads used for this operation around a board to prevent dishing the mortar in the voids. Complete the finish of any area in the same day, and make the limits of a finished area at natural breaks in the surface. Continuously moist cure the surface for 48 hours commencing immediately after finishing operations in each area. The temperature of the air adjacent to the surface must 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 apply the smooth finish in shaded areas or at night, and never be apply when there is significant hot, dry wind.

3.1.4.2 Grout-Cleaned Finish

The surfaces of must 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. Moist cure surfaces to be grout-cleaned for the required period of time before application of the grout-cleaned finish. Delay grout-cleaning 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 must be not less than 5 degrees C 40 degrees F for 24 hours prior to and 72 hours following the application of the finish. Complete the finish for any area in the same day, and make the limits of a finished area at natural breaks in the finished surface.

Thoroughly wet the surface to receive grout-cleaned finish to prevent absorption of water from the grout but have no free water present. Then coat the surface with grout. Apply the grout as soon as the surface of the concrete approaches surface dryness and vigorously and thoroughly rubbed over the

area with clean burlap pads, cork floats or stones, so as to fill all voids. The grout is composed of one part portland cement as used on the project, to two parts by volume of well-graded sand passing a 600- μ m (No.

30) sieve mixed with water to the consistency of thick paint. Use white portland cement for all or part of the cement as approved by the Contracting Officer to give the desired finish color. The applied coating must 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, moist cure the finished surface for 72 hours. Tightly stretch burlap pads used for this operation around a board to

Prevent dishing the mortar in the voids.

3.1.4.3 Textured Finish

Apply this type of finish where specified to conform to details indicated by use of approved textured form liners. Secure liner panels 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. Seal edges of textured panels to each other to prevent grout leakage. Use sealant that is nonstaining to the surface. The finish must be similar to and shall closely match the finish on the sample panel.

3.1.4.4 Exposed Coarse-Aggregate Finish

Coarse aggregate consisting of material, meeting the specified quality requirements, and graded as follows: . Expose coarse aggregate by an approved method. The finish must be similar to and closely match the finish on the sample panel put on display during the bidding period, and the finish on the approved preconstruction test panel.

3.1.4.5 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 must be similar to and closely match the finish on the approved preconstruction test panel.

3.1.4.6 Tooled Finish

Dress the thoroughly cured concrete 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 must be similar to and closely match the finish on the approved preconstruction test panel.

3.2 REPAIRS

Repair in accordance with ACI 301M ACI 301, Section 5.

3.3 FINISHING UNFORMED SURFACES

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

3.3.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed must not be less than[10 degrees C 50 degrees F][5 degrees C 40 degrees F]. In hot weather meet all requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE paragraphs HOT WEATHER REQUIREMENTS and PREVENTION OF PLASTIC SHRINKAGE CRACKING. 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 take such protective measures as quickly as finishing operations will allow. Float finish unformed surfaces that are not to be covered by additional concrete or backfill, with additional finishing as specified below, and true to the elevation indicated. Bring surfaces to receive additional concrete or backfill to the elevation indicated, properly consolidate, and leave true and regular. Unless otherwise indicated, evenly slope exterior surfaces for drainage. Where drains are provided, evenly slope interior floors to the drains. Carefully make joints with a jointing or edging tool. Protect the finished surfaces from stains or abrasions. Grate tampers or "jitterbugs" cannot be used for any

surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing is not be permitted. If bleedwater is present prior to finishing, carefully drag off the excess water or remove by absorption with porous materials such as burlap. During finishing operations, take extreme care to prevent over finishing or working water into the surface; this can cause "crazing" (surface

shrinkage cracks which appear after hardening) of the surface. Remove and replace any slabs with surfaces which exhibit significant crazing. During finishing operations, check surfaces with a 3 m 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.3.2 Rough Slab Finish

In accordance with ACI 301M ACI 301, Section 5.

3.3.3 Float Finish

In accordance with ACI 301M ACI 301, Section 5.

3.3.4 Trowel Finish

In accordance with ACI 301M ACI 301, Section 5.

3.3.5 Superflat Finish

[Areas as indicated] [Construct the following areas [225m²]] as superflat floors. Take extreme care to meet specified tolerances. If necessary, use special heavy duty, laser guided machines built especially for this work and experienced, factory-trained operators. Use a long-handled 3 meter 10 foot "highway type" cutting straightedges plus any other tools necessary to meet the surface tolerance requirements. Conform the surface finish to paragraph.

3.3.6 Non-Slip Finish

Construct non-slip floors in accordance with ACI 301M ACI 301, Section 5..

3.3.7 Dry Shake Finish

Construct[areas as indicated][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 must 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 must be at the rate of two-thirds of the total and applied immediately following floating of total area. First apply the dry shake material to the floated concrete adjacent to forms, entryways, columns, and walls where moisture will be lost first. Distribute dry shake material evenly using an approved mechanical spreader. Do not hand throw the material 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, apply the remaining one-third of the total specified shake in the same manner and machine float. Further compact the surface by a third mechanical floating if time and setting characteristics will allow. At no time can 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 C309](#). When dry, protect the coating from droppings of plaster, paint, dirt, and other debris by a covering of scuffproof, non-staining building paper.
- e. Keep the floor covered and free of traffic and loads for at least 10 days after completion. Make adequate provision to maintain the concrete temperature at [10 degrees C](#) [50 degrees F](#) or above during the curing period. Leave the curing compound 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.

3.4 SPECIALTY FLOORS

3.4.1 Heavy Duty Floors

Place concrete as nearly as practicable in final position, in a uniform layer. Place and screed the overlay 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. Do not use grid type tampers. Float the concrete, while still green but sufficiently hardened to bear a person's weight without deep imprint, to a true even plane with no coarse aggregate visible. Float with an approved disc-type mechanical float which has integral impact mechanism. Leave the surface

of the overlay 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 Sidewalks

Apply a lightly broomed finish.

3.5.3 Curbs and Gutters

Finish exposed surfaces using a stiff bristled brush.

-- End of Section --

1.4.1 Government Testing and Sampling

Provide facilities and labor as may be necessary for procurement of representative test samples. The Government will sample and test aggregates and concrete to determine compliance with the specifications. Samples of aggregates will be obtained at the point of batching in accordance with **ASTM D75/D75M**. Concrete will be sampled in accordance with **ASTM C172/C172M**.

1.4.2 Preconstruction Sampling and Testing

1.4.2.1 Aggregates

The aggregate sources listed at the end of this section have been tested and at the time testing was performed were capable of producing materials of a quality required for this project provided suitable processing is performed. The Contractor may furnish materials from a listed source or

from a source not listed. Samples from any source of coarse aggregate and any source of fine aggregate selected by the Contractor, consisting of not less than **[70 kg 150 pounds]** of each size coarse aggregate and **[35 kg 75 pounds]** of fine aggregate taken under the supervision of the Contracting Officer in accordance with **COE CRD-C 100** shall be delivered to within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. Days will be required to complete evaluation of the aggregates. Testing will be performed by and at the expense of the Government in accordance with

the applicable COE CRD-C or ASTM test methods. The cost of testing one source for each size of aggregate will be borne by the Government. If the Contractor selects more than one source for each aggregate size or selects a substitute source for any size aggregate after the original source was tested, the cost of that additional testing will be borne by the Contractor. Tests to which aggregate may be subjected are listed in paragraph QUALITY in PART 2. The material from the proposed source shall meet the quality requirements of this paragraph. The Government's test data and other information on aggregate quality of those sources listed at the end of this section are included in the DM and are available for review in the district office. Testing of aggregates by the Government does not relieve the Contractor of the requirements outlined in paragraph TESTS AND INSPECTIONS in PART 3.

1.4.2.2 Cementitious Materials and Admixtures

At least 60 days in advance of concrete placement, notify the Contracting Officer of the source of materials, along with sampling location, brand name, type, and quantity to be used in the manufacture and/or curing of the concrete.

1.4.3 Construction Testing by the Government

[Sampling and testing will be performed by and at the expense of the Government except as otherwise specified. No material shall be used until notice has been given by the Contracting Officer that test results are satisfactory.] [The Government will sample and test chemical admixtures, curing compounds, and cementitious materials].

1.4.3.1 Chemical Admixtures Requirements

Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the Contractor when directed by the Contracting Officer and shall be rejected if test results are not satisfactory. Chemical admixtures will be accepted based on compliance with paragraph CHEMICAL ADMIXTURES of PART 2.

1.4.3.2 Cement and Pozzolan

If cement or pozzolan is to be obtained from more than one source, the initial notification shall state the estimated amount to be obtained from each source and the proposed schedule of shipments.

1.4.3.2.1 Prequalified Cement Sources

Cement shall be delivered and used directly from a mill of a producer designated as a qualified source. Samples of cement for check testing

will be taken at the project site or concrete-producing plant by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified cement sources is available from

1.4.3.2.2 Prequalified Pozzolan Sources

Pozzolan shall be delivered and used directly from a producer designated as a qualified source. Samples of pozzolan for check testing will be taken at the project site by the Contracting Officer for testing at the expense of the Government. A list of prequalified pozzolan sources is available from the Director, U.S. Army Corps of Engineers, Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, ATTN: CEWES-SC.

1.4.3.2.3 Nonprequalified Cement Sources

Cement, if not from a prequalified source, will be sampled at the source and stored in sealed bins pending completion of testing. Sampling, testing, and the shipping inspection from the point of sampling, when the point is other than at the site of the work, will be made by or under the supervision of the Government and at its expense. No cement shall be used until notice has been given by the Contracting Officer that test results are satisfactory. In the event of failure, the cement may be resampled and tested at the request and expense of the Contractor. When the point of sampling is other than at the site of the work, the fill gates of the sampled bin and conveyances used in shipment will be sealed under Government supervision and kept sealed until shipment from the bin has been completed. If tested cement is rehandled at transfer points, the extra cost of inspection shall be at the Contractor's expense.

1.4.3.2.4 Nonprequalified Pozzolan Sources

Pozzolan, if not from a prequalified source, will be sampled at the source and stored in sealed bins pending completion of certain tests. Pozzolan will also be sampled at the site when determined necessary. All sampling and testing will be by and at the expense of the Government. Release for shipment and approval for use will be based on compliance with 7-day

Lime- pozzolan strength requirements and other physical and chemical and uniformity requirements for which tests can be completed by the time the

7-day lime-pozzolan strength test is completed. Release for shipment and approval for use on the above basis will be contingent on continuing compliance with the other requirements of the specifications. If a bin fails, the contents may be resampled and tested at the Contractor's expense. In this event, the pozzolan may be sampled as it is loaded into cars, trucks, or barges provided they are kept at the source until released for shipment. Unsealing and resealing of bins and sealing of shipping conveyances will be by or under the supervision of the Government. Shipping conveyances will not be accepted at the site of the work unless received with all seals intact. If pozzolan is damaged in

shipment, handling, or storage, it shall be promptly removed from the site of the work. Pozzolan that has not been used within 6 months after

testing shall be retested at the expense of the Contractor when directed

by the Contracting Officer and shall be rejected if the test results are not satisfactory. If tested pozzolan is rehandled at transfer points, the extra cost of inspection shall be at the Contractor's expense.

1.4.3.3 Concrete Tests

Provide facilities and labor as necessary for procurement of representative test samples. The Government will sample and test concrete

to determine compliance with the specifications. Concrete will be sampled

in accordance with [ASTM C172/C172M](#). Slump and air content will be determined in accordance with [ASTM C143/C143M](#) and [ASTM C231/C231M](#),

respectively. Compression test specimens will be made and laboratory cured in accordance with [ASTM C31/C31M](#), and compression test specimens tested in accordance with [ASTM C39/C39M](#), but results will be used only for determination of the uniformity of the mixture produced.

PART 2 PRODUCTS

2.1.1 Maximum Water-Cement Ratio

The maximum water-cement ratio by weight of equivalent portland cement shall be 0.50, unless otherwise approved in writing.

2.1.2 Cement Content

The cement content of the concrete shall be within the range from a minimum of [\[279 kg\]](#) [\[470 pounds\]](#) to a maximum of [446 kg/cubic meter](#) [752 pounds/cubic yard](#). When a pozzolan is used, the total absolute volume of cementitious material shall be within the same range in absolute

volume as previously specified. Of the total absolute volume of cementitious materials, between 20 and 30 percent may be pozzolan that meets the requirements of paragraph POZZOLAN, OTHER THAN SILICA FUME in

PART 2. [If GGBFS is used, it shall not exceed 25 percent by absolute volume, and percentage shall be as approved before mixture proportioning studies commence.]

2.1.3 Nominal Maximum-Size Coarse Aggregate

The nominal maximum-size coarse aggregate is [19.0 mm 3/4 inch] [25.0 mm 1 inch].

2.1.4 Fine Aggregate

Fine aggregate comprises approximately 40 to 50 percent, by volume, of the total aggregate.

2.1.5 Air Content

Air Content as determined by ASTM C231/C231M to be 6.0 ± 1.5 percent.

2.1.6 Slump

Determined by ASTM C143/C143M between 150 and 225 mm 6 and 9 inches.

2.1.7 Responsibility of Mixture Proportioning

Proportioning of concrete for use in construction of the cutoff wall shall be the responsibility of the Contractor and performed by a laboratory complying with ASTM C1077.

2.1.8 Concrete Proportioning

Trial batches and testing requirements for concrete shall be the responsibility of the Contractor. Samples of approved aggregates shall be obtained in accordance with the requirements of ASTM D75/D75M. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, slumps, and air content suitable for the work shall be made based on ACI 211.1. The maximum water-cement ratio required in the paragraph MAXIMUM WATER-CEMENT RATIO above will be converted to a weight ratio of water to cement plus pozzolan or GGBFS by mass equivalency as described in ACI 211.1. In the case where GGBFS is used, the mass of the slag shall be included in the equation for the term P, which is used to denote the mass of pozzolan. Trial mixtures shall be proportioned for specified slump and air content. The temperature of concrete in each trial batch shall be reported. If a chemical admixture is used, slump loss versus time in each trial batch shall be reported. For each trial mixture, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C192/C192M. They shall be tested at 7 and 28 days in accordance with ASTM C39/C39M, or if a pozzolan is used, they shall be tested at 7, 28, and 90 days. Results of these compressive strength tests shall be submitted but will be used only for quality control purposes. All results of mixture proportioning studies shall be submitted at least 10 days prior to commencing concrete placement.

2.2 MATERIALS

Submit certificate of compliance with all specification requirements for the following: Air-Entraining Admixture, Accelerators, and other Chemical Admixtures.

2.2.1 Cementitious Materials

Cementitious Materials are portland cement or portland cement in combination with pozzolan or GGBFS conforming to appropriate specifications listed below. Do not use cementitious materials until notice of acceptance has been given by the Contracting Officer. Cementitious materials will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. Material not meeting specifications shall be promptly removed from the site of work.

Submit the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished, for cementitious materials, including Cement and Pozzolan, [and GGBFS]. Certification and mill test reports must be from samples taken from the particular lot furnished.

2.2.1.1 Portland Cement

ASTM C150/C150M, Type I or II, except that the maximum amount of C3A in Type I cement shall be 15 percent [including the heat of hydration at 7 days] [including false set requirements] [low alkali when used with aggregates listed at the end of this section which require it]. [In lieu of low-alkali cement, the Contractor may use a combination of portland cement that does not meet the low-alkali requirement with a pozzolan or GGBFS provided the following requirement is met. The expansion of the proposed combination when tested in accordance with **ASTM C441** shall be equal to or less than the expansion of a low-alkali cement meeting the requirements of **ASTM C150/C150M** when tested in general conformance with **ASTM C441**. The expansion tests shall be run concurrently at an independent laboratory that is nationally recognized to perform such tests. The Government reserves the right to confirm the test results and to adjust the percentage of pozzolan or slag in the combination to suit other requirements.]

2.2.1.2 Pozzolan, Other than Silica Fume

Pozzolan shall conform to **ASTM C618**, Class [C], [F], with the optional requirements for multiple factor, drying shrinkage, and uniformity [and [moderate] [severe] sulfate resistance requirements] of Table 2A. Table 1A requirement for maximum alkalis shall apply when used with aggregates listed at the end of this section to require low-alkali cement.

2.2.2 Aggregates

Alkali-Silica Reactivity: Fine and coarse aggregates proposed for use in concrete shall be tested and evaluated for alkali-aggregate reactivity in accordance with **ASTM C1260**. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, the aggregate(s) shall be rejected or additional testing

using ASTM C1260 and ASTM C1567 shall be performed. The additional testing using ASTM C1260 and ASTM C1567 shall be performed using the low alkali portland cement in combination with

ground granulated blast furnace (GGBF) slag, or Class F fly ash. GGBF slag shall be used in the range of 40 to 50 percent of the total cementitious material by mass. Class F fly ash shall be used in the range of 25 to 40 percent of the total cementitious material by mass.

2.2.2.2 Concrete Aggregate Sources

2.2.2.2.1 List of Sources

The concrete aggregates sources may be selected from sources listed at the end of this section.

2.2.2.2.2 Selection of Source

After the award of the contract, designate in writing only one source or combination of sources from which he proposes to furnish aggregates. If the Contractor proposes to furnish aggregates from a source or from sources not listed at the end of this section, then designate only a single source or single combination of sources for aggregates. Regardless of the source, selected samples for acceptance testing shall be provided as required by paragraph GOVERNMENT TESTING AND SAMPLING in PART 1. If a source for coarse or fine aggregates so designated by the Contractor does not meet the quality requirements stated in the paragraph below, the Contractor may not submit for approval other nonlisted sources but shall furnish the coarse or fine aggregate, as the case may be, from sources listed at the end of this section at no additional cost to the Government.

2.2.2.3 Quality

Aggregates delivered to the mixer shall meet the following requirements:

2.2.2.4 Fine Aggregate Grading and Moisture Content

The fine aggregate or each fine aggregate shall have its sieve analysis and fineness modulus determined in accordance with ASTM C136/C136M and COE CRD-C 104, respectively. The moisture content shall be determined with an electric moisture meter that shall be in accordance with COE CRD-C 143. When in the Contracting Officer's opinion the electric moisture meter is not operating satisfactorily, the moisture content shall be determined in accordance with either ASTM C70, ASTM C566, or COE CRD-C 112.

2.2.2.5 Coarse Aggregate Grading and Moisture Content

Each size group of coarse aggregate shall have its sieve analysis determined in accordance with ASTM C136/C136M. The moisture content of each size group of the coarse aggregate shall be made in accordance with ASTM C566 or COE CRD-C 112.

2.2.3 Chemical Admixtures

Admixtures shall comply with the following.

2.2.3.1 Air-Entraining Admixture

The air-entraining admixture shall conform to **ASTM C260/C260M** and shall consistently cause the concrete to have an air content in the specified ranges under field conditions.

2.2.3.2 Accelerating Admixture

Accelerators shall meet the requirements of **ASTM C494/C494M**, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.2.3.3 Flowing Concrete Admixtures

Other chemical admixtures for use in producing flowing concrete shall comply with **ASTM C1017/C1017M**, Type I or II. These admixtures shall be used only if the proposed admixture shows no deleterious effects when used with all other project materials during mixture proportioning studies.

2.2.4 Water

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that nonpotable water may be used if it meets the requirements of **COE CRD-C 400**.

2.3.2 Batch Plant

Batching Plant shall conform to the requirements of **NRMCA CPMB 100** and as specified; however, rating plates attached to batch plant equipment are not required. Submit batch plant data to the Contracting Officer for review for conformance with applicable specifications.

2.3.2.1 Batching Equipment

The batching controls shall be [partially automatic], [semiautomatic], [or] [automatic]. [The semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance.] The batching system shall be equipped with an accurate recorder or recorders that meet the requirements of **NRMCA CPMB 100**. Separate bins or compartments shall be provided for each size group of aggregate and cement, pozzolan, and GGBFS. Aggregates shall be weighed either in separate weigh batchers with individual scales or cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cement, pozzolan, or GGBFS. If both cement and pozzolan or GGBFS are used, they may be

batched cumulatively provided that the portland cement is batched first. If measured by mass, the mass of the water shall not be batched

cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate

mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Admixtures shall not be combined prior to introduction in water. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment. All filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

2.3.2.2 Scales

The equipment for batching by mass shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. Provide standard reference masses and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the frequency required in paragraph TESTS AND INSPECTIONS, in PART 3, and in the presence of a Government inspector.

2.3.2.3 Batching Tolerances

Tolerances on determination of mass:

MATERIAL	PERCENT OF REQUIRED MASS
Cementitious materials	-0 to +2
Aggregate	± 2
Water	± 1
Chemical admixture	-0 to +6

For volumetric batching equipment, the following tolerances shall apply to the required volume of material being batched:

Water	Plus or minus 1 percent
Chemical admixtures	Zero to plus 6 percent

2.3.2.4 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the masses of the materials being batched. [An electric moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measuring

moisture in the fine aggregate. The sensing element shall be arranged so that the measurement is made near the batcher charging gate of the sand bin or in the sand batcher.]

2.3.3 Concrete Mixers

The concrete mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired. Submit concrete mixer data including the make, type, and capacity of concrete mixers proposed for mixing concrete in conformance with specified requirements.

2.3.3.1 Stationary Mixers

Concrete plant mixers shall be tilting, nontilting, horizontal-shaft, vertical-shaft, or pugmill and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C94/C94M applicable to central-mixed concrete.

2.3.3.2 Truck Mixers

Truck mixers, the mixing of concrete, and concrete uniformity shall conform to the requirements of ASTM C94/C94M. A truck mixer may be used for complete mixing or to finish the partial mixing begun in a stationary mixer. Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

2.3.4.2 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C94/C94M. Nonagitating equipment shall not be used for transporting concrete.

2.3.4.3 Chutes

When concrete can be placed directly from a truck mixer or agitator, the chutes attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

2.3.4.4 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure. The

pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped, but not less than 100 mm 4 inches. Aluminum pipe shall not be used. The nominal maximum-size coarse aggregate shall not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

PART 3 EXECUTIONS

3.1 PLACING

Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement. Concrete shall be deposited in the tremie hopper and in so depositing there shall be no vertical drop greater than 1.5 m 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of horizontal cold joints while concrete is being placed. Prior to placement, submit the method and equipment proposed for vertical construction joints cleanup and waste disposal, for review and approval by the Contracting Officer.

3.1.1 Time Interval between Mixing and Placing

Place concrete within 30 minutes after mixing or agitating ceases. When concrete is truck mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work, and discharge shall be completed within 45 minutes after introduction of the cement to the aggregates.

3.1.2 Placing Temperature

Concrete, when deposited in the slurry, shall have a temperature of not less than 5 degrees C 40 degrees F. Heating of the mixing water or aggregates shall not be permitted until the temperature of the concrete has decreased to 7 degrees C 45 degrees F. The materials shall be free from ice, snow, and frozen lumps before entering the mixer. All placing equipment and methods shall be subject to [approval] [review]. When

Heating is necessary to keep the concrete temperature above 5 degrees C 40 degrees F; it shall be regulated so that the concrete temperature does not exceed 15 degrees C 60 degrees F. The concrete, when deposited in the slurry, shall not exceed 32 degrees C 90 degrees F. Cooling of the mixing water and/or aggregates may be required to obtain an adequate placing temperature.

3.1.4 Concrete Placement

Tremie pipe sections shall be suitably secured together and a gasket used at each joint to prevent leakage. A retrievable traveling plug (go-devil) or a dry pipe with a plate and gasket wired to the bottom to prevent contact of the concrete and the slurry in the tremie shall be

required to start each placement. The tremie assembly shall be lowered to rest within

150 mm 6 inches of the bottom of the trench prior to beginning placement. During placement of the concrete, any unnecessary movement of the pipe shall be avoided. The bottom of the tremie pipe shall remain submerged in fresh concrete at all times to a depth that will produce the flat test surface slope that can practically be achieved. This depth shall not be less than 3 m 10 feet nor more than 9 m 30 feet except when beginning placement at the bottom of a panel. Batches of concrete shall be supplied to the tremie pipe at a uniform rate for a continuous flow. The tremie pipe shall be lifted during placement at a rate that will maintain the bottom of the pipe embedded in fresh concrete to a level that will produce the desired surface slope and rate of flow within the limits specified above. It may be necessary to reduce the amount of embedment as the differential head decreases between the concrete in the tremie pipe and the concrete in the panel. The repeated raising and lowering of the tremie pipe in the fresh concrete to facilitate placement shall be minimized. Placement shall proceed without interruption until the concrete has been brought to the required height. Continuously measure

and record the flow and slopes during placement with the use of a sounding line. The tremie shall not be moved horizontally during a placing operation, except that as the required height is reached, the tremie pipes

may be moved to the corners and low areas between the tremie pipes to bring the lift to final elevation. A sufficient number of tremies shall be provided so that the concrete does not flow horizontally a distance of more than 2.1 m 7 feet from a tremie; i.e., tremies shall be placed a maximum of 4.2 m 14 feet on centers. Where more than one tremie pipe is

used in the same placement simultaneously, the concrete level at each pipe

position shall be maintained nearly level with respect to the other. Special care shall be taken to ensure that the bottom of the tremie pipe is not lifted out of the fresh concrete. If this occurs, remove the

tremie pipe, insert a dry pipe with a temporary bottom plug, and restart the placement. Also, as soon as practical, drill a NX-size core boring through the center of the cutoff wall to a depth of at least 3 m 10 feet below the depth where the bottom of the tremie pipe was lifted out of the fresh concrete. Unacceptable zones of concrete such as honeycombed, segregated, or uncemented zones found within the core boring shall immediately be repaired or removed and replaced by an appropriate means. All cost incurred because of this failure, including the initial core boring and as many additional core borings as may be required to delineate the limits of the unacceptable concrete and the repair of the cutoff wall, shall be borne by the Contractor and shall not result in any additional cost to the Government. Submit a plan for repairing or removing and replacing the unacceptable concrete. Placement delays shall not be permitted for periods of time longer than 30 minutes.

3.1.5 Required Height of Concrete

Concrete that is free of laitance, scum, slurry, or other contaminants shall be placed at the top of the wall. All scum, laitance, and contaminated concrete shall be removed from the top of the concrete as the placement is nearing completion and shall be disposed of in the spoil areas. The top surface shall be finished to grade by screeding spoil areas.

3.2 CURING AND PROTECTION

The exposed concrete shall be moist cured for 14 days. Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, and mechanical damage. All materials and equipment needed for adequate curing and protection shall be available and at the placement site prior to the start of concrete placement. Concrete shall be protected from the damaging effects of rain for 12 hours and from flowing water for 14 days. No fire or excessive heat including welding shall be permitted near or in direct contact with concrete or concrete embedments at any time. Submit the curing medium and methods to be used for review and approval.

3.3 TESTS AND INSPECTIONS

Submit statements asserting that the concrete testing technicians and the concrete inspectors meet the specified requirements; also test results and inspection reports daily and weekly as required.

3.3.1 General

Perform the inspection and tests described in the following paragraphs and, based upon the results of these inspections and tests, take the action required and submit reports as required. When, in the opinion of the Contracting Officer, the concreting operation is out of control,

concrete placement shall cease. The laboratory performing the tests shall be onsite and shall conform with [ASTM C1077](#). The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete construction shall have demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Construction Inspector, Level

II. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with [ASTM C1077](#).

3.3.2 Testing and Inspection Requirements

Submit documentation asserting that the concrete testing technicians and the concrete inspectors meet the specified requirements.

3.3.2.1 Fine Aggregate

3.3.2.1.1 Grading

At least once during each shift when the concrete plant is operating, perform one sieve analysis and fineness modulus determination in accordance with [ASTM C136/C136M](#) and [COE CRD-C 104](#) for the fine aggregate or for each size range of fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to

the mixer within specification limits.

3.3.2.1.2 Corrective Action for Fine Aggregate Grading

When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Contracting Officer.

3.3.2.1.3 Moisture Content Testing

When, in the opinion of the Contracting Officer, the electric moisture meter is not operating satisfactorily, there shall be at least four tests for moisture content in accordance with [ASTM C566](#) during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is out of control or excessive variation in workability is reported by the placing foreman. When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content shall be used to adjust the added water in the control of the batch plant.

3.3.2.1.4 Moisture Content Corrective Action

Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation

device) if necessary to maintain the specified slump.

3.3.2.2 Coarse Aggregate

3.3.2.2.1 Grading

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with [ASTM C136/C136M](#) for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control which are coarser than the specification limits for samples taken at locations other than as delivered to the mixer to allow for degradation during handling.

3.3.2.2.2 Corrective Action for Grading

When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of five tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer.

Concreting

shall be stopped and immediate steps shall be taken to correct the grading.

3.3.2.2.3 Coarse Aggregate Moisture Content

A test for moisture content of each size group of coarse aggregate in accordance with [ASTM C566](#) or [COE CRD-C 112](#) shall be made at least once during a shift. When two consecutive readings for smallest-size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified above for fine aggregate, until the difference falls below 1.0 percent.

3.3.2.2.4 Coarse Aggregate Moisture Corrective Action

Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted if necessary to maintain the specified slump.

3.3.2.3 Quality of Aggregates

Submit aggregate quality tests results at least 30 days prior to start of concrete placement.

3.3.2.3.1 Frequency of Quality Tests

Thirty days prior to the start of concrete placement perform all tests for aggregate quality listed below. In addition, after the start of concrete placement, perform tests for aggregate quality in accordance with the frequency schedule shown below. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

FREQUENCY			
PROPERTY	FINE AGGREGATE	COARSE AGGREGATE	TEST
Specific Gravity	Every 3 months	Every 3 months	ASTM C127 ASTM C128
Absorption	Every 3 months	Every 3 months	ASTM C127 ASTM C128
Clay Lumps and Friable Particles	Every 3 months	Every 3 months	ASTM C142/C142M
Material Finer than the 75 µm No. 200 Sieve	Every 3 months	Every 3 months	ASTM C117
Organic Impurities	Every 3 months	Not applicable	ASTM C40 ASTM C87/C87M
L.A. Abrasion	Not applicable	Every 6 months	ASTM C131/C131M ASTM C535

Soft Particles	Not applicable	Every 6 months	COE CRD-C 130
Petrographic Examination	Every 6 months	Every 6 months	ASTM C295/C295M
Coal and Lignite, less than 2.00 specific gravity	Every 6 months	Every 6 months	ASTM C123/C123M or ASTM C295/C295M

3.3.2.3.2 Corrective Action for Aggregate Quality

If the result of a quality test fails to meet the requirements for quality immediately prior to start of concrete placement, production procedures or materials shall be changed and additional tests shall be performed until the material meets the quality requirements prior to proceeding with either mixture proportioning studies or starting concrete placement. After concrete placement commences, whenever the result of a test for quality fails the requirements, the test shall be rerun immediately. If the second test fails the quality requirement, the fact shall be reported to the Contracting Officer, and immediate steps shall be taken to rectify the situation.

3.3.2.4 Deleterious Substances

3.3.2.4.1 Testing

When, in the opinion of the Contracting Officer, a problem exists in connection with deleterious substances in fine or coarse aggregates, tests shall be made in accordance with ASTM C33/C33M at a frequency as directed, but not less than once per week. Results of tests shall be reported in writing.

3.3.2.6 Batch-Plant Control

The measurement of quantities of all constituent materials batched including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate quantities and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water amounts per cubic meter yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water amounts per cubic meter yard for each class of concrete batched during plant operation. Submit the report to the Contracting Officer.

3.3.2.7 Concrete Mixture

3.3.2.7.1 Air Content Testing

Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government quality assurance representative. Tests shall be made in accordance with [ASTM C231/C231M](#). Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged, and this average shall be used as the air content of the batch to plot on the control charts for air content and range and to determine the need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from subparagraph AIR CONTENT of 1.3 'e'. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer; however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the air content at the mixer controlled as directed.

3.3.2.7.2 Air Content Corrective Action

Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as is practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the control chart range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted. All this shall be at no extra cost to the Government.

3.3.2.7.3 Slump Testing

In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with **ASTM C143/C143M** for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government's quality

assurance representative. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies

of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made on the same batch of concrete. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on the control charts for percent air and for range and to determine the need for

any remedial action. An upper warning limit shall be set at **13 mm 1/2 inch**

below the maximum allowable slump on separate control charts for percent air used for each type of mixture as specified in subparagraph SLUMP of

1.3 'f', and upper and lower action limit lines shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at **50 mm 2 inches**.

Samples for slump shall be taken at the mixer; however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the slump at the mixer controlled as directed.

3.3.2.7.5 Compressive Strength

At least once during each shift, fabricate and cure, in accordance with **ASTM C192/C192M**, four **150 by 300 mm 6 by 12 inch** test specimens. Two specimens shall be tested at 7 days and two at 28 days. If pozzolan is used, six specimens shall be fabricated and two tested at 7 days, two at 28 days, and two at 90 days. Testing shall be in accordance with **ASTM C39/C39M**. The results of compressive strength tests will not be used

for acceptance. Results will be for record purposes and to evaluate the uniformity of concrete production. The results of each set of specimens

tested at each age shall be averaged to produce one "test result". These "test results" shall be plotted on control charts for each age. One control chart shall consist of each "test result" plotted consecutively. One control chart shall consist of the range from the "test result" for

any one day to that of the next day. When the range exceeds **6.9 MPa 1,000 psi**, the Contracting Officer shall be notified and the operation modified

3.3.2.7.6 Temperature

The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with **ASTM C1064/C1064M**. The temperature shall be reported along with the compressive strength data.

3.3.4.6 Backfilling Core Holes

Upon completion of core sampling, the holes shall be backfilled under gravity pressure with portland cement grout or mortar as directed by the Contracting Officer. The grout shall be pumped into the hole through drill rods or plastic hose set to within **1.5 m 5 feet** of the bottom of the hole. The bottom of the core hole is defined as being a point in bedrock **900 mm 3 feet** below the bottom of the panel or the point at which the boring deviates from the cutoff wall.

UNIT
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PART 1 GENERAL

1.1 REFERENCES

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

1.2 SUBMITTALS

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cut CMU or (Brick) Drawings

Reinforcement Detail Drawings;

SD-03 Product Data

Hot Weather Procedures;
Cold Weather Procedures;
Clay or Shale Brick;
Glazed Structural Clay Facing Tile;
Glazed Brick;
Salvaged Brick;
Cement;
Cementitious Materials;
Insulation;

SD-04 Samples

Mock-Up Panel;
Clay or Shale Brick;
Glazed Structural Clay Facing Tile;
Glazed Brick; G[,
Concrete Masonry Units (CMU);
Concrete Brick;
Dimension Stone Units;
Admixtures for Masonry Mortar;
Anchors, Ties, and Bar Positioners;
Joint Reinforcement;
Clay Masonry Expansion-Joint Materials;
Insulation;

SD-05 Design Data

Masonry Compressive Strength;
Fire-Rated Concrete Masonry Units
Bracing Calculations;

SD-06 Test Reports

Efflorescence Test

Fire-Rated Concrete Masonry Units
Field Testing of Mortar
Field Testing of Grout
Prism Tests
Single-Wythe Masonry Wall Water Penetration Test

SD-07

Certificates

Special Masonry Inspector Qualifications
Clay or Shale Brick
Glazed Structural Clay Facing Tile
Glazed Brick
Concrete Masonry Units (CMU)
Concrete Brick
Precast Concrete Units
Cementitious Materials
Admixtures for Masonry Mortar
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Anchors, Ties, and Bar Positioners
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Insulation

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar
Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

SD-11 Closeout Submittals

Recycled Content of Clay
Units; S Recycled Content of
Cement; S

1.3 QUALITY ASSURANCE

1.3.1 Masonry Mock-Up
Panels

1.3.1.1 Mock-Up Panel Location

After material samples are approved and prior to starting masonry work, construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the Contracting Officer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

1.3.1.2 Mock-Up Panel Configuration

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry

represented on the project. Provide a straight panel or a leg of an

L-shaped panel of minimum size 2.5 m 8 feet long by [1.2] [1.8] m [4] [6] feet high.

1.3.1.3 Mock-Up Panel Composition

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. Include a [a masonry bonded corner] [a stacked bond corner] [a bond beam corner] [and] [paring] [and] [installation of electrical boxes and conduit]. When the panel represents reinforced masonry, include a 610 by 610 mm 2 by 2 foot opening placed at least 610 mm 2 feet above the panel base and 610 mm 2 feet away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

1.3.1.4 Mock-Up Panel Construction Method

Where anchored veneer walls or cavity walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Demonstrate provisions to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. When water-repellent is specified to be applied to the masonry, apply the approved product to the mock-up panel. Construct panels on a properly designed concrete foundation.

1.3.1.5 Mock-Up Panel Purpose

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved.

Perform cleaning procedures on the mockup and obtain approval of the Contracting Officer prior to cleaning the building. After completion of the work, completely remove the mock-up panels, including all foundation concrete, from the construction site.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

- a. Pack glazed brick, glazed structural clay tile, and prefaced concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.
- b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 38 degrees C 100 degrees F, or exceeds

32 degrees C 90 degrees F and the wind velocity is greater than 13 km/h 8

mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress;

and protection for newly completed masonry.

1.5.2 Cold Weather Procedures

When ambient temperature is below 4 degrees C 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, f'_m , is [14]Mpa [as indicated for each type of masonry] [indicated in a schedule in this Specification].

2.1.2 Performance - Verify Masonry Compressive Strength

Verify specified compressive strength of masonry using the "Unit Strength Method" of TMS MSJC. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used. Submit test results.

2.2 MANUFACTURED UNITS

2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2.2 Clay or Shale Brick

2.2.2.1 General

2.2.2.1.1 Sample Submittal

Submit brick samples as specified, showing the color range and texture of clay or shale brick. Limit units used on the project to those that conform to the approved sample. Submit sample of colored mortar with applicable masonry unit and color samples of three stretcher units and one unit for each type of special shape.
[indicated].

Provide brick with specified sizes.

[a. Modular size, 92 mm 3-5/8 inches thick, 57 mm 2-1/4 inches high, and

194 mm 7-5/8 inches long.

] [b. Closure size, 92 mm 3-5/8 inches thick, 92 mm 3-5/8 inches high, and 194 mm 7-5/8 inches long.

] [c. Utility size, 92 mm 3-5/8 inches thick, 92 mm 3-5/8 inches high, and 295 mm 11-5/8 inches long.

]

2.2.2.3 Hollow Clay or Shale Brick

Provide hollow clay or shale brick that conforms to ASTM C652, Type [HBS] [HBX] [HBA] [HBB].

- a. Provide brick size of [60] mm inches thick, [110] mm inches high, and [60] mm inches long.
- b. Where vertical reinforcement is shown in hollow brick, provide hollow brick designed to provide precise vertical alignment of the cells, with minimum cell dimension of 64 mm 2-1/2 inches.
- c. Provide hollow brick with minimum compressive strength of [13.1] MPa psi.

2.2.2.5 Glazed Brick and Glazed Structural Clay Facing Tile

Provide [ceramic glazed brick] [glazed facing tile] indicated as conforming to ASTM C1405 [ASTM C126], Type I, Grade [SS] [S], glaze as indicated. In two-faced walls, Type II units may be used for the base course. Provide all shapes and sizes for a complete installation. Use bullnose units along sills and caps and at vertical external corners including door jambs, window jambs, and other such openings. Provide coved base units to meet finished floor surfaces where ceramic tile floor occurs.

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2.2.2.6 Salvaged Brick

Use [lead-free] salvaged bricks and other masonry units in place of new bricks or masonry units as indicated. [Wash bricks salvaged from foundries or industrial buildings with appropriate metal-dust removing cleaner.] When using salvaged brick, select salvaged exterior face bricks from exterior locations.

Provide salvaged bricks that meet standards of new bricks otherwise used in application, and cleaned of all mortar prior to use. Submit documentation certifying products are from salvaged/recovered sources. Indicate relative dollar value of salvaged content products to total dollar value of products included in project.

2.2.3.2.6 Unit Types

- a. Hollow Load-Bearing Units: ASTM C90, lightweight [or medium weight] [or normal weight]. Provide load-bearing units for

exterior walls, foundation walls, load-bearing walls, and shear walls.

- b. Hollow Non-Load-Bearing Units: **ASTM C129**, lightweight [or medium weight] [or normal weight]. Load-bearing units may be provided in lieu of non-load-bearing units.
- c. Solid Load-Bearing Units: **ASTM C90**, lightweight [or medium weight] [or normal weight] units. Provide solid units as indicated.

2.2.3.5 Fire-Rated Concrete Masonry Units

For indicated fire-rated construction, provide concrete masonry units of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated by linear interpolation based on the percent by dry-rodded volume of each aggregate used in manufacturing the units.

TABLE I FIRE-RATED CONCRETE MASONRY UNITS							
Aggregate Type	Minimum Equivalent Thickness for Fire-Resistance Rating, mm inch						
	1/2 hour	3/4 hour	1 hour	1-1/2 hour	2 hours	3 hours	4 hours
Calcareous or siliceous gravel (other than limestone)	50.82.0	70.02.4	71.12.8	91.43.6	106.74.2	134.65.3	157.5 6.2
Limestone, cinders, or air-cooled slag	48.31.9	58.42.3	68.62.7	86.43.4	101.64.0	1275.0	149.9 5.9
Expanded clay, expanded shale, or expanded slate	45.71.8	55.92.2	66.02.6	83.83.3	91.43.6	111.84.4	129.5 5.1
Expanded slag or pumice	38.11.5	48.31.9	53.32.1	68.62.7	81.33.2	101.64.0	119.4 4.7

Determine equivalent thickness in accordance with **ACI 216.1**. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; include the thickness of plaster or brick or other material in the assembly in determining the equivalent thickness. Submit calculation results.

2.2.3.6 Prefaced Concrete Masonry Units

Prefaced concrete masonry units [may] [may not] be provided in lieu of ceramic glazed structural clay facing tile units. Where prefaced concrete masonry units are provided, concrete masonry unit backing may be omitted when the nominal thickness of the prefaced concrete masonry units is the same as the total indicated nominal thickness of the

facing tile plus the backing.

- a. Provide prefaced concrete masonry units conforming to ASTM C744 using masonry units conforming to ASTM C90, with the facing turned over the edges and ends of the unit at least 9.5 mm 3/8 inch in the direction of the thickness of the unit to form a lip at least 1.6 mm 1/16 inch thick. Limit variation in color and texture to that in the approved sample.
- b. Provide all shapes and sized for a complete installation. Use bullnose units along sills and caps and at vertical external corners

including door jambs, window jambs, and other such openings with a bullnose radius of 25 mm 1 inch. Cove base units to meet finished floor surfaces where ceramic tile floor occurs.

2.2.4.2 Precast Concrete Lintels

Provide precast concrete lintels, unless otherwise shown, of a thickness equal to the wall and reinforced with minimum two No. 4 bars for the full length. Provide top and bottom bars for lintels over 914 mm 36 inches in length. Provide at least 200 mm 8 inches bearing at each end. Label the top of lintels and clearly mark each lintel to show location in the structure. Design reinforced lintels in conformance with ACI 318M ACI 318 for flexural and shear strength, using concrete with a minimum 28 day compressive strength of [28] MPa psi. Limit lintel deflection due to dead plus live load to L/600 or 7.6 mm 0.3 inches.

2.3 EQUIPMENT

2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

2.4 MATERIALS

2.4.1 Mortar Materials

2.4.1.1 Cementitious Materials

Provide cementitious materials that conform to those permitted by ASTM C270.

2.4.1.2 Hydrated Lime and Alternates

Provide lime that conforms to one of the materials permitted by ASTM C207 for use in combination with portland cement, hydraulic cement,

and blended hydraulic cement. Do not use lime in combination with masonry cement or mortar cement.

2.4.1.4 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to [ASTM C1384](#), unless Type III portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to [ASTM C1384](#). Provide a water-repellent admixture, conforming to [ASTM C1384](#) and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

2.4.1.5 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by [ASTM C270](#).

2.4.2 Grout and Ready-Mix Grout Materials

2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by [ASTM C476](#).

2.4.2.2 Admixtures for Grout

Water-reducing admixtures that conform to [ASTM C494/C494M](#) Type F or G and viscosity-modifying admixtures that conform to [ASTM C494/C494M](#) Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to [ASTM C494/C494M](#), Type C.

2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by [ASTM C476](#).

2.5 MORTAR AND GROUT MIXES

2.5.1 Mortar Mix

- a. Provide mortar Type [N] [S] [M] unless specified otherwise herein. [Do not use masonry cement in the mortar.] [Do not use air-entrainment in the mortar.]
- b. Use [ASTM C270](#) Type [S] [M] cement-lime mortar or mortar cement mortar for seismic-force-resisting elements indicated. [
- c. Provide mortar that conforms to [ASTM C270](#). Use Type [M] [S] [N] mortar

[for foundation walls] [, basement walls,] [and in piers.]]

- d. Provide Type N or S mortar for non-load-bearing, non-shear-wall interior masonry.]]
- e. Provide approved commercial fire clay mortar or refractory cement (calcium-aluminate) mortar for fire brick and flue liners.]

[c][d][e][f]. For field-batched mortar, measure component materials by volume. Use measuring boxes for materials that do not come in packages, such as sand, for consistent batching. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar unless approved by the Contracting Officer. Maintain workability of mortar by remixing or retempering. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

[d][e][f][g]. For preblended mortar, follow manufacturer's mixing instructions.

2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to [ASTM C476](#), [fine] [coarse]. Use conventional grout with a slump between 203 and [279] mm 8 and [11] inches. Use

2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to [ASTM A615/A615M](#) or [ASTM A996/A996M](#), Grade 60.

2.6.5 Concrete Masonry Control Joint Keys

Provide control joint keys of a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to [ASTM D2000](#) M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to [ASTM D2287](#) Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 16 mm 5/8 inch thick and 10 mm 3/8 inch thick flanges, with a tolerance of plus or minus 1.5 mm 1/16 inch, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

2.6.6 Clay Masonry Expansion-Joint Materials

Provide backer rod and sealant, adequate to accommodate joint compression and extension equal to 50 percent of the width of the joint. Provide the backer rod of compressible rod stock of closed cell polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Provide sealant in conformance with Section 07 92 00 JOINT SEALANTS[with a maximum volatile organic compound (VOC) content of 600 grams/liter].

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 3 mm 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

3.3.1 General

- a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in [running] [stacked] [the indicated] bond pattern. Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus 13 mm 1/2 inch. Adjust each unit to its final position while mortar is

still soft and has plastic consistency.

- b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.

- c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Tooothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of 610 mm 2 feet down on each side of the wall and hold securely in place.
- d. UnitEnsure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 13 mm 1/2 inch into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.
- d. In multi-wythe construction with collar joints no more than 20 mm 3/4 inch wide, bring up the inner wythe not more than 400 mm 16 inches ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm 3/8 inch.

3.3.1.1.4 Joint Widths

- a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit, within tolerances permitted by TMS MSJC.
- b. Provide 10 mm 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.
- c. Provide 10 mm 3/8 inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than 5 mm 3/16 inch nor more than 6 mm 1/4 inch wide on prefaced side.

3.3.1.4 Clay Masonry Expansion Joints

Provide clay masonry expansion joints as indicated. Construct by [leaving a gap] [filling with a compressible foam pad]. Ensure that no mortar or

other noncompressible materials are within the joint. Install backer rod and sealant in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.2 Clay or Shale Brick Masonry

3.3.2.1 Brick Placement

Blend all brick at the jobsite from several cubes to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable. Lay brick facing with the better face exposed. Lay brick in running bond with each course bonded at corners, unless otherwise indicated. Lay molded brick with the frog side down. Do not lay brick that is cored, recessed, or has other deformations in a manner that allows those deformations to be exposed to view; lay 100 percent solid units in these areas. Completely fill head and bed joints of solid units with mortar. Lay hollow units with mortar joints as specified for concrete masonry units. [Lay fire brick by dipping each brick in a soft mixture of fire clay and water and then rubbing the brick into place with joints as thin as practicable or provide refractory mortar with joints not more than 10 mm 3/8 inch thick.]

Place exterior face of salvaged bricks towards the exterior.

3.3.2.2 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 0.155 gm per minute per square cm 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C67. Ensure that each unit is nearly saturated when wetted but surface dry when laid.

Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly

selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.3.2.6 Partitions

- a. Construct partitions continuous from floor to underside of floor or roof deck where shown. Fill openings in firewalls around joists and other structural members as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 100 mm 4 inches above the ceiling level. Construct an isolation joint in the intersection between partitions and structural or exterior walls.

- b. Tie interior partitions having 100 mm 4 inch nominal thickness units to intersecting partitions of 100 mm 4 inch units, 125 mm 5 inches into partitions of 150 mm 6 inch units, and 175 mm 7 inches into partitions of 200 mm 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of

partition or solid masonry units may be used. Tie interior partitions over 100 mm 4 inches thick together with joint reinforcement. Provide joint reinforcement with prefabricated pieces at corners and intersections of partitions.

- c. Double-Faced Bases or Partitions: Construct double-faced clay unit bases and partitions of two-unit construction. Bond units by overlapping from opposite faces of the wall, 50 mm for 150 mm 2 inches for 6 inch thick partitions and 100 mm for 200 mm 4 inches for 8 inch thick or greater. A single wythe prefaced concrete masonry base or partition may be made with double faced units.

-- End of Section --

General Notes:

This specification is for general use of construction Projects.

The parts which met the project criteria are applicable in this project.

All project cost and payments are just according to the main contract.

All details and drawings are provided in architecture and structure map of the project.