



PORTICUS CSP
INGENIERIA

ESTADO LIBRE ASOCIADO DE PUERTO RICO

**OFICINA DE
ADMISTRACIÓN DE TRIBUNALES**

PUERTO RICO SUPREME COURT BUILDINGS
SEISMIC RETROFIT

ANNEX BUILDING

TECHNICAL SPECIFICATIONS

El Ingeniero,

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CERTIFICO QUE LAS ESPECIFICACIONES CONSTAN DE 90 PÁGINAS.

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PUERTO RICO SUPREME COURT BUILDINGS SEISMIC RETROFIT

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**SECTION 01710
CLEANING UP**

1. GENERAL

During its progress the work and the adjacent areas affected thereby shall be kept cleaned up and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.

Where material or debris has washed or flowed into or been placed in existing watercourses, ditches, gutters, drains, pipes structures, work done under this contract, or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipes, structures, and work, etc., shall, upon completion of the work, be left in a clean and neat condition.

On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary works, tools, and machinery or other construction equipment furnished by him; shall remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around privies, houses, and other buildings used by him; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operations in a neat and satisfactory condition.

The Contractor shall thoroughly clean all materials and equipment installed by him and his sub-contractors, and on completion of the work shall deliver it undamaged and in fresh and new-appearing condition. All mechanical equipment shall be left fully charged with lubricant and ready for operation.

The Contractor shall restore or replace, when and as directed, any public or private property damaged by his work, equipment, or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required all necessary highway or driveway, walk, and landscaping work. Suitable materials, equipment, and methods shall be used for such restoration. The restoration of existing property or structures shall be done as promptly as practicable as work progresses and shall not be left until the end of the contract period.

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SECTION 02050
DEMOLITION AND ALTERATIONS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Demolition and alterations of existing facilities as indicated on drawings, as specified and directed by Engineer.
- B. Removal, salvage, or other disposition of minor site improvements as specified in Section 02100, Site Preparation.

1.02 RELATED WORK:

- A. Section 02100: Site Preparation

1.03 QUALITY ASSURANCE:

- A. Accomplish demolition and removal of existing construction, utilities, equipment, and appurtenances without damaging integrity of existing structures, equipment, and appurtenances that are to remain.
- B. Store equipment to be salvaged for relocation where directed by Engineer, and if necessary, protect from damage during work.
- C. Repair or remove items that are damaged. Repair and installation of damaged items at no additional compensation and to condition at least equal to that which existed prior to start of work.
- D. Exercise all necessary precautions for fire prevention. Acceptable fire extinguishers made available at all times in areas where demolition work by burning torches is being done. Burning of demolition debris not permitted on or near site.
- E. Provide protection of persons and property throughout progress of work. Proceed in such manner as to minimize spread of dust and flying particles

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and to provide safe working conditions for personnel.

- F. Maintain circulation of traffic within area at all times during demolition operations.
- G. Obtain permission from Engineer before abandoning or removing any existing structures, materials, equipment and appurtenances.
- H. Arrange with and perform work required by utility companies and municipal departments for discontinuance or interruption of utility services due to demolition work.

1.04 SUBMITTALS:

Submit demolition plan to Engineer for review, describing proposed sequence, methods, and equipment for demolition and disposal of each structure.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 DEMOLITION:

- A. Confine apparatus, storage of material, demolition work, new construction, and operations of workmen to areas that will not interfere with continued use and operation of entire facility. Provide and maintain lights, barriers, and temporary passageways for free and safe access.
- B. Wet down work during demolition operations to prevent dust from arising. Provide maximum practicable protection from inclement weather for materials, equipment, and personnel located in partially dismantled structures. Provide shoring or bracing where necessary to prevent settlement or displacement of existing or new structures. Do not overload floors. Complete demolition work on upper levels before disturbing supporting members on lower levels.

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3.02 SALVAGE:

- A. Materials, equipment, and appurtenances removed, that are not designated for relocation, become property of Contractor and hauled from site and disposed of at no additional compensation.

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SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish and place all reinforcement and accessories.

1.02 RELATED WORK:

- A. Section 03300 Cast-in-Place Concrete

1.03 QUALITY ASSURANCE:

- A. Fabrication: Materials for which shop drawings are required not to be fabricated before review of the drawings by the Engineer. Tolerances conforming to ACI MNL-66.
- B. Placement: Place reinforcement to tolerances given in ACI 318.
- C. When welding indicated, specified, or authorized by Engineer, reinforcement, procedures, and welding to conform with requirements of AWS D1.4.
- D. All welding performed by qualified operators, certified within the past 12 months and to conform with requirements of AWS D1.4.

1.04 REFERENCES:

- A. ASTM A615-87a, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- B. ASTM A185-85, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- C. MNL-66, ACI Detailing Manual, 2020.
- D. ACI 318-14, Building Code Requirements for Reinforced Concrete, and

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Commentary.

- E. AWS D1.4-11, American Welding Society, Structural Welding Code, Reinforcing Steel.

1.05 SUBMITTALS:

A. Certificates:

1. Submit certified mill test reports for each shipment of reinforcement showing that steel complies with applicable specification. Reports to be identified with specific lots in shipment and submitted prior to use of reinforcement in work.
2. Submit chemical composition of reinforcement steel. Ladle analysis to state percentage of carbon, phosphorous, manganese and sulfur present in steel.
3. Submit Welder's certification in accordance with AWS D1.4 prior to welding when welding indicated, specified or approved by Engineer.

B. Shop and Placement Drawings:

1. In accordance with Section 01000 for review by Engineer prior to fabrication.
2. Show construction and expansion joints.
3. Show reinforcement detailed in conformance with ACI SP-66.
4. Show details of bar supports including types, sizes, spacing, sequence and support bars.
5. Show marking for each reinforcement item.
6. Submit bar schedule lists giving weight for each individual bar, total weight of each bar size and total weight of all bars on the list, based on nominal weights shown in ASTM A615.

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1.06 DELIVERY, STORAGE AND HANDLING:

- A. Reinforcement and accessories shipped to work with items of same size and shape fastened in bundles with securely wired-on metal identification tags giving size and mark.
- B. Reinforcement and accessories stored above ground on platforms, skids or other supports and covered.
- C. Reinforcement to be protected from rusting, deforming, bending, kinking and other injury.

PART 2 - PRODUCTS

2.01 STEEL REINFORCING BARS:

- A. Newly rolled deformed billet-steel bars for concrete reinforcement conforming to ASTM A615, Grade 60, unless otherwise indicated.
- B. When welding of reinforcement indicated, specified, or approved by Engineer, reinforcement must be weldable steel. Welding of epoxy-coated reinforcement not permitted.
- C. Reinforcing bars mill bent, cold. Conform to dimensions indicated and requirements of ACI MNL-66.

2.02 TIE WIRE:

- A. Mild steel or annealed iron.
- B. Minimum 16 gage.
- C. Plastic, epoxy or nylon-coated tie wire to be used for epoxy-coated reinforcement.

2.03 REINFORCING BAR SUPPORTS:

- A. Support Bars No. 5 minimum.

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- B. Bar supports in contact with exposed surfaces plastic protected in conformance with ACI SP-66 (Class 1 - Maximum Protection).
- C. Precast concrete blocks with wires and/or dowels for bar supports 3-in. by 3-in. and of thickness necessary to produce required concrete cover of reinforcement. Type II cement for blocks in accordance with Section 00300.

2.04 WELDED WIRE FABRIC:

- A. Conform to ASTM A185.
- B. Gage and spacing as indicated.

PART 3 - EXECUTION

3.01 PLACEMENT:

- A. Before placing in form, all reinforcement and accessories to be cleaned thoroughly of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings of any character that would destroy or reduce the bond with the concrete.
- B. Reinforcing bars to be accurately placed and securely held in position using tie wire with ends pointed away from forms.
- C. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, resulting arrangement of bars is subject to acceptance by Engineer. Place required number of bars.
- D. Use chairs, bolsters, spacers and other approved devices of sufficient strength to resist crushing under load in accordance with ACI SP-66. Metal chairs which extend to the surface of the concrete, stones, brick chips etc., and wood block supports not to be used.
- E. For foundation mats, base slabs, and slabs on grade use precast concrete bar support blocks.
- F. Placing bars on layers of fresh concrete as the work progresses, and adjusting bars during the placement of concrete not permitted.

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- G. Place bar laps in contact and tie securely, or space transversely apart to permit embedment of entire surface of each bar in concrete. Length of laps for bars to conform with requirements of ACI 318, except as otherwise indicated.
- H. Do not splice reinforcement steel in mats, slabs, beams, girders and walls at points of maximum stress unless otherwise indicated.
- I. Wire-mesh reinforcement to be lap spliced at least two full meshes; stagger to avoid continuous laps in either direction and wire securely.
- J. Reinforcement continuous through construction joints except as otherwise indicated.
- K. Reinforcement or other fixed metal items not continuous through expansion joints. Reinforcement clearance of two inches from each face of expansion joint.
- L. Do not field bend bars including bars partially embedded in concrete unless indicated or authorized by Engineer. Do not straighten or bend in manner injurious to steel, epoxy coating or concrete.
- M. Do not place bars that have kinks and bends other than shown on approved shop drawings. Reject and remove such damaged bars and replace at no additional compensation.
- N. Use of heat to bend or straighten reinforcing steel not permitted.
- O. Welding of reinforcing bars permitted only where indicated or as otherwise directed by Engineer. Such welding in accordance with AWS D1.4.
- P. Welding reinforcing steel only by operators certified in accordance with AWS D1.4.
- Q. Tack welding to, or of, reinforcement prohibited.
- R. Paint reinforcement which is to be exposed for more than 90 days with coat of neat cement grout to prevent rust formation.

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PART 4 - SUBSECTION INDEX

A. GENERAL

- 1.01 Description
- 1.02 Related Work
- 1.03 Quality Assurance
- 1.04 References
- 1.05 Submittals
- 1.06 Delivery, Storage and Handling

B. PRODUCTS

- 2.01 Steel Reinforcing Bars
- 2.02 Tie Wire
- 2.03 Reinforcing Bar Supports
- 2.04 Welded Wire Fabric

C. EXECUTION

- 3.01 Placement

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SECTION 03300
CAST IN PLACE CONCRETE

For listings of subsections, see subsection index at end of section.

PART 1 - GENERAL

1.01 DESCRIPTION:

Place, finish, protect, and cure, cast-in-place concrete as indicated and specified.

1.02 RELATED WORK:

- A. Section 03200: Concrete Reinforcement

1.03 QUALITY ASSURANCE:

- A. Concrete work in conformance with ACI-301, with one or more copies kept in the Project Field Office at all times.
- B. Admixtures, including calcium chloride, causing accelerated setting of cement in concrete not to be used.
- C. No concrete placed until materials and mix design have been accepted by Engineer.
- D. Test conformity of aggregates to specifications, and actual proportions of cement, aggregates, admixtures when used, and water necessary to produce concrete by an independent accredited testing laboratory employed by Owner and conforming to requirements set forth in Tables A and B. One set of test samples of cement, aggregates, and admixtures paid by Owner. Cost of determining correct proportions for each class of concrete, for each size of coarse aggregate, and for each slump to be used during construction paid by Owner. Laboratory cylinders conform to ASTM C192. Should materials prove to be unacceptable, or should Contractor desire to use aggregate not included in first set of tests, cost of additional tests by Contractor using same Laboratory employed by Owner. If job site concrete is not of required strength, produce new design mix at no

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additional compensation.

- E. Mix Design, Test, Adjustment: Mix design prepared by an independent accredited testing laboratory employed by Owner.

Trial mixes having proportions, admixtures, and slump actually proposed for use, based on ACI 211.1, using at least three different water-cement ratios which will produce a range of strengths encompassing those required for the work. Mixes designed for maximum permitted air and slump. The temperature of concrete used in trial batches to be reported. For each water-cement ratio, at least three compression test cylinders for each test age, made and cured in accordance with ASTM C192 and compression tested at 7 and 28 days in accordance with ASTM C39. From these test results, a curve to be plotted showing the relationship between water-cement ratio and strength. For each strength of concrete, the maximum allowable water-cement ratio to be that shown by these curves to produce an average compressive strength 15 percent greater than specified. The design mix water-cement ratio not to exceed that shown in Table A. Additional testing required when unsatisfactory results from original sample batches, or introduction of new materials sources, as provided in Section 01000. All tests for design and adjustment done by same laboratory employed by Owner.

- F. All Materials for concrete, including water, measured with equipment and facilities suitable for accurate measurement and capable of being adjusted in conformance with ASTM C94. Scales certified by local Sealer of Weights and Measures within one year of use and accurate when static load tested to plus or minus 0.4 percent of total capacity of scale.
- G. Site-mixed concrete plant and all operations pertaining to production of concrete subject to inspection and specific acceptance of Engineer.
- H. Control test specimens, slump tests, air content, and temperature tests taken in field by the Contractor in the presence of the Engineer.
- I. Methods of Sampling and Testing:
 - 1. Fresh Concrete Sampling: ASTM C172

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2. Specimen Preparation: ASTM C31
3. Compressive Strength: ASTM C39
4. Air Content: ASTM C231
5. Slump: ASTM C143
6. Unit Weight: ASTM C138
7. Obtaining Drilled Cores: ASTM C42

J. Acceptance of Structure: Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance, and strength as specified herein, on the drawings and in Chapter 18 of ACI 301.

1.04 CONCRETE TOLERANCES:

A. Finish Tolerances:

1. As defined in ACI 301, Table 4.3.1.
2. Maximum horizontal deviation in visible concrete structures not to exceed 1/4 in. from level, in 10 ft. as determined by a 10 ft. straight edge placed anywhere on the slab in any direction unless otherwise specified or indicated.

1.05 REFERENCES:

- A. ACI 211.1R-09, Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete.
- B. ACI 301-16, Specifications for Structural Concrete for Buildings
- C. ACI 304R-00, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- D. ACI 305R-10, Hot Weather Concreting

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- E. BLANK
- F. ACI 308R-16, Standard Practice for Curing Concrete
- G. ACI 309R-05, Standard Practice for Consolidation of Concrete
- H. ACI 318-14, Building Code Requirements for Reinforced Concrete
- I. ACI 347R-14, Recommended Practice for Concrete Formwork
- J. ASTM A123-84, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- K. ASTM A153-87, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- L. ASTM C31-88, Standard Method of Making and Curing Concrete Test Specimens in the Field
- M. ASTM C33-86, Standard Specification for Concrete Aggregates
- N. ASTM C39-86, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- O. ASTM C40-84, Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
- P. ASTM C42-87, Standard Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- Q. ASTM C67-87, Standard Methods of Sampling and Testing Brick and Structural Clay Tile
- R. ASTM C94-86b, Standard Specification for Ready-Mixed Concrete
- S. ASTM C138-81, Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- T. ASTM C143-78, Standard Test Method for Slump of Portland Cement

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Concrete

- U. ASTM C150-86, Standard Specification for Portland Cement
- V. ASTM C171-69 (1986), Standard Specification for Sheet Materials for Curing Concrete
- W. ASTM C172-82, Standard Method of Sampling Freshly Mixed Concrete
- X. ASTM C192-88, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- Y. ASTM C231-82, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- Z. ASTM C260-86, Standard Specification for Air-Entraining Admixtures for Concrete

- BA. ASTM C289-87, Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
- BB. ASTM C309-81, Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
- BC. ASTM C827-87, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
- BD. ASTM C1064-86, Standard Test Method for Temperature of Freshly Mixed Portland-Cement Concrete
- BE. ASTM E154-68(1979), Standard Methods of Testing Materials for use as Vapor Barriers Under Concrete Slabs and as Ground Cover in Crawl Spaces
- BF. ASTM C827-87, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
- BG. ASTM C1064-86, Standard Test Method for Temperature of Freshly Mixed Portland-Cement Concrete

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BH. ASTM E154-68(1979), Standard Methods of Testing Materials for use as Vapor Barriers Under Concrete Slabs and as Ground Cover in Crawl Spaces

Bl. Federal Specification CCC-C-467C: Cloth, Burlap Jute or Kenaf

BJ. U.S. Department of Commerce, National Bureau of Standards (NBS) Product Standards PS 1-74, Plywood Design Specification

1.06 SUBMITTALS:

A. Contractor to furnish, deliver and be responsible for all costs associated with samples of cement, admixtures, fine and coarse aggregates to laboratory employed by Owner in ample time for determination of concrete mix design before using. Submit at least 2 cu. ft. of each size of aggregate in suitable containers. All samples plainly and neatly labeled indicating source, place of usage, date, and name of collector.

B. Design Mixes: Mix designs as specified herein.

C. Certificates:

1. Submit manufacturer's cement mill test, admixtures, curing materials, and non-shrink non-metallic grout.
2. For each shipment of cement, regardless of quantity, furnish certified copies of mill test reports to Engineer prior to incorporation of the cement into the work.

D. Batch ticket written in ink with each batch delivered to site as specified in ASTM C94 and in addition state:

1. Load number
2. Class of concrete (compression strength)
3. Amount of concrete (cu. yds.)
4. Time truck is charged with cement

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5. Reading of revolution counter at first addition of water
6. Type, brand and amount of cement
7. Type, brand and amount of admixture
8. Information necessary to calculate total mixing water
9. Maximum size of aggregate
10. Weights of fine and coarse aggregates
11. Ingredients certified as being previously approved by the Engineer
12. Signature of ready-mix representative

1.07 DELIVERY:

- A. Transport ready-mixed concrete to site in watertight agitator or mixer trucks.
- B. Dispatch trucks from batching plant so they arrive at site just before concrete is required, thus avoiding excessive mixing of concrete while waiting, or delays in placing successive layers of concrete in forms.
- C. Concrete delivered without a complete delivery batch ticket shall be rejected.
- D. Concrete exceeding time limitations and temperature constraints will be rejected for all work.

1.08 JOBSITE CONDITIONS:

- A. At least 20 hours prior to actual placement, notify Engineer of intention to produce and place concrete.
- B. Do not place concrete until conditions and facilities for making, storage, handling, and transportation of control test specimens are in compliance with ASTM C31.

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PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Portland cement: American-made, ASTM C150, one approved brand from one mill used throughout work. For exposed concrete, use cement of uniform color.
1. Type I for all work.
 2. Lumpy, wetted, partially or wholly set cement is sufficient cause to reject entire shipment.
 3. Cement without efflorescence, in exposed concrete, when tested in accordance with ASTM C67. 2-in. by 7-in. by 1/2-in. mortar slabs for testing, having 1:3 mixture by weight of cement and Ottawa sand, mixed with local tap water to 100 percent flow and aged one week before test. Place, time, frequency, and method of sampling, determined by Engineer in accordance with particular conditions of project.
- B. Water for concrete potable and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances, and conform to the requirements for water specified in ASTM C94.
- C. Aggregates:
1. Fine aggregates for normal weight concrete consist of well graded, natural sand conforming to ASTM C33, and to the following requirements:
 - a. Fineness modulus: 2.50 to 3.10
 - b. Organic impurities: Color intensity not darker than 2/3 standard color solutions. (Not darker than Organic Plate No. 2, determined by ASTM C 40.)
 - c. Mortar strength: Compression ratio 95 percent, minimum.

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- d. Soundness: Weighted average loss, after 5 cycles of magnesium sulfate soundness test, 10 percent, maximum.
 2. Coarse aggregates for normal weight concrete consist of well graded gravel or crushed stones conforming to ASTM C33 and to the following requirements:
 - a. Organic impurities: Color intensity not darker than one-third intensity of standard color solution. (Not darker than Organic Plate No. 1 determined by ASTM C40.)
 - b. Soundness: Weighted average loss, after 5 cycles of magnesium sulfate soundness test, 14 percent, maximum.
 3. Coarse aggregate shall conform to the following sizes:
 - a. 2 in.; massive concrete (30 in. or thicker).
 - b. 1-1/2 in.; footings, foundation mats, and walls 8 in. or more in thickness.
 - c. 3/4-in.; slabs, beams, girders, columns, and walls less than 8-in. thick.
 - d. 1/2-in.; fireproofing around structural steel beams and columns.
 4. Test conformity of aggregate and insure that aggregates intended for use in concrete is potentially non-reactive when tested in accordance with ASTM C289.
- D. Admixtures: Admixtures which have been in storage for longer than 6 months or which have been subjected to freezing shall not be used until proved by retest to be satisfactory.
1. Air-Entrainment:
 - a. Air entrain all concrete. Use admixture meeting ASTM C 260, MBVR, Master Builders Co., Cleveland, OH; Darex AEA, Dewey &

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Almy Chemical Div., of W. R. Grace Co., Cambridge, MA; Sika AER, Sika Chemical Corp., Lyndhurst, NJ; Euco Air Mix, The Euclid Chemical Co., Cleveland, OH.

- b. Ensure average air content in field mixtures equals 5 percent plus or minus one percent when measured by means of an Acme Air Meter, or acceptable equivalent, and in conformance with ASTM C231.

2. Water Reducer:

- a. Use admixture meeting ASTM C494, Type A, Pozzolith 200 N by Master Builders Co., Cleveland, OH; WRDA, Dewey & Almy Chemical Div. of W.R. Grace Co., Cambridge, MA; Eucon WR-75 by The Euclid Chemical Co., Cleveland, OH.
- b. Do not use admixture in greater dosages than recommended by manufacturer. Do not exceed permitted dosage of admixture that results in increase in drying shrinkage of concrete in excess of 5 percent.
- c. Ensure that strength of concrete with proposed admixture, after 48 hours, is not less than strength of similar concrete without admixture.
- d. Ensure that specified air content is not adversely affected by the admixture.

3. General Requirements:

- a. Maintain compressive strength and water-cement ratios given in Table A when using admixtures. When using admixtures in solution form, solution quantity included in water-cement ratio calculations.
- b. Do not use calcium chloride, admixtures causing accelerated setting of cement or combinations of admixtures and cements producing erratic or otherwise undesirable results with aggregates.

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- D. Curing Compound: Consists of liquid which, when applied to fresh concrete by means of spray gun, will form impervious membrane over exposed surface of concrete with compound not preventing future bond of floor covering, and concrete floor treatment. Use Type I-D compound with red fugitive dye, Class B, in conformance with ASTM C309.
- E. Waterproof Curing Sheet: Waterproof paper or white opaque polyethylene film conforming to ASTM C171.
- F. Cloth, Burlap, Jute or Kenaf: CCC-C-467C.
- G. Vapor Barrier: Polyethylene sheet, 6 mils thick conform to ASTM E154 or polyethylene-coated asphalt-saturated reinforced kraft paper.
- H. Dovetail Anchor Slots: 24-gage hot-dip galvanized steel, foam-filled No. F-17 manufactured by The Dayton Sure-Grip & Shore Co., Miamisburg, OH; No. 100 manufactured by Heckmann Products, Inc., Chicago, IL; No. 305 manufactured by Hohmann & Barnard Inc., Hauppauge, NY; or acceptable equivalent, compatible with dovetails.
- I. Adjustable Inserts: Ductile iron wedge inserts, Type F-7, manufactured by The Dayton Sure-Grip & Shore Co., Miamisburg, OH; malleable iron wedge inserts, Type HW, manufactured by Hohmann & Barnard Inc., Hauppauge, NY; malleable iron peerless wedge inserts manufactured by Richmond Screw Anchor Co., Inc., Ft. Worth, TX. All inserts to be galvanized in accordance with ASTM A123 and A153.
- J. Non-shrink, Non-metallic Grout: Commercial formulation of proven satisfactory performance requiring only addition of water with minimum 28-day compressive strength of 5,000 psi, with zero percent volume change for plastic state in accordance with ASTM C827. Grout (5-star) manufactured by U.S. Grout Corp., Old Greenwich, CT; Upcon 262 manufactured by Upco Div. of Emhart Chemical Group, Cleveland, OH; or acceptable equivalent.
 - 1. ASTM C618, Class C or F including requirements of Table 1A.
 - 2. Chemical and physical properties to conform with requirements for

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Class C fly ash.

3. Supplemental requirements in percent:

a.	Maximum carbon content	3%
b.	Maximum loss on ignition	3%
c.	Maximum water requirement (as a percent of control)	100%
d.	Fineness, maximum retained on No. 325 sieve	25%

2.02 MIXES:

- A. Provide ready-mixed, air-entrained concrete composed of Portland cement, aggregate, water, and admixtures, secured from single local plant, conforming to ASTM C94, capable of being placed without segregation, and capable of developing specified characteristics.
- B. Class B concrete used whenever low-strength concrete is permitted by the Engineer, including concrete fill under foundations. Class A, Class C and Class D concrete used where specified or indicated. Class C concrete used for all concrete fills and toppings.
- C. Secure, for every part of work, concrete of homogeneous structure having required strength, water-tightness, and durability. Give careful attention to selection of materials, mixtures, placing, spading, vibrating, and curing.
- D. Classes:
 - 1. Concrete: Meeting limiting requirements in Table A.

TABLE A

Minimum compressive strength at	Maximum water cement ratio (Minimum	Calculated Maximum gallons of
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Class	28 days, psi	sacks /c.yard)	water /c.yard
A	3,000	0.68	33
B	4,000	0.60	36
C	5,000	0.50	32

- E. Consistency: Carefully mix concrete to produce homogeneous, fluid material capable of being worked into constricted areas of forms, corners and around embedded items, without segregation or free water bleeding. Provide slump ranges listed in Table B. Measure consistency by ASTM C143.

TABLE B

Portion of Structure	Slump, inches	
	Maximum	Minimum
Massive sections	2	1
Footings, foundation mats, and walls 8-in. or more thick	3	1
Slabs, beams, girders, columns, walls less than 8-in. thick, and fire-proofing around structural steel beams and columns	4	1

Provide additional slump if needed for pumped concrete to provide slump per Table B at discharge of pumpline.

2.03 FORMS:

- A. In accordance with ACI 347.
- B. Design: Studs and wales spaced to prevent deflection of form sheeting. Forms sufficiently tight to prevent leakage of grout and cement paste

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during placing of concrete. Bottom of forms accurately fitted and securely attached to preceding lift to assure smooth, completed surfaces free from irregularities and offsets. Joints between form work panels arranged vertically and horizontally to match architectural lines and construction joints. Provide temporary openings in wall and column forms, where needed to facilitate cleaning and inspection. Forms readily removable without impact or damage to concrete.

- C. Concrete Surface Not Exposed to View: Concrete surfaces which will not be exposed to view in finished work formed with sound, tight lumber or other material producing equivalent finish.
- D. Concrete Surfaces Exposed to View or Painted: Concrete surfaces to be exposed to view or painted formed with material that is not reactive with concrete. Surfaces equivalent in smoothness and appearance to that produced by new plywood panels conforming to PS 1, Exterior Type, Grade B-B, 4 by 8 foot panels except where otherwise approved or required by location of openings, architectural lines or joints. Cut surfaces treated with form coating. Do not use form materials with defects that would impair texture and appearance of finished surfaces. Form lining, if used, installed over solid backing. Round concrete column formed with prefabricated seamless removable type forms.
- E. Form Ties: Form ties factory-fabricated, snap-off ties of design that will not permit form deflection and will not spall concrete upon removal. Solid backing provided for each tie. Ties fitted with devices that will leave holes in concrete surface not less than 3/8 inch nor more than 1 inch in diameter and 1 inch deep. Portion of tie remaining permanently in concrete to be at least 1 inch back from any concrete surface. Provide ties which pass through walls subjected to hydrostatic pressure, including exterior foundation walls with acceptable waterstops, such as metal washers, securely and continuously fastened to ties.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Batch, mix, and deliver portland cement concrete in accordance with ASTM C94. Batch all constituents at central batching plant. Produce

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concrete in accordance with ACI 301, Chapter 7, and as specified.

3.02 FORMS:

A. General:

1. Inspect forms and embedded items before placing concrete. Ensure that forms and excavation are free from water, dirt, debris, and foreign matter when concrete is placed.
2. Use forms for all concrete including footings, and foundation mats.
3. Ensure that forms are true to line, and within specified Finish Tolerances. Correct deviations by and at expense of Contractor as directed by Engineer, even to extent of tearing down and rebuilding concrete.
4. Ensure that all forms have acceptable non-staining oil or liquid form coating before placing reinforcement.
5. Thoroughly clean all surfaces in contact with concrete. Repair all damaged surfaces and withdraw all projecting nails before reusing form material.

B. Walls, Columns or Piers: Arrange with suitable openings so concrete placed to prevent segregation and accumulations of hardened concrete on forms or reinforcement above fresh concrete, unless special spouts are used to place concrete. Construction joints properly keyed, unless otherwise indicated, and treated.

C. Removal of Forms:

1. Do not remove forms until concrete has aged as follows:
 - a. Beams, slabs, columns, piers.
 - b. Walls and vertical surfaces: 3 days minimum
2. Do not remove forms and/or shores under beams, slabs, columns,

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and piers until concrete has attained at least 70 percent of specified 28 day strength and also sufficient strength to support safely its own weight and construction live loads, unless otherwise indicated.

3.03 JOINTS AND EMBEDDED ITEMS:

A. Construction Joints:

1. Make construction joints straight and as inconspicuous as possible, and in exact vertical or horizontal alignment with structure.
2. Thoroughly clean surface of concrete at construction joints and remove laitance prior to placing adjoining concrete. As allowance for shrinkage, do not place concrete against hardened side of construction joint for at least 48 hours. Where bonding required, use only approved materials.
3. Conform with Section 03251.

B. Embedded Items:

1. Clean embedded items of oil or foreign matter.
2. Install in formwork requisite inserts, anchors, sleeves, and other items specified under other sections of these specifications. Close ends of conduits, piping and sleeves embedded in concrete with caps or plugs.
3. Complete required tests on embedded piping before starting concrete placement.
4. Before depositing concrete check location and support of piping, electrical conduits, and other items fully or partially embedded.

3.04 VAPOR BARRIER:

A. Installation:

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1. Vapor barrier material to be installed under all interior floor slabs on ground when indicated on the drawings.
2. The material to be laid with a 6 in. lap at joints, and joints seal taped as recommended by the vapor barrier manufacturer. Material cut for slab openings to be taped to the pipe, conduit or other items passing through the slab. Tape to be as recommended by the vapor barrier manufacturer.
3. The installed vapor barrier to be without punctures and adequately protected until concrete is placed.
4. Do not place concrete over vapor barrier until the condition of it has been approved by the Engineer. If breaks do occur in the vapor barrier, patch and seal to the satisfaction of the Engineer.

3.05 TRANSPORTING AND MIXING:

- A. General: Conform to concreting procedures set forth in ACI 304 and requirements specified.
 1. Transport concrete to jobsite in revolving drum truck mixers in manner that assures efficient delivery to point of placement without significantly altering specified properties of water-cement ratio, slump, air entrainment, and homogeneity.
 2. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drums or before the drum has revolved 300 revolutions after the addition of water, whichever comes first. Do not add re tempering water at jobsite, nor exceed specified maximum water content.
 3. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified here is necessary, in conformance with the following requirements:
 - a. When concrete temperature at time of placement is between 85 and 90 degrees F, reduce mixing and placement time from 90 to 75 minutes.

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- b. When concrete temperature at time of placement is between 90 and 95 degrees F, reduce mixing and placement time from 75 to 60 minutes.
 - c. Concrete in excess of 95 degrees F shall be rejected.
 - B. Conveying: Convey concrete from mixer to place of final deposit in forms by one of following methods which permit handling at specified slump without segregation:
 1. Buckets or hoppers with discharge gates having a clear opening equal to not less than one-third maximum interior horizontal area or five times maximum aggregate size being used, whichever is greater, and side slopes not less than 60 degrees to horizontal.
 2. Buggies or wheelbarrows equipped with pneumatic tires.
 3. Chutes, constructed of metal or metal-lined, with round bottom, inclined slope of between two to three feet horizontally to one foot vertically, and sufficient capacity to avoid overflow.
 4. Circular drop pipes with top diameter of at least eight times maximum aggregate size, but not less than 4 in., or tapered to not less than six times maximum aggregate size.
 - C. Site Mixing:
 1. Mix in acceptable batch mixer with capacity of not less than 1/2-cu. yd. Volume of mixed batch not to exceed manufacturer's rated capacity of mixer.
 2. Minimum mixing time for each batch (from time when all solid materials and water are in drum) not less than 1 minute for mixers of 1-cu. yd. capacity or less; for mixers of larger capacity, mixing time increased 15 seconds for each additional cu. yd. or fraction thereof of additional capacity. Revolve mixer at uniform peripheral speed of about 200 fpm. Entire batch discharged before mixer is recharged.

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D. Remixing:

1. Remix concrete, which has become compacted or segregated during transportation to or on site, just prior to being placed in forms.
2. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete not permitted. Remove all partially hardened concrete from site at no additional compensation.

3.06 PLACING:

- A. Whenever possible, place concrete during normal working hours. When concrete placement schedules require concrete placement at times other than normal working hours, notify Engineer of special conditions at least 48 hours in advance of placement.
- B. Deposit concrete at its final position in formwork, to preserve slump, air content, and homogeneity in accordance with ACI 304, and as specified herein. Place concrete in horizontal layers 1-1/2 to 2 feet thick completely across forms, avoiding inclined layers and cold joints. On sloping surfaces, place concrete at lower portion of slope first.
 1. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from mortar). Do not move concrete horizontally more than five feet from point of discharge. Space points of deposit not more than 10 feet apart.
 2. Exercise care to avoid splashing forms and reinforcing above level of concrete as placed. Regulate placing of concrete so that pressure caused by wet concrete will not cause distortion, leakage or movement in forms.
 3. All methods of placing concrete subject to Engineer's acceptance in writing prior to placement.
 4. Pump Concrete: Use equipment and procedures suitable and adequate to maintain steady flow at discharge end of pipe, and to maintain specified properties of unit weight, slump, and air

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content. Adjustments in concrete proportions as necessary to provide specified concrete properties. Pumping through aluminum piping prohibited. Use pipe having at least three times nominal maximum size of coarse aggregate but not less than 4 in. All sampling done at discharge end of pipe. Provide labor and assistance as required in obtaining and handling test specimens.

C. Consolidation:

1. Consolidate using approved mechanical vibrators operated within mass of concrete and conforming to procedures set forth in ACI 309, and requirements specified.
2. Conduct vibration in systematic manner with regularly maintained vibrators, and with sufficient backup units at job site. Use largest and most powerful vibrator, with minimum frequency of 8,000 vibrations per minute, and of sufficient amplitude to effectively consolidate concrete.
3. Insert and withdraw vibrator vertically at uniform spacing over entire area of placement. Space distance between insertions such that "spheres of influence" of each insertion overlap.
4. Place concrete in horizontal lifts, and insert vibrator rapidly to bottom of layer, and at least six inches into underlying layer, hold stationary for several seconds, then withdraw slowly at rate of about 3 inches per second. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints, or visible lift lines.
5. Use additional vibration on vertical surfaces and all architectural concrete requiring as-cast finish and to bring full surface of mortar against forms, so as to eliminate all objectionable air voids, bug holes, and other surface defects. Additional procedures for vibrating concrete as follows:
 - a. Reduce distance between internal vibration insertions and increase time for each insertion.
 - b. Insert vibrator as close to face of form as possible, without

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contacting form.

- c. Use spading as supplement to vibration where particularly difficult conditions exist.

3.07 FIELD TESTING:

A. General:

1. Field testing by Contractor in the presence of Engineer.
2. Allow Engineer free access to work for selection of samples should be also take control test specimens, slump test, air test, and temperature test.
3. Reject concrete not meeting specified requirements, and remove from site at no additional compensation.
4. All cost associated with Contractor field testing, and delivery of control test specimens to laboratory employed by owner shall be borne by the Contractor.

B. Control Test Specimens: Taken Contractor in conformance with ASTM C31.

1. Take sets of four field control test specimens for compression testing of each class of concrete not less than once a day, nor less than once for each 150 cu. yd. of concrete, nor less than once each 5,000 sq. ft. of surface area of one side of footings, foundation mats, slabs or walls. Record truck and load number from delivery slip as well as the concrete placement location on each test specimen.
2. Furnish tightly constructed 6 in. diameter by 12 in. long nonabsorbent cylinder molds and firmly braced wooden boxes for initial curing and storage from time of fabrication until delivery to testing laboratory. Use molds of same type and manufacture for all test specimens. Field fabricated concrete test cylinders delivered to testing laboratory by the Contractor to laboratory

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employed by the Owner. Leave molds on cylinders until received in testing laboratory.

3. Test two of each set of four specimens at seven days, and if the seven-day strength is deficient, notify Contractor and Engineer. Test two remaining cylinders at twenty-eight days. Evaluation and acceptance of concrete conforming to ACI 318, Section 4.7. All associated costs borne by Contractor for taking test cores from structure, compression testing, load testing the structure under the direction of an independent accredited testing laboratory, approved by the Engineer.
4. If any part of work cannot pass load tests, conforming to ACI 318, Chapter 20, remove from site and replace in accordance with contract plans and specifications, at no additional compensation.

C. Slump Tests: Taken by Contractor in conformance with ASTM C143.

1. Take one slump test from each concrete truck.

D. Air Content Tests: Taken by Contractor in conformance with ASTM C231.

1. Take one air test from each concrete truck.

E. Temperature Tests: Taken by Contractor in conformance with ASTM C1064.

1. Take one temperature test from each concrete truck.

3.08 CURING AND PROTECTION:

A. General:

1. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury, and maintain concrete with minimal moisture loss at relatively constant temperature. Continuously cure concrete for period of not less than seven days after placement.

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Materials and methods of curing subject to acceptance by Engineer.

2. Comply with curing procedures set forth in ACI 301, applicable portions of ACI 308, and requirements specified.
3. Hot weather concreting in accordance with ACI 305, and as specified herein.

B. Methods of Curing:

1. Unformed Surfaces: Immediately after completing finishing operations and water film has evaporated from surface, or as soon as marring of concrete will not occur, cover and cure entire surface of newly placed concrete. Protect finished slabs from direct rays of sun to prevent checking and crazing.
2. Formed Surfaces: Minimize moisture loss for formed surfaces exposed to heating by sun, by keeping forms wet until safely removed. Immediately following form removal, keep surface continuously wet by water spray or water saturated fabric. Liquid membrane curing compound may be substituted for water curing.
3. Water Curing: Wherever feasible, use water curing for unformed surfaces. Continuously water-cure all exposed concrete by ponding, immersion, spraying, sprinkling, or saturated materials such as burlap or cotton mats kept wet with soil soaking hose and maintained in intimate contact with concrete surface at all times.
4. Membrane Curing:
 - a. Use liquid membrane curing compounds where water curing is not feasible as a temporary method of curing when finishing operations necessitate delay in start of water curing.
 - b. Apply membrane-curing compound uniformly over concrete surface by means of accepted mechanical spray machine at rate of not less than 1 gallon per 150 sq. ft. of surface.

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Agitate curing material in supply container immediately before transfer to distributor, and thoroughly agitate it during application, for uniform consistency and dispersion of pigment.

- c. Do not use curing compounds on surfaces to receive liquid hardener, dustproofer/sealer, concrete paint, tile, concrete fills and toppings, or other application requiring positive bond.
- d. Re-spray concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied, by method as specified for initial application.

5. Sealing Materials:

- a. Use common sealing materials such as plastic film, waterproofing (kraft) paper, and like, only with acceptance of Engineer.
- b. Lap adjacent sheets minimum of 12 inches. Use sheets of sufficient length to adequately cover sides of concrete member.
- c. Place sheet materials only on moist concrete surfaces. If surface appears dry, wet with fine spray. Presence of moisture on concrete surfaces at all times during prescribed curing period is proof of acceptable curing using sheet material.

C. Duration of Curing and Protection: Continuously cure concrete for period of not less than seven days after placing.

3.09 REPAIR:

- A. General: Immediately after form removal, repair all surface defects. Surface defects include tie holes, air voids, bug holes with a nominal diameter or depth generally greater than 1/4 inch, honeycombed areas, visible construction joints, fins and burrs, and other defects. Make concrete repairs as necessary, resulting in concrete surfaces of uniform

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color and texture free of all irregularities.

B. Repair of Defective Areas:

1. Remove honeycombed and other defective concrete down to sound concrete. Saw-cut edges 1 in. minimum depth perpendicular to surface or slightly undercut. No feather-edges permitted. Dampen area to be patched and area at least 6 inches wide surrounding it to prevent absorption of water from patching mortar.
2. Make patching mixture of same materials and of approximately same proportions as used for concrete, except omit coarse aggregate, use not more than 1 part cement to 2-1/2 parts sand by damp loose volume, and substitute white portland cement for a portion of regular grey portland cement to produce patching mix matching surrounding concrete in color when dry. Determine proportion of white portland cement by trial mixes and test areas, prior to repair of actual defective areas.
3. Use no more mixing water than necessary for handling and placing. Mix patching mortar in advance and allow it to stand with frequent manipulation with a trowel, without addition of water, until it has reached stiffest consistency that will permit placing.
4. After surface water has evaporated from area to be patched, brush bond coat of neat cement well into surface. Thoroughly consolidate mortar into place and strike off so as to leave patch slightly higher than surrounding surface. To permit initial shrinkage, leave patch undisturbed for at least 1 hour before being finally finished. Keep patched area damp for 5 days. Do not use metal tools in finishing patch in formed wall to be exposed.

C. Tie Holes: After being cleaned and thoroughly dampened, fill tie holes solid with patching mortar.

D. Final determination as to acceptability of concrete finishes and repairs of surface defects to be made by Engineer.

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3.10 FINISHES:

A. Locations:

1. Steel-trowel finish to all top, substantially horizontal, surfaces not otherwise specified or indicated including concrete fills and toppings, top of walls, and to floors scheduled to receive carpeting, seamless flooring, polyester terrazzo, resilient tile, and thin-set application of ceramic tile, and to roof surfaces to which roof insulation or roofing are to be applied.
2. Hand steel-trowel finish to all surfaces shaped with or without forms and over which liquids will flow.
3. Rough finish to floors scheduled to receive ceramic tile and quarry tile (mud base), terrazzo, or concrete fills and toppings.
4. Broomed finish to exterior walkways, entrance platforms, sidewalks, roadways, and tops of exterior tank walls.
5. Finishes to certain other concrete surfaces indicated on plans or schedules.

B. Descriptions:

1. Steel-Trowel Finish: Remove excess laitance from surfaces given steel-trowel finish, by tamping, screeding and preliminary magnesium or bull-floating. When slab has hardened sufficiently so that water and fine material will not work to top, compact surface with motor-driven floats of disk type and trowel smooth with one steel troweling operation. Dusting with dry cement or other mixtures or sprinkling with water not permitted in finishing. Leave surfaces with smooth hard finish free of blemishes and true to maximum tolerance of one-quarter inch in ten feet.
2. Rough Finish: Prepare surfaces given rough finish by tamping with special tools to force coarse aggregate away from surface, then screeding with straight edges to bring surfaces to required line,

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and then magnesium or bull-floating.

3. Broomed Finish: Steel-trowel surface then broom normal to direction of travel (unless otherwise indicated) with fine hair stable broom to produce non-slip surface of uniformly good appearance. Broom finish tolerance to true planes within one-quarter inch in ten feet.
4. Rough Form: Remove fins and finish flush with parent concrete; make repairs prior to receiving any coatings.
5. Smooth Form: Remove fins and finish flush with parent concrete, make repairs. Wet and rub finned and repaired areas with carborundum brick or other abrasive until uniform color and texture are produced. Rubbing completed not later than following day after repairs and removal of forms.

3.11 METALWORK IN CONCRETE:

- A. Ensure that castings, inserts, conduits, and other metalwork are encased in concrete with precautions taken to prevent metalwork from being displaced or deformed.
- B. Set anchor bolts by means of templates.
- C. Build dovetail anchor slots into new concrete against which facing brick, concrete masonry units, tile, stone, or any type ashlar is to be laid. Place vertically at 24-in. centers where facing brick, etc., passes by concrete and one continuous anchor slot where facing brick, etc., abuts the concrete work.

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Concrete Repair Section 03900

1. Scope

The work shall consist of removal of unsuitable concrete; surface and face preparation; forming; and furnishing, placing, finishing, and curing concrete repair material as required to repair structures designated in section 18 of this specification.

2. Material

Aggregates shall conform to the requirements of ACI 301, Aggregates for Portland Cement Concrete, unless otherwise specified. The grading of coarse aggregates shall be as specified in ASTM shown on the drawings, or as specified by the manufacturer of a proprietary repair material.

Portland cement shall conform to the requirements of ACI 301, Portland Cement, for the specified type. Only one brand of any type of cement shall be used in any single repair.

Water used in mixing and curing of the concrete repair shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, or other deleterious substances.

Fly ash shall conform to the requirements of ACI 301, Supplementary Cementitious Materials.

Air-entraining admixtures shall conform to the requirements of ACI 301, Chemical Admixtures for Concrete. If air-entraining cement is used, any additional air-entraining admixture shall be the same type as that in the cement.

Chemical admixtures for water-reducing, retarding, or water-reducing and retarding shall conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete.

Curing compound shall conform to the requirements of Material Specification, Concrete Curing Compound.

Proprietary concrete repair material shall be subject to review and approval of the engineer before use. The material shall meet all specified salient features for repair material and not react detrimentally with the existing concrete or associated member of the structure being repaired.

Replacement concrete repair material shall be a material that consists essentially of a binding medium of port- land cement and water that will meet all the specified salient

features for repair material and not react detrimentally with the existing concrete or associated members of the structure being repaired. This may be, but is not limited to, a conventional concrete mix with or without admixtures, shotcrete, preplaced aggregate concrete, or grout.

3. Preparation of areas to be repaired

All loose, cracked or otherwise unsuitable or defective concrete shall be removed from the existing structure as shown on the drawings or specified in ICRI technical notes. The final extent of removal shall be determined by the engineer after inspection of prepared surfaces.

Feathered edges at the surface are not permitted. The surface edge of the repaired area shall be cut with a saw, drilled, or chipped to leave a sharp edge with a minimum of a 0.75-inch depth face perpendicular to the face of the wall.

The top side of the repair hole shall be shaped to a uniform, straight face that is sloped upward on a 1-inch rise for each 3 inches of depth of cut toward the face from which the repair material will be placed. The repair hole shall be conical in shape with the large end at the surface from which repair material will be placed.

The bottom and vertical or near vertical sides of the hole shall be cut sharply and approximately perpendicular to the face of the wall. All interior corners shall be rounded to a minimum radius of 1 inch.

Where reinforcement is encountered, the concrete directly in contact with the sides of the reinforcement shall be removed to provide at least 1-inch clear distance between the reinforcement and the in-place concrete.

Before the concrete repair material is placed, all oil and grease shall be steam or solvent cleaned from all reinforcement and surfaces to which the repair material is required to bond. If solvent cleaning is used, solvents and solvent residue shall not impair the repair material or its bonding strengths.

After removal of all oil and grease, the reinforcement shall be cleaned to remove any loose, flaky rust, mill scale, and other coatings or foreign substances that would impair bonding of the repair material to the reinforcement. The prepared faces of the repair hole shall be cleaned by high pressure water jets or compressed air jetting with water to remove all loose particles and dust. The repair hole shall be free of chips, sawdust, debris, free water, ice, snow, or other harmful substances or coatings.

4. Disposal

Unless otherwise specified, all concrete and other debris resulting from the repair works shall be removed from the site and disposed of at location(s) of the contractor's selection. The contractor is responsible for complying with all local, State, and Federal regulations pertaining to the disposal of such waste.

5. Selection of concrete repair material

Only one brand of proprietary concrete repair material shall be used in any single repair

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operation unless compatibility between brands can be proven with actual test or performance data.

A conventional concrete mix to be used as a replacement concrete repair material shall be ready-mix concrete that meets all the specified salient features for repair material and conforms to ASTM C94. Option A from section 5 of ASTM C94 shall apply.

The contractor is responsible for the selection and correct application of the concrete repair material. At least 14 days before installation, the contractor shall provide the engineer for approval all technical data for the repair material. The technical data shall include the design mix and test results to verify satisfactory conformance to the salient feature requirements. If a proprietary material is used, the manufacturer's recommended preparation, use, and installation specifications shall also be submitted 14 days before installation. Concrete repair material shall not be placed before approval.

Concrete repair material shall have the following salient features:

- a) Be a cementitious material that after hardening will remain stable in wet and moist environments and will not dissolve in water.
- b) A 28-day compressive strength of 4,000 pounds per square inch or greater when tested according to ASTM C39, unless otherwise specified.
- c) Bond strength of the repair material shall be tested in accordance with ASTM C882 procedures for type V material and shall have the minimum strength of 1,100 pounds per square inch at 28 days unless otherwise specified.
- d) Shall be suitable for application at the minimum temperature of 55 degrees Fahrenheit.
- e) Shall not contain chlorides, added gypsum, added lime, or high alumina cements. Shall be noncombustible both before and after cure.
- f) Color shall be concrete gray unless otherwise specified.
- g) Shall not produce a vapor barrier material and shall be thermally compatible with concrete.
- h) Shall have a freeze-thaw resistance equal to or greater than 4,000 pounds per square inch, air-entrained concrete designed for severe exposure conditions according to ACI Standard Practice 211.1, unless otherwise specified.
- i) Shall exhibit no shrinkage at 28 days and no more than 0.4 percent expansion at 3, 14, or 28 days after placement when tested according to the procedures in Corps of Engineers Specification for Non-shrink Grout, CRD-C621.

Additional requirements for materials are defined in product data sheets.

6. Handling and measurement of material

For all types of repair material, the cementitious components shall be kept dry and protected from contamination until incorporated in the mix. Broken containers or bags of premeasured and premixed components will not be accepted.

Handling and measurement of conventional concrete mix repair material shall conform to ASTM C94.

Handling and measurement of prepackaged proprietary material shall follow the manufacturer's recommendations and requirements. Handling and measurement of components that are not prepackaged or premeasured shall be in accordance with the following requirements and the manufacturer's requirements. A copy of the manufacturer's written requirements will be provided to the engineer 14 days before installation. The handling and measurement requirements are:

- Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size is avoided and that various sizes do not become intermixed before proportioning. Methods of handling and transporting aggregates shall be such as to avoid contamination, excessive breakage, segregation or degradation, or intermingling of various sizes.
- Scales for weighing aggregates and repair material components shall be beam type, electronic, or spring- less dial type. They shall be accurate within 0.4 percent under operating conditions. All exposed fulcrums, clevises, and similar working parts of scales shall be kept clean and properly maintained.
- The quantities by weight of repair material components and aggregates in each batch of material, as indicated by the scales, shall be within the following percentage of the required batch weights:
- Aggregates ± 2 percent Other components ± 1 percent

Measuring tanks for mixing water or liquid shall be of adequate capacity to furnish the maximum amount of mixing water or liquid required per approved batch. Measuring tanks shall provide the means for readily and accurately measuring the amount of water or liquid required. Accuracy of water measurement shall be plus or minus 1 percent.

7. Forms

Forming material shall be wood, plywood, steel, or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished repair conforms to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities.

Before the forms are set into place, the surface of the form shall be lined with plastic sheeting or coated with a non-staining form release agent compatible with the repair material being used. This prevents bonding of the repair material to the forms. If the forms are lined with plastic, the plastic shall be stretched taut to remove all wrinkles and folds and maintain a smooth condition during the placement and curing of the repair material.

Metal ties or anchorage within the forms shall be equipped with cones, she-bolts, or other devices that permit their removal to a minimum depth of 1 inch without injury to the concrete or repair material. Ties designed to break off below the surface of the concrete shall not be used without cones.

All visible edges and corners included in the repair location shall be shaped the same as

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adjacent or similar edges or corners of the structure being repaired.

Forms shall be constructed to facilitate consolidation and complete filling of the repair void, and, when all surfaces are formed, to facilitate applying pressure to the repair material immediately after placement.

8. Mixing, conveying, and placing

Proprietary repair material shall be mixed and conveyed to the forms according to manufacturer's written recommendations. Material that cannot be placed within the manufacturer's time requirements shall not be placed in the forms and shall be discarded offsite at locations selected by the contractor.

Concrete repair material shall not be placed until the subgrade, forms, and steel reinforcement have been inspected and approved by the engineer.

The contractor shall have all equipment and material required for curing available at the site ready for use before placement of repair material begins.

No concrete repair material shall be placed except in the presence of the engineer. The contractor shall give reasonable notice to the engineer each time concrete repair material is scheduled for placement. Such notice shall be adequate to allow the engineer sufficient time to review and approve the subgrade, forms, steel reinforcement, and other preparations for compliance with the specifications. Other preparations include, but are not limited to, the mixing and delivery equipment and system, placing and finishing equipment and system, schedule of work, work-force, and heating and cooling facilities as applicable. All deficiencies are to be corrected before concrete repair material is mixed for placement.

The concrete repair material shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The depositing of repair material shall be regulated so that the material can be consolidated with a minimum of lateral movement.

Unless otherwise approved, concrete repair material shall not be dropped from a height greater than recommended by the manufacturer or 5 feet, whichever is less.

Unless otherwise specified, all concrete repair material required for each repair location shall be placed in one continuous operation. Successive layers or batches shall be placed at a rate sufficient to prevent setting of material between successive layers.

At the time of placement of repair material, the existing concrete surface shall be damp and without free water unless otherwise specified or required by the manufacturer of the proprietary repair material being used.

9. Consolidating

Concrete repair material shall be consolidated to ensure positive contact of repair material with all repair surfaces and reinforcing steel, to remove entrapped air pockets and voids, and to maximize the density of the repair material.

Vibration shall not be applied directly to the reinforcing steel or other embedded items, the forms, or to concrete repair material that has hardened to the degree that it is no longer plastic. The use of vibrators to transport concrete repair material in the forms or conveying equipment is not allowed.

Proprietary repair material shall be consolidated in accordance with the manufacturer's recommendations.

Unless otherwise specified in section 18, conventional concrete mix repair material shall be consolidated in the following manner:

- Conventional concrete mix repair material shall be consolidated with internal type mechanical vibrators capable of transmitting vibration to the concrete at frequencies not less than 8,000 impulses per minute. Vibration shall be supplemented by spading, rodding, or hand tamping as necessary to ensure smooth and dense concrete along form surfaces, in corners, and around embedded items.
- The location, manner, and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete repair material without causing segregation of the mortar and coarse aggregate and without causing water or cement paste to flush to the surface. Vibration shall compact the concrete repair material and bring it into intimate contact with the forms and embedded items while removing voids and pockets of entrapped air.
- The contractor shall provide sufficient vibrators to properly consolidate the concrete repair material immediately after it is placed. Vibration shall be applied to the freshly deposited concrete repair material by slowly inserting and removing the vibrator at points uniformly spaced and not farther apart than twice the radius of action (i.e., the distance that the concrete repair material is visibly affected by the vibration). The area visibly effected by the vibrator shall overlap the adjacent, just vibrated area. The vibrator shall extend vertically into the previously placed layer of fresh concrete repair material at all points. This ensures an effective bond between layers. In thin slabs the vibrator(s) should be sloped toward the horizontal to allow operations in a fully embedded position.
- The internal vibration of thin slabs (less than 9 inches) may be augmented using surface vibrators when approved by the engineer. Consolidation of the concrete repair material from the top surface down, along with a leveling effect to assist the finishing operation, may be provided by vibrating screeds, plate, or grid vibratory tampers, or vibrating roller screeds. The contractor's plan, including equipment selection and specifications, shall be submitted to the contracting officer for approval at least 5 days before concrete repair material placement using surface vibrating methods.

10. Removal of forms

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Unless otherwise approved, forms shall not be removed sooner than the minimum time recommended by the manufacturer of the repair material or 48 hours, whichever is greater.

Forms shall be removed only when the engineer is present. Forms shall be removed in a manner to prevent damage to the concrete repair material. Supports shall be removed in a manner that permits the repair material to take the stresses caused by its own weight, uniformly and gradually.

11. Finishing formed surfaces

All repaired surfaces shall be true and even, and shall be free of open or rough spaces, depressions, or projections. Immediately after the removal of forms:

All bulges, fins, form marks, or other irregularities that in the judgment of the engineer will adversely affect the appearance or function of the structure shall be removed. All form bolts and ties shall be removed to a minimum depth of 1 inch below the surface of the repair. The cavities produced by form ties and all other holes of similar size and depth shall be thoroughly cleaned. After the interior surface has been kept continuously wet for at least 3 hours, the cavities shall be carefully repaired with a compatible patching mortar or packed with a dry patching mortar mixed not richer than one part cement and three parts sand. Dry patching mortar shall be mixed in advance and allowed to stand without addition of water until it has reached the stiffest consistency that will permit placing. Manipulation of the mortar with a trowel during this period shall be performed as required to ensure the proper consistency.

Holes resulting from form bolts or straps that pass through the wall shall be entirely filled with mortar to form a dense, well-bonded unit. The mortar shall be tamped into place with a rod slightly smaller than the hole being filled. The hardened mortar shall be sound and free from shrinkage cracks.

All repaired areas shall be cured as specified in section 13.

12. Finishing unformed surfaces

All exposed surfaces of the concrete repair material shall be accurately screeded to grade and finished to match adjacent surfaces, unless otherwise specified. Water shall not be sprinkled or in any manner added to the surface of conventional concrete mix repair material during finishing operations.

Proprietary repair material shall be finished in accordance with the manufacturer's recommendations.

Joints and edges on unformed surfaces shall be shaped the same as adjacent or similar edges or corners of the structure being repaired.

13. Curing

The repair material shall be protected against premature surface drying, rainfall, and

freezing for at least 72 hours. For proprietary repair material, the manufacturer's recommendations for curing shall be followed. Replacement concrete repair material shall be protected from drying and freezing for 7 days after placement.

If curing compound is used, it shall be nonsolvent type and shall conform to ASTM C309, Type 1-D, Class B, nonpigmented with a fugitive dye, unless otherwise specified. Curing compounds shall not be used if specifically prohibited by the proprietary repair material user guides.

14. Removal or repair

When the repaired area is honeycombed, damaged, or otherwise defective, the contractor shall remove and replace the defective repair. The engineer determines the required extent of removal, replacement, and/or repair. Removal and repair activities shall be performed only when the engineer is present.

15. Concrete repair in cold weather (N/A)

For proprietary repair material, the manufacturer's recommendation together with the requirements below will be followed.

For conventional concrete mix repair material, the requirements below shall be followed.

Concrete repairing in cold weather shall be performed in accordance with ACI 306, Cold Weather Concreting, of which some specific interpretations are set forth below.

Cold weather concrete repairing shall apply when the 3-day average daily outdoor temperature at the job site is less than 40 degrees Fahrenheit. When cold weather conditions exist on the job site, the following additional provisions shall apply:

- The temperature of the concrete repair material at the time of placing shall not be less than 55 degrees Fahrenheit or more than 90 degrees Fahrenheit. The temperature of the mixing water shall not exceed 140 degrees Fahrenheit when the cement is added nor shall aggregate temperature exceed 150 degrees Fahrenheit.
- Concrete structures shall be immediately protected after placement of the concrete repair material. The temperature of the concrete repair material at the concrete surface shall be maintained at not less than 55 degrees Fahrenheit nor more than 90 degrees Fahrenheit during the 7-day protection period.
- Proper methods of covering, insulating, housing, or heating concrete structures shall be implemented.
- Exhaust flue gases from combustion heaters shall be vented to the outside of the heating enclosure.
- Following the completion of the protection period, the concrete repair material shall be allowed to cool gradually. The concrete repair material surface shall not have a temperature decrease of more than 40 degrees Fahrenheit in a 24-hour period.
- Concrete repair material placed during cold weather not meeting the cold weather definition above shall be protected by proper methods for a minimum of 24 hours after placement.

16. Concrete repair in hot weather

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For proprietary repair material, the manufacturer's recommendation together with the requirements below shall be followed.

For replacement concrete repair material, the requirements below shall be followed.

For this specification, hot weather is defined as any combination of the following conditions that may impair the quality of the freshly mixed and/or hardened concrete repair material by accelerating the rate of moisture loss and rate of cement hydration, or any other action that could contribute to detrimental results. These conditions are:

- High ambient temperature
- High concrete temperature
- Low relative humidity
- Wind velocity
- Solar radiation

Whenever these conditions exist or when climatic conditions are such that the temperature of the concrete repair material may reasonably be expected to exceed 90 degrees Fahrenheit at the time of delivery to the work site or during the placement operations, the following provisions shall apply:

The contractor shall maintain the temperature of the concrete repair material below 90 degrees Fahrenheit during mixing, conveying, and placing.

The exposed concrete repair material surface that tends to dry or set too rapidly shall be continuously moistened using fog sprays or other suitable means to maintain adequate moisture during the period between placement and finishing and following finishing. Water shall not be sprinkled or added directly to the surface of the concrete repair before or during finishing.

Finishing of slabs and other exposed or non-formed surfaces shall be started as soon as the condition of the concrete repair material allows and shall be completed without delay. The formed surface shall be kept completely and continuously moist for the duration of the curing period or until the application of the curing compound is completed.

Concrete repair material surface, especially flat work placed with large surface areas, shall be covered with wet burlap or other similar material as soon as the concrete repair material has sufficiently hardened and shall be kept continuously moist for at least 24 hours for the initial curing period. This protective method shall be continued for the required curing period or until the application of curing compound is completed. Moist curing may be discontinued before the end of the curing period if white, or other color selected in section 18, pigmented curing compound is applied immediately. Under extreme conditions of high ambient temperature, high concrete temperature, low relative humidity, wind velocity, and exposure to solar radiation, the engineer may:

- Restrict placement to the most favorable time of day.
- Restrict the depth of layers to assure coverage of the previous layer while it will still

- respond readily to vibration.
- Suspend placement until conditions improve.
- Require removal of forms, repair, patching, and reapplication of wet curing by small areas at a time.

17. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, concrete repair volume is determined by computing the volume to the nearest 0.1 cubic foot between the neatness shown on the drawings and the approved pay limit.

Method 2—For items of work for which specific unit prices are established in the contract, concrete repair volume is determined by counting the number of premeasured, prepackaged units properly used to perform the approved repair. A premeasured, prepackaged unit is defined as a composite of all components and additives required to be mixed before the repair material can be properly placed.

When only a part of a unit is needed to complete the filling of a repair void, it is counted as one unit. Units required to fill voids outside the approved pay limits are not counted for payment. Units mixed, but not placed in a repair void because of the contractor's improper construction operation or management are not counted.

Method 3—For items of work for which specific unit prices are established in the contract, concrete repair area is determined by measuring the surface treated and computing the area to the nearest 0.1 square foot.

All methods—The following applies to all methods of measurement and payment:

Payment for concrete repair is made at the contract unit price for the item. The payment for repair constitutes full compensation for all labor, material, equipment, transportation, tools, forms, false-work, bracing, and all other items necessary and incidental to the completion of the repair work.

Repair material required to fill voids outside the neatness or pay limits not directed or approved by the engineer and resulting from excessive removal by the contractor, damages caused by the contractor's activities, or improper construction operations as determined by the contracting officer is not measured nor paid for under this item.

Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 18 of this specification.

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ANNEXES:

ACI RAP SERIES

- 01 RAP-1 Epoxy Injection
- 02 RAP-2 Gravity Feed
- 03 RAP-6 Vertical and Overhead Spall by Hand
- 04 RAP-7 Spall repair horizontal
- 05 RAP-10 Vertical and Overhead

MATERIALS SPECIFICATIONS

- 07 masteremaco-adh-327-tds
- 08 masteremaco-n-425-tds
- 09 MasterInject_1210_IUG
- 10 masterinject-1380-tds
- 11 masterprotect-8500-ci-tdg
- 12 masterprotect-p-8100-ap-tds
- 13 masterrheobuild-1000-tds
- 14 masterroc-mp-900-tds
- 15 CINTEC ANCHOR SYSTEM

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SECTION 05119
STRUCTURAL STEEL

For listings of subsections, see subsection index at end of section.

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish, erect, and fasten all structural steel.
- B. Definition: "Structural Steel" as defined in accordance with AISC Code of Standard Practice.

1.02 RELATED WORK:

- A. N/A

1.03 QUALITY ASSURANCE:

- A. Tolerances:
 - 1. Tolerances conform to AISC Code of Standard Practice.
 - 2. Permissible variation tolerances conform to ASTM A6/A6M.
- B. Torque Wrench Calibration:
 - 1. Check calibration device for setting calibrated torque wrenches for accuracy not more than 30 days prior to use on project, and at intervals not more than six months thereafter.
 - 2. If Engineer questions accuracy of calibration device, return to manufacturer for certification of accuracy.
 - 3. Torque wrench calibration as specified in AISC Specification for Structural Joints.

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C. Welding Qualification and Certification:

1. Written welding procedure required for all welds.
2. Each welder, tacker, and welding operator certified by test within the past six months to perform type of work required in conformance with AWS Structural Welding Code.
3. Maintain duplicate records, at the job site readily available for examination of test results.

1.04 REFERENCES:

- A. American Institute of Steel Construction (AISC) Manual of Steel Construction 14th Edition.
- B. AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings dated 2010 with commentary.
- C. AISC Code of Standard Practice for Steel Buildings and Bridges dated 2016 with commentary.
- D. AISC Specification for Structural Joints using ASTM A325 or A490 Bolts dated August 14, 1980.
- E. AISC Structural Steel Detailing Manual (Oct., 1971).
- F. American Welding Society (AWS) Structural Welding Code Steel, D1.1-85, with amendments to date.
- G. Steel Structures Painting Council (SSPC) Surface Preparation Specifications.
- H. American Society for Testing and Materials:
 1. ASTM A6/A6M-88c, Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.

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2. ASTM A36/A36M-88c, Standard Specification for Structural Steel.
3. ASTM A123-84, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153-87, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A307-88a, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
6. ASTM A325-88a, Standard Specification for High-Strength Bolts for Structural Steel Joints.
7. ASTM A449-88, Standard Specification for Quenched and Tempered Steel Bolts and Studs.
8. ASTM A563-88a, Standard Specification for Carbon and Alloy Steel Nuts.

1.05 SUBMITTALS:

- A. Shop and Erection Drawings: In accordance with SECTION 01000.
 1. Submit complete and checked shop and erection drawings for all structural steel components. Show materials, anchor bolts, member and connection details, piece marks, openings, shop and field bolting and welding, in conformity with AISC Detailing Manual and AISC Manual. Also refer to cleaning and shop painting as specified.
 2. Submit, prior to welding, the welding procedure for each type of weld.
 3. Submit qualification test reports bearing witness certification of an independent accredited testing laboratory for each welder, welding operator, and tacker employed in work.
4. Submitt all non destructive weld test.

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- B. Submit mill certificates and certified copy of reports for all analyses and tests required by referenced ASTM Standard Specifications and AWS Structural Welding Code.
- C. Submit certificate of compliance that surface preparation and painting conforms to specifications.
 - 1. List of coating products proposed by type, brand, and manufacturer.
 - 2. Paint manufacturer's current printed recommendations and product data sheets for each product used.
 - 3. Shop painting applicator's correspondence for determining compatibility of shop coatings with field coats and for selecting manufacturer producing field coats.
- D. Submit certificate of compliance with ASTM Specifications for Zinc-coatings.

1.06 DELIVERY, HANDLING AND STORAGE:

- A. Carefully transport, handle, and store materials, protected from weather, rusting, corrosion, and other damage.
- B. Store structural shapes off ground on suitable supports, with webs of flanged shapes vertical.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL:

- A. Carbon Steel: ASTM A36/A36M.

2.02 FASTENERS:

- A. Carbon Steel Bolts, Nuts and Washers: ASTM A307, Grade A.
- B. High-Strength Carbon Steel Bolts, Nuts, and Washers: ASTM A325, Type 1.

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C. Carbon Steel Anchor Bolts: ASTM A36/A36M.

2.03 WELDING:

A. Class E70XX electrodes.

2.04 GALVANIZE:

A. Hot-dip galvanize all steel noted to be galvanized on drawings, standard details, and as specified.

B. Complete all fabrication, and prepare surfaces of steel by removing all weld spatter, flux and residue, burrs and metal surface defects before galvanizing.

C. Dip steel into solution of zinc ammonium chloride immediately prior to galvanizing.

D. To minimize distortion and to thoroughly dry the zinc ammonium chloride, place steel into suitable dryer/preheater with constant heat of not less than 200 degree F., then place in galvanizer's kettle. Type of galvanizing process utilizing flux blanket overlaying molten zinc is not permitted. All galvanizing conform to ASTM A123 and ASTM A153.

E. Tap bolt nuts after hot-dip galvanize conforming to ASTM A563.

2.05 FABRICATION:

A. Fabricate and shop-assemble work, to the greatest practical extent, in accordance with following publications:

1. AISC Manual
2. AISC Specification for Design, Fabrication, and Erection
3. AISC Specification for Structural Joints

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4. AISC Detailing Manual
 5. AWS Structural Welding Code
- B. Ensure that shearing, manual flame cutting with mechanically guided torch, and chipping will not induce residual stress in metal being cut. Radii of re-entrant gas-cut fillets to be not less than 3/4 inch and larger as practicable. Perform flame cutting so that metal being cut is not carrying stress. Finish exposed edges.
- C. Ensure full cross section bearing on milled ends of columns, crane rails monorails and bearing stiffeners.
- D. All members connected with ASTM A325 high strength bolts unless otherwise specified or indicated on drawings. Holes clean-cut without torn or ragged edges and all outside burrs removed.
- E. Welded Connections:
1. Connections indicated on drawings.
 2. All members having Type S and E Service to have complete weather seal weldments made with 1/16-in. minimum fillets.
- F. Shop connections welded or bolted and conforming to specified AISC publications.
- G. Connections made with ASTM A307 carbon steel (unfinished) bolts as specified or indicated on drawings.
- H. Anchor bolts furnished with washer and heavy hex nuts.

PART 3 - EXECUTION

3.01 ERECTION:

- A. Align column bases and bearing plates for beams and similar structural members with steel wedges or shims. After alignment and positioning

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anchor nuts tight, fill entire area under bearing plates with non-shrink, non-metallic grout. Remove steel wedges or shims and grout voids.

- B. Provide anchor bolts and anchors with necessary templates for correct placement into concrete, masonry and other supporting materials.
- C. Hold steelwork securely in place with adequate temporary bracing and stays, until permanently fastened and completed.
- D. Use only calibrated wrenches for tensioning high-strength bolts.
- E. Inspect and torque test field-assembled bolted construction in accordance with AISC Specification for Structural Joints.
- F. High-strength bolts tightened to the snug-tight condition in accordance with AISC Specification for Structural Joints.
- G. Align and adjust members forming parts of a complete assembly after assembly and before permanent fastening.
- H. Fasten splices of compression members after the abutting surfaces have been brought completely into contact.
- I. Report immediately to Engineer errors in shop fabrication or deformation resulting from handling or transportation which prevent the proper erection and fitting of parts.
- J. As erection progresses, perform sufficient bolting of work to support construction live load and combined dead, wind, and erection loads.
- K. Ensure that holes are not enlarged and that metal in vicinity of holes is not damaged by drift pins during assembly.
- L. Enlarge holes to admit bolts for connections only if approved in writing by Engineer. Make enlargement by reaming and not by burning.

3.02 HIGH STRENGTH BOLTING:

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- A. Bolting Operations: Workmanship and techniques for bolted construction conforming to AISC Specification for Structural Joints.
- B. ASTM A325 bolts installed with hardened washer under element being turned. When using oversize and slotted holes, install plate washer in both outer plies. When using galvanized bolts, install galvanized washer under bolt head and nut.

3.03 WELDING:

- A. Welding Operations: Workmanship and techniques for welded construction in conformance with requirements of AWS Structural Welding Code.
- B. No field welding permitted unless shown on approved fabrication shop drawings.
- C. Materials and Process: Equipment for welding, electrodes, welding wire, and fluxes all capable of producing satisfactory welds when used by certified welder using qualified welding procedures. All welding materials comply with requirements of AWS Structural Welding Code.

3.04 GALVANIZE TOUCH-UP:

- A. ZRC Cold Galvanizing Compound by ZRC Chemical Products Co., Division of Norfolk Corp., Quincy, MA, or acceptable equivalent.
- B. Touch-up all damaged surfaces.
- C. Power tool clean, SSPC-SP3. Surfaces to be etched and conditioned in accordance with manufacturer's printed instructions.
- D. Touch-up with cold galvanizing compound, 3 mils dry film thickness, one component, with a minimum of 95 percent zinc by weight in dry film.

3.05 PAINT AND COATING:

- A. Protect all structural steel as specified here-in and in Section 09940 and 09941.

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- B. Complete all welding before preparation or painting, except when size of members, field erection procedures or other approved necessity requires welding after shop priming.
- C. Before cleaning, prepare surfaces of steel by removing all weld spatter, flux and residue, burrs and metal surface defects.
 - 1. Grind smooth, sharp edges and corners, eliminate pinholes and unevenness adversely affecting coating thickness and longevity.
 - 2. Level rough, uneven surfaces, fill significant depressions, produce a satisfactory base for specified primers and finishes, with even transitions permitting consistent film build at inside and outside corners.
 - 3. Do no cleaning or priming until surface preparation is acceptable.
- D. Clean surfaces by blast, grind, or wire brush, as follows:
 - 1. For Type S service: Blast clean to near white metal, SSPC-SP10.
 - 2. For Type E service: Commercial blast clean, SSPC-SP6.
 - 3. For Type I service: Power tool clean, SSPC-SP3. Before coating, clean surfaces free of dirt, oil, grease, dust, moisture, mill scale, corrosion, poorly bonded material including spray dust, paint splatter and foreign matter. Correct conditions detrimental to coating bond and life.
 - 4. Remove dust from cleaning operations in dry environment by vacuuming or dry-air blast, without damaging quality of cleaned surface.
- E. Before rusting, contamination or deterioration starts, prime clean dry surfaces. Prime within eight hours of cleaning under ideal conditions, or sooner if conditions are not ideal. As necessary, protect cleaned surfaces to prevent deterioration before coating. If blast cleaned area is not primed within eight hours of cleaning, reclean as specified just before priming.

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- F. Clean and paint surfaces of assembled items, inaccessible after assembly, before assembly, unless such areas are seal welded.
- G. Apply coatings to suitably prepared, clean, dry surfaces, in accordance with paint manufacturer's current printed recommendations and as herein specified.
- H. Hold back coatings which would be damaged by welding and welding heat from areas to be welded until welding is completed. When areas coated have had coating damaged by welding, reclean and recoat substrate as specified for original coats.
- I. Suitable ambient and surface conditions; moderate temperatures, low humidity, protection from precipitation, low air movement, and avoidance of intense sunlight, are required for coating operations.
- J. Immediately after surface preparation, properly mix and apply coatings to produce a complete, tenacious, bonded film, continuous, uniform in thickness and without defects. Coating film thickness; not less than specified with no runs, sags, skips, holidays, pinholes, or blisters.
- K. Except where manufacturer specifically directs that coatings be thinned, do not extend, modify or dilute factory packaged systems. Thin only in strictest accordance with printed instructions, using materials provided or recommended by manufacturer for specific purpose. Use no materials exceeding use data on labels or stored beyond manufacturer's shelf life.
- L. Remove damaged or defective coatings by specified blast cleaning to meet surface cleaning requirements, just before recoating. When small areas of coating need touch up, surface preparation may be done with suitable power needle gun to match specified blast cleaning results.
- M. Before enclosure, apply 1/8-in. thick trowel grade bituminous mastic damproofing to entire steel when encased in exterior masonry walls.

PART 4 - SUBSECTION INDEX

A. GENERAL

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- 1.01 Description
- 1.02 Related Work
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B. PRODUCTS

- 2.01 Structural Steel
- 2.02 Fasteners
- 2.03 Welding
- 2.04 Galvanize
- 2.05 Fabrication

C. EXECUTION

- 3.01 Erection
- 3.02 High Strength Bolting
- 3.03 Welding
- 3.04 Galvanize Touch-Up
- 3.05 Paint and Coating

* * *

SECTION 05500
MISCELLANEOUS METAL

For listing of subsections, see subsection index at end of section.

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish, erect, install, set and fasten all miscellaneous metal items; including items not specified under other sections.

1.02 RELATED WORK:

- A. Section 09940: Shop Painting
- B. Section 09941: Field Painting

1.03 REFERENCES:

- A. American Institute of Steel Construction (AISC) "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", Nov. 1, 1978, as amended to date.
- B. American Welding Society "Structural Welding Code", D1.1 1980 Edition, with amendments to date.
- C. Aluminum Association Standard Anodic Finish (AASAF).
- D. American Society for Testing and Materials:
 - 1. ASTM A36, Standard Specification for Structural Steel.
 - 2. ASTM A53, Standard Specification for Pipe, Steel Black and

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Hot-dipped, Zinc-Coated Welded and Seamless.

3. ASTM A123, Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
4. ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
6. ASTM A242, Standard Specification for High-Strength Low-Alloy Structural Steel.
7. ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
8. ASTM A276, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
9. ASTM A312, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Pipe.
10. ASTM A325, Standard Specification for High Strength bolts for Structural Steel Joints.
11. ASTM A366- Standard Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
12. ASTM A569, Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
13. ASTM A588, Standard Specification for High-Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 in. Thick.

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14. ASTM 606, Standard Specification for Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy, with improved Corrosion Resistance.
15. ASTM B26, Standard Specification for Aluminum-Alloy and Castings.
16. ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
17. ASTM B211, Standard Specification for Aluminum-Alloy Bar, Rod, and Wire.
18. ASTM B221, Standard Specification for Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
19. ASTM B241, Standard Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
20. ASTM B249, Standard Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes.
21. ASTM B443, Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Plate, Sheet, and Strip.

1.04 SUBMITTALS:

- A. Manufacturer's literature describing standard items.
- B. Shop drawings showing materials, sizes, finishes, locations, attached hardware and fittings, and details for manufactured items and fabricated metalwork, including field erection details showing cuts, copes, connections, holes, thread fasteners and welds. Indicate welds, both shop and field, by symbols conforming to AWS standards. Indicate coatings or other protection against corrosion. Submittals in accordance with GENERAL SPECIFICATIONS.

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- C. Setting diagrams, erection plans, templates and directions for installation of backing plates, anchors, and other such similar items.
- D. Material compliance certification with standards designated.
- E. Samples of materials proposed for use, where required for testing.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Identify and match-mark, all materials, items and fabrications, for installation and field assembly.
- B. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with all anchors, hangers, fasteners and miscellaneous metal items required for installation.
- C. Carefully handle and store materials, protected from weather, rusting and other damage.
- D. Store structural shapes, pipes, tubes and sheets off the ground on suitable supports, with webs of flanged shapes vertical.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Steel Shapes and Plates:
 - 1. Steel: ASTM A36-77A
 - 2. Nuts, Bolts, Rivets, Washers, and Anchorage Devices: ASTM A325 and AISC Specification referenced under Part 1.
 - 3. Steel Sheets: Cold-rolled or hot-rolled carbon steel, ASTM A366, or ASTM A569.
 - 4. Steel Pipe: ASTM A53, Standard Specifications for Pipe, Steel, Black and, Zinc-Coated, Welded and Seamless.

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B. Aluminum:

1. Plates, rolled or extruded shapes, sheets or castings conforming (unless otherwise permitted or indicated) to Aluminum Association alloy and temper designations.

Gratings (bearing bars)	6061-T6
(crimp bars)	6061-T5
Bolts and nuts	2024-T4
Pipe railings	6063-T6

2.02 FABRICATION:

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified with straight lines, square corners or smooth bends; free from twists, kinks, warps, dents, and other imperfections. Straighten work bent by shearing or punching.
2. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded. Construct connections and joints exposed to weather to exclude water.
3. Provide sufficient quantity and size of anchors for the proper fastening of work.

B. Fabricated Products:

1. Pipe Sleeves in Concrete Construction: Weld standard weight, black steel pipe, with anchors to exterior as required to accommodate passage of conduits, pipes ducts and similar items

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2. Use stainless steel stud bolts with heavy aluminum washer and nuts for fastening aluminum pipe railing and handrail and fastening steel pipe railing and handrail using galvanized stud bolts, nuts and washers, as indicated.

2.03 PLATE COVERS AND FRAMES:

- A. Plate covers and frames: Sizes indicated on drawings. Aluminum angle frames with welded strap anchors for securing in concrete. Miter corners, weld joints, grind welds smooth where exposed.
 1. Aluminum tread plate covers with acceptable nonskid surface, reinforced with aluminum bars welded to underside of cover details. Covers to support uniform superimposed load of 100 psf for span with deflection less than 1/4-in., based on allowable fiber stress of 16,000 psi. Covers fit neatly and accurately in frames.
 2. Hinged: Hinge covers to frames with stainless steel, heavy duty plain bearing hinges and stainless steel pins. Attach hinges to covers and frames with stainless steel machine screws, provide flush lift handles made from 1/2-in. dia. 6061-T6 alloy rod. Maximum single-leaf cover plate, 3 ft. square.
 3. Removable: Maximum removable cover plate, 14 sq. feet, longest dimension 7 ft. 0-in. Provide 1-in. dia. finger holes for removal. Grind edges of holes smooth.
 4. Gasketed and Bolted: Plate covers with continuous, compressible neoprene seals between cover and frame at perimeter. Secure to frames with countersunk, flathead, stainless-steel machine screws spaced approximately 6-in. on centers.

2.04 SLEEVES AND INSERTS:

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- A. Furnish sleeves and inserts as required by the GENERAL SPECIFICATIONS.

2.05 ALUMINUM:

- A. Protection:
 - 1. Protect aluminum from contact with concrete, masonry or mortar; use one coat Bitumastic Super Service Black, Koppers Co., Inc., Pittsburgh, PA; Tarmastic 100 Porter Coatings Division, Porter Paint Col., Louisville, KY; 450 Heavy Tnemecol, Tnemec Company, North Kansas City, MO.
 - 2. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, Then immerge in, or wipe thoroughly with an acceptable solvent. Rinse with clean hot water, dry thoroughly.
 - 3. As required in GENERAL SPECIFICATIONS, protect aluminum against electrolysis from all sources.
- B. Finishes: After fabrication, all aluminum pipe railings and ladders shall receive an Aluminum Association Standard Anodic finish, Designation C22A31, followed by a shop coat of methacrylate lacquer.

2.06 MISCELLANEOUS ITEMS:

- A. Items of miscellaneous metalwork not particularly specified shall be of the shape, size, material and details indicated on the drawings or suitable for the purpose intended.

PART 3 - EXECUTION

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3.01 GENERAL:

- A. Accurately set and properly secure in place. Where bolted connections are used, draw closely together and draw nuts tightly.
- B. Locate anchors and anchor bolts and build into connecting work. Insert expansion bolts into drilled holes.
- C. Clean aluminum with mild soap and water, followed by clear water rinse, after erection.

SECTION 09940
SHOP PAINTING

For listing of subsections, see subsection index at end of section.

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Properly prepare surfaces and apply in fabricator's shop, primers and protective coatings for work specified to be shop primed.
- B. Coatings are divided into following types, as determined by service conditions:
 - 1. Type M Service (normal) - standard paints and finishes representing manufacturer's good quality standard practice.
 - 2. Type I Service (interior) - one coat (min.) universal rust inhibitive metal primer for carbon steel or iron, which will be inside a building, which is not submerged, and which is not above a liquid.
 - 3. Type E Service (exterior) - one coat (min.) epoxy polyamide metal primer for carbon steel, malleable iron, or cast iron, which will be exposed to weather and higher than 2 ft. above surface of a liquid.
 - 4. Type S Service (severe) - one coat (or more as may be required to build specified dry film thickness) polyamide epoxy primer for carbon steel, malleable iron, or cast-iron, as follows:
 - a. submerged or splashed
 - b. in contact or adjacent to sludge or part of sludge handling equipment
 - c. in a corrosive atmosphere
 - d. within 2 ft. above surface of a liquid.

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- C. Coatings are not required for glass, plastic, aluminum, stainless steel, galvanized, chrome or cadmium plate.

1.02 RELATED WORK:

- A. Section 09941: Field Painting
- B. Architectural and structural items are generally specified to be shop painted in their respective Sections under Divisions 3 through 10, and Divisions 12, 13 and 14.
- C. Factory prefinished items as specified.

1.03 REFERENCES:

- A. Steel Structures Painting Council (SSPC), Pittsburgh, PA. References include 1971 editorial modifications.
 - 1. Steel Structures Painting Manual, "Surface Preparation Specifications"; SP 3-63, Power Tool Cleaning, SP 6-63, Commercial Blast Cleaning and SP 10-63T, Near White Blast Cleaning.
 - 2. Paint Application Guides; PA 1-64, No. 1 Shop, Field and Maintenance Painting, and PA 2-73T, Measurement of Dry Paint Thickness with Magnetic Gauges.
 - 3. SSPC Description of blast cleaning samples (also ASTM D2200-67).
- B. NACE: National Association of Corrosion Engineers.

1.04 SUBMITTALS:

- A. For all Types of Service, submit four copies as follows:
 - 1. List of coating products proposed, by type, brand and manufacturer.
 - 2. Paint manufacturer's current printed recommendations and product data sheets for each product used.

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3. Shop painting applicator's correspondence for determining compatibility of shop coatings with field coats and for selecting manufacturer producing field coats.

B. Applicator's Certificate:

1. For Type S or Type E service, submit certificate from firm applying paint, that the following was accomplished:
 - a. Immediately before painting, surfaces were cleaned as specified, in suitable condition, dry, free from dust, rust and mill scale when coated.
 - b. Surface preparation, coating use, mixing, application and curing were in accordance with current printed recommendations of the paint manufacturer.
 - c. Products specified were used. List names of products and manufacturers.
 - d. Products used within shelf dates. List dates.
 - e. Paint manufacturers invoices cover products used in this job. Submit copies of invoices.
 - f. Specified dry film thicknesses have been attained.
 - g. State quantities of each product used for different coats on various surfaces.
2. Submittal 30 days before shop painting:
 - a. List of coating products to be used.
 - b. Paint manufacturer's current printed recommendations and product data sheets for each product used.
 - c. Shop painting applicator's correspondence for determining compatibility of shop coatings with field coats and for determining

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name of manufacturer producing field coats.

3. Submittal within 10 days after shop painting completed:
 - a. Applicator's certificate.
 - b. Paint manufacturer's representative's certificate.

C. Submittals for substitution proposals.

1. With substitutions proposals, submit notarized certificates on letterhead of manufacturer, certifying:
 - a. That proposed substitute is equivalent of specified material in qualities specified.
 - b. That list of compared qualities attached is accurate.
 - c. That proposed substitution is suitable for intended use.
2. Submit paint manufacturer's current printed information, recommendations and product data sheets for both proposed substitutions and specified products and compare proposed substitution and specified products for specified qualities.

1.05 DELIVERY, HANDLING, STORAGE, PROTECTION:

- A. Deliver materials to application area in original, unbroken containers, plainly marked with name and analysis of product, manufacturer's name, and shelf-life date. Do not store or use contaminated, outdated, prematurely opened, or diluted materials.
- B. Store coated items to prevent damage or dirtying of coatings. Avoid need for special cleaning, and store coated items out of contact with ground or pavement. Place suitable blocking under coated items during storage.
- C. Do not expose surfaces to weather for more than six months before being top coated, or less time if recommended by coating manufacturer.

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- D. Protect surfaces not to receive paint coatings during surface preparation, cleaning, and painting.
- E. Protect coatings from damage during shipment and handling by padding, blocking, use canvas or nylon slings, and use care when handling.
- F. At time of delivery of shop painted items to job site, ensure coatings are undamaged and in good condition.

1.06 JOB CONDITIONS:

A. Environmental Requirements:

- 1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
- 2. Do not apply coatings when dust is being generated.

PART 2 - PRODUCTS

2.01 MATERIALS; GENERAL:

- A. Use paint coatings suitable for intended use, recommended by their manufacturer for intended service. Use coatings on ferrous surfaces for Type S or Type E service of protective paint coating quality.
- B. Products used: minimum of five years satisfactory use under similar service conditions.
- C. Use shop coats not requiring special intercoat preparation to produce good topcoat bond. Do not use glossy acrylic shop coats on surfaces to be field painted.
- D. Use products of one manufacturer in any one paint coating system; all coating materials compatible. Coatings for touch-up; same as original.

2.02 SPECIFIED PRODUCTS:

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- A. Use following products for surfaces and service specified in shop painting schedule.
- B. Polyamide epoxy primer for Type S service, not less than 56 percent solids content by volume, applied to not less than 2 mils dry film thickness, requires no special intercoat preparation for good topcoat bond. When polyamide epoxy primer is to be used under an aliphatic or linear polyurethane in field the color of primer shall be close to finish color.
 - 1. Koppers 654 Epoxy Primer made by Koppers Co., Pittsburgh, PA;
 - 2. Tnemec 66 Boston Gray Primer made by Tnemec Co., North Kansas City, MO;
 - 3. Valspar 13-R-60 Epoxy Metal Primer made by Valspar Corp., Short Hills, NJ.
- C. Polyamide metal primer for Type E Service; suitable for exposure to weather and ambient atmospheric conditions occurring at jobsite. Solids content, 56 percent (min.), dry film thickness at normal application rate, 2.5 mils (min.).
 - 1. Koppers Co., Pittsburgh, PA, Primer 654.
 - 2. Tnemec Co., North Kansas City, MO, 66-Boston Gray Primer.
 - 3. Valspar Corp., Short Hills, NJ, 13-R-60 Chromox Primer.
- D. Interior metal primer for Type I service shall be a universal rust inhibitor primer. Solids content 43 percent (min.) dry film thickness at normal application rate, 2.5 mils (min.).
 - 1. Koppers Pug Primer made by Koppers Co., Pittsburgh, PA.
 - 2. Tnemec Series 37-77 Chem-Prime made by Tnemec Co., North Kansas City, MO.
 - 3. Valspar 13-R-50 Chromox Primer made by Valspar Corp., Short Hills, N.J.
- E. Manufacturer's standard shop finish for Type M service.

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2.03 SUBSTITUTION PROPOSALS:

- A. Substitutions for materials specified herein will be considered only if they are equal to the specified items in:
1. resistance to abrasion and physical damage
 2. efficiency in protecting substrate from corrosion for extended periods
 3. life expectancy
 4. recoating cycles
 5. solids content by volume
 6. dry film thickness per coat
 7. coverage per gallon
 8. compatibility with other coatings
 9. resistance to chemical attack
 10. submersion limitations
 11. temperature limitations in service and during application
 12. recommended surface preparation for maximum coating life.
 13. effect on cost of other coatings applied to complete coating system
 14. ease of application of damaged areas, and other pertinent criteria.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Complete all welding before preparation or painting, except when size of members, field erection procedures or other approved necessity

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requires welding after shop priming.

- B. Before cleaning, prepare surfaces of carbon steel, cast or malleable iron for use in service Types S, E and I by removing all weld spatter, flux and residue, burrs and metal surface defects.
 - 1. Relieve or grind smooth, sharp edges and corners, eliminate pinholes and unevenness adversely affecting coating thickness and longevity.
 - 2. Level rough, uneven surfaces, fill significant depression and produce a satisfactory base for specified primers and finishes, with even transitions permitting consistent film build at inside and outside corners.
 - 3. Do no cleaning or priming until surface preparation is acceptable.

3.02 CLEANING:

- A. Match cleaned surfaces with copies of standard samples approved by Steel Structures Painting Council (SSPC), Pittsburgh, PA.
- B. Clean surfaces by blast, grind, or wire brush, as follows:
 - 1. For Type S service - blast clean to near white metal, SSPC-SP10.
 - 2. For Type E service - commercial blast clean, SSPC-SP6.
 - 3. For Type I service - power tool clean, SSPC-SP3. Before coating, clean surfaces free of dirt, oil, grease, dust, moisture, mill scale, corrosion, poorly bonded material including spray dust, paint splatter and foreign matter. Correct conditions detrimental to coating bond and life.
 - 4. Remove dust from cleaning operations in dry environment by vacuuming or dry-air blast, without damaging quality of cleaned surface.

3.03 COATING:

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- A. Before rusting, contamination or deterioration starts, prime clean dry surfaces. Prime within eight hours under ideal conditions, or sooner if conditions are not ideal. As necessary, protect cleaned surfaces to prevent deterioration before coating. If blast cleaned area is not primed within eight hours of cleaning, reclean as specified just before priming.
- B. Clean and paint surfaces of assembled items, inaccessible after assembly, before assembly, unless such areas are seal welded.
- C. Apply coatings to suitably prepared clean dry surfaces, in accordance with paint manufacturer's current printed recommendations and as herein specified.
- D. Hold back coatings, which would be damaged by welding and welding heat, from areas to be welded until welding is completed. When areas coated have had coating damaged by welding, reclean and recoat substrate as specified for original coats.
- E. Suitable ambient and surface conditions; moderate temperatures, low humidity, protection from precipitation, low air movement, and avoidance of intense sunlight, are required for coating operations.
- F. Immediately after surface preparation, properly mix and apply coatings to produce a complete, tenacious, bonded film, continuous, uniform in thickness and without defects. Coating film thickness: not less than specified with no runs, sags, skips, holidays, pinholes, or blisters.
- G. In addition to requirements herein specified, follow SSPC-PA 1-64, Paint Application Specification No. 1 for Shop, Field, and Maintenance Painting. More stringent requirements between these specifications and SSPC-PA 1 govern.
- H. Except where manufacturer specifically directs those coatings be thinned, do not extend, modify or dilute factory packaged systems. Thin only in strictest accordance with printed instructions, using materials provided or recommended by manufacturer for specific purpose. Use no materials exceeding use data on labels or stored beyond manufacturer's shelf life.

3.04 TOUCH UP:

- A. Repair or replace damaged or defective coating areas. Resultant shop painting: paint items as specified.
- B. Remove damaged or defective coatings by specified blast cleaning to meet surface cleaning requirements, just before recoating. When small areas of coating need touch up, surface preparation may be done with suitable power needle gun to match specified blast cleaning results.

3.05 TESTING:

- A. Test coating mils for dry film thickness using suitable magnetic detector such as Nordson-Elcometer pull-off gage. Perform dry film thickness magnetic testing in accordance with SSPC-PS 2-73T. Perform testing for holidays, skips, and pinholes using suitable low-voltage wet-sponge holiday detector such as Tinker-Razor Model M-1.
- B. Coordinate, schedule and confirm preparation, cleaning, and priming operations.
- C. Protect ferrous surfaces obviously not to be painted, machined contact surfaces, lubricated contact surfaces moving under load, threaded connections to be put together in field, and similar surfaces, from damage during cleaning and painting. Use an easily removable protective coating or other appropriate, approved method to protect against corrosion, until installation.
- D. Type M Service:
 - 1. Coatings on casings of pumps, motors, speed reducers and similar items; equipment manufacturer's standard finish suitable for intended service.
 - 2. Coatings on electrical equipment, mechanical building services equipment, instrumentation equipment, and chemical feed and handling equipment; as above, unless specified otherwise in

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appropriate Sections.

3. Shop coatings on valves, which are not submerged or splashed, are not in a corrosive atmosphere, and are not exposed to weather; manufacturer's standard, suitable for intended service. Do not use acrylics or other primers requiring special inter coat preparation to achieve good topcoat bond.
- E. Type E and Type I Service - prepare and clean metal surfaces as required and specified:
1. Apply minimum of one coat of universal rust inhibitor primer for Type I, dry film thickness as specified.
 2. Apply minimum of one coat of polyamide epoxy metal primer for Type E, dry film thickness, 2.5 mils, minimum.
- F. Type S service - prepare, blast clean and prime with specified polyamide epoxy primer, one coat or as required to produce dry film coating thickness of not less than 3 mils.

PART 4 - SUBSECTION INDEX

A. GENERAL

- 1.01 Description
- 1.02 Related Work
- 1.03 References
- 1.04 Submittals
- 1.05 Delivery, Handling, Storage, Protection
- 1.06 Job Conditions

B. PRODUCTS

- 2.01 Materials; General
- 2.02 Specified Products
- 2.03 Substitution Proposals

C. EXECUTION

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- 3.01 Preparation
- 3.02 Cleaning
- 3.03 Coating
- 3.04 Touch Up
- 3.05 Testing
- 3.06 Shop Coating Schedule

* * *

SECTION 09941
FIELD PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish and apply required paints and coatings. Prepare, clean, and finish all surfaces specified, scheduled or otherwise indicated to be field painted.
 - 1. The terms "paint" and "coating" used herein include emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, whether used as intermediate, or finish coats.
- B. Complete painting in accordance with Specifications, and paint manufacturer's current surface preparation and application instructions.

1.02 RELATED WORK:

- A. Manufacturer's standard prime paint finishes are specified under the applicable Sections for Architectural.

1.03 SUBMITTALS:

- A. To aid in determining coating compatibility, submit following:
 - 1. List of coating products proposed, giving brand, type, and manufacturer.
 - 2. Manufacturer's current printed recommendations and product data sheets for each.

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3. Field painting applicator's correspondence for determining compatibility of field coatings with primers and for selecting manufacturer producing field coats.
- B. Submit color chips of materials proposed, and sample panels of paints and coatings selected. Make samples not less than 12-in. square, on sheet metal for metal coatings, on cement asbestos board for masonry and concrete coatings.
- C. Submit Manufacturer's certificates and test reports for the following materials:
 1. List materials

1.05 PAINT STORAGE AND MIXING AREAS, AND WASTE DISPOSAL:

- A. Store paints and painter's materials only in area or areas designated solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of painting debris before authorized disposal, to these areas.
- B. Do not use plumbing fixtures, piping or mechanical equipment for mixing or disposal of paint materials.
 1. Transport water to paint area by approved temporary hose or piping.
 2. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in painter's area longer than 24 hours. Finally dispose of waste in an approved disposal system outside of buildings.

1.06 DELIVERY, HANDLING, STORAGE, PROTECTION:

- A. Deliver materials to painter's area in original, unbroken, containers with name and analysis of product, manufacturer's name, and shelf life date. Do not use or retain contaminated, outdated, prematurely opened, or diluted materials.
- B. Store coated items carefully. Avoid damaging or dirtying coatings, by

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contact with soil, pavement or other harmful contacts which might necessitate special cleaning. Use suitable blocking during storage.

- C. Do not expose primed surfaces to weather for more than six months before top coating. Allow less open time if recommended by coating manufacturer.
- D. During surface preparation, cleaning, and painting operations, protect all surfaces not to be painted.
- E. Protect coated items, whether prime or finish, from damage due to shipping and handling. For items with type E or S service coatings; use padding, blocking, fabric slings and extra care.
- F. Upon completion of field painting, ensure coatings undamaged and in good condition. Make good damage or coating deterioration resulting from failure to observe foregoing requirements.

1.07 JOB CONDITIONS:

A. Environmental Requirements:

- 1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
- 2. Do not apply coatings when dust is being generated.

B. Protection:

- 1. Cover or otherwise protect finish work of other trades and surfaces not being painted concurrently or not to be painted.

PART 2 - PRODUCTS

2.01 MATERIALS; GENERAL:

- A. Paint Coatings: Suitable for intended use, recommended by their manufacturer for intended service.

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- B. Products Used: Minimum of five years satisfactory use under similar service conditions.
- C. Use products of one manufacturer in any one paint coating system: all coating materials compatible. Coatings for touch-up; same as original.

2.02 COLORS AND FINISHES:

- A. All finish colors as selected from manufacturer's color chips. Color schedule will indicate colors to be used. Match final colors to selected color chips, as scheduled.
- C. To provide contrast between successive coats, lightly tint each coat to distinguish it from preceding coats.
- D. Unless otherwise indicated, for finish paint use gloss or semigloss on wood and metal, and matte finish or flat on masonry and concrete.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work.
- B. Do not proceed with surface preparation or coating application until conditions are suitable.

3.02 PREPARATION:

- A. Basic Steps:
 - 1. Coordinate cleaning and painting operations to eliminate contamination of one by the other.
 - 2. Maintain all coating materials at manufacturer's recommended mixing

and application temperatures for not less than 24 hours before use. Have clean, proper containers, spray equipment, applicators and accessory items ready for use before decanting or mixing paint materials.

3. Ensure proper coordination of materials to be applied hereunder with previous coatings on affected surfaces. Have all manufacturer's written directions on hand, and follow them strictly, except where otherwise specified.
4. Carefully coordinate preparation and material compatibility requirements with the work under Section 09940.

B. PAINT REMOVAL:

1. **Coordinate cleaning and painting operations to eliminate contamination of one by the other.**
2. **Paint must be removed from cracked finishes before surface preparation. Removal methods are limited to:**
 - **Scraping**
 - **vapor removal**
 - **heat gun removal**

C. Before any paint application, carefully clean all surfaces to be coated of dust, dirt, grease, loose rust, mill scale, paint unsuitable for top coating, efflorescence, oil, moisture, foreign matter, or conditions detrimental to coating bond and durability.

1. Following cleaning, apply preparatory treatment in strict accordance with manufacturer's written instructions.
2. Fill imperfections and holes in surfaces to be painted.

3.03 TOUCH-UP:

- A. Before applying field coat, touch-up abraded areas of shop coats with paint of the same type. Apply an entire coat if necessary. Touch-up coats are in addition to, and not a substitute for first field coat. Clean deteriorated surfaces to bare wood before applying touch-up coat.

3.04 APPLICATION:

- A. In general, apply minimum of one under coat and one finish coat to all previously primed surfaces. Following careful inspection of surfaces not previously primed, prepare and clean as specified, apply proper prime coat and minimum of one under coat and one finish coat. Refer to Paint Schedule at end of section.

B. Conditions:

1. Do not apply paints or other finish to wet or damp surfaces, except in accordance with instructions of manufacturer. Do not apply exterior paint during cold, rainy, or frosty weather, or when temperature is likely to drop to freezing. Avoid painting of surfaces while they are exposed to the sun.
2. Paint surfaces which have been cleaned, pretreated, or otherwise prepared for painting with first field coat as soon as practicable after such preparation has been completed, but in any event prior to deterioration of prepared surface.

C. Methods:

1. Spraying with adequate apparatus may be substituted for brush application of suitable paints and in locations suitable for spraying.
2. Prepare surfaces, mix and apply paint materials in strict accordance with manufacturer's printed instructions and recommendations, except where specifically directed otherwise. Control temperature of materials

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upon mixing and application, surface temperature and condition, thinning and modifying.

3. Protect surfaces to be coated, before, during and after application unless ambient weather conditions are favorable.

D. Workmanship:

1. Spot prime with aluminum paints, all exposed nails and other ferrous metal on surfaces to be painted with water-thinned paints.
2. Apply coating materials to meet manufacturer's spreading rate and dry film thickness recommendations. Dry film thickness specified are constant for brush, spray, roller or other form of application.
 - a. Control thinning for spray use and to manufacturer's printed instructions, and produce specified dry film thickness on level surfaces, interior and exterior angles.
 - b. Record quantities of materials of each type, for each coat, used in each location.
3. Apply paints and coatings using skilled painters, brushed, or rolled out carefully to a smooth, even coating without runs or sags. Flow enamel on evenly and smoothly. Allow each coat of paint to dry thoroughly, on the surface and throughout the film thickness before the next coat is applied. High polymer coatings may be excepted from the drying requirement if recoat time is specified by manufacturer.
4. Finish surfaces: Uniform in finishes and colors, and free from flash spots and brush marks.
5. Accessory items, finish hardware, lighting fixtures, escutcheons, plates, trim and similar finish items not to be painted: Remove or carefully mask before painting adjacent surfaces. Carefully replace and reposition upon completion of adjacent painting and cleaning work.

3.05 PROTECTION, CLEAN-UP:

PUERTO RICO SUPREME COURT BUILDINGS
SEISMIC RETROFIT
ANNEX BUILDING

- A. Protect all materials and surfaces painted or coated under this section, both before and after application. Also protect all adjacent work and materials using sufficient drop cloths during the progress of this work. Upon completion of the work, clean up all paint spots, oil, and stains from floors, glass, hardware, and similar finished items.

3.06 PAINT SCHEDULE:

- A. Coordinate, schedule and confirm the various cleaning, touch-up and finishing operations. Ensure the transmission of materials data, color selections and coating system methods between the coating applicators. Take responsibility for not exceeding exposure and recoat time limits.

3.07 FINAL TOUCH-UP:

- A. Prior to final completion and acceptance, examine painted and finished surfaces and retouch or refinish as necessary and required to leave surfaces in perfect condition.
- B. After doors have been fitted and hung, refinish edges, tops and bottom.

END OF SECTION