CONSTRUCTION STANDARD SPECIFICATION

SECTION 03351

EXPOSED AGGREGATE CONCRETE

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PART 1 - GENERAL{tc \l 1 "PART I - GENERAL"}

1.01 SUMMARY

A. Section Includes: Exposed aggregate concrete produced by exposing the coarse aggregate of a gap graded concrete mix.

B. Related Sections: Refer to the following Sections for related work

Section 02200, “Earthwork”

Section 03300, “Cast-In-Place Concrete”

Section 05500, “Metal Fabrications”

Section 07900, “Joint Sealants”

1.02 REFERENCES

A. American Concrete Institute (ACI)

B. American Society for Testing and Materials (ASTM)

C31 Practice for Making and Curing Concrete Test Specimens in the Field

C33 Specification for Concrete Aggregates

C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens

C42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C94 Specification for Ready-Mixed Concrete

C143 Test Method for Slump of Hydraulic Cement Concrete

C150 Specification for Portland Cement

C172 Practice for Sampling Freshly Mixed Concrete

C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C260 Specification for Air-Entraining Admixtures for Concrete

C494 Specification for Chemical Admixtures for Concrete

D994 Specification for Preformed Expansion Joint Filler for Concrete

C. Concrete Reinforcing Steel Institute (CRSI)

1.03 SUBMITTALS

A. General: Submit the following items in accordance with the Conditions of Contract and Section 01330, "Submittal Procedures."

B. Product Data: Submit product data for the following materials and items.

C. Reinforcement

D. Forming Accessories

E. Admixtures

F. Patching Compounds

G. Sealants

H. Shop Drawings: Submit detailed shop drawings for fabrication, bending and placement of concrete reinforcement.

I. Show bar schedules, stirrup spacing, diagrams of bent bars and arrangement of reinforcement including bar overlap.

J. Include special reinforcement required for openings through concrete structures.

K. Laboratory Test Reports: Submit concrete materials test reports and mix design reports certifying that each material or item complies with or exceeds the specified requirements.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:

1. ACI 301 "Specifications for Structural Concrete for Buildings"

2. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete"

3. ACI 305 "Hot Weather Concreting"

4. ACI 306 "Cold Weather Concreting"

5. ACI 308 "Standard Practice for Curing Concrete"
6. ACI 309 "Standard Practice for Consolidation of Concrete"
7. ACI 318 "Building Code Requirements for Reinforced Concrete"
8. ACI 347 "Recommended Practice for Concrete Formwork"
9. CRSI "Manual of Standard Practice"
10. SP-66 "ACI Detailing Manual"

B. Mock-up Panels: Prepare one mock-up panel at the project site to demonstrate proficiency of the workmen, and define the degree of aggregate exposure. Mock-up panels shall be a minimum of 8'-0" x 12'-0". Contractor shall use the methods and materials proposed for used on the final installation. Uniformity in appearance of each panel shall be the responsibility of the Contractor. The approved mock-up shall serve as a standard of appearance for the final work.

C. Quality Control Testing During Construction: Sandia National Laboratories (SNL) will engage concrete testing service for quality control testing during concrete operations.

1. Notify Sandia Delegated Representative (SDR) at least two (2) working days in advance of field operations requiring concrete testing, or of resumption of operations after stoppages.
2. Coordinate concrete operations with testing service to facilitate quality control testing.
3. Sample and test concrete during placement of concrete as follows:
   a. Sampling Fresh Concrete: ASTM C172; except modified for slump to comply with ASTM C94.
   b. Slump: ASTM C143; one test for each concrete load at point of discharge and one for each set of compressive strength test specimens.
   c. Air Content: ASTM C231; pressure method; one for each set of compressive strength specimens.
   d. Compressive Strength Tests: ASTM C39; one (1) set for each 150 cubic yards (115 cubic meters) or fractions thereof, of each concrete class placed in any one day or for each 5000 sq. ft. (465 square meters) of surface area placed; two (2) specimens tested seven (7) days, three (3) specimens tested 28 days and one (1) specimen retained in reserve for later testing if required.

PART 2 – PRODUCTS

2.01 FORM MATERIALS

A. Unless otherwise indicated, construct formwork with plywood, metal, metal framed plywood faced or other acceptable panel type materials to provide continuous, straight, smooth, exposed surfaces.

1. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

2. Provide forms that comply with US Product Standard PS 1 and the following:

a. B-B High Density Overlaid Concrete Form, Class I.

b. B-B (Concrete Form) Plywood, Class I, exterior grade or better, mill oiled and edge sealed, with each piece bearing legible inspection trademark.

B. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

C. Form Ties: Provide factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

l. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least l/2 inch (12.7 mm) inside concrete for steel ties and l/4 inch (6.35 mm) for wire ties.

2. Unless otherwise indicated, provide form ties which will not leave holes larger than 1 inch (25 mm) diameter in concrete surface.

2.02 REINFORCING MATERIALS

A. Cold-drawn steel wire: ASTM A82.

B. Welded wire fabric: ASTM A185, welded steel wire fabric. Furnish in flat sheets, not rolls, unless rolls are acceptable to the SDR.

C. Reinforcing Bars: ASTM A615, deformed.

1. Provide Grade 40 bars No. 3 and 4 for stirrups and ties.

2. Provide Grade 60 bars No. 3 to 18, except as otherwise noted.

D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place.

1. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, stone, broken block or pieces of concrete.

2. For concrete-on-grade, use supports with sand plates or horizontal runners if base material will not adequately support chair legs.

3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected, stainless steel protected, or special stainless complying with CRSI Classes, C, D, or E respectively.

E. Shop fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors, do not rebend or straighten reinforcement in manner that will injure or weaken material.

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C150 Types I-II and III, "Low-Alkali" cement, unless otherwise specified. Use one brand of cement throughout project unless otherwise acceptable to the SDR

B. Aggregates: Aggregate shall be 3/4" round with the following sieve graduation:

Size	% Passing
1"	100
3/4"	90-100
3/8"	40-60
#4	0-10
#8	0-5

C. Water: Potable, clean, fresh, free from oil, acid, organic matter or other deleterious substances.

D. Admixtures: All admixtures shall be specified in the mix design.

1. Air-Entraining Admixture: ASTM C260

2. Water-Reducing Admixture: ASTM C494, Type A.

3. Water-Reducing, Retarding Admixture: ASTM C494, Type D.

4. Chloride-containing admixtures are not permitted.

2.04 RELATED MATERIALS

A. Expansion Joint Materials

1. Typical Building: ASTM D994, preformed strips of a bituminous mastic composition.

2. Slabs-in-Ground and Sidewalks: ASTM D1751, preformed expansion joint filler having relatively little extrusion and substantial recovery after release from compression.

B. Liquid Membrane-Forming Curing Compound: ASTM C309, Type I or I-D, Class A.

C. Chemical Hardener: Hardener shall be a colorless, aqueous solution of zinc or magnesium fluosilicate. Approved proprietary hardeners shall be delivered ready for use in the manufacturer's original containers.

2.05 CONCRETE MIX DESIGN

A. General: Provide “Ready-Mixed” concrete, unless otherwise approved or specified; in accordance with ASTM C94. Concrete should meet the following criteria.

1. Compressive Strength: Minimum 3,000 psi strength at 28 days.

2. Concrete shall be gap-graded with weathered rounded coarse aggregate with 45 to 48 percent matrix.

3. Water/Cement Ratio: Not greater than 0.55 by weight.

4. Slump: of 3 inches.

5. Air content: Between 4-1/2 % and 7-1/2%.

B. Admixtures

1. Use water-reducing admixture in all concrete.

2. Use air-entraining admixture in exterior exposed concrete.

2.06 PLANT, EQUIPMENT, MACHINES, AND TOOLS

A. General: Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1. Provide equipment with capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified.

2. Use of equipment shall be discontinued if it produces unsatisfactory results.

3. SDR shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

PART 3 – EXECUTION

3.01 FORM SETTING

A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure.

B. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.

C. Design and fabricate formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

D. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades.

E. Tolerances: Set forms with the upper edge true to line and grade with an allowable tolerance of 1/8 inch (3 mm) in any 10 foot (3 m) long section.

3.02 PLACING REINFORCEMENT

A. Comply with CRSI's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports.

B. Clean reinforcement of loose rust and mill scale, earth, ice, oil, concrete splatter from previous pours, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Install welded wire fabric of same gage in as long of lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps of adjacent widths to prevent continuous laps in either direction.

3.03 PREPARATIONS FOR PLACING CONCRETE

A. Remove water from excavations. Before placement of concrete, remove wood chips, shavings, and hardened concrete from forms.

1. Clean all equipment.

2. Wet forms, except in freezing weather, or oil forms.

B. Earth shall be uniformly moist when concrete is placed. Sprinkling method shall not be such as to form mud or pools of water. Watering subgrade immediately prior to placing concrete is not sufficient to make the soil uniformly moist.

C. Notify other crafts to permit installation of their work. Coordinate installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

3.04 PLACING CONCRETE

A. Notify SDR 24 hours in advance prior to concrete placement.

B. Field Inspection: Do not place concrete until forms and reinforcing steel have been inspected and approved.

1. Place Ready-Mix concrete within specified time after batching.

Below 40 degrees F (4 degrees C)	See Cold Weather Placing
40 - 85 degrees F (4 - 29 degrees C)	90 minutes
86 - 90 degrees F (30 - 32 degrees C)	75 minutes
Above 90 degrees F (32 degrees C)	60 minutes

Concrete exceeding delivery time may be rejected by the SDR.

2. Adding Water: Do not add water after initial introduction of mixing water for batch except when slump of concrete is less than that specified upon arrival at job site, and maximum water/cement ratio for mix has not been exceeded.

a. Notify SDR before adding any water.

b. Add water to bring slump within specified limits. Turn drum at least 30 additional revolutions at mixing speed. Do not add water to batch at any later time.

c. Insure that concrete strength meets specified requirements, and water does not exceed maximum amount specified in CONCRETE MIX DESIGN.

C. General: Comply with ACI 304, and as specified herein.

1. Deposit concrete continuously or in layers of such thickness that concrete will not be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness.

2. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable to its final location to avoid segregation.

D. Placing Concrete in Forms:

1. Consolidate placed concrete by high frequency mechanical vibrating equipment, supplemented as necessary by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

a. Do not use vibrators to transport concrete inside forms.

b. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine.

c. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing segregation of mix.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in continuous operation, within limits of construction joints, until placement of panel or section is completed. Maintain reinforcing in proper position during concrete placement operations.

F. Placing Concrete Sidewalks: Place concrete in forms in one (1) layer of such thickness that when consolidated and finished, sidewalks will be of thickness indicated.

G. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures; comply with ACI 306.

H. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

3.05 CONCRETE FINISHING

A. General: Do not use tools such as jitterbugs that force the aggregate away from surface.

1. After screeding and consolidating concrete slabs, do not work surface until ready for floating.

2. As soon as concrete will support the mason on knee-boards, float the surface to bring grout to the surface, completely surrounding the aggregate and filling all surface voids. Float to a uniform appearance.

B. Exposing Aggregate: Proceed as soon as the surface grout can be removed by simultaneous brushing and flushing with water without overexposing or dislodging the aggregate. Avoid traffic on the concrete during this operation. High pressure water may be used if desired finish is more easily achieved without harm to the concrete. Use same method of exposure, either with or without retarder, throughout the job.

C. Liquid Chemical Hardener Finish: Apply chemical hardener finish after complete curing and drying of the concrete surface.

1. Dilute liquid hardener with water, and apply in three (3) coats; first coat, 1/3 strength; second coat, 1/2 strength; third coat, 2/3 strength. Evenly apply each coat, and allow 24 hours for drying between coats.

2. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.

3. After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.06 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Immediately cut out honeycomb, rock pockets, voids over 1/4 inch (6.35 mm) in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than one (1) inch (25 mm).

1. Cut edges perpendicular to concrete surface.

2. Thoroughly clean, dampen with water, and brush coat area to be patched with neat cement grout or proprietary bonding agent before placing cement mortar or proprietary patching compound.

B. Remove and replace concrete with defective surfaces if defects cannot be repaired to satisfaction of SDR.

1. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.

a. Dampen concrete surfaces in contact with patching concrete and brush with neat cement grout, or apply concrete bonding agent.

b. Mix patching concrete of same materials to provide concrete of same type of class as original concrete.

c. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

3.07 CONCRETE TRUCK DISCHARGE

A. Excess Concrete: Discharge excess concrete in mixer trucks that cannot be immediately used to area where it will not create an obstruction or hazard during construction. Remove excess concrete from site in a timely manner to site approved by SDR.

B. Wash Water Discharge: Discharge wash water from mixer trucks to ground surface in manner and at location where discharge cannot escape construction site, or be washed away to arroyos, storm sewers, or sanitary sewers by precipitation or other surface flows.

1. Prior to project completion, remove wash water residue from site to location approved by SDR.

2. Clean wash water discharge site to be free of debris.

END OF SECTION