



# TULE RIVER TRIBAL COUNCIL

## TULE RIVER INDIAN RESERVATION

### ATTACHMENT 1

### MINIMUM MATERIALS / PERFORMANCE SPECIFICATIONS

#### Concrete and Masonry

Note to Contractors: Wall construction to be Structural Insulated Panels requiring close tolerance on forms being square and flat surfaces without undulations. Contractor shall verify all surfaces shall be level and square before placement of any concrete.

### SECTION 032000 – STEEL REINFORCEMENT

#### PART 1 – GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel reinforcement for concrete and masonry.
- B. Related Sections:
  - 1. Division 03 Section "Concrete Formwork."
  - 2. Division 03 Section "Cast-in-Place Concrete."
  - 3. Division 04 Section "Concrete Unit Masonry."

##### 1.2 REFERENCES

- A. Codes and Standards:
  - 1. American Society for Testing and Materials (ASTM): A82-05a Standard Specification for Steel Wire, Plain, for Concrete Reinforcement. A185-06e Standard Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement. A615-06a Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement, including supplementary requirement S1. A675-03e1 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties. A706-06a Standard Specification for Low Alloy Steel Deformed Bars for Concrete Reinforcement.
  - 2. International Code Council (ICC): California Building Code, 2007 Edition. 03/16/2011 Steel Reinforcement 032000 - 207064.02
  - 3. American Welding Society (AWS): D1.4-05 Structural Welding Code - Reinforcing Steel.
  - 4. American Concrete Institute (ACI): 117-90 (2002) Standard Tolerances for Concrete Construction and Materials. SP-66(04) Detailing Manual. 318-05 Building Code Requirements for Reinforced Concrete.
  - 5. Concrete Reinforcing Steel Institute (CRSI): Manual of Standard Practice, 2001 Edition.

- 6. Wire Reinforcing Institute (WRI): Manual of Standard Practice
- 7. Title 24, Part 2, California Code of Regulations.

### **1.3 SUBMITTALS (Section not used)**

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver reinforcement to the job site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to marking shown on placement diagrams.
- B. Store reinforcement at the job site in a manner to prevent bending, damage, and accumulation of dirt and excessive rust. Maintain identification of steel after bundles are broken.

## **PART 2 – PRODUCTS**

### **2.1 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed, including supplementary requirement S1, except that grade 40 bars may be used for ties and stirrups.
- B. (Section not used)
- C. Steel Wire: Comply with ASTM A82, except that  $F_y$  shall be the stress corresponding to a strain of 0.35 percent if the yield strength specified in the design exceeds 60,000 psi.
- D. Welded Wire Fabric: ASTM A 185, except that welded intersections shall be spaced not farther apart than 12 inches in the direction of the principal reinforcement.
- E. Dowels: Dowels for construction joints in slabs on grade shall comply with ASTM A675 Grade 80.
- F. Supports for Reinforcement in Place:
  - 1. Formed Concrete Surfaces: Use wire bar type supports complying with CRSI Manual of Standard Practice, Class 1, unless otherwise indicated. Do not use wood, brick, and other similar materials.
  - 2. Exposed-to-View Concrete Surfaces: Where legs of supports are within 1/2 inch of the concrete surface, provide supports with either plastic protected legs or stainless steel.
  - 3. Slabs on Grade or Foundations: Use precast concrete blocks, plastic-coated steel with bearing plates or specifically designed wire-fabric supports fabricated of plastic. Precast blocks shall be not less than 4 inches square and shall have a compressive strength equal to or greater than the strength of the surrounding concrete.
- G. Spirals: Deformed bars conforming to ASTM A615 Grade 60 or cold-drawn wire conforming to ASTM A82.
- H. Identification: Bundle and tag reinforcing steel with grades and suitable identification marks for checking, sorting and placing. Use waterproof tags and markings and do not remove until steel is in place.

### **2.2 FABRICATING REINFORCEMENT**

A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI Manual of Standard Practice or ACI SP-66 and the details shown on the Drawings.

1. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will damage or weaken the material.

B. Bends shall be made cold using pin sizes as recommended ACI 318 as modified by T24, CCR, Part 2.

C. Unacceptable Work: Reinforcement with any of the following defects will not be permitted:

1. Bar lengths, depths, and bends exceeding specified fabrication tolerance.
2. Bends or kinks not indicated on the project Drawings or the final Shop Drawings.
3. Bars with reduced cross-section due to excessive rusting or other cause.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed, and correct conditions which would prevent proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

### **3.2 STEEL REINFORCEMENT PLACEMENT**

A. General: Comply with CRSI's "Manual of Standard Practice" and with specified standards for details, methods of reinforcement placement, and supports, and as herein specified.

1. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce or destroy bond to concrete.
2. Accurately position, support, and secure reinforcement against displacement by formwork construction, concrete placement, and other construction operations.
3. Locate and support reinforcement with metal chairs, runners, bolsters, spacers, and hangers, as required to insure position and maintain minimum concrete cover by ACI 318.
4. Securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surface.
5. Do not tack weld crossing reinforcing bars.
6. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2" beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
7. Place bars so as to comply with the locations shown in the drawings within the tolerances permitted by ACI 117.
8. 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, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to the review of the Owner or Owner's Designated Representative.
9. Dowels at slab on grade construction joints shall be installed normal to the joint and parallel to the finished concrete surface, and rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.
10. Secure footing dowels in place before concrete is deposited. If there are no bars in position to which dowels may be tied, add No. 3 minimum to provide proper support and anchorage.

11. Fully encased structural steel members shall be wrapped with 4x4 inch mesh of W2.9 wire applied around the steel over spacers providing 3/4 inch clearance from the member. Lap ends 8 inches and tie.

12. Install welded wire fabric in as long as lengths as practicable on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing plus two inches or 6" whichever is greater. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet.

**B. Splices:**

1. Splice reinforcement by lapping ends the amount shown on the Drawings with reinforcement in contact and tightly wire tied. Lapped splices shall not be used for bars larger than No. 11.

2. Splices in addition to those indicated on the drawings shall be reviewed by the Owner or Owner's Designated Representative prior to use. Splices shall not be made in beams, girders and slabs at points of maximum stress.

3. Welded splices and mechanical connections:

a. Welded splices and other mechanical connections may be used when reviewed by the Owner or Owner's Designated Representative.

b. Welding shall conform to AWS D1.4.

c. Welded splices shall have bars butted and welded to develop in tension at least 125 percent of the specified yield strength of the bar.

d. Mechanical connections shall develop in tension or compression, as required, at least 125 percent of the specified yield strength of the bar. Install in accordance with manufacturer's recommendations.

4. Vertical bars in columns shall be offset at least one bar diameter at lapped splices.

5. All splices not shown in the contract documents shall be subject to review.

6. Reinforcement shall not be bent after being embedded in hardened concrete unless permitted by the Owner or Owner's Designated Representative.

C. Welding: Welds shall be made only by operators who have been previously qualified by tests, as prescribed in the "Qualification Procedure" of the American Welding Society, to perform the type of work required, except that this provision need not apply to tack welds not later incorporated into finished welds carrying calculated stress.

**3.3 QUALITY CONTROL**

A. The placement of all reinforcement shall be continuously inspected by an independent inspection laboratory designated by the Owner or Owner's Designated Representative.

B. Owner will engage a qualified testing and inspecting agency to perform tests and inspections and prepare test reports. Testing and inspection agency shall be designated by the Owner or Owner's Designated Representative and approved by the Division of the State Owner or Owner's Designated Representative.

C. Sampling and Testing of Steel Reinforcement: (Section not used)

D. Inspection of Welds and Welding: (Section not used)

**END OF SECTION 032000**

## **SECTION 032500 -- CONCRETE FORMWORK**

### **PART 1 – GENERAL**

#### **1.1 SUMMARY**

- A. Work Included: Provide formwork in accordance with the provisions of this section for all concrete shown on the Drawings or required by other Sections of these Specifications.
- B. Related Work in Other Sections: The following items of associated work are included in other sections of these specifications but are not limited to the following:
  - 1. Division 03 Section “Steel Reinforcement.”
  - 3. Division 03 Section “Cast-in-Place Concrete.”

#### **1.2 QUALITY ASSURANCE**

- A. Design of Formwork is the Contractor's responsibility.
- B. Standards: Comply with the following standards:
  - 1. American Concrete Institute (ACI): ACI 347-04 Recommended Practice for Concrete Formwork
  - 2. International Code Conference (ICC): California Building Code, (CBC) 2007 Edition
  - 3. West Coast Lumber Inspection Bureau (WCLIB): Standard Grading Rules for West Coast Lumber, No. 17, 2001 Edition.
  - 4. U.S. Department of Commerce Product Standard PS 1-07 Construction and Industrial Plywood
  - 5. Redwood Inspection service (RIS) Publication: Standard Specifications for Grades of California Redwood Lumber, 1988 Edition.
  - 6. American Society for Testing and Materials (ASTM): C31-06 Standard Practice for Making and Curing Concrete Test Specimens in the field. A525-83 Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process
  - 7. Title 24, Part 2, California Building Code.

#### **1.3 SUBMITTALS (Section not used)**

### **PART 2 – PRODUCTS**

#### **2.1 FORM MATERIALS**

- A. Earth Forms: Use for footing only where soil is firm and stable and concrete will not be exposed. Where earth forms are used, cut excavations neat and accurate to size for placing concrete directly against the excavation.
- B. Forms for Unexposed Concrete:
  - 1. For concrete which will not be exposed in the finished work, and which are not otherwise scheduled or specified, use one of the following form materials:
    - a. 4" or 6" wide, 1" nominal thickness boards with shiplapped or tongue and groove edges conforming to WCLIB paragraph 118c for STANDARD grade Douglas Fir. Boards shall be S4S.

b. 5/8" minimum thickness plywood conforming to PS1 grade marked B-B Plyform Class I Exterior.

C. Forms for Exposed Surfaces:

1. General: For concrete which will be exposed in the finished work, except where otherwise scheduled or specified, use 5/8" "B-B Plyform Class I Exterior" grade plywood conforming to PS1.
2. Plywood for standard structural finish, concrete surfaces to receive a "rubbed" finish, and surfaces to receive membrane waterproofing shall be "B-B Plyform Class I Exterior" grade.
3. Plywood for smooth structural finish shall be "HD Overlay Plyform Class I Exterior" grade.

D. Round Column Forms: Prefabricated seamless fiber forms.

A. Form Ties:

1. Provide factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
2. Provide ties so that portion remaining within concrete after removal of exterior parts is at least 1 1/2" from the outer concrete surface. Provide form ties which will not leave a hole larger than 1" diameter in the concrete surface.

F. Forms Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, not impede the wetting of surfaces to be cured with water or curing compounds.

## 2.2 DESIGN OF FORMWORK

A. General:

1. Design, erect, support, brace, and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads that might be applied, can be supported by the concrete structure. The design and engineering of the formwork shall be the responsibility of the contractor.
2. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose.
3. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
4. Design forms to include assumed values of live load, dead load, wind load, seismic load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, allowable stresses, lateral stability, and other factors pertinent to safety of structure during construction.
5. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations using wedges or jacks or a combination thereof.
6. Support form facing materials by structural members spaced sufficiently close to prevent objectionable deflection. Limit deflection of facing materials reflected in concrete surfaces exposed to view to 1/240 of the span.
7. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerance.
8. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

9. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.
- B. Tolerances and Variations: The Contractor shall set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete work will exceed any of the tolerances specified. The Contractor shall be responsible for variations due to deflection, when the latter results from concrete quality or curing other than that which has been specified. The tolerances specified shall not be exceeded by any portion of any concrete surface; the specified variation for one element of the structure will not be applicable when it will permit another element of the structure to exceed its allowable variations. Except as otherwise specified herein, tolerances shall conform to ACI 347.
- C. Earth Forms: Side forms of footings may be omitted and concrete placed directly against excavation only when requested by the Contractor and reviewed by the Owner or Owner's Designated Representative. When omission of forms is reviewed, provide additional concrete 1" on each side of the minimum design profiles and dimensions shown. Wood edge strips shall be provided at the top on each side of the excavation to secure reinforcing and to prevent soil from sloughing into the excavation. Earth forms shall be tamped firm and clean of all debris and loose material before depositing concrete.

## **PART 3 – EXECUTION**

### **3.1 SURFACE CONDITIONS**

- A. Examine the substrate and conditions under which work of this Section is to be performed, and correct unsatisfactory conditions which would prevent proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

### **3.2 FORM CONSTRUCTION**

A. General:

1. Construct forms complying with ACI 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, level, and plumb work in finish structures.
2. Provide for openings, offsets, sinkages, keyways, recesses moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required. Use selected materials to obtain required finishes.
3. Forms for openings, and construction which accommodates installation by other trades whose materials and products must be fabricated before the opportunity exists to verify the measurements of adjacent construction which affects such installations, shall be accurately sized and located as dimensioned on the drawings. In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions without additional expense to the Owner.

B. Fabrication:

1. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and the like to prevent swelling and assure ease of removal.
2. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to temporary openings on forms in as inconspicuous locations as possible, consistent with design requirements. Form intersecting planes to provide true, clean cut corners.

- C. Corner Treatment: Unless shown otherwise, form chamfers with 3/4" x 3/4" strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.
- D. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.
- E. Screeds: Set screeds and establish levels for tops of concrete slabs and leveling for finish on slabs. Shape slabs to drain where required or as indicated on drawings.
- F. Screenshot Supports: For concrete over waterproof membranes and/or vapor-barrier membranes, use cradle, pad, or base type which will not puncture the membrane. Do not stake through membrane.
- G. Edge Forms and Screeds Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required. Slope floors uniformly to edges.

### **3.3 FORM COATINGS**

- A. Coat form contact surfaces with form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete.

### **3.4 INSTALLATION OF EMBEDDED ITEMS**

- A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.
- B. Anchorage: Expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement, prior to placing concrete. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

### **3.5 REMOVAL OF FORMS**

- A. General:
  - 1. When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.
  - 2. Top forms on sloping surfaces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once and be followed by the specified curing.
  - 3. Formwork for columns, walls, sides of beams, sides of slabs on grade and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.
- B. Removal Strength:

1. Although forms may be removed as specified above, members may be loaded only after the minimum design strengths as specified on the drawings are attained. Any request for earlier removal of forms and shoring shall be made to the Owner or Owner's Designated Representative in writing, along with supporting evidence that the safety of the structure will not be impaired.

2. When removal of formwork is based on the concrete reaching a specified strength, the concrete shall be presumed to have reached this strength when either of the following conditions has been met.

a. (Section not used)

b. When the concrete has been cured for the same length of time as recommended by the cement manufacturer. The length of time the concrete has been cured in the structure shall be determined by a cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the air in contact with the concrete is above 50°F and the concrete has been damp or thoroughly sealed from evaporation and loss of moisture.

C. Removal:

1. In removing plywood forms, no metal pinch bars shall be used and special care shall be taken in stripping. Start at top edge or vertical corner where it is possible to insert wooden wedges. Wedges shall be done gradually and shall be accompanied by light tapping on the plywood panels to crack them loose. Do not remove forms with a single jerk after it has been started at one end.

2. Forms shall be left in place as long as possible to permit shrinkage away from concrete, and plywood forms shall be left in place until all other forms around are stripped and until there is no danger of damaging the structural concrete due to other work in the vicinity.

D. Protection: After stripping, Contractor shall properly protect all concrete to be exposed in the finish work from damage, with boards and nonstaining building paper to prevent staining, spalled edges, chips, etc.

### **3.6 RE-USE OF FORMS**

A. Clean and repair surfaces of forms to be re-used in the Work. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable. Apply new form coating compound material to concrete surfaces as specified for new formwork. When forms are reused for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

### **3.7 FIELD QUALITY CONTROL**

A. The Contractor shall notify the Owner or Owner's Designated Representative 48 hours prior to placing of any concrete, and after placement of reinforcing steel in the forms.

B. Rejection of Defective Work Due to Improper Forms: Any movement or bellying of forms during construction or variations in excess of the tolerances specified will be considered just cause for the removal of such forms and, in addition, the concrete work so affected. Reconstruction of forms and new concrete shall be furnished at no additional cost to the Owner.

**END OF SECTION 032500**

## SECTION 033000 -- CAST IN PLACE CONCRETE

### PART 1 – GENERAL

#### 1.1 SUMMARY

- A. Work Included: Provide all cast in place concrete for buildings and structures, complete, in place, as indicated on the Drawings, specified herein, and as required for a complete and proper installation.
- B. Related Sections:
1. Division 03 Section "Concrete Formwork."
  2. Division 03 Section "Steel Reinforcement."

#### 1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. Comply with applicable provisions of the following codes and standards:
  - a. International Code Council (ICC): California Building Code, (CBC), 2007 Edition.
  - b. American Concrete Institute (ACI): ACI 211.1-91 Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete. ACI 214.4R-03 Recommended Practice for Evaluation of Strength Test Results of Concrete, ACI 304R-00 Guide for Measuring, Mixing, Transporting, and Placing Concrete, ACI 305R-99 Hot Weather Concreting, ACI 306.1-90 Standard Specification for Cold Weather Concreting, ACI 308R-01 Standard Practice for Curing Concrete, ACI 309R-05 Guide for Consolidation of Concrete, ACI 318-05 Building Code Requirements for Reinforced Concrete SP-2 Manual of Concrete Inspection
  - c. American Society for Testing and Materials (ASTM): The specifications and standards hereinafter referred to, are the latest editions, except when year is specified. C31-06 Standard Practice for Making and Curing Concrete Test Specimens in the Field. C33-03 Standard Specification for Concrete Aggregates. C39-05e1 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, C40-04 Standard Test Method for Organic Impurities in Fine Aggregates for Concrete, C42-04 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, C88-05 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate, C94-06 Standard Specification for Ready-Mixed Concrete, C114-05 Methods of Chemical Analysis of Hydraulic Cement, C127-04 Test Method for Specific Gravity and Absorption of Coarse Aggregate, C128-04a Test Method for Specific Gravity and Absorption of Fine Aggregate, C131-06 Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine, C136-06 Method for Sieve Analysis of Fine and Coarse Aggregates, C138-01a Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete, C142-97 (2004) Test Method for Clay Lumps and Friable Products in Aggregates, C143-05a Standard Test Method for Slump of Portland Cement Concrete, C144-04 Standard Specification for Aggregates for Masonry Mortars, C150-05 Standard Specification for Portland Cement, C156-05 Test Method for Water Retention by Concrete Curing Materials, C157-06 Test Method for Length Change of Hardened Cement Mortar and Concrete, C171-03 Standard Specification for Sheet Materials for Curing Concrete, C172-04 Standard Method of Sampling Freshly Mixed Concrete, C173-01e1 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method C192-06 Standard Method of Making and Curing Concrete Test Specimens in the Laboratory, C227-03 Test Method for Potential Reactivity of Cement-Aggregate Combinations

(Mortar-Bar Method), C231-04 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method, C233-04 Testing for Air-Entraining Admixtures for Concrete, C260-06 Standard Specifications for Air-Entraining Admixtures for Concrete, C289-03 Potential Reactivity of Aggregates (Chemical Method), C309-06 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete, C387-06a Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete, C494-05a Standard Specification for Chemical Admixtures for Concrete, C535-03e1 Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine, C595-06 Standard Specification for Blended Hydraulic Cements, C618-05 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolans for Use in Portland Cement concrete, C666-03 Resistance of Concrete to Rapid Freezing and Thawing, D75-03 Method for Sampling Aggregates, D1751-04 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural construction (Nonextruding and Resilient Bituminous Types), D1752- 04a Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, D2103-05 Polyethylene Film and Sheeting, E329-06a Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction, E1155-96(2001) Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System.

- d. Federal Specifications (Fed. Spec.) UU-B-790A Building Paper, Vegetable Fiber; (Kraft, Waterproofed, Water Repellent and Fire Resistant), CCC-C-467C Cloth, Burlap, Jute (or Kenaf), DDD-M-148 Mats; Cotton (for Concrete Curing),
- e. Provisions of California Building Code, Title 24, Part 2 are applicable to the work. When requirements of such codes are at variance with requirements specified in foregoing paragraph, the provisions of California Building Code shall take precedence.
- f. U.S. Army Corps of Engineers Handbook for Concrete and Cement, CRD-C572-74 Polyvinyl Chloride Waterstop, CRD-C621-80 Non-Shrink Grout

**B. Qualifications of Installer:**

1. Throughout the progress of installation of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this Section.
2. In actual installation of the work of this Section, use adequate numbers of skilled workmen to insure installation in strict accordance with the contract documents design.
3. In acceptance or rejection of work performed under this Section, the Owner or Owner's Designated Representative will make no allowance for lack of skill on the part of the workmen.

**1.3 SUBMITTALS**

- A. Delivery Tags: Submit copies of delivery tags for all concrete.

**PART 2 – PRODUCTS**

**2.1 MATERIALS**

**A. Cement:**

1. Cement shall conform to ASTM C150, Type II. The cement used in the work shall correspond to that on which the selection of concrete proportions is based.

2. Where aggregates contain reactive substances low alkali cement shall be used in all structural concrete. Low alkali cement shall not contain more than 0.6 percent total alkali when calculated as sodium oxide as determined by the method given in ASTM C114.
3. All cement used in the manufacture of concrete for exposed surfaces shall be of the same brand and type, except as otherwise specifically permitted in writing by the Owner or Owner's Designated Representative.
4. The contractor shall furnish to the Owner or Owner's Designated Representative and the Enforcement Agency a certification from the cement manufacturer that the cement proposed for use in the project has been manufactured and tested in compliance with ASTM C150.

**B. Concrete Aggregates:**

**1. Hardrock Aggregate:**

- a. Concrete aggregate shall conform to ASTM C33, except as modified herein. The sieves used in the sieve analysis shall be of square mesh wire cloth.
- b. Fine and coarse aggregates shall be regarded as separate ingredients. Each size of coarse aggregate, as well as the combination of sizes when two or more are used, shall conform to the grading requirements of ASTM C33.
- c. Coarse aggregate: Coarse aggregate shall consist of a clean, hard, fine grained, sound crushed rock, or washed gravel or a combination of both. It shall be free from oil, organic matter, or other deleterious substances. Aggregate shall be uniformly graded from one-quarter inch size to maximum size.
- d. The maximum size of aggregates used in the project shall be consistent with the dimensions and form of the section being placed, the location and spacing of the reinforcing bars, and with the method of compaction, and shall be such as will produce dense and uniform concrete free from rock pockets, honey-comb and other irregularities. The nominal maximum size of the aggregate shall not be more than one-fifth the narrowest dimension between forms, one-third the depth of slabs nor three-fourths the minimum clear spacing between reinforcing bars.
- e. Combined Grading: The combined grading shall be such that the percentage by weight of the combined aggregates shall fall within the limits established as follows:

Percentage by weight

Sieve number or size in inches maximum				
1 1/2 " 1" 3/4"				
Passing a 2-inch	----	----	----	
Passing a 1-1/2 inch	95-100	----	----	
Passing a 1-inch	70-90	90-100	----	
Passing a 3/4-inch	50-80	70-95	90-100	
Passing a 3/8-inch	40-60	45-70	55-75	
Passing a No. 4	35-55	35-55	40-60	
Passing a No. 8	25-40	27-45	30-46	
Passing a No. 16	16-34	20-38	23-40	
Passing a No. 30	12-25	12-27	13-28	
Passing a No. 50	2-12	5-15	5-15	
Passing a No. 100	0-3	0-5	0-5	

- f. Reactivity: Aggregates shall be free from any substance which may be deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of the concrete or which will interfere with normal hydration of the cement. Acceptability of the aggregate shall be based upon satisfactory evidence that the aggregate is free from such materials.

i. Aggregates shall be tested, when required by the Owner or Owner's Designated Representative prior to the concrete mix being established, in accordance with the following specifications:

Abrasion ASTM C131 and C535  
Alkali Reactivity ASTM C289  
Clay Lumps ASTM C142

Gradation ASTM C136  
Organic Impurities ASTM C40  
Alkali Reactivity ASTM C227

C. Water:

1. Water used in mixing concrete shall be clean, potable, and free from injurious amounts of oils, acids, alkalies, salts, organic materials, or other substances that may be deleterious to concrete or reinforcement.
2. Conform to the requirements of ASTM C94.

D. Admixtures:

1. Admixtures shall be reviewed and approved by the Owner or Owner's Designated Representative.
2. An admixture shall be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions.
3. Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.
4. Admixtures to be used in concrete shall conform to the specifications listed below:
  - a. Fly Ash: Conform to ASTM C618 Class C or F. The use of a quality fly ash will be permitted as a cement-reducing admixture up to a maximum of 15% of the weight of portland-cement. The loss on ignition in Table 1 or C618 shall not exceed 3% Quality assurance testing and reports for a minimum of six months shall be submitted by the fly ash supplier. The amount retained on the 325 sieve in Table 2 shall not exceed 20% 5. Certification: Certification of the above requirements and chloride ion content is required from the admixture manufacturer prior to mix design review.

E. Preformed Expansion Joint Filler:

1. Premolded expansion joint filler shall conform to one of the following:
  - a. General Use: ASTM D1751
  - b. Sealant Topped: ASTM D1752, Type I or II.

F. Curing Materials:

1. Liquid membrane-forming compound shall conform to ASTM C309, Type 1, Class B and shall conform to the California Air Resources Board requirements. Use Kurez VOX by the Euclid Chemical Company, Masterkure or Masterkure W by Master Builders, Aqua Resin Cure by Burke or equivalent.
2. Impervious Membrane conforming to ASTM C171:
  - a. Clear or white polyethylene sheeting, 6 mil minimum thickness.
  - b. Waterproof kraft paper conforming to Fed. Spec. UU-B-790A.
  - c. Polyethylene coated burlap. 6 mil white opaque polyethylene film impregnated or extruded on one side of burlap. Burlap shall weigh not less than 9 ounces per square yard and shall conform to Fed. Spec. CCC-C-467C.
3. Absorptive Mats:
  - a. Burlap conforming to Fed. Spec. CCC-C-467C weighing not less than 9 ounces per square yard.

- b. Cotton mats conforming to Fed. Spec DDD-M-148 and free from any substance which may have a deleterious effect on fresh concrete.
- F. Curing and Sealing Compounds: The compound shall conform to ASTM C309 Type 1, Class B and the California Air Resources Board with 30% solids content minimum and having moisture retention tests per ASTM C156 by an independent testing laboratory showing a maximum moisture loss of 0.03 gm/cm<sup>2</sup> at a coverage of 300 square feet per gallon. Use Super Aqua Cure VOX by the Euclid Chemical Company, Kure-N-Seal WB by Sonneborn, Spartan-cote WB by Burke, or equivalent.
- G. Concrete Sealer: The compound shall be a water based acrylic sealer and shall meet the California Air Regulation Board requirements. Use Floor Seal VOX at interior locations and Diamond Seal VOX at exterior slabs by the Euclid Chemical Company or equivalent.
- H. Plastic Strip Control Joint Filler: Plastic control joint material shall be at least one inch deep, T-shaped 1/16" thick plastic strip, with a minimum 3/4" wide Pull-Top stiffener. This plastic strip shall have suitable anchor to prevent vertical movement.
- I. Patching Mortar: The compound shall be an epoxy type, three component, 100% solids, pre-packaged and ready to use. Use Euco 456 Mortar by the Euclid Chemical Company, Sidatur 43 Patch-Pak by Sika Corporation or equivalent.
- J. Surface Evaporation Retardant: For use on hot and/or windy days to prevent rapid moisture loss and subsequent plastic shrinkage cracks in concrete slabs: Use Eucobar by the Euclid Chemical Company or Confilm by Master Builders or equivalent.

## **2.2 CONCRETE MIXES**

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 25 percent.
  - 2. Combined Fly Ash and Pozzolan: 25 percent.
  - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
  - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  - 5. Silica Fume: 10 percent.
  - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

## **2.3 CONCRETE MIXTURES FOR BUILDING ELEMENTS**

A. All Concrete: Proportion normal-weight concrete mixture as follows:

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

## **2.4 GROUT MIXES**

A. Non-Shrink Grout:

1. Ready to use non-metallic aggregate product requiring only the addition of water at the job site. Product shall have the following characteristics:
  - a. Be capable of producing a mortar bed material having no drying shrinkage or settlement at any age.
  - b. Compressive strength of mortar (2" cubes) shall be not less than 5,000 psi at age seven days and 7,500 psi at age 28 days.
2. Use Euco N-S Grout or Euco High Flow Grout by Euclid Chemical Company, Masterflow 928 or Masterflow 713 by Master Builders, or SonogROUT by Sonneborn or equivalent.

## **2.5 STORAGE OF MATERIALS (Section not used)**

### **PART 3 – EXECUTION**

#### **3.1 PREPARATION BEFORE PLACING**

- A. Before concrete is placed, all equipment for mixing and transporting the concrete shall be clean, all debris and ice shall be removed from the spaces to be occupied by the concrete, forms shall be properly coated, and the reinforcing shall be thoroughly clean of ice or other deleterious coatings. Water shall be removed from the place of deposit before concrete is placed. All laitance and other unsound material shall be removed from hardened concrete before additional concrete is placed.
- B. Hardened concrete and foreign materials shall be removed from the inner surfaces of the conveying equipment.
- C. Formwork shall have been completed; reinforcement shall have been secured in place; expansion joint material, anchors, and other embedded items shall have been positioned; all preparations shall be reviewed by Owner or Owner's Designated Representative and project inspector.
- D. Semi-porous subgrades shall be sprinkled sufficiently to eliminate suction and porous subgrades shall be sealed.
- E. Concrete shall not be placed on frozen ground.

#### **3.2 PRODUCTION OF CONCRETE**

- A. General: All concrete shall be mixed until there is a uniform distribution of materials and shall be discharged completely before mixer is recharged.

B. Ready-Mixed Concrete: Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C94.

D. Control of Admixtures:

1. Admixtures shall be used in accordance with the manufacturer's instructions.

### **3.3 CONVEYING**

A. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.

B. Conveying equipment shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operations shall conform to the following additional requirements:

1. Truck mixers, agitators and non-agitating units and their manner of operation shall conform to the applicable requirements of ASTM C94. Concrete shall be protected against undue drying or rise in temperature.

C. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 ft. long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

D. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete. The loss of slump in pumping or pneumatic conveying equipment shall not exceed 2-in. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. When the concrete is placed into final position by means of pumping, the pumping method for placing concrete shall be reviewed and approved by the Owner or Owner's Designated Representative at least one week prior to placing the concrete.

### **3.4 DEPOSITING**

A. General: Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as shown in the contract documents or as approved. Placing shall be carried on at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or has been contaminated by foreign materials shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their service unnecessary.

B. Segregation: Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to any procedure which will cause segregation.

C. Consolidation: All concrete shall be consolidated by vibration so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms,

eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Internal vibrators shall have a minimum frequency of 8,000 vibrations per min. and sufficient amplitude to consolidate the concrete effectively. They shall be operated by competent workmen. Use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at points approximately 18 in. apart. At each insertion, the duration shall be sufficient to consolidate the concrete, but not sufficient to cause segregation. A spare vibrator shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

- D. After concreting is started, it shall be carried on as a continuous operation until placing of a panel or section, as defined by its boundaries or predetermined joints, is completed.

### **3.5 TEMPERING AND CONTROL OF MIXING WATER**

- A. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be retempered, but shall be discarded.
- B. When concrete arrives at the project with slump below that suitable for placing, as indicated by the specifications, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. An addition of water shall be accompanied by a quantity of cement sufficient to maintain the proper water-cement ratio. Such addition shall be reviewed by the Owner or Owner's Designated Representative.

### **3.6 WEATHER CONDITIONS**

A. Wet Weather Requirements:

1. Do not place concrete during rain, sleet or snow.
2. All concrete placed at ambient temperatures below 50° F shall contain an accelerator admixture as specified herein.

B. Hot Weather Requirements:

1. Comply with the applicable provisions of ACI 305 except as modified herein.
2. When the ambient temperature exceeds 90° F, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that may impair required strength or serviceability of the member or structure.
3. The ingredients shall be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.
4. The placing temperature of the mix shall not exceed 90° F.
5. All concrete placed at ambient temperatures above 80°F shall contain a retarding admixture as specified herein.

### **3.7 EMBEDDED ITEMS AND CONSTRUCTION JOINTS**

A. Conduits and Pipes Embedded in Concrete:

1. Pipes, other than conduits for electrical circuits, shall not be embedded in structural concrete unless specifically reviewed and approved by the Owner or Owner's Designated Representative. Any pipe or conduit may pass through any walls or floor slab by means of a sleeve so located that it does not impair the strength of the structure.

2. Unless otherwise approved, embedded pipes or conduits, other than those merely passing through, shall be not larger in outside dimension than one-third the thickness of the slab, wall, or beam in which they are embedded, nor shall they be spaced closer than three diameters or widths on center and shall have at least 1.5 inch concrete cover.
3. Sleeves, pipes, or conduits of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

**B. Construction Joints:**

1. Joints not indicated on the contract documents shall be located and constructed to minimize the impact on the strength of the structure. Joint types and location shall be acceptable to the Owner or Owner's Designated Representative. In general, joints shall be located near the middle of the spans of slabs. Joints shall be perpendicular to the main reinforcement.
3. All reinforcement shall be continued across joints.
4. The surface of all horizontal construction joints shall be cleaned and roughened by removing the entire surface and exposing clean aggregate solidly embedded in mortar matrix. The contact surface must be thoroughly cleaned by chipping or sand blasting the entire surface not earlier than five days after initial pour or by an approved method that will assure equal bond such as a thorough hose washing of the surface not less than two or more than four hours after the concrete is placed (depending on setting time), all wash water and chalk-like material being entirely cleaned from the surface.
5. In the event that the contact surface becomes coated with earth, sawdust, etc., after being cleaned, the entire surface so coated shall be recleaned.
6. A mix containing the same proportion of sand and cement used in the concrete plus a maximum of 50 percent of the coarse aggregate shall be placed on horizontal joints before proceeding with the regular specified mix.

**C. Control Joints:**

1. Joints in slabs on grade shall be located not more than 10 feet on center.
2. Saw-cut joints are permitted, cutting shall be timed properly with the set of concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking.
3. Plastic Strip Slab Control Joints: After preliminary troweling, the concrete shall be parted to a depth of approximately 2" with a joint thin metal straight edge. The plastic strip shall then be inserted in the impression so that the upper surface of the pull-top stiffener is flush with the concrete and pull-top stiffener is immediately peeled off. After the pull-top is removed the concrete shall be floated to fill all voids adjacent to the strip. During final troweling, the edges at plastic control joints shall be finished to a radius not to exceed 1/8" using a slit jointer tool. The finished joint opening shall not be wider than 1/8" exclusive of radii.
4. Sawcut joints in concrete may be used as an alternative to plastic strip control joints. At each control joint location saw cut concrete with Soff-Cut Model 566/656 Saw as manufactured by Soff-Cut International, Corona, CA or equal. Sawings shall be completed no later than 2 hours after final finish, but sooner than 2 hours if the weight of the saw and operator can cut the concrete without disturbing the final finished product. The depth of cut shall not exceed one third of the depth of the slab nor shall it be less than 1 inch.

### **3.8 CURING AND PROTECTION**

**A. General:**

1. Comply with the applicable provisions of ACI 308 except as modified herein.

2. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury, and shall be maintained with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval.

**B. Preservation of Moisture:**

1. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing:

- a. Ponding or continuous sprinkling
- b. Application of absorptive mats or fabric kept continuously wet
- c. Application of sand kept continuously wet
- d. Application of waterproof sheet materials, conforming to ASTM C171
- e. Application of other moisture-retaining covering reviewed by Owner or Owner's Designated Representative.
- f. Application of a curing compound conforming to ASTM C309. The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proven that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications. Exterior slabs, sidewalks, curbs, and structural concrete shall be cured with the specified clear, non-yellowing curing compound.

2. When concrete slab placements are subject to high temperatures, wind and/or low humidity, the Owner or Owner's Designated Representative may require the use of the specified surface evaporation retarder to minimize plastic cracking. The compound may be required to be applied one or more times during the finishing operation.

3. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal the concrete shall be cured until the end of the time prescribed.

4. Curing in accordance with Subparagraph 1 or 2 shall be continued for at least 7 days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the specified 28 day strength. If one of the curing procedures of Subparagraph 1(a) through 1(c) is used initially, it may be replaced by one of the other procedures of Subparagraph 1 any time after the concrete is 1 day old provided the concrete is not permitted to become surface dry during the transition.

5. Liquid membrane curing compounds shall not be used for curing slabs on grade when the ambient temperature exceeds 90° F or the wind velocity exceeds 10 mph.

6. Liquid membrane curing compounds shall not be used for curing when freezing weather is anticipated during the first few days of curing period.

**C. Temperature, Wind and Humidity:**

1. Cold weather: When the mean daily outdoor temperature is less than 40 degrees F, the temperature of the concrete shall be maintained between 50 and 70 degrees F for the required curing period. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hr. unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.

2. Hot weather: When necessary, provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material shall be made in advance of placement,

and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

3. Rate of temperature change: Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5° F in any 1 hour or 50° F in any 24 hour period.

D. Protection from Mechanical Injury: During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete. During the first 2 day period of curing, no traffic on or loading of the floors will be permitted.

### **3.9 FINISHING OF FORMED CONCRETE SURFACES**

A. General:

1. After removal of forms the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the contract documents or if the finish is not designated in the contract documents, the following as-cast finishes shall be used as applicable:

- a. Rough form finish
- b. Smooth form finish

### **3.10 CONCRETE SLAB FINISHES**

A. Integral monolithic finish shall be produced by striking surfaces of structural slabs at proper level. The concrete shall be rolled or tamped to force aggregate away from surfaces and surface shall then be screeded. After screeding and while the concrete is still plastic, the surface shall be floated with wood, cork, or metal floats or with a power finishing machine. During this operation, the surface shall be brought to a true grade by cutting or filing as may be appropriate. Care shall be exercised to avoid overworking the plastic concrete.

C. Specified Finishes: Concrete finishes shall be as noted or scheduled on the Drawings to conform to the finish types listed below. When a specific type finish is not scheduled or otherwise noted, the finish shall be as follows:

C. Finish types:

1. Scratched Finish: After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, the surface shall be roughened with stiff brushes or rakes before the final set.

2. Floated Finish: After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating with a hand float or with a bladed power trowel equipped with float shoes, or with a powered disc float shall begin when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10-ft. straightedge applied at not less than two different angles. All high spots shall be cut down and all low spots filled during this procedure to produce a surface within Class B tolerance throughout. The slab shall then be refloated immediately to a uniform sandy texture.

3. Troweled Finish: The surface shall first be float-finished as specified above. It shall next be power troweled, and finally hand troweled. The first troweling after power floating shall

produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks, uniform in texture and appearance and shall be plane to a Class A tolerance.

4. Broom or Belt Finish: Immediately after the concrete has received a float finish as specified above, it shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

5. Cured and Sealed Finish: Apply liquid membrane curing and sealing compound specified herein to the troweled finish in accordance with the manufacturer's recommendations.

6. Sealed Finish: Apply concrete sealer specified herein to a troweled finish in accordance with the manufacturer's recommendations.

D. Finishing tolerances:

1. Finishes with Class A tolerances shall be true planes within 1/8 in. in 10 ft. as determined by a 10-ft straightedge placed anywhere on the slab in any direction.

2. Finishes with Class B tolerances shall be true planes within 1/4 in. in 10 ft., as determined by a 10-ft straightedge placed anywhere on the slab in any direction.

3. Finishes with Class C tolerances shall be true planes within 1/4 in. in 2 ft. as determined by a 2-ft straightedge placed anywhere on the slab in any direction.

### **3.11 FIELD QUALITY CONTROL**

A. General:

1. Concrete materials and operations will be tested and inspected as the work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Owner or Owner's Designated Representative for final acceptance.

2. The Owner or Owner's Designated Representative shall have the right to order the testing of any materials used in concrete construction to determine if they are of the quality specified.

### **3.12 SUPERVISION AND TESTING**

A. The contractor is solely responsible for the direction and supervision of the entire construction operation, the performance of materials and labor, safety of working conditions, and the ultimate quality of the structure.

1. The Contractor shall provide and maintain an adequate program of quality control for materials, production methods, and workmanship to assure conformance of all work to the project documents.

### **3.13 EVALUATION AND ACCEPTANCE OF CONCRETE**

A. Evaluation of test results:

1. Test results for standard molded and standard cured test cylinders shall be evaluated separately for each specified concrete mix design.

2. For evaluation of potential strength and uniformity, each specified mix design shall be represented by at least five tests.

3. Acceptance of Concrete: The strength level of the concrete will be considered satisfactory so long as the averages of all sets of three consecutive strength tests results equal or exceed the specified strength f'c, and no individual strength test result falls below the specified strength f'c.

### 3.14 REPAIR OF SURFACE DEFECTS

#### A. General:

1. Surface defects, including tie holes, unless otherwise specified by the contract documents, shall be repaired immediately after form removal.

#### B. Repair of Defective Areas:

1. All honeycombed and other defective concrete shall be removed down to sound concrete. If chipping is necessary the edges shall be perpendicular to the surface or slightly undercut. No feathered edges will be permitted. The area to be patched and an area at least 6 in. wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. The specified bonding agent shall be used for all patching and the specified epoxy adhesive/ and or epoxy mortar shall be used for all structural repairs. All patching and repairs shall have prior approval of the Owner or Owner's Designated Representative as to method and procedure. Any concrete which has not been formed as shown on the contract drawings, is out of alignment or level or indicated a defective surface or unsoundness of any nature shall be removed and replaced to the limits required by the Owner or Owner's Designated Representative unless the Owner or Owner's Designated Representative grants permission to patch or otherwise correct the defective work. Permission to patch or attempt the correction shall not be construed to be a waiver of the Owner or Owner's Designated Representative's right to require complete removal of the defective work.

2. The patching mixture shall be made of the same materials and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume. White portland cement shall be substituted for a part of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

3. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least 1 hour before being finally finished. The patch area shall be kept damp for 7 days. Metal tools shall not be used in finishing a patch in a formed wall which will be exposed.

4. Repair materials and procedures, other than those specified may be used for repair when reviewed by the Owner or Owner's Designated Representative. Materials include but are not limited to:

- a. Shotcrete.

- b. Commercial patching products, including:

- (1) Latex-modified portland cement mortar.

- (2) Latex bonding agents if not re-emulsifiable when subsequently exposed to moisture.

- (3) Epoxy mortars and compounds that are moisture insensitive with an epoxy binder that conforms to ASTM C 811, Type III. Caution shall be exercised when using these materials with regard to possible color

changes from weathering and delamination due to different coefficients of thermal expansion.

- C. Tie Holes: After being cleaned and thoroughly dampened, the tie holes shall be filled solid with patching mortar.
- D. Foreign Materials: In the event efflorescence, stains, oil, grease, or any unsightly accumulation of foreign materials are visible on the exposed interior or exterior surfaces of finished concrete, the Owner or Owner's Designated Representative may require remedial action to remove such blemishes.
  - 1. Remove oil and grease with detergents and scrubbing and thoroughly wash with water. While the surface is wet, apply a grout coat of cement and fine sand mixed 1 to 1-1/2 with white cement added as directed to attain desired color. Immediately float surface with cork or other suitable floats to fill any holes. While the grout is plastic, finish with a sponge rubber float, removing excess grout. This shall be done when grout will not be pulled from holes. Allow surface to dry thoroughly, then rub with dry burlap to remove all dry loose grout. Complete all cleaning on any section in one day, leaving no loose grout on the surface after the termination of the regular work day.
  - 2. Spots or streaks remaining may be lightly dry honed in such manner that will not change the texture of the concrete.

### **3.15 CLEANING**

- A. All interior cement finishes shall be washed and mopped clean. Floors scheduled to receive floor coverings shall be left in proper condition to receive such covering. Integrally colored floors shall be waxed, except as may otherwise be required for a specified system. Exterior slab finishes shall be hosed clean, with all mortar or paint splotches, stains, or other defacements removed to the satisfaction of the Owner or Owner's Designated Representative. Upon completion all equipment, forming materials and debris shall be removed from the site.