SECTION 03 10 00
CONCRETE FORMS AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Form work for cast-in-place concrete shown on the drawings or required by other sections of these Specifications.

B. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 RELATED SECTIONS

A. Section 03 20 00 – Concrete Reinforcement.

B. Section 03 30 00 – Cast-in-Place Concrete.

1.3 QUALITY ASSURANCE

A. Comply with all pertinent provisions of the following standards

B. ACI 847 - Recommended Practice for Concrete Formwork

C. ACI 301 - Standard Specification for Structural Concrete for Building

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms

1. Construct forms for exposed (painted or unpainted) concrete surfaces with smooth faced undamaged plywood to provide continuous, straight, and smooth as-cast surfaces.
2. Construct forms for concrete concealed from view with rough-sawed boards of sound grade, plywood, or steel.
3. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without excessive and objectionable bow or deflection.

B. Form Ties

1. Provide factory-fabricated, adjustable-length, removable or snap off metal form ties, designed to prevent form deflection and spalling concrete surfaces upon removal.
2. Provide ties so that the portion remaining within the concrete after removal is at least 1-1/2" from the outer concrete surface.
3. Provide ties that do not leave a hole larger than one inch in diameter in the concrete’s surface.

C. Form Coatings

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

2.2 FABRICATION

A. Design, erect, support, brace, and maintain forms that will safely support vertical and lateral loads until the concrete structure can support such loads.

B. Design forms to include assumed values of live and dead loads, weight of moving equipment operated on forms, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

C. Provide shoring and struts with positive means of adjustment capable of taking up form settlement during concrete placement.

D. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

E. Support form facing materials by structural members spaced sufficiently to prevent deflection.

F. Fit forms placed in successive units for continuous surfaces to provide accurate alignment, free from irregularities, and within allowable tolerances.

G. Provide camber in forms required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrata and conditions which work under section is to be performed.

B. Correct conditions detrimental to the proper and timely completion of the work.

C. Do not proceed until satisfactory conditions have been corrected.

3.2 ERECTION

A. General

1. Construct forms complying with ACI 347 to the size, shape, line, and dimensions shown, and required to obtain accurate alignment, location, grade, level, and plumb in finish structure.

2. Provide for features including openings, offsets, sinkages, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bullheads, anchorages, and inserts. Use selected materials to obtain required finish.

3. Provide openings in concrete forms to accommodate work of other trades after verifying size and location of openings with the trade requiring such items.

B. Fabrication

1. Place forms to protect previously installed structures.

2. Fabricate forms for easy removal without hammering or prying against exposed concrete surfaces.

3. Where stripping may damage cast concrete surfaces, provide crush or wrecking plates.

4. Forms shall be sufficiently tight to prevent loss of mortar from the concrete.

5. Solidly butt joints and provide material at joints as needed.

3.3 PREPARATION

A. Cleaning

1. Thoroughly clean forms and adjacent surfaces of accumulated mortar, grout, wood chips, sawdust, dirt, or other foreign material before placing concrete.

B. Form Coating

1. Coat form contact surfaces with an approved form coating material that will effectively prevent absorption of moisture and prevent bond with the concrete.
2. Do not allow excess form-coating material to accumulate or contact surfaces that will be bonded to fresh concrete.
3. Apply in accordance with manufacturers instructions.

3.4 INSTALLATION

A. Set and build into the work anchorage and other embedded items required for other work to be attached or supported by cast-in-place concrete.

B. Use supplier provided setting drawings, diagrams, instructions, and directions for embedded items.

C. Forms not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F for 24 hours after placing, provided that:

1. Concrete is sufficiently hard to not be damaged by form removal operations.
2. Maintain curing and protection operations

D. Backfilling on only one side of concrete walls shall not be permitted unless:

1. The walls have attained the 28-day design compressive strength and have appropriate lateral bracing. The final concrete structure or sufficient temporary bracing may be used for the lateral support.
2. Sufficient temporary bracing is installed to provide adequate lateral support of the entire wall surface until condition 1 above occurs.

E. Forms supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed in less than 14 days, and not until concrete has attained design minimum 28-day compressive strength. Determine the compressive strength of in-place concrete by testing field-cured specimens representative of the concrete locations or members.

F. Forms supporting weight of concrete may be removed four days after concrete placement only if shores and other vertical supports have been arranged to adequately support the concrete until the concrete has attained the design minimum 28 -day compressive strength.

END OF SECTION 03 10 00

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SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel bars and welded steel wire fabric for cast-in-place concrete, complete with tie wire.

B. Support chairs, bolster, bar supports, and spacers for reinforcing.

C. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 RELATED SECTIONS

A. Section 01 33 00 – Submittals

B. Section 03 10 00 – Concrete Forms and Accessories.

C. Section 03 30 00 – Cast-In-Place Concrete.

1.3 REFERENCE

A. ACI 315 - American Concrete Institute - Manual of Standard Practice.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.'

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 01 33 00.

B. Include diagram of bent bars and arrangement, bar schedules, and stirrup spacing.

C. Make shop drawings in accordance with ACI 315.

D. Submit steel producers certificates of mill analysis, tensile, and bend tests for reinforcing steel.

1.5 QUALITY ASSURANCE

A. Perform concrete reinforcing work in accordance with CRSI and ACI Publications listed in reference standards unless specified otherwise in this section or on the drawings.

B. CRSI - Manual of Standard Practice

C. CRSI - Recommended Practice for Placing Reinforcing Bars

D. CRSI - Recommended Practice for Placing Bar Supports, Specifications, and Nomenclature

E. CRSI - Recommended Practice for Reinforcing Bar Splices

F. ASTM A82 - Standard Specifications for Cold-Drawn Steel Wire For Concrete Reinforcement

G. ASTM Al 85 - Welded Steel Wire Fabric for Concrete Reinforcement

H. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement

I. AWS D12.1 - Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Construction

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Deliver reinforcement to the job site bundled, tagged, and marked.
2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. Storage

1. Store reinforcement at the job site in a manner to prevent damage and accumulation of dirt and excessive rust.

1.7 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

A. Work under this section is incidental to other sections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing steel: 60 ksi yield grade, ASTM A615, plain finish.

B. Tie rods, turn buckles, plates, and nuts: ASTM A36.

C. Welded Steel Wire Fabric: ASTM A185; in flat sheets or coiled rolls, plain finish; 12" maximum wire spacing. Use WWF 6x6-W4.0xW4.0 unless otherwise noted.

D. Steel Wire: ASTM A82.

2.2 ACCESSORIES

A. Chairs, Bolster, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcing during construction conditions.

B. Tie Wire: Minimum 16.5 gauge, black annealed type, or patented system accepted by the Owner's Representative.

C. Special Chairs, Bolsters, Bar Supports, Spacers where adjacent to exposed concrete surfaces: Plastic-coated or hot-dipped galvanized steel type, sized and shaped as required.

PART 3 - EXECUTION

3.1 FABRICATION

A. General

1. Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI Manual of Standard Practices and ACI 315.
2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
3. Locate reinforcing splices, not indicated on drawings, at points of minimum stress. Location of splices subject to review of Owner's Representative.
4. Where indicated, weld reinforcing bars in accordance with AWS D12.1.

B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work.

1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
2. Bends or kinks not indicated on drawings or final shop drawings.
3. Bar with reduced cross-section due to excessive rusting or other cause.

3.2 PREPARATION

A. Examine the substrate, forms, and the conditions under which concrete reinforcement is to be placed.

B. Correct conditions detrimental to the proper and timely completion of the work.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Reinforcing shall be accurately placed and rigidly secured in position in accordance with the requirements of Recommended Practice for Placing Reinforcing Bars (CRSI), Recommended Practice for Placing Bar Supports (CRSI), and with further requirements specified herein and on the drawings.

B. Tie reinforcing with black annealed (16.5 gauge min.) wire and bend all wire back beyond general plane of reinforcing.

C. Welded wire fabric reinforcement in slabs shall be continuous, shall have joints lapped at least one full mesh, but not less than 8", and shall be supported at proper elevations by accessories. Stagger laps of sheets to avoid continuous lap in either direction. Provide support bars to maintain the fabric in its proper position during the placing of the concrete.

D. Bending, tack welding, curing or substituting reinforcement in the field, other than shown on the contract drawings, in any manner is prohibited, unless the Engineer gives specific approval for each case.

E. At the time of placing the concrete, all reinforcement shall be free from excessive rust, scale, or other coatings that might destroy or reduce the bond.

F. Prior to placing concrete, avoid reinforcement's exposure to the weather for any considerable length of time. Where this is unavoidable, paint reinforcement with a heavy coat of cement grout. The Contractor shall be responsible for protecting exposed concrete and any other materials against staining from exposed reinforcement.

G. Before concrete is cast, check all reinforcement after placement to insure reinforcement conforms to contract drawings, approved shop detail drawings, and Specification requirements.

1. Checking shall be done by qualified, experienced personnel
2. Notify the Owner’s Representative at least 36 hours (excluding weekends and holidays) prior to concrete placement and given the opportunity to inspect the completed reinforcement and forms before concrete placement.

H. Splice the reinforcement in accordance with recommended practice for reinforcing bar splices (CRSI) unless shown otherwise on the drawings or approved by the Owner’s Representative.

I. The minimum cover of concrete for all reinforcement shall conform to the drawing dimensions, which indicate the clear distance from the edge of the reinforcement to the

concrete surface. Where not otherwise specified or shown by written dimension, the minimum coverage of the concrete over the steel shall be as follows:

1. Concrete cast against and permanently exposed to earth — 3 inches
2. Formed concrete exposed to earth or weather — 2 inches
3. Formed concrete not exposed to weather or in contact with ground.
   a. Slabs and walls — ¾ inch
   b. Beams and columns — 1-½ inches

J. Lap splices as shown or called for on the drawings. Those not shown or called out shall have a minimum lap of 30 bar diameters.

END OF SECTION 03 20 00

SECTION 03 30 00
CAST IN PLACE CONCRETE

PART 1- GENERAL

1.1 SECTION INCLUDES

A. Poured-in-place concrete floors, foundation walls, and supported slabs

B. Floors and slabs on grade

C. Poured-in-place equipment pads

D. Surface finish of walls, beams, and other formed surfaces

E. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 RELATED SECTIONS

A. Section 01 33 00 – Submittals

B. Section 03 10 00 – Concrete Forms and Accessories

C. Section 03 20 00 – Concrete Reinforcement

1.3 REFERENCE STANDARDS

A. Applicable standards listed in this section include, but are not necessarily limited to, the following:

1. ACI 21 1.1 - Recommended Practice for Selecting Proportions for Normal Weight Concrete
2. ACI 301 - Specification for Structural Concrete for Buildings
3. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
4. AC I 305 - Recommended Practice for Hot Weather Concreting
5. ACI 306 - Recommended Practice for Cold Weather Concreting
6. ACI 318 - Building Code Requirements for Reinforced Concrete
7. ASTM C31 - Making and Curing Concrete Test Specimens
8. ASTM C33 - Concrete Aggregates
9. ASTM C94 - Ready-mixed Concrete
10. ASTM C143 - Test for Slump of P.C. Concrete
11. ASTM C150 - Portland Cement
12. ASTM C171 - Sheet Materials for Curing Concrete
13. ASTM C260 - Air Entraining Admixtures for Concrete
14. ASTM C309 - Liquid Membrane - Forming Compound for Curing Concrete
15. ASTM C494 - Chemical Admixtures for Concrete
16. AASHTO M 182 - Specification for Burlap Cloth made from Jute or Kenaf

1.4 SUBMITTALS

A. Manufacturer’s Data in accordance with Section 01 33 00.

1. Submit manufacturers data and instructions for proprietary materials and items, including reinforcement accessories, admixtures, patching compounds, joint systems, and others as requested.

B. Ready-mixed concrete delivery tickets: Furnish duplicate delivery tickets with each load of concrete. Delivery tickets shall provide the following information:

1. Date
2. Name of supplier
3. Job location
4. Contractor
5. Type and brand name of cement
6. Class and specified cement content - bags per cu./yd.
7. Truck number
8. Time dispatched and time placed
9. Amount of concrete in load
10. Admixture, if any
11. Maximum size aggregate
12. Time water is added to dry cement and aggregate

1.5 QUALITY ASSURANCE

A. Standards

1. Comply with standards specified in this section.
2. In case of conflict between the referenced standards, the more stringent requirements shall govern.

B. Quality Control

1. The Owner or his Representative will provide materials testing.
2. Provide free access to work and cooperation.
3. Take three concrete test cylinders for every 75 or less cubic yards of concrete placed.
4. Take one slump test for each set of test cylinders taken.

C. Use necessary means to protect the materials before, during, and after installation. Protect the work and materials of all other trades.

D. In case of damage, immediately make repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement

1. Portland cement shall conform to the requirements of ASTM C 150, Type 1.

B. Aggregates

1. Aggregates shall conform to requirements of ASTM C33.
2. Maximum aggregate size shall be not larger than 1/5th of the narrowest dimension between sides of form, 1/3rd of the depth of the slabs, or ¾ of the minimum clear spacing between individual reinforcing bars.
3. The combined maximum weight of flint and chert shall be 1% of the weight of coarse aggregate.
4. The maximum weight of lignite shall be 0.07% of the weight of the fine aggregate.

C. Water

1. Water used as an ingredient in concrete shall be clean, potable, and free from injurious amounts of foreign matter.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260

B. Chemical: ASTMC494, Type A, Water-reducing agents shall be applied at the dosage rates recommended by the manufacturer. Chlorides are not permitted.

2.3 CURING MATERIALS

A. Liquid curing and sealing compounds shall conform to ASTM C309, Type 1. Curing materials used with metallic toppings and hardeners shall be Masterseal, by Master Builders.

B. Sheet material shall conform to ASTM C171.

C. Burlap cloth made from jute or kenaf. Material shall weigh approximately 9 oz/sy, conform to AASHTO M 182 for moist curing, and shall be used in two layers.

2.4 JOINT MATERIALS

A. Performed joint filler shall be Sonoflex F by Sonnebom, or approved equal.

B. Backup rod shall be Ethafoam by Dow Chemical, or approved equal.

C. Joint filler for slabs shall be Dymeric sealant, by Tremco, or approved equal.

2.5 RELATED MATERIALS

A. Concrete repair compound shall be Sonopatch, by Sonneborn Building Products Division, Embeco 411 Mortar, by Master Builders, or approved equal.

2.6 PROPORTIONING AND DESIGN OF MIXES

A. Proportion mixes by the Laboratory Trial Batch Method. Use the same materials to be employed on the project for each class of concrete required. Comply with ACI 211.

1. Required 28-day compressive strength of concrete: 4,000 psi (unless noted otherwise)
2. Slump: 4-in. maximum, 2-in. minimum.

B. Laboratory Trial Batches:

1. The Contractor shall retain an independent testing facility or concrete plant, acceptable to the Owner's Representative, to select concrete mix proportions.

2. Test specimens shall be prepared in accordance with ASTM C192.
3. Conduct strength tests in accordance with ASTM C39, specified in ACI 301.

C. Submit written test reports, to the Owner's Representative, for each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until the Owner's Representative has accepted mixes.

D. Adjustment to Concrete Mixes: The Contractor may propose mix design adjustments when characteristics of materials, job conditions, weather, test results or other circumstances, warrant. The Owner's Representative must accept test data for revised mix designs and strength results before using in the work.

E. Use air-entraining admixture in exterior exposed concrete or structures and slabs exposed to freezing and thawing. Add air-entraining admixture at the manufacturers prescribed rate to result in concrete at the point of placement having air content within the following limits:

1. 1" Aggregate Concrete Mix: 4% to 5%
2. ¾" Aggregate Concrete Mix: 6% to 7%
3. ½" Aggregate Concrete Mix: 7% to 8%

F. The mix may use water-reducing agents as determined by the mix design organization subject to the approval of the Owner's Representative. Water-reducing agents are encouraged in conjunction with slabs to receive metallic hardeners or Anvil-Top.

2.7 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with the requirements of ASTM C94, and as herein specified. Do NOT add water to the batch.

B. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.

C. When the air temperature is between 85°F and 90°F, reduce the mixing and delivery time from 90 minutes to 75 minutes. When the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the area and condition that work under this section.

B. Correct conditions detrimental to the proper and timely completion of the work.

C. Do not proceed until achieving satisfactory conditions.

3.2 CONCRETE PLACEMENT

A. Place concrete in accordance with ACI 304.

B. Notify Owner's Representative 36 hours prior to commencement of concrete placing operations.

C. Ensure anchors, seats, plates, and other items cast into concrete, are placed, held securely, and will not cause hardship in placing concrete.

D. Maintain records of poured concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

E. Ensure concrete placement does not disturb reinforcement, inserts, embedded parts, formed expansion and contraction joints, and special form materials.

F. Concrete shall be deposited continuously, in layers of such thickness that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams and planes of weakness within the section.

   1. If, due to emergency conditions, the Contractor cannot place a section continuously between planned construction joints, introduce a field joint and additional reinforcement to preserve the structural continuity.
   2. Notify the Owner's Representative immediately and obtain his consent.

G. Construction Joints

   1. Place construction joints in slabs and beams at the center of spans.
   2. Secure full bond at construction joints. Prior to placement of new concrete, clean the surfaces of the concrete already placed, including vertical and inclined surfaces.
      a. Thoroughly clean surface of foreign materials and laitance.
      b. Roughen with suitable tools; chipping hammers, wire brushes, etc.
      c. Re-clean with a stream of water or compressed air.
   3. Dampen the joints with water.
   4. Apply bonding compound: Euro Weld, by Euclid Chemical Company, or approved equal. Place new concrete after the bonding compound has dried.

H. Place concrete in a manner to prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the placed mass of concrete. Use hoppers, spouts with restricted outlets, tremies, etc. as needed.

I. Do NOT add water to concrete between the mixing and placing operation without approval of Owner's Representative. Under no circumstances shall added water cause concrete to slump greater than that established in the design of the mix.

J. Avoid cold joints. If a cold joint occurs, the Owner's Representative may require removal of all or parts of the concrete at the cold joint. Minimum requirement is treating a cold joint as a bonded construction joint as specified above.

K. Footings: Pour footings and grade beams on well dampened, firm, undisturbed soil or engineered compacted backfill, unless otherwise shown on the Drawings.

L. In locations where doweling new concrete to existing work, drill holes in existing concrete, inset steel dowels, and pack solidly with no shrink grout.

M. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Owner’s Representative upon discovery.

N. Maintain minimum concrete cover around reinforcing as follows, unless noted otherwise:

1. Walls (exposed to weather or backfill)	2 in
2. Footings and concrete formed against earth	3 in
3. Slabs on fill	2 in

3.3 HOT WEATHER PLACEMENT

A. Hot weather concrete placement procedures shall be followed when the rate of evaporation is expected to approach 0.2-lb./sq. ft./hr., calculated from Figure 2.1.5, ACI 301, or when the maximum daytime temperature exceeds 85°F.

B. Place and protect concrete in conformance with ACI 305 during hot weather. The critical air temperature decreases as relative humidity decreases, as concrete temperature as placed increases, and as wind increases.

C. The temperature of the concrete as placed shall be kept below 80°F by one or more of the following:

1. Sprinkle aggregate stockpiles to lower temperatures through evaporation
2. Chilling the mixing water
3. Replacing some of the mixing water with shaved ice

D. Cool forms by sprinkling. Remove all excess water before placing concrete.

E. Concrete shall be in the forms within 45 minutes after water is added to the dry ingredients.

F. Curing procedures shall start as soon as the condition of the concrete surface permits.

G. Use windbreaks and sunshades to protect flat work from drying winds and direct sun.

H. Do NOT use admixtures to retard setting without the authorization of the Owner's Representative.

3.4 COLD WEATHER PLACEMENT

A. Follow cold weather concrete placement procedures when the surrounding air temperature is below 40°F or if freezing temperatures are likely during the specified curing period.

B. Place and protect concrete in accordance with ACI 306 during cold weather. Minimum temperature maintained during curing shall be as specified in Table 1.4.1, ACI 306.

C. From November 1st to April 15th, concrete shall not be placed without materials for its protection readily available on the job site, in quantities sufficient to protect all concrete that has not cured for the specified curing time.

D. The tables and graphs in Chapter 4, ACI 306 indicate the required minimum amount of insulation.

E. Do NOT use frozen materials or materials containing ice in the concrete.

F. Forms, reinforcement, filler, etc. are to be free from frost and concrete. Do NOT place forms over or in contact with frozen earth.

G. Concrete placement with air temperature at or anticipated to fall below 40°F within the 24-hours of placement shall use heated mixing water and aggregate. Protect the concrete by adequate heating and/or covering.

H. Heating: Within the enclosure, provide artificial heat to maintain the temperatures specified, continuously, and with a reasonable degree of uniformity in all parts of the enclosure.

1. All exposed concrete surfaces within the heated area shall be wet down with a hose stream at least once every 24 hours during the heating period.
2. The Contractor shall provide' adequate fire protection at all times on each floor where heating is in progress.
3. The Contractor shall maintain watchmen or other attendants to keep the heating units in continuous operation.
4. Do NOT place heating appliances in a manner to endanger formwork, expose any area of concrete to drying out, or other injury due to excessive temperatures.
5. Vent heating units. Do NOT permit the heat to dry the concrete. Venting shall adequately exhaust carbon dioxide and carbon monoxide to prevent damage to the concrete and protect the workers.

I. Covering: Protect exposed surfaces of slabs on earth, frames, slabs, beams, girders, walls, etc., formed with 1 in. or less thick wood forms or all metal forms. Protect with 2-in. blanket insulation covered with polyethylene sheets, Sisalkraft, or tarpaulins. Protection is in addition to curing membrane.

J. Placing concrete when outside temperature is below 40°F:

1. Standard concrete mixes shall have a temperature of not less than 70°F or more than 80°F when placed in the forms.
2. Maintain standard concrete mixes at a temperature of not less than 70°F for three days or 50°F for five days.
3. Maintain high strength concrete at a temperature of not less than 70°F for two days or 50°F for three days.
4. The method of protection and curing shall prevent evaporation of moisture from the concrete and injury to the surface.

K. After discontinuing heating, lower temperatures gradually. Drop shall not exceed 1 degree per hour for the first 24 hours and 2 degrees per hour thereafter until reaching the outside temperature.

L. Do NOT use of salts or chemicals for protection from freezing.

M. Remove and replace concrete damaged by freezing at the Contractor’s expense.

3.5 CONVEYING

A. Conveying method shall insure a uniform concrete mixture at the forms faces with a minimum slump loss.

B. Use chutes, steep enough to permit concrete of design consistency to flow to point of deposit, or other means of conveying.

C. Placement in Deep, Narrow Forms

1. If free fall exceeds 3-feet, discharge into a hopper feeding into a drop chute (tremie).
2. Drop to vertical: Do NOT push or pull the chute bottom from the vertical position to distribute the concrete. Move the chute.
3. Place concrete of a drier consistency near top of lift to offset the tendency of the concrete to become wetter at top.

4. Place full height of each section in one day.

D. Allow six hours (minimum) after depositing concrete in columns or walls before depositing beams, girders, or slabs supported thereon.

E. Unless otherwise permitted, execute the work so a section begun on any one day is complete in daylight on the same day.

3.6 PLACING CONCRETE BY PUMPING

A. Contractor may place cast-in-place concrete by pumping in accordance with ACI 304.

B. Design Mix

1. Submit separate design mix for pumped concrete.
2. Note, the fine aggregate gradation, and water and cement content are more critical and different from the regular concrete mix.
3. The supplier may increase the slump 1-in. for individual batches at point of discharge. Flowable Concrete may have a 7-in. slump.

C. Pumping Equipment and Placement

1. Do not convey concrete through aluminum or aluminum alloy pipes.
2. The loss of slump in pumping equipment shall not exceed 2 inches.
3. Discard the mortar used for lubricating the pumping equipment. Do not incorporate in the work.
4. Take slump and air tests at both points of delivery to pump equipment and at point of discharge from the line.
5. Take concrete cylinders at the point of discharge from the line.

3.7 VIBRATION OF CONCRETE

A. Insert and withdraw slowly internal type vibrators.

B. Insert vibrator vertically to full depth of placed layer at regular intervals (18 to 30).

C. All vibrators used for normal weight concrete shall operate at a speed of not less than 10,000 rpm and be of suitable capacity.

D. For all surfaces exposed to view in the finished work, supplement vibration by proper wooden spade puddling to remove bubbles and honeycomb.

E. For placements other than concealed massive foundations, etc., at least one vibrator shall be on hand for every 10 cubic yards of concrete placed per hour plus one spare. All vibrators shall be operable and on the site prior to starting equipment.

F. Do not use vibrator to cause concrete to flow from one location to another.

3.8 SCREEDING

A. Screed floors, slabs-on-fill, and concrete base for toppings level: Maintain surface flatness of maximum 1/8th in. in 10 ft. except where drains occur. Around drains, pitch floors in planes true to the same tolerance.

3.9 CONCRETE FINISHING

A. Finish concrete surfaces to be left exposed without special finish as follows:

1. Fill honeycomb, tie holes, and other depressions.
2. Remove projecting fins.
3. Leave surfaces as they come from forms, except as noted above.

3.10 FINISHING, HARDENING, AND CURING OF INTERIOR FLOOR SLABS

A. Perform initial finishing operations including screeding, tapering, and floating until surface water glaze is disappearing. Use only wood floats.

B. Apply floor hardener as recommended by the manufacturer.

C. Steel trowel finish floor surfaces.

D. Cure slab with hardener manufacturers recommended curing compound applied in accordance with manufacturer's recommendations.

3.11 FINISHING AND CURING OF EXTERIOR SLABS

A. Float slabs and stoops, trowel, and fiber broom finish. Tool the edges.

B. Seal concrete slabs with a curing membrane as soon as finishing operation is completed. Apply in accordance with the manufacturer's recommendations.

3.12 CONCRETE CURING AND PROTECTION

A. General

1. Protect exposed, freshly placed concrete from drying and wash by rain, water leaks, falling objects, floor traffic, and other hazards that might mar the surface.
2. Concrete shall be kept continually wet for seven days after placing, including weekends and holidays. Do NOT alternate cycle of wetting and drying. Take particular care when heating surrounding air during cold weather operations. Provide uniform distribution of heat during cold weather, between 50°F and 60°F.

B. The following are approved methods of curing:

1. Horizontal Surfaces
   a. Cover with burlap, cotton, or other approved fabric mats. Keep mat wet during curing period.
   b. Cover with 0.004 thick Polyethylene sheets. Lap edges 4" (min.). Seal with adhesive tape.
   c. Apply one coat of concrete curing compound. Apply with lamb's wool applicator paintbrush or spray. Make application immediately after troweling or as soon as the concrete can be walked upon (usually 1 to 8 hours). Apply in accordance with manufacturers specifications.
   d. Curing compound shall not be used when other hardeners and applications are specified which are not compatible with curing compounds, or on horizontal exposed surfaces on top of walls.
2. Vertical Surfaces
   a. Wood forms (kept wet), and metal forms provide satisfactory protection against loss of moisture; top surfaces are to be cured as specified above.

b. After removal of forms, continue curing for specified period with one of the methods listed for horizontal surfaces. Do not use curing compound on exposed vertical surfaces.

3.13 SLAB SURFACE TOLERANCES – (not applicable)

3.14 PATCHING

A. Repair surface defects, including tie holes and honeycomb, unless otherwise specified by the contract documents immediately after form removal.

B. Remove all honeycombed and other defective concrete down to sound concrete with edges perpendicular to the surface or slightly undercut.

1. Do NOT feather the edges.
2. Dampen the area for patching and an area at least six inches wide surrounding it, to prevent absorption of water from the patching mortar.
3. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surface.

C. The patching mixture shall be consist of the same materials and approximate the same proportions used for the concrete with the following changes:

1. Omit the coarse aggregate
2. The mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume
3. Substitute white portland cement for a part of the gray portland cement on exposed concrete. Match color by a trial patch.
4. Quantity of mixing water shall be no more than necessary for handling and placing.
5. Mix the patching mortar in advance. Allow mortar to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

D. After evaporation of the surface water from the patched area, brush the bond coat into the surface.

1. When the bond coat begins to lose the water sheen, apply the premixed patching mortar.
2. Thoroughly consolidate into place and strike off the mortar.
3. Leave the patch slightly higher than the surrounding surface.
4. To permit initial shrinkage, leave the patch undisturbed for at least one hour before final finishing.
5. Keep the patched area damp for seven days. In a formed, exposed wall, do NOT use metal tools to finish a patch.

E. After cleaning and thoroughly dampening, fill the tie holes solid with patching mortar.

F. Repair concrete slab surfaces containing defects that adversely affect durability, strength, or appearance, by a method approved by the Owners Representative or replace.

3.15 DEFECTIVE CONCRETE

A. Do not patch defective concrete until the Owner's Representative examines and approves the areas. Where so approved, make repairs using the following procedures:

1. Clean surfaces to patch of all loose particles, oils, grease, etc., and roughen surfaces as required.
2. Pre-dampen surfaces before application of patching compound.
3. Mix, apply, finish, and cure patching compound in strict compliance with the manufacturer's instructions.

B. Where concrete is to be exposed to view in the finished work, exercise care to avoid damaging the virgin skin of surrounding parent concrete.

END OF SECTION 03 30 00

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