SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install cast-in-place concrete as per contract drawings and perform all related and incidental work

1.2 RELATED SECTIONS

A. Section 03 20 00 – Concrete Reinforcing

1.3 REFERENCES

A. Latest editions of Applicable Standards from ACI Manual of Concrete Practices

B. Applicable ASTM (American Society for Testing and Materials) Standards

1.4 SUBMITTALS

The Contractor shall submit the following to the City for approval:

A. Aggregates: Proof of aggregates compatibility with cement to be used, and certification that aggregates meet specifications. State the source of the aggregates.

B. Admixtures, if used: Certificates of conformance to ASTM C260 or ASTM C494 as appropriate, shall be submitted by the admixture manufacturer prior to review of mix designs by the Engineer.

C. Concrete: Proposed concrete mix shall be designed by a recognized testing laboratory. A certificate for each mix showing slump, water/cement ratio, and weights per cubic yard of concrete for:
1. Cement
2. Pozzolan
3. Admixtures, if used.

D. Manufacturer's specifications with application and installation instructions for all proprietary materials and items, including admixtures, bonding agents, joint systems, and curing compounds.

1.5 QUALITY CONTROL

A. Specifications herein set minimum results required. The Contractor is responsible for the quality of concrete cast-in-place and bears the burden of proof that all concrete as cast meets minimum requirements.

B. Codes and Standards: Comply with the provisions specified in latest editions of all applicable standards of “ACI Manual of Concrete Practice”, including but not limited to the following:
1. ACI 318 - Building Code Requirements for Structural Concrete
2. ACI 301 - Specifications for Structural Concrete for Building

3. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete

C. Maintain copies of all applicable Codes and Standards at the project site at all times.

D. Acceptance tests for materials and design mixes:
1. No concrete shall be used in the work until the materials and mix designs have been accepted by the Engineer.
2. The Contractor shall furnish design mixes. The mixes will be tested and certified by the Contractor's Testing Agency. The testing agency shall comply with ASTM E329. The testing agency will sample, cast and test fresh concrete with standard concrete test cylinders. The responsibility for furnishing and placing concrete conforming with the requirements of the drawings and/or Specifications rests solely on the Contractor.

D. Tolerances:
1. Formed surfaces: Tolerances on formed surfaces shall be as specified in ACI 347, except where other tolerances as indicated.
2. Unformed surfaces: Tolerances on unformed surfaces shall be as specified in ACI 301 for the applicable surface finish, except where other tolerances as indicated.

1.6 JOBSITE CONDITIONS

A. Hot weather: Comply with the recommended practices of ACI 305R and the requirements specified herein. Procedures for hot weather concreting will be subject to the approval of the Engineer.

B. Cold weather: Comply with the recommended practices of ACI 306R and the requirements specified herein. Procedures for cold weather concreting will be subject to the approval of the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150, Type II.

B. Aggregate: As per sections 800.03, 800.04, 800.05, and 800.06 of the Standard Specifications. Coarse aggregate shall be normal weight aggregate.

C. Water: Water shall be clean and potable, free from impurities detrimental to concrete. It shall comply with the provisions specified in section 800.07 of Standard Specifications

D. Admixtures: As per sections 800.08 of the Standard Specifications.

E. Liquid Curing Compounds
1. Pigmented curing compound conforming to ASTM C309, Type 2, Class A or B.
2. Non-pigmented curing compound conforming to ASTM C309, Type 1, Class A or B.
3. Non-pigmented curing compound conforming to ASTM C309, Type 1D,Class A.

F. Selection of Type of Liquid Curing Compound to be used shall be as per provisions specified in the Section 800.16 of the Standard Specifications

G. Curing paper: ASTM C 171, non-staining waterproof paper, regular type.

H. Form Material: As per applicable provisions specified in part 2 and part 4 of Standard Specifications

I. Other materials:
1. Expansion joint material: As specified in the applicable provisions of Part 2 and Part 4 of the Standard Specifications.
2. Non-shrink Cementitious Grout: SikaGrout 212, manufactured by Sika Corp., Embeco Grout manufactured by Master Builders or an approved equal.
3. Epoxy Grout: Sikadur 42, manufactured by Sika Corp., Ceilcote 648cp manufactured by Master Builders or an approved equal.

2.2 CONCRETE MIX DESIGNS

A. Mix designs for concrete shall be at the Contractor's expense and shall be prepared by a qualified testing agency. Mix designs prepared by the batching plant are acceptable if the batching plant has a qualified testing laboratory. Concrete mix designs, including quantities of admixture, shall be submitted for review and approval at least 30 days prior to placing any concrete.

B. Mix designs shall be proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 with a maximum of water-cement ratio of 0.50. Submit mix designs for each class of concrete for review.

2.3 SCHEDULE OF CONCRETE CLASSES

B. Strength: Concrete shall develop compressive strengths as noted above at the age of 28 days. The tests shall be performed on concrete cylinders in accordance with ASTM C-39. The averages of all sets of three consecutive strength tests shall be equal to or greater than the specified strength and no individual strength test result shall fall below the specified strength by more than 500 psi.

PART 3 - EXECUTION

3.1 PRODUCTION OF CONCRETE

A. Concrete shall be ready mixed as per ASTM C 94. Equipment shall be adequate for the purpose and kept in good mechanical condition at all times. No hand-mixing will be permitted.

B. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities for the respective conditions as stated on the nameplate. Discharge at the site shall be completed within 1 ½ hours, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of water to the mix. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85°F, or above, a time less than 1 ½ hours may be required. Central mixed concrete shall be plant-mixed a minimum of 1 ½ minutes per batch and then shall be truck-mixed or agitated a

minimum of 8 minutes. Agitation shall begin immediately after charging the truck, followed by agitation without interruption until discharged.

C. Mixers shall be equipped with an automatic device for recording number of revolutions of drum or blades prior to completion of mixing operation. Revolution counters shall be set at "0" and shall commence to operate when drum revolution begins after introduction of ingredients into the mixer. Delivery tickets shall show departure time from plants.

D. Retempering of concrete, that is, remixing with or without additional cement, aggregates, water, or admixtures, will not be permitted.

E. No water shall be added to the mix after the initial introduction of mixing water for the batch except when, on arrival at the job site, the slump of the concrete is less than that specified. In this case, additional water may be added only if neither maximum permissible water-cement ratio nor maximum slump is exceeded and if the addition of water is approved by the Engineer. The drum or blades shall then be turned an additional 30 revolutions or more until the mix is uniform.

3.2 PLACING CONCRETE

A. General:
1. Maintain continuous and accurate log of placing of concrete in structure. Record date, location, quantity, air temperature, test samples taken. A copy of the log shall be given to the Engineer.
2. Notify the Engineer 48 hours before placing of any concrete.

B. Preparation
1. Forms shall be constructed to sizes, shapes, lines, dimensions as required to obtain accurate alignment, location, grades, level, and plumb work in the finished structure. Formwork construction shall be as per section 411.04 of the Standard Specifications.
2. Remove debris, mud, water, and all foreign material(s) from places to receive concrete. All surfaces of forms and embedded materials shall be cleaned of all mortar or grout before the surrounding or adjacent concrete is placed.
4. Absorbent forms shall be thoroughly wetted before concrete is placed. Aggregate base/sand beds for slabs on grade shall be moist but not saturated when concrete is placed.
5. No concrete shall be placed until reinforcing is fastened in place and inspected nor until forms are complete. No concrete shall be placed before work that is to be embedded has been set. Reinforcing or other materials that have been set in place shall not be disturbed.
6. Before placing concrete, embedded pipes and conduits shall be sleeved providing ¼-inch clearance (min.) all around. Sleeves shall be positioned so as not to impair the strength of surrounding elements. All items to be embedded in the concrete shall be free from oil, or foreign matter, that would impede the bond of the concrete to these items.
7. Roughen and clean existing concrete to be joined with new concrete and coat with a concrete bonding agent; mix and apply in strict accordance with manufacturer's recommendations.

C. Conveying:
1. Transport concrete from mixer to place of final deposit as rapidly and directly as practicable and by methods which prevent segregation or loss of

ingredients and displacement of reinforcement, and which avoid rehandling. Do not deposit partially hardened concrete.

2. Conveying equipment shall be acceptable to the Engineer and 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 workday. Equipment having components made of aluminum or magnesium alloys, which would have contact with plastic concrete during pumping, chutting or tremie operations, shall not be used.

D. Depositing:

1. Place no concrete when sun, wind, heat or other limitation of facilities will prevent proper finishing and curing procedures. Depositing under water will not be permitted.
2. Concrete shall not be dropped through the reinforcing steel in such a manner as to cause segregation of the aggregates. In no case, within the formwork or otherwise, shall concrete be permitted to fall from a height greater than 4-feet except through elephant trunks or other approved devices.
3. Deposit concrete in layers not exceeding 18-inches in thickness, force concrete around and under reinforcing and embedded items without displacing them. Integrate fresh concrete with that already placed; no retempering of concrete already placed will be allowed. After concrete has taken an initial set, protect forms from jarring and do not place any strain on ends of projecting reinforcement.
4. Splash or accumulation of hardened or partially hardened concrete shall be removed. Contact faces of forms for exposed concrete shall be protected from splash during placing of adjacent concrete.
5. Interruption in depositing longer than 45 minutes shall be cause for discontinuing casting of the section of work. In this event, cut back concrete and provide construction joints as the Engineer directs; clean forms and reinforcing as necessary to receive concrete at later time.

3.3 CONSOLIDATION

A. Concrete shall be thoroughly consolidated by placing the mechanical vibrator directly in concrete at 18 to 30-inches intervals for a period of approximately 5 to 15 seconds and withdrawing slowly or as directed. Thoroughly work concrete around reinforcing and embedded items and into corners and shapes of formwork. One vibrator will be required for each location where simultaneous concrete placing takes place, to ensure thorough vibrating of all sections. Provide sufficient spare vibrators on the job so as to have them readily available in case any vibrator in use should suddenly cease to function properly.

B. Mechanical vibrator shall be of the flexible immersion type having a frequency of not less than 8,000 rpm. Use and type of vibrator shall conform to ACI 309, "Standard Practice for Consolidation of Concrete."

C. Consolidate slabs four inches and less in thickness by means of vibrating screeds or for small areas such as curbs, by means of wood tampers.

3.4 CONSTRUCTION JOINTS

As per applicable provisions specified in the section 800.15 of Standard Specifications, except as modified herein:

A. Placement of construction joints and the manner in which they are provided, shall be approved by the Engineer or as shown on the Drawings. Construction joints shall be as few as possible and will not be permitted simply to save forms.

B. Construction joints including keys shall be cleaned and roughened by removing entire joint surface and exposing clean aggregate solidly embedded by means of sandblasting or other approved methods. Forms and reinforcing shall be cleaned of drippings, debris, etc.

3.5 CONCRETE FINISH

The concrete finish shall match the existing surrounding pavement.

3.6 CURING AND PROTECTION

The Curing and Protection shall be as per applicable provisions specified in the section 800.16 of the Standard Specifications, except as specified or modified herein. In the curing compound method, the nominal rate of applications shall be 200 square feet per gallon for pigmented curing compound and 250 square feet per gallon for non-pigmented type.

3.7 REMOVAL OF FORMS

As per applicable provisions of Part 2 & Part 4 of the Standard Specifications.

3.8 PATCHING AND REPAIRS

A. General: In accordance with requirements of ACI 301 and as follows; Immediately after removal of forms; inspect surfaces for defects; repair and/or patch defects within 48 hours after removal of forms and cure simultaneously with concrete. If rock pockets, in the opinion of the Engineer, are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected at the Contractor's expense.

B. Sacking: Superficial air voids and irregularities shall be filled with a cement mortar grout with all excess grout "sacked" off without the use of water. The following formula (all by volume) for cement grout shall be used for this purpose:
5 ½ parts sand
2 ½ parts Portland cement
1 ½ parts lime hydrate
Care shall be taken in the application of the grout and in sacking the excess grout from the surface in order that all voids will be filled without grout built up on the surface, and in order that a smooth surface is maintained.

C. Patching Mortar: In accordance with ACI 301, where patchwork is allowed, mixture shall match adjacent surfaces in color and texture. Determine exact mix by trial mixtures before patching; obtain approval from the Engineer of the proposed mix prior to application.

3.9 FIELD QUALITY CONTROL

A. Certification: In addition to the information specified in ASTM C94 to be provided on the delivery ticket with each batch of concrete, provide the following information on the same ticket:
   1. Reading of the revolution counter at the first addition of aggregates to the mixer.
   2. Times of day at which cement and aggregates are first intermingled, and at which water and cement are first intermingled.
   3. Mix identification.

4. Weight of cement, aggregate, water and admixtures, and aggregate size.
5. Indicate that all ingredients are as previously approved for use.

B. Testing:
1. Compression Tests: Work related to compression tests shall be performed by the Contractor's Testing Agency. During progress of work four (4) compression test cylinders shall be taken for each placement of 150 cu. yd. or fraction thereof of each class of concrete placed each day. Make, cure, and store test cylinders as per ASTM C 31. One cylinder will be tested at 7 days for information; two at 28 days for acceptance; and one retained as a spare. Cylinders will be numbered in sets (1A, 1B, 1C, 1D) and a record kept on extent of pour represented by each set and type of concrete tested. Cylinders will be tested in accordance with ASTM C 39. If any test report indicates 28-day specimen below required strength level (within standard of acceptability established by ACI 318), and if required by Engineer, testing agency will take test cores of hardened concrete in accordance with ASTM C 42. Such concrete shown to be defective shall be removed and replaced. Cost of core tests, repairs, removal and replacement of defective concrete shall be paid by the Contractor at no additional cost to the City.
2. Slump Test: Slump tests will be performed as per ASTM C 143 (slump cone) at time of taking test cylinders.
3. Air Content Test: Air content tests will be performed per ASTM C231.

C. Inspection:
1. The Contractor shall advise the Contractor's Testing Agency and the Engineer of readiness to proceed at least 48 hours prior to each concrete placement. No placement shall be made without the inspection and acceptance of the Contractor's Testing Agency.
2. When forms are removed, voids, stone pockets and other defects shall not be remedied until the Engineer has inspected them and given directions.

3.10 DEFECTIVE CONCRETE

A. Defective work is any work which does not comply with all requirements of the Contract Documents.

B. The Engineer may require defective work to be demolished and rebuilt whenever, in his opinion, the work cannot be corrected to comply with Contract requirements.

C. The Engineer may have cores taken from any questionable area in the concrete work required for determination of concrete quality. The Contractor shall repair all core holes to the satisfaction of the Engineer. Core specimens shall be drilled and tested in accordance with the requirements of ASTM Designation C 42, "Obtaining and Testing Drilled Cores". The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.

3.11 DAMAGED WORK

A. Before final acceptance of the work, damaged surfaces, corners of concrete, and concrete finish, whether such damage shall have resulted from the action of the elements or from any cause whatsoever, shall be neatly repaired. Any damaged places where surfaces repairs are permitted shall be brought to a smooth, dense, watertight condition to the satisfaction of the Engineer.

END OF SECTION