SECTION 03 45 00

PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for designing, furnishing, and installing architectural precast concrete wall panels, plates, angles, and other required secondary structural steel and attachment devices for securing precast panels to the new poured in place concrete Parking Structure.

B. Precast concrete panels at Parking Structure shall be designed with color and score lines as indicated, to resemble the appearance of the Hall of Justice.

C. Related Sections:

1. Field-applied water-repellent coating is specified in Section 07 19 00.

2. Joint sealants are specified in Section 07 92 00.

3. Graffiti-resistant coatings are specified in Section 09 92 23.

1.02 DESIGN CRITERIA

A. General: The requirement for design includes the requirement to develop the precast panel system and the connections and supports. The Drawings are diagrammatic and intended to indicate the external dimensions, organization of units, profiles, conditions, and scope. The Developer Design/Builder is responsible for compliance with the design criteria. Variations in internal detail may be proposed as required to conform to the criteria.

B. Structural Loads: The design shall conform to the loads specified in the California Building Code (CBC).

C. Wind Loads: The wind loads for engineering design of the precast concrete panels shall be those specified in the California Building Code.

D. Thermal Movement: Provide for noiseless expansion and contraction of the components and assemblies caused by an external temperature range of +20-degrees F. to +180-degrees F.

E. Panel joint design shall accommodate required drift and movement and shall be located only where indicated on the reviewed shop drawings.

F. Anchorage and Support: Work under this Section includes all required structural members required for anchorage and support of the precast panels to the building.

1. Panel system anchorage and support assemblies shall be designed to accommodate all loads and thermal, seismic, and building movements without any harmful effect on the panel system.

2. Precast concrete panel fabricator shall be responsible for locating and detailing support and anchor layouts in such a manner so as to not deviate from the design intent or cause excessive stress or deflection in the structure.

3. Fastener types and profiles are intended to be schematic in nature. Final types shall be as designed by a California registered structural engineer employed by the Developer Design/Builder.

4. Provide panel clips as required to maintain specified dimensional tolerances and for anchorage and attachment.

1.03 SUBMITTALS

A. Product Data: Manufacturer's specifications, data and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required. Include water absorption test reports for units with exterior exposure.

B. Shop Drawings: Show information for fabrication and installation of precast concrete units.

1. Indicate member dimensions and cross-section; location, size and type of reinforcement, including special reinforcement and lifting devices required for handling and erection. Lifting points shall be located away from exposed surfaces.

2. Include erection procedure for precast units, sequence of erection, and required handling equipment.

3. Show layout, dimensions, and identification of units corresponding to sequence and procedure of installation.

4. Show layout and location of joints between panels.

5. Indicate welded connections by AWS standard symbols.

6. Detail inserts, connections, and joints, including accessories and construction at openings in units.

7. Show gravity, wind, seismic and other loads imposed on all supporting structural members and attachments. Forces, moments, and stresses shall be computed.

8. Show location and details of anchorage devices to be embedded in other construction.

9. Show deviations from design profiles.

C. Design Calculations: Furnish design calculations prepared and signed by a professional structural engineer licensed in the State of California. Review of calculations shall not relieve the Developer Design/Builder from the requirement to provide installed panels and attachments of required strengths.

D. Samples: Approximately 24-inches square, 2-inches thick to illustrate quality, color, and texture of surface finish. These samples are for initial review of quality, color, and texture only.

E. Visual Plant Sample:

1. Upon County's Representative's review and acceptance of sample for quality, color, and texture, provide one full-size precast-concrete panel for each type of finish required (or only one where finishes are combined in a common panel) for review of materials, color, quality of workmanship, finish, and conformance with the architectural design intent. Fabricate in full-size unit suitable for use in the work.

2. Notify the County's Representative for plant review of completed panel prior to erecting. Erect at the plant in a location which will permit reviewing in full.

3. The mock-up will be reviewed by the County's Representative for visual quality only. Compliance with the structural requirements is the responsibility of the Developer Design/Builder. The reviewed and accepted mock-up shall be retained at the fabricating plant to serve as a standard of quality for all precast work.

F. Visual Jobsite Mock-Up:

1. Upon County's Representative's review and acceptance of plant sample for quality, color, and texture, provide one full-size precast panel, as mock-up for architectural review of materials, color, quality of workmanship, finish, and conformance with the architectural design intent. Construct the mock-up unit and provide all materials and finishes as required for actual installation. Deliver to the jobsite.

2. The mock-up units will be reviewed by the County's Representative for visual quality only; compliance with the structural requirements is the responsibility of the Developer Design/Builder. If any mock-up unit is deficient, it shall be repaired or redone until satisfactory results are obtained. The mock-up units, when accepted by the County's Representative, shall be retained at the jobsite to serve as standard of quality for all precast concrete work. Do not begin fabrication of precast concrete units until the mock-up units are accepted by the County's Representative.

3. Mock-up of sealant work around the mock-up panel shall be provided, similar to that described above, prior to commencement of any further sealant operation. Refer to Section 07 92 00.

G. Mix Design: Concrete mix design for review. Include the amount and proportion of each color admixture, sources of cement, and fine and coarse aggregates. All aggregates shall be from one source.

H. Test Reports: Reports on materials, specified tests and inspections and water-absorption tests.

I. Design Calculations: Structural design calculations in accordance with PCI MNL-121.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum 5-years experience in the fabrication of precast units similar to those required for this Project. Fabricator shall have sufficient production capacity to produce, transport, and deliver required units without causing delays in the work.

B. Fabrication Qualifications: Produce precast units at fabricating plant.

C. Design Modifications: As necessary to meet field conditions and to ensure proper fitting of the work, when accepted by County's Representative.

1. Maintain general design concept without increasing or decreasing sizes of members or altering profiles and alignment.

2. Furnish design calculations and drawings prepared by a registered professional engineer, if requested by County's Representative.

D. Erector Qualifications: Minimum 5-years experience in the erection of architectural precast concrete units, similar to those required for this Project. Welders shall be qualified in accordance with AWS D1.1.

E. Source Quality Control: Perform water-absorption test on sample in accordance with PCI MNL-117.

F. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards.

1. ACI 318.

2. CRSI.

3. Prestressed Concrete Institute (PCI) MNL-117.

4. AWS D1.1.

1.05 TESTING REQUIREMENTS

A. General: Comply with testing provisions of PCI MNL-117.

B. Testing Agency: Minimum 5-years experience performing tests of type specified and capable of performing testing in accordance with ASTM E329.

C. Concrete Design Mixes:

1. Test and report as specified for production mixes, except test for compressive strength at 7- 14- and 28-days.

2. Test each type or class of concrete and each proposed mix design.

D. Concrete Production Mix Tests:

1. Compression Tests:

a. One 28-day test for each day of production.

b. Three specimens each test.

c. Obtain from production mixes.

d. Cast specimens in standard cylinders in accordance with ASTM C31.

e. Cure by same method as for precast units until forms are stripped, then moist-cure until tested.

2. Slump: Daily if slump is greater than 2-inches; otherwise once each week.

3. Air Content: Daily.

4. Unit Weight: Once each week for standard weight; daily for lightweight.

E. Water-Absorption Tests:

1. Test face mixes only using ASTM C127 and C128 as applicable.

2. Absorption Limits by Volume: 12-percent average, 14-percent maximum.

F. Structural Welding Inspection: Visually inspect structural welds as work progresses and at frequencies required by Testing Agency. Examine butt welds using ultrasonic methods.

G. Production Inspection:

1. Continuously inspect concrete batching, mixing, conveying, placing, consolidation, and finishing.

2. Inspection may be provided by precast panel manufacturer if approved by Testing Agency.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver precast concrete units to Project site in quantities and times to assure continuity of installation. Protect and cover units during loading, shipment, and unloading to prevent damage, soiling, and vandalism.

B. Lift and support units at designated lifting or supporting points, as indicated on reviewed shop drawings. Lift units from truck to in-place location wherever possible.

C. If units are stored at the Project site, store units to prevent cracking, distortion, warping, staining, and other physical damage, with markings visible.

1.07 FIELD CONDITIONS

A. Minor modifications to precast units may be made only as required to meet field conditions and to ensure proper fitting of work. Maintain the design concept without increasing or decreasing sizes of units or altering profiles and alignment.

B. If precast concrete units are to be modified, obtain prior acceptance of the County's Representative.

C. Modifications shall be made without additional cost to the County.

PART 2 - PRODUCTS

2.01 FORMWORK

A. Provide forms and form facing materials of metal, plastic, wood, or other acceptable materials that are non-reactive with concrete, producing required finish surfaces.

B. Construct forms mortar-tight, of sufficient strength to withstand pressures due to concrete placing operations and temperature changes.

1. Maintain formwork to provide units of shapes, lines and dimensions, within specified fabrication tolerances.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60, unless otherwise required.

B. Steel Wire: ASTM A82, plain, cold-drawn, steel.

C. Welded Deformed Steel Wire Fabric: ASTM A497.

D. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing.

1. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with plastic protected legs (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.03 COLOR AND FINISH

A. Color of precast concrete shall resemble the color of the Hall of Justice after cleaning. Finish exposed surfaces with a light sandblast finish to match approved samples.

B. Provide architectural reveals as indicated to resemble the Hall of Justice.

2.04 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I or Type III. Use only one brand and type of cement throughout the Project.

1. Use white portland cement for facing concrete mix if required to match mock-up sample.

2. Standard gray portland cement may be used for non-exposed back-up concrete.

B. Coarse Aggregate for Facing Mixes: ASTM C33; hard, durable, selected and graded; free of material causing staining or reaction with cement.

1. Use aggregate from same source as those used in mock-up sample.

C. Fine Aggregate for Facing Mixes: ASTM C33; manufactured sand of same material as coarse aggregate, unless otherwise accepted.

D. Pigments: Non-fading, resistant to lime and other alkalies.

E. Water: Drinkable, free from foreign materials in amounts harmful to concrete and embedded steel.

F. Air-Entraining Admixture: ASTM C260.

G. Water-Reducing Admixture: ASTM C494, Type selected by fabricator and containing not more than 0.1-percent chloride ions.

2.05 CONNECTION MATERIALS

A. Steel Plates: Structural quality, hot-rolled carbon steel, ASTM A283, Grade C.

B. Steel Shapes: ASTM A36.

C. Stainless Steel Shapes: AISI Type 302/304.

D. Anchor Bolts: ASTM A307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers.

E. Finish of Steel Units: Exposed units hot-dip galvanized in accordance with ASTM A153; inserts cast into precast units hot-dip galvanized, electro-galvanized or cadmium coated; others painted with rust-inhibitive primer.

2.06 GROUT MATERIALS

A. Cement Grout: Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C404. Mix at ratio of 1-part cement to 3-parts sand, by volume, with minimum water required for placement and hydration.

B. Metallic Shrinkage-Resistant Grout: Pre-mixed packaged ferrous aggregate grouting compound, Euclid Chemical Co. "Firmix", Sonneborn "Ferrolith G" or approved equal.

C. Non-Metallic Shrinkage-Resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, Euclid Chemical Co. "Euco H.S." Master Builders "Masterflow 713" or approved equal.

2.07 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type of concrete required.

B. Design mixes may be prepared by independent testing facility or by qualified precast manufacturing plant personnel.

C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for each type of concrete required, complying with ACI 318 as follows:

1. Laboratory Trial Batches: When laboratory trial batches are used to select concrete proportions, prepare test specimens in accordance with ASTM C192, and conduct strength tests in accordance with ASTM C39, as specified in ACI 301.

2. Field Experience Method: When field experience methods are used to select concrete proportions, establish proportions as specified in ACI 301. Strength data for establishing standard deviation will be considered suitable if the concrete production facility has certified records consisting of at least thirty consecutive tests on one group or the statistical average for two groups totaling thirty or more tests, representing similar materials and Project conditions.

D. Facing Mix: Standard-weight concrete consisting of specified portland cement, aggregates, admixtures, and water to produce the following properties:

1. Compressive Strength: 5,000-psi minimum at 28-days.

2. Total Air Content: 4- to 6-percent.

3. Water Absorption: Maximum 5- to 6-percent, maximum 3- to 4-percent for sloping surfaces such as sills.

E. Back-Up Concrete: Standard-weight concrete with compressive strength of 5,000-psi at 28-days.

F. Submit written reports of proposed mix for each type of concrete at least 15-days prior to start of precast unit production.

G. Adjustments to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Laboratory test data for revised mix designs and strength results shall be accepted before using in the work.

H. Admixtures: Use air-entraining admixture in compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete may be used. Use amounts recommended by manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

2.08 FABRICATION

A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and following dimensional tolerances.

1. Dimensional Tolerances of Finished Units: Overall height and width measured at face adjacent to mold at time of casting:

a. 10-feet or under: plus or minus 1/8-inch.

b. 10- to 20-feet: plus 1/8-inch, minus 3/16-inch.

c. 20- to 30-feet: plus 1/8-inch, minus 1/4-inch.

d. Each additional 10-feet: plus or minus 1/16-inch per 10-feet.

e. Angular deviation of plane of side mold: 1/32-inch per 3-inch depth, or 1/16-inch total, whichever is greater.

f. Openings within one unit: plus or minus 1/4-inch, except plus or minus 1/8-inch for windows and door frames.

g. Out of square (difference in length of two diagonals): 1/8-inch per 6-feet or 1/4-inch total, whichever is greater.

h. Thickness: plus 1/4-inch, minus 1/8-inch.

i. Tolerance of other dimensions not otherwise specified: Numerically greater of plus or minus 1/16-inch per 10-feet or plus or minus 1/8-inch.

2. Position Tolerances: For cast-in items measured from datum line locations indicated on reviewed shop drawings:

a. Anchors and Inserts: within 3/8-inch of centerline location.

b. Blockouts and Reinforcements: within 1/4-inch of position indicated on reviewed shop drawings where such positions have structural implications or affect concrete cover, otherwise within plus or minus 1/2-inch.

B. Fabricate units straight, smooth, and true to size and shape, with exposed edges and corners square.

1. Units which are warped, cracked, broken, spalled, stained, or otherwise defective will not be acceptable.

C. Built-In Items: Provide reglets, slots, holes, and other accessories in units to receive dowels, reglets, flashings, and other work.

D. Anchorages: Provide loose steel plates, clip angles, seat angles, anchors, dowels, hangers, and other steel shapes required for securing precast units to supporting and adjacent members.

E. Panel Thickness: Minimum 6-inches.

F. Surface Finish: Fabricate precast units and provide exposed surface finish to match reviewed mock-up.

1. Provide a light sandblast finish on edges of panels to be sealed with water-repellent coating to remove curing compounds and form-release agents.

G. Casting: Precast-concrete units shall be plant cast in forms and/or molds supported on pouring platforms adequate to carry the superimposed loads of the weight of concrete, equipment, and personnel. Wall panels shall be cast in molds in any position best suited for pouring, finishing, and handling operations.

H. Workmanship:

1. The mixing, conveying, placing, finishing, and curing of the concrete shall conform to the applicable requirements for concrete in Section 03 30 00.

2. Reinforcement, anchorage devices, and other inserts shall be installed and secured before concrete is poured. Support for these items will not be permitted from the exposed finished surfaces of the units.

3. Steel inserts, fittings, and connections shall be protected from rust and corrosion and shall be free from twists and bends. Holes and cut and sheared edges shall be neatly made without kinks, burs, or warped edges. Steel left exposed shall be straight, smooth, and free of nicks, scars, and dents. Exposed welds shall be uniform and neat. Steel or portions of steel not embedded in concrete shall be prime painted.

I. Handling: Precast units shall be removed from forms and/or molds within 3-days from the time that they are cast. Minimum compressive strength of concrete before moving units shall be 2,500-psi. Units shall be moved from casting area to sandblasting area with a minimum amount of handling.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Deliver anchorage items to be embedded in other construction. Provide setting diagrams, templates, instructions and directions as required for installation.

B. Install precast concrete members plumb, level, and in alignment within PCI MNL-117 and specified limits of erection tolerances.

1. Provide temporary supports and bracing required to maintain position, stability and alignment during connection.

2. Maintain horizontal and vertical joint alignment and uniform joint width.

C. Accessories: Install clips, hangers, and other accessories required for erection of precast units to supporting members and back-up materials.

D. Anchor units by bolting, welding, grouting, or as otherwise required. Remove temporary shims, wedges, and spacers after anchoring is completed.

1. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.

2. At welded connections, apply rust-inhibitive coating on damaged areas. Use galvanizing repair coating on galvanized surfaces.

3. Supporting brackets shall be designed to provide adjustment and accurate location of panels. After panels are properly positioned, connections shall be rigidly fixed by welding or other positive means.

E. Workmanship:

1. Erect panels plumb and true, in proper alignment and relation to established lines and grades, with uniform joints and reveals.

2. Do not ship or install panels which are defective in any way. Remove and replace members which have been damaged during installation or thereafter before the time of final acceptance.

3. Do not cut, trim, weld, or braze component parts during erection in any manner which would damage the finish, decrease the strength, or result in visual imperfection or failure in performance.

4. Secure panels to structure with non-staining and noncorrosive shims, anchors, fasteners, spacers, and fillers. Use erection equipment which will not mar or stain finished surfaces.

5. Clean debris and other substances from behind and adjacent to the panels as they are erected, and provide temporary closures as required to prevent the accumulation of debris in the void spaces behind the panels.

F. Cleaning: Clean exposed facings to remove dirt and stains after erection and completion of joint treatments.

1. Wash and rinse in accordance with precast manufacturer's recommendations.

2. Protect other work from damage due to cleaning operations.

3. Do not use cleaning materials or processes harmful to exposed concrete finishes.

G. Protection:

1. Protect precast units before, during, and after construction until final acceptance.

2. Protect precast units from finished grade to the second floor level commencing after their erection and until directed to remove the protection materials from the jobsite.

3. Surface defects resulting from failure to design, provide, monitor, or maintain adequate precast protection may result in the removal and replacement of the damaged units at no cost to the County.

3.02 ERECTION TOLERANCES

A. Warpage: Install units so that each panel complies with the following dimensional requirements after erection.

1. Bowing of any part of a flat surface not to exceed length of bow/360, with a maximum of 3/4-inch up to 30-feet.

2. Maximum warpage of one corner out of plane of other three, the greater of 1/16-inch per foot distance from nearest adjacent corner, or 1/8-inch.

B. Tolerance for Location of Precast Units: Fabricate and erect precast units so that joints between panels comply with the following:

1. Face width of joints: plus or minus 3/16-inch.

2. Joint taper: 1/40-inch per foot length, with maximum length of tapering in one direction of 10-feet.

3. Step in face: 1/4-inch.

4. Jog alignment of edge: 1/4-inch.

5. Alignment for exterior panels is outside face.

6. Variation from plumb or level: plus or minus 1/2-inch in any 40-foot run.

3.03 PERFORMANCE REQUIREMENTS

A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.

1. Patching limitations will be determined by County's Representative.

2. Repair of Concrete Surfaces:

a. Proposed surface repair procedures, materials, and examples of completed repair operations shall be submitted to the County's Representative for review prior to the shipment or erection of precast units that exhibit surface defects and prior to commencing repair operations.

b. Avoid the need for repair and patching in-place precast units. Do not erect precast units which arrive at the jobsite in a condition exhibiting surface defects.

c. Repair exterior exposed-to-view concrete surfaces that are damaged or that contain defects which adversely affect the appearance of the finish. Repaired surfaces shall match adjacent concrete in form, texture, and color. Remove and replace panels with defective surfaces if the defects cannot be repaired to the satisfaction of the County's Representative. Surface defects include color and texture irregularities, cracks, spalls, and discoloration that cannot be removed by cleaning.

B. In-place units may be rejected for the following:

1. Exceeding specified installation tolerances.

2. Damaged during construction or as a result of inadequate protection of precast units.

3. Exposed-to-view surfaces which develop surface finish defects.

4. Other defects listed in PCI MNL-117.

END OF SECTION