

SECTION 03 45 00 – PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 - Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

- A. Provided all labor, material, and equipment to cast, fabricate, deliver, and erect all architectural precast concrete as shown on the Architectural Drawings and in schedules.
- B. Architectural Precast Concrete shall include the following unit types:
 - 1. Plain smooth faced concrete units.
 - 2. Exposed aggregate units (integral, not surface applied aggregate).
 - 3. Special formed and textured units.
- C. Precast prestressed structural concrete units are specified under another section of Division 03.
- D. Caulking, sealants, and gaskets are specified in Division 07.

1.3 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except as otherwise indicated:
 - 1. ACI 318 "Building Code Requirements for Reinforced Concrete.
 - 2. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
 - 3. Prestressed Concrete Institute MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products".
 - 4. PCI Manual for Structural Design of Architectural Precast Concrete as published by the Prestressed Concrete Institute.
 - 5. PCI Design Handbook, Fourth Edition, as published by the Prestressed Concrete Institute.
- B. Fabricator Qualifications: Firms which have a minimum of 2 years successful experience in the fabrication of architectural precast concrete units, similar to units required for this project, will be acceptable. Fabricator must have sufficient production capacity to produce, transport, and deliver required units without causing delay in the work.

- C. Fabrication Qualifications: Produce precast concrete units at fabrication plant engaged primarily in manufacturing of similar units, unless plant fabrication or delivery to site is impractical.

If units are not produced at precast concrete fabricating plant, maintain procedures and conditions for quality control equivalent to plant production.

- D. Design Responsibility:

1. Design: The design and detailing of all Architectural Precast Concrete and their connections shall be the responsibility of the precast fabricator. This shall include all bolts, plates, braces, weld sizes, and any embedded items in both precast and the structural frame for all connections between the precast and the support frame. The design shall be performed by or under the direct supervision of a registered professional engineer in the state where the project is located. Design calculations, stamped by the registered engineer, shall be submitted for Engineer review.

Design modifications may be made only as necessary to meet field conditions and to ensure proper fitting of the work, and only as acceptable to the Architect. Maintain general design concept shown without increasing or decreasing sizes of members or altering profiles and alignment shown. Provide complete design calculations and drawing prepared and stamped by a registered professional engineer in the state where the project is located.

2. Design Procedure: Design calculations shall consider and show stress from dead load of panel, wind load, and erection loads. Wind loads shall be as specified in the project General Notes of the structural drawings or as shown on the architectural drawings.

- E. Erector Qualifications: Regularly engaged for at least 2 years in the erection of architectural precast structural concrete similar to the requirements of this project. Upon request, provide written evidence that equipment and personnel are adequate and qualified for performance of contract requirements.
- F. Welder and Welding Machine Operator Qualifications: All field and plant welders shall be certified in accordance with AWS D1.1 for the type of welding required.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver precast concrete units to project site in such quantities and at such times to assure continuity of installation. Any storage of units at the project site shall be done so as to prevent cracking, distortion, warping, staining, or other physical damage and so that markings are visible. Lift and support units only at designated lifting or supporting points as shown on final shop drawings.

1.5 SUBMITTALS

- A. Certification and Test Reports: Submit manufacturer's specifications and instructions for manufactured materials and products. Include manufacturer's and plant's certifications and laboratory test reports for the following:
1. PCI Plant Certification.

2. Concrete mix designs, including sources of coarse, fine and lightweight aggregates as well as admixtures and fly ash.
 3. Prestressing strand mill certificates.
 4. Mill certificates for reinforcing bars and welded wire mesh.
 5. Mill certificates for high strength reinforcing bars.
 6. Structural steel mill certificates.
 7. Welder and welding operator certifications.
 8. Calibrations of prestressing jacks.
 9. Calibration of cylinder testing machine.
 10. Mill certificates for cement.
 11. Cylinder test reports on concrete for all precast units.
 12. Compressive strength test reports for structural grout.
 13. Certification from the bearing pad manufacturer verifying conformance with standards set forth in Division 2, Section 25 of AASHTO Standard Specification for Highway Bridges.
 14. Certification from manufacturer of slide bearing assemblies verifying conformance with ASTM D1457.
 15. Manufacturer's identification number as an approved fabricator in accordance with the City of Houston Policy Memorandum Relative to Fabricators, Prefabricated Construction and Certifying Agencies, Revision 1 issued November 4, 1982.
- B. Product Data: Submit manufacturer's specifications, data and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
- C. Shop Drawings: Submit shop drawings showing complete 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 necessary for handling and erection.
 2. Indicate erection procedure for precast units, sequence of erection, and required handling equipment.
 3. Show layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation.

4. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints including accessories and construction at openings in precast unit.
 5. Show location and details of anchorage devices that are to be embedded in other construction.
 6. Coordination with Structural Steel Detailer: Prior to the start of the structural steel shop drawings, the precaster shall furnish the Architect/Engineer a set of shop drawings showing the location of all gravity and lateral connections to the structure. The General Contractor shall furnish this information to the structural steel detailer, after it has been approved by the Architect/Engineer, and prior to the completion of structural steel shop drawings.
- D. Design Calculations: The Precaster's design of all precast elements shall be submitted for Engineer approval. Such calculations shall be performed by or under the direct supervision of a registered professional engineer in the state where the project is located. The calculations shall be bound with the Engineer's signature, seal, and date stamped on the cover sheet. Calculations shall be indexed by precast element and arranged in a logical orderly fashion. Incomplete submittals will be rejected. Where computer aided design is submitted, the input data shall be included and output must be clear. At least one hand calculation shall be submitted for each member type designed by computer.
- E. Samples: Submit samples (minimum 3) approximately 12" X 12" and of appropriate thickness, to illustrate quality, color, and texture of surface finish prior to commencement of production. One will be returned to the General Contractor and one to the precaster prior to production. All approved samples shall be initialed by the Architect.
1. Submit samples of cast-in gaskets, anchorages, and other attachments and accessories as requested by Architect.
 2. Prepare a full-size sample of each required architectural precast concrete unit for the Architect's inspection at production plant or on site prior to start of installation work, and after Architects review of finish samples. Acceptable full-size samples may be incorporated in job installation.

PART 2 - PRODUCTS

2.1 FORMWORK

- A. Provide forms and, where required, form facing materials of metal, plastic, wood, or other acceptable material that is non-reactive with concrete and will produce required finished surfaces. Rust-stained or excessively worn forms that would impair the quality of the finished surface are not acceptable. Comply with recommendations set forth in ACI Standard 347, Recommended Practice for Concrete Formwork.
- B. Accurately construct forms mortar-tight and of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and when prestressed, the pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated on the approved shop drawings within specified fabrication tolerances.

- C. Unless forms for plant-manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced from precast units due to deformation of concrete under prestress or to movement during detensioning.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615, Grade 60, except all reinforcing steel required to be welded shall conform to ASTM A 706.
- B. Galvanized Reinforcing Bars: ASTM A767, Class II.
- C. Epoxy Coated Reinforcing Bars: ASTM A775.
- D. Steel Wire: ASTM A82, plain, cold-drawn steel.
- E. Welded Wire Fabric: ASTM A185.
- F. Deformed Steel Wire: ASTM 496.
- G. Welded Deformed Steel Wire Fabric: ASTM A497.
- H. Prestressing Tendons: Uncoated, 7-wire, stress-relieved strand; ASTM A416, Grade 270K.
- I. Prestressing Bars: ASTM A722.
- J. Supports for Reinforcement:
 - 1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting or fastening reinforcing, complying with CRSI recommendations.
 - 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI Class 1) or stainless steel protected (CRSI Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III.

Use only one brand and type of cement throughout the project, unless otherwise acceptable to Architect.
 - 1. Use "buff" color portland cement for facing concrete mix to match Architect's control sample.
 - 2. Use "White" portland cement for facing concrete mix to match Architect's control sample.
 - 3. Standard "gray" portland cement may be used for non-exposed back-up concrete.
- B. Coarse Aggregate: ASTM C 33; hard, durable, carefully selected and graded; free of material causing staining or reacting with cement.

Use aggregates from same sources as those used in Architect's control sample.

- C. Fine Aggregate: ASTM C 33; manufactured sand of same material as coarse aggregate, unless otherwise acceptable to Architect.
- D. Water: Drinkable, free from foreign materials in amounts harmful to concrete and embedded steel.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Admixtures:
 - 1. Air-Entraining; complying with ASTM C260 and as manufactured by:
 - a. Dayton Superior Corp.
 - b. Gifford-Hill & Co., Inc.
 - c. W. R. Grace & Co.
 - d. Master Builders
 - 2. Water-Reducing; complying with ASTM C494, Type A and as manufactured by:
 - a. Gifford-Hill & Co.
 - b. W. R. Grace & Co.
 - c. Monier Resources
 - 3. Fly Ash; complying with ASTM C618 and as manufactured by:
 - a. Monier Resources
 - b. Ash Management System
 - 4. Calcium Chloride; Not permitted

2.4 CONNECTION MATERIALS

- A. Steel Plates: ASTM A36.
- B. Steel Shapes: ASTM A36.
- C. Anchor Bolts: Non-headed type with tensile strength requirements conforming to ASTM A36, unless otherwise indicated. Provide regular hexagon nuts and carbon steel washers
- D. High Strength Anchor Bolts: Non-headed type made from threaded round stock conforming to ASTM A572 Grade 50 or A572 Grade 42 as shown on the drawings or high-strength bars conforming to ASTM A722. Where grade is not specifically shown, ASTM A572 Grade 50 anchor bolts shall be furnished.
- E. Weldable Reinforcing Bars: ASTM A706.
- F. Headed Studs: ASTM A108, 60,000 psi minimum tensile strength.
- G. Deformed Bar Anchors: ASTM A496, 70,000 psi minimum yield strength.
- H. Prestressing Steel Bars: ASTM A722.

Approved Manufacturer: Dywidag Systems International, USA, Inc.

- I. Threaded Rods: ASTM A36.
- J. Welding Electrodes: Comply with AWS D1.1.
- K. Ductile Iron Inserts: ASTM A536.

Approved Manufacturers:

- 1. Richmond Screw Anchor Company, Inc.
 - 2. Hohman & Barnard, Inc.
 - 3. Dayton Superior Corporation.
- L. Corrosion Protection of Materials: Shop prime all items that are cast in the supporting concretes and concrete units. All other connection material shall be hot dip galvanized in accordance with ASTM A 153. Touch-up after field welding with zinc-rich coating as manufactured by Sherwin-Williams (Zinc-Clad 5 B69 A 45) or ZRC Cold Galvanizing Compound. Exposed surfaces of all plates embedded in concrete shall be painted with zinc-rich coating specified above after the field connection is complete.

2.5 BEARING PADS

A. Elastomeric Pads:

- 1. Provide structural grade chloroprene bearing pads with Shore A durometer hardness of 60 ± 5 and having a minimum thickness of 3/8" for tees, 1/2" for beams, and 1/4" for slabs, unless otherwise shown on the drawings. Bearing pads provided shall conform to Standard Specifications for Highway Bridges inclusive of all Interim Specifications up to date adopted by the American Association of State Highway and Transportation Officials.
- 2. Design bearing pads in accordance with recommendations set forth in PCI Design Handbook, Fourth Edition.
- 3. Size pads so that both surfaces are in complete contact with the bearing pads. The design bearing pressure shall not exceed 800 psi under total service load, and 500 psi under dead load. Pads greater than 1 1/4" in thickness shall be laminated with steel plates (min. 1/16" thick) molded into the material.
- 4. Provide beveled, plain elastomeric bearing pads between non-parallel load surfaces.
- 5. Approved manufacturers of elastomeric pads:
 - a. Oil States Industries, Inc.
 - b. Scougal Rubber Co., Inc.
 - c. Con-Serv, Inc.
 - d. JVI Inc.
 - e. Tulsa Rubber Co.
 - f. Old North Manufacturing Co.

B. Tetrafluoroethylene (TFE) Slide Bearings:

1. Glass-filled virgin Teflon slide bearings as shown on the drawings and as manufactured by:
 - a. EGC Corporation
 - b. Con-Serv, Inc.
 - c. Fluorocarbon

2.6 GROUT MATERIALS

- A. Nonshrink Grout: All base plates, bearing plates, and concrete bearing joints shall be grouted with non-shrink non-metallic grout as specified herein. Provide premeasured, prepackaged, non-metallic, non-corrosive, non-staining material requiring only the addition of water complying with the following:
1. Corps of Engineers Specification for Nonshrink Grout (CRD-C621).
 2. Attain 28 day compressive strength as determined by grout cube tests conforming to ASTM C109 in accordance to the following:
 - a. 6,000 psi for supporting concrete up to 3,000 psi.
 - b. 8,000 psi for supporting concrete between 3,000 psi and 4,000 psi.
 - c. 10,000 psi for supporting concrete greater than 4,000 psi.
 3. Follow manufacturer's directions and recommendations for mixing and placing grout.
 4. Grout to be similar in color to that of surrounding concrete.
 5. Acceptable non-shrink grouts:
 - a. "Supreme" as manufactured by Gifford Hill Co.
 - b. "Crystex" as manufactured by L&M Construction Chemicals, Inc.
 - c. "Five Star Grout" as manufactured by U.S. Grout Corp.
- B. Sand Cement Grout: Provide sand cement grout for grouting all pockets and blockouts in precast members and in grouting prestressed ducts where specified on the drawings. Sand cement grout shall consist of Portland Cement (ASTM C 150 Type I or III), sand (ASTM C33), and water. Proportions by weight shall be one part cement, 2 1/4 to 2 1/2 parts sand, and the minimum amount of water required to obtain a workable mix. Minimum compressive strength shall be 3500 PSI at 28 days. Admixtures to accelerate the set or prevent freezing may be utilized, except the use of admixtures containing chlorides will not be permitted.

PART 3 - EXECUTION

3.1 FABRICATION

- A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations and dimensional tolerances of PCI MNL-116 and MNL-117, and as specified for types of units required.

B. Proportioning and Design of Mixes:

1. Prepare design mixes for each type of concrete required.
2. Design mixes may be prepared by an independent testing facility or by qualified precast manufacturing personnel, at precast manufacturer's option.
3. Proportion mixes by either trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 211.1 or ACI 211.2.
4. Submit written reports to Architect/Engineer of proposed mix for each type of concrete at least 30 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed and approved by Architect/Engineer and Owner's testing laboratory.
5. 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 must be submitted to and accepted by Architect/Engineer and Owner's testing laboratory before using in the work.
6. Produce normal weight concrete consisting of specified portland cement, aggregates, admixtures and water to produce the following properties:
 - a. Compressive Strength at 28 days: 5,000 psi minimum at 28 days, or as required by design or as noted on the drawings.
 - b. Release Strength: The minimum release strength for prestressed units shall be 3500 psi.
7. Produce lightweight concrete consisting of specified portland cement, aggregates, admixtures and water to produce the following properties:
 - a. Compressive Strength: 5,000 psi minimum at 28 days, or as required by design or as noted on the drawings.
 - b. The split cylinder strength factor ($F_{ct}/(f'_c)^{0.5}$) shall not be less than 5.7 and a drying shrinkage limit of 0.03% at 28 days.
 - c. Air-dry density: Not less than 110 nor more than 116 pounds per cubic foot.
 - d. Release Strength: The minimum release strength of prestressed members shall be 3500 psi.
8. Cure compression test cylinders using the same methods as will be used for the precast concrete work.

C. Admixtures:

1. Comply with ACI 212.2R.
2. Use air-entraining admixture in concrete unless otherwise indicated.
3. Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased

- workability for low-slump concrete, may be used subject to Architect/Engineer's approval.
4. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.
- D. Embedded Items: Accurately position and secure cast-in anchorage devices. Locate anchorages where they do not affect position of reinforcement or placing of concrete. Do not relocate bearing plates or reinforcing steel in units unless approved in writing by the Architect/Engineer.
- E. Reinforcement Installation:
1. Clean reinforcement of loose rust and mill scale, earth and other materials which reduce or destroy bond with concrete.
 2. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as specified by CRSI Manual of Standard Practice.
 3. Place reinforcement to obtain at least the minimum coverages for concrete protection as specified in the drawings. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- F. Tensioning: Pretensioning of tendons for prestressed concrete may be accomplished either by single strand tensioning method or multiple-strand tensioning method. Comply with PCI MNL-116 requirements.
- G. Concrete Placement: Place concrete in a continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 304 and ACI 309. Thoroughly consolidate placed concrete by internal and/or external vibration without dislocation or damage to reinforcement and embedded items.
- H. Identification:
1. Provide permanent markings to identify pick-up points and orientation in the structure, complying with markings indicated on final shop drawings. Imprint date of casting on each precast unit on a surface which will not show in finished structure.
 2. Provide additional marking as required by local building codes or ordinances.
- I. Curing:
1. Cover all precast and precast/prestressed concrete members with tarpaulins or other suitable means immediately after casting.
 2. Curing by low-pressure steam, by steam vapor, by radiant heat and moisture, or other similar process may be employed to accelerate concrete hardening and to reduce curing time.

3. Test cylinders shall be cured with and by the same methods as the members they represent.
 4. Make test cylinders as follows:
 - a. Minimum of two (2) per bed for each pour to verify specified release strength.
 - b. Minimum of two (2) per 50 cubic yards for each class of concrete to verify 28-day strength but not less than one set per days operation.
 - c. Minimum of two (2) to verify release strength and two (2) for 28-day strength for small units or individual pieces.
- J. Detensioning:
1. Delay detensioning of prestressed units until concrete has attained design release strength, as established by test cylinders.
 2. If concrete has been heat-cured, perform detensioning while concrete is still warm and moist to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.
 3. Detensioning of prestressed tendons may be accomplished either by gradual release of tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- K. Finishes:
1. Architectural Surface Finishes:
 - a. Abrasive blast finish, using abrasive grit, equipment, application techniques and cleaning to expose aggregate and surrounding matrix surfaces, to match Architect's control sample.
 - b. Exposed aggregate finish, using chemical retarding agents applied to concrete forms, with washing and brushing procedures after form removal to match Architect's control sample.
 - c. Bushhammer finish, using power and hand tools and cleaning procedures to match Architect's control sample.
 - d. Smooth surface finish free of pockets, sand streaks, and honeycomb, with uniform color and texture to match Architect's control sample.
 - e. Textured surface finish imparted by form liners or inserts to provide surfaces free of pockets, streaks and honeycomb, with uniform color and texture to match Architect's control sample.
 - f. As-cast or float finish for unexposed surfaces.
 2. Other Formed Surfaces: Provide normal plant run finish in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal form joint marks, and minor chips and spalls may be acceptable, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.
 3. Other Unformed Surfaces: Provide trowel finish to unformed surfaces unless otherwise indicated. Consolidate concrete, bring to proper level with a straightedge, and float and trowel to a smooth uniform finish.

3.2 FABRICATION TOLERANCES

Provide fabrication tolerances as follows:

- A. Standard tolerances according to PCI MNL-116 and 117 and Part 8 of the PCI Design Handbook, Fourth Edition unless stricter requirements are specified on the drawings.
- B. Areas or members with special tolerances are indicated on the plans.
- C. Precast units having dimensions not conforming to specified tolerances will be rejected if appearance or function of the structure is adversely affected. Repair, or remove and replace rejected units as required to comply with contract documents. All repairs must be approved by the Architect/Engineer.

3.3 INSTALLATION

- A. General:
 - 1. Examine supporting structure and conditions under which precast concrete work is to be erected and provide written notification of conditions detrimental to proper and timely completion of work. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Erector.
 - 2. General Contractor shall monitor all phases of erection to ensure the work is in conformance with the contract documents.
 - 3. Erect members by means of suitable lifting devices at points provided by the manufacturer.
 - 4. Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.
 - 5. Properly align, plumb and level precast units. Level out variations between adjacent members by shimming, loading or any other feasible method recommended by the manufacturer and acceptable to the Architect/Engineer.
 - 6. Provide accurate placement and alignment of anchor bolts, plates or dowels in supporting structural elements.
 - 7. Provide true, level bearing surfaces on all field placed foundations, bearing walls and other supporting members.
 - 8. Bearing Pads: Install specified bearing pads as precast units are being erected and maintain in correct position until precast units are placed. Bearing pads must be placed under all precast floor members unless specifically detailed otherwise on the drawings.
 - 9. Do not install precast units until concrete has attained its 28 day design strength.
- B. Erection Tolerances: Install precast concrete members plumb, level, and in alignment within PCI MNL-17 and PCI Design Handbook, Part 8, Fourth Edition specified limits of erection tolerances. Provide temporary supports and bracing as required to maintain position, stability and alignment as members are being permanently connected.

Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses. Deflections of the supporting frame may occur as panels are erected, necessitating readjustment, alignment, and possibly resetting of certain panels to meet specified tolerances. It is the responsibility of the precast erector to consider such deflection, whether specifically indicated on the drawings or not, and provide for same in the erection process at no additional cost to the Owner.

Anchor units in final position by bolting, welding, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible 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, same as shop applied material. Use galvanizing repair coating on galvanized surfaces.

C. Field Welding:

1. Perform welding in compliance with AWS D1.1 and D1.4.
2. Protect units from damage by field welding operations and provide non-combustible shields as required.
3. Remove all lifting loops and touch-up paint all galvanized field welded connections as specified.
4. Repair damaged metal surfaces by cleaning and applying a coat of liquid galvanizing repair compound to galvanized surfaces and primer compatible with painted surfaces.

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

E. Cleaning: Clean exposed facings to remove dirt and stains which may be on units after erection and completion of joint treatments. Wash and rinse in accordance with precast manufacturer's recommendations. Protect other work from damage due to cleaning operations. Do not use cleaning materials or processes which could change the character of exposed concrete finishes.

3.4 DAMAGED OR MISCAST UNITS

- A. Any units that are noticeably cracked from the process of lifting, handling, or any other reason shall be replaced by the Contractor at no additional cost to the Owner.
- B. Concrete units which are not formed as shown on the drawings or are out-of-tolerance or show a defective finish shall be considered as not conforming with the intent of this specification and shall be removed from the job and replaced by the Contractor at no additional cost to the Owner.

3.5 CONCRETE SURFACE REPAIRS

A. Classification:

1. Structural Repair: Major defective areas including cracks, spalls, or honeycombs that affect the structural integrity of the unit shall require a structural repair using a two part epoxy bonder and/or epoxy mortar. Location of structural repairs shall be at the discretion of the Architect/Engineer.
 2. Cosmetic Repair: Minor defective areas in units that do not affect the structural integrity of the unit shall require a cosmetic repair using a non-shrink patching mortar and bonding agent. Location of cosmetic repairs shall be at the discretion of the Architect and Engineer.
- B. Method: The method of repair shall be approved by the Architect/Engineer after samples are submitted for review by the Contractor.
- C. Waiver: Permission to patch or repair any area shall not be considered as a waiver of the Architect's right to require complete removal of the defective work if the repair does not, in the opinion of the Architect, satisfactorily restore the quality and appearance of the work.

3.6 PERFORMANCE REQUIREMENTS

- A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.
- Limitations as to the amount of patching which will be permitted is subject to acceptance of Architect.
- B. In addition to above, in-place precast units may be rejected for any one of the following:
1. Exceeding the specified installation tolerances.
 2. Damaged during construction operations.
 3. Exposed-to-view surfaces which develop surface finish deficiencies.
 4. Other defects as listed in PCI MNL-117.
- C. Products Not Meeting Specifications: Precast units that do not conform to all specified requirements including strength, tolerances, both fabrication and erection, and finishes shall be rejected and replaced with units meeting all requirements of the Contract Documents, unless approval by the Engineer, Architect and Owner is obtained in writing for an authorized repair.
- D. Authorized Repairs: No structural or architectural repair shall be made to any precast unit either in the plant or in the field without written documented approval for each occurrence in the form of a letter or drawing from the Engineer, Architect, and Owner. Unauthorized repair details shall not be allowed.

END OF SECTION 03 45 00