# SECTION 030500 GENERAL CONCRETE CONSTRUCTION

## PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of formwork, reinforcing steel, joints, concrete, and finishing and curing for general concrete construction.

B. Related Work Specified Elsewhere

1. Precast Concrete Vaults: 034220.

2. Painting and Coating: 099000.

3. Trenching, Backfill, and Compaction: 312316.

4. Asphalt Concrete Paving: 321216.

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.

2. Prepare concrete and mortar mix designs and laboratory 7-day and 28-day compressive tests, or submit test reports of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects. Submit mix design in writing for review by the Owner at least 15 days before placing of any concrete.

3. Submit manufacturer's catalog data and descriptive literature for form ties, spreaders, corner formers, form coatings and curing compound, bond breakers, joint sealant, backing rod, and epoxy bonding compound.

4. Submit mill test certificates identifying chemical and physical analyses of each load of reinforcing steel delivered. If mill test reports are unavailable and the quantity of steel for a structure exceeds 5 tons, provide a laboratory test to prove conformance with the specified ASTM standard.

5. Submit reinforcing bending lists and placing drawings for all reinforcing. Placing drawings shall indicate all openings (mechanical, electrical, equipment, and architectural) including additional reinforcing at openings and corner bar arrangements at intersecting beams, walls, and footings indicated in the typical detail and structural drawings. Placing drawings shall be coordinated with the concrete placing schedule. Each bending list and placing drawing submitted shall be complete for each major element of a structure (grade slabs, footings, walls, deck, floor, or roof slabs) including

dowels and corner bars. Furnishing such lists shall not be construed that the lists will be reviewed for accuracy. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown in the drawings and as specified. Placing drawings shall be prepared by the Contractor and shall not incorporate photocopies of the contract drawings.

6. Submit six copies of a report from a testing laboratory verifying that aggregate material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics.

## PART 2 - MATERIALS

### A. Nondomestic Cement and Additives

1. The use of nondomestic cement and additives in concrete may be permitted only after review of a written request to use such materials. The request to use nondomestic materials shall include a chemical analysis that indicates the material meets the project specifications. Certifications that state the nondomestic materials meet the project requirements will not be accepted.

2. Test reports for concrete materials shall be current to within three months of inclusion into the project and shall be identifiable to the materials supplied.

### B. Formwork

1. Design forms according to ACI 347.

2. Class I Forms: Use steel forms, ply form, or smooth-surface plywood 3/4-inch minimum thickness for straight surfaces and 1/2-inch minimum thickness for curved surfaces.

3. Class II Forms: Use plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints.

4. Class II forms may be used for exterior concrete surfaces that are 1 foot or more below finished grade. Use Class I forms for all other surfaces.

5. Coat forms with form release agent.

### C. Bond Breaker

Bond breaker shall be a nonstaining type which will provide a positive bond prevention, such as Williams Tilt-Up Compound, as manufactured by Williams Distributors, Inc., Seattle, Washington; Silcoseal 77, as manufactured by SCA

Construction Supply Division, Superior Concrete Accessories, Franklin Park, Illinois; or equal.

D. Form Release Agent

1. Form release agent shall effectively prevent absorption of moisture and prevent bond with the concrete. Agent shall be nonstaining and nontoxic after 30 days.

2. For steel forms, release agent shall prevent discoloration of the concrete due to rust.

E. Reinforcing Steel

1. Reinforcement shall conform to ASTM A615 or A706, Grade 60.

2. Fabricate reinforcing in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute. Bend reinforcing steel cold.

3. Deliver reinforcing steel to the site bundled and with identifying tags.

F. Welded Wire Reinforcement

Welded wire reinforcement shall conform to ASTM A185.

G. Tie Wire

Tie wire shall be 16 gauge minimum, black, soft annealed.

H. Bar Supports

Bar supports in beams and slabs exposed to view after form stripping shall be galvanized and plastic coated. Use concrete supports for reinforcing in concrete placed on grade.

I. Bar Couplers

Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by Dayton Barsplice Inc. or equal. Use couplers that do not reduce tensile or ultimate strength of bars.

J. Joint Sealant for Concrete Structures

1. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints and Grade NS, Class 25 for

vertical joints and be recommended by the manufacturer for continuous immersion in water.

| Characteristic or Parameter | Technical Requirements |
|---|---|
| Pot life | 1 to 3 hours |
| Hardness | 35 Shore A, ±5, ASTM D2240 |
| Elongation | 650%, ASTM D412 |
| Tensile strength | 200 psi, ASTM D412 |
| Peel strength on concrete | No adhesion loss at 25 pounds |
| Temperature service range | 40°F to 167°F |
| Immersion in water | Continuous |

2. Sealant shall be Tremco Vulkem 227 or Sikaflex-2CNS (for Grade NS, Class 25), Sikaflex-2CSL of Sika Corporation or Vulkem 245 (for Type M, Grade P, Class 25), or equal. Troweling of sealants into joints will not be permitted.

K. Backing Rod for Expansion Joints

Backing rod shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam SB, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/4 inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices. Apply backup rod and bond breaker tape in expansion joints.

L. Bond Breaker Tape

Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

M. Preformed Control Joint

Preformed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex Corp., Knoxville, Tennessee, or a one-piece steel strip with preformed groove, such as Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, California, or equal. Provide the preformed control joint material in full-length unspliced pieces.

N. Premolded Joint Filler

Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D1752, Type I, as manufactured by W. R. Grace Company of Cambridge, Massachusetts; W. R. Meadows, Inc., Elgin, Illinois; or

equal or bituminous-type preformed expansion joint filler conforming to ASTM D994.

O. Steel Expansion Joint Dowels

1. Steel expansion joint dowels shall conform to one of the following:

   a. Steel bar dowels with a 12-mil-thick epoxy coating. Steel bar dowels shall conform to ASTM A36 or ASTM 615, plain rounds, Grade 40. Epoxy coating shall be in conformance with ASTM A775.

   b. Stainless steel bar dowels conforming to ASTM A276, Type 302.

2. Exposed portion of expansion joint dowels shall be thoroughly greased prior to casting of adjoining wall or slab.

P. Cement

1. Use domestic portland cement that conforms to ASTM C150, Type II.

2. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.

3. Maximum tricalcium aluminate shall not exceed 8%. The maximum percent alkalies shall not exceed 0.6%.

Q. Aggregates

Aggregates shall be natural rock, sand, or crushed natural rock, shall comply with ASTM C33, and shall contain less than 1% asbestos by weight or volume. Aggregates shall be free from any substances that will react with the cement alkalies, as determined by Appendix X-1 of ASTM C33.

R. Water and Ice

Use water and ice that is clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities that might reduce the strength, durability, or otherwise adversely affect the quality of the concrete. Water shall not contain more than 500 mg/L of chlorides or more than 500 mg/L of sulfate.

S. Concrete Admixtures

1. Concrete shall contain an air-entraining admixture conforming to ASTM C260. Admixtures shall be Master Builders MB-AE 90, Sika AER, or equal.

2. Concrete shall contain a water-reducing admixture conforming to ASTM C494, Type A. It shall be compatible with the air-entraining admixtures. The

amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations. Admixture shall be Master Builders Pozzolith polymer-type normal setting, Plastocrete 161 or Plastiment, Sika Chemical Corporation, or equal.

3. Pozzolan Admixture: Where specified, provide concrete containing pozzolan admixture conforming to ASTM C618.

4. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.

T. Grout

1. Nonshrink grout shall conform to ASTM C1107 and to these specifications. Use a nongas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be UPCON High Flow, Master Flow 928, or equal. Components shall be inorganic.

2. Ordinary type grout (dry pack) shall consist of one part portland cement to two parts sand (100% passing a No. 8 sieve). Add sufficient water to form a damp formable consistency.

3. Expansive Grout: Premixed, cementitious mixture with a minimum 28-day strength of 3,500 psi. Provide air-entraining admixture as recommended by the manufacturer.

4. Epoxy Grout:

   a. Mix the two components of epoxy bonding compound in compliance with the manufacturer's instructions.

   b. Use sand that is oven dry and meets the following gradation requirements for epoxy grout:

| **Sieve Size** | **No. 8** | **No. 50** | **No. 100** |
|---|---|---|---|
| % Passing | 100 | 30 ±15 | 5 ±5 |

U. Grout Bedding for Horizontal Joints

The grout placed on horizontal construction joints shall be a mixture of cement, sand, and water in the same proportions and strength used in the overplaced concrete with coarse aggregate omitted.

V. Repair Mortar

1. Mortar used for repair of concrete voids shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted or

the mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

2. Materials for repair of major defects or cracks shall be in accordance with "Repair of Defects and Cracks" specified in Part 3.

W. Bonding Compound

1. Epoxy bonding compound shall be Sikadur 32 Hi-Mod, Sika Chemical Corporation, Lyndhurst, New Jersey; Concresive by BASF; Euco Epoxy 452 by Euclid Chemical Company; or equal.

2. Nonepoxy bonding compound shall be Weldcrete by Larsen Products Corp., Link by Sta-Dry Manufacturing Corp., Euco Weld by Euclid Chemical Co., or equivalent. The compound shall be rewettable for up to two weeks.

X. Concrete Mix Design

1. Conform to ASTM C94, except as modified by these specifications.

2. Air content as determined by ASTM C231 shall be 4% ±1%.

3. Maximum water-cement ratio for Class A concrete = 0.45 by weight.

4. Use classes of concrete as described in the following table:

| Class | Type of Work | 28-Day Compressive Strength (in psi) | Minimum Cement Content (in lbs per C.Y.) |
|---|---|---|---|
| A | Concrete for all structures and concrete not otherwise specified. Concrete fill at structure foundations, cradle, supports across pipe trenches, and reinforced pipe encasement. | 4,000 | 564 |
| B | Pavement | 3,000 | 500 |
| C | Floor grout and miscellaneous unreinforced concrete. | 2,000 | 376 |

5. Measure slump in accordance with ASTM C143. Slump shall be as follows:

| | |
|---|---|
| Slab on grade or heavy sections wider (in plan view) than 3 feet | 3 inches maximum |
| Footings, walls, suspended slabs, beams, and columns | 4 inches maximum |
| Pavement | 2 inches maximum |
| Floor grout | 4 inches maximum |

Proportion and produce the concrete to have a maximum slump as shown. A tolerance of up to 1 inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

6. Aggregate size shall be 3/4 inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for slabs and sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1 1/2 inches maximum for all larger slabs and sections. Aggregate size for floor grout shall be maximum 3/8 inch.

7. Combined aggregate grading shall be as shown in the following table:

| **Sieve Sizes** | **Maximum Aggregate Size** | | |
|---|---|---|---|
| | **1 1/2"** | **1"** | **3/4"** |
| | **Percent Passing** | | |
| 2" | 100 | --- | --- |
| 1 1/2" | 90 - 100 | 100 | --- |
| 1" | 50 - 86 | 90 - 100 | 100 |
| 3/4" | 45 - 75 | 55 - 100 | 90 - 100 |
| 3/8" | 38 - 55 | 45 - 75 | 60 - 80 |
| No. 4 | 30 - 45 | 35 - 60 | 40 - 60 |
| No. 8 | 23 - 38 | 27 - 45 | 30 - 45 |
| No. 16 | 17 - 33 | 20 - 35 | 20 - 35 |
| No. 30 | 10 - 22 | 12 - 25 | 13 - 23 |
| No. 50 | 4 - 10 | 5 - 15 | 5 - 15 |
| No. 100 | 1 - 3 | 1 - 5 | 0 - 5 |
| No. 200 | 0 - 2 | 0 - 2 | 0 - 2 |

8. Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void content of the coarse aggregate.

Y. Slurry Cement Backfill

1. Slurry cement backfill shall consist of a fluid, workable mixture of aggregate, cement, and water.

2. Aggregate shall be either:

a. Material selected from excavation, imported material, or a combination thereof, free from organic matter and other deleterious materials and meeting the following gradation:

| Sieve Sieves | Percentage Passing |
|---|---|
| 1 1/2 inches | 100 |
| 1 inch | 80 to 100 |
| 3/4 inch | 60 to 100 |
| 3/8 inch | 50 to 100 |
| No. 4 | 40 to 80 |
| No. 100 | 10 to 40 |

b. Commercial quality concrete sand.

3. Proportion the aggregate, cement, and water by either weight or volume. Include at least 188 pounds of cement per cubic yard produced. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

4. Thoroughly machine-mix the materials for the slurry cement backfill in pugmill, rotary drum, or other mixer. Continue the mixing until the cement and water are thoroughly dispersed throughout the material. Place slurry cement backfill within one hour after mixing.

Z. Curing Compound

1. Curing compound shall conform to ASTM C309, Type 1, Class A.

2. Curing compound shall be compatible with required finishes and coatings and shall meet the State of California Clean Air Quality Standards which limit the quantity of volatile organic compounds.

AA. Mats, Paper, and Sheeting for Curing

1. Burlap mats shall conform to AASHTO M182.

2. Sisal-kraft paper and polyethylene sheets shall conform to ASTM C171.

BB. Reinforcing Dowel Adhesive

Dowel anchor adhesive shall be HIT-RE 500-SD by Hilti; Sikadur 31, Hi-Mod Gel by Sika; or equal.

PART 3 - EXECUTION

A. Form Tolerances

1. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

2. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

| | **Maximum Tolerance (inch)** |
|---|---|
| Sleeves and inserts | +1/4 -1/4 |
| Projected ends of anchors | +1/4 -0.0 |
| Anchor bolt setting | +1/4 -1/4 |
| Finished concrete, all locations | +1/4 -1/4 in 10 feet |
| | Max ±1-inch in total length |

The planes or axes from which the above tolerances are to be measured shall be as follows:

| | |
|---|---|
| Sleeves and inserts: | Centerline of sleeve or insert. |
| Projected ends of anchors: | Plane perpendicular to the end of the anchor as located in the drawings. |
| Anchor bolt setting: | Centerline of anchor bolt. |
| Finish concrete: | The concrete surface as defined in the drawings. |

Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

B. Form Surface Preparation

1. Clean form surfaces to be in contact with concrete of foreign material prior to installation.

2. Coat form surfaces in contact with concrete with a release agent prior to form installation.

C. Form Reuse

Reuse only forms that provide a uniform surface texture on exposed concrete surfaces. Apply light sanding or other surface treatment between uses for uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side. Do not patch forms other than filling tie rod holes, except in the case of Class II forms. Do not use metal patching discs on Class I forms.

D. Removal of Forms

1. Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and reshore. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed:

| | |
|---|---|
| Sides of footings and encasements | 24 hours |
| Walls, vertical sides of beams, girders, columns, and similar members not supporting loads | 48 hours |
| Slabs, beams, and girders | 10 days (forms only) |
| Shoring for slabs, beams, and girders | Until concrete strength reaches specified 28-day strength |
| Wall bracing | Until top or roof slab concrete reaches specified 28-day strength |

2. Do not remove forms from concrete that has been placed with outside air temperature below 50°F without first determining if the concrete has properly set without regard for time. Do not apply heavy loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

E. Formed Openings

Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with

reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

F. Embedded Items

Set anchor bolts and other embedded items accurately and hold securely in position until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to concreting.

G. Time Between Pours

At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise indicated in the drawings.

H. Placing Reinforcement

1. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.

2. Place reinforcing in accordance with the following, unless otherwise indicated:

   a. Reinforcement indicated in the drawings is continuous through the structure to the farthest extent possible. Terminate bars and hooks 2 inches clear from faces of concrete.

   b. Splices may be used to provide continuity due to bar length limitations. Minimum length of bars spliced for this reason is 30 feet. Splicing of reinforcement that is detailed to be continuous in the drawings is not permitted.

3. Reinforcing steel, before being positioned and just prior to placing concrete, shall be free from loose mill and rust scale and from any coatings that may destroy or reduce the bond. Clean reinforcing steel by sandblasting or wire brushing and remove mortar, oil, or dirt to remove materials that may reduce the bond.

4. Do not straighten or rebend reinforcing steel in the field.

5. Position reinforcing steel in accordance with the drawings and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms to

provide the specified concrete coverage. Bars, in addition to those shown in the drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at his own expense.

6. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

7. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.

8. Roll wire mesh used for reinforcement flat before placing concrete. Support and tie wire mesh to prevent movement during concrete placement.

9. Position dowels for masonry walls to occur at reinforced block cells.

I. Site-Mixed Concrete

Conform to ACI 304.

J. Ready-Mixed Concrete

Conform to ASTM C94.

K. Placing Concrete

Conform to ACI 304.

L. Pumping Concrete

Conform to ACI 304.2R-91.

M. Weather Requirements

1. Conform to ACI 305 for placing during hot weather.

2. Conform to ACI 306 for placing during cold weather.

N. Grouting Machinery Foundations

Block out the original concrete or finish off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown in the drawings. After the machinery has been set in position and placed at the proper elevation by steel wedges, fill the space between the bottom of the machinery base and the original pour of concrete with a pourable nonshrink grout. Grout and grouting procedure shall be in accordance with API 686, Chapter 4, paragraphs 3.6 and 3.7, and Chapter 5.

O. Backfill Against Walls

1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.

2. Do not backfill the walls of structures that are laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

P. Placing Slurry Cement Backfill

Place slurry cement backfill in a uniform manner that will prevent voids in, or segregation of, the backfill. Remove foreign material that falls into the excavation or trench. Do not commence backfilling over or place any material over the slurry cement backfill until at least four hours after placing the slurry cement backfill, except that when concrete sand is used for the aggregate and the in-place material is free draining, backfilling may commence as soon as the surface water is gone.

Q. Concrete Finishes

1. Complete concrete surfaces in accordance with the following schedule:

| **Finish Designation** | **Area Applied** |
|---|---|
| F-1 | Beams, columns, and exterior walls not exposed to view. |
| F-4 | Exterior and interior surfaces to be coated. |
| S-1 | Slabs and floors to be covered with concrete or grout. |
| S-4 | Slabs and floors of structures or buildings exposed to view. |
| E-1 | Exposed edges. EXCEPTION: edges normally covered with earth. |
| E-2 | Top of walls, beams, and similar unformed surfaces. |

2. Finish F-1: Repair defective concrete, fill depressions deeper than 1/2 inch, and fill tie holes.

   Finish F-4: Repair defective concrete, remove fins, fill depressions 1/16 inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16 inch.

   Finish S-1: Screed to grade without special finish.

Finish S-4: Steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

Finish E-1: Provide chamfer or beveled edges.

Finish E-2: Strike smooth and float to an F-3 or F-4 finish.

R. Curing Concrete

1. Conform to ACI 308.

2. Water cure with burlap mats unless optional curing methods are permitted.

3. Do not use curing compound on surfaces that are to be coated in accordance with Section 099000.

4. It is the responsibility of the Contractor to select the appropriate curing method in response to climatical and/or site conditions occurring at the time of concrete placement. Take appropriate measures as described in ACI 305 and 306 for protecting and curing concrete during hot and cold weather.

S. Repair of Defects and Cracks

1. Do not repair defects until concrete has been evaluated by the Owner's Representative.

2. Surface Defects:

   a. Repair surface defects that are smaller than 1 foot across in any direction and are less than 1/2 inch in depth.

   b. Repair by removing the honeycombed and other defective concrete down to sound concrete, cut or grind edges perpendicular to the surface and at least 3/8 inch deep, abrasive clean and thoroughly dampen the surface, work into the surface an epoxy bonding agent, and fill the hole with one part cement to one part fine sand. Match the finish on the adjacent concrete, and cure as specified.

3. Severe Defects:

   a. Repair severe defects that are larger than surface defects but do not appear to affect the structural integrity of the structure.

   b. Repair by removing the honeycombed and other defective concrete down to sound concrete, make edges of the repair area perpendicular to the surface, as required above, sandblast the sound concrete surface, coat the exposed surfaces with epoxy bonding compound,

place nonshrink grout, match the finish on the adjacent concrete, and cure as specified.

4. Repair minor cracks in concrete structures that are wider than 1/10 inch by cutting out a square edged and uniformly aligned joint 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joint, priming the joint, and applying polyurethane joint sealant.

5. If the cracks are major or affect the hydraulic capacity or function of the element, the Owner's Representative may require the concrete to be repaired by epoxy injection.

6. Major Defects and Cracks: If the defects affect the structural integrity of the structure or if patching does not satisfactorily restore quality and appearance to the surface, the Owner’s Representative may require the concrete to be removed and replaced, complete.

T. Aluminum Surfaces in Contact With Concrete

Coat aluminum surfaces in contact with concrete per Section 099000, System No. 54.

U. Concrete Tests

1. Concrete quality testing will be performed on the concrete by the Owner as follows:

   a. Frequency of Sampling: Cast four concrete test cylinders from each 50 cubic yards, or fraction thereof, of each class of concrete placed in any one day. Sampling and curing of cylinders shall conform to ASTM C31.

   b. Strength Testing: Test cylinders in accordance with ASTM C39. Test one cylinder at 7 days for information; test two cylinders at 28 days for acceptance; and hold one cylinder for verification. Strength acceptance will be based on the average of the strengths of the two cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the fourth cylinder for the test result.

   c. Determine concrete slump by ASTM C143 with each strength test sampling and as required to establish consistency.

   d. Determine air content of the concrete using ASTM C231 to verify the percentage of air in the concrete immediately prior to depositing in forms.

e. The average value of concrete strength tests shall be equal to or greater than the specified 28-day strength. No test shall be less than 90% of the specified 28-day strength.

f. If the 28-day strength tests fail to meet the specified minimum compressive strength, the concrete will be assumed to be defective and one set of three cores from each area may be taken as selected by the Owner and in accordance with ASTM C42. If the average compressive strength of the set of three concrete cores fails to equal 90% of the specified minimum compressive strength or if any single core is less than 75% of the minimum compressive strength, the concrete will be considered defective. The Owner may require additional coring, nondestructive load testing, or repair of defective concrete. Costs of coring, testing of cores, load testing, and required repairing pertaining thereto shall be paid by the Contractor at no extra cost to the Owner.

2. To facilitate concrete sampling and testing, the Contractor shall:

a. Furnish labor to assist the Owner in obtaining and handling samples at the project site.

b. Advise the Owner in advance of concrete placing operations to allow for scheduling and completion of quality testing.

c. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

END OF SECTION