

SECTION 03 00 00 – CONCRETE

PART 1 – GENERAL

1.01 SUMMARY

Construction documents shall show compressive strength of all grades and types of concrete, size, grade, type and location of reinforcement and anchors, rebar to be welded, and the size and location of structural elements. Construction documents shall show provisions for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature and moisture (per CBC, latest Office of State Fire Marshal adopted edition).

1.01.2 QUALIFICATIONS AND EXPERIENCE

A. Concrete Contractor Qualifications:

Firm shall be regularly engaged in concrete work and shall have a minimum of 5 years documented experience with work of similar scope and complexity.

Provide evidence of successful completion of at least [3] concrete projects within the past 5 years for state-owned or public institutional facilities, with higher education campus experience preferred.

Demonstrate capability to perform work in active campus environments, including coordination with campus operations, restricted access/delivery windows, pedestrian and emergency routes, noise/dust controls, and work-hour limitations.

B. Personnel Qualifications:

Provide a dedicated on-site superintendent/foreman with a minimum of 5 years experience on comparable concrete work who shall be present during placement, finishing, jointing, curing, and protection operations.

The Concrete Placing, Finishing, and Curing Crews shall include at least one Lead Foreman or Journeyman with a ACI Certified American Concrete Institute certification (or approved equivalent) on site during the concrete operations.

C. Concrete Producer Qualifications:

Ready-mix concrete producer shall have a minimum of 5 years experience supplying concrete for public/institutional work and shall operate under a documented quality control program.

Producer shall be capable of meeting project sequencing and delivery constraints typical of higher education campuses and shall provide batch tickets and supporting documentation for each delivery.

D. Qualification Submittals:

Submit a list of at least [3] completed projects meeting the requirements above, including project name, owner, location, brief scope, completion date, and owner/architect contact information.

Submit resumes and certifications for proposed concrete superintendent/foreman and key finishing/testing personnel.

Submit American Concrete Institute certification for the following:

- I. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.

Submit documentation of concrete producer quality control program and batch plant information upon request.

F. Preinstallation Conference:

Conduct a preinstallation conference with Owner/Architect/Engineer, Contractor, concrete producer, reinforcing installer, and testing agency to review campus constraints, access/deliveries, placement sequencing, jointing plan, curing/protection, and coordination with adjacent work.

1.01.2 Shop Drawings

Submit shop drawings for formwork, shoring, reshoring, and backshoring, signed and sealed by a California licensed design engineer prior to submittal. Submit design calculations for formwork, shoring, reshoring, and backshoring, signed and sealed by a California licensed design engineer.

Submit procedure for reshoring and backshoring, including drawings signed and sealed by a California licensed design engineer. Include on shop drawings the formwork removal procedure and magnitude of construction loads used for design of reshoring or backshoring system.

Indicate in procedure the magnitude of live and dead loads assumed for required capacity of the structure at time of reshoring or backshoring.

- A. Formwork: Drawings showing details of formwork including but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Indicate placement schedule, construction, location and method of forming control joints. Include locations of inserts, conduit, sleeves and other embedded items. Reproductions of contract drawings are unacceptable. Submit form removal schedule indicating element and minimum length of time for form removal.

Design, fabricate, erect, support, brace, and maintain formwork so that it is able to support, without failure, all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

- B. Formwork Calculations: ACI 347R. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Furnish drawings and calculations of shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members. Indicate in calculations concrete pressure with both live and dead loads, along with material types.
- C. Reinforcing Steel: Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

Expansion and contraction/control joints shall be detailed on the design drawings. Control-joint spacing guidelines per ACI shall be followed. Provide expansion joint details with slip dowels allowing horizontal movement but preventing differential vertical movement. Deep tooled contraction/control joints are preferred over saw-cut control joints so that crack control is initiated during plastic shrinkage of concrete. Cut alternate reinforcing bars running through contraction/control joints. Isolation joints shall be detailed around columns. "Diamond" block-outs are preferred. A joint plan for all concrete shall be submitted for structural, architectural and site work slabs.

- D. Submit proposed materials, methods and duration for curing concrete elements in accordance with ACI SPEC 308.1.

1.01.3 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit all documentation required in ACI 301 Section 4 and as specified in this section. Submit a complete list of materials including type; brand; source and amount of cement, supplementary cementitious materials, fibers, and admixtures; and

applicable reference specifications. Submit mill test and all other test for cement, supplementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained versus sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Engineer of Record. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. Required average strength can be documented by field experience if field strength test data are available and represent a single group of at least 10 consecutive strength tests for one mixture, using materials and conditions similar to those expected for work, and encompassing a period of not less than 45 days. The average of field strength tests must equal or exceed f'_{cr} . Changes in materials, conditions, and proportions within the test record must not have been more closely restricted than those for the proposed work. Test records must not be more than 24 months old. Obtain mix design approval from the Engineer of Record prior to concrete placement.

1.01.4 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.01.5 Finishing Plan

Submit proposed material and procedures to be used in obtaining the finish for the floors. Include qualification of person to be used for obtaining floor tolerance measurement, description of measuring equipment to be used, and a sketch showing lines and locations the measuring equipment will follow.

1.02 DEFINITIONS

Class of Concrete: The University identifies concrete for miscellaneous uses, curb, gutter, sidewalk, drainage structures, etc. as specified by class. Note: Sidewalk panels that are subject to vehicular traffic shall be concrete with a minimum 28-day compressive strength (f'_{c}) of 3,500 psi, unless noted otherwise. The class of the concrete as shown or in compliance with Engineering Standards. The class of concrete is defined as follows:

Class	Cement Content lb/cy	Cement Content Sack (94 lb per sack per cy)	28-day strength	7-day strength	Slump
1	675 lb/cy	7.2	5000	3500	2-4 in
2	590 lb/cy	6.3	3000	2100	2-4 in
3 or Minor	550 lb/cy	5.9	2500	1750	2-4 in

PART 2 – PRODUCTS

2.01 CEMENTITIOUS MATERIALS

Fly ash may be substituted for Portland cement. The following recommendations apply to concrete mix designs available in the area and consider the quality of locally available aggregate. 15% fly ash substitution may be made without impacting strength for concrete with up to $f'c = 5$ ksi. At this level of substitution, it improves the workability of the concrete and is less expensive than the Portland cement it replaces. Up to 25% substitution for $f'c$ less than or equal to 5 ksi may be used although concrete quality begins to degrade because it is harder to work and strength is impacted. 35% may be used in foundations or retaining walls where there is little need to work the concrete, but strength is limited to $f'c = 4$ ksi and is determined based on 56 days rather than the traditional 28 days.

2.02 REINFORCING STEEL

2.02.1 Use ASTM A615/A615M, Grade 60, deformed bars for #5 and larger sizes. Use STAM A706 rebar when welding is required. Traceable mill certificates shall be provided with all rebar delivered to the jobsite.

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

2.02.3 Epoxy Coated Reinforcing Steel

Record coating lot on each shipping notice and carefully identify and re-tag bar bundles from bending plant. Provide systems for handling coated bars which have padded contact areas such as, nylon slings, all free of dirt and grit. Lift bundled coated bars with strong back, multiple supports, or platform bridge to prevent sagging and abrasion. Pad bundling bands where in contact with bars. Do not drop or drag bars or bundles. Store coated bars both in shop and in

field, aboveground, on wooden or padded cribbing. Space the dunnage close enough to prevent excessive sags. Stack large quantities of straight bars with adequate protective blocking between layers. Schedule deliveries of epoxy coated bars to the job site to avoid the need for long term storage. Protect from direct sunlight and weather. Cover bars to be stored longer than 12 hours at the job site with opaque polyethylene sheeting or other suitable equivalent protective material.

2.03 CAST-IN-PLACE CONCRETE

Cast-in-place concrete will utilize cementitious and aggregate materials produced locally. Contractor shall submit all concrete mixes for approval. Maximum specified shrinkage of concrete mixes based upon current laboratory testing shall be submitted by the contractor and supplier. Fly ash and/or pozzolan replacement of cement may be allowed. Concrete admixes shall not contain chloride.

Concrete mix designs with accelerating admixes for concrete placement in cold weather, shaded areas, etc. may be considered. Concrete mix designs with set retarding admixes for concrete placement in hot weather may be considered. Concrete mix designs with air entraining admixes for freeze-thaw resistance, resistance to chemical attack, watertightness, workability, and pumpability may be considered. Shrinkage compensating admixes intended to counteract the effects of plastic shrinkage may be considered.

Corrosion inhibiting admixes and/or minimum water cement ratios per ACI are required for concrete mixes exposed to the marine environment.

Spray-on evaporation retarding finishing aids (e.g. "Confilm, Eucobar, or equal) may be used for hot weather concreting. Contractor to confirm compatibility of finishing aids with floor covering adhesives and finishes.

Concrete aggregates shall be graded per ASTM C 33 so that coarse aggregate nominal size is not larger than 1/5 of the narrowest dimension between form faces; nor $\frac{3}{4}$ of the minimum clear spacing between individual reinforcing bars or bundles of bars, whichever is less, but never greater than $\frac{3}{4}$ inch in any dimension for slabs 4 inch thick or less.

Minimum concrete coverage for reinforcing steel shall conform to ACI structural concrete building code.

2.04 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301, ACI 304R and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor retarder, vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces. NOTE: Materials which are woven, fibrous, or porous in nature have a high capacity to adsorb VOC emissions; for instance, acoustical ceilings, carpet, textiles, and unprimed gypsum wall board.

2.05 INSPECTIONS

Refer to 01 45 23, 1.5, E. Required Inspections.

PART 3 – EXECUTION

3.01 PLACEMENT

The slump of concrete delivered to the jobsite shall be adjusted to within one inch of the specified slump prior to delivery on-site. Final slump shall be adjusted to conform to approved plans and specifications by contractor/supplier at time of discharge. After addition of water in the field, each concrete batch shall receive a minimum 2 minutes of mixing to produce a uniform slump and W/C ratio. Concrete slump shall be fully adjusted prior to discharge; further adjustments of slump after discharge has started are discouraged. Concrete batches exceeding specified slump shall not be incorporated into the work.

All concrete placed, including slabs-on-grade, sidewalks, curbs, gutters, and foundations, shall be consolidated by mechanical vibration using internal (pencil) vibrators or other approved vibration equipment appropriate to the placement. Vibration shall produce dense, uniform concrete free of voids and honeycombing. Hand rodding, spading, or tapping of forms shall not be used as a substitute for mechanical vibration except where specifically approved for locations not accessible to vibrators. All concrete shall be consolidated using internal vibration. Insert concrete vibrators vertically and withdraw slowly to avoid voids and segregation. Do not use

vibrators to move, spread, or transmit concrete along forms, reinforcing, or across the placement; place concrete as near as practicable to its final position prior to vibration.

Existing concrete shall be protected from damage during placement of new concrete. Cast in place dowels or adhesive bonded (2-part epoxy or equal) dowels inserted into drilled holes shall be installed where fresh concrete is placed against hardened concrete, typical.

Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Reinforcing steel and pre-stressing tendons shall be placed and securely anchored against moving prior to concrete placement. "Web-setting" of embedded items is not allowed.

Contractor shall monitor ambient temperature, humidity and wind speed before, during, and after concrete placement. Concrete placement techniques per ACI shall accommodate ambient conditions. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

Sidewalks shall have a thickened edge with a depth that is twice the slab thickness, with a width that matches the slab thickness, and where the return slope is 1:1. All sidewalk, curb and gutter shall be constructed on a minimum 6-inch-thick layer of compacted aggregate base.

Set forms and screeds to design grades to control strike-off of all concrete. Free hand strike-off is not allowed. Use bull floats or darbies after strike-off to eliminate high and low spots, embed large aggregate and to form a flat, uniform and open textured surface plane. Use wood floats for normal concrete mixes. Magnesium-aluminum alloy floats can be used on air entrained concrete.

Do not use steel finishing tools until bleed water has disappeared. Premature floating and troweling can cause scaling, crazing, or dusting, and will result in a surface with reduced wear resistance.

Concrete slabs shall be level, and flat to within no more than 1/8 inch in 10 feet; flatness shall be measured and confirmed by contractor during and after concrete placement, and check by the University. Concrete walls, columns, pilasters, beams, spandrels, girders and suspended slabs

shall be cast plumb, line, plane, and square. $\frac{3}{4}$ x $\frac{3}{4}$ inch chamfer strips shall be used at concrete corners, typical, unless otherwise noted. Footing trenches shall be cut neat and square. ACI tolerances shall apply.

Protect concrete from construction traffic, weather or mechanical damage. Avoid use of hydraulic equipment on slabs; diaper equipment if needed. Do not use or locate pipe cutting equipment on exposed slabs. Do not place steel on exposed slabs.

Overhead anchorage into concrete ceilings or soffits with adhesive anchors is not allowed.

END OF SECTION 03 00 00 – CONCRETE

SECTION 03 15 00 Concrete Accessories

Specifier Note: This specification is intended to address the use of anchors for safety-related applications, such as structural connections, earthquake bracing, guard rails, mechanical and electrical equipment support, piping and ductwork support and bracing, cladding and façade connections, or rebar doweling. Light-duty anchors are not included.

1.01 SECTION INCLUDES

Specifier Note: If cast-in anchors are not used, delete reference here and in Sections 2.02 and 3.01.

- A. Cast-in and drilled anchors for concrete.

Specifier Note: Revise paragraph below to suit project requirements. Add/delete section numbers and titles per project requirements and specifier's practice.

1.02 RELATED SECTIONS

- 1. **Division 3 Concrete Sections.**

1.03 SUBMITTALS

Specifier Note: Insert appropriate section for the project as referred to below for shop drawings or submittals

- A. Submit in accordance with *Conditions of the Contract* and Division 1 Submittal Procedures Section.
- B. Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
- C. Samples: Representative lengths and diameters of each type of anchor shown on the Drawings.
- D. Quality Assurance Submittals:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

Specifier Note: Add paragraph below to suit project and local jurisdiction requirements. Two international certifications for drilled-in anchors are listed below. Coordinate with section 1.03.D.

- 2. Certificates:
 - a. ICC-ES Evaluation Reports.
 - b. Manufacturer's installation instructions.
 - c. Installer Qualifications & Procedures: Submit installer qualifications as stated in Section .B. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

- E. Closeout Submittals: Submit the following: Project record documents for installed

materials in accordance with Division 1 Closeout Submittals Section.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Drilled-in anchors shall be installed by a [contractor] [installer] with at least [three] [five] years of experience performing similar installations.
- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the [contractor] [installer] on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:
 - a. hole drilling procedure
 - b. hole preparation & cleaning technique
 - c. Adhesive injection technique & dispenser training / maintenance
 - d. rebar dowel preparation and installation
 - e. proof loading/torquing

Specifier Note: Revise paragraph below to suit project and local jurisdiction requirements. Two common international certifications for drilled-in anchors are listed. Coordinate with section 1.02.A.3.b. above.

- C. Certifications: Unless otherwise authorized by the Engineer, anchors shall have one of the following certifications:
 - a. ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Section–Product Storage and Handling Requirements.

Specifier Note: Coordinate with inspection requirements as required. Injection adhesive anchor cartridges and capsule anchors have special requirements with respect to temperature and sunlight exposure as well as shelf life.

- 1. Store anchors in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Fasteners and Anchors:

Specifier Note: Add paragraph below to suit project requirements. Coordinate terminology with designations used on the Drawings for high-strength bolts, stainless steel, etc.

1. Bolts and Studs: ASTM A307; ASTM A449 where "high strength" is indicated on the Drawings.
2. Carbon and Alloy Steel Nuts: ASTM A563.
3. Carbon Steel Washers: ASTM F436.
4. Carbon Steel Threaded Rod: ASTM F1554 Grade 36, or ASTM F1554 Grade 55; or ASTM F1554 Grade 105
5. Wedge Anchors: ASTM A510; or ASTM A108.
6. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
7. Stainless Steel Nuts: ASTM F594.
8. Zinc Plating: ASTM B633.
9. Hot-Dip Galvanizing: ASTM A153.
10. Metric Anchor Bolts, Screws, and Studs: ISO 898 Part 1.
11. Metric Anchor Nuts: EN 24033.
12. Metric Anchor Stainless Steel Bolts, Screws, and Studs: ISO 3506 Part 1.
13. Metric Anchor Stainless Steel Nuts: ISO 3506 Part 2.
14. Reinforcing Dowels: ASTM A615

2.02 CAST-IN-PLACE BOLTS

Specifier Note: Expand or replace with project specific specification for CIP anchors and inserts as required.

- A. Anchors, Bolts, Nuts, and Washers: Bolts and studs, nuts, and washers shall conform to ASTM A307, Grade A, and ASTM A449, ASTM A563, and ASTM F436, as applicable. Hot-dip galvanized bolts and studs including associated nuts and washers in accordance with ASTM A153.

2.03 DRILLED-IN ANCHORS

Specifier Note: Verify the anchor types indicated on the Drawings and add specific anchor types used.

- A. Anchors:

Specifier Note: The following paragraph applies to interior applications in a non-corrosive environment. If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, consider alternatives to zinc electroplated carbon steel fasteners.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1). If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, provide alternatives to zinc electroplated carbon steel fasteners.

Specifier Note: Verify the type (304 and/or 316) of stainless-steel anchors indicated on the Drawings. Proper consideration should be given to contact between galvanically dissimilar metals. AISI 316 should not be used where pitting corrosion is a concern.

2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI [Type 304] [and] [Type 316] stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Contact between galvanically dissimilar metals shall not be permitted. AISI 316 shall not be used where potential for pitting corrosion.
 3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. Hilti Kwik Bolt 3, ICC ESR-1385 and ESR-2302.
 - b. Hilti Kwik Bolt TZ, ICC ESR-1917 and ESR-3785 (carbon steel and AISI Type 304 or 316 Stainless Steel).
- B. Screw Anchors: Screw type. Pre-drilling of the hole per the manufactures' installation instructions. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings.

Specifier Note: The following paragraph applies to interior applications in a non-corrosive environment. If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, consider alternatives to zinc electroplated carbon steel fasteners.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating equivalent to DIN EN ISO 4042 (8• m min.). If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, provide alternatives to zinc electroplated carbon steel fasteners.
2. Exterior Use: As indicated on the Drawings, provide mechanically galvanized or stainless-steel anchors. Mechanically galvanized steel anchors shall meet ASTM B695 Class 55 specifications. Stainless steel anchors shall be AISI [Type 316] stainless steel. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. Hilti Kwik HUS-EZ (KH-EZ), KH-EZ C, KH-EZ E, KH-EZ I, KH-EZ P, ICC ESR-3027 (carbon steel).
 - b. Hilti KH-EZ CRC, ICC ESR-3027 (mechanically galvanized carbon steel).
 - c. Hilti KH-EZ SS316, ICC ESR-3027 (stainless steel).
 - d. Hilti Kwik HUS.
- C. Heavy Duty Metric Sleeve Anchors: Torque-controlled, exhibiting follow-up expansion under load, with provision for rotation prevention during installation. Type and size as indicated on Drawings.

Specifier Note: The following paragraph applies to interior applications in a non-corrosive environment. If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, consider alternatives to zinc electroplated carbon steel fasteners.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5 • m min.). If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, provide alternatives to zinc electroplated carbon steel fasteners.

Specifier Note: Verify the type (304 and/or 316) of stainless-steel anchors indicated on the Drawings, if any. Proper consideration should be given to contact between galvanically dissimilar metals. AISI 316 should not be used where pitting corrosion is a concern.

2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI [Type 304] [and] [Type 316] stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Stainless steel anchors shall not be in contact with galvanically dissimilar metals AISI 316 should not be used where there is a potential of pitting corrosion.
3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

- a. Hilti HSL, HSLG, or HSLB.
 - b. Hilti HSL-3, HSL-3-G, or HSL-3-B, ICC ESR-1545 (carbon steel).
 - c. Hilti HSL-3-R, ICC ESR-1545 (stainless steel)
- D. Heavy Duty Metric Undercut Anchors: Bearing type. Installed anchor shall have a minimum tension bearing area in the concrete, measured as the horizontal projection of the bearing surface, not less than two times the net tensile area of the anchor bolt. The installed anchor shall exhibit a form fit between the bearing elements and the undercut in the concrete. Type and size as indicated on Drawings.

Specifier Note: The following paragraph applies to interior applications in a non-corrosive environment. If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, consider alternatives to zinc electroplated carbon steel fasteners.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5 • m min.). If the interior environment is potentially corrosive, alternatives to zinc electroplated carbon steel fasteners shall be provided.

Specifier Note: Specify the type (316) of stainless-steel anchors indicated on the Drawings, if any. Proper consideration should be given to contact between galvanically dissimilar metals. AISI 316 should not be used where pitting corrosion is a concern.

2. Exterior Use: As indicated on the Drawings, provide sherardized or stainless-steel anchors. Sherardized anchors shall be manufactured from materials conforming to ISO 898 Part 1 and having corrosion resistance equivalent to ASTM A153 with sherardized dry diffusion zinc coating (50 • m min.). Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI [Type 316] stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Stainless steel anchors shall not be in contact with galvanically dissimilar metals AISI 316 should not be used where there is a potential of pitting corrosion.
3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. Hilti HDA, ICC ESR-1546.

- E. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.

Specifier Note: The following paragraph applies to interior applications in a non-corrosive environment. If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, consider alternatives to zinc electroplated carbon steel fasteners.

- 1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM F1554 Grade 36, or ASTM F1554 Grade 55; or ASTM F1554 Grade 105 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) [or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038]. If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, provide alternatives to zinc electroplated carbon steel fasteners.

Specifier Note: Verify the type (304 and/or 316) of stainless-steel anchors indicated on the Drawings, if any. Proper consideration should be given to contact between galvanically dissimilar metals. AISI 316 should not be used where pitting corrosion is a concern.

- 2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI [Type 304] [and] [Type 316] stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Stainless steel anchors shall not be in contact with galvanically dissimilar metals AISI 316 should not be used where there is a potential of pitting corrosion.
- 3. Reinforcing dowels Shall be A615 Grade 60.
 - a. HIT-HY 200 Safe Set System using Hilti Hollow Drill Bit and VC 150/300 vacuum System for anchorage to concrete, ICC ESR-3187.
 - b. HIT-RE 500 V3 Safe Set System using Hilti Hollow Drill Bit and VC 150/300 vacuum System for anchorage to concrete, ICC ESR-3814.
- 4. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. HIT-HY 200 Safe Set System using Hilti Hollow Drill Bit and VC 150/300 vacuum System for anchorage to concrete, ICC ESR-3187.
 - b. Hilti HIT-Z anchor rods with HIT-HY 200 Safe Set System for anchorage to concrete, ICC ESR-3187.
 - c. Hilti HAS threaded rods with HIT-RE 500 V3 Safe Set System using Hilti Hollow Drill Bit and VC 150/300 vacuum System for anchor and rebar anchorage to concrete, ICC ESR-3814.

Specifier Note: Verify the anchor types indicated on the Drawings and delete those anchor types not used.

- F. Anchors: Type and size as indicated on Drawings.

Specifier Note: The following paragraph applies to interior applications in a non-corrosive environment. If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, consider alternatives to zinc electroplated carbon steel fasteners.

1. Interior Use: Interior Use: Unless otherwise indicated on the Drawings, provide chisel-pointed carbon steel rods confirming to ASTM F1554 Grade 55; or ASTM F1554 Grade 105 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1). If the interior environment is potentially corrosive, or if galvanically dissimilar metals are in contact with one another in a moist atmosphere, provide alternatives to zinc electroplated carbon steel fasteners.

Specifier Note: Verify the type (304 and/or 316) of stainless-steel anchors indicated on the Drawings, if any. Proper consideration should be given to contact between galvanically dissimilar metals. AISI 316 should not be used where pitting corrosion is a concern.

2. Exterior Use: As indicated on the Drawings, provide chisel-pointed stainless-steel anchors. Stainless steel anchors shall be AISI [Type 304] [and] [Type 316] stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals. Stainless steel anchors shall not be in contact with galvanically dissimilar metals. AISI 316 should not be used where there is a potential of pitting corrosion.
3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect, provide the following:
 - a. Hilti HVA Adhesive System with HVU2 capsules.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Cast-In-Place Bolts: Use templates to locate bolts accurately and securely in formwork.
- B. Drilled-In Anchors:

Specifier Note: Verify if restrictions exist on the type of drilling equipment to be used for the project.

1. Drill holes with rotary impact hammer drills using [carbide-tipped bits], [hollow drill bit system], [and][or] [core drills using diamond core bits]. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 - a. Cored Holes:
 - b. Embedded Items:
 - c. Base Material Strength:
2. Perform
3. Wedge Anchors,
4. Cartridge Injection
5. Capsule Anchors:
6. Observe manufacturer recommendations

3.02 REPAIR OF DEFECTIVE WORK

Specifier Note: Coordinate high-strength, non-shrink, and nonmetallic grout selection with other sections in Division 3.

- A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

3.03 FIELD QUALITY CONTROL

Specifier Note: Job site testing is a common method of assuring correct installation of anchor systems. In order to achieve the appropriate level of quality control, testing should be performed by the owner's inspector in consultation with the manufacturer representative. Adjust testing requirements to suit job and local jurisdiction conditions. Select percentage of anchors 10 % or 20% to be tested. Smaller or more critical installations may warrant a higher percentage of anchors to be tested and a greater penalty for malfunctioning anchors. Verify that anchor embedment's and proof loads are shown on the Drawings.

- A. Testing: [10%] [25%] _____ of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If [any] [more than 10%] _____ of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.
 1. Tension testing should be performed in accordance with ASTM E488.
 2. Torque shall be applied with a calibrated torque wrench

3. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed $D/10$, where D is the nominal anchor diameter.
- B. Minimum anchor Minimum anchor embedment's, proof loads and torques shall be as shown on the Drawings.

END OF SECTION 03 15 00 CONCRETE ACCESSORIES

SECTION 03 20 00 - Concrete Reinforcing

Recycled content for reinforcing steel shall be a minimum of 80%.

END OF SECTION 03 20 00 - Concrete Reinforcing