

SPECIFICATION SECTION 03151 – CONCRETE ANCHORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements pertaining to post-installed anchors for materials and equipment. This section pertains to all other sections of these specifications that require post-installed anchors, unless specified otherwise.

1.02 RELATED DOCUMENTS

- A. Division 1 – Specification Section
- B. Division 3 – Concrete
- C. Division 4 – Masonry
- D. Division 5 – Metals
- E. Division 9 – Ceiling Suspension Systems
- F. Division 15 – Basic Mechanical Materials & Methods
- G. Division 16 – Basic Electrical Materials & Methods

1.03 REFERENCES

- A. ACI 318 – Building Code Requirements for Structural Concrete
- B. ACI 355.2 – Standard for Evaluating the Performance of Post-Installed Mechanical Anchors in Concrete
- C. ASTM A36 – Standard Specification for Carbon Structural Steel
- D. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- E. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- F. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- G. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- H. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- I. ASTM B695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
- J. ASTM C881 – Standard Specification Epoxy-Resin-Based Bonding Systems for Concrete
- K. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
- L. ASTM E1512 – Standard Test Methods for Testing Bond Performance of Bonded Anchors
- M. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- N. Federal Specifications A-A-1922A, A-A01923A and A-A-55614 for Expansion and Shield-Type Anchors
- O. ICC-ES AC01 – Acceptance Criteria for Expansion Anchors in Masonry Elements
- P. ICC-ES AC58 – Acceptance Criteria for Adhesive Anchors in Masonry Elements
- Q. ICC-ES AC60 – Acceptance Criteria for Anchors in Unreinforced Masonry Elements
- R. ICC-ES AC70 – Acceptance Criteria for Fasteners Power-Driven into Concrete, Steel and Masonry Elements
- S. ICC-ES AC106 – Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Concrete or Masonry Elements
- T. ICC-ES AC193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
- U. ICC-ES AC308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

1.04 QUALITY ASSURANCE

- A. Post-Installed anchors and related materials shall be listed by one or more of the following agencies, as applicable:
 - 1. ICC Evaluation Service
 - 2. City or County of ()
 - 3. Underwriters Laboratories (UL) and/or Factory Mutual (FM)

1.05 SUBMITTALS

- A. Product Data: Submit data for proprietary materials, manufacturer's specifications (including finishes and/or materials), Material Safety Data Sheets (MSDS) and installation procedures.
- B. Test Reports: ICC-ES listings and performance data that includes recommended loading for each application.
- C. Only manufacturers with an ICC-ES listing will be considered for substitution requests. The contractor shall submit for Engineer-of-Record's review, calculations that are prepared & sealed by a registered Professional Engineer demonstrating that the substituted product is capable of achieving the pertinent equivalent performance values of the specified product using the appropriate design procedure and/or standard(s) as required by the Building Code. In addition, the calculations shall specify the diameter and embedment depth of the substituted product. Any increase in material costs for such submittal shall be the responsibility of the contractor.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.
- B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

PART 2 PRODUCTS

2.01 CRITERIA

A. EXPANSION ANCHORS

1. Cracked Concrete Wedge Anchors: Anchors used to transmit load [i.) Between structural elements and/or ii.) From life safety-related attachments] shall be designed in accordance with ACI 318 Appendix D, which requires post-installed mechanical anchors to be qualified according to ACI 355.2. Such anchors shall be an imperial sized, threaded stud with an integral cone expander and three-segment expansion clip. The stud shall be manufactured from carbon steel and the expansion clip shall have 2 undercutting embossments per segment and be manufactured from 316 stainless steel. Carbon steel anchors shall have an electroplated zinc finish in accordance with ASTM B633, Class SC1, Type I. Anchors shall have an evaluation report issued by ICC-ES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2 and ICC-ES AC193 for all mandatory tests and including the following:
 - i. Seismic tension & shear in cracked concrete

Unless otherwise noted, cracked concrete wedge anchors shall be "Strong-Bolt" Wedge Anchors by Simpson Strong-Tie (ICC-ES ESR-1771).

2. Wedge Anchors: Anchors shall meet the physical requirements of Federal Specification A-A-1923A, Type 4. Anchors shall be non-bottom bearing type with a single piece steel expansion clip providing 360-degree contact with the base material and shall not require oversized holes for installation. Carbon steel anchors shall have an electroplated zinc finish or shall be mechanically galvanized in accordance with ASTM B695, Class 55, Type 1, as appropriate. Stainless steel anchors shall be type 303, 304 or 316. Anchors shall have an evaluation report issued by ICC-ES and have been tested in accordance with ICC-ES AC01 for all mandatory tests and including the following:
 - i. Seismic tension & shear
 - ii. Combination of tension and shear loads
 - iii. Critical and minimum edge distance

Unless otherwise noted, wedge anchors shall be "Wedge-All" Wedge Anchors by Simpson Strong-Tie (ICC-ES ESR-1396).

3. Sleeve Anchors: Anchors shall meet the physical requirements of Federal Specification A-A-1922A. Anchors shall be non-bottom bearing type with a single piece steel expansion sleeve providing 360-degree contact with the base material and shall not require oversized holes for installation. Carbon steel anchors shall have an electroplated zinc finish. Stainless steel anchors shall be type 304. Anchors shall have been tested in accordance with ICC-ES AC01 for the following:
 - i. Static Loads
 - ii. Critical and minimum edge distance and spacing

Unless otherwise noted, sleeve anchors shall be "Sleeve-All" Sleeve Anchors by Simpson Strong-Tie.

4. Flush-Mount, Internally Threaded Shell Anchor: Anchors shall meet the physical requirements of Federal Specification A-A-55614, Type I. Anchors shall be bottom-bearing type with a slotted single piece steel shell and a tapered expander plug providing 360-degree contact with the base material. Carbon steel anchors shall have an electroplated zinc finish. Stainless steel anchors shall be type 303 or 316. Anchors shall have been tested in accordance with ICC-ES AC01 for all mandatory tests and including the following:
 - i. Seismic tension and shear
 - ii. Combination of tension and shear loads
 - iii. Critical and minimum edge distance and spacing

Unless otherwise noted, flush-mount, internally threaded shell anchors shall be "Drop-In" Anchors by Simpson Strong-Tie.

B. ADHESIVE ANCHORS

1. An adhesive anchors shall consist of i.) an insert, and ii.) an adhesive formula. Inserts shall meet the requirements of ASTM A307, A36, A193 Grade B7, or F1554 for threaded rods or ASTM A615 or A706 for rebar. For exterior exposure the threaded insert shall be stainless steel or zinc coated carbon steel. The zinc coating shall be either hot-dipped in accordance with ASTM A153 Class C or

D; mechanically deposited in accordance with ASTM B695, Class 65, Type I; or demonstrated through tests to be equivalent to the coatings previously described. The adhesive formula shall be one of the following:

2. Cracked Concrete Epoxy Adhesives: Anchors used to transmit load [i. Between structural elements and/or ii.) From life safety-related attachments] shall be designed in accordance with ACI 318 Appendix D as amended by the specific design provisions of ICC-ES AC308. Adhesives shall be a cartridge type, two-component, high solids epoxy based system dispensed and mixed through a static mixing nozzle supplied by the manufacturer. The adhesive shall meet the minimum requirements of ASTM C-881 Type I and IV, Grade 3, Class C. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Epoxy adhesives shall have an evaluation report issued by ICC-ES and have been tested and qualified for use in cracked and uncracked concrete in accordance with ICC-ES AC308 for all mandatory tests and including the following:
 - i. Seismic tension and shear in cracked concrete
 - ii. Static and cyclic cracks
 - iii. Horizontal and overhead installations
 - iv. Long term creep at elevated temperatures
 - v. Damp holes
 - vi. Freeze-thaw conditions
 - vii. Critical and minimum edge distance and spacing

Unless otherwise notes, cracked concrete epoxy adhesives shall be "SET-XP" (ICC-ES ESR-2508) by Simpson Strong-Tie.

3. Epoxy Adhesives: Adhesives shall be a cartridge type, two-component, solid epoxy based system dispensed and mixed through a static mixing nozzle supplied by the manufacturer. The adhesive shall meet the minimum requirements of ASTM C-881 Type I, II, IV and V, Grade 3, Class B and C. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Epoxy adhesives shall have an evaluation report issued by ICC-ES and shall have been tested in accordance with ICC-ES AC58 for all mandatory tests and including the following:
 - i. Seismic tension and shear
 - ii. Long term creep at elevated temperatures
 - iii. Static loading at elevated temperatures
 - iv. Damp and water-filled holes
 - v. Freeze-thaw conditions
 - vi. Critical and minimum edge distance and spacing

Unless otherwise noted, epoxy adhesives shall be "Epoxy-Tie Adhesive" (ET) (ICC-ES ER-4945) or "Epoxy-Tie High-Strength Adhesive" (SET) (ICC-ES ESR-1772) by Simpson Strong-Tie.

4. Acrylic Adhesives: Adhesive shall be a cartridge type, two-component, acrylic based system dispensed and mixed through a static mixing nozzle supplied by the manufacturer. The adhesive shall meet the minimum physical requirements of ASTM C-881 Type I and IV, Grade 3, Class A, B and C. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Acrylic adhesives shall have an evaluation report issued by ICC-ES and have been tested in accordance with ICC-ES AC58 for all mandatory tests and including the following:
 - i. Seismic tension and shear
 - ii. Long term creep at elevated temperatures
 - iii. Static loading at elevated temperatures
 - iv. Damp and water-filled holes
 - v. Freeze-thaw conditions
 - vi. Critical and minimum edge distance and spacing

Unless otherwise noted, acrylic adhesives shall be "Acrylic-Tie Adhesive" (AT) by Simpson Strong-Tie (ICC-ES ER-5791).

5. Encapsulated Adhesives: Capsule shall be a two-component, vinyl ester based adhesive capsule-within-a-capsule system supplied in manufacturer's standard packaging. The capsule is placed in the hole and the resin and initiator components are combined when the rod or rebar is driven to the bottom of the hole through the capsule. No spinning or insert end preparation shall be required for proper installation. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation.

Unless otherwise noted, encapsulated adhesives shall be "Vinylester Glass Capsule Adhesive" (VGC) by Simpson Strong-Tie.

6. Adhesive Limitations:

- i. Installation Temperature: When the base material temperature drops below 40-degrees F (5-degrees C), only Acrylic or Encapsulated Adhesives shall be used for adhesive installations. See manufacturer's instructions for additional minimum temperature requirements.
- ii. Hollow Substrates: The adhesive manufacturer's screen tubes shall be used for adhesive installations into hollow substrate material. Encapsulated Adhesives shall not be used in hollow substrate applications.
- iii. Moisture: Encapsulated Adhesives shall not be used when moisture is present in or around hole.
- iv. Oversized Holes: Refer to manufacturer's information if drilled hole size is larger than what is recommended.
- v. Core-drilled holes: Refer to manufacturer's information if holes are drilled with a core-drill bit.

C. CONCRETE AND MASONRY SCREW ANCHORS

1. Cracked Concrete Screw Anchors: Anchors used to transmit load [i.) Between structural elements and/or ii) From life safety-related attachments] shall be designed in accordance with ACI 318 Appendix D as amended by the specific design provisions of ICC-ES AC193. Anchors shall be manufactured from carbon steel which is subsequently heat-treated. Anchors shall be zinc-plated in accordance with ASTM B633, Class SC1, Type I. Anchors shall have an evaluation report issued by ICC-ES and have been tested in accordance with ICC-ES AC193 for all mandatory and including the following:
 - i. Seismic tension and shear
 - ii. Reliability of screw anchors against brittle failure

Unless otherwise noted, cracked concrete screw anchors shall be "Titen HD" Anchors by Simpson Strong-Tie (ICC-ES ESR-2713)

2. Masonry Screw Anchors: Anchors shall have 360-degree contact with the base material and shall not require oversized or undersized holes for installation. Anchors shall be manufactured from carbon steel which is subsequently heat-treated. Anchors shall be zinc-plated in accordance with ASTM B633 or mechanically galvanized in accordance with ASTM B695. Anchors shall have an evaluation report issued by ICC-ES and have been tested in accordance with ICC-ES AC106 for the following:
 - i. Seismic tension and shear
 - ii. Static tension and shear loading
 - iii. Critical and Minimum edge distance and spacing

Unless otherwise noted, concrete and masonry screw anchors shall be "Titen HD" Anchors by Simpson Strong-Tie (ICC-ES ESR-1056).

3. High strength, heat-treated anchors are recommended for permanent dry, interior non-corrosive applications or temporary outdoor applications.

D. POWDER ACTUATED FASTENERS

1. Fasteners shall be drive pin and threaded stud types, as applicable for each condition. Fasteners shall be manufactured from AISI 1060 to 1065 steel austempered to a Rockwell "C" Hardness of 51-56, and have a mechanically galvanized finish. Fasteners shall have a minimum bending yield strength of 90,000 psi. Fasteners shall have an evaluation report issued by ICC-ES and have been tested in accordance with ICC-ES AC70.

Unless otherwise noted, powder actuated fasteners shall be manufactured by Simpson Strong-Tie (ICC-ES ESR-2138).

E. ANCHOR SIZES

1. The anchor size (nominal diameter and embedment depth) shall be as indicated on the drawings. If not indicated on the drawings, sizes shall be provided as required to maintain not less than the appropriate Code safety factors over manufacturer's performance load tables. If the actual concrete compressive strength is not known, the compressive strength shall be determined through testing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Where manufacturer recommends use of special tools for installation of anchors, such tools shall be used, unless otherwise permitted specifically by the Engineer or Architect of Record.
- B. Where holes are drilled in concrete or masonry, holes shall be accurately and squarely drilled, and the holes shall be cleaned in accordance with the manufacturer's recommendations.

Last revised on 01/21/09

3.02 FIELD QUALITY CONTROL

- A. Special Inspection, periodic or continuous, of post-installed anchors shall be provided as required by ICC-ES evaluation reports and/or as specified by the Engineer of Record. This service shall be performed by personnel independent of the Manufacturer or Contractor so as to prevent a conflict of interest.
- B. The Engineer or Architect of Record may require pullout or shear tests, in addition to Special Inspection, to determine the adequacy of anchors. A field testing program shall be established by the independent test laboratory and/or Engineer of Record and performed in accordance with appropriate ASTM test standards. Field tests shall be non-destructive whenever possible.

END OF SECTION