

SECTION 03 15 23
CONCRETE ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place anchors.
- B. Cementitious grouted anchors,
- C. Post-installed (drilled-in) mechanical anchors.
- D. Post-installed (drilled-in) adhesive anchors..

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO LRFD Bridge Design Specifications
 - 2. AASHTO M314 Standard Specification for Steel Anchor Bolts
- B. American Concrete Institute (ACI): Comply with the following ACI standards, as applicable:
 - 1. ACI 318 Building Code Requirements for Structural Concrete and Commentary, Appendix D - Anchoring to Concrete
 - 2. ACI 349 Code Requirements for Nuclear Safety Related Concrete Structures and Commentary, Appendix D - Anchoring to Concrete
 - 3. ACI 349.2R Guide to the Concrete Capacity Design (CCD) Method - Embedment Design Examples
 - 4. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
- C. American National Standards Institute (ANSI)
 - 1. ANSI B212.15 Cutting Tools - Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills.
- D. American Railway Engineering and Maintenance-of-Way Association (AREMA)
 - 1. AREMA Manual for Railway Engineering (MRE)
- E. ASTM International (ASTM)
 - 1. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 2. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 3. ASTM A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

06/29/2012 ADDENDUM 3 - RFP HSR 11-16

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

4. ASTM B695 Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
5. ASTM C824 Standard Practice for Specimen Preparation for Determination of Linear Thermal Expansion of Vitreous Glass Enamels and Glass Enamel Frits for the Dilatometer Method
6. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
7. ASTM E488 Standard Test Methods for Strength of Anchors in Concrete Elements
8. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
9. ASTM F594 Standard Specification for Stainless Steel Nuts
10. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength and Supplements S1, S4, and S5

F. International Code Council Evaluation Service (ICC-ES):

1. AC193 Acceptance Criteria for Mechanical Anchors in Concrete Elements
2. AC308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

G. State of California, Department of Transportation (Caltrans) Standard Specifications:

1. Section 75-1.03 Miscellaneous Bridge Metal

1.3 REGULATORY REQUIREMENTS

A. In addition to the foregoing referenced standards, the regulatory requirements that govern the work of this Section include the following codes:

1. California Code of Regulations, Title 24, Part 2, California Building Code (CBC), Chapters 17 and 17A, “Structural Tests and Special Inspections”.

1.4 NOTED RESTRICTIONS

- A. For bridge joints, only cast-in-place anchors shall be used in new concrete. Anchor bolts may be swedged or threaded. Expansion anchors, countersunk anchor bolts, and cement grouted anchor bolts shall not be used in new construction. Expansion (post-installed) anchors and countersunk anchor bolts may be used for bridge joints in accordance with AASHTO LRFD Article 14 .5.3.7 for existing facilities.
- B. For highway and high speed train bridge bearings, only cast-in-place anchors shall be used in new concrete. Anchor bolts may be swedged or threaded. Expansion (post-installed) anchors, countersunk anchor bolts, and grouted in place anchor bolts may be used for bridge bearings in accordance with AASHTO LRFD Article 14.8.3.
- C. For railroad bridge bearings, only cast-in-place or cementitious grouted anchors shall be used. Anchor bolts may be swedged or threaded. Expansion (post-installed) anchors and countersunk anchor bolts shall not be used for bridge bearings in accordance with AREMA MRE Chapter 14, Article 10.3.7.

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

- D. For traffic signs, signals, and luminaires the requirements of Caltrans Standard Specification 75-1.03C shall be used. If permanent tension or vibratory loading is anticipated, adhesive anchors shall not be allowed.
- E. The capacities of post-installed anchors shall be determined per independent testing laboratory in accordance with ACI 355.2 or ICC-ES AC193 for post-installed mechanical anchors, or ICC-ES AC308 for post-installed adhesive anchors. In no case shall manufacturer's literature be relied upon to determine capacities.
- F. Post-installed, torque-controlled expansion anchors and undercut anchors where not otherwise prohibited by ICC-ES AC193 are permitted for use in fire-resistant rated construction provided they conform to ICC-ES AC193 Article 6.2.2.
- G. Adhesive anchors shall not be used in overhead applications or connections where anchors must be capable of resisting sustained tension.
- H. Adhesive anchors shall not be used where they will be exposed to sustained temperatures above 110-degrees Fahrenheit or short-term temperatures above 180-degrees Fahrenheit unless tested per ICC-ES AC308 for higher temperature.
- I. Adhesive anchors shall not be installed if substrate temperature is below 40-degrees Fahrenheit unless tested per ICC-ES AC308 for lower installation temperature.
- J. Cast-in-place anchors shall be used for seismic, vibration, fatigue, shock, or impact loadings, unless anchors are specifically tested in accordance with ASTM E488 for the loading to which they will be subjected. Cast-in-place anchors shall be used for blast loadings, unless anchors are specifically tested for the loading to which they will be subjected.
- K. Post-installed anchors shall not be used with lightweight concrete unless specifically tested per ICC-ES AC193, ICC-ES AC308, or ACI 355.2

1.5 QUALITY CONTROL

- A. Installer Qualifications: Post-installed anchors shall be installed by an installer with a minimum of five years experience performing similar installations.
- B. Installer Training: Conduct thorough training with the manufacturer or the manufacturer's representative for the installer. Training shall consist of a review of the complete installation process for drilled-in anchors including the following:
 - 1. Hole drilling procedure.
 - 2. Hole preparation and cleaning technique.
 - 3. Adhesive injection technique and dispenser training/maintenance.
 - 4. Anchor element type, material, diameter, and length.
 - 5. Proof loading/torquing.
 - 6. Other procedures and techniques as necessary.
- C. Certifications: Anchors shall have one of the following certifications:
 - 1. ACI 355.2 Evaluation Report.
 - 2. ICC-ES Evaluation Report indicating conformance with applicable ICC-ES AC193 or ICC-ES AC308.

CONCRETE ANCHORS

1.6 SUBMITTALS

- A. Product Data: Include recommended design values and physical characteristics for post-installed anchors including anchor embedment, test load and torque, and manufacturer’s installation instructions.
- B. Samples: Representative length and diameters of each type anchor shown on the Construction Drawings.
- C. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - 1. Description of manner in which ASTM E488 vibration and fatigue loading testing has been tailored to simulate the type of load that the anchor will be subjected to during its use.
- D. Installer Qualifications and Procedures: Submit installer qualifications as specified herein. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer’s training date, and a list of the personnel to be trained on anchor installation.
- E. Installation and Field Quality Control methods, including method of locating embedded reinforcing steel.
- F. Certificates:
 - 1. ACI Evaluation Reports.
 - 2. ICC-ES Evaluation Reports.
- G. Installation and testing methods.
- H. Documentation:
 - 1. Test Reports.
 - 2. Installation Inspection Record
 - 3. Test Inspection Record: The test inspection record shall include the following information:
 - a. General location of anchor and group represented
 - b. Method of test or verification
 - c. Test results, accepted or rejected
 - d. Inspector’s name
 - e. Date of test
 - f. Identification number of testing tool
 - g. Other information selected by the inspector or required in the Contractor’s Quality Management System
 - 4. Failed Anchor Documentation: Documentation for anchors is required for an anchor that does not pass the test acceptance criteria specified herein. Failed anchor documentation shall be submitted to the Contracting Officer. The documentation shall include the following:
 - a. Exact location of failed anchor
 - b. Reason for failure
 - c. Repair steps taken
 - d. Inspector’s name

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

- e. Date of test
 - f. Other information selected by the inspector or required in the Contractor’s Quality Management System
- I. Record Documents: Record Documents (“As-Builts”) in respect to concrete anchors shall include, at minimum, product data, certificates, test reports, Installation Inspection Record, Test Inspection Record, and Failed Anchor Documentation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle anchors in accordance with manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fasteners and Anchors:
 - 1. Bolts and Studs: ASTM F1554 AASHTO M314. Where bolts are designed for seismic, fatigue, vibration, shock, or impact, forces, Charpy V-Notch testing per ASTM F1554 S1, S4, and S5 shall be required.
 - 2. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593
 - 3. Stainless Steel Nuts: ASTM F594
 - 4. Zinc Coating: ASTM B695, Class 65
 - 5. Hot-Dip Galvanizing: ASTM A153, Class C
 - 6. Reinforcing Bars: ASTM A706, deformed Grade 60

2.2 CAST-IN-PLACE BOLTS

- A. Bolts and studs, nuts, and washers shall conform to ASTM F1554, hot-dip galvanized including associated nuts and washers in accordance with ASTM A153. or Stainless steel anchor bolts, studs, nuts, and washers shall conform to ASTM F593 and ASTM F594.
- B. Grout shall conform to ASTM C1107 with no shrinkage and tested in accordance with ASTM C824. Grout shall be non-metallic.
- C. Sleeves shall be corrugated, galvanized steel or corrugated high-density polyethylene.

2.3 POST-INSTALLED ANCHORS

- A. Anchors for exterior, damp, or aggressive` environment shall be Type 316 stainless steel.
- B. Anchors for all other installations shall be hot-dip galvanized per ASTM A153 Class C or D, or mechanically coated per ASTM B695, Class 65.
- C. Post-installed mechanical anchors shall conform to ACI 355.2 or ICC-ES AC193.
- D. Post-installed adhesive anchors shall conform to ICC-ES AC308.
- E. Post-installed adhesive anchors shall be tested for simulated seismic loads per ICC-ES AC308 and ASTM E488.

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

- F. Post-installed adhesive anchors shall be tested for installation temperature below 40-degrees Fahrenheit. Anchors that are installed in concrete with temperatures below 40-degrees Fahrenheit shall be tested to the minimum allowable installation temperature per ICC-ES AC308.
- G. Post-installed adhesive shall be tested for long-term temperature exposure of 110-degrees Fahrenheit in accordance with ICC-ES AC308. Anchors that are subject to higher temperatures shall be tested for the temperature that is equal to or exceeds the maximum long-term service temperature per ICC-ES AC308.
- H. Post-installed adhesive anchors shall be tested for installation in holes drilled with any method or drill other than a carbide-tipped bit using a rotary hammer drill per ICC-ES AC308.
- I. Post-installed adhesive anchors shall be tested for installation in water-saturated concrete per ICC-ES AC308.
- J. Post-installed adhesive anchors shall be tested for standing water in holes per ICC-ES AC308.
- K. Post-installed adhesive anchors shall be tested for use in submerged concrete per ICC-ES AC308.
- L. Post-installed mechanical anchors shall be tested for installation in holes drilled with any method or drill other than a carbide-tipped bit using a rotary hammer drill.
- M. Post-installed mechanical anchors shall be tested for simulated seismic loads per ACI 355.2. and ASTM E488.
- N. Anchors shall be tested for vibration or fatigue loading in accordance with ASTM E488. Suitable testing provisions shall be included in the testing specifications to simulate the type of load that the anchor will be subjected to during its use.

2.4 DESIGN CRITERIA

- A. Select applicable standards. Use AASHTO for highway work and AREMA for rail work.
- B. Specific concrete anchor materials and products shall be as specified on the Construction Drawings or Construction Specifications.

PART 3 - EXECUTION

3.1 GENERAL

- A. Training:
 - 1. Installer Training: Implement a training and/or qualification program for installers of post-installed anchors. Anchor installers shall be trained and made fully familiar with the manufacturer's installation procedures including additional requirements as specified or as directed.
- B. Examination/Site Verification of Conditions:
 - 1. The use of anchors shall be restricted to the applications and installations as indicated on the Construction Drawings.

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

2. Post-installed anchors may only be installed in sound concrete. Surfaces showing obvious distress by way of porosity, disintegration, carbonation, and cracks over 0.02-inch in width and 12-inches or longer and within the distance of the embedment length shall be reported to the Contractor's engineer for evaluation.

C. Preparation:

1. Existing reinforcement shall be exposed as indicated on the Construction Drawings to establish the reinforcement pattern before drilling.
2. No cutting of reinforcement will be permitted without prior written approval from the Contractor's engineer. Multi-cutting of the same bar is considered as one cut.
3. Reinforcement will be considered to be cut if:
 - a. For No. 4 through No. 7: Cuts, nicks, or drill into bar body are greater than 1/16-inch
 - b. For No. 8 and Larger: Cuts, nicks, or drill into bar body are greater than 1/8-inch
4. When installing anchors through cut reinforcement, the anchoring mechanism shall be located at least two anchor diameters beyond the cut reinforcement.

3.2 INSTALLATION

- A. Cast-In-Place Anchors: Use templates to locate bolts accurately and securely in formwork.
- B. Anchors shall be installed according to the location, spacing, and edge distances specified in the Construction Drawings.
- C. Post-installed anchors shall be installed in accordance with the ICC-ES reports and manufacturer's installation instructions. Where installation criteria differ, the order of precedence from highest to lowest is 1) this Specification; 2) the ICC-ES reports; 3) the manufacturer's installation instructions.
- D. Holes for post-installed anchors shall be drilled with carbide-tipped bits using rotary hammer drills meeting the requirements of ANSI B212.15 unless ICC-ES AC193 or ICC-ES AC308 testing demonstrates that using percussive drilling or another type(s) of bit, including core drills, is acceptable. Drilled holes shall be cleaned of chips, dust, loose material, and water prior to anchor installation. The hole diameters and depths shall be as recommended in the manufacturer's instructions. The hole diameter shall be checked every ten holes for conformance to the hole tolerances specified in ICC-ES AC308 for adhesive anchors, ICC-ES AC193 or ACI 335.2 for mechanical anchors. Verify depth of the concrete member before drilling holes. The embedment depth of the post-installed anchor shall not exceed the greater of 2/3 of the concrete member thickness or the concrete member thickness minus 1 1/2-inches. Contact the Contractor's engineer if these requirements cannot be met based on the actual member thickness.
- E. Anchors shall be installed perpendicular to the concrete surface within a plus or minus 5-degree tolerance. Post-installation verification of this criterion may be satisfied by visual inspection to verify proper seating of the nut and washer.
- F. In areas where concrete has been removed, the minimum anchor embedment shall be measured from the surface of sound concrete.
- G. Unless otherwise noted on the Construction Drawings, the spacing requirements indicated in the applicable ICC ES report shall be used.

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

- H. Bending and welding of post-installed anchors is not permitted.
- I. The nut thread engagement for the anchors (studs) shall be such that the bolt threads project past the outside face of the nut when completely installed.
- J. The length identification code on the head of the anchor shall not be damaged during installation. Anchor projection may be cut-off subject to the approval of the Contractor's engineer and documentation of the location, embedment, and length code.
- K. Unused anchors shall be driven in and cut-off flush. Cut-off anchors shall be considered an abandoned ungrouted hole for future anchor spacing requirements.
- L. Care shall be exercised to avoid bending anchors to match base plate holes, or loosening of anchors by prying sideways after tightening. Care shall also be exercised to ensure that the cone nut of an undercut anchors does not become loose from the stud during the setting or tensioning operation.
- M. Non-grouted base plates may have a maximum 1/8-inch gap as evidenced under exterior edges around the plate provided that 1) the plate exhibits bearing contact within its interior against the concrete surface; and 2) the uneven bearing does not prevent application of the prescribed torque. If an unacceptable bearing contact condition exists, one of the following procedures shall apply:
 - 1. The concrete surface shall be reworked to obtain a proper fit.
 - 2. For gaps of up to 1-inch, the base plate may be grouted instead using the following technique:
 - a. Insert post-installed anchors and set the base plate.
 - b. Insert nuts to finger-tight condition.
 - c. Install shims positioned no more than 1/2-inch away from the anchors to reduce gaps between base plate shims to 1/8-inch or less at anchor locations.
 - d. Apply tightening torque. The bolt tightening shall not be performed when interior shims under the base plates have been placed away from anchors so that downward bending of the base plate would result upon tightening. Shims shall be moved as close as possible to the anchors before applying the installation torque.
 - e. Fill the gap with non-shrink grout leaving the shims in place. For base plates on walls where grouting is not feasible, the gap may be filled with shim plates. The shims may be stacked but no more than four shims shall be stacked.
- N. Relocating Holes Within Base Plates: The bolts may be relocated no more than 1-inch in any direction from the original position with respect to the attachment principal axis unless otherwise noted on the Construction Drawings.

3.3 INSPECTION

- A. All anchors shall be visually inspected in order to verify and document that they have been installed as specified herein. As a minimum, inspection attributes for post-installed anchors shall comply with the special inspection section of the applicable ICC-ES report (with the exception of validating the strength of existing concrete) plus additional attributes imposed by this Specification. These attributes of inspection shall be identified in the inspection report documentation.

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

- B. If visual inspection reveals that the installed anchor does not meet the specified requirements, the anchor shall be removed, replaced, or relocated with the written approval of the Contractor's engineer.

3.4 FIELD QUALITY CONTROL

- A. An on-site Quality Control Program shall be provided for all post-installed adhesive anchors in accordance with ICC-ES AC308 Articles 14.3 and 14.4 and Annex A. Special inspection shall apply as spelled out in the referenced ICC-ES AC308 regardless of the applicability of the building code to a particular installation.
- B. Full-time special inspection is required for all adhesive anchor systems together with proof load testing. Proof load testing alone is not recognized as meeting special inspection requirements.
- C. When special inspections are required, make arrangements through the Contracting Officer with Authority-hired inspection agency and ensure that inspections and verifications are performed.
- D. "Inspector" shall be understood to mean the special inspector.
- E. Minimum anchor embedments, test (proof) loads, and torques shall be as shown on the approved shop drawings.
- F. Testing of post-installed anchors shall be witnessed by the Inspector. Test of post-installed anchors is mandatory.
- G. Testing Method: Post-installed anchors shall be tested by the direct tension method as follows:
 - 1. Direct Tension Method: A tensile load as defined herein below is applied. If the tension load is applied by jacking against the concrete, the jacking pressure shall be distributed outside of an area having its center at the post-installed anchor and its diameter, or least dimension, equal to the required anchor spacing as given in the ICC ES report. Post-installed anchors tested by this method shall be retightened by applying the installation torques.
 - 2. Testing shall be in accordance with ICC-ES AC308 Figure 5-1 or ACI 355.2 and ASTM E488.
- H. Test (Proof) Load: Tension test (proof) load shall be as indicated on the approved shop drawings.
 - 1. For post-installed adhesive anchors, the test shall be equal to the lesser of:
 - a. A tensile load equal to 80-percent of the specified nominal yield strength of the anchor bolt material times the tensile area of the bolt; or
 - b. A tensile load equal to twice the design load and at least 50-percent of the expected ultimate load based on the adhesive bond strength shown in the ICC-ES report, whichever is greater.
 - 2. For post-installed mechanical anchors, the test load shall be a tensile load equal to 80-percent of the specified nominal yield strength of the anchor bolt material times the tensile area of the bolt.

06/29/2012 ADDENDUM 3 - RFP HSR 11-16

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

- I. Acceptance Criteria: A post-installed anchor is acceptable if the test load specified herein is attained without:
 - 1. Slippage of more than:
 - a. 1/16-inch for adhesive anchors.
 - b. 2.5-percent of the embedded length, rounded to the nearest 1/16-inch for mechanical anchors.
 - 2. Bolt failure.
 - 3. A sign of damage in the surrounding concrete.
- J. Test Frequency: Unless otherwise specified, the following test frequencies shall apply:
 - 1. Post-Installed Mechanical Anchors: All anchors shall be tension-tested.
 - 2. Post-Installed Adhesive Anchors: All anchors shall be tension-tested.

3.5 REPAIR AND RESTORATION OF DEFECTIVE WORK

- 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.
- B. Abandoned holes shall be grouted with non-shrink grout. When post-installed anchors fail to meet the acceptance criteria under inspection and testing, the following repairs may be undertaken:
 - 1. When failure is due to excessive anchorage pullout, the Contractor’s engineer shall evaluate the damage, develop a repair method, and document that method in writing. If approved, the anchor may be reset once prior to redrilling the hole and installing an anchor of equal size. Use the minimum spacing embedment depth, and installation torque required for the original anchor.
 - 2. When failure is due to breaking of the anchor, slippage or loosening, bending, improper installation or poor attachment, remove the defective anchor, redrill the hole, and install the same diameter anchor if the integrity of surrounding concrete has not been disturbed.
 - 3. For cases where excessive slippage upon torquing is experienced, or usage of the same hole is not possible, fill the existing hole with non-shrink grout and relocate the anchor location.
 - 4. When failure is due to breakout of concrete around the anchor, the Contractor’s engineer shall evaluate the damage, develop a repair method, and document that method in writing. Local spalling of the concrete around the anchor, up to a maximum depth of 1/4-inch, is not considered a concrete breakout failure.
 - 5. Mislocated anchors may be cut flush with concrete surface, and need not be removed if they do not interfere with subsequent installations.
 - 6. Mislocated anchors or anchors installed for temporary applications may be left in place. Those anchors that must be removed to accommodate other attachments, aesthetics, or safety of personnel shall either be removed completely or abandoned in place by cutting off beneath the surface after chipping the concrete 1-inch minimum and patching with epoxy grout. Mislocated anchors that will be covered by a base plate or an attachment may be cut-off flush with the concrete. In the event that an anchor must be removed from the hole and a new anchor installed, the removal and installation of the new anchor shall be in accordance with the manufacturer’s specifications. The abandoned hole or removed concrete shall be filled with non-shrink grout.

CONCRETE ANCHORS

CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS

7. Removal of installed anchors for inspection or replacement may be performed by using a bolt extractor as manufactured by Drillco Devices, Ltd., or approved equal.
8. Retest all replaced anchors as specified herein.

END OF SECTION

06/29/2012 ADDENDUM 3 - RFP HSR 11-16

CONCRETE ANCHORS

Date: 06/29/2012

03 15 23 – 11

FileName: 03 15 23 concrete anchor 20120601.docx

Addendum No. 3

SaveDate: 28-Jun-12 7:53 PM

This Page Intentionally Left Blank

CONCRETE ANCHORS

Date: 06/29/2012

03 15 23 – 12

FileName: 03 15 23 concrete anchor 20120601.docx

Addendum No. 3

SaveDate: 28-Jun-12 7:53 PM