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Concrete Anchorage Testing Requirements

1. Introduction

This document outlines a proposed update to the University of California's concrete anchorage requirements, specifically adjusting the mandated testing frequency for post-installed anchors in nonstructural applications. It explains the rationale for reducing proof-testing from current OSHPD/DSA levels, summarizes gaps in existing statewide code provisions, and presents the UC Seismic Advisory Board's recommended adoption of CBC Section 1901.3 with modifications to achieve an appropriate balance of reliability, practicality, and consistency across projects.

2. Proposed Code Adoption:

UC adopts CBC Section 1901.3, Anchoring to Concrete, in its entirety, with the following modifications:

Section *1901.3.4.3.2 Test Frequency - Nonstructural Applications* shall be replaced with the following:

1901.3.4.3.2 NONSTRUCTURAL APPLICATIONS. ~~FIFTY~~ *TWENTY-FIVE* PERCENT OF POST-INSTALLED ANCHORS USED IN NONSTRUCTURAL APPLICATIONS SHALL BE PROOF TESTED. THE PERCENTAGE OF TESTED ANCHORS APPLIES TO EACH SET OF ANCHORS OF A COMMON TYPE (E.G., ADHESIVE, WEDGE, OR SHELL AND SLEEVE FOR EXPANSION BOLTS), SIZE, AND EMBEDMENT DEPTH, AND TO EACH GROUP OF ANCHORS. FOUR OR MORE ANCHORS CONNECTED TO A COMMON ELEMENT SHALL BE DEFINED AS A GROUP.

EXCEPTIONS:

1. **REPETITIVE ANCHORS.** WHEN ANCHORS ARE USED REPETITIVELY (WITH THREE OR MORE IDENTICAL ANCHORS) IN DISTRIBUTION SYSTEMS (SUCH AS PIPE, DUCT, OR CONDUIT SUPPORTS) OR ARCHITECTURAL SYSTEMS (SUCH AS SUSPENDED CEILINGS, CLADDING, AND PARTITIONS), ~~20~~ *10* PERCENT OF ANCHORS, INCLUDING AT LEAST ONE ANCHOR IN EACH GROUP, SHALL BE TESTED.

2. **ANCHORS WITH LOW TENSION.** WHEN THE DESIGN TENSION ON ANCHORS IS LESS THAN 100 POUNDS, AND THOSE ANCHORS ARE CLEARLY NOTED ON THE APPROVED CONSTRUCTION DOCUMENTS, 10 PERCENT OF ANCHORS SHALL BE TESTED.

And *Section 1901.3.4.5 Test Acceptance Criteria* shall be modified as follows:

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1901.3.4.5 TEST ACCEPTANCE CRITERIA. [OSHPD 1R, 2 & 5] PROOF TESTS SHALL SATISFY THE FOLLOWING MINIMUM REQUIREMENTS.

1. **TENSION TEST:** ANCHORS SHALL BE TESTED ~~*IN THE UNCONFINED CONDITION*~~ IN ACCORDANCE WITH ASTM E3121 ~~*EXCEPT THAT THE MINIMUM CLEARANCE TO THE TEST FRAME SHALL BE 1.5 TIMES THE ANCHOR'S EMBEDMENT DEPTH.*~~ TEST LOAD SHALL BE MAINTAINED FOR A MINIMUM OF 15 SECONDS AND SHALL EXHIBIT NO DISCERNABLE MOVEMENT DURING THE TENSION TEST, E.G., AS EVIDENCED BY LOOSENING OF THE WASHER UNDER THE NUT OR AN ABRUPT DECREASE IN THE GAUGE PRESSURE.

EXCEPTION: ADHESIVE ANCHORS SHALL BE PERMITTED TO BE TESTED IN CONFINED CONDITIONS IN ACCORDANCE WITH ASTM E3121 WHEN THE APPROVED CONSTRUCTION DOCUMENTS INDICATE THAT CONCRETE BREAKOUT DOES NOT CONTROL THE DESIGN TENSILE STRENGTH.

Reason for change:

The Building Standards Commission has not adopted code provisions specifying the details and frequency of testing for post-installed anchors in concrete. Consequently, each building official has the responsibility for approving proposed test protocols on a project-by-project basis. CBC Section 1901.3 includes detailed requirements for testing anchorage to concrete, which are adopted for OSHPD 1R, 2, and 5. DSA and OSHPD adopt slightly adjusted requirements in CBC Sections 1909 and 1910A, respectively (referenced sections quoted below).

DSA and OSHPD both require 50 percent of post-installed anchors used in nonstructural applications to be proof tested. The UC Seismic Advisory Board believes that testing 25 percent of post-installed anchors is sufficient to achieve an acceptable level of reliability (10 percent for repetitive anchors) and recommends adopting the detailed requirements in Section 1901.3.

The requirement for “unconfined testing” is removed in recognition that tension testing is being used to verify adequacy of the anchor installation, not the concrete, which is checked via calculation by the designer. This is consistent with current practice in which tension testing of nonstructural anchors is typically based on confined testing.

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2025 CBC – For Reference

1901.3 Anchoring to concrete. Anchoring to concrete shall be in accordance with ACI 318 as supplemented in Section 1905, and applies to cast-in (headed bolts, headed studs, and hooked J- or L-bolts), post-installed expansion (torque-controlled and displacement-controlled), undercut, screw, and adhesive anchors.

1901.3.1 Power actuated fasteners. [OSHPD 1R, 2 & 5] Power-actuated fasteners qualified in accordance with ICC-ES AC 70 shall be deemed to satisfy the requirements of ASCE 7, Section 13.4.5.

Power-actuated fasteners shall be permitted in seismic shear for components exempt from construction documents review by ASCE 7, Section 13.1.4, and for interior non-bearing non-shear wall partitions only. Power-actuated fastener shall not be used to anchor seismic bracing, exterior cladding, or curtain wall systems.

Exception: Power-actuated fasteners in steel-to-steel connections prequalified for seismic application by cyclic tests in accordance with ICC-ES AC 70 shall be permitted for seismic design.

1901.3.2 Mechanical anchors and specialty inserts. [OSHPD 1R, 2 & 5] Mechanical anchors qualified in accordance with ICC-ES AC 193 shall be deemed to satisfy the requirements of this section. Specialty inserts, including cast-in-place specialty inserts, tested in accordance with ICC-ES AC 232 or AC 446, shall be deemed to satisfy the requirements of this section.

Note: The removal and resetting of post-installed mechanical anchors are prohibited by ACI 318 Section 17.1.3.

1901.3.3 Post-installed adhesive anchors. [OSHPD 1R, 2 & 5] Post-installed reinforcing bars, adhesive anchors, and torque-controlled adhesive anchors qualified in accordance with ICC-ES AC 308 shall be deemed to satisfy the requirements of this section.

1901.3.4 Proof tests for post-installed anchors in concrete. [OSHPD 1R, 2 & 5] When post-installed anchors are used in lieu of cast-in place bolts, the proof test loads, frequency, and acceptance criteria shall be in accordance with this section.

Exceptions. Proof tests are not required for the following:

1. Undercut anchors that allow visual confirmation of full set.

2. Repetitively installed anchors (with three or more identical anchors) of diameter one-quarter (¼) inch or less used for distributed systems or architectural components.

3. Power actuated fasteners used to attach tracks of interior nonstructural partition walls resisting only shear loads, and with at least three fasteners per segment of track.

4. Shear dowels across cold joints in slabs on grade, where the slab is not structural in accordance with Section 1907.1.

1901.3.4.1 General. [OSHPD 1R, 2 & 5] Test loads or torques, test frequencies, and acceptance criteria shall be shown on the construction documents.

If any anchor fails testing, all anchors of the same type shall be tested until twenty (20) consecutive anchors pass, then resume the initial test frequency.

Anchors to be tested shall be selected at random by the special inspector or inspector of record (IOR) when 100 percent of the anchors are not tested.

The testing of the post-installed anchors shall be done in the presence of the special inspector, and a report of the test results shall be submitted to the enforcement agency.

1901.3.4.2 Proof testing procedure. [OSHPD 1R, 2 & 5] Post-installed anchors shall be tension tested in accordance with ASTM E3121 with test frequency and test loads in accordance with Section 1901.3.4.3 and 1091.3.4.4, respectively. Proof tests using ASTM E3121 tension test procedure do not require displacement measurement.

> **Exception:** Torque-controlled post-installed and screw-type anchors shall be permitted to be tested using torque based on a valid evaluation report using criteria adopted in this code.

1901.3.4.3 Testing frequency. [OSHPD 1R, 2, & 5]

1901.3.4.3.1 Structural applications. One hundred percent of post-installed anchors used for structural applications shall be proof tested.

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EXCEPTIONS:

1. **SILL BOLTS.** WHEN POST-INSTALLED ANCHORS ARE USED FOR SILL PLATE OR BOTTOM TRACK BOLTING APPLICATIONS, 10 PERCENT OF THE ANCHORS SHALL BE TESTED.

2. **REBAR DOWELS.** WHEN ADHESIVE ANCHOR SYSTEMS ARE USED TO INSTALL REINFORCING DOWEL BARS IN HARDENED CONCRETE, 25 PERCENT OF DOWELS SHALL BE TESTED IF ALL THE FOLLOWING CONDITIONS ARE MET:

   2.1 THE DOWELS ARE USED EXCLUSIVELY TO TRANSMIT SHEAR FORCES ACROSS JOINTS BETWEEN EXISTING AND NEW CONCRETE.

   2.2 THE NUMBER OF DOWELS IN ANY ONE MEMBER EQUALS OR EXCEEDS TWELVE (12).

   2.3 THE DOWELS ARE UNIFORMLY DISTRIBUTED ACROSS SEISMIC FORCE RESISTING MEMBERS (SUCH AS SHEAR WALLS, COLLECTORS, AND DIAPHRAGMS).

1901.3.4.3.2 NONSTRUCTURAL APPLICATIONS. FIFTY PERCENT OF POST-INSTALLED ANCHORS USED IN NONSTRUCTURAL APPLICATIONS SHALL BE PROOF TESTED. THE PERCENTAGE OF TESTED ANCHORS APPLIES TO EACH SET OF ANCHORS OF A COMMON TYPE (E.G., ADHESIVE, WEDGE, OR SHELL AND SLEEVE FOR EXPANSION BOLTS), SIZE, AND EMBEDMENT DEPTH, AND TO EACH GROUP OF ANCHORS. FOUR OR MORE ANCHORS CONNECTED TO A COMMON ELEMENT SHALL BE DEFINED AS A GROUP.

EXCEPTIONS:

1. **REPETITIVE ANCHORS.** WHEN ANCHORS ARE USED REPETITIVELY (WITH THREE OR MORE IDENTICAL ANCHORS) IN DISTRIBUTION SYSTEMS (SUCH AS PIPE, DUCT, OR CONDUIT SUPPORTS) OR ARCHITECTURAL SYSTEMS (SUCH AS SUSPENDED CEILINGS, CLADDING, AND PARTITIONS), 20 PERCENT OF ANCHORS, INCLUDING AT LEAST ONE ANCHOR IN EACH GROUP, SHALL BE TESTED.

2. **ANCHORS WITH LOW TENSION.** WHEN THE DESIGN TENSION ON ANCHORS IS LESS THAN 100 POUNDS, AND THOSE ANCHORS ARE CLEARLY NOTED ON THE APPROVED CONSTRUCTION DOCUMENTS, 10 PERCENT OF ANCHORS SHALL BE TESTED.

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1901.3.4.4 Test loads. [OSHPD 1R, 2 & 5] Required test loads shall be determined by one of the following methods:

1. Twice the maximum allowable tension load or one and a quarter (1¼) times the maximum design strength of anchors as provided in approved evaluation report using criteria adopted in this code or determined in accordance with Chapter 17 of ACI 318.

   Tension test load need not exceed 80 percent of the nominal yield strength of the anchor element (= 0.8 A_{SE} F_{YA}).

2. The manufacturer's recommended installation torque based on approved evaluation report using criteria adopted in this code.

1901.3.4.5 Test acceptance criteria. [OSHPD 1R, 2 & 5] Proof test shall satisfy the following minimum requirements.

1. **Tension test:** Anchors shall be tested in the unconfined condition in accordance with ASTM E3121, except that the minimum clearance to the test frame shall be 1.5 times the anchor's embedment depth. Test load shall be maintained for a minimum of 15 seconds and shall exhibit no discernable movement during the tension test, e.g., as evidenced by loosening of the washer under the nut or an abrupt decrease in the gauge pressure.

   Exception: Adhesive anchors shall be permitted to be tested in confined conditions in accordance with ASTM E3121 when the approved construction documents indicate that concrete breakout does not control the design tensile strength.

2. **Torque test:** Torque-controlled post-installed anchors tested with a calibrated torque wrench shall attain the specified torque within ½ turn of the nut; or one-quarter (¼) turn of the nut for a 3/8 inch sleeve anchor only.

   Screw-type anchors tested with a calibrated torque wrench shall attain the specified torque within one-quarter (¼) turn of the screw after initial seating of the screw head.

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DSA

SECTION 1909 ADDITIONAL REQUIREMENTS FOR COMMUNITY COLLEGES [DSA-SS/CC]

1909.2.6 PROOF TESTS FOR POST-INSTALLED ANCHORS IN CONCRETE. WHEN POST-INSTALLED ANCHORS ARE USED IN LIEU OF CAST-IN-PLACE BOLTS, THE PROOF TEST LOADS, FREQUENCY, AND ACCEPTANCE CRITERIA SHALL BE IN ACCORDANCE WITH THIS SECTION.

EXCEPTIONS: PROOF TESTS ARE NOT REQUIRED FOR THE FOLLOWING:

1. UNDERCUT ANCHORS THAT ALLOW VISUAL CONFIRMATION OF FULL SET.

2. REPETITIVELY INSTALLED ANCHORS (WITH 3 OR MORE IDENTICAL ANCHORS) OF DIAMETER ONE-QUARTER (¼)-IN. OR LESS USED FOR DISTRIBUTED SYSTEMS OR ARCHITECTURAL COMPONENTS.

3. POWER-ACTUATED FASTENERS USED TO ATTACH TRACKS OF INTERIOR NONSTRUCTURAL PARTITION WALLS, RESISTING ONLY SHEAR LOADS AND WITH AT LEAST THREE ANCHORS PER SEGMENT OF TRACK.

4. SHEAR DOWELS ACROSS COLD JOINTS IN SLABS ON GRADE, WHERE THE SLAB IS NOT STRUCTURAL PER SECTION 1907A.1.

1909.2.6.1 GENERAL. TEST LOADS OR TORQUES, TEST FREQUENCIES, AND ACCEPTANCE CRITERIA SHALL BE SHOWN ON THE CONSTRUCTION DOCUMENTS.

IF ANY ANCHOR FAILS TESTING, ALL UNTESTED ANCHORS OF THE SAME TYPE AND INSTALLED BY THE SAME TRADE SHALL BE TESTED UNTIL TWENTY (20) CONSECUTIVE ANCHORS PASS, THEN RESUME THE INITIAL TEST FREQUENCY.

ANCHORS TO BE TESTED SHALL BE SELECTED AT RANDOM BY THE SPECIAL INSPECTOR OR INSPECTOR OF RECORD (IOR), WHEN 100 PERCENT OF THE ANCHORS ARE NOT TESTED. THE TESTING OF THE POST-INSTALLED ANCHORS SHALL BE DONE IN THE PRESENCE OF THE SPECIAL INSPECTOR, AND A REPORT OF THE TEST RESULTS SHALL BE SUBMITTED TO THE ENFORCEMENT AGENCY.

1909.2.6.2 PROOF TESTING PROCEDURE. POST-INSTALLED ANCHORS SHALL BE TENSION TESTED TO VERIFY PROPER INSTALLATION IN ACCORDANCE WITH ASTM E3121 WITH TEST FREQUENCY AND TEST LOADS IN ACCORDANCE WITH SECTIONS 1909.2.6.3 AND 1909.2.6.4, RESPECTIVELY. TENSION TESTS DO NOT REQUIRE DISPLACEMENT MEASUREMENT.

EXCEPTION: TORQUE-CONTROLLED POST-INSTALLED ANCHORS AND SCREW TYPE ANCHORS SHALL BE PERMITTED TO BE TESTED USING TORQUE BASED ON AN APPROVED EVALUATION REPORT USING CRITERIA ADOPTED IN THIS CODE.

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1909.2.6.3 Test frequency.

1909.2.6.3.1 Structural applications. 100 percent of post-installed anchors used in structural applications shall be proof tested.

Exceptions:

1. **Sill bolts.** When post-installed anchors are used for sill plate or bottom track bolting applications, 10 percent of the anchors shall be tested.

2. **Rebar dowels.** When adhesive anchor systems are used to install reinforcing dowel bars in hardened concrete, 25 percent of the dowels shall be tested if all of the following conditions are met:

   2.1 The dowels are used exclusively to transmit shear forces across joints between existing and new concrete.

   2.2 The number of dowels in any one member equals or exceeds 12.

   2.3 The dowels are uniformly distributed across seismic force resisting members (such as shear walls, collectors, and diaphragms).

1909.2.6.3.2 Nonstructural applications. 50 percent of post-installed anchors used in nonstructural applications shall be proof tested. The percentage of tested anchors applies to each set of anchors of a common type (e.g., adhesive, wedge, or shell and sleeve for expansion bolts), size, and embedment depth, and to each group of anchors. Four or more anchors connected to a common element shall be defined as a group.

Exceptions:

1. **Repetitive anchors.** When anchors are used repetitively (with 3 or more identical anchors) in distributed systems (such as pipe, duct or conduit supports) or architectural systems (such as suspended ceilings, cladding, and partitions), 20 percent of anchors, including at least one anchor in each group, shall be tested.

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2. **ANCHORS WITH LOW TENSION.** WHEN THE DESIGN TENSION ON ANCHORS IS LESS THAN 100 LBS. AND THOSE ANCHORS ARE CLEARLY NOTED ON THE APPROVED CONSTRUCTION DOC

1909.2.6.4 TEST LOADS. REQUIRED TEST LOADS SHALL BE DETERMINED BY ONE OF THE FOLLOWING METHODS:

1. TWICE THE MAXIMUM ALLOWABLE TENSION LOAD OR ONE AND A QUARTER (1¼) TIMES THE MAXIMUM DESIGN STRENGTH OF ANCHORS AS PROVIDED IN AN APPROVED TEST REPORT USING CRITERIA ADOPTED IN THIS CODE OR DETERMINED IN ACCORDANCE WITH CHAPTER 17 OF ACI 318.

TENSION TEST LOAD NEED NOT EXCEED 80 PERCENT OF THE NOMINAL YIELD STRENGTH OF THE ANCHOR ELEMENT ($= 0.8\ A_{SE}\ F_{YA}$).

2. THE MANUFACTURER'S RECOMMENDED INSTALLATION TORQUE BASED ON AN APPROVED TEST REPORT USING CRITERIA ADOPTED IN THIS CODE.

1909.2.6.5 TEST ACCEPTANCE CRITERIA. PROOF TESTS SHALL SATISFY THE FOLLOWING MINIMUM REQUIREMENTS.

1. **TENSION TEST:** ANCHORS SHALL BE TESTED IN THE UNCONFINED CONDITION IN ACCORDANCE WITH ASTM E3121, EXCEPT THAT THE MINIMUM DISTANCE TO THE TEST FRAME SHALL BE 1.5 TIMES THE ANCHOR'S EMBEDMENT DEPTH. TEST LOAD SHALL BE MAINTAINED FOR A MINIMUM OF 15 SECONDS AND SHALL EXHIBIT NO DISCERNIBLE MOVEMENT DURING THE TENSION TEST, E.G., AS EVIDENCED BY LOOSENING OF THE WASHER UNDER THE NUT OR AN ABRUPT DECREASE IN THE GAUGE PRESSURE.

EXCEPTION: ADHESIVE ANCHORS SHALL BE PERMITTED TO BE TESTED IN CONFINED CONDITIONS IN ACCORDANCE WITH ASTM E3121 WHEN THE APPROVED CONSTRUCTION DOCUMENTS SHOWS THAT CONCRETE BREAKOUT DOES NOT CONTROL THE DESIGN TENSILE STRENGTH.

2. **TORQUE TEST:** TORQUE-CONTROLLED POST-INSTALLED ANCHORS TESTED WITH A CALIBRATED TORQUE WRENCH SHALL ATTAIN THE SPECIFIED TORQUE WITHIN ½ TURN OF THE NUT; OR ONE-QUARTER (¼) TURN OF THE NUT FOR A ⅜ INCH SLEEVE ANCHOR ONLY. SCREW-TYPE ANCHORS TESTED WITH A CALIBRATED TORQUE WRENCH SHALL ATTAIN THE SPECIFIED TORQUE WITHIN ONE-QUARTER (¼) TURN OF THE SCREW AFTER INITIAL SEATING OF THE SCREW HEAD.

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OSHPD/HCAI

Section 1910A Concrete, Reinforcement, and Anchor Testing

1910A.5.3.2 Nonstructural applications. 50 percent of post-installed anchors used in nonstructural applications shall be proof tested. The percentage of tested anchors applies to each set of anchors of a common type (e.g., adhesive, wedge, or shell and sleeve for expansion bolts), size, and embedment depth, and to each group of anchors. Four or more anchors connected to a common element shall be defined as a group.

Exceptions:

1. **Repetitive anchors.** When anchors are used repetitively (with 3 or more identical anchors) in distribution systems (such as pipe, duct, or conduit supports) or architectural systems (such as suspended ceilings, cladding, and partitions), 20 percent of anchors, including at least one anchor in each group, shall be tested.

2. **Anchors with low tension.** When the design tension on anchors is less than 100 pounds, and those anchors are clearly noted on the approved construction documents, 10 percent of anchors shall be tested.

3. **[OSHPD 4]** In state detention and correctional facilities, tension testing is not required for post-installed anchors used for attaching nonstructural components, such as grab bars and shower seats, to concrete walls if the components do not contribute to security/detainment, life safety and the continuous operation of the institution following an event of extreme environmental loading from flood, wind, snow or earthquakes, as determined by the enforcing agency.