



ICC Evaluation Service, Inc.
Los Angeles Business/Regional Office
5360 Workman Mill Road
Whittier, CA 90601
tel: 562.699.0543
fax: 562.695.4694
www.icc-es.org

December 1, 2009

**TO: PARTIES INTERESTED IN EVALUATION REPORTS ON ANCHORS
IN UNREINFORCED MASONRY ELEMENTS**

**SUBJECT: Proposed Revisions to the Acceptance Criteria for Anchors in
Unreinforced Masonry Elements, Subject: AC60-1209-R1 (ME/BG)**

Dear Madam or Sir:

The revisions proposed to the subject acceptance criteria, as presented in the enclosed criteria draft, are being posted on the ICC-ES web site to allow for public comment. The revisions include:

1. Updating the criteria to reference the 2009 *International Building Code (IBC)*, 2009 *International Residential Code (IRC)*, and 2009 *International Existing Building Code* in addition to 2006 I-Codes.
2. Revising Section 1.3 to show reference standard editions applicable to the 2009 IBC, 2009 IRC and 2009 IEBC.
3. Revising Section 5.0 to reference the current version of AC10 (Acceptance Criteria for Quality Documentation).

Staff seeks the opinion of manufacturers and testing agencies as to whether the new edition of the ASTM A 307 standard affects the test procedures and whether retesting is required.

You are cordially invited to submit written comments, within 30 days of the date of this letter. Please use the comment form on the web site attaching any letters to the form. An explanation of the alternate criteria process can be found on our web site at http://www.icc-es.org/Criteria_Development/alternative_criteria_process.shtml.

All comments received in the 30-day comment period will be considered. During this same 30-day period, however, the draft criteria will be balloted to the Evaluation Committee. If the public comments raise major issues, generate controversy, or require the criteria to be substantially rewritten, then ICC-ES staff may decide to reballot the criteria; or place a revised draft on the web site for further public comment; or put the criteria on the agenda for a future Evaluation Committee meeting.

Correspondence received and a memo outlining staff's resolution of the comments in the correspondence will be posted on the web site shortly after the close of the comment period.

Your cooperation is requested in forwarding to the Los Angeles business/regional office all material directed to the Evaluation Committee. Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members. The committee reserves the right to refuse communications that do not comply with this request.

Newly approved acceptance criteria may involve test methods or test protocols that are not currently included in the scope of testing services offered by accredited testing laboratories. As noted in the ICC-ES Rules of Procedure for Evaluation Reports, the scope of the laboratory's accreditation must include the type of testing that is to be reported to ICC-ES. We encourage accredited laboratories to expand their scopes of accreditation to include testing under newly approved acceptance criteria. Please note that testing laboratories must be accredited by the International Accreditation Service (IAS) or by another accreditation body that is a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement. For further information, please contact IAS at (562) 699-0541, extension 3309, or send an e-mail to pmccullen@iasonline.org.

Please submit all comments using the form on the web site. Attach any letters to the comment form. If you have any questions (not comments), please contact the undersigned at (800) 423-6587, extension 3721, or Brian Gerber, at extension 3260. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

A handwritten signature in black ink, appearing to read 'M. Ekenel', with a long horizontal flourish extending to the right.

Mahmut Ekenel, Ph.D., P.E.
Staff Engineer

ME/BG/gh:raf

Enclosure

cc: Evaluation Committee

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR ANCHORS IN UNREINFORCED MASONRY ELEMENTS

AC60

Proposed December 2009

Previously approved April 2005, January 1995, September 1994, July 1994

PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the *International Building Code*® reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria proposed in this document, and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria proposed in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise meet the applicable performance requirements of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

Acceptance criteria are developed for use solely for purposes of issuing ICC-ES evaluation reports.

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR ANCHORS IN UNREINFORCED MASONRY ELEMENTS

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for recognition of anchors in unreinforced masonry in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2009 International Building Code[®], 2006 *International Building Code*[®] (IBC), the 2009 International Residential Code[®], 2006 *International Residential Code*[®] (IRC), the 2009 International Existing Building Code[®], 2006 *International Existing Building Code*[®] (IEBC), the 1997 *Uniform Building Code*[™] (UBC) and the 1997 *Uniform Code for Building Conservation*[™] (UCBC). Bases of recognition are IBC Section 104.11, IRC Section R104.11, IEBC Section 104.11, UBC Section 104.2.8 and UCBC Section 108.

The reason for the development of this criteria is to provide guidelines for the evaluation of alternative anchors in unreinforced masonry elements to those addressed by the codes.

1.2 Scope: The scope of these criteria is limited to adhesively bonded anchors used to attach building components to unreinforced masonry walls. The anchors strengthen the walls to resist short-term loads imposed by wind and earthquake and are limited to three applications:

1. Embedded bent anchors resisting tension and shear loads.
2. Embedded anchors resisting shear loads.
3. Through-wall anchors resisting tension and shear loads.

The anchors are alternatives to "New bolts" described in Section A107.4 of Appendix A of the IEBC and Section A107.4 of Appendix Chapter 1 of the UCBC.

1.3 Codes and Reference Standards:

1.3.1 2009 International Building Code[®] (IBC), International Code Council.

1.3.2 2009 International Residential Code[®] (IRC), International Code Council.

1.3.3 2009 International Existing Building Code[®] (IEBC), International Code Council.

1.3.4 ~~1.3.4~~ 2006 *International Building Code*[®] (IBC), International Code Council.

1.3.5 ~~1.3.2~~ 2006 *International Residential Code*[®] (IRC), International Code Council.

1.3.6 ~~1.3.3~~ 2006 *International Existing Building Code*[®] (IEBC), International Code Council.

1.3.7 ~~1.3.4~~ 1997 *Uniform Building Code*[™] (UBC).

1.3.8 ~~1.3.5~~ 1997 *Uniform Code for Building Conservation*[™] (UCBC).

1.3.9 ~~1.3.6~~ ASTM A 307-03, Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength, ASTM International. (2006 and 1997 codes)

1.3.10 ASTM A 307-04 (2009 codes)

1.3.11 ~~1.3.7~~ ASTM E 488-96(2003), Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements, ASTM International.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted:

2.1.1 Product Description: Product description shall include the following:

2.1.1.1 Type of adhesive used and product designation.

2.1.1.2 Adhesive component mix proportions.

2.1.1.3 Adhesive storage instructions and shelf life.

2.1.1.4 Description and specifications of hardware accessories: Accessories include screens, bolts, reinforcing bars, plates, nuts, and any other components used in the anchoring system.

2.1.2 Installation Instructions: Complete anchor installation instructions shall be provided describing:

2.1.2.1 Surface preparation.

2.1.2.2 Drill bit types, sizes and lengths, in compliance with the report applicant's installation instructions.

2.1.2.3 Templates, if applicable.

2.1.2.4 Preparation and cleaning of holes for anchors.

2.1.2.5 Detailed mixing and placement procedures for adhesives.

2.1.2.6 Detailed installation of hardware, including sleeves and screens, if used as components of the anchor system.

2.1.2.7 Temperature range (ambient and masonry) for installation.

2.1.2.8 Manufacturer's recommended cure time.

2.1.2.9 Bolt tightening procedures.

2.1.2.10 Minimum edge and end distances for anchors.

2.1.3 Packaging and Identification: A description of the method of packaging and field identification of the unreinforced masonry anchor components. Identification provisions shall include the evaluation report applicant's name, address, product name, lot number traceable to a production date, expiration date, the evaluation report number and, for the adhesives, the name or logo of the inspection agency.

Accessory components supplied by the evaluation report applicant and listed in Section 2.1.1.4 shall be identified with the name and address of the evaluation report applicant.

Accessory components not supplied by the evaluation report applicant need to be identified such that the code

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official can verify the components comply with the specifications.

2.2 Testing Laboratories: Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

2.3 Test Reports: Test reports shall comply with AC85. In addition, the test reports shall include the following information:

2.3.1 Anchor test locations on masonry walls: See Section 4.1.

2.3.2 Condition of brick and mortar test specimens.

2.3.3 Anchor movement or elongation under load.

2.3.4 Loading procedure, loading increments and rate of loading.

2.3.5 Masonry wall thickness and anchor embedment dept.

2.3.6 Mode of failure in each test.

2.3.7 Photographs of test equipment and typical failure conditions.

2.4 Product Sampling: Adhesive components of the unreinforced masonry anchors for tests under this criteria shall be sampled in accordance with Section 3.1 of AC85. All other components shall be sampled in accordance with Section 3.1 or 3.2 of AC85.

2.5 Calculations: Calculations used to determine allowable load capacities shall be sealed by a registered design professional.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Tension:

3.1.1 Procedure: Tension tests on the unreinforced masonry anchors shall be conducted in accordance with Section 4.2.

3.1.2 Conditions of Acceptance: The allowable tension load is the lesser of:

- a. The average peak load divided by a safety factor of five.
- b. The average load at which $\frac{1}{8}$ -inch (3.2 mm) deformation (elongation) occurs.
- c. 1,200 pounds (5334 N).

3.2 Shear:

3.2.1 Procedure: Shear tests on the unreinforced masonry anchors shall be conducted in accordance with Section 4.3.

3.2.2 Conditions of Acceptance: The allowable shear load is the lesser of:

- a. The average peak load divided by a safety factor of five.
- b. The load at which $\frac{1}{8}$ -inch (3.2 mm) deformation occurs.
- c. The shear loads noted in Sections 6.1.1.3, 6.1.2.2, 6.1.3.3, as applicable.

3.3 In-place Mortar Shear Strength Test:

3.3.1 Procedure: In-place mortar shear strength tests shall be conducted in accordance with Section 4.4 on the masonry walls in which the anchor shear and tension tests are conducted.

3.3.2 Conditions of Acceptance: The building shall have a minimum in-place mortar shear strength of 30 psi (207 kPa), that is exceeded by 80 percent of the in-place shear test results.

4.0 TEST METHODS

4.1 General: Anchor and in-place masonry shear tests shall be conducted at, or adjacent to, the roof level of existing unreinforced masonry buildings. Tests at other locations shall be specifically authorized by ICC-ES. Anchors shall be installed in mortar joints in a "T" section formed between the bed joint located over a head joint. Tests shall be conducted on buildings in which the mortar strength is determined by the in-place shear test described in Section 4.4.

4.2 Tension Test: Tension tests of the installed anchor system shall be conducted in accordance with procedures described in ASTM E 488. At least five tests are required for each anchor configuration.

4.3 Shear Test: Shear tests of the installed anchor system shall be conducted in accordance with procedures described in ASTM E 488. At least five tests are required for each anchor configuration.

4.4 In-place Mortar Shear Strength Test: In-place mortar shear strength tests shall be conducted in accordance with IEBC Section A106.3.3.1. A minimum of five tests are required. Test locations shall be in close proximity to anchor test locations and observe general requirements in Section A 106.3.3.3 of the IEBC and Section A 106.3.3.2 of the UCBC. Shear test values, v_{to} , shall be determined in accordance with Section A106.3.3.5 of the IEBC or Section A106.3.3.4 of the UCBC.

5.0 QUALITY CONTROL

5.1 The adhesives shall be manufactured under ~~an~~ approved quality ~~control program~~ documentation with inspections by an inspection agency accredited by the International Accreditation Service (IAS) or otherwise acceptable to ICC-ES.

5.2 A ~~Quality control manual~~ Quality control documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted for each component supplied by the evaluation report applicant.

5.3 Inspections by an accredited inspection agency are not required for the manufacture of hardware accessories.

5.4 The registered design professional and contractor shall submit a report to the code official for each job, verifying that the requirements noted in Section 6.0 have been met.

6.0 EVALUATION REPORT RECOGNITION

6.1 Use shall be limited to resisting wind and seismic forces only.

6.2 The report shall include basic information required by Section 2.1 of this criteria, including anchor and

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component description, installation procedures, packaging, and identification.

6.3 Mortar Shear Strength of Existing Buildings:

The in-place mortar shear strength of the building shall be at least equal to the value determined by the tests conducted under Section 3.3 and also comply with requirements in Section A 106.3.3.5 of the IEBC or Section A 106.3.3.5 of the UCBC.

6.4 Combined Tension and Shear (Short-term Loads):

Allowable shear and tension loads complying with Sections 3.1 and 3.2 may be combined in design of bent anchors (Section 6.6.1), and through-bolts with plates (Section 6.6.3), in accordance with the following equation:

$$[P_s/P_t] + [V_s/V_t] \leq 1$$

where:

P_s = Applied service tension load.

P_t = Service tension load.

V_s = Applied service shear load.

V_t = Service shear load.

6.5 Installed Anchors:

6.5.1 IBC: Continuous special inspection shall be done in accordance with Section 1704.5 of the IBC.

6.5.2 IEBC: Periodic inspection and direct-tension test and calibrated torque wrench tests shall be done in accordance with Section A107.4 of the IEBC. In lieu of testing and periodic inspection, IEBC will permit continuous special inspection during installation of bolts used to resist tension forces or shear forces only.

6.5.3 UBC: Continuous inspections shall be done in accordance with Section 1701.5.7 of the UBC.

6.5.4 UCBC: Periodic inspection and direct-tension tests and calibrated torque wrench tests shall be done in accordance with Section A107.4 of the UCBC. In lieu of testing and periodic inspections, the UCBC will permit continuous special inspection during installation of bolts resisting shear forces only.

6.6 Allowable Load Values and Installation Requirements: Installation of ASTM A 307 threaded rods and bolts or Grade 60 reinforcement complying with the applicable code in existing unreinforced masonry walls, shall be as follows:

6.6.1 For use of $3/4$ -inch-diameter (19.1 mm) bent threaded rod in tension and shear:

6.6.1.1 The anchor shall be embedded (with a screen) to within a minimum of 1 inch (25 mm) of the exterior wall surface in a 1-inch-diameter (25 mm) hole at an angle of $22^{1/2}$ degrees measured from horizontal.

6.6.1.2 The allowable tension load is limited to values derived as noted in Section 3.1, up to a maximum

of 1,200 pounds (5334 N), with no adjustment for wind or earthquake loading.

6.6.1.3 The allowable shear load is limited to values derived as noted in Section 3.2 up to a maximum of 1,000 pounds (4445 N) with no adjustment for wind or earthquake loading.

6.6.1.4 Minimum wall thickness shall be 13 inches (330 mm).

6.6.2 For use of $3/4$ -inch-diameter (19.1 mm) threaded rod or No. 4, No. 5 and No. 6 reinforcement in shear:

6.6.2.1 The $3/4$ -inch-diameter (19.1 mm) rod or No. 4, No. 5 and No. 6 rebar shall be embedded (with a screen) a minimum of 8 inches (203 mm) into a predrilled hole specified by the report holder's installation instructions.

6.6.2.2 The allowable shear load for a $3/4$ -inch-diameter (19.1 mm) rod or No. 6 rebar, No. 5 rebar and No. 4 rebar is limited to the value derived in Section 3.2 up to a maximum of 1,000 pounds (4445 N) for $3/4$ -inch-diameter (19 mm) or No. 6 rebar, 750 pounds (3334 N) for No. 5 rebar, and 500 pounds (2223 N) for No. 4 rebar with no adjustments for wind or earthquake loading.

6.6.2.3 Minimum wall thickness shall be 13 inches (330 mm).

6.6.3 For use of $5/8$ -inch-diameter (15.9 mm) through-bolt with 6-inch-by-6-inch-by- $3/8$ -inch (9.5 mm) steel plate in tension or shear:

6.6.3.1 The $5/8$ -inch-diameter (15.9 mm) threaded rod, with an 8-inch-long (203 mm) steel sleeve, shall be embedded [with an 8-inch-long (203 mm) screen tube] a minimum of 8 inches (203 mm) into a 1-inch-diameter (25 mm) hole. The steel sleeve shall have a plug at one end to prevent leakage of adhesive during installation.

6.6.3.2 The allowable tension loads are limited to values derived from Section 3.1 up to a maximum of 1,200 pounds (5334 N) with no adjustment for wind or earthquake loading.

6.6.3.3 The allowable shear loads are limited to values derived from Section 3.2 up to a maximum of 750 pounds (3334 N) with no adjustment for wind or earthquake loading.

6.6.3.4 Minimum wall thickness shall be 13 inches (330 mm).

6.7 Additional Requirements:

6.7.1 The use of anchors shall be approved by the registered design professional.

6.7.2 The anchors shall be installed under special inspection in accordance with Section 6.5 of this criteria. ■