October 1, 2008

TO: **PARTIES INTERESTED IN FASTENERS POWER-DRIVEN INTO CONCRETE, STEEL AND MASONRY ELEMENTS**

SUBJECT: Proposed Revisions to the Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements, AC70-1008-R1 (DP/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 proposed revisions include modification to Section 6.6 of the subject criteria, to address the specific limitations of Section 13.4.5 of ASCE/SEI 7-05, which reads as follows: "Power actuated fasteners shall not be used for tension load applications in Seismic Design Categories D, E, and F unless approved for such loading."

Additionally, a proposed editorial change is included in Section 3.3.4, to correct the reference from "Section 4.1.8" to "Section 4.1.7."

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 in preparing revisions to the criteria that may be considered at a future Evaluation Committee meeting. Comments received will be posted on the web site shortly after the close of the comment period.

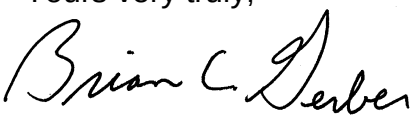
Your cooperation is requested in forwarding to the Los Angeles business/regional office all material directed to the Evaluation Committee. Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members. The committee 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 3257, or David Pereg, P.E., Staff Engineer, at extension 3257. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,



Brian Gerber, S.E.
Principal Engineer

BG/lh

Enclosure

cc: Evaluation Committee

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR FASTENERS POWER-DRIVEN INTO CONCRETE, STEEL AND MASONRY ELEMENTS

AC70

Proposed October 2008

Previously approved October 2006, October 2004, October 2003, September 1995

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 FASTENERS POWER-DRIVEN INTO CONCRETE, STEEL AND MASONRY ELEMENTS

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for fasteners power-driven into concrete, steel and masonry elements to be recognized in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006 *International Building Code*® (IBC), the 2006 *International Residential Code*® (IRC), the BOCA® *National Building Code*/1999 (BNBC), the 1999 *Standard Building Code*© (SBC) and the 1997 *Uniform Building Code*™ (UBC). The bases of recognition are IBC Section 104.11, IRC Sections R104.11 and R301.1, BNBC Section 106.4, SBC Section 103.7 and UBC Section 104.2.8. The reason for the development of this criteria is to provide guidelines for the evaluation of alternative fasteners to those addressed by the codes.

1.2 Scope: This acceptance criteria applies to fasteners power-driven into uncracked concrete, minimum $^1/_8$-inch-thick (4.8 mm) steel and uncracked masonry elements as alternatives to anchor bolts in concrete and concrete masonry and bolts in steel. The fasteners form connections between the uncracked concrete, steel, and uncracked concrete masonry base materials and other building elements. Other base materials such as brick may be considered if substantiated by appropriate data. Fasteners addressed under this criteria are limited to allowable stress design (ASD). Fasteners are not permitted for earthquake load resistance except when used in areas enforcing the IBC or IRC, with architectural, electrical and mechanical components as described in Section 13.1.4 of ASCE/SEI 7, and when used to attach wood foundation sills to concrete foundations as specified in Section 3.4 of this criteria.

1.3 Referenced Documents:

1.3.1 2006 *International Building Code*® (IBC), International Code Council.

1.3.2 2006 *International Residential Code*® (IRC), International Code Council.

1.3.3 BOCA® *National Building Code*/1999 (BNBC).

1.3.4 1999 *Standard Building Code*© (SBC).

1.3.5 1997 *Uniform Building Code*™ (UBC).

1.3.6 ACI 211.1-91, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, American Concrete Institute.

1.3.7 ACI 318-05, Building Code Requirements for Structural Concrete, American Concrete Institute.

1.3.8 ACI 530-05, Building Code Requirements for Masonry Structures, American Concrete Institute.

1.3.9 ANSI A10.3-95, Operations - Safety Requirements for Powder-actuated Fastening Systems, American National Standards Institute.

1.3.10 ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers/Structural Engineering Institute.

1.3.11 National Design Specification (NDS) for Wood Construction, American Forest & Paper Association. See Table 3 for the edition applicable to the referenced code.

1.3.12 ASTM C 31-98, Standard Practice for Making and Curing Concrete Test Specimens in the Field, ASTM International.

1.3.13 ASTM C 33-03, Standard Specification for Concrete Aggregates, ASTM International.

1.3.14 ASTM C 39-99ae1, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ASTM International.

1.3.15 ASTM C 42-99, Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, ASTM International.

1.3.16 ASTM C 55-03, Standard Specification for Concrete Brick, ASTM International.

1.3.17 ASTM C 90-03, Standard Specification for Loadbearing Concrete Masonry Units, ASTM International.

1.3.18 ASTM C 330-04, Standard Specification for Lightweight Aggregates for Structural Concrete, ASTM International.

1.3.19 ASTM C 270-04, Standard Specification for Mortar for Unit Masonry, ASTM International.

1.3.20 ASTM C 476-02, Standard Specification for Grout for Masonry, ASTM International.

1.3.21 ASTM C 1314-03b, Standard Test Methods for Compressive Strength of Masonry Prisms, ASTM International.

1.3.22 ASTM E 1190-95 (2000), Standard Test Methods for Strength of Power-Driven Fasteners in Structural Members, ASTM International.

1.3.23 Standard 4450, Approval Standard for Class I Insulated Steel Deck, February 1989, FM Global.

1.3.24 Standard 4470, Approval Standard for Class I Roof Covers, 1992, FM Global.

1.4 Definitions:

1.4.1 Alignment Tips: Alignment tips are a washer, eyelet or other guide member located on the fastener shank to align and retain fasteners in driving equipment.

1.4.2 Evaluation Report: An evaluation report is a document published by ICC-ES recognizing fastener performance features required by the IBC, IRC, BNBC, SBC or UBC.

1.4.3 Eye Pin: An eye pin is a fastener with a hole in the head for receiving chains and wires, which in turn support suspended ceilings, light fixtures, etc.

1.4.4 Fasteners: Fasteners are drive pins or threaded studs manufactured from special heat-treated steel, which attach one component to another.

1.4.5 Fastener Test Series: A fastener test series is a group of identical fasteners tested under identical conditions. Identical conditions encompass fastener type, diameter, length, embedment, spacing, edge distance, concrete/masonry density/weight, test member thickness and concrete/masonry compressive strength, steel thickness and steel strength.

1.4.6 Masonry: Masonry is masonry construction with mortar, grout and masonry units that comply with Section 3.1.

1.4.7 Power-driven Fastening System: A power-driven fastening system is a system that uses explosive powder, gas combustion, compressed air or other gas to embed the fastener into base materials.

1.4.8 Stabilizer: A stabilizer is an accessory supplied with driving tools and used to reduce flying particles and hold the driving tool perpendicular to material surface.

1.4.9 Test Member: The test member is the structural member, usually a concrete slab, steel plate or masonry prism, receiving fasteners to be tested.

1.4.10 Tool Class: Tool class is a velocity class of power-actuated tools used in the tests, designated in accordance with ANSI A 10.3.

1.4.11 Uncracked Concrete/Masonry: Concrete or masonry elements where analysis indicates no cracking ($f_t < f_r$) due to service loads or deformations. For concrete, f_r is defined in ACI-318, Section 9.5.2.3 (IBC, BNBC, and SBC) or in UBC Section 1909.5.2.3. For masonry, f_r is defined in ACI 530, Section 3.1.8.2 (IBC), or UBC Section 2108.2.4.6.

1.4.12 Additional definitions are noted in Section 3 of ASTM E 1190.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted.

2.1.1 Product Description:

2.1.1.1 Generic or trade name.

2.1.1.2 Manufacturer's catalog number.

2.1.1.3 Fastener head diameter and thickness.

2.1.1.4 Nominal fastener or shank diameter.

2.1.1.5 Fastener shank length.

2.1.1.6 Permitted manufacturing tolerances.

2.1.1.7 Washer or clip size and thickness, if used.

2.1.1.8 Alignment tips.

2.1.1.9 Shank treatment. If knurled, the knurl pattern must be described.

2.1.1.10 Fastener and, as applicable, washer or clip material specifications, including protective coatings and physical properties, such as tensile strength and/or hardness.

2.1.1.11 Appropriate national standard for the fastener and, as applicable, washer or clip materials. All tested fasteners, whether they are prototypes or production fasteners, shall be proven by the testing laboratory to conform to the manufacturer's fastener specifications. This evaluation shall include confirmation of equivalent dimensions, chemical composition, and material properties, such as strength and/or hardness. As an alternative to chemical testing, a mill certificate for the raw wire material, corresponding to the tested fastener lot, may be submitted to demonstrate compliance with the chemical composition requirements. Where the actual material strength exceeds the specified strength, fastener load test results shall be adjusted by the quotient of F_u specified/F_u actual, when failure is attributed to the subject fastener material. Where no physical property specifications exist, acceptable properties shall be submitted for installation, application and design.

2.1.2 Installation Instructions: Recommended installation procedures. Manufacturer's published instructions shall be submitted for installation, application and design.

2.1.3 Packaging and Identification: A description of the method of packaging and manner of field identification prior to or after installation is needed. The manufacturer's name or insignia and the product's type and size shall be marked on the fastener or packaging units. The ICC-ES evaluation report number shall be placed on packaging.

2.1.4 Exposure: When fasteners are recognized for exterior exposure or damp environments, evidence of durability shall be established using appropriate methods such as Factory Mutual Research Corrosion Test Procedure in Standards 4450 and 4470.

2.2 Testing Laboratories: Testing laboratories shall comply with 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, test reports shall include the following information:

2.3.1 Information specified in report section of the applicable test standard.

2.3.2 Method of failure for each test (e.g., concrete or masonry cracking, concrete spalling, fastener pullout, fastener shear, steel tear out, or ductile steel failure).

2.3.3 Seal of a registered design professional.

2.3.4 Fastener Identification:

2.3.4.1 Manufacturer's catalog number or model line designation.

2.3.4.2 Physical dimensions, which may be shown on drawings.

2.3.4.3 Washer dimensions, which may be shown on drawings.

2.3.4.4 Description of coatings or finishes.

2.3.5 Data collection sheets.

2.3.6 The fasteners, tool setting aids and necessary driving aids, such as stabilizers, used in the tests.

2.4 Product Sampling: Sampling of the fasteners for tests under this criteria shall comply with Sections 3.2, 3.3 and 3.4 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Test Member Specifications:

3.1.1 Concrete:

3.1.1.1 To obtain desired concrete compressive strengths, the mix shall be based on recommendations for proportioning in the Design and Control of Concrete

Mixtures, ACI 211.1, and Chapter 19 of the IBC (ACI 318). Proportions are permitted vary to meet local requirements and to achieve desired nominal compressive strength. The reasons for variations shall be documented in the test report.

3.1.1.2 Coarse and fine aggregate in concrete shall comply with either ASTM C 33 or ASTM C 330. The aggregate description shall include the rock and mineral components, shape, hardness, maximum size, and grading specification.

3.1.1.3 Concrete test members shall be prepared in accordance with ASTM C 31. Compressive strength cylinders shall be stored and cured in accordance with Section 9.3.1 of ASTM C 31 (field cure). These cylinders are tested in accordance with ASTM C 39 and Section 3.1.3 of this criteria.

3.1.1.4 Where cylinders are unavailable, compressive strength shall be determined by obtaining, preparing and testing drilled cores. Procedures in ASTM C 42 shall be followed. One sample from each of three cores shall be tested in accordance with ASTM C 42 and Section 3.1.3 of this criteria.

3.1.1.5 Reinforcement is used only to stabilize test members during transportation. Reinforcing elements in concrete test members shall be outside the potential failure region of each test fastener. The testing laboratory shall control and verify location of reinforcing.

3.1.2 Masonry:

3.1.2.1 Masonry test specimens shall be prepared in accordance with IBC Chapter 21. Masonry strength shall be determined in accordance with IBC Chapter 21 where masonry unit, mortar, and grout strengths are less than or equal to 110 percent of specified values. As an alternative, masonry strength may be determined by prism tests without limitations to masonry unit, mortar and grout strengths.

3.1.2.2 The testing laboratory shall verify that masonry units comply with the following standards, as appropriate:

3.1.2.2.1 Concrete building brick: ASTM C 55.

3.1.2.2.2 Concrete masonry units: ASTM C 90.

3.1.2.2.3 Brick not conforming with above-noted standards shall comply with a nationally recognized standard.

3.1.2.3 Mortar shall be prepared in accordance with IBC Section 2103 and ASTM C 270. The testing laboratory shall report the mortar composition, mortar type, proportions, and compliance with the standard. The compressive strength of the mortar used in the test specimens shall be 110 percent (maximum) of specified values.

3.1.2.4 Grout shall be prepared in accordance with IBC Section 2103 and with ASTM C 476. The testing laboratory shall report grout composition, grout type, proportions and compressive strength. The compressive strength of the grout used in the test specimens shall be 110 percent maximum of specified values.

3.1.2.5 When masonry strength is determined by prism tests, masonry prisms shall be prepared and tested in accordance with ASTM C 1314 and Section 3.1.3 of this criteria.

3.1.2.6 Reinforcement shall only be used to stabilize test members during transportation. Reinforcing elements in masonry test members shall be outside the potential failure region of each test fastener. The testing laboratory shall control and verify the location of reinforcing.

3.1.3 Concrete and Masonry Strength Determination:

3.1.3.1 Concrete and masonry test members shall age a minimum of 21 days prior to the beginning of fastener load tests described in Section 4.1 of this criteria. For masonry where strength is determined according to IBC Table 2105.2.2.1.2, fastener load tests shall be done when masonry reaches 21 to 35 days of age, and masonry unit, mortar and grout tests for strength shall be done at 28 days of age.

Exception: For tests to determine performance of fasteners in high early strength or uncured concrete.

3.1.3.2 For concrete or masonry less than 90 days old, two cylinders, cores or prisms, prepared according to Section 3.1.1 or 3.1.2 of this criteria, shall be tested at the beginning and two at the end of fastener load testing, as indicated in Table 1. The beginning test shall be concurrent with the initiation of fastener testing. The beginning and end strength results shall be averaged (four cylinders, cores or prisms total) to establish the strength of the test members during the test period.

3.1.3.3 For concrete or masonry aged 90 days or more, the compressive strength shall be the average of a single test of three cylinders, cores, or prisms determined after at least 90 days, and within 30 days of fastener testing.

3.1.3.4 Reported concrete or masonry strength for any anchor test series shall be determined from the tests in this section within the time limitations indicated in Table 1 of this criteria.

3.1.4 Steel: Steel plates shall comply with the appropriate standard for structural quality steel. Compliance is determined by test reports submitted by the mill or a testing laboratory.

3.1.5 Other Test Members: Test members not otherwise described in Section 3.1 of this criteria shall be described and shall meet applicable standards.

3.2 Load Test Program: For determining allowable loads used in structural designs, tests shall be done in accordance with Sections 4.1 and 4.3 of this criteria, as applicable.

3.3 Allowable Load Determination:

3.3.1 General: The documents containing allowable load determinations shall be sealed by a registered design professional.

3.3.2 Concrete, Masonry and Steel: Based on results from tests described in Sections 4.1 through 4.3 of this criteria, the allowable load shall be computed using Equation 3-1. Where the COV is less than 15 percent, a safety factor of no less than 5 shall be applied to the average ultimate load. When testing satisfies the alternate sample size described in Section 8.1 of ASTM E 1190 (the COV from ten tests is 15 percent or greater), the allowable load shall be determined by applying a minimum safety factor of 5 to the lowest ultimate load of the ten tests.

$$F_{all} = \frac{F - 2s}{3.5} = F\frac{(1 - 2COV)}{3.5} \qquad (3\text{-}1)$$

where:

F_{all} = allowable load, pounds (N).

COV = s/F = coefficient of variation in a test series.

s = standard deviation in a test series.

F = average ultimate load in test series, pounds (N).

3.3.3 Load Adjustment:

3.3.3.1 Concrete: Where the concrete test member's compressive strength exceeds f_{ci} by more than 10 percent, but is within 1,000 psi (6,895 kPa), the fastener test values shall be adjusted using Equation 3-2:

$$F_1 = F_t\sqrt{\frac{f_{ci}}{f_{ct}}} \qquad (3\text{-}2)$$

where:

F_1 = allowable load described in evaluation report, pounds (N).

F_t = allowable load derived from test series, pounds (N).

f_{ci} = specified concrete compressive strength described in evaluation report, psi (kPa).

f_{ct} = compressive strength of concrete test member at time of fastener test, psi (kPa).

3.3.3.2 Masonry: Where masonry units used in test members have net area compressive strength properties exceeding 110 percent of the specified values, or dimensions varying from specified values, design loads for fasteners installed directly into units shall be adjusted based on ratios of test member values to specified values.

Where mortar compressive strength exceeds 110 percent of the specified values, design loads for fasteners installed in mortar joints shall be adjusted based on ratios of tested mortar strength to specified mortar strength.

Where grout compressive strength exceeds 110 percent of the specified values, design loads for fasteners installed down into the top of grouted cells shall be adjusted based on ratios of tested grout strength to specified grout strength.

3.3.3.3 Steel: Design loads derived from tests in steel shall be adjusted for steel strength as follows:

1. If tests have been conducted in one steel strength, the following relationship shall be used to derive design values for lesser steel strengths:

$$F_1 = F_t \cdot \left(1 - \frac{F_{u,test} - F_u}{100}\right) \text{ [lb, N]} \qquad (3\text{-}3)$$

where:

$F_u \le F_{u,test}$

F_u = Specified steel tensile strength, ksi (MPa).

$F_{u,test}$ = Steel tensile strength of test member, ksi (MPa).

2. If tests have been conducted in more than one steel tensile strength with the difference between the maximum and minimum tested steel tensile strengths, Δ_{fu}, greater than or equal to 10 ksi (68.9 MPa), a relationship for the influence of steel tensile strength on fastener capacity may be derived from the test results. Maximum fastener capacity shall be limited to those values associated with the maximum tested steel tensile strength.

3.3.4 Combined Loads: Allowable loads for fasteners subjected to combined shear and tension loads are calculated by Equation 3-4.

$$\left(\frac{P_s}{P_t}\right)^n + \left(\frac{V_s}{V_t}\right)^n \le 1 \qquad (3\text{-}4)$$

where:

P_s = applied service tension load, pounds (N).

P_t = service tension load, pounds (N).

V_s = applied service shear load, pounds (N).

V_t = service shear load, pounds (N).

To permit $n = {}^5/_3$ in Equation 3-4, combined load oblique tension tests described in Section ~~4.1.8~~ 4.1.7 of this criteria, at 45 degrees are required to confirm the Equation 3-5. If combined load tests are not done or if Equation 3-5 is not satisfied, then $n = 1$ in Equation 3-4.

$$\left(\frac{P_a}{P_u}\right)^{5/3} + \left(\frac{V_a}{V_u}\right)^{5/3} \ge 1 \qquad (3\text{-}5)$$

where:

P_a = average ultimate tension test load from combined load test, pounds (N).

P_u = average ultimate tension test load from tension load test, pounds (N).

V_a = average ultimate shear test load from combined load test, pounds (N).

V_u = average ultimate shear test load from shear load test, pounds (N).

3.3.5 Wood to Steel, Concrete or Masonry: Reference shear load values are determined according to the NDS. Bending yield strength values shall result from tests conducted on the fasteners in accordance with the ICC-ES Acceptance Criteria for Test Method to Determine Bending Yield Moment of Nails (AC95). If hardness values under Section 2.1.1.10 and 2.1.1.11 of this criteria give Rockwell C hardness values greater than R_c 45, then bending yield

strength tests do not have to be performed and the bending yield strength values for the fasteners shall be the values noted in the NDS based on nail diameter.

3.4 Foundation Sill Plate Application for Conventional Light Wood-frame Construction:

3.4.1 Fastener spacing for attaching wood foundation sills to foundations in Seismic Design Category A or B (IBC or IRC), Seismic Performance Category A, B, C or D (BNBC or SBC), Seismic Zones 0, 1, 2, and 3 (UBC) and in areas with basic wind speeds up to 85 mph (137 km/h) fastest mile wind speed or 100 mph (161 km/h) 3-second-gust wind speed, shall be according to Table 2 of this criteria, provided fastener test results conducted in accordance with Section 4.2 of this criteria satisfy shear and tension load requirements in Table 2 of this criteria. For use of fasteners in 90 mph (145 km/h) fastest mile wind speed or greater basic wind speed areas, or 105 mph (161 km/h) 3-second-gust wind speed or greater basic wind speed areas, or when test results do not satisfy minimum load requirements of Table 2 of this criteria, an engineering design is required that uses allowable loads determined in Section 3.3 of this criteria.

EXCEPTION: The seismic and wind limitations of Section 3.4.1 are permitted to be waived for fasteners used in interior non-shear wall applications.

3.4.2 Fasteners used to attach code-complying preservative-treated wood foundation sills to concrete foundations shall comply with IBC Section 2304.9.5.

4.0 TEST METHODS

4.1 Fastener-load Testing Procedures:

4.1.1 Concrete Test Specimens: Concrete slabs are formed and poured to sufficient size to permit installation of a fasteners with spacings and edge distances complying with Table 1of ASTM E 1190.

4.1.2 Masonry Test Specimens: Masonry assemblies shall be fully grouted, partially grouted or ungrouted and be of sufficient size to permit installation of fasteners with spacings and edge distances complying with Table 1 of ASTM E 1190. Fastener locations include face shells of units into grouted spaces, ungrouted spaces, mortar joints or down through grouted cells, simulating concrete masonry foundation walls. The fastener position used in the test establishes the position specified in the evaluation report.

4.1.3 Steel Test Specimens: Steel plates shall be of sufficient size to permit installation of fasteners with spacings and edge distances complying with Table 2 of ASTM E 1190.

4.1.4 Installation: Fasteners shall be installed into the test member according to the manufacturer's recommended procedure, with spacing from edges and adjacent fasteners as set forth in Table 1 of ASTM E 1190. Additional tests may be required to determine fastener loads at spacings and edge distances described in the manufacturer's installation instructions. Fasteners shall be driven into concrete or masonry when the specified compressive strength is attained plus or minus a 400 psi (2.8 MPa) deviation. Fastener embedment shall be observed and recorded.

4.1.5 Sample Size: The minimum sample quantity for each data category shall comply with Section 8 of ASTM E 1190.

4.1.6 Testing Methods: Test apparatus shall comply with Section 5 of ASTM E 1190, for tensile and shear loading. Test procedures shall comply with Section 9 of ASTM E 1190. Ultimate load and failure mode shall be recorded for each test.

4.1.7 Combined Loads: For combined loads, tests shall be done by loading the fastener obliquely at a 45˚ angle from test member surface. Figure 1 of this criteria illustrates loading set-up. Other aspects of the test program shall comply with general requirements in ASTM E 1190.

4.2 Sill Attachment Test Procedure:

4.2.1 Installation: Fasteners shall be placed into the concrete test member through the center of a nominal 2-inch-thick (51 mm) wood member with a specific gravity of 0.5 or greater. The concrete compressive strength shall be 2,000 psi ± 400 psi (13.8 MPa ± 2.8 MPa) when the fastener is installed and tested. Any concrete spalling or cracking after installation shall be reported.

For recognition of use to attach sill plates for exterior shear walls, interior shear walls, and interior non-shear walls, the fastener shall be installed with a minimum $1^3/_4$-inch (44.5 mm) edge distance.

For recognition of use to attach sill plates for interior shear walls and interior non-shear walls only, the fastener shall be installed with an edge distance equal to or greater than the minimum edge distance, *c*, specified in Table 1 of ASTM E 1190.

4.2.2 Testing: The fasteners shall be tested for shear and tension loads according to ASTM E 1190, except that edge distance shall be as described in Section 4.2.1 of this criteria, depending on the installation conditions and locations that are sought. The sill plate shall be removed before testing. The shear load shall be applied towards the closest test member edge.

4.3 Ceiling Clip Assemblies (fastener and clip combination):

4.3.1 Installation: Assemblies shall be installed into test members as a complete unit.

4.3.2 Testing: Assemblies shall be tested by loading the assembly in the same manner as the loading when assemblies are installed in field conditions, i.e., load attached to the hole where the wire would attach.

5.0 QUALITY CONTROL

5.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality control program shall verify continued fastener compliance with fastener specifications in Section 2.1 of this criteria.

5.2 Third-party follow-up inspections are not required under this acceptance criteria.

6.0 EVALUATION REPORT RECOGNITION

The evaluation report shall include the following:

6.1 Basic information required by Section 2.1 of this criteria, including product description, installation procedures, packaging and identification.

6.2 Allowable loads for each fastener and ceiling clip assembly determined by Section 3.3 of this criteria. The

allowable loads shall include tension, shear and combined loads, as applicable.

6.3 Unless data in accordance with Section 2.1.4 of this criteria is submitted, the evaluation report shall state that installation must be limited to dry, interior conditions.

6.4 Information concerning connections with wood, in accordance with Section 3.3.5 of this criteria, as applicable.

6.5 Information concerning foundation sill plate application, based on Sections 3.4 and 4.2 of this criteria, as applicable.

6.6 The evaluation reports shall state that earthquake load resistance is beyond the scope of the report.

EXCEPTIONS:

1. Fasteners used with architectural, electrical and mechanical components as described in Section 13.1.4 of ASCE/SEI 7 (IBC and IRC), subject to the limitations in Section 13.4.5 of ASCE/SEI 7-05.

2. Foundation sill plate applications complying with Section 3.4 of this criteria.

6.7 The evaluation reports shall state that use is limited to uncracked concrete or masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.■

TABLE 1—TEST MEMBER STRENGTH TEST TIME LIMITATIONS

AGE OF CONCRETE OR MASONRY AT BEGINNING OF FASTENER TEST	MAXIMUM TIME BETWEEN TEST MEMBER STRENGTH TESTS (TEST PERIOD)	COMMENTS
Less than 21 days	3 days	Per Section 3.1.3.1, for special tests only
21 - 35 days	7 days	None
36 - 56 days	14 days	None
57 - 90 days	30 days	None
More than 90 days	—	See Section 3.1.3.3

TABLE 2—LOAD AND SPACING REQUIREMENTS FOR WOOD SILL PLATE ANCHORAGE

NOMINAL FASTENER SHANK DIAMETER (inch)[10]	MINIMUM FASTENER LENGTH (inches)	MINIMUM LOAD REQUIREMENTS FOR SILL PLATE ANCHORAGE (lbs)[1,2]		FASTENER SPACING (ft.)[3,4,5,6,7]		
		Allowable Shear Load (lbs)[8]	Allowable Tensile Load (lbs)[8]	Interior Shear Walls[5,9]	Interior Nonshear Walls[10]	Exterior Shear Walls[5,9]
0.136 - 0.142	$2^{7}/_{16}$	100	100	1	2	1
0.143 - 0.155	$2^{3}/_{4}$	150	125	1.5	3	1.5
0.156 - 0.187	3	200	150	2	4	2
0.188 and greater	3	300	250	3	4	3

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 plf = 74.6 N/m, 1 psi = 6.89 kPa.

[1]Allowable loads from tests conducted under Section 4.2.2 of this criteria are calculated using the methods described in Section 3.3 of this criteria.
[2]For step shank fasteners, the smallest diameter of the fastener is considered the shank diameter for purposes of this table.
[3]Spacings are based on the attachment through the center of 2-inch nominal thickness wood with specific gravity of 0.5 or greater to concrete floor slabs or footings in accordance with BNBC Section 2305.17, SBC Section 2307.1or UBC Sections 1806.6 and 2320.6, as applicable [Section 2308.6 of the IBC or Section R403.1.6 of the IRC (for maximum two-story buildings)]. For other species of lumber, the required spacings of fasteners require special calculations complying with the NDS.
[4]Fasteners shall not be driven until the concrete has reached a minimum concrete compressive strength of 2,000 psi.
[5]Bearing walls shall have bracing in accordance with IBC Section 2308.9.3, IRC Section R602.10, BNBC Section 2305.8, SBC Section 2308.2.2 or UBC Section 2320.11.3, as applicable. Interior and nonbearing partitions are not assumed to be braced.
[6]Fasteners shall not be used to attach shear walls having a unit shear exceeding 100 pounds per foot to other building elements.
[7]All fasteners must be installed with a minimum $^{3}/_{4}$-inch-diameter (19.1 mm), No. 16 gage (0.0598-inch) washer.
[8]Larger category shank diameter may meet minimum load requirements of a smaller category shank diameter, provided spacing requirements are also applied.
[9]Walls shall have two fasteners placed 6 inches and 10 inches, respectively, from each end of sill plates with maximum spacing between, as shown in this table.
[10]Walls shall have fasteners placed at 6 inches from ends of sill plates with maximum spacing between, as shown in this table.

TABLE 3—CODE-REFERENCED NDS STANDARDS

STANDARD	2006 IBC	2006 IRC	1999 BNBC	1999 SBC	1997 UBC
NDS	ANSI/AF&PA NDS-2005	ANSI/AF&PA NDS-2005	ANSI/AF&PA NDS-1997	ANSI/AF&PA NDS-1997	ANSI/NFoPA NDS-1991

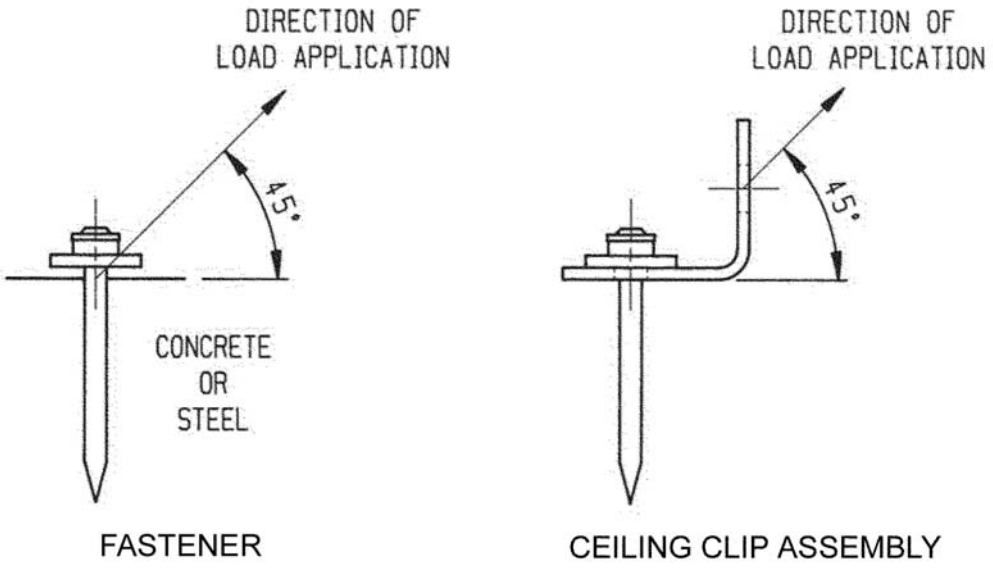


FIGURE 1—FASTENER AND CEILING CLIP ASSEMBLY