ICC EVALUATION SERVICE

ICC Evaluation Service, LLC
Chicago Regional Office
4051 W Flossmoor Road
Country Club Hills, IL 60478
tel: 708.799.2305
fax: 708.799.0310
www.icc-es.org

August 31, 2010

TO: **PARTIES INTERESTED IN EVALUATION REPORTS ON POWER-DRIVEN PINS FOR SHEAR WALL ASSEMBLIES WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS**

SUBJECT: Proposed Revisions to the Acceptance Criteria for Power-driven Pins for Shear Wall Assemblies with Cold-formed Steel Framing and Wood Structural Panels, Subject AC230-1010-R2 (EL/BG)

Hearing Information:
Thursday, October 7, 2010
8:00 a.m.
Sheraton Gateway Hotel Los Angeles
6101 West Century Boulevard
Los Angeles, California 90045
(888) 627-7104

Dear Madam or Sir:

Proposed revisions to the subject acceptance criteria will discussed at the hearing noted above. In June 2010, proposed revisions to the subject acceptance criteria were posted on the ICC-ES web site under the Alternative Criteria Process to allow for industry input and public comment. The criteria draft posted in June 2010 may be found at: http://www.icc-es.org/Criteria_Development/1006-alt/AC230.pdf. We received several comments on the posted draft. Based on these comments and additional questions that have arisen in the course of working with applicants, we have prepared revisions to the subject criteria as shown in the enclosed criteria draft. Public comments received on the June 2010 criteria draft may be found at: http://www.icc-es.org/Criteria_Development/1006-alt/AC230_Comments.pdf .

The intent of the proposed revisions is to remove testing requirements that are considered unnecessary, clarify testing and analysis requirements, expand and clarify requirements for evaluation reports, and update the criteria to the 2009 *International Building Code*® (IBC) and *International Residential Code*® (IRC).

Proposed revisions that have been added or redrafted since June 2010 are as follows:

1. **Expand and revise Section 1.2.** As in June 2010, we propose revising and expanding Section 1.2 to address installation limitations, scope of the evaluation and types of recognition that the criteria addresses, in addition to describing the types of assemblies that can be evaluated under AC230.

Section 1.2 should address whether qualification under AC230 is applicable to both Type I and Type II shear walls, as defined in Section A2 of the AISI North American Standard for Cold-formed Steel Framing—General Provisions (AISI S200). Currently, AC230 does not address requirements for determining strength reductions due to openings in shear walls (which would lead to a table similar to Table C3.2-1 of AISI S213). There is also no basis to apply AISI table C3.2-1 to shear walls constructed with power-driven pins, particularly since shear walls constructed with pins evaluated under AC230 are not required to have strength equal to or better than shear walls constructed with screws. Therefore, the proposed revision indicates that the scope of AC230 is limited to Type I shear walls.

2. **Delete "site-built" from Sections 1.1 and 1.2.** In response to a comment received on the June 2010 criteria draft, the removal of the term "site-built" from Sections 1.1 and 1.2 of the criteria is proposed. There is no similar limitation in AISI S213, and the code adequately addresses how to handle prefabricated structural elements. As proposed, AC230 has the same requirements for site-built and prefabricated assemblies.

3. **Revise Section 1.5.** In addition to the revisions to Section 1.5 which were proposed in June 2010, the definition of V_{ASD} has been further revised in the enclosed criteria draft, in response to a submitted comment, and in conjunction with the proposed revision to Appendix A of AC230.

4. **Revise Section 2.1.1.1.** In response to a submitted comment, a minor revision to Section 2.1.1.1 is proposed as shown in the attached criteria draft.

5. **Revise Section 3.1.** Several revisions to Section 3.1 are proposed to clarify requirements for the power-driven pins, as follows:

    a. In response to submitted comments, the proposed wording for Section 3.1.1 has been revised as shown in the attached criteria draft.

    b. We propose deleting Section 3.1.2. The public comments show concurrence with this proposal – tensile strength is typically not specified for these fasteners.

    c. In response to submitted comments, we have reconsidered the requirements for corrosion protection. We note that shear wall assemblies recognized under AC230 must be covered by an exterior wall envelope complying with the code, since the walls are not tested with wet wood structural panels. We also note that the code does not address corrosion protection requirements for the power-driven pins. In light of these considerations, we propose to limit the scope of AC230 to structural performance of the fasteners, by deleting Section 3.1.3 as shown in the attached criteria draft.

6. **Revise Section 3.3.** In response to submitted comments, the proposed revisions to Section 3.3 have been modified as follows:

   a. The proposed wording for Section 3.3.3 allows for the base steel thickness and strength properties of the steel framing to be based on testing of representative members, rather than requiring every member to be tested. This is consistent with Section 3.1.2.2 of the ICC-ES Acceptance Criteria for Power-driven Pins for Attaching Gypsum Board Materials to Cold-formed Steel Framing (AC259), which was approved by the Evaluation Committee in June 2010.

   b. The proposal for Section 3.3.4 shows the adjustment for steel thickness based on the design thickness of the CFS, which is consistent with Section F1.1(c) of AISI S100. The proposal also requires overstrength of both studs and tracks to be considered, because connections to both contribute to the shear resistance of the wall, but does not arbitrarily require the higher overstrength ratio to be used. Instead, the reported failure mode can be considered when determining an appropriate reduction factor.

7. **Revise Section 3.4.** The proposed revisions to Section 3.4 to allow for recognition of single-fastener connection values have been modified. The intent of the revisions to Section 3.4 remain the same as in June 2010, but the current draft takes into account submitted comments and further study on the part of staff regarding appropriate test methods, sample size, and determination of available strength. The main issue that has been studied is that there is not a standard test method for testing the capacity of a piece of wood structural panel attached to cold-formed steel. The proposed approach is to separate this testing into two parts. The wood structural panel's resistance to the pin pulling through the panel would be assessed by testing in a manner similar to ASTM D 1037. This is the same approach used in the ICC-ES Acceptance Criteria for Alternate Dowel-Type Threaded Fasteners (AC233). The sample size for this testing is typical for testing wood connections and is similar to AC233. The second part of determining the connection's tension strength would be to test the pull out capacity of the pin installed in cold-formed steel. The proposed test method is a standard AISI test method, and the sample size is typical for steel products, where the variability is much less than for wood. The recognized allowable tension load would be based on the type of test which gives the more conservative result.

8. **Revise Section 3.5.2:** The proposed revision to this section would allow tested shear walls to have an aspect of either 1:1 or 2:1, to establish shear strengths for walls with a an aspect ratio up to 2:1. The Shear Wall Design Guide, dated February 1998, published by the North American Steel Framing Alliance, discusses the data upon which the nominal strength tables in AISI S213 are based. This document shows that many of the tests were performed on walls measuring 4 feet by 8 feet. Other tests described in the

Shear Wall Design Guide indicate that the unit shear strength for 4-by-8 walls is comparable to the strength for 8-by-8 walls. Therefore, AC230 should not preclude the use of 4-by-8 shear wall test specimens.

9. **Revise Section 3.8.** In addition to the revisions proposed in June 2010, new revisions to Section 3.8.1 are proposed in response to a submitted comment, to clarify that nominal strength based on drift due to seismic loads is calculated differently than nominal strength based on wind load.

10. **Section 4.4.3:** This section currently requires the calculated deflection values to "reasonably predict" the measured drift of the tested shear walls. To ensure consistent evaluation amongst staff, a more quantitative condition of acceptance is needed. The staff questions what latitude should apply in a reasonable prediction and asks for input on defining the level of precision that is required in order for the calculation method to be considered acceptable.

11. **Revise Section 6.0.** The proposed revision to Section 6.0 is as shown in the criteria draft proposed in June 2010, except as follows:

    a. Requirements for Type II shear walls are no longer included, since these are outside the scope of the proposed criteria.

    b. Item 10 has been expanded to reference Sections C2 and C5 of AISI S213 for design of the sheathing, framing and anchorage of the shear walls.

12. **Revise Appendix A.** In response to a submitted comment, the revision to Appendix A has been modified to clarify that a report applicant can choose to reduce the allowable shear strength determined in accordance with Section 3.7, in order to ensure conformance with the parameters established in Appendix A.

Several revisions proposed in June 2010 were unopposed by those who commented. The proposals, which are unchanged from the June 2010 draft, are listed below, with a brief description. For more details, please refer to the documents posted on the June 2010 Alternative Criteria Process agenda, available through the following link: http://www.icc-es.org/Criteria_Development/1006-alt/index.shtml.

13. Remove the 1997 *Uniform Building Code*™ (UBC) from the criteria.

14. Revise Section 1.3 to be consistent with the 2009 IBC and IRC, and to match the remainder of the proposed criteria.

15. Revise Section 1.4 to be consistent with similar ICC-ES acceptance criteria.

16. Revise Sections 2.1.2 and 2.1.3 to clarify what information needs to be submitted regarding cold-formed steel framing and wood structural panels.

17. Add Section 2.1.4 to clarify that applicants need to describe the shear wall assemblies for which recognition is sought.

18. Revise Section 3.2 to clarify requirements for the wood structural panels described in evaluation reports as part of the recognized assembly, and requirements for the wood structural panels used in the qualification testing.

19. Revise Section 3.7 to resolve ambiguities in the current criteria.

20. Delete Section 4.2.2 to coordinate with other proposed revisions to the criteria.

21. Revise Section 4.3 for clarity.

22. Revise Section 4.4 to clarify which deflection and corresponding force from the test data should be used to verify the proposed deflection equation.

23. Editorial revisions.

Proposed revisions are shown in the enclosed criteria draft in strikeout/underline format. Since the revisions are extensive, to facilitate review, a draft showing how the resulting criteria would look if all of the proposed revisions were approved is also enclosed.

You are cordially invited to submit written comments on agenda items, or to attend the Evaluation Committee hearing and present verbal comments. If you wish to contribute to the hearing, please note the following:

1. Written comments that are received by the Los Angeles business/regional office by **September 17, 2010,** will be forwarded to the committee prior to the hearing, and will be posted on the ICC-ES web site shortly after the comment deadline.

2. Written comments received up to ten days before the meeting, and staff memos responding to comments, will be posted to the web site on **September 28, 2010**.

3. ICC-ES is no longer providing printed copies at the meeting of proposed acceptance criteria, staff memos or public comments. These documents will be available on a limited number of CDs at the meeting, for uploading to computers; and ICC-ES will make arrangements with the hotel business center to have hard copies available for photocopying.

4. Written comments that miss the deadline noted in item (1), above, will only be available at the meeting if you provide 35 copies, collated, stapled, and three-hole punched, either at the meeting itself or to the Los Angeles business/regional office by **September 28, 2010**.

5. If you plan to speak for more than 15 minutes, or offer a visual presentation lasting longer, you should notify ICC-ES staff as far as possible in advance. There will be a computer, projector, and screen available at the meeting for anyone wishing to make

a visual presentation, and presentations in most cases will need to be in PowerPoint format. Also, ICC-ES will need to be provided with your presentation at least a half-hour before the start of the relevant meeting session (morning or afternoon) on either a CD or a flash card.

6. If you have any special needs related to a presentation, you should contact ICC-ES staff well in advance of the meeting.

7. Any visual aids for viewing at committee meetings (charts, overhead transparencies, slides, videos, electronic presentations, etc.) will be permitted only if a copy is provided to ICC-ES, before the presentation, in a medium that can be retained with other records of the meeting.

8. Any materials submitted for committee consideration are considered nonconfidential and available for public discussion, as noted in Section 2.7 of the ICC-ES Rules of Procedure for the Evaluation Committee.

9. Prior to the meeting, you should refrain from trying to communicate directly with committee members about agenda items, either verbally or in writing. Committee members reserve the right to refuse such communications.

Your cooperation with these guidelines is much appreciated, as is your interest in the deliberations of the Evaluation Committee. If you have any questions, please contact the undersigned at (800) 423-6587, extension 4315, or Brian Gerber, Principal Structural Engineer, at extension 3255. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

Elyse G. Levy

Elyse G. Levy, S.E.
Senior Staff Engineer

EL/raf

Enclosures

cc: Evaluation Committee

ICC EVALUATION SERVICE

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

ICC EVALUATION SERVICE, LLC, RULES OF PROCEDURE FOR THE EVALUATION COMMITTEE

1.0 PURPOSE

The purpose of the Evaluation Committee is to monitor the work of ICC-ES, in issuing evaluation reports; to evaluate and approve acceptance criteria on which evaluation reports may be based; and to sponsor related changes in the applicable codes.

2.0 MEETINGS

2.1 The Evaluation Committee shall schedule meetings that are open to the public in discharging its duties under Section 1, subject to Section 3.

2.2 All scheduled meetings shall be publicly announced.

2.3 Two-thirds ($^2/_3$) of the voting Evaluation Committee members shall constitute a quorum. A majority vote of members present is required on any action.

2.4 In the absence of the nonvoting chairman-moderator, Evaluation Committee members present shall elect an alternate chairman from the committee for that meeting. The alternate chairman shall be counted as a voting committee member for purposes of maintaining a committee quorum and to cast a tie-breaking vote of the committee.

2.5 Minutes of the meetings shall be kept.

2.6 An electronic audio record of meetings shall be made by ICC-ES; no other audio, video, electronic or stenographic recordings of the meetings will be permitted. Visual aids (including, but not limited to, charts, overhead transparencies, slides, videos, or presentation software) viewed at meetings shall be permitted only if the presenter provides ICC-ES before presentation with a copy of the visual aid in a medium which can be retained by ICC-ES with its record of the meeting and which can also be provided to interested parties requesting a copy. A copy of the ICC-ES recording of the meeting and such visual aids, if any, will be available to interested parties upon written request made to ICC-ES together with a payment as required by ICC-ES to cover costs of preparation and duplication of the copy. These materials will be available beginning five days after the conclusion of the meeting but will no longer be available after one year from the conclusion of the meeting.

2.7 Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members regarding agenda items. All written communications and submissions regarding agenda items should be delivered to ICC-ES. All such written communications and submissions shall be considered nonconfidential and available for discussion in open session of an Evaluation Committee meeting, and shall be delivered at least ten days before the scheduled Evaluation Committee meeting if they are to be forwarded to the committee. Materials delivered to ICC-ES at least ten days before the scheduled meeting will be posted on the ICC-ES web site (www.icc-es.org) prior to the meeting. After this time, parties wishing to submit materials for consideration by the Evaluation Committee must deliver a sufficient number of copies as directed by ICC-ES. Consideration of materials not received by ICC-ES at least ten days before the meeting is at the discretion of the Evaluation Committee. Following the meeting, ICC-ES will make all materials considered by the Evaluation Committee available on the web site for a maximum period of one year following the meeting. The committee reserves the right to refuse recognition of communications which do not comply with the provisions of this section.

3.0 CLOSED SESSIONS

Evaluation Committee meetings shall be open except that the chairman may call for a closed session to seek advice of counsel.

4.0 ACCEPTANCE CRITERIA

4.1 Acceptance criteria are established by the committee to provide a basis for issuing ICC-ES evaluation reports on products and systems under codes referenced in Section 2.0 of the Rules of Procedure for Evaluation Reports. They also clarify conditions of acceptance for products and systems specifically regulated by the codes.

Acceptance criteria may involve a product, material, method of construction, or service. Consideration of any acceptance criteria must be in conjunction with a current and valid application for an ICC-ES evaluation report, an existing ICC-ES evaluation report, or as otherwise determined by the Evaluation Committee.

4.2 Procedure:

4.2.1 Proposed acceptance criteria shall be developed by the ICC-ES staff and discussed in open session with the Evaluation Committee during a scheduled meeting, except as permitted in Section 5.0 of these rules.

4.2.2 Proposed acceptance criteria shall be available to interested parties at least 30 days before discussion at the committee meeting.

4.2.3 The committee shall be informed of all pertinent written communications received by ICC-ES.

4.2.4 Attendees at Evaluation Committee meetings shall have the opportunity to speak on acceptance criteria listed on the meeting agenda, to provide information to committee members.

4.3 Approval of acceptance criteria shall be as specified in Section 2.3 of these rules.

4.4 Actions of the Evaluation Committee may be appealed in accordance with the ICC-ES Rules of Procedure for Appeal of Acceptance Criteria or the ICC-ES Rules of Procedure for Appeals of Evaluation Committee Technical Decisions.

5.0 COMMITTEE BALLOTING FOR ACCEPTANCE CRITERIA

5.1 Acceptance criteria may be issued without a public hearing following a 30-day public comment period and a majority vote for approval by the Evaluation Committee when, in the opinion of ICC-ES staff, one or more of the following conditions have been met:

1. The subject is nonstructural, does not involve life safety, and is addressed in nationally recognized standards or generally accepted industry standards.

2. The subject is a revision to an existing acceptance criteria that requires a formal action by the Evaluation Committee, and public comments raised were resolved by staff with commenters fully informed.

3. Other acceptance criteria and/or the code provide precedence for the revised criteria.

5.2 Negative votes must be based upon one or more of the following, for the ballots to be considered valid and require resolution:

a. *Lack of clarity*: There is insufficient explanation of the scope of the acceptance criteria or insufficient description of the intended use of the product or system; or the acceptance criteria is so unclear as to be unacceptable. (The areas where greater clarity is required must be specifically identified.)

b. *Insufficiency*: The criteria is insufficient for proper evaluation of the product or system. (The provisions of the criteria that are in question must be specifically identified.)

c. *The subject of the acceptance criteria is not within the scope of the applicable codes*: A report issued by ICC-ES is intended to provide a basis for approval under the codes. If the subject of the acceptance criteria is not regulated by the codes, there is no basis for issuing a report, or a criteria. (Specifics must be provided concerning the inapplicability of the code.)

d. *The subject of the acceptance criteria needs to be discussed in public hearings*. The committee member requests additional input from other committee members, staff or industry.

5.3 An Evaluation Committee member, in voting on an acceptance criteria, may only cast the following ballots:

- Approved
- Approved with Comments
- Negative: Do Not Proceed

6.0 COMMITTEE COMMUNICATION

Direct communication between committee members, and between committee members and an applicant or concerned party, with regard to the processing of a particular acceptance criteria or evaluation report shall take place only in a public hearing of the Evaluation Committee. Accordingly:

6.1 Committee members receiving an electronic ballot should respond only to the sender (staff). Committee members who wish to discuss a particular matter with other committee members, before reaching a decision, should ballot accordingly and bring the matter to the attention of ICC-ES staff, so the issue can be placed on the agenda of a future committee meeting.

6.2 Committee members who are contacted by an applicant or concerned party on a particular matter that will be brought to the committee will refrain from private communication and will encourage the applicant or concerned party to forward their concerns through the ICC-ES staff in writing, and/or make their concerns known by addressing the committee at a public hearing, so that their concerns can receive the attention of all committee members.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR POWER-DRIVEN PINS FOR SHEAR WALL ASSEMBLIES WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS

AC230

Proposed August 2010

Previously approved October 2008, May 2008, October 2003, January 2002, January 2001

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (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 propo sed 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 by ICC-ES for purposes of issuing ICC-ES evaluation reports.

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR POWER-DRIVEN PINS FOR SHEAR WALL ASSEMBLIES WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS (AC230)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for power-driven pins ~~for~~, used to construct shear wall assemblies with cold-formed steel (CFS) framing and wood structural panels, resisting wind or seismic loads, to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the ~~2006~~2009 *International Building Code*® (IBC)~~,~~ and the ~~2006~~2009 *International Residential Code*® (IRC)~~, and the 1997 *Uniform Building Code*™ (UBC)~~. The bases of recognition are IBC Section 104.11~~,~~ and IRC Section R104.11~~, and UBC Section 104.2.8~~.

The reason for this criteria is the absence of referenced standards in the IBC that can be used to establish code compliance for ~~site-built~~ shear walls consisting of wood-~~based~~ structural~~-use sheathing~~ panels attached to CFS framing with power-driven pins ~~that are alternates to No. 8 and No. 10 flat-head tapping screws, which are code prescribed in Sections B1 and C2.2.2(4) of AISI Lateral Design~~.

1.2 Scope: This criteria applies to power-driven pins used to attach wood structural panels to CFS framing to create shear walls or for general use. This criteria establishes requirements for determining single fastener connection strengths and shear wall unit shear strength and deflection.

The shear walls shall be limited to Type I shear walls (defined in Section A2 of AISI S200)~~ site-built shear wall assemblies consisting of wood-based structural-use sheathing attached to CFS framing with power-tool driven pin fasteners.~~ which are protected by a weather-resistant exterior wall envelope. The shear wall assemblies are alternates to systems described in Section C2.2.2 of AISI S213 (referenced in IBC Section 2210.~~5~~6)~~,~~ and IRC Section R603.~~7~~9~~, and UBC Chapter 22, Division VIII~~.

Recognition of shear wall assemblies shall be limited to height limits and seismic design categories indicated for the equivalent *R* system listed in Table 12.2-1 of ASCE 7 (Item A13 for shear walls which comply with Appendix A of this criteria; Item H for shear walls which do not comply with Appendix A of this criteria.).

1.3 Codes and Referenced Standards:

1.3.1 ~~2006~~2009 *International Building Code*® (IBC), International Code Council.

1.3.2 ~~2006~~2009 *International Residential Code*® (IRC), International Code Council.

~~**1.3.3** 1997 *Uniform Building Code*™ (UBC).~~

1.3.3 ~~**1.3.4**~~ ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures, including Supplements No. 1 and 2 and Excluding Chapter 14 and Appendix 11A; American Society of Civil Engineers.

~~**1.3.5** ASTM A 90-07 Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM International.~~

1.3.4 ~~**1.3.6**~~ ASTM A 370-07a, Standard Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

1.3.5 ASTM A 653-07, Specification for Steel Sheet, Zinc-coated Galvanized or Zinc-iron Alloy-coated Galvannealed by the Hot-dip Process, ASTM International.

1.3.6 ASTM A 1003-05, Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members, ASTM International.

1.3.7 ASTM D 1037-06a Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials, ASTM International.

1.3.8 ASTM D 1761-~~88(2000)ε01~~06 Standard Test Methods for Mechanical Fasteners in Wood, ASTM International.

1.3.9 ASTM D 2915-03, Standard Practice for Evaluating Allowable Properties for Grades of Structural Lumber, ASTM International.

~~**1.3.10** ASTM E 1190-95 (2007) Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members, ASTM International.~~

1.3.10 ~~**1.3.11**~~ ASTM E 2126-07a Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings, ASTM International.

~~**1.3.12** ASTM G 87-02. Standard Practice for Conducting Moist SO_2 Tests, ASTM International.~~

1.3.11 ~~**1.3.13**~~ AISI-~~NAS~~ S100-07, North American Specification for the Design of Cold-formed Steel Structural Members ~~(2001), with Appendix A, and 2004 Supplement~~, American Iron and Steel Institute ~~(as referenced in the IBC)~~.

1.3.12 AISI S200-07, North American Standard for Cold-formed Steel Framing—General Provisions, American Iron and Steel Institute.

1.3.13 ~~**1.3.14**~~ AISI-~~Lateral—04~~ S213-07, Standard for Cold-formed Steel Framing—Lateral Design, American Iron and Steel Institute ~~(as referenced in the IBC)~~.

1.3.14 AISI S905-08, Test Methods for Mechanically Fastened Cold-Formed Steel Connections, American Iron and Steel Institute.

~~**1.3.15** Specification for Design of Cold-formed Steel Structural Members, 1986 with December 1989 addendum, published by the American Iron and Steel Institute (AISI) (referred to as 1986 ASD Specifications), as referenced in the UBC.~~

~~**1.3.16** Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members, March 1991, published by AISI (referred to as 1991 LRFD Specifications), as referenced in the UBC.~~

1.3.15 ~~**1.3.17**~~ US DOC PS-1-~~95~~07, ~~Construction and Industrial~~ Structural Plywood, United States Department of Commerce, National Institute of Standards and Technology.

1.3.16 ~~**1.3.18**~~ US DOC PS-2-~~92~~04, Performance Standard for Wood-based Structural-use Panels, United States Department of Commerce, National Institute of Standards and Technology.

~~**1.3.19** FMRC 4450 (1989), Approval Standard for Class 1 Insulated Steel Deck Roofs—with Supplements through July 1992, Factory Mutual Global Technologies, LLC.~~

~~**1.3.20** FMRC 4470-(1992), Approval Standard for Class 1 Roof Covers, Factory Mutual Global Technologies, LLC.~~

1.4 Definitions:

1.4.1 Allowable Stress Design (ASD): Method of proportioning structural components such that the allowable strength equals or exceed the required strength of the component under the action of the ASD load combinations.

1.4.2 Allowable Shear Strength: Nominal shear strength divided by the appropriate safety factor.

1.4.3 Available Shear Strength: Design shear strength (see Section 1.4.~~4~~5) or allowable shear strength (see Section 1.4.2), as appropriate.

1.4.4 Base Steel Thickness: The base steel thickness is the thickness of the steel exclusive of all coatings.

1.4.5 ~~**1.4.4**~~ **Design Shear Strength:** Resistance factor multiplied by the nominal shear strength, ΦR_n.

1.4.6 ~~**1.4.5**~~ **Drift:** The difference in in-plane wall displacement between the top and bottom of the wall assembly.

1.4.7 ~~**1.4.6**~~ **Envelope:** Plot of a series of points that bound a particular behavior.

1.4.8 ~~**1.4.7**~~ **Load Effect:** Forces, stresses, and deformations produced in a structural component by the applied loads.

1.4.9 ~~**1.4.8**~~ **LRFD (Load and Resistance Factor Design):** Method of proportioning structural components such that the design strength equals or exceeds the required strength of the component under the action of the LRFD load combinations.

1.4.10 ~~**1.4.9**~~ **Nominal Shear Strength:** Shear strength of the wall assembly (without the resistance factor or safety factor applied) to resist lateral load effects.

1.4.11 ~~**1.4.10**~~ **Peak Strength:** The maximum lateral resistance developed by the wall assembly.

1.4.12 ~~**1.4.11**~~ **Power-driven Pins:** A forced-entry pin fastener characterized by an upset head and a point, typically hardened for penetrating steel and placed with a power tool.

1.4.13 ~~**1.4.12**~~ **Rational Engineering Analysis:** Analysis based on theory that is appropriate for the situation, relevant test data if available, and sound engineering judg~~e~~ement.

1.4.14 ~~**1.4.13**~~ **Resistance Factor, Φ:** Factor that accounts for unavoidable deviations of the nominal strength from the actual strength and for the manner and consequences of failure.

1.4.15 ~~**1.4.14**~~ **Shear Wall:** Wall that provides resistance to lateral loads in the plane of the wall and provides stability for the structure.

~~**1.4.15 Specified Minimum Yield Stress:** Lower limit of yield stress specified for a material as defined by ASTM.~~

1.4.16 Structural Analysis: Determination of load effects on members and connections based on principles of structural mechanics.

~~**1.4.17 Tensile Strength (of Material):** Maximum tensile stress that a material is capable of sustaining as defined by ASTM.~~

1.5 Notations:

~~**1.5.1** e_n = Fastener slip, in. (mm).~~

1.5.1 ~~**1.5.2**~~ h = Height of the test shear wall, in. (mm).

1.5.2 ~~**1.5.3**~~ $t_{(specified)}$ = Specified base steel thickness, inc~~h~~. (mm).

1.5.3 ~~**1.5.4**~~ $t_{(tested)}$ = Measured base steel thickness, inc~~h~~. (mm).

1.5.4 ~~**1.5.5**~~ C_d = Deflection amplification factor.

1.5.5 F_s = Force corresponding to δ_{xe} on the envelope curve.

~~**1.5.6** F_y(specified) = Specified yield point of the steel, psi (Pa).~~

~~**1.5.7** F_y(tested) = Measured yield point of the steel, psi (Pa).~~

1.5.6 ~~**1.5.8**~~ $F_{u(specified)}$ = Specified minimum tensile strength of the CFS studs used in the tested assemblies, ksi (MPa) ~~wire material used to fabricate the pin fasteners, psi (Pa)~~.

1.5.7 ~~**1.5.9**~~ $F_{u(tested)}$ = Measured tensile strength of the CFS studs used in the tested assemblies, ksi (MPa) ~~wire material used to fabricate the pin fasteners, psi (Pa)~~.

~~**1.5.10** F_s = Force corresponding to δ_{xe}, lbs. (N).~~

1.5.8 ~~**1.5.11**~~ I = Importance factor as defined by Section 11.5 of ASCE 7.

~~**1.5.12** R_p = Adjustment factor for pin fastener overstrength (see Section 3.1.2).~~

1.5.9 ~~**1.5.13**~~ R_s = Adjustment factor for steel framing overstrength and thickness (see Section 3.3~~.3.1~~4).

1.5.10 ~~**1.5.14**~~ V_p = Peak shear strength from ~~first-cycle~~ envelope curve, lbs. (N)

1.5.11 ~~**1.5.15**~~ V_{ASD} = Allowable ~~design~~ shear strength determined for the tested assembly, unadjusted by R_s, lbs (N).

1.5.12 V'_{ASD} = Allowable shear strength, adjusted by R_s, lbs (N).

1.5.13 V_{LRFD} = Design shear strength, lbs (N).

1.5.14 V'_{LRFD} = Design shear strength, adjusted by R_s, lbs (N).

1.5.15 ~~**1.5.16**~~ δ_x = Inelastic deflection, in. (mm).

1.5.16 ~~**1.5.17**~~ δ_{xe} = Strength design level response displacement, in. (mm).

1.5.17 ~~**1.5.18**~~ Δ_a = Allowable story drift, in. (mm).

1.5.18 Δ_{VASD} = Deflection at V_{ASD}, in. (mm).

1.5.19 ~~**1.5.19**~~ $\Delta_{SLS p}$ = Deflection at the peak strength ~~limit state~~, in. (mm).

1.5.20 ~~**1.5.20**~~ Φ = Resistance factor.

1.5.21 ~~**1.5.21**~~ Ω_0 = Seismic Over-strength factor.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted and shall be included in the submitted test reports:

2.1.1 Power-driven Pins ~~Fasteners~~:

2.1.1.1 Generic or trade name, and manufacturer's catalog number or catalog series.

2.1.1.2 Drawings and details of the pins noting the following: dimensions and manufacturing dimensional tolerances; head characteristics; shank deformations (if any); tip geometry; washer size and thickness, if used; head markings (if any); and material specifications, including specified tensile strength, case and core hardness range, and protective coatings.

2.1.1.3 Installation details and instructions, noting installation limitations and the sizes and locations of fasteners, and including a description of recommended tools and recommended tool operation.

2.1.1.4 A description of the method of packaging and field identification of the power-driven pins ~~fasteners~~. The identifying information on each box or package of power-driven pins ~~fasteners~~ shall include the pin brand name and model number, nominal pin size and length, the evaluation report holder's name, the ASTM designation if applicable, and the ICC-ES evaluation report number.

2.1.2 ~~**Cold-formed Steel (CFS)**~~ **Framing:** Description of CFS framing members used in the shear wall assemblies for which recognition is sought, ~~Steel description,~~ including flange width, web depth, material specification, specified ~~and measured~~ yield and tensile strengths, and specified ~~and measured uncoated (base-metal)~~ base steel thickness.

2.1.3 Wood Structural ~~**Sheathing**~~ **Panels:** Description of the wWood~~-based~~ structural~~-use~~ ~~sheathing material~~ panels used in the shear wall assemblies for which recognition is sought, including type, specification, thickness, and grade ~~as specified by the manufacturer~~.

2.1.4 Shear Wall Assemblies: Description of the shear wall assemblies for which recognition is sought, including maximum height, aspect ratio, stud spacing, fastener spacing, orientation of wood structural panels, chord details and hold-down and anchorage details. A description of the applicable installations shall also be submitted addressing Seismic Design Categories, Occupancy Categories in accordance with IBC Table 1604.5 and seismic design factors (R, Ω_0, C_d).

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.

2.4 Product Sampling: Sampling of the ~~fasteners~~ power-driven pins for tests under this criteria shall comply with Section 3.2 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Requirements for Pins: Prior to shear wall testing, the core hardness of power-driven pins from the same lot as those that will be used in the shear wall testing shall be measured in accordance with ASTM A 370, and shall comply with the manufacturer's specifications. A minimum of five pins shall be tested.

~~**3.1.1** Pin core hardness shall be measured following ASTM A 370.~~

~~**3.1.2** Wire tensile strength shall be measured following ASTM A 370. Where the actual wire tensile strength exceeds the specified strength, test results shall be adjusted by the following adjustment factor:~~

$$R_p = \frac{F_{u(specified)}}{F_{u(tested)}} \leq 1.0$$

3.1.3 ~~When pin fasteners are to be recognized for exterior exposure or damp environments, evidence of durability shall be established in accordance with either Section 3.1.3.1 or Section 3.1.3.2. The pin fasteners shall be suitable for use in exterior and damp exposures if they show no more than 15 percent of the surface area corroded (red rust) and there is no evidence of coating degradation, such as blistering, peeling, or cracking after testing according to Section 3.1.3.1 or 3.1.3.2. In addition, coating thickness (mass) of the pins shall be quantified by using ASTM A 90 or other approved method for non-zinc coatings.~~

3.1.3.1 ~~Evidence of durability shall be established according to the corrosion test procedure in ASTM G 87, where the tests consist of 15 exposure periods (cycles) of 24 hours where each cycle consists of an exposure to a moist atmosphere containing sulfur dioxide for 8 hours followed by drying in ambient atmosphere for 16 hours. The volume of sulfur dioxide to be introduced for each exposure shall be 0.20 liters. The pins shall be rinsed with distilled water and visually inspected following each cycle. At least ten representative samples shall be prepared with $^3/_4$-inch thick (19 mm) plywood, where the fasteners are removed from the plywood before conducting the tests.~~

3.1.3.2 ~~Evidence of durability shall be established according to the corrosion test procedure in Factory Mutual Research Standard 4450 or 4470.~~

3.2 Requirements for Wood~~-based~~ Structural Panels: The wood structural panel ~~sheathing~~ component of the shear walls for which recognition is sought shall comply with a current ICC-ES evaluation report, a national product standard (PS-1 or PS-2), or otherwise be justified to the satisfaction of ICC-ES. The material shall be clearly identified to verify panel compliance. Minimum panel width shall be 12 inches (305 mm). Wood structural panels used in qualification testing in accordance with Sections 3.4 and 3.5 shall be representative of the shear wall assemblies for which recognition is sought.

3.3 Requirements for ~~Cold-formed Steel (CFS)~~ Framing:

3.3.1 CFS framing used in shear wall assemblies recognized under this criteria shall comply with Sections 3.3.1.1 through 3.3.1.3.

3.3.1.1 ~~**3.3.1**~~ CFS ~~framing~~ studs shall be C-shaped members with a minimum thickness designation of 33 mils, a minimum flange width of 1$^{5}/_{8}$ inches (41 mm), a minimum web depth of 3$^{1}/_{2}$ inches (89 mm) and a minimum edge stiffener length of $^{3}/_{8}$ inches (9.5 mm).

3.3.1.2 ~~**3.3.2**~~ CFS ~~wall~~ tracks shall ~~be~~ have a minimum thickness designation of 33-mils with a minimum flange width of 1$^{1}/_{4}$ inches (32~~1.8~~ mm) and a minimum web depth equal to the web depth of the wall studs.

3.3.1.3 ~~**3.3.3**~~ As a minimum, CFS ~~wall~~ studs and tracks shall be of ASTM A 1003, Grade 33, Type H steel or ASTM A 653 SS Grade 33 steel with a minimum G60 coating for members with a designation thickness of 33 and 43 mils; and ASTM A 1003, Grade 50, Type H steel or ASTM A 653 SS Grade 50, Class 1 steel with a minimum G60 coating for members with a designation thickness equal to or greater than 54 mils.

3.3.2 CFS framing used in shear wall test assemblies shall be representative of the shear wall framing for which recognition is sought.

3.3.3 The base steel thickness, yield strength, tensile strength and elongation of the steel of all tested CFS framing members shall be established from coupon tests of representative members. The yield strength and tensile strength of coupons cut from the representative CFS framing members shall be determined in accordance with ASTM A 370. These mechanical properties shall comply with the framing manufacturer's specifications.

~~**3.3.4** Tensile characteristics of coupons cut from CFS framing members shall be used to provide evidence that the steel specifications comply with Section 3.3.3.~~

~~**3.3.5** The base-metal thickness (uncoated) of all CFS framing members shall be measured and reported. Base-metal thickness is the thickness of the steel exclusive of any coating, such as galvanization. The yield strength and tensile strength of the steel shall be measured and reported. The measured strengths shall meet the minimum specified strengths for the particular steel grade when tested in accordance with ASTM A 370. Where measured strength properties and dimensions differ from specified values, adjustment of design values based on ratios of test values to specified values shall be considered in accordance with Sections 3.3.5.1 and 3.3.5.2, respectively.~~

3.3.4 ~~**3.3.5.1**~~ If the measured tensile strength of the ~~steel from which the~~ tested CFS ~~structural~~ framing members ~~forming the assembly is larger than~~ exceeds the specified minimum value, and/or the measured base steel thickness of the CFS framing members exceeds the specified design base steel thickness, the test results shall be adjusted as required by Sections 3.4.4, 3.7 and 3.8 using ~~calibrated to the specified minimum tensile strength of the steel by~~ the following adjustment factor, R_s:

$$R_s = \left(\frac{F_{u(specified)}}{F_{u(tested)}}\right) \times \left(\frac{t_{(specified)}}{t_{(tested)}}\right) \leq 1.0$$

When R_s for the studs differs from R_s for the tracks, R_s shall be based on the type of member (stud or track) where the predominant failure occurred.

~~**3.3.5.2** If the thickness of the CFS framing members is greater than the specified (base-metal) thickness by more than 5 percent, the test results shall be reduced by the ratio of the specified (base-metal) thickness of the framing members to the measured (base-metal) thickness as shown in Section 3.3.5.1.~~

3.4 Single-Fastener ~~Shear~~ Connection Tests ~~(Optional):~~ ~~The provisions of Sections 3.4.1 through 3.4.3 are applicable if the shear wall design values are based on the provisions of Section 4.3.~~

3.4.1 Transverse Load (Optional): The allowable transverse load capacity of a connection comprised of a wood structural panel attached to CFS framing with a power-driven pin shall be the lesser of allowable strength due to the pull-through capacity of the wood structural panel and the allowable strength due to the pull-out capacity of the pin installed in CFS framing, determined as follows:

3.4.1.1 Pull-through Test: A test setup and procedure similar to the one described in ASTM D 1037 shall be used to determine the pull-through capacity of the power-driven pin installed in the wood structural panel. At a minimum, testing shall be performed on specimens with a panel edge distance that is representative of the minimum specified condition at the perimeter of the shear wall assembly for which recognition is sought. As an option, to address higher transverse load capacity of the fasteners in the field of the sheathing panel, additional data may be submitted.

The target number of test specimens shall be determined in accordance with ASTM D 2915, equation 1. Testing for representative material combinations shall be based on a minimum sample size of 15 specimens and a target of 5 percent precision with a 75 percent confidence for the mean capacity. The sample size need not exceed 30 specimens.

The average ultimate load shall be divided by a safety factor of 5 to determine the allowable load.

3.4.1.2 Pull-out Test: Pull-out testing of fasteners installed in CFS shall be conducted in accordance with Section 8.3 of AISI S905, using the alternative tension test fixture. Sample size shall be determined in accordance with Section 7.0 of AISI S905. Allowable pull-out strength shall be determined in accordance with Section F1.1 of AISI S100. The available strengths shall be adjusted by R_s in accordance with Section 3.3.4.

3.4.2 Lateral Load (Optional): The provisions of this section are applicable if the shear wall design values are based on the provisions of Section 4.3. These provisions may also be used to determine available lateral strength values for inclusion in evaluation reports. See Section 6.0.

~~**3.4.1**~~ The ~~empirical~~ shear strength of the single-fastener connection of the wood structural panel to the framing shall be determined by testing in general accordance with ASTM E 1190 with support of test specimens as described in ASTM D 1761. Specimen geometry and fixtures shall be modified as necessary to obtain valid tests of the connection capacity. Test failures located away from the connection and clearly unrelated to the connection shall be censored from the data set and replaced.

3.4.2 Testing more than 30 specimens shall not be required. The target number of test specimens is determined in accordance with ASTM D 2915, equation 1. Testing for representative material combinations shall be based on a minimum sample size of 15 specimens and a target of 5 percent precision with a 75 percent confidence for the mean capacity.

The allowable strength and the design strength of a single fastener connection of the wood structural panel to the framing shall be determined in accordance with Section F1 of AISI S100, or other approved method with prior approval of ICC-ES. The available strengths shall be adjusted by R_s in accordance with Section 3.3.4.

3.4.3 The single-pin fastener tests shall be used to establish pin fastener slip, e_n, values for use in shear wall deflection equations.

3.5 Cyclic-load Shear Wall Tests:

3.5.1 Shear wall testing shall use materials, sheathing, connections of sheathing to framing, and framing spacing consistent with the details of construction to be recognized, including minimum fastener edge distances and framing section profiles, in the evaluation report, and shall be conducted in accordance with ASTM E 2126, Method A or Method C. The sheathing shall not bear on any portion of the test fixture.

3.5.2 The tested wall assemblies shall have aspect ratios (wall height-to-length ratios) and dimensions consistent with the intended use, and such aspect ratios shall be the maximum permitted for recognition in the evaluation report, except. Ttest wall assemblies shall haveing an aspect ratio of 1:1 may be used to determine full available strength for applications with aspect ratios equal to or less than 2:1. If wall assemblies having an aspect ratio greater than 2:1 are recognized in the evaluation report, then an available strength reduction factor shall be determined by additional tests. The test-based reduction factor shall result in adjusted design shears that are no greater than those achieved using a reduction factor of $2w/h$ applied to design strengths of tested walls with aspect ratios of 1:1 to 2:1, where w is the width of a test shear wall measured in the direction of application of force, and h is the height of the test shear wall. If the test-based reduction factor results in higher design shears, then the factor $2w/h$ shall be used to adjust the design shears. The maximum wall aspect ratio shall be no greater than 4:1.

3.5.3 A minimum of two replicate assemblies shall be tested for each shear wall assembly for which empirical data is sought. The shear wall unit shear values for the shear wall assemblies described in Section 4.0 4.2 may be based on the average of the two values tests if the two test values are within 10 percent of each other; otherwise, the average of three test values shall be used.

3.6 Cyclic Shear Wall Data Analysis:

3.6.1 The documentation containing analysis shall be signed and sealed by a registered design professional.

3.6.2 The shear wall available unit shear values shall be determined as outlined in Section 3.7 for Allowable Stress Design or Section 3.8 for Load and Resistance Factor Design.

3.7 Allowable Stress Design (ASD): The allowable shear strength shall be established per the code for which recognition is sought as follows:

3.7.1 IBC: The allowable shear strength, V_{ASD}, shall be taken as the lesser of the allowable strengths based on drift and the allowable strength based on the peak test load of the shear wall as follows:, as described in Sections 3.7.1 through 3.7.3, as applicable. The drift corresponding to the allowable shear strength, Δ_{VASD}, shall be included in the analysis.

The adjusted allowable strength, V'_{ASD}, for use with the basic load combinations of Section 1605.3.2 of the IBC, shall be equal to V_{ASD} multiplied by R_s, (defined in Section 3.3.4).

3.7.1 3.7.1.1 Allowable Strength Based on Drift (Seismic): The allowable shear strength shall be determined on the basis of the requirements of ASCE/SEI 7 Section 12.8.6 as follows:

(a) The Mmaximum Iinelastic Rresponse Ddisplacement, δ_x, shall be taken as the lesser of the code-specified allowable story drift from Table 12.12-1 of ASCE 7, Δ_a, and the mean displacement at the Strength Limit State peak strength of the tested wall assemblies, Δ_{SLS} Δ_p, corresponding to the peak load, V_p, from the test.

(b) Using δ_x and the assigned C_d factor, the Strength Design level response displacement, δ_{xe}, shall be calculated as $\delta_{xe} = \delta_x I \div C_d$, where I is the importance factor determined in accordance with Section 11.5.1 of ASCE/SEI 7.

(c) From the first-cycle envelope curve defined in ASTM E 2126, the force F_s corresponding to δ_{xe} shall be determined. This force corresponds to a design shear strength.

(d) The design shear strength F_s shall be multiplied by a factor of 0.7 to determine the appropriate allowable shear strength for use with the basic load combinations of Section 1605.3 of the IBC.

(e) The drift corresponding to the allowable shear strength shall be included in the evaluation report.

3.7.2 3.7.1.2 Allowable Strength Based on Drift (Wind): The allowable shear strength shall be equal to the test load derived from the first-cycle envelope curve at a deflection of $^h/_{180}$, where h is equal to the height of the tested shear wall assembly.

3.7.3 3.7.1.3 Allowable Strength Based on Peak Strength (Seismic and Wind):

3.7.1.3.1 From the first-cycle envelope curve defined in Section 3.3.2 ASTM E 2126, the allowable shear strength shall be taken as the average peak shear strength of the tested shear wall, V_p, divided by a safety factor of 2.5 for seismic forces and 2.0 for wind forces.

~~**3.7.1.3.2** The drift corresponding to this allowable shear strength shall be derived from the first-cycle backbone curve and included in the evaluation report.~~

~~**3.7.2 UBC:** The allowable shear strength shall be taken as the lesser of the allowable shear strengths based on drift and peak strength of the shear wall as follows:~~

~~**3.7.2.1 Drift (Seismic):** The allowable shear strength shall be determined on the basis of the requirements of UBC Sections 1630.9 and 1630.10 as follows:~~

~~**3.7.2.2 Drift (Wind):** The allowable shear strength shall be equal to the test load derived from the first-cycle envelope curve at a deflection of $^{h}/_{180}$, where h is equal to the height of the tested wall assembly.~~

~~**3.7.2.3 Peak Strength (Seismic and Wind):**~~

~~**3.7.2.3.1** From the first-cycle envelope curve defined in ASTM E 2126, the allowable shear strength shall be taken as the peak test load of the shear wall divided by a safety factor of 2.5 for seismic forces and 2.0 for wind forces.~~

~~**3.7.2.3.2** The drift corresponding to this allowable shear strength value shall be derived from the first-cycle envelope curve and included in the evaluation report.~~

3.8 LRFD (Load and Resistance Factor Design): For LRFD, the nominal shear strength shall be multiplied by a resistance factor Φ = 0.6 (for seismic loads) or Φ = 0.65 (for wind loads) ~~(for the IBC) or Φ = 0.55 (for the UBC) shall be multiplied to the nominal shear strength~~ to obtain the design shear strength, V_{LRFD}. ~~The nominal shear strength shall be established per the code for which recognition is sought as follows:~~ The adjusted design strength, V'_{LRFD}, for use with the basic load combinations of Section 1605.2.1 of the IBC shall be equal to V_{LRFD} multiplied by R_s (defined in Section 3.3.4).

~~**3.8.1 IBC:**~~ The nominal shear strength shall be taken as the lesser of the ~~available~~ nominal shear strength value~~s~~ based on drift and the nominal shear strength based on the peak test load of the shear wall as follows:

3.8.1 ~~**3.8.1.1**~~ **Nominal Strength Based on Drift:** The nominal shear strength shall be determined as the lower of 2.5 times the allowable shear strength defined in Section 3.7.~~1.~~1 or 2.0 times the allowable shear strength defined in Section 3.7.~~1.~~2, whichever is less. ~~The drift corresponding to the nominal resistance load shall be included in the report.~~

3.8.2 ~~**3.8.1.2**~~ **Nominal Strength Based on Peak Strength:** The nominal shear strength shall be taken as the peak test load of the shear wall.

~~**3.8.2 UBC:** The nominal shear strength shall be taken as the lesser of the shear strength loads based on drift and the peak test load of the shear wall as follows:~~

~~**3.8.2.1 Drift:** The nominal shear strength shall be determined as 2.5 times the allowable strength defined in Section 3.7.2.1 or Section 3.7.2.2, whichever is less. The drift corresponding to the nominal shear strength value shall be included in the report.~~

~~**3.8.2.2 Peak Strength:** The nominal shear strength shall be taken as the peak test load of the shear wall.~~

4.0 ENGINEERING ANALYSIS

4.1 General:

4.1.1 Available unit shear strength values of shear walls consisting of wood~~-based~~ structural~~-use sheathing~~ panels attached to CFS framing with power-driven pins ~~fasteners~~ shall be determined by using an empirical method according to Section 4.2 or ~~by~~ an analytical method according to Section 4.3, and a shear wall deflection function shall be verified according to the provisions in Section 4.4. Seismic design compatibility of shear walls consisting of wood~~-based~~ structural~~-use sheathing~~ panels attached to CFS framing with power-driven pins ~~fasteners~~ shall be determined according to the provisions of Section 4.5.

4.1.2 Shear walls consisting of wood~~-based~~ structural~~-use sheathing~~ panels attached to CFS framing with power-driven pins ~~fasteners~~ shall conform to the limitations on sheathing, steel framing members, and fastener spacing for lateral resistant systems specified in AISI~~-Lateral~~ S213.

4.2 Shear Wall Unit Shear—Empirical:

~~**4.2.1**~~ For available unit shear values based on an empirical analysis, a cyclic shear wall test program shall be conducted as described in Section 3.5. The test program shall include maximum and minimum fastener spacing for each fastener/sheathing/stud thickness combination to be recognized. The shear wall test data analysis shall be as described in the applicable parts of Section 3.6. Linear interpolation is permitted to establish capacities at intermediate fastener spacings.

~~**4.2.2** When material compliance testing of Section 3.1.2 for the wire used to fabricate the pins and of Sections 3.3.4 and 3.3.5 for the steel framing show that the pin or steel framing materials, or both, have properties that differ from specified properties, the available unit shear values determined according to Section 4.2.1 shall be adjusted according to the provisions of Sections 3.1.2, 3.3.5.1, and 3.3.5.2.~~

4.3 Shear Wall Unit Shear—Analytical:

4.3.1 An outline of an analytical method of deriving shear wall available shear strength values and an outline of a confirmation test plan shall be submitted to ICC-ES prior to conducting single-fastener connection tests in accordance with Section 3.4 and conducting shear wall confirmatory tests in accordance with Section 4.3.4~~2~~. The proposed analytical method shall be based on rational engineering analysis and structural analysis using available power-driven pin ~~fastener~~ connection shear strength values determined in accordance with Section 3.4. ~~complying with the provisions of Sections 4.3.2 and 4.3.3, and t~~The results of confirmatory testing shall be used to demonstrate that the predicted shear wall available strength is less than actual available strength.

~~**4.3.2** The available shear strength value of the single-fastener connection shall be determined according to AISI-NAS, Section F1.1 for LRFD and Section F1.2 for ASD, where the test data from Section 3.4. are used as the basis of the calculations; or other approved method with prior approval of ICC-ES.~~

~~**4.3.3** When compliance testing of Section 3.1.2 for the wire used to fabricate the pins and of Sections 3.3.4 and~~

3.3.5 for the steel framing show material properties differ from specified properties, the shear values for single-fastener connections determined according to Section 4.3.2 shall be modified using the adjustment factors specified in Sections 3.1.2, 3.3.5.1, or 3.3.5.2, whichever is more restrictive.

4.3.2 **4.3.4** Cyclic-load shear wall testing in accordance with Section 3.5 shall be conducted and the results shall be analyzed in accordance with Section 3.6. used to validate the in-plane shear values analytically derived for shear wall assemblies with CFS framing, wood structural panels, and power-driven pins. Critical features of the power-driven pins, such as nominal shank diameter and head geometry, shall be incorporated in the validation test plan. Shear wall test assemblies shall have an aspect ratio as set forth in Section 3.5.2. No individual test shall be eliminated unless a rationale for its exclusion can be given. The minimum test program for each fastener diameter and head geometry (where appropriate) shall include:

4.3.2.1 **4.3.4.1** The thinnest sheathing with the thinnest CFS studs (minimum base-metal thickness) at maximum and minimum fastener spacing; and

4.3.2.2 **4.3.4.2** The thickest sheathing with the thickest CFS studs (maximum base-metal thickness) at minimum and maximum fastener spacing; and

4.3.2.3 **4.3.4.3** For design tables with more than two CFS stud thicknesses and two sheathing thicknesses, an intermediate thickness sheathing with an intermediate thickness CFS stud (base-metal thickness) and minimum fastener spacing.

4.3.3 **4.3.5** For the purpose of confirming the analytical model, an adjusted available shear strength value for the each shear wall test assembly shall be derived in accordance with Section 3.7 or Section 3.8, as applicable, and these empirically derived adjusted available shear strength values shall meet or exceed, within 15 percent, the available shear strength values predicted by the analytical model.

4.3.4 **4.3.6** For the purpose of confirming seismic equivalency according to Section 4.5, and deflection equations according to Section 4.4, each confirmatory test configuration shall be evaluated. the allowable shear strength values analytically derived in accordance with Sections 4.3.1 through 4.3.3 shall be used to compute the parameters with the load and deflection data of the validation tests.

4.4 Shear Wall Deflection:

4.4.1 Shear wall test data that were used to derive available shear strength values shall be used to verify deflection calculations that follow from AISI-Lateral S213 deflection equations.

4.4.2 It shall be permitted to verify another displacement function that is supported by engineering derivation based on the principles of mechanics.

4.4.3 Calculated shear wall deflections shall be considered acceptable when the AISI-Lateral S213 deflection equation (Section 4.4.1) or the proprietary displacement function (Section 4.4.2) verifies that the calculated values reasonably predict the measured drifts of tested shear walls at 1.4 times the allowable strength values LRFD design strength levels. To do this, the deflection shall be calculated using F_S (determined in accordance with Section 3.7.1(c)) in lieu of v and compared to δ_{xe} (determined in accordance with Section 3.7.1(b)) in lieu of δ.

4.5 Seismic Design Compatibility with a Code-defined Seismic-force Resisting System:

4.5.1 A seismic-force resisting system consisting of shear wall assemblies with CFS framing, wood structural panels, and power-driven pins may be used as an alternate to a seismic-force resisting system consisting of shear wall assemblies with CFS framing, wood structural panels, and flat-head tapping screws that are code prescribed in Sections B1 and C2.2.2(4) of AISI-Lateral Design S213. The alternate shear wall assemblies with the power-driven pins may be assigned the following response modification coefficient, R, system overstrength factor, Ω_0, and deflection amplification factor, C_d, provided compliance with the evaluation parameters specified in Section A2 of Appendix A is established for the average results of a group of assembly tests from the same configuration:

IBC:

Response Modification Coefficient:	$R = 6^1/_2$
System Overstrength Factor:	$\Omega_0 = 3$
Deflection Amplification Factor:	$C_d = 4$

UBC:

Response Modification Coefficient:	$R = 5^1/_2$
System Overstrength Factor:	$\Omega_0 = 2.8$
Deflection Amplification Factor: Not Applicable.	

4.5.2 Where the cyclic-load test data obtained from Section 3.5 for shear wall assemblies with CFS framing, wood structural panels, and power-driven pins establish noncompliance with any of the evaluation parameters specified in Appendix A, the values for the response modification coefficient, R, the system overstrength factor, Ω_0, and the deflection amplification factor, C_d, for seismic-force resisting systems consisting of these walls shall be no greater than 3. Additionally, use of seismic-force resisting systems consisting of these walls shall be limited to use in structures located in Seismic Design Categories A and B, where the height of the structures is unlimited.

5.0 QUALITY CONTROL

5.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality documentation shall ensure that the fastener properties listed in Section 2.1.1 are maintained.

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:

1. Basic power-driven pin information required by Section 2.1, including product description, installation procedures, and packaging and identification.

2. Shear wall assembly description, including size and material specifications for the CFS framing and the

sheathing, and information regarding hold-downs and foundation anchorage.

2 3. Available shear strength values and deflections for each shear wall assembly, based on analysis of data in accordance with this criteria.

4. Available transverse strength of the single fastener connections, determined in accordance with Section 3.4, as applicable.

5. Lateral strength of single fastener connections, determined in accordance with Section 3.4, as applicable. When lateral connection strengths are included in the evaluation report, the report shall clearly state that these values are for general attachment of sheathing to CFS framing, and must not be used to determine shear wall or diaphragm capacities.

6. Design information addressing applicable Seismic Design Categories, seismic factors and coefficients in accordance with Section 4.5, and aspect ratios in accordance with Section 3.5.2,

3 7. A condition of use indicating that tThe wood structural panels sheathing used on weather-exposed surfaces defined in Section 202 of the IBC or Section R703 of the IRC shall be protected by a weather-resistant exterior wall envelope, or Section 224 of the UBC shall be protected by a water-resistive barrier.

4 8. This criteria will allow the use of the assemblies within height limits and seismic categories (IBC) and seismic zones (UBC) permitted for the equivalent *R* system listed in ASCE 7 Table 12.12-1 (IBC) and UBC Table 16-N, respectively. When the assemblies are installed in jurisdictions governed by the IBC, periodic inspections in Seismic Categories C, D, E, or F shall be provided of the fastening and anchoring of the assembly within the seismic-force-resisting system. Inspection shall include connections of the wall assemblies to drag struts and hold-downs, in accordance with IBC Section 1707.4, unless exempted by IBC Section 1707.1. A statement that special inspections are required for the fastening and anchoring of the shear walls, in accordance with IBC Sections 1706.3 and 1707.4, unless exempted by IBC Sections 1706.1 and 1707.1, respectively. When special inspections are required, a statement of special inspections shall be submitted to the code official in accordance with IBC Section 1705.

9. A statement that allows for use under the IRC when an engineered design is submitted in accordance with the code.

10. The following conditions of use:

■ Calculations and details showing that the sheathing, the CFS framing and the foundation anchorage are adequate to resist the applied transverse loads and comply with applicable provisions in Sections C2 and C5 of AISI S213 must be submitted to the code official. The CFS framing must also be adequate to support the applied gravity loads. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

■ Calculations and details must be submitted to the code official showing how the lateral loads are transferred from the roof or floor diaphragm into the shear wall. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

■ When the shear wall assemblies are used in buildings that are more than one story tall, calculations and details must be submitted to the code official showing the load path for the transfer of lateral and overturning forces from the upper story shear walls to the foundation. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed. ■

Appendix A

Equivalency Characteristics and Parameters for Power-driven Pins for Shear Wall Assemblies with Cold-formed Steel Framing and Wood-based Structural-use Sheathing Panels

A1. Definitions:

V_{ASD} = allowable design capacity, not to exceed values as determined from Section 3.6 3.7 of this criteria.

Δ_{VASD} = displacement at V_{ASD}

V_P = peak strength capacity of the wall assembly

$\Delta_{0.8VP}$ = displacement at 80% post-peak strength capacity = $0.8V_P$

h_x = height of the wall assembly

A2. Characteristics and Parameters: The following requirements must be met to verify equivalency. V_{ASD} determined in accordance with Section 3.7 may be reduced to ensure compliance with the following requirements, provided the reduced V_{ASD} is used consistently throughout the determination of load values which are to be recognized.

(a) Ratio of peak load capacity, V_P, to ASD design capacity, V_{ASD}, shall be in accordance with the following:

$$2.5 \geq \frac{V_p}{V_{ASD}} \geq 5.0$$

$$2.5 \leq \frac{V_p}{V_{ASD}} \leq 5.0$$

The ratio of peak load capacity to ASD design capacity may exceed 5.0 provided the evaluation report includes a requirement that collectors and their connections, bearing and anchorage of the panel, and the lateral load path to the panel are designed in accordance with the special load combinations of Section 12.4.4 of ASCE 7, using E_m, where E_m is calculated using the test wall assembly overstrength.

(b) Ratio of post peak load displacement to ASD design capacity displacement shall be:

$$\frac{\Delta_{0.8VP}}{\Delta_{VASD}} \geq 11$$

(c) The minimum post-peak displacement shall be in accordance with the following:

$$\Delta_{0.8VP} \geq 0.028h_x$$

ICC EVALUATION SERVICE

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

Resulting ACCEPTANCE CRITERIA FOR POWER-DRIVEN PINS FOR SHEAR WALL ASSEMBLIES WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS if all proposed revisions are approved

AC230

Proposed August 2010

Previously approved October 2008, May 2008, October 2003, January 2002, January 2001

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (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 propo sed 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 by ICC-ES for purposes of issuing ICC-ES evaluation reports.

Resulting ACCEPTANCE CRITERIA FOR POWER-DRIVEN PINS FOR SHEAR WALL ASSEMBLIES WITH COLD-FORMED STEEL FRAMING AND WOOD STRUCTURAL PANELS (AC230) if all proposed revisions are approved

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for power-driven pins, used to construct shear wall assemblies with cold-formed steel (CFS) framing and wood structural panels, resisting wind or seismic loads, to be recognized in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2009 *International Building Code*® (IBC) and the 2009 *International Residential Code*® (IRC). The bases of recognition are IBC Section 104.11 and IRC Section R104.11.

The reason for this criteria is the absence of referenced standards in the IBC that can be used to establish code compliance for shear walls consisting of wood structural panels attached to CFS framing with power-driven pins.

1.2 Scope: This criteria applies to power-driven pins used to attach wood structural panels to CFS framing to create shear walls or for general use. This criteria establishes requirements for determining single fastener connection strengths and shear wall unit shear strength and deflection.

The shear walls shall be limited to Type I shear walls (defined in Section A2 of AISI S200) which are protected by a weather-resistant exterior wall envelope. The shear wall assemblies are alternates to systems described in Section C2.2.2 of AISI S213 (referenced in IBC Section 2210.6) and IRC Section R603.9.

Recognition of shear wall assemblies shall be limited to height limits and seismic design categories indicated for the equivalent *R* system listed in Table 12.2-1 of ASCE 7 (Item A13 for shear walls which comply with Appendix A of this criteria; Item H for shear walls which do not comply with Appendix A of this criteria.).

1.3 Codes and Referenced 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 ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures, including Supplements No. 1 and 2 and Excluding Chapter 14 and Appendix 11A; American Society of Civil Engineers.

1.3.4 ASTM A 370-07a, Standard Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

1.3.5 ASTM A 653-07, Specification for Steel Sheet, Zinc-coated Galvanized or Zinc-iron Alloy-coated Galvannealed by the Hot-dip Process, ASTM International.

1.3.6 ASTM A 1003-05, Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members, ASTM International.

1.3.7 ASTM D 1037-06a Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials, ASTM International.

1.3.8 ASTM D 1761-06 Standard Test Methods for Mechanical Fasteners in Wood, ASTM International.

1.3.9 ASTM D 2915-03, Standard Practice for Evaluating Allowable Properties for Grades of Structural Lumber, ASTM International.

1.3.10 ASTM E 2126-07a Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings, ASTM International.

1.3.11 AISI S100-07, North American Specification for the Design of Cold-formed Steel Structural Members, American Iron and Steel Institute.

1.3.12 AISI S200-07, North American Standard for Cold-formed Steel Framing—General Provisions, American Iron and Steel Institute.

1.3.13 AISI S213-07, Standard for Cold-formed Steel Framing—Lateral Design, American Iron and Steel Institute.

1.3.14 AISI S905-08, Test Methods for Mechanically Fastened Cold-Formed Steel Connections, American Iron and Steel Institute.

1.3.15 US DOC PS-1-07, Structural Plywood, United States Department of Commerce, National Institute of Standards and Technology.

1.3.16 US DOC PS-2-04, Performance Standard for Wood-based Structural-use Panels, United States Department of Commerce, National Institute of Standards and Technology.

1.4 Definitions:

1.4.1 Allowable Stress Design (ASD): Method of proportioning structural components such that the allowable strength equals or exceed the required strength of the component under the action of the ASD load combinations.

1.4.2 Allowable Shear Strength: Nominal shear strength divided by the appropriate safety factor.

1.4.3 Available Shear Strength: Design shear strength (see Section 1.4.5) or allowable shear strength (see Section 1.4.2), as appropriate.

1.4.4 Base Steel Thickness: The base steel thickness is the thickness of the steel, exclusive of all coatings.

1.4.5 Design Shear Strength: Resistance factor multiplied by the nominal shear strength, ΦR_n.

1.4.6 Drift: The difference in in-plane wall displacement between the top and bottom of the wall assembly.

1.4.7 Envelope: Plot of a series of points that bound a particular behavior.

1.4.8 Load Effect: Forces, stresses, and deformations produced in a structural component by the applied loads.

1.4.9 LRFD (Load and Resistance Factor Design): Method of proportioning structural components such that the design strength equals or exceeds the required strength of the component under the action of the LRFD load combinations.

1.4.10 Nominal Shear Strength: Shear strength of the wall assembly (without the resistance factor or safety factor applied) to resist lateral load effects.

1.4.11 Peak Strength: The maximum lateral resistance developed by the wall assembly.

1.4.12 Power-driven Pins: A forced-entry pin fastener characterized by an upset head and a point, typically hardened for penetrating steel and placed with a power tool.

1.4.13 Rational Engineering Analysis: Analysis based on theory that is appropriate for the situation, relevant test data if available, and sound engineering judgment.

1.4.14 Resistance Factor, Φ: Factor that accounts for unavoidable deviations of the nominal strength from the actual strength and for the manner and consequences of failure.

1.4.15 Shear Wall: Wall that provides resistance to lateral loads in the plane of the wall and provides stability for the structure.

1.4.16 Structural Analysis: Determination of load effects on members and connections based on principles of structural mechanics.

1.5 Notations:

1.5.1 h = Height of the test shear wall, in. (mm).

1.5.2 $t_{(specified)}$ = Specified base steel thickness, in. (mm).

1.5.3 $t_{(tested)}$ = Measured base steel thickness, in. (mm).

1.5.4 C_d = Deflection amplification factor.

1.5.5 F_s = Force corresponding to δ_{xe} on the envelope curve.

1.5.6 $F_{u(specified)}$ = Specified minimum tensile strength of the CFS studs used in the tested assemblies, ksi (MPa).

1.5.7 $F_{u(tested)}$ = Measured tensile strength of the CFS studs used in the tested assemblies, ksi (MPa).

1.5.8 I = Importance factor as defined by Section 11.5 of ASCE 7.

1.5.9 R_s = Adjustment factor for steel framing overstrength and thickness (see Section 3.3.4).

1.5.10 V_p = Peak shear strength from envelope curve, lbs. (N)

1.5.11 V_{ASD} = Allowable shear strength determined for the tested assembly, unadjusted by R_s, lbs (N).

1.5.12 V'_{ASD} = Allowable shear strength, adjusted by R_s, lbs (N).

1.5.13 V_{LRFD} = Design shear strength, lbs (N).

1.5.14 V'_{LRFD} = Design shear strength, adjusted by R_s, lbs (N).

1.5.15 δ_x = Inelastic deflection, in. (mm).

1.5.16 δ_{xe} = Strength design level response displacement, in. (mm).

1.5.17 Δ_a = Allowable story drift, in. (mm).

1.5.18 Δ_{VASD} = Deflection at V_{ASD}, in. (mm).

1.5.19 Δ_p = Deflection at the peak strength, in. (mm).

1.5.20 Φ = Resistance factor.

1.5.21 Ω_0 = Seismic Over-strength factor.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted and shall be included in the submitted test reports:

2.1.1 Power-driven Pins:

2.1.1.1 Generic or trade name, and manufacturer's catalog number or catalog series.

2.1.1.2 Drawings and details of the pins noting the following: dimensions and manufacturing dimensional tolerances; head characteristics; shank deformations (if any); tip geometry; washer size and thickness, if used; head markings (if any); and material specifications, including specified tensile strength, case and core hardness range, and protective coatings.

2.1.1.3 Installation details and instructions, noting installation limitations and the sizes and locations of fasteners, and including a description of recommended tools and recommended tool operation.

2.1.1.4 A description of the method of packaging and field identification of the power-driven pins. The identifying information on each box or package of power-driven pins shall include the pin brand name and model number, nominal pin size and length, the evaluation report holder's name, the ASTM designation if applicable, and the ICC-ES evaluation report number.

2.1.2 CFS Framing: Description of CFS framing members used in the shear wall assemblies for which recognition is sought, including flange width, web depth, material specification, specified yield and tensile strengths, and specified base steel thickness.

2.1.3 Wood Structural Panels: Description of the wood structural panels used in the shear wall assemblies for which recognition is sought, including type, specification, thickness, and grade.

2.1.4 Shear Wall Assemblies: Description of the shear wall assemblies for which recognition is sought, including maximum height, aspect ratio, stud spacing, fastener spacing, orientation of wood structural panels, chord details and hold-down and anchorage details. A description of the applicable installations shall also be submitted addressing Seismic Design Categories, Occupancy Categories in accordance with IBC Table 1604.5 and seismic design factors (R, Ω_0, C_d).

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.

2.4 Product Sampling: Sampling of the power-driven pins for tests under this criteria shall comply with Section 3.2 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Requirements for Pins: Prior to shear wall testing, the core hardness of power-driven pins from the same lot as those that will be used in the shear wall testing shall be measured in accordance with ASTM A 370, and shall comply with the manufacturer's specifications. A minimum of five pins shall be tested.

3.2 Requirements for Wood Structural Panels: The wood structural panel component of the shear walls for which recognition is sought shall comply with a current ICC-ES evaluation report, a national product standard (PS-1 or PS-2), or otherwise be justified to the satisfaction of ICC-ES. The material shall be clearly identified to verify panel compliance. Minimum panel width shall be 12 inches (305 mm). Wood structural panels used in qualification testing in accordance with Sections 3.4 and 3.5 shall be representative of the shear wall assemblies for which recognition is sought.

3.3 Requirements for CFS Framing:

3.3.1 CFS framing used in shear wall assemblies recognized under this criteria shall comply with Sections 3.3.1.1 through 3.3.1.3.

3.3.1.1 CFS studs shall be C-shaped members with a minimum thickness designation of 33 mils, a minimum flange width of $1^5/_8$ inches (41 mm), a minimum web depth of $3^1/_2$ inches (89 mm) and a minimum edge stiffener length of $^3/_8$ inches (9.5 mm).

3.3.1.2 CFS tracks shall have a minimum thickness designation of 33-mils with a minimum flange width of $1^1/_4$ inches (32 mm) and a minimum web depth equal to the web depth of the wall studs.

3.3.1.3 As a minimum, CFS studs and tracks shall be of ASTM A 1003, Grade 33, Type H steel or ASTM A 653 SS Grade 33 steel with a minimum G60 coating for members with a designation thickness of 33 and 43 mils; and ASTM A 1003, Grade 50, Type H steel or ASTM A 653 SS Grade 50, Class 1 steel with a minimum G60 coating for members with a designation thickness equal to or greater than 54 mils.

3.3.2 CFS framing used in shear wall test assemblies shall be representative of the shear wall framing for which recognition is sought.

3.3.3 The base steel thickness, yield strength, tensile strength and elongation of the steel of all tested CFS framing members shall be established from coupon tests of representative members. The yield strength and tensile strength of coupons cut from the representative CFS framing members shall be determined in accordance with ASTM A 370. These mechanical properties shall comply with the framing manufacturer's specifications.

3.3.4 If the measured tensile strength of the tested CFS framing members exceeds the specified minimum value, and/or the measured base steel thickness of the CFS framing members exceeds the specified design base steel thickness, the test results shall be adjusted as required by Sections 3.4.4, 3.7 and 3.8 using the following adjustment factor, R_s:

$$R_s = \left(\frac{F_{u(specified)}}{F_{u(tested)}}\right) \times \left(\frac{t_{(specified)}}{t_{(tested)}}\right) \leq 1.0$$

When R_s for the studs differs from R_s for the tracks, R_s shall be based on the type of member (stud or track) where the predominant failure occurred.

3.4 Single-Fastener Connection Tests:

3.4.1 Transverse Load (Optional): The allowable transverse load capacity of a connection comprised of a wood structural panel attached to CFS framing with a power-driven pin shall be the lesser of allowable strength due to the pull-through capacity of the wood structural panel and the allowable strength due to the pull-out capacity of the pin installed in CFS framing, determined as follows:

3.4.1.1 Pull-through Test: A test setup and procedure similar to the one described in ASTM D 1037 shall be used to determine the pull-through capacity of the power-driven pin installed in the wood structural panel. At a minimum, testing shall be performed on specimens with a panel edge distance that is representative of the minimum specified condition at the perimeter of the shear wall assembly for which recognition is sought. As an option, to address higher transverse load capacity of the fasteners in the field of the sheathing panel, additional data may be submitted.

The target number of test specimens shall be determined in accordance with ASTM D 2915, equation 1. Testing for representative material combinations shall be based on a minimum sample size of 15 specimens and a target of 5 percent precision with a 75 percent confidence for the mean capacity. The sample size need not exceed 30 specimens.

The average ultimate load shall be divided by a safety factor of 5 to determine the allowable load.

3.4.1.2 Pull-out Test: Pull-out testing of fasteners installed in CFS shall be conducted in accordance with Section 8.3 of AISI S905, using the alternative tension test fixture. Sample size shall be determined in accordance with Section 7.0 of AISI S905. Allowable pull-out strength shall be determined in accordance with Section F1.1 of AISI S100. The available strengths shall be adjusted by R_s in accordance with Section 3.3.4.

3.4.2 Lateral Load (Optional): The provisions of this section are applicable if the shear wall design values are based on the provisions of Section 4.3. These provisions may also be used to determine available lateral strength values for inclusion in evaluation reports. See Section 6.0.

The shear strength of the single-fastener connection of the wood structural panel to the framing shall be determined by testing in general accordance with ASTM D 1761. Specimen geometry and fixtures shall be modified as necessary to obtain valid tests of the connection capacity. Test failures located away from the connection and clearly unrelated to the connection shall be censored from the data set and replaced.

Testing more than 30 specimens shall not be required. The target number of test specimens is determined in accordance with ASTM D 2915, equation 1. Testing for representative material combinations shall be based on a minimum sample size of 15 specimens and a target of 5 percent precision with a 75 percent confidence for the mean capacity.

The allowable strength and the design strength of a single fastener connection of the wood structural panel to the framing shall be determined in accordance with Section F1 of AISI S100, or other approved method with prior approval of ICC-ES. The available strengths shall be adjusted by R_s in accordance with Section 3.3.4.

3.5 Cyclic-load Shear Wall Tests:

3.5.1 Shear wall testing shall use materials, sheathing, connections of sheathing to framing, and framing spacing consistent with the details of construction to be recognized, including minimum fastener edge distances and framing section profiles, in the evaluation report, and shall be conducted in accordance with ASTM E 2126, Method A or Method C. The sheathing shall not bear on any portion of the test fixture.

3.5.2 The tested wall assemblies shall have aspect ratios (wall height-to-length ratios) and dimensions consistent with the intended use, and such aspect ratios shall be the maximum permitted for recognition in the evaluation report, except test wall assemblies having an aspect ratio of 1:1 may be used to determine full available strength for applications with aspect ratios equal to or less than 2:1. If wall assemblies having an aspect ratio greater than 2:1 are recognized in the evaluation report, then an available strength reduction factor shall be determined by additional tests. The test-based reduction factor shall result in adjusted design shears that are no greater than those achieved using a reduction factor of $2w/h$ applied to design strengths of tested walls with aspect ratios of 1:1 to 2:1, where *w* is the width of a test shear wall measured in the direction of application of force, and *h* is the height of the test shear wall. If the test-based reduction factor results in higher design shears, then the factor $2w/h$ shall be used to adjust the design shears. The maximum wall aspect ratio shall be no greater than 4:1.

3.5.3 A minimum of two replicate assemblies shall be tested for each shear wall assembly for which empirical data is sought. The shear wall unit shear values described in Section 4.2 may be based on the average of the two tests if the two test values are within 10 percent of each other; otherwise, the average of three test values shall be used.

3.6 Cyclic Shear Wall Data Analysis:

3.6.1 The documentation containing analysis shall be signed and sealed by a registered design professional.

3.6.2 The shear wall available unit shear values shall be determined as outlined in Section 3.7 for Allowable Stress Design or Section 3.8 for Load and Resistance Factor Design.

3.7 Allowable Stress Design (ASD): The allowable shear strength, V_{ASD}, shall be taken as the lesser of the allowable strength based on drift and the allowable strength based on the peak test load of the shear wall, as described in Sections 3.7.1 through 3.7.3, as applicable. The drift corresponding to the allowable shear strength, Δ_{VASD}, shall be included in the analysis.

The adjusted allowable strength, V'_{ASD}, for use with the basic load combinations of Section 1605.3.2 of the IBC, shall be equal to V_{ASD} multiplied by R_s, (defined in Section 3.3.4).

3.7.1 Allowable Strength Based on Drift (Seismic): The allowable shear strength shall be determined on the basis of the requirements of ASCE/SEI 7 Section 12.8.6 as follows:

(a) The maximum inelastic response displacement, δ_x, shall be taken as the lesser of the allowable story drift from Table 12.12-1 of ASCE 7, Δ_a, and the mean displacement at the peak strength of the tested wall assemblies, Δ_p, corresponding to the peak load, V_p, from the test.

(b) Using δ_x and the assigned C_d factor, the Strength Design level response displacement, δ_{xe}, shall be calculated as $\delta_{xe} = \delta_x I \div C_d$, where *I* is the importance factor determined in accordance with Section 11.5.1 of ASCE/SEI 7.

(c) From the envelope curve defined in ASTM E 2126, the force F_s corresponding to δ_{xe} shall be determined.

(d) F_s shall be multiplied by a factor of 0.7 to determine the allowable shear strength.

3.7.2 Allowable Strength Based on Drift (Wind): The allowable shear strength shall be equal to the test load derived from the envelope curve at a deflection of $^{h}/_{180}$, where *h* is equal to the height of the tested shear wall assembly.

3.7.3 Allowable Strength Based on Peak Strength (Seismic and Wind): From the envelope curve defined in ASTM E 2126, the allowable shear strength shall be taken as the average peak shear strength of the tested shear wall, V_p, divided by a safety factor of 2.5 for seismic forces and 2.0 for wind forces.

3.8 LRFD (Load and Resistance Factor Design): For LRFD, the nominal shear strength shall be multiplied by a resistance factor $\Phi = 0.6$ (for seismic loads) or $\Phi = 0.65$ (for wind loads) to obtain the design shear strength,

V_{LRFD}. The adjusted design strength, V'_{LRFD}, for use with the basic load combinations of Section 1605.2.1 of the IBC shall be equal to V_{LRFD} multiplied by R_s (defined in Section 3.3.4).

The nominal shear strength shall be taken as the lesser of the nominal shear strength values based on drift and the nominal shear strength based on the peak test load of the shear wall as follows:

3.8.1 Nominal Strength Based on Drift: The nominal shear strength shall be determined as the lower of 2.5 times the allowable shear strength defined in Section 3.7.1 or 2.0 times the allowable shear strength defined in Section 3.7.2, whichever is less.

3.8.2 Nominal Strength Based on Peak Strength: The nominal shear strength shall be taken as the peak test load of the shear wall.

4.0 ENGINEERING ANALYSIS

4.1 General:

4.1.1 Available unit shear strength values of shear walls consisting of wood structural panels attached to CFS framing with power-driven pins shall be determined by using an empirical method according to Section 4.2 or an analytical method according to Section 4.3, and a shear wall deflection function shall be verified according to the provisions in Section 4.4. Seismic design compatibility of shear walls consisting of wood structural panels attached to CFS framing with power-driven pins shall be determined according to the provisions of Section 4.5.

4.1.2 Shear walls consisting of wood structural panels attached to CFS framing with power-driven pins shall conform to the limitations on sheathing, steel framing members, and fastener spacing for lateral resistant systems specified in AISI S213.

4.2 Shear Wall Unit Shear—Empirical: For available unit shear values based on an empirical analysis, a cyclic shear wall test program shall be conducted as described in Section 3.5. The test program shall include maximum and minimum fastener spacing for each fastener/sheathing/stud thickness combination to be recognized. The shear wall test data analysis shall be as described in the applicable parts of Section 3.6. Linear interpolation is permitted to establish capacities at intermediate fastener spacings.

4.3 Shear Wall Unit Shear—Analytical:

4.3.1 An outline of an analytical method of deriving shear wall available shear strength values and an outline of a confirmation test plan shall be submitted to ICC-ES prior to conducting single-fastener connection tests in accordance with Section 3.4 and conducting shear wall confirmatory tests in accordance with Section 4.3.2. The proposed analytical method shall be based on rational engineering analysis and structural analysis using available power-driven pin connection shear strength values determined in accordance with Section 3.4. The results of confirmatory testing shall be used to demonstrate that the predicted shear wall available strength is less than actual available strength.

4.3.2 Cyclic-load shear wall testing in accordance with Section 3.5 shall be conducted and the results shall be analyzed in accordance with Section 3.6. Critical features of the power-driven pins, such as nominal shank diameter and head geometry, shall be incorporated in the validation test plan. Shear wall test assemblies shall have an aspect ratio as set forth in Section 3.5.2. No individual test shall be eliminated unless a rationale for its exclusion can be given. The minimum test program for each fastener diameter and head geometry (where appropriate) shall include:

4.3.2.1 The thinnest sheathing with the thinnest CFS studs (minimum base-metal thickness) at maximum and minimum fastener spacing; and

4.3.2.2 The thickest sheathing with the thickest CFS studs (maximum base-metal thickness) at minimum and maximum fastener spacing; and

4.3.2.3 For design tables with more than two CFS stud thicknesses and two sheathing thicknesses, an intermediate thickness sheathing with an intermediate thickness CFS stud (base-metal thickness) and minimum fastener spacing.

4.3.3 For the purpose of confirming the analytical model, an adjusted available shear strength value for each shear wall test assembly shall be derived in accordance with Section 3.7 or Section 3.8, as applicable, and these empirically derived adjusted available shear strength values shall meet or exceed, within 15 percent, the available shear strength values predicted by the analytical model.

4.3.4 For the purpose of confirming seismic equivalency according to Section 4.5, and deflection equations according to Section 4.4, each confirmatory test configuration shall be evaluated.

4.4 Shear Wall Deflection:

4.4.1 Shear wall test data that were used to derive available shear strength values shall be used to verify deflection calculations that follow from AISI S213 deflection equations.

4.4.2 It shall be permitted to verify another displacement function that is supported by engineering derivation based on the principles of mechanics.

4.4.3 Calculated shear wall deflections shall be considered acceptable when the AISI S213 deflection equation (Section 4.4.1) or the proprietary displacement function (Section 4.4.2) verifies that the calculated values reasonably predict the measured drifts of tested shear walls at LRFD design strength levels. To do this, the deflection shall be calculated using F_s (determined in accordance with Section 3.7.1(c)) in lieu of v and compared to δ_{xe} (determined in accordance with Section 3.7.1(b)) in lieu of δ.

4.5 Seismic Design Compatibility with a Code-defined Seismic-force Resisting System:

4.5.1 A seismic-force resisting system consisting of shear wall assemblies with CFS framing, wood structural panels, and power-driven pins may be used as an alternate to a seismic-force resisting system consisting of shear wall assemblies with CFS framing, wood structural panels, and flat-head tapping screws that are code prescribed in Sections B1 and C2.2.2(4) of AISI S213. The alternate shear wall assemblies with the power-driven pins may be assigned the following response modification coefficient, *R*, system overstrength factor, Ω_0, and deflection amplification factor, C_d, provided compliance with the evaluation parameters specified in Section A2 of Appendix A is established for the average results of a group of assembly tests from the same configuration:

Response Modification Coefficient:	$R = 6^1/_2$
System Overstrength Factor:	$\Omega_0 = 3$
Deflection Amplification Factor:	$C_d = 4$

4.5.2 Where the cyclic-load test data obtained from Section 3.5 for shear wall assemblies with CFS framing, wood structural panels, and power-driven pins establish noncompliance with any of the evaluation parameters specified in Appendix A, the values for the response modification coefficient, *R*, the system overstrength factor, Ω_0, and the deflection amplification factor, C_d, for seismic-force resisting systems consisting of these walls shall be no greater than 3. Additionally, use of seismic-force resisting systems consisting of these walls shall be limited to use in structures located in Seismic Design Categories A and B, where the height of the structures is unlimited.

5.0 QUALITY CONTROL

5.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality documentation shall ensure that the fastener properties listed in Section 2.1.1 are maintained.

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:

1. Basic power-driven pin information required by Section 2.1, including product description, installation procedures, and packaging and identification.

2. Shear wall assembly description, including size and material specifications for the CFS framing and the sheathing, and information regarding hold-downs and foundation anchorage.

3. Available shear strength values for each shear wall assembly, based on analysis of data in accordance with this criteria.

4. Available transverse strength of the single fastener connections, determined in accordance with Section 3.4, as applicable.

5. Lateral strength of single fastener connections, determined in accordance with Section 3.4, as applicable. When lateral connection strengths are included in the evaluation report, the report shall clearly state that these values are for general attachment of sheathing to CFS framing, and must not be used to determine shear wall or diaphragm capacities.

6. Design information addressing applicable Seismic Design Categories, seismic factors and coefficients in accordance with Section 4.5, and aspect ratios in accordance with Section 3.5.2,

7. A condition of use indicating that the wood structural panels used on weather-exposed surfaces defined in Section 202 of the IBC or Section R703 of the IRC shall be protected by a weather-resistant exterior wall envelope.

8. A statement that special inspections are required for the fastening and anchoring of the shear walls, in accordance with IBC Sections 1706.3 and 1707.4, unless exempted by IBC Sections 1706.1 and 1707.1, respectively. When special inspections are required, a statement of special inspections shall be submitted to the code official in accordance with IBC Section 1705.

9. A statement that allows for use under the IRC when an engineered design is submitted in accordance with the code.

10. The following conditions of use:

■ Calculations and details showing that the sheathing, the CFS framing and the foundation anchorage are adequate to resist the applied transverse loads and comply with applicable provisions in Sections C2 and C5 of AISI S213 must be submitted to the code official. The CFS framing must also be adequate to support the applied gravity loads. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

■ Calculations and details must be submitted to the code official showing how the lateral loads are transferred from the roof or floor diaphragm into the shear wall. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

■ When the shear wall assemblies are used in buildings that are more than one story tall, calculations and details must be submitted to the code official showing the load path for the transfer of lateral and overturning forces from the upper story shear walls to the foundation. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed. ■

Appendix A

Equivalency Characteristics and Parameters for Power-driven Pins for Shear Wall Assemblies with Cold-formed Steel Framing and Wood Structural Panels

A1. Definitions:

V_{ASD}	=	allowable design capacity, not to exceed values as determined from Section 3.7 of this criteria.
Δ_{VASD}	=	displacement at V_{ASD}
V_P	=	peak strength capacity of the wall assembly
$\Delta_{0.8VP}$	=	displacement at 80% post-peak strength capacity = $0.8V_P$
h_x	=	height of the wall assembly

A2. Characteristics and Parameters: The following requirements must be met to verify equivalency. V_{ASD} determined in accordance with Section 3.7 may be reduced to ensure compliance with the following requirements, provided the reduced V_{ASD} is used consistently throughout the determination of load values which are to be recognized.

(a) Ratio of peak load capacity, V_P, to ASD design capacity, V_{ASD}, shall be in accordance with the following:

$$2.5 \leq \frac{V_p}{V_{ASD}} \leq 5.0$$

The ratio of peak load capacity to ASD design capacity may exceed 5.0 provided the evaluation report includes a requirement that collectors and their connections, bearing and anchorage of the panel, and the lateral load path to the panel are designed in accordance with the special load combinations of Section 12.4.4 of ASCE 7, using E_m, where E_m is calculated using the test wall assembly overstrength.

(b) Ratio of post peak load displacement to ASD design capacity displacement shall be:

$$\frac{\Delta_{0.8VP}}{\Delta_{VASD}} \geq 11$$

(c) The minimum post-peak displacement shall be in accordance with the following:

$$\Delta_{0.8VP} \geq 0.028h_x$$