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August 31, 2010

**TO: PARTIES INTERESTED IN EVALUATION REPORTS ON LIGHT-FRAME CONSTRUCTION**

**SUBJECT: Proposed Revisions to the Acceptance Criteria for Reinforcement of Openings in Shear Walls with Steel Brackets, Subject AC323-1010-R1 (BG/DZ)**

**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 be discussed at the hearing noted above. The revisions, noted in the enclosed draft, are as follows:

1. There are revisions throughout the document permitting recognition for use under the 2009 *International Building Code* (IBC) and 2009 *International Residential Code* (IRC), including addition of new reference standards ANSI/AF&PA SDPWS-08 and AISI S100-07. As the *Uniform Building Code* has become obsolete as an enforcement document, references to this code have been removed.
2. **Sections 1.2 and 5.4:** Remove exclusion of square or rectangular holes. An interested party proposes that since the bracket is fastened to the sheathing at its opening, any size or shape of hole inscribed within the confines of the bracket should be acceptable. A reentrant corner formed by square or rectangular shapes may create a tensile stress concentration at the corner as a sheathing tries to linearly shrink and move in two directions at right angles to each other. Overcutting of sheathings at corners of square or rectangular holes at the job site will aggravate this condition, especially for seismic (cyclic) load applications. The staff seeks comments on this issue.
3. **Section 3.3:** This section was added to permit variations in hole locations within a shear wall without testing each instance. An interested party indicates that shear walls normally exhibit a constant shear from point of load application to point of restraint, and flexural stresses are normally resisted by boundary framing members— which supports the proposal. The staff seeks comments on whether this is viable or whether

holes should be located near the expected failure zone. If a specified hole location is warranted, information supporting possible locations is requested. The staff seeks comments on this issue.

4. **Use of Sheathing to Resist Combined Shear and Uplift:** Since the testing in AC323 only evaluates in-plane shear performance, use of sheathing to resist combined shear and uplift from wind, as noted in Section 4.4 of ANSI/AF&PA SDPWS-2008, is considered outside the scope of this criteria. Section 5.7 of the enclosed criteria draft is proposed to address this limitation.
5. **IRC and Braced Wall Panels:** AC323 now indicates that walls with steel bracket reinforcement would be used for engineered design only. A question has been raised on whether the subject walls could be considered as an alternative to one of the prescriptive bracing methods permitted by IRC Section R602.10. The criteria for equivalence is needed, since the IRC does not explicitly provide guidance on probable performance of the methods contained therein.
6. **Annex A:** To permit recognition in Seismic Design Categories (SDCs) A to F under the IBC and SDCs A to E under the IRC, this annex includes cyclic in-plane tests of the shear walls. The test results are analyzed for performance equivalence to shear walls with wood structural panel sheathing, which are permitted by the IBC via ASCE7 in Seismic Design Categories A to F by comparative testing. The test results are also analyzed for determining strength and deflection results are within norms set forth in Section 5.2 of the Acceptance Criteria for Prefabricated Wood Shear Panels (AC130). Comments are requested on this proposal.

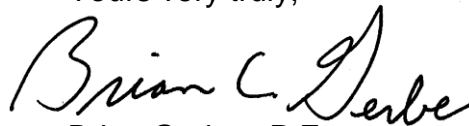
You are cordially invited to submit written comments on agenda items, or to attend the Evaluation Committee hearing and present verbal comments. If you wish to contribute to the hearing, please note the following:

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 3260, or David Zhao, at extension 3721. You may also reach us by e-mail at [es@icc-es.org](mailto:es@icc-es.org).

Yours very truly,



Brian Gerber, P.E.  
Principal Structural Engineer

BG/md

Enclosures

cc: Evaluation Committee



## 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 ( $\frac{2}{3}$ ) 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](http://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.

# PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR REINFORCEMENT OF OPENINGS IN SHEAR WALLS WITH STEEL BRACKETS

AC323

Proposed August 2010

Previously approved June 2005

## 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 proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

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

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

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

# PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR REINFORCEMENT OF OPENINGS IN SHEAR WALLS WITH STEEL BRACKETS

## 1.0 INTRODUCTION

**1.1 Purpose:** The purpose of this acceptance criteria is to establish requirements for recognition of steel brackets that are used for reinforcement of openings in shear walls in ICC Evaluation Service, LLC (ICC ES), evaluation reports under the ~~2003~~ 2009 and 2006 *International Building Code*<sup>®</sup> (IBC), and the ~~2003~~ 2009 and 2006 *International Residential Code*<sup>®</sup> (IRC) and the ~~1997~~ Uniform Building Code<sup>™</sup> (UBC). Bases of recognition are IBC Section 104.11, and IRC Sections R104.11 and R301.1.3, and ~~IBC Section 104.8.14.~~

The reason for the development of this criteria is to establish guidelines for the evaluation of steel brackets used to strengthen openings created in wood structural panel components of shear walls with wood framing.

**1.2 Scope:** This criteria addresses the use of steel brackets used to reinforce ~~round~~ openings, a maximum of 12 inches (305 mm) in diameter, in the sheathing of wood-framed shear walls constructed in accordance with Table 4.3A of AF&PA SDPWS (2009 IBC or 2009 IRC), 2006 IBC Table 2306.4.1 and UBC Table 23-11-1.1. Square and rectangular holes are beyond the scope of this criteria. This criteria requires comparative racking shear tests to be conducted to establish equivalence to the allowable shear values specified in Table 4.3A of AF&PA SDPWS (2009 IBC or 2009 IRC), or 2006 IBC Table 2306.4.1 and UBC Table 23-11-1.1.

The steel brackets shall be preformed and have a maximum 12-inch-diameter (305 mm) circular hole centered on the bracket, with fastener holes around the perimeter of the hole that are used to attach the bracket to the sheathing. The bracket shall be cold-formed and have flanges that are used to attach the bracket to the wood framing. The steel shall comply with Section A2.1 ~~of the 2004 AISI North American Specification for the Design of Cold-Formed Steel Structural Members, AISI S100 (2009 IBC and IRC) or NAS-01 (2006 IBC or IRC).~~

### 1.3 Codes and Referenced Standards:

**1.3.1** ~~2003-2009~~ *International Building Code*<sup>®</sup> (2009 IBC), International Code Council.

**1.3.2** ~~2003-2009~~ *International Residential Code*<sup>®</sup> (2009 IRC), International Code Council.

**1.3.3** *2006 International Building Code*<sup>®</sup> (2006 IBC), International Code Council.

**1.3.4** *2006 International Residential Code*<sup>®</sup> (2006 IRC), International Code Council.

~~1.3.3~~ *1997 Uniform Building Code*<sup>™</sup> (UBC).

**1.3.5** ~~1.3.6~~ *ANSI/AF&PA SDPWS-08, Special Design Provisions for Wind and Seismic, American Forest and Paper Association*

**1.3.6** ~~1.3.7~~ *AISI S100-2007, North American Specifications for the Design of Cold-Formed Steel Structural Members, American Iron and Steel Institute.*

**1.3.7** ~~1.3.8~~ *NAS-01, North American Specifications for the Design of Cold-Formed Structural Steel Members, including 2004 Supplement, American Iron and Steel Institute.*

~~1.3.8~~ ~~1.3.9~~ *ASTM E 72-02, Standard Test Method of Conducting Strength Test for Panels for Building Construction, ASTM International.*

## 2.0 BASIC INFORMATION

**2.1 General:** The following information shall be submitted:

**2.1.1 Product Description:** Complete information regarding the steel bracket, including steel specification, dimensioned scale drawings and details of the metal brackets, coatings and the manufacturing process.

**2.1.2 Installation Instructions:** Installation details, including a description of the construction of the assembly and all fasteners used to attach the bracket. Manufacturer's instructions shall include procedures for cutting holes in the sheathing that are consistent with the procedures used in preparing the qualifying test specimens.

**2.1.3 Packaging and Identification:** Method of packaging and field identification of the steel brackets. Identification provisions shall include the ICC-ES evaluation report number.

**2.1.4 Field Preparation:** The steel brackets shall be preformed, and field cutting, trimming or forming is not permitted.

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

**2.3 Test Reports:** Test reports shall comply with AC85.

**2.4 Product Sampling:** Sampling of the steel brackets for tests under this criteria shall comply with Section 3.2 of AC85.

## 3.0 TEST AND PERFORMANCE REQUIREMENTS

**3.1** For recognition in Seismic Design Category A, B, or C under the IBC or IRC, Racking shear tests shall be conducted in accordance with ASTM E 72, Section 14. The test apparatus and test procedure shall be identical for all tests. Tests shall be conducted on the sheathing type, i.e., plywood or OSB, for which recognition is sought.

**3.1.1** Tests shall be conducted on the following 4-foot-wide-by-8-foot-high (1219 mm by 2048 mm) assemblies:

**3.1.1.1** <sup>5</sup>/<sub>16</sub>-inch-thick (7.9 mm) ~~thick~~ Structural I sheathing on one face of the assembly, attached with 6d common nails spaced at 2 inches (51 mm) on center:

**3.1.1.1.1** Without holes (control assembly).

**3.1.1.1.2** With one 12-inch-diameter (305 mm) ~~diameter~~ circular hole in the sheathing, reinforced with the proprietary steel bracket. The location is to be specified in the test report and shall be adjacent to vertical boundary framing.

**3.1.1.1.3** (Optional) With two 12-inch-diameter (305 mm) ~~diameter~~ circular holes in the sheathing, reinforced with the proprietary steel bracket. The locations

**PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR REINFORCEMENT OF OPENINGS IN SHEAR WALLS WITH STEEL BRACKETS (AC323)**

are to be specified in the test report and shall be adjacent to vertical boundary framing.

**3.1.1.1.4** The assemblies shall be identical, including, but not limited to, framing members, sheathing and fasteners, except as noted in this section (~~3.1.1.3-2.4~~).

**3.1.1.2** <sup>15</sup>/<sub>32</sub>-inch-thick (11.9 mm) Structural I sheathing with 10d common nails spaced at 2 inches (51 mm) on center.

**3.1.1.2.1** Without holes (control assembly).

**3.1.1.2.2** With one 12-inch-diameter (305 mm) ~~diameter circular~~ hole in the sheathing, reinforced with the proprietary steel bracket. The location is to be specified in the test report and shall be adjacent to vertical boundary framing.

**3.1.1.2.3** (Optional) With two 12-inch-diameter (305 mm) diameter holes in the sheathing, reinforced with the proprietary steel bracket. The locations are to be specified in the test report and shall be adjacent to vertical boundary framing.

**3.1.1.2.4** The assemblies shall be identical in construction except as noted in this section (~~3.2.2-3.1.2~~).

**3.1.2** A minimum of three assemblies shall be tested for each combination described in Sections ~~3.2.4~~ 3.1.1.1 and ~~3.2.2~~ 3.1.1.2. To apply the average result, none of the results shall vary by more than 15 percent of the average of the results for the three assemblies. Otherwise, the lowest test value ~~is~~ shall be used. The average result based on a minimum of five tests may be used, whatever the variations.

**3.1.3 Conditions of Acceptance:**

**3.1.3.1** The average ultimate racking shear strength of the assembly shall be equal to or greater than the ~~allowable nominal~~ shear specified in Table 4.3A of AF&PA SDPWS multiplied by 1.4 (2009 IBC or 2009 IRC) or the allowable shear specified in 2006 IBC Table 2306.4.1 multiplied by 2.8.

**3.1.3.2** The average ultimate racking shear strength of the assembly with holes shall be equal to or greater than the average ultimate racking shear strength of the control assembly.

**3.1.4** The average deflection of the assembly with holes shall be equal to or less than the average deflection of the control assembly at a load equal to the code-prescribed allowable stress design (ASD) load (Table 4.3A of AF&PA SDPWS [2009 IBC or 2009 IRC] or 2006 IBC Table 2306.4.1).

**3.1.5** The mode of failure shall be the same for the assemblies with holes and for the control assemblies. If the mode of failure differs, additional testing may be required at the discretion of ICC-ES staff.

**3.2** For recognition in Seismic Design Categories A, to F under the IBC, or Seismic Design Categories A to E under the IRC, in lieu of Section 3.1 of this criteria, qualification shall comply with requirements set forth in Appendix A of this criteria.

**3.3** Hole location shall be limited to the location used in test assemblies, except where an analysis is submitted indicating that the hole location does not compromise the shear wall strength and stiffness.

**4.0 QUALITY CONTROL**

**4.1** ~~A Quality control manual—documentation complying with the ICC-ES Acceptance Criteria for Quality Control—Manuals—Documentation (AC10) shall be submitted.~~

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

**5.0 EVALUATION REPORT RECOGNITION**

The following information shall be included in the evaluation report:

**5.1** Holes and notches in framing members are allowed as permitted by the applicable code for shear walls in in Table 4.3A of AF&PA SDPWS (2009 IBC or IRC), or 2006 IBC Table 2306.4.1 or UBC Table 23-11-4.

**5.2** Size and location of holes in the sheathing; size, type, quantity and location of fasteners; sheathing orientation; and shear wall length and height, as determined by testing.

**5.3** For recognition under the IRC, design shall be provided in accordance with provisions of the IBC.

**5.4** A statement shall be included in the evaluation report that ~~square or rectangular~~ holes shall not be ~~permitted in the shear wall assembly greater than the opening size of the steel bracket.~~

**5.5** When information complying with Section 3.1 of this criteria is provided, A a statement shall be included in the evaluation report limiting use of the metal bracket to reinforce shear walls to use in resisting wind loads, and seismic loads in Seismic Design Categories A, B and C under the 2009 or 2006 IBC, and 2009 or 2006 IRC and Seismic Zones 1 and 2 under the UBC.

**5.6** When information complying with Section 3.2 of this criteria is provided, a statement shall be included in the evaluation report permitting use of the metal bracket to reinforce shear walls for use in resisting wind loads, and seismic loads in Seismic Design Categories A to F under the 2009 or 2006 IBC, and Seismic Design Categories A to E under the 2009 or 2006 IRC,

**5.7** Use of sheathing in walls containing the steel brackets to resist combined shear and wind uplift from wind is outside the scope of this criteria. ■

## APPENDIX A

### QUALIFICATION OF BRACKET REINFORCEMENT FOR SEISMIC DESIGN CATEGORIES D, E AND F UNDER THE INTERNATIONAL BUILDING CODE (IBC)

**A1 Scope:** In order to qualify walls using the steel brackets as reinforcement in Seismic Design Categories D, E and F under the IBC, the shear wall assemblies shall be tested in accordance with Section 5.1 of the ICC-ES Acceptance Criteria for Prefabricated Wood Shear Panels (AC130) and analyzed for equivalent performance and seismic design compatibility with a code-defined seismic-force resisting system. The system using the steel brackets to reinforce the 12-inch-diameter (305 mm) holes shall not be tested to establish design values but only to determine that its use maintains the shear capacities of the code-complying walls without holes. The object shall be to compare the performance of the code-complying walls without holes with the performance of walls with holes reinforced with the steel bracket.

**A2 Panel Cyclic Shear Tests:** Since the IBC does not have any published shear values taken from cyclic shear tests for wood structural shear panels similar to those walls tested under monotonic test methods, comparative test results shall be generated as follows:

1. Cyclic shear wall tests shall be conducted in accordance with Section 5.1 of the ICC-ES Acceptance Criteria for Prefabricated Wood Shear Panels (AC130).
2. Tests shall be conducted on 4-foot-wide-by-8-foot-high (1219 mm by 2048 mm) assemblies.
3. Three identical cyclic tests shall be conducted using  $1\frac{5}{32}$ -inch-thick (11.9 mm) Structural I wood structural sheathing on one face of the wall framing with fasteners spaced at 2 inches (51 mm) on center.
4. Three identical cyclic tests shall be conducted with the same wood structural panel sheathing, fasteners, and fastener spacing as indicated in item 3, with the holes cut out and reinforced with the steel brackets. Brackets shall be positioned adjacent to vertical boundary framing.
5. Three identical cyclic tests shall be conducted using  $\frac{5}{16}$ -inch-thick (7.9 mm) wood structural sheathing on one face of the wall framing with fasteners spaced at 6 inches (152 mm) on center.
6. Three identical cyclic tests shall be conducted with the same wood structural panel sheathing, fasteners, and fastener spacing as in item 5 with the holes cut out and reinforced with the steel brackets.

**A3 Conditions of Acceptance for Equivalent Performance:** Walls using the steel brackets as reinforcement shall be designed for shear resistance in accordance with the IBC provided acceptable equivalent performance between code-complying test assemblies and assemblies with holes is determined as follows:

1. The average peak shear strength of the assemblies with holes shall be equal to or greater than the average peak shear strength of the code-complying control assemblies.
2. The average deflection of the assemblies with holes shall be equal to or less than the average deflection of the code-complying control assemblies at a load equal to the code-prescribed allowable load.
3. The mode of failure shall be the same for the assemblies with holes and for the code-complying control assemblies. If the mode of failure differs, additional testing may be required at the discretion of ICC-ES staff.

#### **A4 Seismic Design Compatibility with a Code-defined Seismic-force-resisting System:**

**A4.1:** Walls using the steel brackets may be used as a seismic-force-resisting system consisting of light-framed load-bearing wood walls sheathed with wood-based structural-use panels rated for shear resistance, and be assigned the following response modification coefficient,  $R$ , system overstrength factor,  $\Omega_o$ , and deflection amplification factor,  $C_d$ , provided compliance with the evaluation parameters specified in Sections A4.2, A4.3, and A4.4 is established:

Response Modification Coefficient:  $R = 6\frac{1}{2}$

System Overstrength Factor:  $\Omega_o = 3$

Deflection Amplification Factor:  $C_d = 4$

**A4.1.1** The evaluation parameters specified in Sections A4.2, A4.3, and A4.4 were based on data derived from testing using the CUREE protocol, and may be used for comparison with walls tested using either the SEAOSC (SPD) or CUREE test method. Test results from SPD and CUREE shall not be mixed for purposes of determining compliance with evaluation parameters specified in Sections A4.2, A4.3, and A4.4.

**PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR REINFORCEMENT OF OPENINGS IN SHEAR WALLS WITH STEEL BRACKETS (AC323)**

**A4.1.2** The evaluation procedure set forth in Section A4 is intended for determining equivalency of a specific set of seismic-design coefficients and factors ( $R$ ,  $\Omega_o$ , and  $C_d$ ) only; it is not intended to negate the provisions for allowable stress design (ASD) load value derivation in other sections of this criteria.

**A4.2** The lower bound on the ratio of the displacement at the post-peak load to the displacement at the assigned ASD design load shall comply with Eq. 1:

$$\Delta_U/\Delta_{ASD} \geq 11 \quad \text{(Eq-1)}$$

where:

$\Delta_{ASD}$  = The average deflection of the test assembly with holes at a load less than or equal to the code-prescribed allowable load (Table 4.3A of AF&PA SDPWS [2009 IBC or 2009 IRC] or 2006 IBC Table 2306.4.1), in. (mm).

$\Delta_U$  = The average ultimate displacement of the test assembly with holes taken from the backbone curve corresponding to an absolute load having no more than 20 percent strength degradation of the post-peak load data point (see Sections 3.2.6 and 3.2.12 of ASTM E 2126), in. (mm).

**A4.3** The minimum post-peak displacement shall be in accordance with Eq-2:

$$\Delta_U \geq 0.028H \quad \text{(Eq-2)}$$

where:

$H$  = The height of the tested wall panel, in (mm).

$\Delta_U$  = The average ultimate displacement of the test assembly with holes taken from the backbone curve corresponding to an absolute load having no more than 20 percent strength degradation of the post-peak load data point (See Sections 3.2.6 and 3.2.12 of ASTM E 2126), in. (mm).

**A4.4** The ratio of peak strength to the assigned ASD design load shall be in accordance with Eq-3:

$$2.5 \leq \frac{P_{peak}}{P_{ASD}} \leq 5.0 \quad \text{(Eq-3)}$$

where:

$P_{peak}$  = The peak strength of the prefabricated wood shear panel, lbf (N).

$P_{ASD}$  = The assigned ASD design load taken from code prescribed allowable load, lbf (mm).