ICC EVALUATION SERVICE

ICC Evaluation Service, Inc.
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December 29, 2009

TO: **PARTIES INTERESTED IN EVALUATION REPORTS ON CONTINUOUS ROD TIE-DOWN ASSEMBLIES**

SUBJECT: Proposed Revisions to the Acceptance Criteria for Continuous Rod Tie-down Assemblies, Subject AC391-0210-R1 (JS/BG)

Hearing Information:
Tuesday, February 2, 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, as presented in the enclosed criteria draft and cover letter from Simpson Strong-Tie Co., will be considered by the ICC-ES Evaluation Committee at the hearing noted above.

The enclosed criteria draft is presented in single-column, double-spaced format due to the extensive revisions being proposed throughout the criteria. The primary changes found in the proposed rewritten version of AC391 may be summarized as follows:

1. The proposed draft is limited in scope to continuous rod tie-down systems designed to resist roof wind uplift only.

2. The proposed draft includes provisions to allow evaluation of either: (a) the independent “continuous rod tie-down run” (CRTR), which is a newly proposed term for the continuous rod tie-down assembly; or (b) the “continuous rod tie-down system” (CRTS), which would include both the continuous rod tie-down assembly and the wood framing through which loads are transferred to the rods.

3. The proposed draft includes provisions for deflection limitations in the top plate, in the case of CRTS evaluations. For applications in shear walls, the proposed deflection limitation is 0.25 inch. In other applications, the proposed deflection limitation is $L/180$, where L is the distance along the top plate between CRTRs.

Staff seeks comments, in particular, on the following items:

1. It should be noted that the design of framing members within the load path of the continuous rod tie-down system is currently outside the scope of AC391, as stated in Section 1.2.1. Such framing members must therefore be designed to transmit the loads – in combination with any other applicable axial, shear or flexural loads – in accordance with the applicable provisions of the code. Comments are sought regarding the proposed expansion of the scope of AC391 to include the framing which transfers the uplift loads to the continuous rod tie-down system, in the case of evaluations performed on the CRTS. The following also relate to this item:

    a. Staff seeks comments on whether there would be interest among applicants in pursuing evaluations of the entire continuous rod tie-down *system* (including the framing members within the load path), rather than limiting the evaluation to the continuous rod tie-down assembly (as currently required under AC391).

    b. If the scope of AC391 is expanded to include the framing members, should the criteria be limited to applications in light-frame wood construction, as indicated in Sections 1.1 and 1.4.2 of the proposed draft?

    c. Section 4.1.1 and Figure 2 of the proposed draft describe a new proposed test setup and assembly that would be required for cases where the applicant chooses to test the CRTS to derive allowable loads for the system. Staff seeks input on the availability of the necessary testing equipment, as described, among accredited testing laboratories.

    d. Comments are sought regarding the top plate deflection limitations of 0.25 inch for shear wall applications and *L*/180 for non-shear wall applications in Section 3.5.1.4 of the proposed draft. Staff proposes the deflection limit be 0.1 inch, maximum, which represents a typical top plate span of 24 inches (maximum) subject to a limit of *L*/240 as specified in IBC Table 1604.3 for roof members supporting a nonplaster ceiling.

    e. If the scope of AC391 is *not* expanded as proposed to include the framing members, what revisions, if any, might be made to the current criteria, to clarify that the framing members are indeed outside the scope? What statements, if any, should be included within the evaluation reports, to further clarify that framing members have not been evaluated, and must therefore be designed by others to transmit the loads in accordance with the applicable provisions of the code? Should any revisions be made to Section 6.2.3.6 of the current AC391 in order to provide such clarification, or is the current language clear?

2. Currently, the scope of AC391 includes continuous rod tie-down systems used to resist wind uplift, as well as shear wall overturning forces induced by either wind

or seismic loads. Comments are sought regarding the proposed limitation of the scope of AC391 to applications in which the continuous rod tie-down system is used to resist wind uplift loads only.

3. It should be noted that the proposed draft of AC391 does not contain provisions for the development of strength-level design values for use in load and resistance factor design (LRFD). Comments are sought regarding the proposed removal of provisions relating to LRFD.

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 **January 19, 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 **January 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 **January 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.

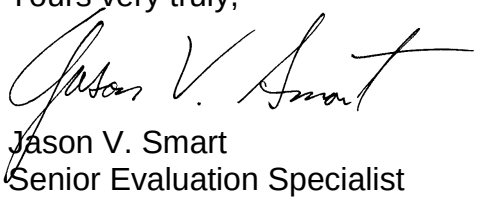
7. Any visual aids for viewing at committee meetings (charts, overhead transparencies, slides, videos, electronic presentations, etc.) will be permitted only if a copy is provided to ICC-ES, before the presentation, in a medium that can be retained with other records of the meeting.

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 5692, 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,



Jason V. Smart
Senior Evaluation Specialist

JVS/raf

Enclosures

cc: Evaluation Committee

ICC EVALUATION SERVICE, INC.,
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 a 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.■

Effective March 18, 2008

ICC EVALUATION SERVICE

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

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR CONTINUOUS ROD TIE-DOWN ~~ASSEMBLIES~~ RUNS AND CONTINUOUS ROD TIE-DOWN SYSTEMS RESISTING ROOF WIND UPLIFT FORCES FOR LIGHT-FRAME WOOD CONSTRUCTION

AC391

Proposed December 2009

Previously approved June 2009

PREFACE

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

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

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

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

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

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR CONTINUOUS ROD TIE-DOWN ~~ASSEMBLIES~~ RUNS AND CONTINUOUS ROD TIE-DOWN SYSTEMS RESISTING ROOF WIND UPLIFT FORCES FOR LIGHT-FRAME WOOD CONSTRUCTION

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for continuous rod tie-down runs or continuous rod tie-down systems used in light-frame wood construction to resist roof wind uplift loading, to be recognized in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006 and 2009 *International Building Code*® (IBC) and the 2006 and 2009 *International Residential Code*® (IRC). Bases of recognition are IBC Section 104.11 and IRC Section R104.11.

The reason for the development of this criteria is to establish guidelines for the evaluation of either the roof wind uplift continuous rod tie-down runs (CRTR) or roof wind uplift continuous rod tie-down systems (CRTS), since the IBC, IRC, and associated referenced standards do not specify qualification, installation, design, and quality requirements for such systems.

1.2 Scope:

1.2.1 This criteria provides methods to establish the Allowable Stress Design (ASD) loads for continuous rod tie-down runs (CRTR) and continuous rod tie-down systems (CRTS) resisting roof wind uplift forces, based on calculations or tests.

1.2.1.1 Allowable loads for the steel components of the CRTR and CRTS shall be calculated in accordance with the code per Section 3.2.1 of this criteria.

1.2.1.1.1 Allowable capacity of threaded rod coupler components is not permitted to be calculated per Section 3.2.1 and shall be determined through testing per Section 4.5.

1.2.1.2 Allowable loads for the CRTS shall be calculated in accordance with the code and the additional requirements in Section 1.2.1.2.1 and Section 3.2.2 of this criteria.

1.2.1.2.1 Roof wind uplift resisting system considerations, including top plate design (bending capacity, deflection limitations, rotation control, and splices), wood shrinkage, bearing plate capacities, rod strength capacities, and rod elongation are addressed within this criteria, where the evaluation report applicant prefers to provide a system capacity for the CRTS.

1.2.1.3 CRTS may be tested in accordance with Section 4.0 of this criteria, but individual CRTR component capacities within the system may not exceed the applicable code calculations.

1.2.2 The following systems, components, anchorage devices, and framing conditions are outside the scope of this criteria:

1.2.2.1 Except as noted in Section 3.2.2.2, lateral load resisting system considerations, including shear wall geometry, shear resisting element size, shear resisting element material, overturning resisting components, fastening, and compression framing, shall be considered and designed separately.

1.2.2.2 Devices that are connected to wood members and installed partially embedded into concrete or masonry construction, such as metal straps, die-stamped sill plate connectors, or similar cold-formed or structural steel devices.

1.2.2.3 Straight flat metal straps installed to collect and transfer tension forces from their point of origin to load-resisting elements.

1.2.2.4 Systems using wire rope or cable as the tension component.

1.2.2.5 Anchorage to concrete or masonry.

1.2.2.6 Cold-formed steel framing

1.2.3 Installations are limited to dry, interior locations protected from exposure to weather, except as permitted by Section 3.6 of this criteria.

1.3 Codes and Referenced Standards:

1.3.1 2006 *International Building Code*® and 2009 *International Building Code*®, International Code Council.

1.3.2 2006 *International Residential Code*® and 2009 *International Residential Code*®, International Code Council.

1.3.3 AF&PA NDS-2005, National Design Specification for Wood Construction (NDS), American Forest & Paper Association

1.3.4 AISI NAS-01, North American Specification for the Design of Cold-formed Steel Structural Members, including 2004 Supplement.

1.3.5 AISI S100-07, North American Specification for the Design of Cold-formed Steel Structural Members.

1.3.6 ASTM A 90-09, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM International.

1.3.7 ASTM A 123-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, ASTM International.

1.3.8 ASTM A 370-09, Standard Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

1.3.9 ASTM A 563-07a, Standard Specification for Carbon and Alloy Steel Nuts, ASTM International.

1.3.10 ASTM A 924-09, Standard Specification for General Requirements for Steel Sheet, Metallic-coated by Hot-Dip Process, ASTM International.

1.3.11 1.3.11 ASTM D 2395-02, Standard Test Method for Specific Gravity of Wood and Wood-Based Materials, ASTM International.

1.3.12 ASTM D 4442-92 (2003), Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials, ASTM International.

1.3.13 ASTM D 4444-92 (1998), Standard Test Methods for Use and Calibration of Hand Held Moisture Meters, ASTM International.

1.3.14 ASTM E 4-07, Standard Practices for Force Verification of Testing Machines, ASTM International.

1.3.15 ASTM E 8-01, Standard Test Methods for Tension Testing of Metallic Materials, ASTM International.

1.3.16 ASTM F 1470-02, Standard Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection, ASTM International.

1.3.17 ASTM F 1575-03, Standard Test Method for Determining Bending Yield Moment of Nails, ASTM International.

1.3.18 ASTM F 1667-01A, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples, ASTM International.

1.4 Definitions:

1.4.1 Roof Wind Uplift Continuous Rod Tie-down Run (CRTR): A CRTR is made

up of the following components:

1.4.1.1 Continuously or Partially Threaded Steel Rod: Threaded rod grade shall be an approved per AISC 360 or as approved by ICC-ES.

1.4.1.2 Threaded Rod Coupler: Threaded rod couplers used with threaded steel rod as defined in Section 1.4.1.1 shall satisfy the requirements cited in the rod specification and the additional requirements in Section 3.2.1.2 of this criteria.

1.4.1.3 Steel Bearing Plate: Steel bearing plates used with threaded steel rod as defined in Section 1.4.1.1 shall satisfy the flexural requirements of AISC 360 and wood bearing requirements of the 2005 NDS.

1.4.1.4 Steel Nut: Steel nuts used with threaded steel rod as defined in Section 1.4.1.1 shall satisfy the requirements cited in the rod specification. The strength of the nuts shall comply with the proof load requirements of ASTM A 563.

1.4.1.5 Hold-down: Hold-downs shall comply with AC155.

1.4.1.6 Shrinkage Compensating Device: Shrinkage Compensating Devices shall comply with AC316.

1.4.2 Roof Wind Uplift Continuous Rod Tie-Down System (CRTS): A continuous rod tie-down system is an assembly consisting of the following components: (1) threaded steel rods; (2) threaded rod couplers; (3) steel bearing plates (or hold-downs complying with AC155); (4) steel nuts; (5) shrinkage compensating devices complying with AC316 when determined necessary by the registered design professional; and (6) wood framing which transfers loads to the rods. System anchorage to the supporting element (e.g., a foundation) is outside the scope of this criteria, but must follow

applicable code and standards.

1.4.3 Wood Framing: Wood framing may be solid-sawn or engineered lumber.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted:

2.1.1 Product Description: Complete information pertaining to the CRTR components, including material specifications, scaled production drawings showing all dimensions and tolerances, and information on protective coatings and the manufacturing process. Material specifications shall comply with applicable referenced standards noted in Section 1.3 of this criteria. If the steel material used in the calculation method has higher strengths than the minimum specified in the referenced standards, verification of the higher strength material is required to be in the quality control documentation in accordance with Section 5.0.

2.1.2 Installation Instructions: Installation details and drawings, noting installation requirements and/or limitations.

2.1.3 Packaging and Identification: Descriptions are required for field identification of the continuous rod tie-down components. Each component shall be clearly marked to identify the manufacturer (a registered trademark may serve as such identity), the model number, and evaluation report number.

2.1.3.1 High-strength threaded rod identification shall comply with Section 2.1.3 and also include ASTM specification and grade, heat batch number, and, as applicable, the inspection agency.

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 and include the following information:

2.3.1 A description of the tested CRTS and its components, including drawings detailing all pertinent dimensions of the system and components. The description shall also include information concerning each component of the tested CRTS described in Section 1.4.2 of this criteria.

2.3.2 Actual dimensions, species, grade, specific gravity, and moisture content for each wood specimen.

2.3.3 A description of any modifications to wood members used in system testing.

2.3.4 The measured steel physical properties of the continuous rod tie-down components, including yield strength, tensile strength, elongation, and base-metal thickness.

2.3.5 A description of the components, including the information required by Section 3.3 of this criteria.

2.3.6 Detailed drawings of the test setup, depicting the threaded rod attached to the steel bearing plate (or hold-down), threaded rod location and spacing, wood top plate splice location and detailing, location and direction of load application, load applicator (e.g., hurricane tie simulator) including fastener description, location of displacement instrumentation and points of reference, and details of any deviations from the test requirements per Section 4.0 of this criteria. Additionally, photographs shall supplement

the detailed drawings confirming the test setup; and the failure modes during and at the conclusion of the test shall be noted.

2.3.7 Individual and average maximum test load values observed. There shall be a description of the nature, type and location of failure exhibited by each CRTS tested, and a description of the general behavior of the test assembly during load application.

2.3.8 A description of the test method and loading procedure used; rate of loading; and time to failure or maximum load in accordance with Section 4.4.2 of this criteria.

2.3.9 The test sample size shall be in compliance with Section 4.2 of this criteria.

2.4 Product Sampling: Sampling shall comply with Section 3.1 of AC85 for welded components. Sampling shall comply with Section 3.2 of AC85 for components fabricated without welds.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 General:

3.1.1 Component Capacities

3.1.1.1 Allowable loads for continuous rod tie-down components shall be determined by calculations in accordance with Section 3.2.1 of this criteria.

3.1.2 System Capacities

3.1.2.1 Allowable loads for the CRTS shall be determined by calculations in accordance with Section 3.2.2 of this criteria.

3.1.2.2 Testing of the CRTS in accordance with Sections 3.3 through 3.5 of this criteria may be utilized in lieu of system calculation requirements per Section 3.1.2.1. At no time shall the tested system capacity exceed the calculated component

capacities per Section 3.2.1.

3.2 Calculations:

3.2.1 Steel Component Calculations:

3.2.1.1 Threaded Rod: The ASD steel tension load capacity and elongation shall be calculated in accordance with AISC 360. Threaded rod elongation shall be limited to 0.18 inches for total rod length based on the net tensile area. Net tensile area shall equal 0.75 times gross area.

3.2.1.2 Nuts and Threaded Rod Couplers: Nuts and thread engagement length of couplers shall comply with ASTM A 563. High-strength nuts and couplers shall be used with high strength threaded rod. Threaded rod coupler capacity shall be determined through testing in accordance with Section 4.5.

3.2.1.3 Steel Bearing Plates: For steel plate materials, ASD structural capacities shall be calculated in accordance with AISC 360. Steel bending capacity values shall be derived from cantilever bending action of the steel plate as shown in Figure 1 to determine the required plate thickness. ASD wood bearing shall be calculated in accordance with the AF&PA NDS and shall be derived from the perpendicular to grain bearing stress of the wood member and the effective contact area of the steel bearing plate on wood, including the bearing area factor, C_b, as it applies, and taking a reduction of the plate area for the tension rod hole area.

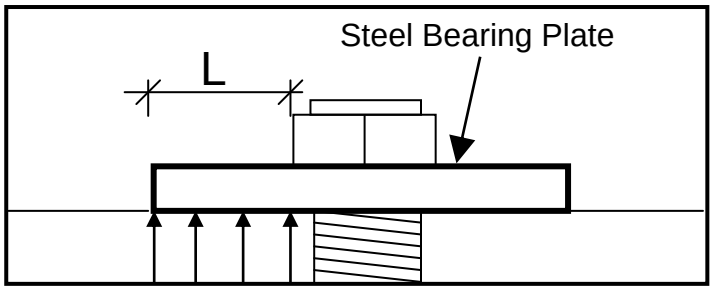


Figure 1: Steel Bearing Plate Cantilever Length

3.2.2 System Calculations: CRTS capacity shall be limited by the lower of: (1) CRTS steel components calculated per Section 3.2.1; (2) wood member and steel splice connection considering both deflection and capacity limit states as defined per Sections 3.2.2.1 – 3.2.25 and in accordance with AF&PA NDS for wood and, and AISC 360 or AISI S100 and following the applicable load combinations per ASCE 7.

3.2.2.1 Wood Member Flexural Stress: The flexural capacity of two plates working as a composite member to resist distributed uplift loading while spanning between adjacent CRTR may be considered when: (a) detailing is justified through calculation such that sufficient shear transfer connections from plate to plate exist to create composite bending action; and (b) connections are added at top plate splices and justified through calculation demonstrating that the spliced connection capacity meets or exceeds shear and flexural demands. When evaluation is in this manner, details of the splices and shear transfer connections between plates shall be provided in the evaluation report. Alternatively, it is permitted to limit the capacity to that of a single top plate without regard to connection details

3.2.2.2 Wood Member Flexural Deflection: The maximum calculated deflection of the top plate(s) shall not exceed the limitations given in 3.2.2.2.1 and 3.2.2.2.2.

3.2.2.2.1 Non–Shear Wall Locations: The maximum calculated deflection of the top plate(s) shall be limited to L/180, where L is the span of the top plate(s) equal to the distance between CRTR. Either one or two top plates shall be considered effective in accordance with the limits of 3.2.2.1.

3.2.2.2.2 Shear Wall Locations: The sum of the calculated change in length of the CRTR and the calculated deflection of the top plate(s) between CRTR shall not exceed 0.25 inches.

3.2.2.3 Top Plate Rotation Restraint: A positive method to resist torsional rotation of the top plates due to offsets between the point of load application (e.g., hurricane ties at the sides of the top plates) and load resistance (e.g., rods at the center of the top plate) shall be provided where such conditions exist. Calculations in accordance with well established principles of mechanics shall be used to determine the demand on connections used to resist top plate torsion. Details of the connection shall be provided in the report.

3.2.2.4 Wood Member Shear Stress: Allowable ASD load values based on shear stress perpendicular to grain shall be in accordance with the AF&PA NDS. Calculated capacity shall be based on a single top plate unless top plate splices are specifically designed and detailed per 3.2.2.1 to transfer shear and details are provided in the report.

3.2.2.5 Wood Member Combined Axial and Flexural Stress: Where the wood top plate(s) transfer combined axial and bending forces (i.e., the top plate acts as drag strut/collector while also acting as a horizontal beam spanning between CRTR), the

calculated limit due to combined action shall be established. Consideration of one or two plates being effective in resisting combined behavior shall be made in accordance with Section 3.2.2.1, with additional consideration of axial forces in the splice connections.

3.3 Test Materials:

3.3.1 Wood:

3.3.1.1 All wood materials shall be of structural quality with allowable values substantiated by accepted procedures, such as those referenced in Section 2303 of the IBC.

3.3.1.2 The specific gravity of the wood members used in continuous rod roof uplift tie-down system testing shall have a tested specific gravity, determined in accordance with ASTM D 2395, within 10 percent of the code-specified value, and shall be reported on an oven-dry basis in accordance with ASTM D 2395. Specific gravity measurements taken at moisture contents other than oven-dry condition shall be adjusted to the oven-dry moisture content in accordance with Appendix X1 of ASTM D 2395.

3.3.1.3 The moisture content of the wood members shall be determined in accordance with ASTM D 4442 or D 4444.

3.3.2 Steel: The steel properties of the tested continuous tie-down components, including yield point, tensile strength, and uncoated base-metal steel thickness shall be determined. Standard tensile tests of the steel from which the continuous tie-down components was produced shall be conducted in accordance with ASTM E 8. Alternatively, the data are permitted to be obtained from the mill certification of the steel

from which the continuous tie-down components is manufactured. The uncoated base-metal thickness of the steel from which the tested continuous tie-down components is formed shall be measured or calculated.

3.3.2.1 If mill certificates or testing show that yield and tensile strengths of the steel components exceed minimum specified values as established in accordance with Section 2.1 of this criteria, the allowable loads shall be proportionally reduced in accordance with Section 3.4.

3.3.3 Fasteners: Fasteners from the same manufacturer's lot that are used in continuous tie-down system testing shall be sampled in accordance with ASTM F 1470.

3.3.3.1 Anchor bolts/rods used in testing shall comply with a recognized standard.

3.3.3.2 Nails shall comply with ASTM F 1667 or ICC-ES Acceptance Criteria for Nails and Spikes AC116. Nail bending yield strength, Fyb, shall be derived using the procedures of ASTM F 1575, or the ICC-ES Acceptance Criteria for Nails and Spikes (AC116), as applicable.

3.3.3.3 Wood screws shall comply with either ANSI/ASME Standard B18.6.1 or the ICC-ES Acceptance Criteria for Alternate Dowel-type Threaded Fasteners Less Than $^1/_4$ Inch in Diameter (AC233). Bending yield strength of the screws shall be derived using the procedures of Section 4.4 of AC233. Predrilled holes shall be a field requirement when wood screws are installed into predrilled holes for testing.

3.4 Adjustments to Test Results: Where ultimate capacity of the tested system is controlled by failure of dowel-type fasteners in wood-to-wood connections, the specific gravity reduction factors of Section 3.3 of AC155 shall be applied to the test result, P_{all},

as defined in Section 3.5. Where ultimate capacity of the tested system is controlled by failure of dowel-type fasteners in steel-to-wood connections, the steel strength and specific gravity reduction factors of Section 3.3 of AC155 shall be applied to the test result.

3.5 Derivation of Allowable Tension Loads for CRTS: The allowable uplift uniform load, P_{all}, in pounds per lineal foot (plf) for roof wind uplift loads, of the CTRS shall be based on the criteria in Section 3.5.1.

3.5.1 Tested Allowable Load for CRTS: The test value, P_{ult}, shall be the total load applied (lbs) divided by the length of the wall (ft). The allowable load, $P_{all(plf)}$, shall be limited to the test value, P_{ult}, divided by a factor of safety, or the test value, P_{ult}, at a deflection limit in accordance with the following:

3.5.1.1 CRTS Test Setup: The CRTS test setup shall be in accordance with Section 4.0 and Figure 2.

3.5.1.2 CRTS Test Quantity A minimum of two CRTS tests are required. If the test value, P_{test}, for either CRTS varies by more than 15 percent from the average result, then an additional CRTS test must be completed.

3.5.1.3 Allowable Uplift Load, Strength Limit: An allowable uplift load, P_{all}, (plf) shall be derived for the CRTS by multiplying the test value, P_{ult}, (plf) by the reduction factors as described in Section 3.4, where appropriate, and dividing by a safety factor equal to 2.0.

3.5.1.4 Allowable Uplift Load, Deflection Limits:

3.5.1.4.1 Non–Shear Wall Locations: The allowable uplift load of the CRTS

shall be limited to the total load divided by the length of the wall corresponding to the first instance of any span reaching a deflection of L/180, where L is the top plate span length equal to the distance between CRTR. See Figure 2.

3.5.1.4.2 Shear Wall Locations: The allowable load of the CRTS shall be limited to the total load divided by the length of the wall corresponding to the first instance of any span reaching a deflection 0.25 inch between CRTR. Where end use applications of the CRTR include rod lengths greater than that used in testing, the load at which 0.25-inch deflection occurred in testing shall be reduced due to the calculated additional elongation of the longer rod segments. When this occurs, the CRTS load shall be linearly reduced considering the additional calculated elongation of the longer length of rod. See Figure 2.

3.6 Exterior Exposure or Damp Environments: Where the CRTS is intended for exterior exposure or damp environments, evidence of durability shall be submitted. The steel components shall be produced from corrosion-resistant stainless steel or the steel shall be zinc-coated. Evidence of compliance based on the requirements in the applicable code or referenced standard shall be submitted.

4.0 TEST METHODS

4.1 Apparatus:

4.1.1 CRTS Testing Machine: A testing machine that attaches to a wood wall assembly at 24 inches on center with independent uplift load actuators that apply an equal uplift force at each point of load application, and force measuring devices that are calibrated in accordance with ASTM E 4, shall be used. A typical setup for testing the

CRTS is shown in Figure 2.

4.1.2 Displacement Measurements: All displacements during tests shall be measured by dial gages or linear variable displacement transformers (LVDTs) having a least reading increment of 0.001 inch (0.025 mm) or less.

4.1.2.1 When testing continuous rod tie-down components, the displacement measurement device shall measure the relative movement between the component-to-component assembly or between the component and the test apparatus. Placement of the dial gages or LVDTs shall be placed as specified in Figure 2 to ensure accurate measurement of the relative movement of the wood top plate.

4.2 Test Specimen Quantity:

4.2.1 The system shall be tested for each selected combination of variables affecting the CRTS performance (e.g., selecting different lumber types or grades or different splice detailing would require new sets of system tests).

4.2.2 Refer to Section 3.5 to determine the quantity of tests required. A CRTS test shall consist of a minimum of four CRTR as shown in Figure 2 and defined in Section 1.4.1.

4.3 Test Setup:

4.3.1 General:

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR CONTINUOUS ROD TIE-DOWN ~~ASSEMBLIES~~ RUNS AND CONTINUOUS ROD TIE-DOWN SYSTEMS RESISTING ROOF WIND UPLIFT FORCES FOR LIGHT-FRAME WOOD CONSTRUCTION

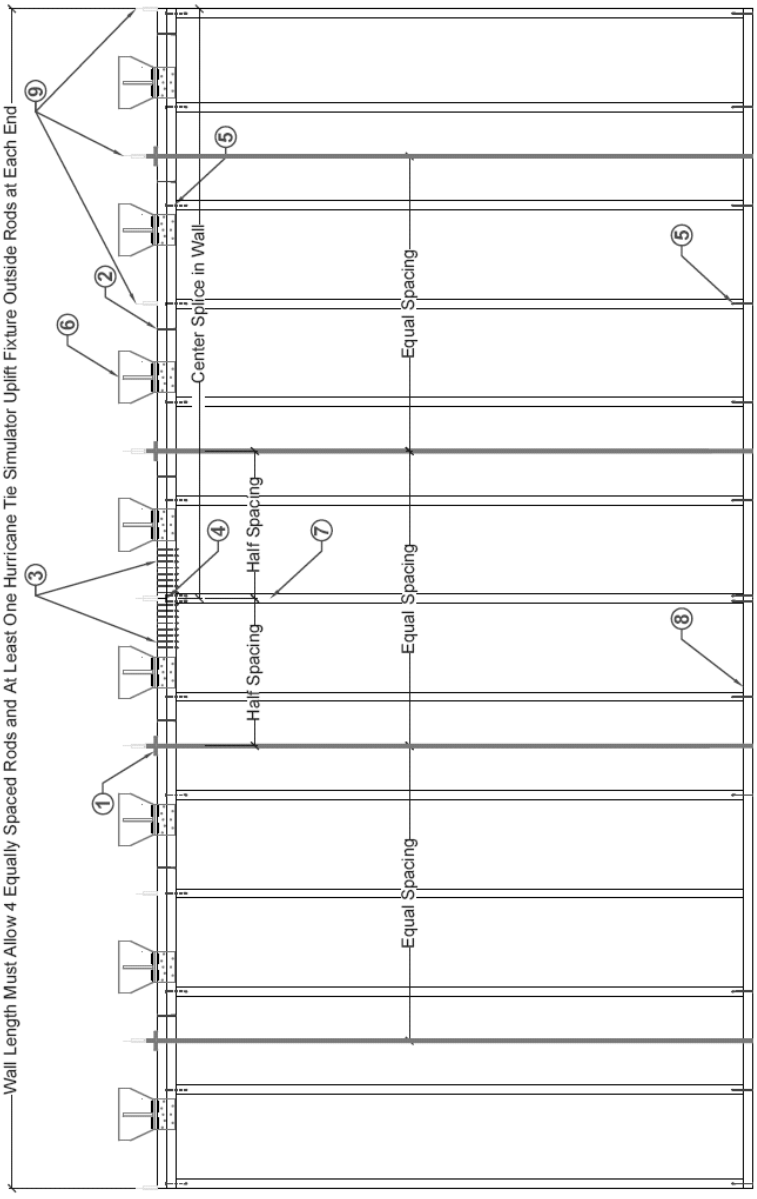


Figure 2: CRTS Test Set-up

4.3.1.1 CRTS shall be tested in such a manner as to simulate the essential function of the tie-down system. Test loads shall be applied with reference to the intended end use of the CRTS. The load transfer plate (hurricane tie simulator) shall be attached to the side of the top plates of the wall assembly to simulate actual load transfer from truss/rafter to wall assembly.

4.3.1.2 The wall assembly length must be sufficient to allow four equally spaced CRTR and at least one hurricane tie simulator uplift fixture that is outside the CRTR at each end.

4.3.1.3 The wood wall assembly construction shall be, at a minimum, built in accordance with the code. A splice in the uppermost top plate is required in the center of the wall assembly and the fastening schedule at the top plate splice shall be noted. 8 foot nominal stud height minimum shall be used in the wall assembly.

4.4 Test Procedure

4.4.1 Preloading: An initial load, or preload, shall not be applied for tension (uplift) load testing of CRTS.

4.4.2 Test Load Application and Recording: CRTS shall be loaded to failure over a time period of no less than one minute and not to exceed ten minutes.

4.4.3 Displacement Recording: The displacements shall be recorded to the nearest 0.001 inch (0.025 mm), and a sufficient number of readings shall be taken until failure or maximum load is achieved.

4.5 Static Tension Test of Rod Couplers: Couplers shall be tested in all threaded rod sizes for which recognition is sought. For each threaded rod diameter and grade, a

minimum of five couplers shall be tested in accordance with ASTM A 370. Each connection, in tension, shall develop 100 percent of the specified tensile strength, Fu, times net area of the threaded rod, and 125 percent of the specified yield strength, Fy, times the net area of the threaded rod. Net tensile area shall equal 0.75 times gross area.

5.0 QUALITY CONTROL

5.1 Quality Documentation: Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted.

5.2 Structural Welding: If the system or components incorporate structural welds, inspections by an inspection agency accredited by the International Accreditation Service, or otherwise acceptable to ICC-ES, shall be provided.

5.3 Material Traceability: The evaluation report holder shall demonstrate, within the quality documentation, continuous material traceability of all continuous rod tie-down components within the quality documentation. This requirement includes documenting the batch or heat lot number on high-strength or heat-treated threaded rods and high-strength couplers.

5.3.1 Mechanical Properties Testing Requirements: If components of the tested systems consist of either high-strength threaded rods defined in Section 5.3.2 of this criteria or items with properties exceeding values specified in the referenced standards, the report holder shall provide, in the quality documentation, mill certificates and mechanical property test reports for each batch or heat lot procured. Verification shall comply with either Section 5.3.1.1 or Section 5.3.1.2.

5.3.1.1 The report holder shall obtain continual mechanical property test reports from the manufacturer for the high-strength threaded rods or other components, in lieu of independent testing by an accredited test facility.

5.3.1.2 The report holder shall obtain reports of continual independent testing from an accredited testing laboratory for each batch or heat lot procured.

5.3.2 High-strength threaded rod shall comply with requirements described in Section 1.4.1.

5.3.3 Identification of Nonstandard Rods If the steel under consideration uses materials with yield and tensile strengths always greater than the minimum specified by the referenced standard, and these higher strengths are confirmed by the quality documentation, then calculations based on the higher strength can be used. The higher strength, nonstandard products shall be clearly identified. In addition, periodic special inspection is required. Verification of the higher strength material certifications in the quality control documentation, by an accredited inspection agency, is required.

6.0 EVALUATION REPORT RECOGNITION

6.1 General: The evaluation report shall include the basic information in accordance with Section 2.1 of this criteria.

6.2 The evaluation report shall also include the following information.

6.2.1 CRTR component dimensions as set forth in Section 2.1.1 of this criteria.

6.2.2 Where the evaluation report applicant intends to list system capacities, ASD load and deflection values of the CRTS, as determined in accordance with Section 3.2 or Section 3.5 of this criteria, shall be provided with the following footnoted information:

6.2.2.1 A statement indicating that when specified by the registered design professional, or when required by the code official, hold-downs complying with AC155 and/or wood shrinkage compensating devices complying with AC316, shall be installed in accordance with the manufacturer instructions.

6.2.2.2 A statement indicating that the contribution of wood shrinkage to the overall deflection of the CRTS shall be analyzed by the registered design professional. Shrinkage compensating devices meeting AC316 may be required by the registered design professional.

6.2.2.3 A statement indicating which adjustment factors taken from the AF&PA NDS are included in the calculation of the tabulated allowable loads for wood members and steel-to-wood connections.

6.2.2.4 The following statement: “When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the CRTS shall not be further increased for wind loading. When using the alternate basic load combinations in IBC Section 1605.3.2 that include wind loads, the tabulated allowable loads for the CRTS shall not be further increased by $33^{1}/_{3}$ percent, nor shall the alternative basic load combinations be reduced by a factor of 0.75.”

6.2.2.5 The following statement: “The components described in this report have been evaluated with respect to their performance characteristics and their performance characteristics with relation to other components described in this report and the identified structural members. Uses of any components other than those specifically identified within this report are outside the scope of this report.”

High-strength Threaded Rod: A statement that the report holder shall have available, upon request of by the code official, current mill certificates and mechanical property test reports to demonstrate compliance with the appropriate specification of for each batch or heat lot to be used in the field. Identification of the high-strength material must be provided that clearly indicates high-strength rod, on each rod for verification in the field.

6.3 CRTS Diagrams: Where the evaluation report applicant intends to list CRTS capacities based on spacing of the CRTR, the evaluation report shall include sample single- and multi-story diagrams that clearly illustrate the complete CRTS used in wind uplift applications. Diagrams shall include building tie-off points, and clearly depict intended load path to supporting foundation or anchorage point. Special anchorage conditions, such as a steel beam or wood beam connection, may optionally be included.

6.4 Conditions of Use: The evaluation report shall include the following Conditions of Use:

6.4.1 Chemically Treated (Preservative- or Fire-treated) Wood: The use of CRTR in contact with chemically treated wood is subject to the approval of the code official, since the effects of corrosion of metal in contact with chemically treated wood, on the structural performance of the components, are outside the scope of this report.

6.4.2 Exterior or Damp Environment Exposed Conditions Exposure: The evaluation report shall state whether CRTR exposure to exterior or damp environments is permitted.

6.4.3 Drawings and Design Details: Drawings and design details verifying compliance with this report shall be submitted to the code official for approval. Drawings and calculations shall be prepared by a Registered Design Professional when required by the statutes of the jurisdiction in which the project is to be constructed. ■