



SIMPSON STRONG-TIE® COMPANY, INC.

The World's "No Equal" Structural Connector Company

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Brian Gerber, S.E.
Principal Structural Engineer
ICC Evaluation Services, Inc.
5360 Workman Mill Rd.
Whittier, CA 90601

March 7, 2008

VIA EMAIL

RE: Comments on AC391, Alternative Acceptance Criteria for Continuous Tiedowns

Dear Mr. Gerber:

Please consider the following comments and revisions to proposed AC391.

Item 1 (Staff Comment 1):

An AC for tiedown systems is not needed or required. With the exception of the take-up device, all components of the tiedown system can be designed per code. That being said, please consider our additional comments if this acceptance criteria is pursued.

Item 2 (Staff Comment 2):

We agree with ICC's staff comments. If a criteria were to be developed it would need to address the use of continuous rod systems for both shear wall overturning and wind uplift restraint. Additionally, if the scope only covers the design of the continuous tie-down system, then the design of all other elements would be beyond the scope of the criteria. Cable systems should also be addressed for wall overturning and wind uplift restraint, but may better be addressed in another AC.

Item 3 (Staff Comment 3):

This AC only establishes design values for system components, not for an entire system. There could be tables for rod capacities, and plate capacities on various wood species, which are all calculated by code, and most manufacturers already provide to their customers. There is no need to test components when they can be designed per code, and calculations should always be required. Tested values should not exceed the calculated values.

Item 4:

Anchorage design and testing should not be included in the AC. There are many load combinations going into the foundation, and tension from the tiedown is only one. In addition, the AC, as written is very vague on the anchorage testing. Any calculations and testing should comply with ACI-318 Appendix D for cracked concrete. Referencing AC's which are written for post-installed anchors for the factor of safety is not satisfactory.

Item 5:

For prescriptive design, it appears that equivalent tensile forces for the holdown requirements of the Alternate Braced Wall Panels are being used. It should be clearly stated that the tie-down may only be used where an Alternate Braced Wall Panel may be used (in a one-story building or the first story of a

two-story building). The full construction of the Alternate Braced Wall Panel shall be designed and detailed to be equivalent to the code Alternate Braced Wall Panels.

Item 6:

This AC is written to address continuous tiedown systems which resist overturning forces. However, it could also include systems which resist wind uplift. Therefore, these two uses and criteria need to be clearly defined. Some of these criteria for wind uplift should include:

- The uplift rod system should be limited to deflection criteria from AC13, which is currently used for hurricane ties.
- The continuous rod system for wind uplift shall not be used to also resist overturning unless the system is designed for the increased force and tied off at every level.
- Wood shrinkage should be addressed and accounted for.
- Spacing of rods to resist wind uplift shall be limited to the top plate bending capacity of a single top plate unless provisions are included by the designer to increase bending capacities at top plate splices. If sheathing fasteners are used then, unity shall be checked on the sheathing fasteners that were designed to resist racking forces, not racking and uplift.

Thank you for your consideration of these comments. Feel free to contact me to discuss any of the above items.

Sincerely,
SIMPSON STRONG-TIE CO., INC

Lisa McGurty, P.E.
Senior Engineering Project manager

Rosalind Fazel

Subject: FW: AC391 Response to Comments

Attachments: AC391-0208_Response 080128.wpd; AC391 Response_080128.pdf; AC391-0208_Response 080128_Compared.pdf

From: Edward Chin [mailto:ed@holdown.com]

Sent: Monday, January 28, 2008 8:10 AM

To: Brian Gerber

Cc: Joe Hale; Jason Milligan; Bill Wade; go-bolt@cfl.rr.com; Ward Gould

Subject: AC391 Response to Comments

Brian,

Please find attached our response to the comments you sent on Jan 7th. You will the following attachments:

- 1) Cover letter with direct response to your comments.
- 2) WPD document with our final edits and a test apparatus sketch.
- 3) A compared doc in PDF so you can easily see the changes since the 1/7 version.

We would like to give you a chance to review our comments and invite you to a group teleconference either this Wed 1/30 or Friday 2/1 at 10:30 PST. Please confirm one of these dates and I will provide you with the 800 dial number for the teleconference.

If you have any questions, please call or email!

Thanks,

Ed Chin and on behalf of Ward Gould, Joe Hale, Jason Milligan and Bill Ward.

Edward Chin, PE

Vice President

Earthbound Corporation

800-944-5669

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ed@holdown.com



January 28, 2008

Mr. Brian Gerber, SE
Principal Structural Engineer
ICC Evaluation Service
5360 Workman Mill Road
Whittier, CA 90601

SUBJECT: Response to 01/07/08 ICC Comments on AC391
Proposed Acceptance Criteria for Continuous Rod Tie-downs

Dear Mr. Gerber:

This letter shall serve as our official response to the emailed comments we received on January 7, 2008:

1. **Section 1.2.1:** *Lines 16-20 imply the tie-downs are used with shear walls only. Wouldn't they also be used to a tie-down to resist tension due to wind uplift? Please clarify your intentions. In lines 19-20, compression framing is excluded from the scope. What about tension framing?*

Response: We clarified this section to resist tension to both wind and seismic. See revisions. In a continuous rod tie-down system, the framing is never used as a tension member unlike AC155 components. The threaded rod is our tension member.

2. **Section 1.4:** *I am not sure we are clear on what the difference is between a continuous tie-down and a continuous tie-down assembly. Also, once the distinction is made, we need to make sure each term is used consistently as intended throughout the AC.*

Response: We concur this section needs to be edited to clarify. We edited 1.4.1 and 1.4.2 accordingly to define assembly and components. The document globally has been adjusted to use "assembly."

3. **Section 2.3.8:** *I am not sure what is being stated by the second sentence with respect to sample size.*

Response: Section 2.3.8 is deleted as Section 2.4 has adequate enough information regarding sample size.



4. **Section 3.1.2:** *What is a “steel jig” in the context of this AC? Sections 4.1 to 4.3 don’t seem to be clear either.*

Response: “Steel jig” was taken from AC 155. All references to “steel jig” has been changed to “test apparatus”. A sample test apparatus figure is supplied at the end of the document for illustrative purpose.

5. **Section 3.2.2.1 (now renumbered to 3.2.1.1):** *Please look at Section 3.3 of AC155, which goes into more detail on the potential adjustments that need to be made to test results. Some of the adjustments, in my view, apply here.*

Response: With regards to Sec 3.3 of AC155 Adjustments to Test Results:

We have removed the references to wood from the definition of an assembly. This should clear up some of the confusion.

We are using standard thread profiles in our assemblies not a formed hold down from light gauge steel.

AC155-3.3.1: This section does not apply to rod based products for a few reasons. Coating thickness varies greatly within the cross section of a threaded product. As zinc electroplating does not change the properties of a non heat-treated rod, no adjustment should be necessary. Heat-treated steel requires special handling when coated and should be tested after coating. Next, base metal thickness is not typically used in calculating the strength of a threaded rod—either a nominal dimension is used or a tensile stress area is used as dictated by the thread pitch.

Furthermore, whether cut thread or upset thread, the threaded area of the rod is location of failure for threaded rods in tension and the thread profile is standardized.

AC155-3.3.2 Section 3.5.1.1 does not apply since there is no fasteners or bolts used to attach to wood other than the rod itself which is bearing on a plate which is in turn bearing on the wood. A fundamental difference between a formed hold down and a threaded rod is that a rod is typically classified by its performance. If a proprietary process results in a better capacity then the rod can be recognized by that performance. The performance level becomes part of the



Quality Assurance program and the rod provided shall not be designated a standard rod.

AC155-3.5 This section does not apply with respect to fasteners since dowel bearing and other considerations are not associated with Continuous Tie Down Assemblies as described in this criteria.

AC155-3.6 The steel is the only tensile member in an assembly in these criteria.

In summary, the load adjustments referenced in your inquiry do not apply or are not necessary since standard thread profiles of standard geometry are being used.

6. **Section 3.4:** *What exactly are the situations where testing is preferred over calculation? If this is not cleared up, I guess testing may end up being used to obtain higher values than calculation, which should be avoided. Therefore, the AC should be clear where calculations must be done. Please review the format of AC155, particularly Sections 3.3 to 3.6 for some guidelines here.*

Response: Testing is required when you are offering a rod product that exceeds standard capacities as explained above. The caveat of providing a “stronger” than standard rod is that the capacity of the rod will become a parameter for certification in the Quality Assurance manual of the manufacturer. As you can see in the attached test apparatus, the coupler and nut are part of the test assembly as an option. In this way, the capacity of the coupler and nut can be tested to show they are suitable for use with the non-standard rod. The other option would be to use couplers and nuts that are of a standard capacity that exceeds the tested capacity of the rod test specimen. If the coupler or nut being used exceeds standard capacity then that higher capacity will become a parameter for certification in the Quality Assurance manual of the manufacturer.

7. **Section 4.0.** *Again more detail is needed on testing. For example, Sections 4.1.2.1 and 4.2.1.1 both indicate component testing is needed, but the rest of section 4.0 seems to explain testing of assemblies. Also, as far as testing an assembly, Section 4.3 is vague. Perhaps some illustrations like in AC155 may help.*

Response: For standard rod, the values are published. However, if a proprietary rod is used that exceeds a standard capacity, then the other parts of an assembly—anchor, nuts, couplers, etc must be either a standard type with a published capacity such as a ASTM 194 Grade 2H heavy hex or provide testing with the minimum capacity as rated being part of the Quality Assurance program.



Regarding the test apparatus, LVDT2 is necessary to compare with LVDT1 to reveal if stripping of the nut thread is a failure mode.

8. **Section 4.3.1.2:** *Line 257 refers to a “device” but this term is not used elsewhere not is it defined.*

Response: “Device” was changed to “test apparatus.”

9. **Section 5.2.3:** *What is meant by “high-strength” threaded rod? How is it distinguished from low-strength rod?*

Response: We added Sections 1.4.3 and 1.4.4 to define “high-strength” threaded rod (and couplers/nuts) early in the document. Each manufacturer will have some sort of identification on their respective shop drawings if both standard and high strength components are on a job site. For example, Earthbound uses zinc plated standard strength (A36 / A307) and black (non zinc coated) rod for high strength (HS) threaded rod conforming to Section 1.4.3 so they can easily be identified on the job site and be inspected.

10. **Section 6.2.2.3:** *I am not sure this will work as proposed. I believe you are attempting to serve San Diego, Los Angeles, and San Francisco, which have established limits. Limits were also taken in AC13 and AC155, not to mention proposed AC348, so there is some precedence for placing deflection limits here.*

Response: You are correct that the intent of this paragraph is to satisfy special elongation requirements for specific jurisdictions. However since San Francisco is 0.132 inches and San Diego & Los Angeles is 0.125 inches, we felt that we cannot stipulate a hard elongation value. We edited this paragraph in an attempt to clarify further.

11. **Section 6.4.1:** *See IBC Section 2304.9.5 for a preferred way to deal with treated wood. Also, would the tie-downs be permitted for exterior exposure? If so, should corrosion resistance be addressed here?*

Response: This IBC Section essentially says that hot-dipped galvanized fasteners be used in treated wood. Hot dipped galvanized anchors are typically provided at treated sill plates at the requirement of the Engineer of Record or local officials. Typically the all thread will transition to non hot-dipped rod at the coupler between the anchor rod and first level all thread.



Fire Treated (“FT”) Walls: In multistory fire treated (“FT”) lumber scenarios, it is cost prohibitive to furnish hot-dipped galvanized all thread and associated hot-dipped bearing plates in contact with the FT wood. Couplers will have to be over-tapped to be able to thread easily onto the thicker hot dipped galvanized rod which also increases cost.

We have had local officials approve plastic sleeves where the all thread rod travels thru FT wood and a stainless steel shim plate underneath our standard bearing plates in lieu of either being hot-dipped. The associated costs to provide assemblies in FT walls go down dramatically.

Exterior Exposure: Tie-down assemblies are typically enclosed in shear walls. In the event that the assemblies are exposed for some architectural reason, then we would recommend hot-dipped galvanized, zinc plated or even stainless steel components. A draft paragraph is added at 6.4.2.

12. Section 6.4.2 (“Duration of Load Increase” now renumbered to 6.4.3): See IBC Section 1605.3. This may need to be revised.

Response: Our interpretation of this section is that the steel components of the tie-down assemblies cannot be further increased for wind or seismic, however in NDS 2005, the seismic duration factor for column buckling calculations of the compression lumber may be increased to either 133 or 160 but is outside the scope of this AC. We clarified this section specifically for the tie-down assemblies.



We would like to have you join us in a teleconference after you review these documents. Ed Chin will schedule the next meeting and provide the dial in conference telephone number.

Please call or email if you have any questions.



Edward Chin, PE
Vice President
Earthbound Corporation

Ward Gould
President
Go-Bolt, Inc



Joe Hale
Senior Engineer
Hurri-Bolt, Inc.



Bill Wade
Director of Sales and Marketing
TIE MAX

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PROPOSED ACCEPTANCE CRITERIA DRAFT FOR CONTINUOUS ROD TIE-DOWN ASSEMBLIES

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1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for continuous rod tie-down assemblies attached to structural members to be recognized in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006 International Building Code® (IBC), the 2006 International Residential Code® (IRC), and the 1997 Uniform Building Code™ (UBC). Bases of recognition are IBC Section 104.11, IRC Section R104.11, and UBC Section 104.2.8.

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The reason for the development of this criteria is to establish guidelines for the evaluation of continuous rod tie-down assemblies, since the IBC, IRC, UBC, and associated referenced standards do not specify qualification, installation, design, and quality requirements for these systems.

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1.2 Scope:

1.2.1 This criteria provides methods to establish the Allowable Stress Design (ASD) design loads for continuous rod tie-down assemblies by test and calculation. This acceptance criteria is limited to determining the continuous tie-down systems' function due to tension loading only from wind or seismic. Continuous rod tie-down systems shall be considered to be independent from the rest of the lateral load resisting system (e.g., shear wall). Lateral load resisting system variables, including shear wall geometry, shear resisting element size, shear resisting element material, fastening, and compression framing shall be

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considered and designed separately and are outside the scope of this criteria.

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1.2.1.1 Allowable loads for continuous rod tie-down assemblies

attached to structural members shall be based on measured (tested) or calculated strength characteristics, and measured (tested) or calculated displacement characteristics.

1.2.1.2 Allowable steel-strength loads for continuous rod

tie-down assemblies components shall be based on measured (tested) strength or calculated strength of the components.

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1.2.1.3 Allowable loads for continuous rod tie-down assemblies

shall be based on prescriptive applications according to Section R602.10.6 of the IRC.

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1.2.2 This criteria is applicable to continuous rod tie-down assemblies

components and assemblies as defined in Section 1.4.1 and 1.4.2, respectively, of this criteria.

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1.2.3 The following anchorage devices are outside the scope of this criteria:

1.2.3.1 Devices consisting of a structural steel strap with a bent

end, where the bent end of the device is cast-in-place in concrete or masonry construction, or devices that are connected to wood members and installed partially embedded into concrete or masonry construction, such as cold-formed structural steel straps, die-stamped sill-plate connectors, or similar cold-formed or structural steel devices.

1.2.3.2 Straight structural-steel straps installed to collect and

transfer tension forces from their point of origin to load-resisting elements.

1.2.3.3 Anchors to concrete or masonry that are elements of the

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continuous rod tie-down assemblies shall be evaluated in accordance with the requirements of applicable code or acceptance criteria.

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1.3 Codes and Reference Standards:

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

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

1.3.3 1997 Uniform Building Code™ (UBC).

1.3.4 ANSI/AF&PA NDS-2005, National Design Specification for Wood Construction (NDS), 2005 edition, American Forest & Paper Association.

1.3.5 ASTM A 193-04a, Standard Specification for Alloy-Steel Nuts, ASTM International.

Deleted: <#> . ASTM D 2395-07, Standard Test Method for Specific Gravity of Wood and Wood-Based Materials, ASTM International.¶

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

<#> . ASTM D 4444-92 (1998), Standard Test Methods for Use and Calibration of hand-held Moisture Meters, ASTM International.¶

1.3.6 ASTM A325-04b Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

1.3.7 ASTM A 354-03a, Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.

1.3.8 ASTM A 434-06 Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered.

1.3.9 ASTM A 449-04, Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.

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1.3.10 ASTM A 563-04, Standard Specification for Carbons and Alloy Steel Nuts, ASTM International.

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

1.3.12 ACI 318-05, Building Code Requirements for Structural Concrete and Commentary, American Concrete Institute.

1.3.13 ACI 530-05, Building Code Requirements for Masonry Structures and Specifications for Masonry Structures, American Concrete Institute.

1.4 Definitions:

1.4.1 **Continuous Rod Tie-Down Assembly**: A continuous rod tie-down assembly is installed in light-framed steel or wood walls and is used to resist tension loads caused by wind or seismic forces. Continuous rod tie-down assemblies shall consider and include all components defined in Section 1.4.2 needed to transfer tension loads from a structure into a foundation.

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1.4.2 **Continuous Rod Tie-Down Assembly Components**: A continuous rod tie-down assembly consists of the following components: (1) rods, (2) an anchor, (3) intermediate connectors or coupling devices used to attach the continuous rod tie-down components, and (4) bearing plates or washers used to enhance the performance of the assembly.

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1.4.3 High Strength Threaded Rod: High strength threaded rod shall be defined to conform but not be limited to the following standards: ASTM A 193, A 325, A 354, A 434 and A 449.

1.4.4 High Strength Couplers and Nuts: Couplers and nuts used with high

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strength threaded rod as defined in Section 1.4.3 shall comply with the cited rod standard recommendations and conform to ASTM A 563.

2.0 BASIC INFORMATION

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

2.1.1 Product Description: Complete information pertaining to the continuous rod tie-down components, including material specifications, scaled production drawings showing all dimensions and tolerances, and the manufacturing process (including welds when applicable). Material specifications shall comply with applicable reference standards.

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

2.1.3 Packaging and Identification: A description of field identification of the continuous rod tie-down components. For components that do not comply with code-referenced standards, identification provisions shall include the ICC-ES evaluation report number. Components shall be accompanied by packaging/labeling that clearly identifies the manufacturer (such as a registered trademark), the model number, and the ICC-ES evaluation report number (ICC-ES ESR-XXX).

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.

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2.3 Test Reports: Test reports shall comply with AC85, and include the following:

2.3.1 A description of the tested continuous rod tie-down assembly and its components, or individually tested components, including a drawing detailing all pertinent dimensions of the assembly and/or components. The description shall also include information concerning each component of the tested continuous rod tie-down when testing assemblies (refer to Section 1.4.2 of this criteria).

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

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~~<#>~~ . A description of any modifications made to the wood members used in continuous rod tie-down assembly testing. ¶

2.3.3 A description of the components, including the information required in Section 3.2.4 of this criteria.

2.3.4 A detailed drawing of the test setup, depicting location and direction of load application, location of displacement instrumentation and their point of reference, and details of any deviations from the test requirements as outlined in Section 4.0 of this acceptance criteria. Additionally, photographs shall supplement the detailed drawings of the test setup and failure modes.

2.3.5 Individual and average maximum test load values observed. Description of the nature, type and location of failure exhibited by each continuous rod tie-down assembly or component tested, and a description of the general behavior of the test assembly or components during load application.

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~~<#>~~ . The sample size shall be in accordance with Section 4.2 of this criteria as a minimum. Testing performed as per a recognized test method requiring sample sizing in excess of this minimum shall be performed as per the recognized test method requirements. ¶

2.3.6 A description of the test method and loading procedure used, rate of loading, and time to maximum load in conformance to Section 4.4.2.

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2.4 Product Sampling: Sampling shall comply with Section 3.1 of AC85 for welded continuous rod tie-down components. Sampling shall comply with Section 3.2 of AC85 and Section 4.2 of this criteria for continuous rod tie-down components fabricated without welds.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 General:

3.1.1 Tension Load Testing:

3.1.2 Continuous rod tie-down components shall be tested such that a tension load is applied in reference to the intended application of the components when attached to a test apparatus as described in Sections 4.1 through 4.3,. The allowable steel-strength tension load capacity shall be calculated as follows: peak load/factor of safety = allowable design load.

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3.1.2.1 (Optional) Continuous rod tie-down assemblies shall be tested and evaluated for an allowable uplift load capacity for use with alternate braced wall panels described in IRC Section R602.10.6.1 or IRC Section R602.10.6.2. Testing shall comply with applicable requirements in Section 4.0 of this criteria, and assembly uplift capacity shall be evaluated in accordance with Section 3.6 of this criteria.

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<#> All wood materials shall be solid-sawn lumber of structural quality with allowable values substantiated by accepted procedures, such as those referenced in the NDS and/or Section 2303 of the IBC. ¶

<#> The moisture content of the wood members shall be determined in accordance with ASTM D 4442 or D 4444.¶

<#>

3.2 Test Materials:

3.2.1 Steel: The steel properties of the tested continuous rod tie-down components, including yield point, tensile strength, and uncoated base-metal steel

thickness shall be determined by testing. Mill certificates shall be provided for the specific heat or lot of material subjected to the load tests of this acceptance criteria.

3.2.1.1 Standard Steel Components Used in Typical

Assemblies: If tested yield and tensile strengths of the steel components exceed specified values, the allowable loads from tests in Section 3.1.1 shall be proportionally reduced. If materials with higher properties than stated in the referenced specifications are unique to their product offering and these higher yield and tensile strengths are confirmed within the quality documentation, then the reductions are not necessary.

3.2.2 Components: Components that are used in continuous rod tie-down assembly testing shall be sampled from the same manufacturer's lot in accordance with Section 4.2 of this criteria.

3.2.2.1 Anchor bolts/rods shall comply with a recognized standard.

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3.3 Factor of safety: Factor of safety for Determination of Allowable Design Loads from Tested Results:

3.3.1 Anchorage to Concrete or Masonry: Factor of safety shall be as set forth in the applicable code or acceptance criteria.

3.3.2 Threaded Rods and Couplers: For threaded rod and coupling components used to extend the continuity of the anchors, the minimum factor of safety shall be 2.5.

3.4 Continuous Rod Tie-Down Design Load Calculations: In lieu of testing

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described in Section 4.0, calculations determining the allowable design load shall be submitted in accordance with the following:

3.4.1 Threaded Rod Capacities: Threaded rod capacities for ASD shall be calculated in accordance with IBC Section 2205.1 or IRC or UBC Chapter 22, Division III.

3.4.2 Bearing Plate Capabilities: For plate stresses, materials and structural capacities for ASD shall be calculated in accordance with IBC Section 2205. For plate bearing against wood, structural capacities shall be calculated in accordance with Section 2.2.5 of this criteria.

3.4.3 Nuts and Couplers: Nuts and couplers shall comply with ASTM A 563. High strength grade nuts and couplers shall be used with corresponding high strength grade threaded rod.

3.4.4 Allowable Design Load: The allowable design loads for continuous rod tie-down assemblies shall equal the lowest determined allowable load of any component or connection of components comprising the intended assembly.

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3.4.5 Steel to Wood Bearing Calculations: Calculated allowable resistance values for steel to wood bearing connections shall be determined in accordance with the NDS and shall consider the following: (1) cross-sectional area of the wood member attached to the continuous rod tie-down component; (2) continuous rod tie-down quantity, type, and size specified for the installation; (3) continuous rod tie-down device steel tensile strength value specified for production in the approved quality control manual, and (4) applicable adjustment factors specified in NDS.

3.4.6 Wood to Wood Compression Calculations: Calculated allowable resistance values for wood to wood connections in compression shall be determined in accordance with the NDS and shall consider the lower of the following: (1) cross-sectional area of the vertical wood member perpendicular to grain wood compression maximums and also submit for specific wood species; (2) wood compression parallel to grain calculations considering buckling with varying stud or posting heights; (3) applicable adjustment factors specified in the NDS.

3.4.7 (Optional) Derivation of Allowable Uplift Capacities for

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Continuous rod tie-down Assemblies complying with the IRC: The provisions of this section are applicable when requesting evaluation of a continuous rod tie-down system for compliance with IRC Section R602.10.6 as a tie-down assembly. The allowable uplift load for short-term load duration, such as wind/earthquake loads, of the tie-down assembly shall be limited to the lowest allowable load based on the criteria of Sections 3.6.1.

3.4.8 Strength Criterion: An allowable uplift load based on the strength of the tie-down assembly shall be derived in accordance with Section 3.5.1 and Section 3.5.2 of this criteria, as applicable, and shall not be less than that required by IRC Section R602.10.6, depending on the application.

4.0 TEST METHODS

4.1 Apparatus:

4.1.1 Testing Machine: A testing machine that is capable of operation at a constant rate of motion of the movable crosshead or a constant rate of loading, and a force

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measuring device that is calibrated in accordance with ASTM E 4, shall be used.

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

4.1.2.1 When testing continuous rod tie-down components on a test apparatus, the displacement gauge shall measure the relative movement between the component to component assembly or between the component to substrate assembly. Placement of the dial gauges or LVDTs shall ensure accurate measurement of the relative movement.

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4.2 Test Sample Size:

4.2.1 Continuous rod tie-down Component Testing:

4.2.1.1 Differences in continuous rod tie-down component size, configuration, and material specifications shall be the basis for establishing a test sample size.

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4.2.1.2 A minimum of three continuous rod tie-down component for each type of component (size, configuration, and material specifications) shall be tested on a test apparatus.

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4.2.1.3 If the maximum test load for a tested component varies by more than 20 percent from the average, testing shall be conducted on three additional continuous rod tie-down components.

4.2.2 Continuous rod tie-down Assembly Testing:

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4.2.2.1 Differences in assembly configuration and component specifications (refer to Section 1.4.2) shall be the basis for establishing a test sample size.

4.2.2.2 A minimum of three continuous rod tie-down assemblies shall be tested for their intended usage and for each selected combination of variables affecting the continuous rod tie-down assembly performance.

4.2.2.3 If the maximum test load for a tested assembly varies by more than 20 percent from the average, testing shall be conducted on three additional continuous rod tie-down assemblies.

4.3 Test Setup:

4.3.1 General:

4.3.1.1 Continuous rod tie-down components and assemblies shall be tested individually in such a manner to simulate the essential function of the continuous rod tie-down component or assembly. Test loads shall be applied with reference to the intended end-use application of the continuous rod tie-down component or assembly.

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4.3.1.2 The anchor bolt/rod shall be fastened to the test apparatus in such a manner that the connection to the test bed does not affect the test results. Additionally, the anchor bolt/rod shall be attached to the test apparatus with a nut and washer in accordance with the end-use application (manufacturer's installation instructions).

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4.3.2 Continuous rod tie-down Assembly Testing:

4.3.2.1 Continuous rod tie-down assembly testing shall only

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require the application of load up to the displacement limitations described in Section 4.4.3 of this criteria.

4.4 Test Procedure

4.4.1 Preloading: An initial load, or preload, shall be applied for tension (uplift) load testing of continuous rod tie-down components or assemblies as follows: (1)

The nut securing the bearing plate shall be tightened as defined in the manufacturers installation instructions. (2) The testing machine load shall be recorded at this point (identified as preload). (3) Displacement measuring devices shall then be zeroed.

Deleted: <#>. Wood test members shall be conditioned to reach equilibrium with a moisture content of 11 to 19 percent when the continuous rod tie-down assemblies are tested. Refer to Section 3.2.1 of this criteria for details on measuring wood moisture content.¶

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4.4.2 Test Load Application and Recording: The test load shall be applied at a uniform crosshead rate between 0.03 and 0.20 inch (0.8 to 5.1 mm) per minute until failure or maximum load. Loads shall be recorded to a precision of 1 percent during application of test loads.

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

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Deleted: at strength-level-response displacement limits of 0.50 inch (12.6 mm) for continuous rod tie-down assembly testing on wood structural members and of 0.37 inch (9.4 mm) for continuous rod tie-down assembly testing on a steel jig.

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 Material Traceability: The evaluation report holder shall demonstrate 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

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high strength or heat treated threaded rods and high strength couplers.

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5.2.1 Mechanical Properties Testing Requirements: If high strength rod threaded rods defined in Section 5.2.2 are components of the tested assemblies, the applicant shall provide continual mill certificates and mechanical property test reports in their Quality Control manual on each batch or heat lot they procure.

5.2.1.1 The report holder shall obtain continual mechanical property test reports for the finished threaded product by the producing manufacturer in lieu of independent testing by an ICC approved test facility.

5.2.1.2 If the mechanical property test report is not available per 5.2.1.1, then the report holder shall obtain continual independent testing from an ICC approved test facility on each batch or heat lot they procure.

5.2.2 High strength threaded rod shall be defined to conform but not be limited to the following standards: ASTM A 193, A 325, A 354, A 434 and A 449.

5.2.3 Couplers and nuts used with high strength threaded rod shall comply with the cited rod standard recommendations and conform to ASTM A 563.

6.0 EVALUATION REPORT RECOGNITION

6.1 General: The evaluation report shall describe the continuous rod tie-down components with respect to material specifications.

6.2 Engineered Applications of Continuous rod tie-down components and Assemblies: The evaluation report shall provide a table specifying the following information:

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6.2.1 Continuous rod tie-down component dimensions.

6.2.2 Allowable steel-strength load of the continuous rod tie-down assembly shall be determined in accordance with Section 2.2 or 3.4 of this criteria, with the following footnoted information:

6.2.2.1 A statement indicating that the allowable load values of the continuous rod tie-down assembly are calculated per Section 2.2 or is based on a measure of steel strength of the components when tested on a test apparatus with a factor of safety of 2.5 applied to the (lowest or average, whichever is applicable) maximum test load.

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6.2.2.2 A statement indicating that when the registered design professional deems necessary, or when required by the local building code, a listed in compliance to IBC wood shrinkage compensating devices can be installed with consideration of controlling allowable values.

6.2.2.3 A statement indicating that the anchor bolt/rod elongation be designed in accordance to the building official if specific and established elongation limit is required and shall be checked by the registered design professional.

6.2.3 The lowest of the allowable loads, or at the option of the evaluation report applicant, all of the allowable loads of the continuous rod tie-down assembly, determined in accordance with Section 2.2 or 3.4 of this criteria, with the following footnoted information:

6.2.3.1 A statement indicating that the assembly shall have an

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allowable strength equal to or exceeding the required strength of the assembly under the action of the ASD (Allowable Stress Design) load combinations referenced in the applicable code.

6.2.3.2 A statement indicating which adjustment factors from the

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NDS is included in the derivation of the tabulated allowable load for wood compression members and steel to wood connections.

6.2.3.3 The following statement: “When using the basic load

combinations in accordance with IBC Section 1605.3.1 (or UBC Section 1612.3.1), the tabulated allowable loads for the continuous rod tie-down assembly shall not be increased for wind or earthquake loading. When using the alternate basic load combinations in IBC Section 1605.3.2 (or UBC Section 1612.3.2) that include wind or earthquake loads, the tabulated allowable loads for the continuous rod tie-down assembly shall not be increased by 33 1/3 percent, nor shall the alternative basic load combinations be reduced by a factor of 0.75.”

6.2.3.4 The following statement: The components covered by

this report are evaluated with respect to their performance characteristics to each other and the identified structural members. Uses of any components other than those identified within this report are not covered by this report. (Optional) Proprietary Hold-down connectors: Hold-down and structural capacities shall comply with AC155.

6.2.3.5 High strength threaded rod: A statement that the report

holder shall have mill certificates and mechanical property reports be available for local

building official inspection upon request that clearly shows conformance to the appropriate specification and the batch or heat lot used in the field.

6.3 Prescriptive Applications of Tie-down Assemblies According to the IRC

(Optional): For tie-down assemblies complying with Section 3.6 of this criteria, the evaluation report shall include the following information:

6.3.1 Tie-down component dimensions, and required components, including type, size, for attaching the tie-down components to the structural member.

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6.3.2 An allowable uplift load of the tie-down assembly, which shall not be less than that required by IRC Section R602.10.6, depending on the application.

6.3.3 A figure, drawn to scale, showing the complete tie-down assembly, including details on the concrete spread footing, anchorage to the concrete footing, and attachment of the tie-down components to the boundary members of the alternate braced-wall panel. The figure shall have sufficient detail and information such that the building official may use the evaluation report to verify compliance with Section R602.10.6 of the IRC and waive the requirement of submission of construction documents and other data according to Section R106.1 of the IRC.

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 continuous rod tie-down assemblies in contact with chemically treated preservative wood is subject to the approval of the building official, since the effects of corrosion of metal in

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contact with chemically treated wood on the structural performance of the components are outside the scope of this report.

6.4.2 Exterior Exposed Conditions: If the final installation of the tie-down assemblies is exterior exposed, the coating material for the threaded rod, coupler, bearing plate and nuts shall subject to the approval of the Building Official.

6.4.3 Duration of Load Increase: No further duration of load increase for wind or earthquake loading on the tie-down assemblies shall be allowed.

6.4.4 Drawings and Design Details: Drawings and design details verifying compliance with this report shall be submitted to the building official for approval. The 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.

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