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**To:** ICC-ES Evaluation Committee  
**From:** Jason Smart, ICC-ES Staff  
**Date:** June 10, 2010  
**Subject:** Proposed Revisions to the ICC-ES Acceptance Criteria for Shrinkage Compensating Devices, Subject AC391-0610-R1 (JS/BG)

**MEMO**

In response to the request for public comments noted in the May 13, 2010, staff letter on the subject, the following correspondence was received:

- Letter dated June 1, 2010, from Alfred D. Commins, President, Commins Manufacturing, Inc.
- Letter dated June 1, 2010, from Sam Hensen, PE, Branch Engineering Manager, Simpson Strong-Tie Co., Inc.
- Letter dated June 4, 2010, from Edward Chin, PE, Vice President, Earthbound Corporation.

After considering the comments provided in the aforementioned correspondence, ICC-ES staff believes that the following additional revisions should be made to the draft of AC391 proposed under cover of the May 13, 2010, staff letter:

- **Revise the last sentence of Section 1.2.1.3 as follows:**  
...shall not exceed the values determined in accordance with the IBC and Section 3.2 of this criteria.
- **Revise Section 1.3.7 as follows:**  
ASTM A ~~193-04a~~ 194-08, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both, ASTM International.
- **Add the following new standard reference to Section 1.3:**  
ASTM F 1554-07a, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength, ASTM International.
- **Revise Section 1.4.1 as follows:**  
**Continuous Rod Tie-down Run (CRTR):** A CRTR is made up of a particular series of any of the following components including: (1) continuously or partially threaded steel rod; (2) steel nuts; (3) steel bearing plates; (4) hold-downs; (5) threaded rod couplers; and/or (6) shrinkage compensating devices, as needed to transfer tension loads from a structure into a supporting element such as a foundation. For the purposes of this criteria, the CRTR is installed shall be limited to installations in light-framed walls and is shall be used to resist tension loads caused by vertical wind (uplift) restraint only.
- **Revise Section 1.4.2 as follows:**  
**Continuous Rod Tie-down System (CRTS):** A CRTS is ~~made up of a particular combination of the components listed a light-frame wood wall assembly containing multiple CRTRs, as defined in Section 1.4.1, in addition to the wood framing that transfers loads from and to the CRTR components~~ having (1) a specified wall height and stud spacing, (2) specified wood framing member grades and dimensions, (3) specified sheathing (if included within the evaluated CRTS), and (4) specified framing-to-framing, framing-to-sheathing and framing-to-CRTR connections. For purposes of this criteria, the CRTS shall be limited to installations in light-frame wood walls, and shall only be used to resist tension loads caused by vertical wind (uplift) restraint.

- Revise Section 1.4.4 as follows:

**Steel Nuts:** Steel nuts used with continuously or partially threaded steel rod as defined in Section 1.4.3 shall ~~satisfy the requirements cited in the rod specification, comply with ASTM A 563 or ASTM A 194. Nut dimensions shall comply with ANSI B18.2.2.~~ The strength of the nuts shall comply with the proof load requirements of the applicable nut specification. High strength hex nuts shall be used with high strength threaded rod.

- Revise the second sentence of Section 1.4.5 as follows:

The minimum ASD strength, as established through testing in accordance with Section 4.1, shall equal or exceed the ASD strength of the connected threaded rod.

- Revise Section 1.4.6 as follows:

**Steel Bearing Plate:** Steel bearing plates used ~~with threaded steel rod as defined in Section 1.4.3~~ within a CRTR shall satisfy the flexural requirements of AISC 360 and the wood-bearing requirements of the 2005 NDS.

- Revise the second sentence of Section 2.1.1 as follows:

Material specifications shall comply with applicable referenced standards noted in Section 1.3 of this criteria, or with the applicant's published specification.

- Revise Section 2.1.3 as follows:

**System Calculations:** For CRTR evaluations, full system sample calculations shall be submitted, considering all of the design considerations given in Section 6.2.3 of this criteria. For CRTS evaluations, full system calculations shall be submitted in accordance with Section 3.2.2.

- Revise Section 3.1.1 as follows:

**Component Capacities:** Allowable (ASD) loads and corresponding displacements of the threaded rods and bearing plates shall be determined by calculations in accordance with Section 3.2.1 of this criteria. Allowable (ASD) loads and corresponding displacements for threaded rod couplers and other proprietary components that do not comply with a referenced standard or an ICC-ES acceptance criteria shall be determined ~~through testing~~ in accordance with Sections 3.4.1.1 and 3.4.1.2, respectively, based on testing in accordance with Section 4.1. Allowable (ASD) loads and corresponding displacements for hold-downs and shrinkage compensating devices shall be evaluated in accordance with AC155 and AC316, respectively. Displacements for shrinkage compensating devices shall include the device average travel and seating increment,  $\Delta_R$ , as defined in AC316, which is independent of load.

- Revise Section 3.2.1 as follows:

**Component Calculations:** ASD loads and corresponding displacements of the threaded rods and steel bearing plates shall be calculated in accordance with Sections 3.2.1.1 and 3.2.1.2, respectively....

- Revise Section 3.2.1.1 as follows:

**Threaded Rod:** The ASD steel tension load capacity and elongation shall be calculated in accordance with AISC 360. Threaded rod elongation shall be based on the ~~root net tensile area.~~ Elongation,  $\Delta_{rod}$ , shall be limited to 0.18 inches (4.6mm) for total rod length at the allowable (ASD) load. ~~Root-Rod elongation,  $\Delta_{rod}$ , and net tensile area,  $A_r A_n$ ,~~ shall be determined in accordance with Equation 1.

- Replace Equation 1 with the following:

$$\Delta_{rod} = \frac{PL}{A_n E} \quad (\text{Eq. 1})$$

where:

$$A_n = 0.7854 \left( D - \frac{0.9743}{n} \right)^2$$

$A_r$  = cross-sectional area at minor diameter, in<sup>2</sup> or mm<sup>2</sup>

$A_n$  = net tensile area, in<sup>2</sup> or mm<sup>2</sup>

$E$  = steel modulus of elasticity = 29,000,000 psi (200,000 MPa)

$L$  = total rod length, in or mm

$P$  = tension in rod, lbs or N

- $D$  = basic major diameter, in. or mm  
 $n$  = number of threads per inch of rod length (Ref. ASME B1.1)

- Add the following to the end of Section 3.2.1.2:

Displacements of the CRTR resulting from bearing plate bending and wood compression shall be calculated assuming a wood bearing deformation of 0.040 inch at the adjusted compression design value perpendicular-to-grain, and a linear load-deformation relationship up to that point.

- Revise the first sentence of Section 3.2.2.1 as follows:

The flexural capacity of two wood top plates ~~working as~~ acting as a composite member...

- Revise the second sentence of Section 3.3.1.3 as follows:

...shall not exceed ~~40~~110 percent of the code-specified value for that lumber species and grade.

- Add a new Section 3.4.1.1 as follows:

**Allowable (ASD) Loads for Threaded Rod Couplers:** Threaded rod couplers shall be tested for all rod sizes, including transition couplers, in which recognition is sought. For each size, a minimum of three threaded rod couplers shall be tested in accordance with Section 4.1, and the threaded rod coupler shall develop 100 percent of the intended rod tensile strength,  $F_u$  of the rod, and 125 percent of the specified yield strength,  $F_y$  of the intended rod.

- Renumber Section 3.4.1.1 as Section 3.4.1.2, and revise as follows:

**Allowable (ASD) Loads for Threaded Rod Couplers and Other Proprietary Components Not Complying with a Referenced Standard or Acceptance Criteria:** Where the sample size of tests performed on ~~threaded rod couplers and other~~ proprietary components tested in accordance with Section 4.1 is three to five, the ASD load is the lowest peak value from a single specimen divided by a factor of safety of 3.0. Where the test sample size is six or more, the ASD load is the mean peak value from all specimens divided by a factor of safety of 3.0. The ASD loads shall be adjusted in accordance with Section 3.5, as applicable.

- Revise Section 4.1.5 as follows:

**Test Procedure:** Threaded rod couplers and other proprietary components shall be tested in tension, in accordance with ASTM A 370. Where pretensioning of the threaded rod occurs during installation, 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 manufacturer's installation instructions. (2) The testing machine load shall be recorded at this point (identified as preload). (3) Displacement measuring devices shall then be zeroed. 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. 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. At a minimum, each threaded rod coupler or proprietary component shall develop the greater of 100 percent of the specified tensile strength,  $f_u$ , times the net area of the threaded rod, or 125 percent of the specified yield strength,  $f_y$ , times the net area of the threaded rod. ~~The net tensile area of the threaded rod coupler or proprietary component shall be taken as 0.75 times the gross area.~~

- Revise Section 5.2 as follows:

**Manufacturing Facility Inspections:** If any of the CRTR or CRTS components incorporate structural welds or are manufactured using materials complying with an applicant's published specification, inspections by an inspection agency accredited by the International Accreditation Service, or otherwise acceptable to ICC-ES, shall be provided. Third-party follow-up inspections are not required for CRTR or CRTS that do not contain welded components or components that are manufactured using materials complying with a referenced specification.

- Revise Figures 2 and 3 as shown in the letter from Sam Hensen, PE, Branch Engineering Manager, Simpson Strong-Tie Co., Inc., dated June 1, 2010.

Staff believes the following additional issues, which were raised within the aforementioned letters, warrant further discussion:

- The letter from Commins Manufacturing, dated June 1, 2010, includes a comment suggesting that AC391 should require all threaded rod couplers used within a CRTR or CRTS to have sight holes located no closer than the minimum required engagement distance from the end of the coupler. It should be noted that note 7 on page D-23 of IFI-128 indicates that “Nuts shall be furnished *without* a hole, unless specifically ordered by the purchaser.” Staff seeks input from the industry regarding this issue.
- Two of the comments provided in the Earthbound letter dated June 4 express concern regarding the 0.180-inch rod elongation limit and 0.250-inch system deformation limit. In these comments, the sources of these deformation limits are questioned. There also appears to be lack of clarity as to whether these deformation limits apply to the entire CRTR/CRTS height, or if they apply to deformations within each story. Staff seeks additional input regarding the deformation limit provisions within the proposed AC391 draft.
- One of the comments received includes proposed revisions that would require a CRTR to be limited to applications within light-frame wood walls only. The proposed AC391 draft limits CRTS evaluations to applications within light-frame wood walls; however, on CRTR evaluations, there is no such limitation, since framing is explicitly outside the scope of a CRTR evaluation.
- In considering the revision proposed to the second sentence of Section 4.1.5 in the Simpson Strong-Tie letter dated June 1, 2010, it should be noted that Section 4.1 (and subsections therein) apply only to individual component testing performed on couplers and other proprietary components that do not comply with a referenced standard or acceptance criteria. Staff questions whether these proposed revisions belong in Section 4.1.5.

Staff thanks the committee for consideration of these comments.