ICC EVALUATION SERVICE

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February 12, 2010

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

SUBJECT: Acceptance Criteria for Continuous Rod Tie-Down Assemblies Used to Resist Wind Uplift, Subject AC391-0210 (JS/BG)

Dear Madam or Sir:

Enclosed is a copy of the subject revised acceptance criteria approved by the ICC-ES Evaluation Committee on February 2, 2010, effective March 1, 2010.

The revisions include:

1. The scope of the acceptance criteria has been revised such that it applies only to continuous rod tie-down assemblies that are used to resist wind uplift loads. Continuous rod tie-down assemblies used to resist wind or seismic shear wall overturning forces are now outside the scope of the criteria. Revisions have been made throughout the criteria, including the title, and Sections 1.1, 1.2, 1.4, 6.3 and 6.5.

2. Revisions have been made to Sections 1.1, 1.2, 3.1, 6.2 and 6.3 to clarify that evaluations performed in accordance with AC391 apply only to continuous rod tie-down *assemblies*, and *not* to the other elements of the wall *system* (i.e., framing and other elements within the wind uplift resisting load path). New Sections 6.4 and 6.5.5 have been added, requiring the inclusion of specific language regarding this scope limitation within the *Design* and *Conditions of Use* sections of the evaluation reports.

3. New Section 2.1.3 has been added, requiring the submittal of full system sample calculations to ICC-ES. Sample calculations must consider all of the design considerations given in new Section 6.4. In accordance with Section 4.1 of the ICC-ES Rules of Procedure for Evaluation Reports, these calculations must be prepared and sealed by a registered design professional.

Evaluation reports issued on or after the effective date noted above, and falling within the scope of this criteria, will be required to comply with the enclosed edition of the criteria. Evaluation reports issued prior to the effective date may be in compliance either with the enclosed acceptance criteria or with the previous edition. Evaluation reports based on a superseded version of an acceptance

criteria must be brought into compliance with the most recent edition at the time the reports are reissued. Therefore, applicants should submit data verifying compliance at the time they apply for re-examination.

If you have any questions, please contact Jason V. Smart, Senior Evaluation Specialist, at (800) 423-6587, extension 5692. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

Gary G. Nichols, PE, SECB
Vice President

GGN/raf

Enclosure

cc: Evaluation Committee

ICC EVALUATION SERVICE

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ACCEPTANCE CRITERIA FOR CONTINUOUS ROD TIE-DOWN ASSEMBLIES USED TO RESIST WIND UPLIFT

AC391

Approved February 2010

Effective March 1, 2010

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.

This acceptance criteria has been issued to provide all interested parties with guidelines for demonstrating compliance with performance features of the applicable code(s) referenced in the acceptance criteria. The criteria was developed and adopted following public hearings conducted by the ICC-ES Evaluation Committee, and is effective on the date shown above. All reports issued or reissued on or after the effective date must comply with this criteria, while reports issued prior to this date may be in compliance with this criteria or with the previous edition. If the criteria is an updated version from the previous edition, a solid vertical line (**I**) in the margin within the criteria indicates a technical change, addition, or deletion from the previous edition. A deletion indicator (➜) is provided in the margin where a paragraph has been deleted if the deletion involved a technical change. This criteria may be further revised as the need dictates.

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 set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria set forth in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise demonstrate compliance with the performance features 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 if 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.

ACCEPTANCE CRITERIA FOR CONTINUOUS ROD TIE-DOWN ASSEMBLIES USED TO RESIST WIND UPLIFT (AC391)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for continuous rod tie-down assemblies used to resist wind uplift, to be recognized in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2009 *International Building Code*® (IBC), and the 2009 *International Residential Code*® (IRC). 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 continuous rod tie-down assemblies used to resist wind uplift, since the IBC, IRC, and associated referenced standards do not specify qualification, installation, design, and quality requirements for such assemblies.

1.2 Scope:

1.2.1 This criteria provides methods to establish the Allowable Stress Design (ASD) loads for continuous rod tie-down assemblies used to resist wind uplift, based on tests or calculation. The evaluation report applicant has the option of deriving tie-down assembly or component capacities by either test-based methodology or calculation-based methodology. This acceptance criteria is limited to determining the continuous rod tie-down assemblies' capacity to resist tension loads caused by wind uplift restraint in light-framed, cold-formed steel or wood structures. Continuous rod tie-down assemblies shall be considered to be independent from the lateral load–resisting system (e.g., shear wall). Uplift load–resisting system considerations, including framing, connections, and other elements within the wind uplift resisting load path shall be considered and designed separately and are outside the scope of this criteria. Installations are limited to dry, interior locations protected from exposure to weather, except as permitted by Section 3.5 of this criteria.

1.2.1.1 ASD allowable loads and load-deflection characteristics for continuous rod tie-down assemblies shall be based on measured (tested) or calculated strength characteristics, and measured (tested) or calculated displacement characteristics.

1.2.1.2 ASD allowable loads and load-deflection characteristics for continuous rod tie-down assembly components shall be based on measured (tested) strength or calculated strength of the components.

1.2.2 This criteria is applicable to continuous rod tie-down components and assemblies as defined in Sections 1.4.1 and 1.4.2, respectively, of this criteria.

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

1.2.3.1 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.

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

1.2.3.3 Anchorage to concrete or masonry.

1.2.3.4 Assemblies using wire rope or cable as the tension component.

1.2.3.5 Continuous rod tie-down assemblies used to resist wind or seismic shear wall overturning forces.

1.3 Codes and Referenced Standards:

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

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

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

1.3.4 ASTM A 36–05, Standard Specification for Carbon Structural Steel, ASTM International

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

1.3.6 ASTM A 307-04e01, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength, ASTM International

1.3.7 ASTM A 325-04b, Standard Specification for Structural Bolts, Steel, Heat Treated,120/105 ksi Minimum Tensile Strength, ASTM International.

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

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

1.3.10 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, ASTM International.

1.3.11 ASTM A 563-04, Standard Specification for Carbon and Alloy Steel Nuts, ASTM International.

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

1.3.13 ACI 318-08, Building Code Requirements for Structural Concrete and Commentary, American Concrete Institute.

1.3.14 ACI 530-08, Building Code Requirements for Masonry Structures and Specifications for Masonry Structures, American Concrete Institute.

1.3.15 ANSI/AISI S100-2007, North American Specification for the Design of Cold-Formed Steel Structural Members, American Iron and Steel Institute.

1.3.16 AC155, Acceptance Criteria for Hold-downs (Tie-downs) Attached to Wood Members, ICC Evaluation Service, Inc.

1.3.17 AC316, Acceptance Criteria for Shrinkage Compensating Devices, ICC Evaluation Service, Inc.

1.4 Definitions:

1.4.1 Continuous Rod Tie-down Assembly: A continuous rod tie-down assembly is installed in cold-

formed steel or wood light-framed walls and is used to resist tension loads caused by vertical wind (uplift) restraint. Continuous rod tie-down assemblies shall include all components defined in Section 1.4.2 that are needed to transfer tension loads from a structure into a supporting element such as a foundation.

1.4.2 Continuous Rod Tie-down Assembly Components: A continuous rod tie-down assembly consists of the following components: (1) steel rods; (2) metal intermediate connectors or coupling devices used to attach the continuous rod tie-down components, such as hold-downs evaluated in an ICC-ES evaluation report in accordance with AC155, or shrinkage compensating devices evaluated in an ICC-ES evaluation report in accordance with AC316, if applicable; and (3) steel bearing plates or washers used to enhance the performance of the assembly.

1.4.3 Threaded Steel Rod: Mild steel threaded rod shall comply with ASTM A 36 or ASTM A 307. High-strength threaded steel rod shall comply with one of the following standards: ASTM A 193, A 325, A 354 or A 449. Other specifications may be acceptable with prior concurrence of ICC-ES staff.

1.4.4 Nuts: Nuts used with threaded steel rod as defined in Section 1.4.3 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.

1.4.5 Couplers: The evaluation report applicant shall submit coupler dimensions and material specifications to justify the coupler capacity, including cross-sectional area and thread engagement lengths. Complying couplers shall be supplied by the evaluation report applicant and shall be described in the quality documentation.

1.4.6 Manufacturer Exclusive or Tested Items: An exclusive or tested item submitted for testing is any item that has a characteristic or property that does not comply with the code-referenced standards. These characteristics or properties may include, but are not limited to, such things as ultimate tensile strength or mechanical configuration.

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 information on protective coatings and the manufacturing process (including welds, if applicable). Material specifications shall comply with applicable referenced standards noted in Section 1.3 of this criteria. If a material used in the calculation method has higher strengths than specified in the referenced standards, verification of the higher strength, through certification, shall be required in the quality control documentation in accordance with Section 5.3.1.

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

2.1.3 System Calculations: Full system sample calculations, considering all of the design considerations given in Section 6.4 this criteria.

2.1.4 Packaging and Identification: Descriptions are required of field identification methods for the continuous rod tie-down components. For components that comply with the standards referenced in Section 1.3 of this criteria, identification provisions shall comply with the stated requirements. For manufacturer exclusive or tested items, components shall be clearly identified as to the manufacturer (such as a registered trademark), the model number, the ICC-ES evaluation report number (ICC-ES ESR-XXXX), 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 continuous rod tie-down assembly and its components, or individually tested components, including drawings 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 assemblies described in 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, elongation, and base-metal thickness.

2.3.3 A description of the components, including the information required in Section 3.2 of this criteria.

2.3.4 Detailed drawings of the test setup, depicting location and direction of load application, location of displacement instrumentation and points of reference, and details of any deviations from the test requirements as outlined in Section 4.0 of this criteria. Additionally, photographs shall supplement the detailed drawings confirming the test setup, and failure modes during and after testing.

2.3.5 Individual and average maximum test load values observed. There shall be a 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.

2.3.6 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.

2.4 Product Sampling: Sampling shall comply with Section 3.1 of AC85 for welded continuous rod tie-down components. Sampling shall comply with either Section 3.1 or Section 3.2 of AC85 for continuous rod tie-down components fabricated without welds. The testing laboratory shall check and report on the characteristics of the specimens to confirm compliance with the drawings and specifications referenced in Section 2.1.1 of this criteria.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 General: Allowable loads shall be determined by testing in accordance with Sections 3.1 through 3.3 of this criteria or by calculations in accordance with Section 3.4. Testing may be utilized where the assembly contains a component that does not comply with a referenced standard or acceptance criteria; or where the performance of the assembly cannot be confirmed by calculation. Testing, when used, shall include tests of various lengths of assemblies to confirm length effects on deflection.

3.1.1 Tension Load Testing: 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 of this criteria . The ASD allowable steel tension load capacity shall be calculated from tested maximum load in accordance with AISC 360 or in accordance with either AC155 or AC316, as applicable. In addition, load deflection characteristics shall be reported.

3.2 Test Materials:

3.2.1 Steel: The steel properties of the tested continuous rod tie-down components, including yield point, tensile strength, elongation, and uncoated base-metal steel thickness, shall be determined by testing in accordance with the corresponding referenced standard. As an alternative, mill certificates shall be provided for the specific heat or lot of material subjected to the load tests described in this acceptance criteria.

3.2.1.1 Standard Steel Components Used in Typical Assemblies: If tested yield and tensile strengths or dimensions of the steel components exceed minimum specified values as established in accordance with Section 2.1 of this criteria, the allowable loads determined in accordance with Section 3.3 shall be proportionally reduced.

3.2.2 Components: All components that are used in continuous rod tie-down assembly testing shall be sampled from the same manufacturer's lot in accordance with Section 2.4.

3.2.2.1 Anchor bolts and threaded rods shall comply with a standard referenced in Section 1.3

3.3 Factor of safety: Factor of safety for determination of ASD allowable loads from test results:

3.3.1 Continuous Rod Tie-down Assemblies and Components: Except as set forth in Section 3.3.3, the allowable load shall be determined as follows:

3.3.1.1 Where the test sample size is three to five, the allowable load is the lowest peak value from a single specimen divided by a factor of safety of 3.

3.3.1.2 Where the test sample size is six or more, the allowable load is the mean peak value from all specimens divided by a factor of safety of 3.

3.3.1.3 The allowable loads derived in accordance with Section 3.3.1.1 or 3.3.1.2 shall be adjusted in accordance with Section 3.2.1.1, as applicable.

3.3.2 Threaded Rod Couplers: For threaded rod coupling components used to extend the continuity of the anchors, the minimum ASD strength shall equal or exceed the ASD strength of the connected threaded rod. Couplers shall be tested in accordance with Section 4.5. The report applicant shall submit minimum coupler dimensions and material specifications to justify the coupling cross-sectional area and thread engagement lengths that satisfy this requirement. These couplers shall be procured by the report applicant and documented in the quality control manual.

3.4 Continuous Rod Tie-down Design Load Calculations: In lieu of testing described in Sections 3.1 through 3.3 of this critieria, calculations determining the ASD allowable load for certain components shall be submitted in accordance with the following requirements:

3.4.1 Threaded Rod Capacities: The ASD steel and Load Resistance and Factor Design (LRFD)_tension load capacity and elongation shall be calculated in accordance with AISC 360.

3.4.2 Steel Bearing Plate Capabilities: For steel plate materials, ASD and LRFD structural capacities shall be calculated in accordance with AISC 360. For plate bearing against wood, ASD structural capacities shall be calculated in accordance with Section 3.4.5 of this criteria.

3.4.3 Nuts and Couplers: Nuts and thread engagement length of couplers shall comply with ASTM A 563. High-strength-grade nuts and couplers shall be used with corresponding high-strength-grade threaded rod. When calculating the minimum dimensions of a coupler, the cross-sectional area and thread engagement length shall be sufficient such that the coupler strength exceeds the greater of 100 percent of the specified tensile strength, f_u of the threaded rod or 125 percent of the specified yield strength, f_y, of the threaded rod, based on threaded rod gross cross-sectional area (Ag).

3.4.4 ASD Allowable Load and Deflection: The ASD allowable 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. The cumulative deflections corresponding to the ASD load and the LRFD load shall be established, along with variations due to length of the assembly.

3.4.5 Steel-to-wood Bearing Calculations: ASD load and deformation values for steel-to-wood bearing connections shall be calculated in accordance with the ANSI/AF&PA NDS and shall consider the following: (1) contact area of the steel bearing plate supported by a wood member attached to the threaded rod by a continuous rod tie-down component; and (2) applicable adjustment factors specified in the ANSI/AF&PA NDS. In addition, for LRFD, the deformation at 1.4 times the ASD load shall be reported.

3.4.6 Wood-to-wood Compression Calculations: ASD load and deformation values for wood-to-wood connections in compression shall be calculated in accordance with the ANSI/AF&PA NDS. In addition, for LRFD, the deformation at 1.4 times the ASD load shall be reported

3.4.7 Steel-to-steel Compression Calculations: ASD load and deformation values for steel to cold-formed steel shall be determined in accordance with AISC 360 for steel bearing plates. The plates shall be designed to span across cold-formed steel support members. The cold-formed steel support members shall be designed in accordance with ANSI/AISI S100.

3.5 Exterior Exposure or Damp Environments: Where the continuous rod tie-down assembly is intended for exterior exposure or damp environments, evidence of durability shall be submitted. The steel components shall be produced from corrosion-resistant stainless or zinc-coated steel. 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 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-measuring device that is calibrated in accordance with ASTM E 4, shall be used. A typical apparatus is illustrated in Figure 1.

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 continuous rod tie-down components are tested, 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 ensure accurate measurement of the relative movement.

4.2 Test Specimen Quantity:

4.2.1 Continuous Rod Tie-down Component Testing:

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

4.2.1.2 If the maximum test load for an individual tested component varies by more than 15 percent from the average result, testing shall be conducted on three or more additional (six or more, total) continuous rod tie-down components.

4.2.2 Continuous Rod Tie-down Assembly Testing:

4.2.2.1 Differences in assembly configuration and component specifications, as indicated in Section 1.4.2 of this criteria, shall be the basis for establishing the test specimen quantity.

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 an individual tested assembly varies by more than 15 percent from the average result, testing shall be conducted on three or more (six or more, total) 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 and independently in such a manner as 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.

4.3.1.2 The anchor bolt or 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 or rod shall be attached to the test apparatus with a nut and washer in accordance with the end-use application as set forth in the manufacturer's installation instructions.

4.3.2 Continuous Rod Tie-down Assembly Testing:

4.3.2.1 Continuous rod tie-down assembly testing shall only require the application of load up to the peak load or capacity of the critical component.

4.4 Test Procedure

4.4.1 Preloading: 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.

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 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 the greater of 100 percent of the specified tensile strength, f_u of the threaded rod, or 125 percent of the specified yield strength, f_y, of the threaded rod.

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 assembly 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. 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 assemblies 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 for 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 1.4.3.

5.3.3 Couplers and nuts used with high-strength threaded rod shall comply with Sections 1.4.4 and 1.4.5.7.

6.0 EVALUATION REPORT RECOGNITION

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

6.2 Engineered Applications of Continuous Rod Tie-down Components and Assemblies: The evaluation report shall include a table specifying the following information:

6.2.1 Continuous rod tie-down component dimensions as set forth in Section 2.1.1 of this criteria.

6.2.2 ASD and LRFD (1.4 times the ASD load) load and load-deflection characteristics of the continuous rod tie-down assembly as determined in accordance with Section 3.3 or Section 3.4 of this criteria, 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 or wood shrinkage compensating devices evaluated in an ICC-ES evaluation report may be installed with consideration of corresponding allowable values.

6.2.2.2 A statement indicating that the contribution of anchor bolt or rod elongation, wood shrinkage, wood deformation under load, and fastener or component slip, to the overall deflection of the continuous rod tie-down assembly, shall be analyzed by the registered design professional.

6.2.2.3 A statement indicating that the allowable loads are obtained from calculations or from tests on the assemblies or components. Other variables that may further limit capacities, such as anchorage strength in tension or shear, net tension of wood or steel members, and compression of wood or steel members, shall be analyzed by the registered design professional.

6.2.3 The lowest of the ASD allowable loads or, at the option of the evaluation report applicant, the ASD allowable loads for each component of the continuous rod tie-down assembly, determined in accordance with Section 3.3 or Section 3.4 of this criteria, with the following footnoted information:

6.2.3.1 A statement indicating that the assembly shall have an ASD allowable strength equal to or exceeding the required strength of the assembly determined in accordance with the ASD (Allowable Stress Design) load combinations referenced in the applicable code.

6.2.3.2 A statement indicating which adjustment factors taken from the ANSI/AF&PA NDS are included in the derivation of the tabulated allowable loads 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, 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 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 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.”

6.2.3.5 For assemblies with high-strength threaded rod, a statement that the report holder shall have available, upon request by the code official, current mill certificates and mechanical property test reports to demonstrate compliance with the appropriate specification for each batch or heat lot to be used in the field.

6.2.3.6 A statement indicating that capacities for the continuous rod tie-down assemblies are not intended to represent the capacity of framing systems connected to the assemblies.

6.2.3.7 The following statement: “Design of the framing systems is the responsibility of the design professional, and must be performed in accordance with the applicable code, considering all of the design considerations given in Section X of this report”, where “Section X” is the section of the evaluation report containing the design information required under Section 6.4 of this criteria.

6.3 Continuous Rod Tie-down Assembly Diagrams: The evaluation report shall include sample multistory diagrams that clearly illustrate the complete continuous tie-down assembly used to resist wind uplift. Diagrams of typical system assemblies shall be submitted for intended multistory wood and cold-formed steel frame construction applications, and show building tie-off points, and clearly depict intended load path to supporting foundation or anchorage point via the wood or cold-formed steel members. Special anchorage conditions, such as a steel beam or wood beam connection, may optionally be included. Each diagram shall include a statement indicating that the design of the framing systems is the responsibility of the design professional, and shall be performed in accordance with the applicable code, considering all of the design considerations given in Section 6.4 of this criteria.

6.4 Design: The evaluation report shall include a section entitled "Design," which shall include the following:

6.4.1 A statement indicating that the design of framing and other elements within the wind uplift resisting load path is the responsibility of the design professional, and shall be performed in accordance with the applicable code, considering loads, displacements, shrinkage, etc.

6.4.2 A statement indicating that the design of wall top plates receiving uplift load and distributing it to points of restraint (tie-downs) shall consider both deflection and strength limit states, including combined axial and flexural stress for cases where the wood top plate(s) also acts as a drag strut or collector, and shall also consider geometric compatibility.

6.4.3 A statement indicating that a positive method to resist torsional rotation and cross-grain flexure 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; and that calculations in accordance with principles of mechanics shall be used to determine the demand on connections used to resist top plate torsion.

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

6.5.1 Chemically Treated Preservative- or Fire-treated Wood: The use of continuous rod tie-down assemblies 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.

6.5.2 Exposure: Installation of the tie-down assemblies shall be limited to dry interior locations. As an option, however, installations may be allowed in exterior exposures or damp environments when evidence of compliance with Section 3.5 of this criteria is provided.

6.5.3 Duration of Load Increase: No further increase in duration of load for wind loading shall be allowed for the tie-down assemblies.

6.5.4 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.

6.5.5 Framing Members: The following statement shall be included as a condition of use: "Design of the framing systems is the responsibility of the design professional, and must be performed in accordance with the applicable code, considering all of the design considerations given in Section X of this report", where "Section X" is the section of the evaluation report containing the design information required under Section 6.4 of this criteria. ■

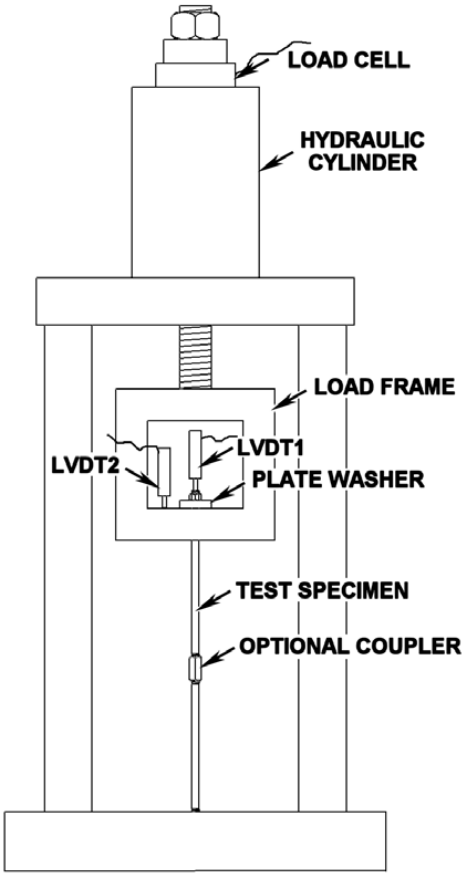

FIGURE 1—SAMPLE TEST APPARATUS