ICC EVALUATION SERVICE, INC.
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April 3, 2008

TO: **PARTIES INTERESTED IN PIN-CONNECTED OPEN-WEB TRUSSES WITH WOOD CHORDS AND TUBULAR STEEL WEBS**

SUBJECT: Proposed Revisions to the Acceptance Criteria for Pin-connected Open-web Trusses with Wood Chords and Tubular Steel Webs, Subject AC306-0408-R2 (JVS/RK/KS)

Dear Madam or Sir:

The revisions proposed to the subject acceptance criteria, noted in the enclosed criteria draft, are being posted on the ICC-ES web site to allow for public comment. The revisions may be summarized as follows:

1. A reference to AF&PA Technical Report 12 (TR-12), General Dowel Equations for Calculating Lateral Connection Values, has been added to Section 1.3.

2. A statement has been added to Section 2.1.1 clarifying that the acceptance criteria applies to trusses having parallel chords, tapered chords, pitched chords, and other shapes.

3. Section 3.0 (Test and Performance Requirements) is being reorganized for clarity, and includes the following changes:

   a. Former Sections 3.1.1 through 3.1.4 have been deleted, and the provisions contained within these sections have been reorganized into new Sections 3.3, 3.4 and 3.5.

   b. Former Section 4.7 has been moved to new Section 3.2. A statement has been added requiring that the analysis address the chord net section at pin holes.

   c. The requirements of former Section 3.1.1 have been moved to new Section 3.3.

   d. To clarify web analysis requirements formerly included under Section 3.1.3, references to AISI NAS Sections C2, C4, and E3.3.2 have been added to the new Section 3.3.

   e. New Sections 3.3.1 and 3.3.2 clarify the requirements for derivation of allowable web tension and compression design values, respectively.

f. New Section 3.4 provides greater detail on the requirements for derivation of allowable lateral loads for pin connections. AF&PA TR-12 is referenced for configurations in which gaps exist between the chord and web members.

g. Proposed changes to new Section 3.5 provide greater detail on the testing and analysis requirements for top and bottom chord bearing. A reference has been added to refer the user to new Appendix C (Chord Bearing Tests), which contains proposed testing requirements for derivation of allowable chord bearing values.

4. The order of former Appendices A and B has been reversed to coincide with the order in which they are referenced within the criteria. Thus, Appendix A now contains the web testing provisions, and Appendix B contains provisions for derivation of safety factors to be applied to the values derived in Appendix A.

5. Section 2.0 of Appendix A (formerly Appendix B) is being revised to require that actual base metal thickness, yield strength, and ultimate tensile strength be measured and reported for the web members tested.

6. Changes have been proposed to Sections 3.0 and 4.0 of Appendix A, to require that the test assembly include wood spacers between the metal plates and the flattened portion of the web members. Also, the proposed changes would require the degree of confinement of the flattened portions of the web members within the test assemblies to be the same as specified in the manufacturing standard. New diagrams have been proposed for Figures A1 and A2 to depict proposed changes to the test assembly.

7. Numerous editorial revisions have been made to Appendix B (formerly Appendix A).

8. Proposed new Appendix C provides test requirements for chord bearing testing.

Comments are requested on the proposed changes and, in particular, on the following items:

1. In Appendix A (formerly Appendix B), regarding the proposed changes to the test assemblies. Specifically, justification is requested for requiring wood spacers between the flattened ends of the web members and the metal plates of the test fixture.

2. In Section 3.0 of Appendix B (formerly Appendix A), regarding whether the test results should be adjusted to account for cases where the base metal thickness of the tested web member is greater than the specified thickness (similar to the adjustment currently required for cases where the actual ultimate tensile strength is greater than the specified ultimate tensile strength).

3. Comments are requested on the end reaction testing procedures proposed in the new Appendix C.

You are cordially invited to submit written comments, within 30 days of the date of this letter. An explanation of the alternate criteria process can be found on our web site at http://www.icc-es.org/Criteria_Development/alternative_criteria_process.shtml.

All comments received in the 30-day comment period will be considered in preparing revisions to the criteria that may be considered at a future Evaluation Committee meeting. Comments received will be posted on the web site shortly after the close of the comment period.

Your cooperation is requested in forwarding to the Los Angeles business/regional office all material directed to the Evaluation Committee. Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members. The committee reserves the right to refuse communications that do not comply with this request.

Newly approved acceptance criteria may involve test methods or test protocols that are not currently included in the scope of testing services offered by accredited testing laboratories. As noted in the ICC-ES Rules of Procedure for Evaluation Reports, the scope of the laboratory's accreditation must include the type of testing that is to be reported to ICC-ES. We encourage accredited laboratories to expand their scopes of accreditation to include testing under newly approved acceptance criteria. Please note that testing laboratories must be accredited by the International Accreditation Service (IAS) or by another accreditation body that is a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement. For further information, please contact IAS at (562) 699-0541, extension 3309, or send an e-mail to pmccullen@iasonline.org.

If you have any questions, please contact the undersigned at (800) 423-6587, extension 5692, or Russ Krivchuk, Senior Staff Engineer, at extension 3231. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

Jason Smart
Senior Evaluation Specialist

JVS/raf

Enclosure

cc: Evaluation Committee

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR PIN-CONNECTED OPEN-WEB TRUSSES WITH WOOD CHORDS AND TUBULAR STEEL WEBS

AC306

Proposed April 2008

Effective ~~May 1, 2007~~

Previously approved February 2006

PREFACE

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

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

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

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

PROPOSED REVISIONS TO THE ACCEPTANCE CRITERIA FOR PIN-CONNECTED OPEN-WEB TRUSSES WITH WOOD CHORDS AND TUBULAR STEEL WEBS

1.0 INTRODUCTION

1.1 Purpose: The purpose of this criteria is to establish minimum requirements for recognition of pin-connected open-web trusses with wood chords and tubular steel webs in ICC-ES evaluation reports under the 2006 *International Building Code*® (IBC), the 2006 *International Residential Code*® (IRC), the BOCA® *National Building Code*/1999 (BNBC), the 1999 *Standard Building Code*© (SBC), and the 1997 *Uniform Building Code*™ (UBC).

The reason for the development of this criteria is to provide information in regard to a combined analytical and empirical approach to qualify the trusses, since the current codes do not provide such information.

1.2 Scope: This acceptance criteria applies to proprietary pin-connected open-web trusses with wood chords, consisting of sawn lumber~~,~~ or other wood-based material, ~~and~~ tubular steel webs and solid steel pins used as structural members. The chord members are continuous ~~and~~, or are fabricated with finger joints, or proprietary connections, as required by design. The tubular steel web members are fabricated from cold-rolled steel tubing and die-stamped to the lengths required by design. The web members are pin-connected to the chord members. The trusses are used as floor or roof framing members.

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 BOCA® *National Building Code*/1999 (BNBC).

1.3.4 1999 *Standard Building Code*© (SBC).

1.3.5 1997 *Uniform Building Code*™ (UBC).

1.3.6 ASTM D 2559-04, Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions, ASTM International.

1.3.7 ASTM E 73-83 (2002), Practice for Static Load Testing of Truss Assemblies, ASTM International.

1.3.8 ASTM E 119-00, Test Method for Fire Tests of Building Construction and Materials, ASTM International.

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

1.3.10 ASTM D 4442-92 (2003), Test Method for Direct Moisture Content Measurements of Wood and Wood-Based Materials, ASTM International.

1.3.11 ASTM D 5055-04, Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists, ASTM International.

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

1.3.13 AISI NAS~~PEC 01~~, North American Specification for the Design of

Cold-formed Steel Structural Members, 2001, including 2004 Supplement.

1.3.14 AF&PA Technical Report 12 (TR-12), General Dowel Equations for Calculating Lateral Connection Values, American Forest & Paper Association.

2.0 BASIC INFORMATION

2.1 General Information:

2.1.1 Product Description: The top and bottom chords ~~shall~~ consist of visually graded or machine stress rated (MSR) sawn lumber, or structural wood-based lumber complying with the ICC-ES Acceptance Criteria for Structural Wood-based Products (AC47)~~. The structural wood-based lumber shall be~~ and recognized in a current ICC-ES evaluation report. Chord members ~~may be~~ are of either single-chord or double-chord configuration. The minimum thickness of top and bottom chord members ~~shall be~~ is a nominal 2 inches (51 mm). Web members ~~shall~~ consist of various gages and diameters of cold-rolled tubular steel tubing and are die-stamped to the lengths required by design, with a flattened end profile that is punched or drilled with the proper hole size. The web members are connected to the chord members with steel pins. The trusses may be connected to bearing supports through proprietary bearing hardware, connected to the trusses at either the top or bottom chord locations as required by design. The trusses are manufactured in either parallel chord, tapered chord (single slope), pitched chord (double slope), or other shapes with and without cantilevers, as needed to fit the end use. The chord members, steel webs, steel pins and bearing hardware ~~shall be~~ are as specified in the manufacturer's approved quality control

manual and manufacturing standard. The proprietary trusses evaluated as per this acceptance criteria shall be recognized in a current ICC-ES evaluation report.

2.1.2 Installation Instructions: Installation instructions or engineering ~~ed~~ drawings shall accompany the product to the final jobsite. The instructions shall include any special instructions required for the product, as well as weather protection and handling requirements. Where attachment requirements, lateral support details, framing details and bearing or connection requirements are not adequately covered by general notes, standard details and charts shall be included with the installation instructions, or specific job drawings shall cover these requirements.

2.1.3 Identification: The trusses shall be clearly identified by the evaluation report number, product name, company name, plant location or identifier, inspection agency name or logo, and a means of establishing the date of manufacture.

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

2.3 Test Reports: Test reports shall comply with AC85.

2.4 Product Sampling: Product sampling for tests under this criteria shall be in accordance with Section 3.1 of AC85. Specimens for qualification testing shall be representative of production.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 General: Testing and analysis shall be performed in accordance with

Sections 3.2 through 3.8 for trusses and their components. The test program and analytical approach shall be approved by ICC-ES prior to the commencement of any testing. ~~The test program and analysis shall include and consider the following:~~ Calculations shall be sealed by a registered design professional.

~~**3.1.1** Web compression and tension test values shall be determined in accordance with Appendix A of this criteria, using the results of the tests performed in accordance with Appendix B of this criteria. Web test values shall be adjusted in accordance with Section 3.0 of Appendix A in this criteria. This is a material test independent from the web tests specified in Appendix B in this criteria.~~

~~**3.1.2** Bearing of the top and bottom chords. The distance between the center of bearing and first pin is important and installation tolerances (maximum and minimum) need to be established. For support conditions, smallest angle from the vertical to the first web shall be tested.~~

~~**3.1.3** An analysis considering bearing and shear on the steel tube caused by the pin; and net section and long column buckling (kl/r) on each web member. The "k" value in kl/r shall be 1.0, unless justification is provided to support a lower value. The "l" in kl/r shall be the distance between the centerline of the pin hole and the centerline of the pin hole in the web member. AISI specifications shall be used in the analysis of the web members. Sample calculations for kl/r shall be part of the submittal to ICC-ES.~~

~~**3.1.4** Allowable load capacity for the steel pin connection in the wood~~

~~chords.~~

3.2 Chord Members: Qualification and development of design properties for chord members consisting of structural composite lumber (SCL) or alternative strand lumber shall be in accordance with AC47. Qualification and development of design properties for chord members consisting of solid sawn lumber shall be in accordance with grading rules established by a recognized grading agency. Analysis of the net section of chord members at pin holes shall be considered. Where chord members contain finger joints, joint qualification shall be performed in accordance Section 6.4 of ASTM D 5055.

3.3 Web Members: Testing of web members shall be in accordance with Appendix A. Test values from Appendix A shall be adjusted in accordance with Appendix B. In addition to testing, web members shall be analyzed in accordance with the AISI NAS Sections C2, C4, and E3.3.2. Allowable tension and compression design values for web members shall be derived in accordance with Sections 3.3.1 and 3.3.2 of this criteria, respectively.

3.3.1 Allowable tension design values for web members shall be the lesser of the following:

a. The allowable design strength, *R*, derived in accordance with Appendix B from tension test results,

b. The allowable load based on analysis in accordance with AISI NAS Section C2,

c. The allowable load based on fracture at the pin connection, calculated in accordance with AISI NAS Section E3.3.2.

3.3.2 Allowable compression design values for web members shall be the lesser of the following:

a. The allowable design strength, *R*, derived in accordance with Appendix B from compression test results,

b. The allowable axial compression strength calculated in accordance with AISI NAS Section C4,

c. In cases where tension tests exhibit bearing failure of the steel web at the pin connections, the allowable design strength, *R*, derived in accordance with Appendix B from tension test results.

For calculations in accordance with AISI NAS Section C4, the effective length factor, *K*, shall be taken as 1.0, unless justification is provided to support a lower value. The laterally unbraced length, *L*, shall be taken as the distance from centerline to centerline of the pin holes in the web member.

3.4 Pin Connections: Allowable lateral loads for pin connections shall be calculated in accordance with Section 11.3 of the NDS. For configurations in which gaps exist between the chord and web members perpendicular to the longitudinal axis of the pin, allowable lateral loads for pin connections shall be calculated in accordance with AF&PA TR-12, using the reduction terms corresponding to bolts and drift pins.

3.5 End Reactions: End reaction testing of top- and/or bottom-chord-bearing

trusses shall be in accordance with Appendix C. In addition to testing, chord members shall be analyzed for shear, bearing, and flexure (where applicable), in accordance with the NDS. Allowable end reaction values on the top and/or bottom chord shall be the lesser of the following:

a. The allowable reaction, *R*, derived in accordance with Appendix C,

b. The allowable design reaction based on shear stress in the critical section of the chord member (typically at the first pin), calculated in accordance with Section 3.4 of the NDS,

c. The allowable design reaction based on bearing stress in the chord member, calculated in accordance with Section 3.10 of the NDS.

d. For eccentric bearings, the allowable design reaction based on flexural stress in the chord member, calculated in accordance with Section 3.3 of the NDS.

For eccentric bearings, the distances from the center of the bearing pin to the face of the bearing support and from the center of the bearing pin to the end of the chord are important and installation tolerances (maximum and minimum) need to be established through testing. For non-eccentric bearings, the distance from the center of the bearing pin to the face of the bearing support is important and installation tolerances (maximum and minimum) need to be established. Some bearing conditions require a bevel or shaped support plate for proper bearing, and installation tolerances (top bearing low end, top bearing high end, and bottom bearing anywhere) need to be

established. For eccentric bearing conditions, the smallest angle from the vertical to the first web shall be tested.

~~3.2~~ 3.6 ~~Types of~~ Confirmatory Tests: ~~The following~~ Confirmatory tests shall be conducted to verify the assigned design capacities and design assumptions, in addition to those noted in Sections 3.2 through 3.5. ~~3.1.1 of this criteria.~~ The test program shall be in accordance with Sections 3.6.1 and 3.6.2.

~~3.2.1~~ 3.6.1 Verification: Tests to verify component material properties, such as mill certification, or specified quality control tests or checks at the component manufacturing location or the truss manufacturing location, shall be required for the chord material, steel web members, steel pins and proprietary bearing hardware.

~~**3.2.2** End reaction capacity may be enhanced by proprietary bearing hardware. End reaction tests may be conducted using a small triangle truss assembly or shorter span full-size truss.~~

~~**3.2.3** Full-scale tests of the chord member finger joints, in accordance Section 6.4 of ASTM D 5055, are required.~~

~~3.2.4~~ 3.6.2 Full-scale Tests: A full-scale test program shall be developed and conducted in accordance with ASTM E 73, or an equivalent test method, for verification of the assembled truss performance, and shall consider the following:

a. Size of chord members

b. Chord member configuration (single or double chord)

c. Moment capacity

d. Shear and reaction capacity

e. Deflection

f. Creep recovery

g. Duct chase

h. Multiple spans

i. Full-scale, short-span truss tests shall be conducted to verify actual web capacities and failure modes in a truss application, to confirm applicability of the test and procedures in Appendix A and B. The trusses shall be designed to maximize shear and prevent the webs from failing at a location other than the pin connection area. Web diameters, gauges and pin sizes to be selected for these tests shall be representative of a typical truss. A minimum of three trusses of each selected combination shall be tested.

~~The full-scale tests shall be conducted in accordance with the methods and principles noted in ASTM E 73 or an equivalent test method.~~

~~3.3~~ 3.7 Special Details: Special details, such as concentrated loads, blocking, and bracing, shall conform to accepted engineering practice, and shall be acceptable to ICC-ES.

~~3.4~~ 3.8 Moisture Content and Specific Gravity: The moisture content

and specific gravity shall be measured and reported for representative samples of the truss chord members from the trusses tested as per Section ~~4.2.2~~ 3.5 Measurements of moisture content shall be in accordance with ASTM D 4442, and measurements of specific gravity shall be in accordance with ASTM D 2395.

4.0 DESIGN PROPERTIES AND OTHER CONSIDERATIONS

4.1 Truss Design Properties: Allowable moment, shear and reaction capacities shall be determined using appropriate analytical and statistical methods based on the established truss component properties. Design properties shall be derived and verified from the testing and analysis required in Sections 3.2 through 3.6. ~~3.1 and 3.2.~~

4.2 Stiffness: Truss stiffness shall be determined analytically and verified by the deflection data obtained during the tests required in Section ~~3.2.2~~ 3.6.2.

4.3 Design Details: Where applicable, design details for wood products noted in the NDS are applicable to trusses evaluated to this acceptance criteria.

4.4 Duration of Load: Code-prescribed adjustments for duration of load (C_D) with sawn lumber are applicable to the truss chord members and their connections.

4.5 Notching and Holes: Not permitted in any truss component members.

4.6 (Optional) Fire-resistive Construction: Testing in accordance with

ASTM E 119 shall be conducted.

~~**4.7 Chord Material:** Design properties shall be qualified under a separate program (beyond the scope of this criteria), such as ASTM D 5456, or grading rules established by a recognized grading agency.~~

5.0 QUALITY CONTROL

5.1 The trusses evaluated under this acceptance criteria shall be manufactured under an approved quality control program with inspections by an inspection agency accredited by the International Accreditation Service, Inc. (IAS), or otherwise acceptable to ICC-ES.

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

5.3 Appropriate sections of Appendix A of AC14 (the ICC-ES Acceptance Criteria for Prefabricated Wood I-joists) shall be covered in the quality control manual. ■

APPENDIX ~~B~~ A

Web Design Values per Testing

A1.0 INTRODUCTION

The purpose of this appendix is to specify the test protocol to be used for the tension and compression testing of the tubular steel web components of the open-web trusses governed by this criteria, for the purpose of determining design values in accordance with Appendix ~~A~~ B.

Scope: This appendix details the procedures to be used to determine the ultimate web test values for web tension and compression. The web tension test procedure described herein includes consideration for pin bearing, end shear and net ~~tension~~ section fracture. The confined test procedure described ~~below~~ herein includes consideration for pin bearing on the web member and ~~profile~~ buckling of the ends of the web member. Long column buckling limitations shall be determined by analysis in accordance with the AISI NAS ~~NASPEC 2001 (AISI)~~ specifications. The intent of the confined test procedure is to replicate as closely as possible the conditions found in a truss with web members pinned and the flattened web profile confined in the routed chord of the truss in the case of a single chord member, or between two chord members in the case of double chord members. The steel pins used for testing shall be in compliance with specific open-web truss manufacturing standard. The web members used for testing shall be in compliance with and shall be manufactured as per

the specific open-web truss manufacturing standard.

A2.0 TEST PARAMETERS

The final test program shall be approved by ICC-ES prior to the commencement of any testing. An adequate number of tests shall be conducted on each critical combination of steel gauge (wall thickness), tube diameter and connecting pin diameter for tension tests and for compression tests. The web member length used for the tension tests may be any length suitable for use with the test setup. The web length used for the compression tests shall be selected to avoid long column (Euler) buckling failures. The load rate shall be set at a uniform rate to cause failure in 2 to 3 minutes. Load versus deformation of the total assembly (i.e. cross-head movement) shall be continuously recorded during the tests by use of an LVDT or similar device. Plots of the load versus deformation curves shall be included in the test report. The actual base metal thickness (t), F_y (yield), F_U (ultimate) of the steel tubes used in the web member tests shall be measured and recorded for each test specimen. The mode of failure shall be recorded for each test specimen.

A3.0 WEB TENSION TEST

A3.1 The test setup shall be as depicted in Figure ~~B1 (confined of Figure B2 (Unconfined)~~ A1 or A2, with the approved pins inserted through the web holes.

A3.2 No preload shall be applied.

A3.3 The pins shall be loaded in double shear adjacent to the web-pin interface placing the web member in tension and shall be tested using a maximum load rate of 0.10 inch/min. (2.5 mm/min.).

A3.4 For single or double chord member truss application, the test web member and dummy web member shall be pin-connected between two sections of wood and steel members as part of the load application apparatus (see Figure A1 or A2). ~~When unconfined (see Figure B2),~~ The load application apparatus shall not interfere with the web failure mechanisms at or near the web-pin interface. ~~When confined (see Figure B1), the web member shall be pin-connected between two sections of steel members along with a short "dummy" web section pinned in the assembly with the same pin, to approximate the degree of web confinement expected in actual truss.~~ If the truss manufacturer's standard allows a gap between the flattened portion of the web member and side or face of the rout within the chord, this condition should be duplicated in the test setup by leaving the same gap between the face of the test web and the face of the wood block for each combination of web gauge, pin diameter and rout width used. The ~~pin hole~~ diameter and location of the pin hole in the web member ~~and gap between the two steel members~~ shall be as specified ~~for normal truss production~~ in the open-web truss manufacturing standard~~, using the maximum gap specified for each combination of web gauge and diameter~~.

A3.5 The average value of test results, R_n (see Appendix ~~A~~ B), shall be taken as the average of the proportional limit loads offset by 5 percent of the pin diameter adjusted

in accordance with Section 3.0 of Appendix ~~A~~ B, where necessary.

A4.0 ~~CONFINED~~ WEB COMPRESSION TEST

A4.1 The test setup shall be as depicted in Figure ~~B1~~ A1 or A2, with the approved pins inserted through the web holes.

A4.2 No preload shall be applied.

A4.3 For single or double chord member truss application, the test web member and dummy web member shall be pin-connected between two sections of wood and steel members ~~along with a short "dummy" web section pinned in the assembly with the same pin, to closely approximate the degree of web confinement expected in actual truss.~~ (see Figure A1 or A2). The ~~pin hole~~ diameter and location of the pin hole in the web member ~~and gap between the two steel members~~ shall be as specified in the open-web truss manufacturing standard~~, using the maximum gap specified for each combination of web gauge and diameter~~. The load application apparatus shall not interfere with the web failure mechanisms at or near the web-pin interface. If the manufacturer's standard allows a gap between the flattened portion of the web member and the side or face of the rout, this condition should be duplicated in the test setup by leaving the same gap between the face of the test web and the face of the wood block for each combination of web gauge, pin diameter and rout width used. The load apparatus shall be configured to prevent contact under load between the ends of the compression webs and the load apparatus.

A4.4 The ~~assembly~~ pins shall be loaded in double shear adjacent to the web-pin interface placing the web member in compression and shall be tested using a maximum load rate of 0.10 inch/min. (2.5 mm/min.).

A4.5 The average value of test results, R_n (see Appendix ~~A~~ B), shall be taken as the average of the proportional limit loads offset by 5 percent of the pin diameter adjusted in accordance with Section 3.0 of Appendix ~~A~~ B, where necessary.

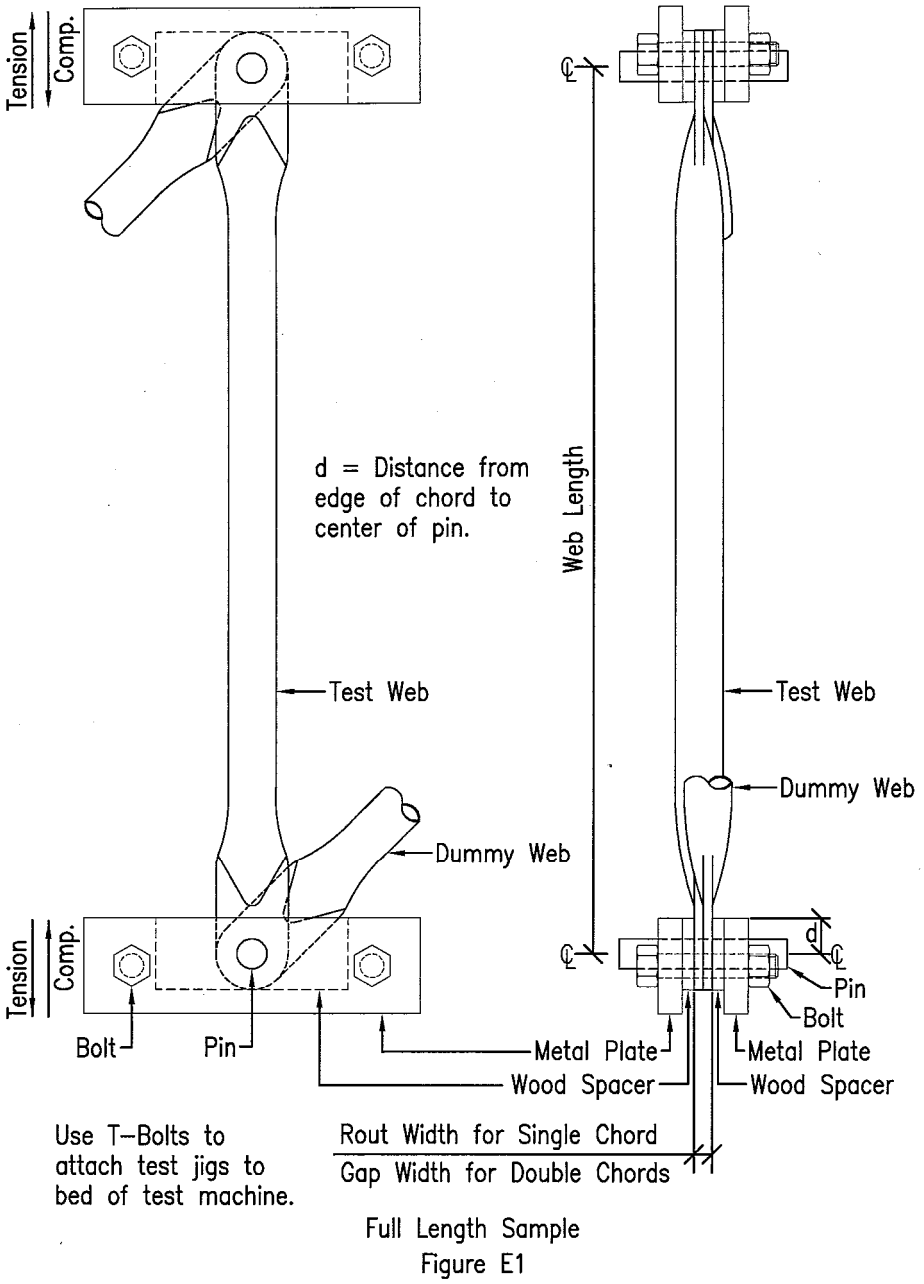
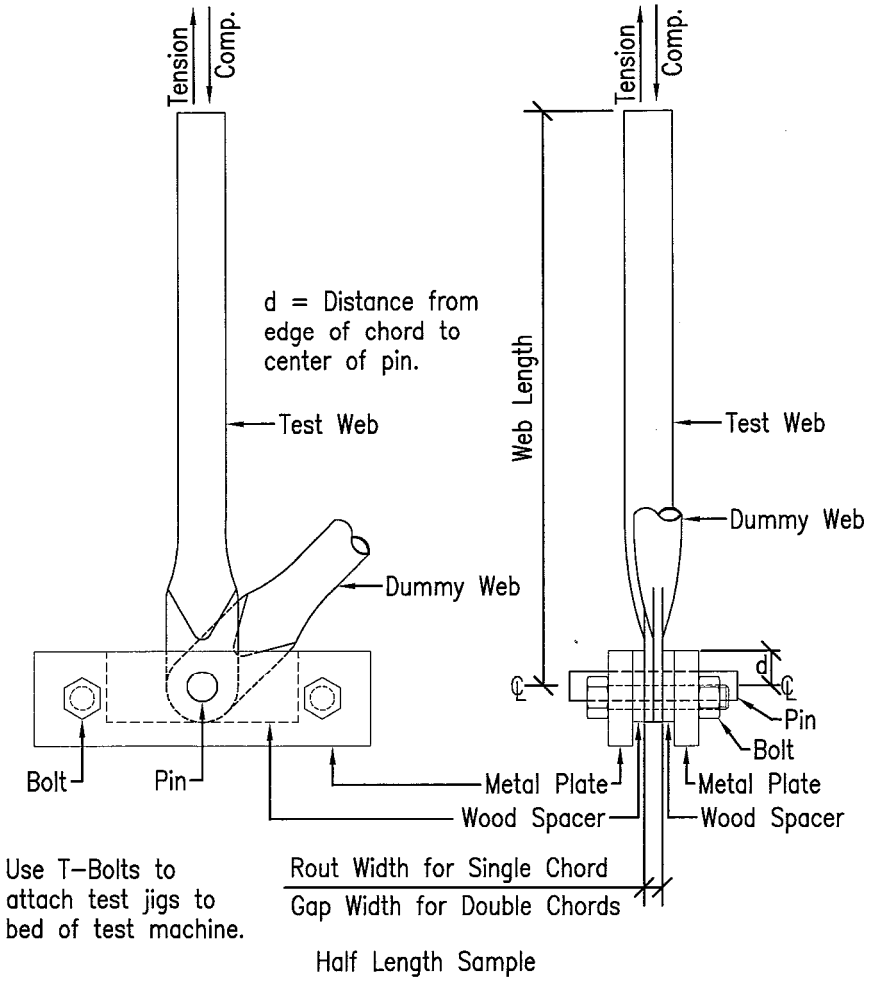

Tension
Comp.
d = Distance from edge of chord to center of pin.
Web Length
Test Web
Dummy Web
Test Web
Dummy Web
Tension
Comp.
d
Pin
Bolt
Bolt
Pin
Metal Plate
Wood Spacer
Metal Plate
Wood Spacer
Use T-Bolts to attach test jigs to bed of test machine.
Rout Width for Single Chord
Gap Width for Double Chords
Full Length Sample
Figure E1

Figure A1


Tension
Comp.
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Test Web
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Bolt
Pin
Metal Plate
Wood Spacer
Use T–Bolts to attach test jigs to bed of test machine.
Web Length
Rout Width for Single Chord
Gap Width for Double Chords
Half Length Sample
Figure E2

Figure A2

APPENDIX ~~A~~ B

Safety Factors for Web Testing

B1.0 INTRODUCTION

The purpose of this appendix is to specify the methodology to be used for the determination of the safety factor to be applied to the results of steel web tests performed in accordance with Appendix ~~B~~ A, in order for the resultant web member design properties to be recognized in the evaluation report issued in accordance with this acceptance criteria.

Scope: This appendix uses the procedures of Section F1.1 of the AISI NAS ~~NASPEC 2001 (AISI)~~ as the methodology to be used for the derivation of the safety factors, Ω, to be applied to the results of steel web tests (performed in accordance with Appendix ~~B~~ A), to determine the allowable ~~strength~~ design strength (R) for allowable strength design (ASD) method of design.

B2.0 DEFINITIONS

R = Allowable design strength of the web member (lbs.) (See Section 4.0 below)

R_n = Average value of test results from Appendix A (lbs).

$R_{n,adj}$ = Adjusted average value of test results from Appendix ~~B~~ A (lbs.) (~~adjusted in accordance with~~ See Section 3.0 below)

Ω = Factor of Safety ~~to be computed as follows: Ω~~ = 1.6/Φ ~~≥~~, but not less than 1.75

Φ = Resistance factor:

$\Phi = C_\Phi(M_M F_M P_M)e^{A}$, where: ~~$(-\beta_O(V_M^2+V_F^2+C_P V_P^2+V_Q^2)^{1/2})$~~

$A = (-1)\beta_O(V_M^2+V_F^2+C_P V_P^2+V_Q^2)^{1/2}$

C_Φ = Calibration coefficient = 1.52

M_M = Mean value of material factor = 1.10

F_M = Mean value of fabrication factor = 1.0

P_M = Mean value of professional factor = 1.0

β_O = Target reliability index = 2.5

V_M = Coefficient of variation of material factor = 0.08

V_F = Coefficient of variation of fabrication factor = 0.05

C_P = Correction factor = (1+1/n)m/(m-2) for n≥4, and 5.7 for n=3

m = Degrees of freedom = n-1

n = Number tests (minimum = 3)

V_P = Coefficient of variation of test sample group, but not less than 6.5% (0.065)

V_Q = Coefficient of variation of load effect = 0.21

e = Natural logarithmic base = 2.718…

F_{USPEC} = Specified ultimate tensile strength of the steel (psi)

F_U = Actual average ultimate tensile strength of test material (psi)

B3.0 ADJUSTMENT FOR ACTUAL STEEL STRENGTH

~~If the actual ultimate tensile strength of the test material, F_U, is greater than the~~

~~specified ultimate tensile strength, F_{USPEC},~~ The adjusted average value of web member test results, $R_{n,adj}$, shall be calculated from the average value of test results ~~(~~from Appendix A ~~B)~~ , R_n, for each set of tests as follows: ~~shall be adjusted as described below:~~

~~R_n = Average value of test results from Appendix B, adjusted for (F_{USPEC}/F_U)~~

If $F_U > F_{USPEC}$, then $R_{n,adj} = R_n(F_{USPEC}/F_U)$

If $F_U \leq F_{USPEC}$, then $R_{n,adj} = R_n$.

B4.0 ALLOWABLE DESIGN STRENGTH

The ~~maximum~~ allowable design strength, R, shall be calculated as:

$R = R_{n,adj}/\Omega$

APPENDIX C

Truss End Reaction Tests

C1.0 INTRODUCTION

The purpose of this appendix is to specify the test protocol to be used for the reaction testing of the bearing assembly of the open-web trusses governed by this criteria, for the purpose of determining allowable design values.

Scope: This appendix details the test procedures to be used to determine the reaction loads to determine the allowable design strength for the allowable strength design (ASD) method of design.

C2.0 TEST PARAMETERS

A minimum of five tests shall be conducted on each critical combination of bearing hardware, range of distances between the first pin connection and the edge of the truss bearing support, and bearing lengths. The diameter and location of the pin hole in the chord and web members shall be as specified in the open-web truss manufacturing standard. Dimensions and material properties of the pins, web members and chord members used in the tested assemblies shall be as specified in the open-web truss manufacturing standard. If the manufacturer's standard allows a gap between the flattened portion or the web member and the rout or bearing hardware, this condition shall be duplicated in the test setup by leaving the same gap between the web or strap

and one face of the rout or bearing hardware for each combination of web gauge, pin diameter and rout width used. The "B" distance shown in Figure C1 or C2 shall be tested in ¼-inch (6.4 mm) increments from minimum to maximum. The "PTE" distance shall be tested in ½- to ¾-inch (12.7 to 19 mm) increments from minimum to maximum. If the manufacturer's standard requires the use of head and/or spring washers on the pin, the same shall be used in the tested assemblies. The load rate shall be set at a uniform rate to cause failure in two to three minutes. Load versus deformation of the total assembly (i.e., cross-head movement) shall be continuously recorded during the tests by use of an LVDT or similar device. Plots of the load versus deformation curves shall be included in the test report. The moisture content and specific gravity of the chord member shall be measured and recorded for each test specimen in accordance with Section 3.8 of this criteria. The mode of failure shall be recorded for each test specimen.

C3.0 REACTION TESTS

C3.1 The test setup shall be as depicted in Figure C1 or C2 with the approved pins inserted through the hole in chord and bearing hardware.

C3.2 No preload shall be applied.

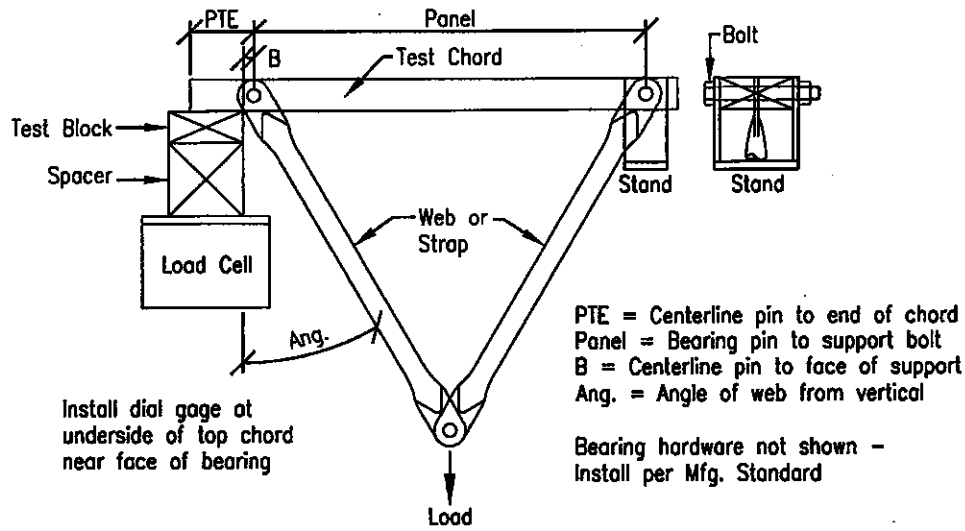
C3.3 The pin shall be loaded in double shear adjacent to the chord-pin interface by placing the web or strap member in tension and shall be tested using a load rate of 0.10 inch/min. (2.5 mm/min.).

C3.4 The load application apparatus shall not interfere with the bearing assembly failure mechanism.

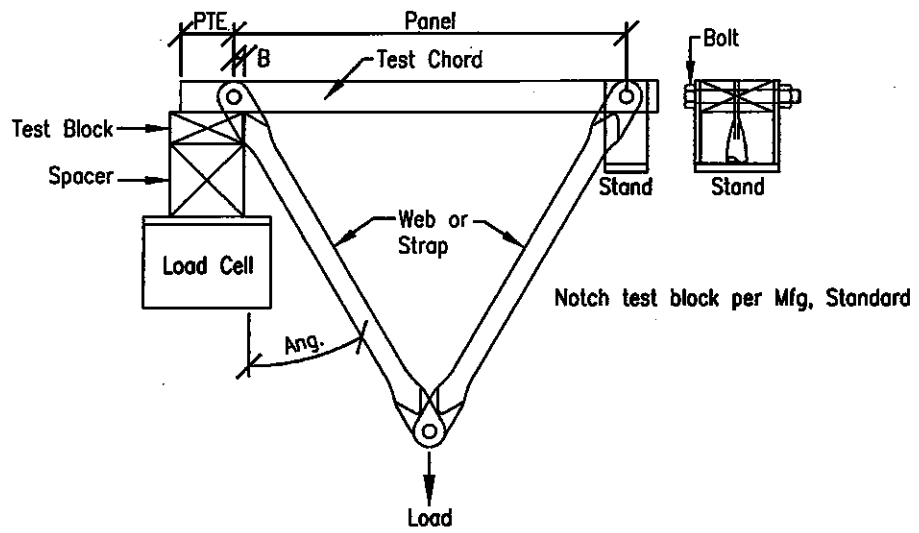
C3.5 The average value of test results, $P_{a5\%}$, shall be taken as the average of the proportional limit loads offset by 5 percent of the pin diameter. If the 5 percent offset is past first peak on plots of the load versus deformation curves, use value of first peak for test value.

C4.0 DESIGN VALUES

R_A = Allowable Reaction (Lbs.) = $P_{a5\%}$/ 3.2



Bearing Pin off Support Plate
Figure C1



Bearing Pin on Support Plate
Figure C2

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441 **Figures C1 and C2**