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ACCEPTANCE CRITERIA FOR WOOD STRUCTURAL PANELS

AC182

Approved April 2001

Effective May 1, 2001

(Editorially revised November 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 for purposes of issuing ICC-ES evaluation reports.

ACCEPTANCE CRITERIA FOR WOOD STRUCTURAL PANELS (AC182)

1.0 INTRODUCTION

1.1 Purpose: This acceptance criteria establishes minimum requirements for recognition in an ICC-ES evaluation report of manufacturer-specific design capacities for wood structural panel products. The bases of recognition are Section 104.2.8 of the 1997 *Uniform Building Code*™, Section 104.11 of the 2006 and 2009 *International Building Code*® (IBC), and Section R104.11.1 of the 2006 and 2009 *International Residential Code*® (IRC).

1.2 Codes and Referenced Standards:

1.2.1 1997 *Uniform Building Code*

1.2.2 2006 and 2009 *International Building Code*®, International Code Council.

1.2.3 2006 and 2009 *International Residential Code*®, International Code Council.

1.2.4 ASTM D 1037-06a, Test Methods for Evaluating Properties of Wood-base Fiber and Particle Panel Materials, ASTM International.

1.2.5 ASTM D 1761-06, Test Methods for Mechanical Fasteners in Wood, ASTM International.

1.2.6 ASTM D 2718-00(2006), Test Method for Structural Panels in Planar Shear (Rolling Shear), ASTM International.

1.2.7 ASTM D 2719-89(2007), Test Methods for Structural Panels in Shear Through-the-Thickness, ASTM International.

1.2.8 ASTM D 2915-03, Practice for Evaluating Allowable Properties for Grades of Structural Lumber, ASTM International.

1.2.9 ASTM D 3043-00(2006), Methods of Testing Structural Panels in Flexure, ASTM International.

1.2.10 ASTM D 3500-90(2003), Test Method for Structural Panels in Tension, ASTM International.

1.2.11 ASTM D 3501-05a, Test Method for Wood-based Structural Panels in Compression, ASTM International.

1.2.12 ASTM D 5456-05a, Specification for Evaluation of Structural Composite Lumber Products, ASTM International.

1.2.13 ASTM D 5457-04a, Standard Specification for Computing the Reference Resistance of Wood-Based Materials and Structural Connections for Load and Resistance Factor Design, ASTM International.

1.2.14 ASTM E 4-09, Practices for Force Verification of Testing Machines, ASTM International.

1.2.15 U.S. Department of Commerce Voluntary Product Standard PS2-04.

1.3 Definitions:

1.3.1 Design Capacity: A design capacity, also known as the section capacity, is a single value that represents the product of the allowable stress and the corresponding section property for a given load condition.

1.3.2 Wood Structural Panel: A panel product comprised primarily of wood components bonded with exterior adhesive formulations. Structural properties are referenced to the primary and secondary structural axes, which typically correspond to the manufacturing machine and cross-machine directions, respectively.

1.3.3 Primary Axis: The primary axis typically corresponds to the manufacturing machine direction and exhibits high mechanical properties relative to the secondary axis. The primary axis typically corresponds to the eight-foot dimension of a four-foot by eight-foot wood structural panel.

1.3.4 Secondary Axis: The secondary axis typically corresponds to the manufacturing cross-machine direction and exhibits lower mechanical properties relative to the primary axis. The secondary axis typically corresponds to the four-foot dimension of a four-foot by eight-foot wood structural panel.

2.0 REPORT OF TESTS, BASIC INFORMATION AND GENERAL REQUIREMENTS

2.1 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.

2.2 Test reports shall comply with AC85. All reports shall be issued or certified by an accredited testing laboratory. Tests conducted at a manufacturer's facility shall be under the control of and witnessed by an accredited testing laboratory. The manufacturer's test facility is considered a subcontractor of the accredited laboratory. The accredited laboratory shall ensure that the relevant requirements of Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports are fulfilled.

2.3 Test specimens shall be sampled in accordance with the product sampling requirements of Section 3.1 of AC85.

2.4 Measured dimensions of sampled panels and test specimens shall be recorded in accordance with the degree of accuracy specified in the ASTM standards identified in of this criteria. The test report shall include statements indicating whether specimens were produced in accordance with the minimum requirements of the approved quality control manual.

2.5 Details describing the test configuration, test methods and test procedures, including load application rate, shall be included in the test report.

2.6 Load measuring equipment shall have a degree of accuracy of 2 percent as determined in accordance with ASTM E 4.

2.7 Panels sampled for testing shall be representative of the population for which design capacities are desired. Panel sampling and grouping procedures shall comply with Section 4 of ASTM D 5457.

3.0 MATERIALS

3.1 Panel products evaluated under this acceptance criteria shall comply with code requirements and applicable standards listed in the applicable code or covered in an evaluation report issued by ICC-ES.

3.2 The standard under which the panels are certified shall be identified along with corresponding grades (e.g., span ratings for PS2 products) and nominal thickness.

Each product (standard, grade, nominal thickness) represents a unique product designation under this acceptance criteria. Grouping within product designations shall comply with Section 4 of ASTM D 5457.

3.3 In addition to the testing required by Section 4.0, reports of tests demonstrating compliance with the requirements of Section 3.1 shall be submitted.

3.4 Specimens shall be tested in an "as manufactured" condition or after conditioning to standard moisture conditions.

4.0 TESTING REQUIREMENTS

4.1 General: For each manufacturing facility and product for which proprietary design capacities are desired, the minimum number of test replications shall be 28 (ASTM D 2915, Table 2) with the exception of flexural rigidity and moment capacity, for which the minimum number of test replications shall be 53.

4.2 Flexural Rigidity (*EI*): Flexural rigidity shall be determined in accordance with ASTM D 3043, Method C—Pure Moment Test. Flexural rigidity shall be reported on a per foot of width basis. Test panel thickness shall be recorded. Flexural rigidity shall be determined in the primary and secondary panel directions. The applicable moment arm shall be the load bar spacing between points of contact with the test panel.

4.3 Moment Capacity (F_bS): Moment capacity shall be determined in accordance with ASTM D 3043, Method C—Pure Moment Test. Moment capacity shall be determined for the same panel specimens evaluated under Section 4.2. Moment capacity shall be reported on a per foot of panel width basis. Test panel thickness shall be recorded. The applicable moment arm shall be the load bar spacing between points of contact with the test panel.

4.4 Planar Shear Capacity [$F_s(Ib/Q)$]: Planar shear capacity shall be determined in accordance with ASTM D 2718. Planar shear capacities along the primary and secondary axes shall be determined. Planar shear capacity shall be reported on a pounds per foot of panel width basis. Test specimen thickness shall be recorded.

4.5 Shear Through-the-Thickness (F_vt_v): Shear through-the-thickness shall be determined in accordance with ASTM D 2719. Test panel thickness shall be recorded. Shear through-the thickness shall be determined along the primary and secondary axes and shall be reported on the basis of pound-force per inch of shear-resisting panel length.

4.6 Shear Rigidity Through-the-Thickness (G_vt_v): Shear rigidity through-the-thickness shall be determined in accordance with ASTM D 2719. Test panel thickness shall be recorded. Shear rigidity through-the-thickness shall be determined along the primary and secondary axes and shall be reported in units of pound-force per inch of panel depth.

4.7 Axial Stiffness (*EA*): Axial tension and compression stiffness shall be determined in accordance with ASTM D 3500, Method B—Tensile Strength of Large Specimens, and ASTM D 3501, Method B—Compression Test for Large Specimens, respectively. Test panel thickness shall be recorded. Axial stiffness shall be determined along the primary and secondary axes. Axial stiffness shall be reported on a per foot of panel width basis. Specimen dimensions shall be recorded.

4.8 Axial Strength (F_cA, F_tA): Axial tension and compression strength shall be determined in accordance with ASTM D 3500, Method B—Tensile Strength of Large Specimens, and ASTM D 3501, Method B—Compression Test for Large Specimens, respectively. Test panel thickness shall be recorded. Axial strength shall be determined along the primary and secondary axes. Axial strength shall be reported on a per foot of panel width basis. Specimen dimensions shall be recorded.

4.9 Fastener Withdrawal: Fastener withdrawal tests shall be conducted in accordance with ASTM D 1037. Specimen thickness and density shall be recorded. Results shall be reported as tested and as normalized to a per inch of thickness basis. Fastener specifications shall be recorded and shall include actual diameter.

4.10 Lateral Fastener Capacity: The equivalent dowel bearing strength of the wood structural panel shall be determined in accordance with Annex A2 of ASTM D 5456. Lateral fastener capacity shall be determined along the primary and secondary axes. Specimen thickness and density shall be recorded.

4.11 Nail-head Pull-through: Nail-head pull-through tests shall be conducted in accordance with ASTM D 1037 to measure the resistance of a panel to having the head of a nail or other fastener pulled through the board. Specimen thickness and density shall be recorded. Results shall be reported as tested.

5.0 DETERMINATION OF DESIGN CAPACITIES

5.1 Allowable Stress Design (ASD): Design capacities for allowable stress design shall be determined in accordance with ASD procedures established in this criteria or through soft conversion from reliability-based design capacities developed in accordance with ASTM D 5457 (Section 5.2 of this criteria and Section 6.7 of ASTM D 5457).

5.1.1 Characteristic Values: Characteristic values shall be determined by either parametric or non-parametric procedures as specified in ASTM D 2915.

5.1.2 Parametric Characteristic Values: The procedures of Sections 3 and 4 of ASTM D 2915 shall be followed except that provisions of this criteria govern where differences occur.

5.1.2.1. The fifth percentile tolerance limit with 75 percent confidence shall be the characteristic value for strength capacities.

5.1.2.2. The characteristic value for the panel stiffness shall be the average of the test results determined in accordance with this criteria.

5.1.3 Non-parametric Characteristic Values: The nonparametric characteristic value for strength capacities shall be the fifth percentile tolerance limit with 75 percent confidence.

5.1.4 Adjustments to Characteristic Values: Test data from panels evaluated as manufactured or after conditioning to standard conditions need no further adjustment. Test data from panels tested with significantly higher moisture contents are permitted to be adjusted prior to analysis. The basis for any adjustment factor shall be in accordance with applicable standards and shall be reported.

5.2 Load and Resistance Factor Design (LRFD): Design capacities for LRFD shall be determined in accordance with reliability-based provisions of ASTM D 5457. Reliability indices established for each strength limit state shall be presented with corresponding design capacities. Design capacities for ASD can be developed through soft conversion of reliability-based LRFD design strength capacities. Design capacities for stiffness shall be determined in accordance with Section 5.1 of this criteria.

5.3 Design Capacities: Design capacities shall be determined by dividing the characteristic values from Section 5.1 or 5.2 by the corresponding adjustment factors provided in Table 1. The applicable moisture content from which the design values are derived shall be reported in the evaluation report. If ASD design capacities are derived through soft conversion from LRFD design capacities in accordance with Section 5.2 of this criteria, the adjustment factors provided in Table 1 shall be used in the soft conversion process. The characteristic value for fastener withdrawal and nail head pull-through is the average of the test results determined by Section 4.9 and Section 4.11, respectively. Appendix A provides example derivation of design capacities.

TABLE 1—DESIGN CAPACITY ADJUSTMENT FACTORS

CAPACITY	ADJUSTMENT FACTOR
Flexural rigidity	1.00
Moment capacity	2.10
Planar shear	2.10
Shear through-the-thickness	2.10
Shear rigidity (shear through-the-thickness)	1.00
Axial stiffness (compression and tension)	1.00
Axial tensile strength	2.10
Axial compressive strength	2.10
Fastener withdrawal	5.00
Nail-head pull-through	5.00

5.4 Design Section Properties: To provide the basis for derivation of design section properties consistent with design capacities determined in Section 5.3 of this criteria, design section properties shall be determined. Design capacities determined in Section 5.3 shall be normalized as necessary to compensate for adjustment of section properties of test material to published design section properties. Normalization of design capacities shall be conservative and normalization shall be applied within specific product designations. Appendix B provides an example of derivation of design section properties and normalization of design capacities.

6.0 QUALITY CONTROL

6.1 Quality Control: The wood structural panel products shall be produced under a quality control program administered by an inspection agency accredited by the International Accreditation Service (IAS), or otherwise acceptable to ICC-ES. Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted. The quality documentation shall specify quality assurance testing and process control requirements in accordance with Sections 6.2 and 6.3 of this criteria.

6.2 Quality Assurance Testing:

6.2.1 Test equipment shall be properly maintained, calibrated, and evaluated for accuracy and adequacy at a frequency satisfactory to the inspection agency.

6.2.2 Test frequency for all tests shall be chosen to yield quality assurance that performance is consistent with design capacities and design section properties assigned to the product and its intended use.

6.3 Process Control:

6.3.1 Data from tests outlined in Section 6.2 shall be evaluated prior to shipment of the material represented by the sample. Analytical procedures shall determine if product capacities are in statistical control. The control levels selected shall be consistent with current design capacities and design section properties.

6.3.2 When the analysis described in Section 6.3.1 indicates that the product is below the control level, the associated portion of production shall be subject to re-examination in accordance with the acceptance procedures provided in the approved quality assurance documentation.

6.3.3 All pertinent records shall be maintained on a current basis and be available for review by both in-house and qualified inspection agency personnel. As a minimum, such records shall include:

6.3.3.1. All inspection reports and records of test equipment calibration whether accomplished by in-house or by qualified agency personnel.

6.3.3.2. All test data, including retests and data associated with rejected production.

6.3.3.3. Details of any corrective actions taken and the disposition of any rejected production resulting from tests or inspection.

7.0 IDENTIFICATION

The product shall be clearly and properly identified by product and company name, plant location or number, inspection agency name or logo, a means of establishing date of manufacture, and the ICC-ES evaluation report number. The marking shall also include applicable certification marks. All identification marking shall be legible and durable and, as a minimum, shall last through typical handling, distribution, job site storage and installation to allow for field identification.■

APPENDIX A

Example Derivations of Design Capacities

Parametric Design Capacity Derivation Examples

Moment Capacity (F_bS), primary axis - lbf-in/ft (240 replications)

DISTRIBUTION	K-S	LOWER 5TH POINT ESTIMATE	CHARACTERISTIC VALUE	DESIGN ADJUSTMENT FACTOR	DESIGN CAPACITY [1]
Normal	0.075	2,771	2,744		
Log-Normal	0.052	2,706	2,684	2.1	1,278
2-p Weibull	0.124	2,628	2,565		

[1]Log-normal distribution provides the best fit for this sample (lowest Kolmogorov-Smirnov statistic).

Planar Shear Capacity (F_sIb/Q), primary axis - lbf/ft (120 replications)

DISTRIBUTION	K-S	LOWER 5TH POINT ESTIMATE	CHARACTERISTIC VALUE	DESIGN ADJUSTMENT FACTOR	DESIGN CAPACITY [1]
Normal	0.042	931	911	2.1	434
Log-Normal	0.058	951	935		
2-p Weibull	0.065	938	895		

[1]Normal distribution provides the best fit for this sample (lowest Kolmogorov-Smirnov statistic).

Flexural Rigidity (EI), primary axis - lbf-in^2/ft (480 replications)

MEAN	CHARACTERISTIC VALUE	DESIGN ADJUSTMENT FACTOR	DESIGN CAPACITY
311,788	311,788	1.0	311,788

Nonparametric Design Capacity Derivation Examples

Moment Capacity (F_bS), primary axis - lbf-in/ft (240 replications)

DISTRIBUTION	LOWER 5TH POINT ESTIMATE	CHARACTERISTIC VALUE	DESIGN ADJUSTMENT FACTOR	DESIGN CAPACITY
Nonparametric	2,737	2,731	2.1	1,300

Planar Shear Capacity (F_sIb/Q), primary axis - lbf/ft (120 replications)

DISTRIBUTION	LOWER 5TH POINT ESTIMATE	CHARACTERISTIC VALUE	DESIGN ADJUSTMENT FACTOR	DESIGN CAPACITY
Nonparametric	963	877	2.1	417

Flexural Rigidity (EI), primary axis - lbf-in^2/ft (480 replications)

MEAN	CHARACTERISTIC VALUE	DESIGN ADJUSTMENT FACTOR	DESIGN CAPACITY
311,788	311,788	1.0	311,788

APPENDIX B

Design Section Properties and Design Capacity Normalization

Section properties of test specimens will typically differ from design section properties. Design section properties shall be consistent with section properties of finished product. Design capacities shall be normalized to reflect the adjustment from test section properties to design section properties.

Normalization of capacities involves conversion of test capacities to test properties on the basis of an assumed homogeneous cross section. Allowable design properties are then determined in accordance with the procedures provided in this criteria for design capacities. Allowable design capacities are then determined by simply multiplying allowable design properties by design section properties.

Tables B1 through B3 provide examples of capacity normalization.

TABLE B1—ADJUSTMENT OF TEST CAPACITY TO NORMALIZED CAPACITY - MOMENT CAPACITY

F_bS	TEST-THICKNESS (INCH)	APPARENT PROPERTY, F_b (psi)	DESIGN THICKNESS	NORMALIZED CAPACITY
2,684	0.695	2,778	0.685	2,607
2,684	0.675	2,945	0.685	2,764

Normalized capacities determined on the basis of apparent properties.

TABLE B2—ADJUSTMENT OF TEST CAPACITY TO NORMALIZED CAPACITY - PLANAR SHEAR CAPACITY

F_s (lb/Q)	TEST-THICKNESS (INCH)	APPARENT PROPERTY, MOE (psi)	DESIGN THICKNESS	NORMALIZED CAPACITY
877	0.695	158	0.685	866
877	0.675	162	0.685	888

Normalized capacities determined on the basis of apparent properties.

TABLE B3—ADJUSTMENT OF TEST CAPACITY TO NORMALIZED CAPACITY - FLEXURAL RIGIDITY

EI	TEST-THICKNESS (INCH)	APPARENT PROPERTY, MOE (psi)	DESIGN THICKNESS	NORMALIZED CAPACITY
311,730	0.695	928,590	0.685	298,467
311,730	0.675	1,013,602	0.685	325,791

Normalized capacities determined on the basis of apparent properties.