Designation: D7341 – 09

StandardPractice for Establishing Characteristic Values for Flexural Properties of Structural Glued Laminated Timber by Full-Scale Testing[1]

This standard is issued under the fixed designation D7341; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes procedures for full scale testing of structural glued laminated timber (glulam) to determine or verify characteristic values used to calculate flexural design properties. Guidelines are given for: *(1)* testing individual structural glued laminated timber lay-ups (with no modeling), *(2)* testing individual glulam combinations (with limited modeling), and *(3)* validating models used to predict characteristic values.

1.2 This practice is limited to procedures for establishing flexural properties (Modulus of Rupture, MOR, and Modulus of Elasticity, MOE). Some of the principles for sampling and analysis presented may be applicable to other properties. However, other properties may require additional testing considerations that are beyond the scope of this practice.

1.3 This practice is not intended to supersede the provisions of Practice D3737, but provides an alternative method for establishing characteristic values. Lay-up combinations developed in accordance with Practice D3737 are not required to be governed by this standard.

NOTE 1—The models described by Practice D3737 have been developed and modified based on more than 50 years of experience and many test programs. In some cases, however, it may be desirable to develop a new model based on other input properties or using lumber materials or grades not covered by that standard.

1.4 Details of production, inspection, and certification are beyond the scope of this document. However, for test results to be representative of production, quality control systems shall be in place to ensure consistent quality. Manufacturing shall conform to recognized manufacturing standards such as ANSI/AITC A190.1 or CSA O122.

1.5 Adjustments to characteristic values to determine reference values for design shall be in accordance with Practice D2915 for allowable stress design (ASD) or Specification D5457 for load and resistance factor design (LRFD).

1.6 Adjustments to ASD reference values for end-use conditions intended for design purposes shall be performed in accordance with Practice D3737. The same adjustment factors shall apply to LRFD reference values, except that the ASD *load duration* factor shall be replaced by an appropriate LRFD *time effect* factor as determined in accordance with recognized industry practice.

1.7 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D198 Test Methods of Static Tests of Lumber in Structural Sizes

D245 Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber

D2915 Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products

D3737 Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam)

D4761 Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Material

D5456 Specification for Evaluation of Structural Composite Lumber Products

D5457 Specification for Computing Reference Resistance of Wood-Based Materials and Structural Connections for Load and Resistance Factor Design

D6815 Specification for Evaluation of Duration of Load and Creep Effects of Wood and Wood-Based Products

[1] This practice is under the jurisdiction of ASTM Committee D07 on Wood and is the direct responsibility of Subcommittee D07.02 on Lumber and Engineered Wood Products.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 *Other Standards:*
AITC Test T119 Full Size End Joint Tension Test[3]
ANSI/AITC A190.1 American National Standard for Wood Products – Structural Glued Laminated Timber[3]
CSA O122 Structural Glued Laminated Timber[4]
PS-20 Voluntary Product Standard, ALS[5]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *apparent properties, n*—Mechanical properties as related to the actual cross-sectional dimensions of the structural glued laminated timber.

3.1.2 *characteristic value, n*—A test statistic from which design values can be derived by the application of appropriate adjustment factors. For strength properties of structural glued laminated timber, this value is typically a fifth percentile estimate with 75 % confidence. For deformation-based properties, such as modulus of elasticity, this value is represented by the average value. Other statistics are permitted to be used as characteristic values for input properties of laminations depending on the model. Characteristic values for structural glued laminated timber are typically based on apparent properties.

3.1.3 *combination, n*—A series of lay-ups having similar lamination properties (grades, species, and end joint strengths), similar percentages of grade placement in the areas of critical stresses, and similar predicted properties, that are grouped together for design purposes.

NOTE 2—An example of a lay-up combination based on Practice D3737 would be a 24F-V4 Douglas fir combination.

3.1.4 *lay-up, n*—The specific arrangement of well-defined lamination grades for a single structural glued laminated timber depth.

3.1.5 *model, n*—A mathematical method for predicting a characteristic value for full-scale laminated timber based on the input properties of the individual laminations.

3.1.6 *reference value, n*—The characteristic value of a material that has been adjusted by the procedures in Practice D2915 or Specification D5457 for use in design equations, but has not been adjusted for end-use conditions.

3.1.7 *structural glued laminated timber, n*— A product made from suitably selected and prepared pieces of component laminations, hereafter referred to as *lumber* in this practice but including sawn lumber, manufactured lumber, or structural composite lumber, bonded together with an adhesive, with the grain of all pieces essentially parallel to the longitudinal axis of the member.

3.1.8 *well-defined grade, n*—A lumber grade with specific limits on acceptable characteristics, such as knots, slope of grain, density, modulus of elasticity, tensile strength, etc., to ensure reproducibility in production.

[3] Available from the American Institute of Timber Construction (AITC), 7012 S. Revere Parkway Suite 140, Centennial, CO 80112, info@aitc-glulam.org

[4] Available from Canadian Standards Association (CSA), 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada, http://www.csa.ca.

[5] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

4. Modeling Requirements

4.1 *General:*

4.1.1 *Purpose for Modeling*—For test results to be applicable to structural glued laminated timber sizes that are not tested, it is necessary to relate the properties of the component laminations to the beam properties through the use of an analytical model.

4.1.2 *Predictive Models*—Models that will be used to develop new combinations, predict characteristic values, and assign design values shall be able to predict accurately these values for a broad range of combinations. These results must be validated by full-scale tests according to appropriate test methods for the property of interest.

4.1.3 *Single Combination*—For comparing different lay-ups and identifying critical sizes for testing within a single combination, transformed section analysis is sufficient to predict the stresses on each grade in the lay-up relative to the stresses in the tested lay-up. No further modeling shall be required.

4.1.4 *Single Lay-Up*—All modeling requirements shall be waived if the test results are limited to a single, well-defined lay-up (that is, the number of laminations is fixed, the lamination properties are well defined, and the size (depth) tested is representative of the size intended for production).

4.2 *Minimum Model Inputs:*

4.2.1 *General*—At a minimum, a suitable model shall be based on defined lamination properties representative of the material used for each lamination and shall account for the placement of different qualities of laminations throughout the cross section.

4.2.2 *Lamination Properties*—The model shall account for both lumber and end joint properties.

4.2.2.1 *Lumber Grade*— The species and grades of lumber used in structural glued laminated timber shall be well defined to ensure consistent performance between the grades used in test members and future production members. Strength and stiffness properties for the laminations shall be assigned according to the lumber grade. For deterministic models, the properties assigned to the grade shall be a representative characteristic value for the grade. For probabilistic models, a parametric distribution of values shall be determined to represent the grade.

(1) Species—The species or groups of species permitted by the grade shall be well defined and shall be represented in the tested members.

(2) Modulus of Elasticity—For each grade of lumber used, the modulus of elasticity shall be determined in accordance with Test Methods D198 or D4761 or by the procedures of Specification D5456 or Practice D245.

(3) Strength—Strength values shall be assigned to each grade of lumber used in the laminated timber. Values shall be determined by testing in accordance with Test Methods D198 or D4761 or by the procedures of Specification D5456 or Practice D245. Strength values are also permitted to be assigned to a grade zone based on its interaction with the beam as a whole. (For example, the I_K/I_G model used in Practice D3737 assigns strength values in this way.)