Designation: D7672 – 14

Standard Specification for Evaluating Structural Capacities of Rim Board Products and Assemblies[1]

This standard is issued under the fixed designation D7672; 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.

INTRODUCTION

Rim board assemblies are an engineered component within light-frame wood platform construction. Rim board assemblies serve in multiple structural capacities, including: providing floor closure and diaphragm attachment, transferring vertical and in-plane lateral loads, restricting out-of-plane rotation and lateral translation at the ends of the floor joists, providing deck ledger attachment, and spanning wall openings as a header material. Rim board products, which serve a principal role as a component integrated within a rim board assembly, can vary by wood species, size, shape, and type. Rim board products and assemblies require evaluation of their mechanical properties, physical properties, and their response to end use environments. Procedures established in this Specification provide a means to test rim board products and assemblies, to judge their acceptability, and to establish allowable design capacities.

1. Scope

1.1 This specification provides procedures for testing and establishing the structural capacities of proprietary rim board products and assemblies for use in light-frame wood construction using I-joist or structural composite lumber joist framing. This specification does not apply to commodity rim board products.

1.2 This specification was developed in light of currently manufactured panel, structural composite lumber, and prefabricated I-joist rim board products as defined in 3.2. Materials that do not conform to the definitions of 3.2 are beyond the scope of this specification.

1.3 Fire safety, sound transmission, building envelope performance, and cutting/notching attributes of rim board products and assemblies fall outside the scope of this specification.

1.4 This specification primarily considers end use in dry service conditions, such as most protected framing members, where the equilibrium moisture content for solid-sawn lumber is less than 16 %.

1.5 This specification provides methods to establish "allowable stress" design resistances for use with the National Design Specification for Wood Construction (NDS). Derivation of design resistances from the test data in accordance with "load and resistance factor design" or "limit states design" are beyond the scope of this specification.

1.6 Quality control requirements are outside the scope of this Specification.

1.7 The performance of a rim board product will be affected by the constituent wood species, geometry, adhesive, and production parameters. Therefore, rim board products produced by each individual manufacturer shall be evaluated to determine their product properties, regardless of the similarity in characteristics to products produced by other manufacturers.

1.8 Where a manufacturer produces product in more than one facility, each production facility shall be evaluated independently. For additional production facilities, any revisions to the full qualification program in accordance with this specification shall be approved by an accredited, independent qualifying agency.

1.9 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.10 *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.*

[1] This specification is under the jurisdiction of ASTM Committee D07 on Wood and is the direct responsibility of Subcommittee D07.05 on Wood Assemblies.

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2. Referenced Documents

2.1 *ASTM Standards:*[2]

D9 Terminology Relating to Wood and Wood-Based Products
D198 Test Methods of Static Tests of Lumber in Structural Sizes
D1037 Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
D2395 Test Methods for Density and Specific Gravity (Relative Density) of Wood and Wood-Based Materials
D2915 Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products
D4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials
D4761 Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Material
D5055 Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists
D5456 Specification for Evaluation of Structural Composite Lumber Products
D7033 Practice for Establishing Design Capacities for Oriented Strand Board (OSB) Wood-Based Structural-Use Panels
F1667 Specification for Driven Fasteners: Nails, Spikes, and Staples

[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:*

NDS ANSI/AF&PA National Design Specification for Wood Construction
ANSI/ASME Standard B18.2.1
ANSI/APA PRR-410 Standard for Performance-Rated Engineered Wood Rim Boards
ICC-ES AC124 ICC Evaluation Service Acceptance Criteria for Rim Board Products
PS-1 U.S. Product Standard, Structural Plywood
PS-2 U.S. Product Standard, Performance Standard for Wood-Based Structural Use Panels

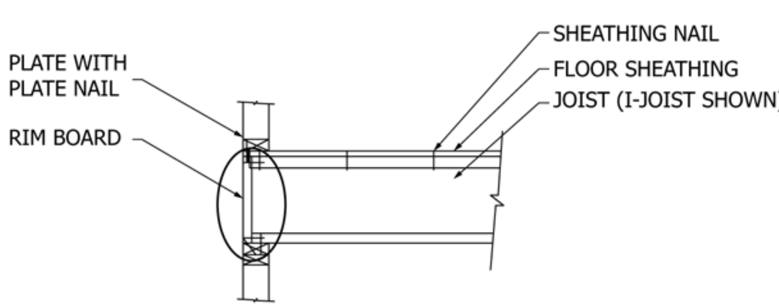
3. Terminology

3.1 *Definitions*—Standard definitions of wood terms are given in Terminology D9.

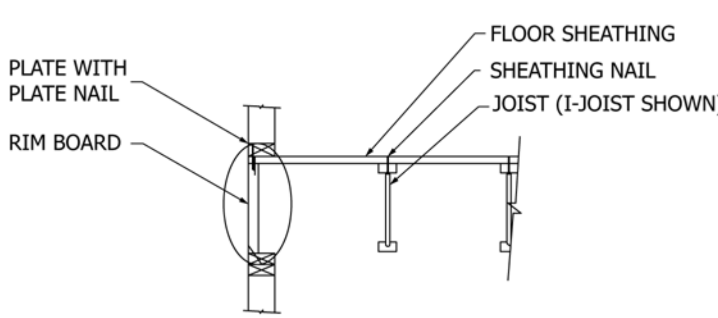
3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Rim Board Assembly*—An assemblage of framing, sheathing, and fasteners at the boundary of a platform floor or roof framed with joists. **DISCUSSION:** The rim board assembly, as illustrated in Fig. 1 for a floor, consists of the sheathing, rim board, wall plate framing, the ends of any perpendicular (Fig. 1A) or parallel (Fig. 1B) joists, and the variety of fasteners that hold these components together.

3.2.2 *Rim Board*—The component of a rim board assembly that provides in-plane lateral and vertical load path continuity, stability, and closure for the full depth of the joist space. **DISCUSSION:** As depicted in Fig. 1 and Fig. 2, the longitudinal axis runs parallel to the wall or foundation framing that supports the platform edge. The product depth extends vertically between the floor platform sheathing above and the wall



a.) Perpendicular to the joists



b.) Parallel to the joists

FIG. 1 Typical Rim Board Assembly Sections for Floor Framing

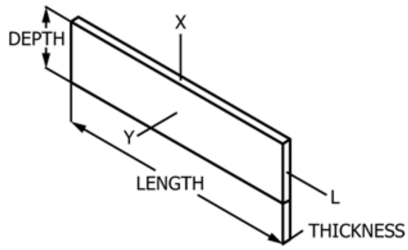


FIG. 2 Orientation for Rim Board

or foundation plate beneath the platform. The rim board product provides vertical load transfer and lateral load transfer through the diaphragm boundary. It works with the sheathing and plate materials to restrain the rotation and lateral translation of the perpendicular floor joists at their end bearing locations. Except when used in a qualified header or cantilever application, the rim board bears upon the wall or foundation plate beneath the platform for the full length and thickness of the product.

3.2.3 *Commodity Rim Board*—Products manufactured to a rim board standard with commodity product capacities and predetermined grades that are qualified and used by multiple manufacturers. **DISCUSSION:** Commodity rim board products are not addressed by this standard.

NOTE 1—ANSI/APA PRR-410 is an example of a commodity rim board standard.

3.2.4 *Rectangular Wood-Based Rim Board*—A structural composite lumber, oriented strand board, or plywood rim board with a rectangular cross section.

3.2.5 *I-joist Rim Board*—A pre-fabricated I-joist rim board.

4. Materials

4.1 *General*—As a condition to being qualified in accordance with this Specification, a rim board product shall comply with the requirements and application limitations of Section 4.

4.2 *Header Applications*—Only rim board qualified for in-plane bending shall be permitted to span a wall opening, foundation opening, or extend beyond a lower wall to support a cantilevered framing offset at the rim board elevation in the structure. Rim board used as a header or cantilever shall be designed for the application using the qualified design properties established in accordance with the reference standards of 4.4. Otherwise, the rim board shall be continuously supported for the full length and thickness of the product.

4.3 *Fastener Capacities*—Rectangular wood-based rim boards and the flanges of I-joist rim boards shall have established capacities for fasteners inserted parallel with the *X* and *Y* orientations of Fig. 2. Minimum allowed spacings shall be set to prevent unusual splitting of the rim board. Fastener capacities are required to be developed that address (*1*) connection of the diaphragm to the top edge of the rim board; (*2*) attachment of the rim board to wall plates above and below; (*3*) attachment of the rim board to the joist ends; (*4*) attachment of exterior wall siding to the rim board; and (*5*) attachment of any required hardware to the face. These capacities shall be permitted to be based upon the material properties established in 4.4 and the relevant design provisions of the NDS. The in-plane lateral load capacity of the rim board assembly shall be empirically established as outlined in this Specification. If the rim board assembly with a rectangular wood-based rim board is to be additionally qualified to support an exterior deck ledger, then deck ledger fastener attachments must also be developed. The procedure outlined in this Specification shall be permitted as a means for the qualification of deck ledger attachments. Alternative deck ledger attachment qualification procedures shall also be permitted provided that they consider all potential failure modes, including deck ledger splitting perpendicular-to-grain.

4.4 *Product Specific Requirements :*

4.4.1 *I-joist Rim Board Products*—I-joist rim board products must be qualified as an I-joist framing material in accordance with Specification D5055, have a minimum flange width of 1.5 in. (38 mm), and a minimum manufactured length of 8 ft. (2.4 m). I-joists with sawn lumber flanges shall have established fastener capacities into the face and edge that comply with the provisions of the NDS. I-joists with structural composite lumber flanges shall have fastener capacities established in accordance with Specification D5456. Deck ledger attachments to I-joist rim board products fall outside the scope of this specification.

4.4.2 *Rectangular Wood-Based Rim Boards*—Rectangular wood-based rim board products shall have a minimum thickness of 1.0 in. (25 mm) and a minimum manufactured length of 8 ft. (2.4 m). Additionally, they shall satisfy the following.

4.4.2.1 *Structural Composite Lumber*—Structural composite lumber rim board products shall be made from a material qualified in accordance with Specification D5456. The axial tension and compression capacities need not be qualified for rim board applications unless the product will be permitted to be used as a drag strut or diaphragm chord. SCL rim board products shall have fastener capacities into the edge and face established in accordance with Specification D5456. Where a Specification D5456 test method requires minimum specimen dimensions that exceed the product thickness, testing the rim board with its actual thickness shall be permitted.

4.4.2.2 *Proprietary Plywood and Oriented Strand Board*—Proprietary plywood and oriented strand board rim board products shall be initially qualified in accordance with PS-1 or PS-2. In addition, when used as a structural header, the edgewise bending performance of proprietary plywood and oriented strand board rim board products shall be evaluated in accordance with the Specification D5456 requirements for laminated veneer lumber or oriented strand lumber, respectively. This evaluation shall include, but is not limited to, relevant considerations applicable to edgewise bending, such as edgewise flexure, shear, and bearing design load establishment, duration of load, volume effects, moisture content, etc. The axial tension and compression capacities need not be qualified in accordance with Specification D5456 for rim board applications unless the product will be used as a drag strut or diaphragm chord. Where a Specification D5456 specified test method requires minimum specimen dimensions that exceed the product thickness, testing the rim board with its actual thickness shall be permitted. Proprietary plywood and

OSB rim board products shall have fastener capacities into the edge and face that either comply with published values in the NDS or have been developed in accordance with Practice D7033.

5. Qualification

5.1 *General*—This section describes procedures, both empirical and analytical, for initial qualification of the structural capacities of rim board products and assemblies. Qualification is required for typical details of rim board application since they are used commonly and influence structural capacities.

5.2 *Qualification Process*—Rim board products shall be tested in accordance with Section 6 and evaluated in accordance with Section 7. The allowable design values and durability targets shall comply with the limitations specified by Table 1.

5.2.1 When deck ledger attachments are qualified for rectangular wood-based rim board products using the procedure outlined in this specification, they shall comply with the limitations specified in Table 2.

5.2.2 When a manufacturer chooses not to establish a concentrated vertical load capacity in accordance with the provisions 6.3 and 7.3, then squash blocks or alternative detailing provisions shall be provided to address concentrated load transfer through the rim board assembly.

5.3 *Sampling*—Samples for qualification testing shall be representative of the population being evaluated. When a modification to the manufacturing process results in a reduction in properties, new qualification testing is required. Sampling of the test material shall be done in accordance with the applicable portions of Section 3, "Statistical Methodology," of Practice D2915.

5.4 *Witnessing*—Qualification tests shall be conducted or witnessed by a qualified agency in accordance with Section 8. All test results are to be certified by an accredited, independent qualifying agency.

5.5 *Moisture Content and Density*—Moisture content shall be measured and reported for each rim board product specimen tested in the qualification program in accordance with Test Methods D4442. The moisture content of other assembly components does not need to be determined. It shall be permitted to determine the moisture content for I-joist rim board products as either the moisture content of the flanges or the full cross-section. Specific gravity or product density shall be measured and reported for rectangular rim board products. Specific gravity shall be determined in accordance with Test Methods D2395. Product density shall be reported based upon the specimen weight divided by the specimen volume at the tested moisture content.

5.6 *Test Equipment Tolerances*—Tests in accordance with this specification are to be conducted using a machine or apparatus calibrated in accordance with Practices E4.

6. Mechanical Testing

6.1 *Uniform Vertical Load Transfer*—The uniform vertical load transfer capability of the rim board assembly is based upon the *X*-orientation compressive capacity of the rim board illustrated in Fig. 2. As specified in 7.1, the rim board vertical load capacity shall be determined based upon the lower of a direct test or calculation. Section 6.1.2 outlines the test used to directly establish the capacity. Section 6.1.3 describes the test to establish the *X*-orientation compression strength of the material for the calculation. The *X*-orientation stiffness shall be determined using the uniform vertical compression test of

TABLE 1 Assembly Limitations

Minimum Rim Board Thickness[A]	Uniform Vertical Load Transfer Design Capacity (X direction)		Lateral Load Transfer Design Capacity (L direction)		Minimum Retained Lateral Load Transfer Durability[B]	Maximum Average Thickness Swell[C]
	Minimum[D]	Maximum	Minimum	Maximum[E]	75 %	10 %
1.0 in. (25 mm)	2000 plf (29.2 kN/m)	360 psi (2.48 N/mm^2) x rim board thickness[F]	180 plf (2.63 kN/m)	190 plf (2.77 kN/m)		
1.125 in. (29 mm)				220 plf (3.21 kN/m)		
1.25 in. (32 mm) and greater				Not Limited		

[A] For the purposes of this table, the thickness of I-joist rim board is the flange width.
[B] The retained lateral load transfer durability is the ratio of the average durability lateral load transfer capacity divided by the dry lateral load transfer capacity as outlined in 7.5.
[C] The thickness swell requirements shall apply only to rectangular rim board products. The average calculated thickness swell for all specimens from a five-panel sample originally conditioned in accordance with 6.4.2 shall not exceed 10 % and no individual panel shall have a measured swell greater than 12 %.
[D] Lower uniform vertical load capacities are permitted to be qualified when the product is limited to engineered construction.
[E] For rim board productions having a thickness between 1 in. (25 mm) and 1.25 in. (32 mm), the allowable capacity shall be interpolated between the following values:

1.0 in. (25 mm) 190 plf (2.77 kN/m)
1.125 in. (29 mm) 220 plf (3.21 kN/m)
1.25 in. (32 mm) 240 plf (3.50 kN/m)

The 240 plf (3.50 kN/m) capacity for 1.25-in. thick (32 mm) rim board is added in this category for interpolation purposes only.
[F] A product shall be permitted to exceed the 360 psi (2.48 N/mm^2) maximum stress provided that the greater capacity is justified with assembly testing to verify that rim board assemblies with representative wall plate, floor sheathing, and floor plate boundary conditions are capable of achieving satisfactory performance.

TABLE 2 Deck Ledger Attachment Shear Capacity Limitations[A,B]

Minimum Rim Board Thickness	1/2 in. (12.7 m) Lag Screw with Washer		1/2 in. (12.7 mm) Bolt with Washers Each End		1/2 in. (12.7 mm) Bolt with Washers Each End and 1/2 in. (12.7 mm) Shimmed Airspace	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
1.0 in. (25 mm)	300 lbs. (1.34 kN)	725 lbs. (3.23 kN)	300 lbs. (1.34 kN)	725 lbs. (3.23 kN)	300 lbs. (1.34 kN)	615 lbs. (2.74 kN)
1.125 in. (29 mm)	350 lbs. (1.56 kN)		350 lbs. (1.56 kN)		350 lbs. (1.56 kN)	
1.25 in. (32 mm) and greater	350 lbs. (1.56 kN)		350 lbs. (1.56 kN)		350 lbs. (1.56 kN)	

[A] Lag screws and bolts shall conform with ANSI/ASME Standard B18.2.1.
[B] The fasteners are installed in the *Y* orientation and loaded in the *X* orientation per Fig. 2.

6.1.2, the *X*-orientation compression strength test of 6.1.3, or the weak-axis bending test of 6.1.4.

6.1.1 *Conditioning*—The rim board material tested in 6.1.2, 6.1.3, and 6.1.4 shall be conditioned to equilibrium moisture content prior to testing under standardized atmospheric conditions of 68 ± 11°F (20 ± 6°C) and 65 ± 5 % relative humidity. Alternatively, material tested in accordance with 6.1.2 is permitted to be tested "as received" and without supplemental conditioning provided that the higher load factor described in 7.1.1 is used for design load development.

6.1.2 *Direct Test of Uniform Vertical Load Transfer:*

6.1.2.1 *Sample Sizes*—The sample sizes shall be sufficient to permit estimation of a population mean with 5 % precision and 75 % confidence. As shown in Fig. 3, the specimen length (*L* direction of Fig. 2) shall be a minimum of 12 in. (30 cm). For rectangular rim board products, a minimum of ten specimens of each depth and thickness shall be tested for each grade and species. As an alternative, testing can be limited to the most critical depth and thickness that is assigned the same uniform vertical load transfer design value. For I-joists, a minimum of ten specimens of each depth, minimum web thickness, and web-to-flange joint configuration shall be tested for each type of flange material (sawn lumber or SCL, species and size), using the joist product with the minimum flange width and thickness. As an alternative, testing can be limited to the most critical combination that is assigned the same uniform vertical load transfer design value.

6.1.2.2 *Test Setup*—Fig. 3 illustrates the test setup. The rim board specimen shall be tested in uniform compression with the load applied parallel to the *X*-Axis of Fig. 2. Fixed steel platens shall be used. The deformation or crushing of the specimen for the full height shall be measured either using the cross-head movement of the test frame or by direct measurement with an external device.

6.1.2.3 *Initial Measurements*—Prior to each test, the specimen thickness (flange and web for an I–joist), depth, length, and weight shall be recorded.

6.1.2.4 *Loading*—A pre-load not to exceed 10 % of the anticipated failure load shall initially be applied and the deflection gauge zeroed. After the pre-load, the loading shall progress at a constant rate such that the average time to maximum load for the test series shall be at least 2 min. Total depth deformation versus load readings shall be taken continuously or at least every 0.01 in. (0.25 mm) until a 0.06-in. (1.5-mm) deformation limit is reached. Loading shall continue until failure occurs.

6.1.2.5 *Recording*—The member dimensions, failure mode, peak load, and load at 0.06-in. (1.5 mm) of deformation shall be recorded from each test. The loads shall be reported as both

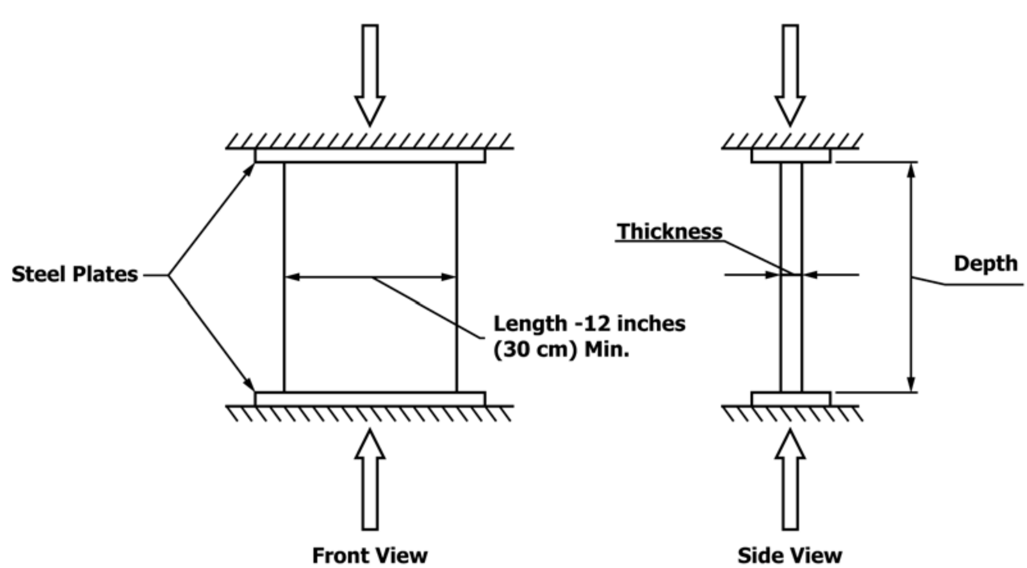


FIG. 3 Test Setup for Direct Measurement of Vertical Load Transfer

an absolute value and normalized by dividing the test result by the specimen length (*L* direction of Fig. 2).

6.1.3 *X-Orientation Crushing Strength and Stiffness* —The *X*-orientation crushing strength and stiffness of rectangular wood-based rim board products shall be tested in accordance with this section. Alternatively, published strength and stiffness values shall be permitted to be used in lieu of this testing for oriented strand board, plywood, and the web materials for an I-joist rim board.

6.1.3.1 *Sample Sizes*—The sample sizes shall be sufficient to estimate a fifth percentile tolerance limit with 75 % confidence. The calculated fifth percentile parametric tolerance limits (PTL) shall have a standard error no greater than 5 % of the PTL, when evaluated in accordance with 3.4.3.2 of Practice D2915.

6.1.3.2 *Test Method*—The short-column compression strength tests shall be undertaken in accordance with the principles of Test Methods D198 or D4761. The stiffness shall be permitted to be estimated using the deformation measurements outlined in D198. Deformation measurements shall be permitted to be omitted when the crushing tests of this section are used only to measure the short-column compressive strength. The minimum cross-section permitted for the test shall be defined by the full product thickness paired with the corresponding width necessary to maintain at least 4.0 in.^{2} (26 cm^2) of tested surface area. The height shall be adjusted to provide an H/r ratio that is greater than 15 and less than 17, where *H* is the effective unsupported height and *r* is the least radius of gyration.

6.1.4 *X-Orientation Stiffness—Alternative Weak-Axis Flatwise Bending Test*: The *X*-orientation modulus of elasticity shall be permitted to be estimated using a flatwise bending test about the *L*-axis as described below.

6.1.4.1 *Sample Sizes*—The sample sizes shall be sufficient to estimate a fifth percentile tolerance limit with 75 % confidence. The calculated fifth percentile parametric tolerance limits (PTL) shall have a standard error no greater than 5 % of the PTL, when evaluated in accordance with 3.4.3.2 of Practice D2915.

6.1.4.2 *Test Method*—These weak axis bending tests shall be undertaken in accordance with the principles of Test Methods D198. The depth of the test specimen shall be the actual product thickness in the *Y* direction, the width of the product shall be 3.5 in. (89 mm) in the *L* direction, and the length in the *X*-direction shall be sufficient to achieve a span-to-depth ratio of between 18 and 21. Loading shall be at third-points.

6.2 *Lateral Load Transfer*—The total lateral load transfer capacity of a rim board assembly shall be tested in accordance with this section.

6.2.1 *Sample Sizes*—The sample sizes shall permit estimation of a population mean with 5 % precision and 75 % confidence. For rectangular rim board products, a minimum of ten specimens of each depth and thickness shall be tested for each grade and species. As an alternative, testing can be limited to the most critical depth and thickness combination that is assigned the same lateral load transfer design value. For I-joists, a minimum of ten specimens of each depth, minimum web thickness and flange-to-web joint configuration shall be tested for each type of flange material (sawn lumber or SCL, species and size), using the joist product with the minimum flange width and thickness. As an alternative, testing can be limited to the most critical combination that is assigned the same lateral load transfer design value.

6.2.2 *Rim Board Assembly Construction*—A test assembly shall consist of rim board, sheathing, joists, and a sill plate, as shown in Fig. 4. The components and fastenings shall be representative of minimum details to be assigned the same design value in application. The joists shall be representative of the minimum I-joist that might be used with the rim board

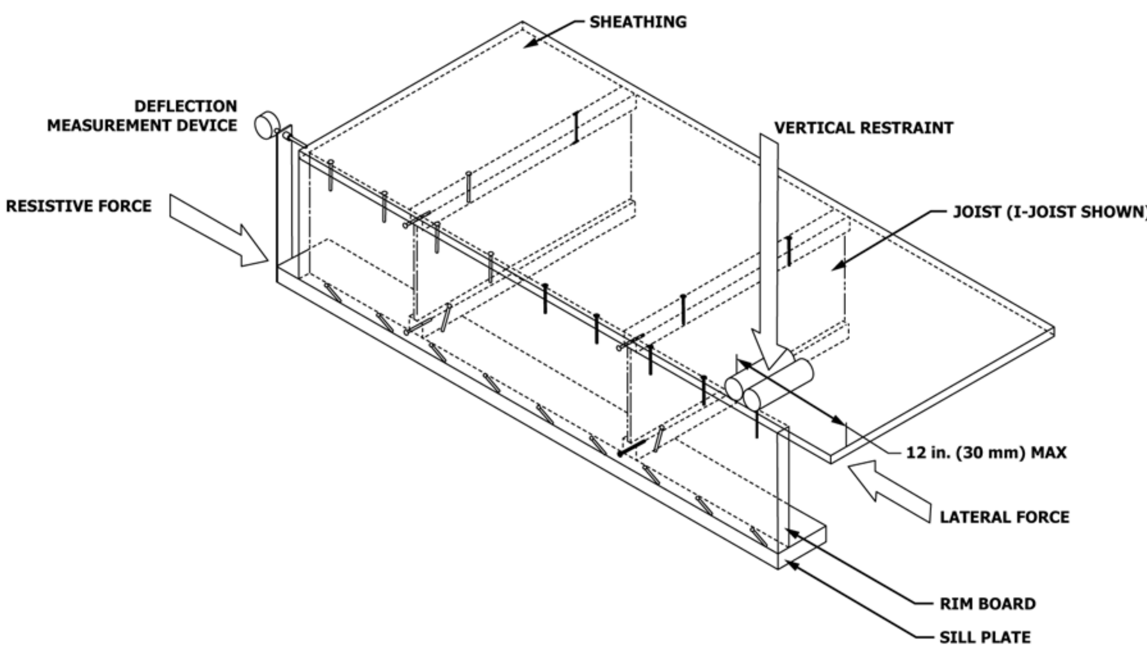


FIG. 4 Lateral Load Transfer Capacity Test

(lowest grade flange, thinnest web, thinnest flange, etc.). Dimensions for each component of the assembly shall meet the requirements given in Table 3. Joist spacing for the assembly shall be 24 in. (61 cm). The assembly shall be fabricated at least 12 h before mechanical testing. At a minimum, the nailing schedule for the test assembly shall follow the requirements given in Table 4. More intensive fastening schedules (that is, larger diameter nails or tighter fastener spacings, or both), alternative sheathing products and thicknesses, and alternative sill plate materials shall be permitted to be qualified when they are representative of lower bounds of the end-use application. The first and last fasteners between sheathing and rim board (edge nails), the sheathing and the joist, and the rim and the plate shall be not more than one half the nominal fastener spacing for each connection type.

6.2.3 *Test Setup*—Loads shall be applied through the sill plate while the sheathing reacts through full-width bearing, or vice versa. The line of load application shall be centered at the rim board or fixed platens shall be used to prevent out-of-plane rotation of the assembly under load. Vertical restraints, such as discrete rollers that do not interfere with the lateral resistance, or other similar devices shall be permitted to provide vertical restraint for the assembly to avoid in-plane overturning. This restraint shall not interfere with the lateral deformation of the assembly in the direction parallel to loading and shall be placed within 12 in. (30 cm) of the loaded sheathing edge as depicted in Fig. 4. No in-plane or out-of-plane restraint shall be provided for the joists. Assembly deformations shall be measured based on the relative lateral displacements between the sill plate and sheathing along the entire length of the rim board. Vertical displacements caused by in-plane overturning forces are permitted to be isolated from the measurements of lateral deformations.

6.2.4 *Loading*—The loading rate shall not exceed 450 lbf (2.00 kN) per minute. The assembly shall be loaded to ultimate load or 0.4-in. (10-mm) lateral deformation, whichever comes first. No preload shall be applied. Load and deformation readings shall be taken at approximately equal load increments.

6.2.5 *Recording*—The rim board dimensions, commercial species grouping of the sill plate material, failure mode, peak load, and load at 0.4 in. (10 mm) of deformation shall be recorded for each test. The loads shall be reported as both an absolute value and normalized by dividing the test result by the specimen length.

6.3 *Concentrated Vertical Load Transfer Capacity* —The concentrated vertical load transfer capacity test procedures outlined by this section shall be considered as an optional test method that only needs to be undertaken if the manufacturer chooses to establish a related design value. Subject to the following exceptions, the concentrated vertical load transfer test specimens shall be conditioned to an equilibrium moisture content under conditions specified by 6.1.1 and tested in a manner consistent with 6.1.2:

6.3.1 The specimen length shall be a minimum of 16 in. (41 cm).

6.3.2 Load shall be applied as a concentrated load through a 4.5 in. long (11.4 cm) steel bar, with a minimum thickness of 0.50 in. (12.7 mm) and a width at least equal to the rim board thickness at the top edge of the rim board specimen. The 4.5-in. (11.4-cm) length of the steel bar shall be centered on the 16 in. (41 cm) length of the test specimen.

6.3.3 Material is permitted to be tested "as received" and without supplemental conditioning provided that the higher load factor described in 7.3 is used for design load development.

6.4 *Thickness swell*—All rectangular wood-based rim board products shall be tested for thickness swell.

6.4.1 *Sampling*—Ten specimens shall be taken per product panel or sample from a minimum of five panels or samples. All specimens shall be 6.0 × 6.0 in. (15 × 15 cm) by the product thickness.

6.4.2 *Conditioning*—When the moisture content of the specimens exceeds what would normally be achieved under environmental conditions of 68 ± 11°F (20 ± 6°C) and 65 ± 5 % relative humidity, then five specimens from each panel or sample shall be conditioned to a constant weight and moisture content under environmental conditions of 68 ± 11°F (20 ± 6°C) and 65 ± 5 % relative humidity. Five matching specimens shall not be conditioned. When the moisture content of the unconditioned specimens is less than or equal to the typical moisture content of the rim board material in the referenced conditions, then conditioning of the specimens is not required.

6.4.3 *Initial Measurements*—Specimen thickness measurements shall be taken to the nearest 0.001 in. (0.03 mm) at four points: midway along each of the four sides, at a distance of 1.0 in. (25 mm) from the edge. The measuring device used shall have flat contacting anvils with a minimum diameter of 0.75 in.

TABLE 3 Test Assembly Material Dimensions

NOTE 1—For SI: 1 inch = 25.4 mm.

Test Assembly Component	Thickness (in.)	Depth or Width (in.)	Length (in.)
Rim Board	See 6.2.1	See 6.2.1	36
Joist[A]	Maximum 1¾ [B]	Minimum 9¼	12
Sheathing[C]	23/32	12	39
Sill Plate[D]	1.5	3.5	39

[A] Part of assembly construction (not rim board).
[B] Alternative joist thicknesses shall be permitted where they are representative of the minimum thickness to be used in application.
[C] Baseline qualification tests shall be conducted using oriented strand board produced in compliance with PS-2. Alternate sheathing materials and thicknesses shall be permitted where they are representative of the lower bounds that will be used in application.
[D] Baseline qualification tests shall be conducted using either spruce-pine-fir or hem-fir sill plate materials with no individual piece having an oven-dry specific gravity greater than 0.45. Sill plate materials with higher specific gravities shall be permitted to be qualified provided that they are representative of the lower bounds that will be used in application.

TABLE 4 Minimum Nailing Schedule[A]

NOTE 1—For SI: 1 in. = 25.4 mm.

Sheathing to Rim Board or Joist	Rim Board to Sill Plates[B]	Joist to Sill Plate[B]	Rim Board to Joist
8d common (2.5 × 0.131 in.) at 6 in. on center	8d box (2.5 × 0.113 in.) at 6 in. on center	2-8d box with I-joist joists 3-8d box with rectangular joists (2.5 × 0.113 in.)	2-8d box (2.5 × 0.113 in.)

[A] More intensive nailing schedules (that is, larger diameters or tighter nail spacings, or both) shall be permitted to be tested where they are representative of the application.
[B] Toe-nailed fasteners shall be permitted.

(20 mm). Pressure on the contacting surfaces shall not be greater than 10 psi (70 kPa).

6.4.4 *Water Soak*—All specimens shall be submerged horizontally oriented in clean, fresh water with a minimum temperature of 68°F (20°C) for 24 h. The water level shall be maintained so that the top surface of the specimens shall have a minimum of 1 in. (25 mm) of water above them for the duration of the soak.

6.4.5 *Final Measurements*—After soaking, all specimens shall be removed and suspended vertically to drain for 10 min before re-measuring thickness.

6.5 *Lateral Edge Nailing Durability*—The lateral edge nailing durability testing described in this section shall be undertaken to assess the relative rim board susceptibility to degradation from wetting during the construction cycle. Subject to the following exceptions, the tests shall be conducted in a manner consistent with 6.2:

6.5.1 *Sampling*—A minimum of three replicates shall be tested for each test group instead of the ten replicates required by 6.2.1.

6.5.2 *Conditioning*—The full-size rim board specimens shall be submerged horizontally in clean, fresh water with a minimum temperature of 68°F (20°C) for 24 h. The water level shall be maintained so that the top surface of the specimens shall have a minimum of 1 in. (25 mm) of water above them for the duration of the soak. The test assemblies shall be fabricated in accordance with 6.2.2 while the rim board is still wet. The rim board shall be re-dried to a moisture content between 8 and 12 % prior to the lateral load transfer capacity test. This determination shall be permitted to be based upon the moisture content originally determined for the rim board in 5.5, by weighing the rim board prior to and immediately after the water soak, by weighing the lateral load assembly immediately after fabrication, and by periodically re-weighing the assembly as it dries.

6.6 *Deck Ledger Attachment Assembly*—Deck ledger attachment assemblies for rectangular wood-based rim board products shall be tested in accordance with this section.

6.6.1 *Conditioning*—The rim board material shall be conditioned to an equilibrium moisture content prior to testing under standardized atmospheric conditions of 68 ± 11°F (20 ± 6°C) and 65 ± 5 % relative humidity.

6.6.2 *Sample Sizes*—The sample sizes for each connection configuration shall permit estimation of a population mean with 5 % precision and 75 % confidence. A minimum of ten assemblies shall be tested for each combination of rim board species, thickness, grade, and fastener type.

6.6.3 *Fastener Configurations*—The tests shall be run on any or all of three different deck ledger attachment configurations: a ½-in. (12.7-mm) lag screw with washer; a ½-in. (12.7-mm) diameter bolt with washers on both ends; and a ½-in. (12.7-mm) bolt with a minimum ½-in. (12.7-mm) air gap created by stacked washers. Bolts and lag screws shall comply with ANSI/ASME Standard B18.2.1. The lag screws shall be selected to provide threads in the shear plane between the ledger and the sheathing.

6.6.4 *Deck Ledger Assembly Construction*—A test assembly shall consist of rim board, sheathing, wax paper, fastener (with washers), and deck ledger as illustrated in Fig. 5. The deck ledger material shall be either spruce-pine-fir or hem-fir with no individual piece having a oven-dry specific gravity in excess of 0.45. The dimensions of each component shall comply with Fig. 5. The rim board, sheathing, and ledger dimensions parallel to the major strength axis shall be not greater than two (2) times the manufacturer's recommended minimum end distance, with a maximum of 10 in. (25 cm), to avoid splitting. The sheathing shall be attached to the rim board with six 6-6d box nails (2.0 × 0.099 in. (51 × 2.51 mm)) staggered to prevent splitting. When lag screws are tested, a ½-in. (12.7-mm) clearance hole shall be provided for the shank and a 5⁄16-in. (7.9-mm) lead hole shall be provided for the threads. When bolts are tested, the clearance holes into all of the connected parts shall be drilled to a diameter of 9⁄16 in. (14.3 mm). The bolts and lag screws shall not be tightened beyond the point where all of the connected pieces come into contact. The connection shall not be pre-stressed. The assembly shall be fabricated at least 12 h before mechanical testing.

6.6.5 *Test Setup*—Fig. 5 illustrates the test setup. Loads shall be applied through the ledger while the rim board and sheathing react through full-width bearing, or vice versa. The wax paper between the ledger and sheathing shall be used to reduce friction. The rim and deck ledger boards are to be restrained from rotation under load. Assembly deformations shall be measured as the displacement of the test frame cross-head or as vertical slip of the connection between the rim board and ledger.

6.6.6 *Loading Rate*—The loading rate shall be constant and not exceed 0.3 in. (7.6 mm) per minute. Loading shall progress until a maximum load or a deformation of 1.5 in. (38 mm) is achieved, whichever comes first. Preload shall not be applied. Load and deformation readings shall be taken at approximately equal load increments.

6.6.7 *Recording*—The rim board dimensions, commercial species grouping of the deck ledger board, failure mode, peak

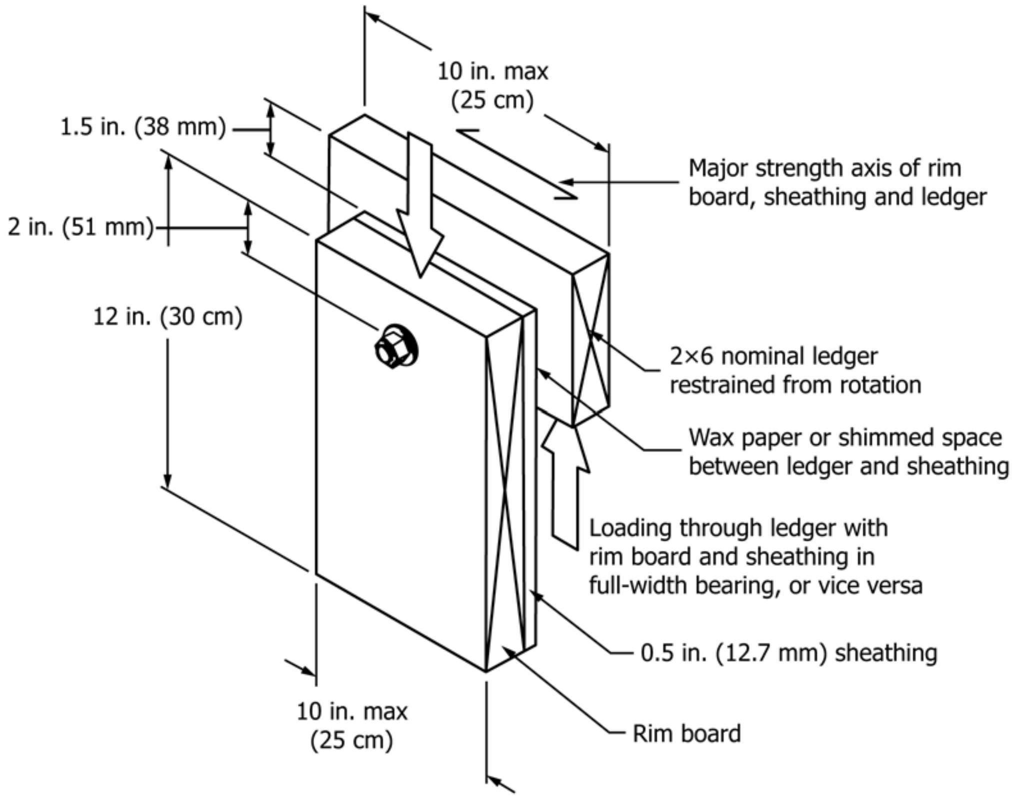


FIG. 5 Deck Ledger Attachment Test

load, and maximum load achieved prior to 1.5 in. (38 mm) of deformation shall be recorded from each test.

6.6.8 *Deck Ledger Properties*—The moisture content, dimensions, and specific gravity of the ledger boards used in each assembly shall be measured and reported. Measurement for moisture content shall be in accordance with Test Methods D4442 and measurement of specific gravity shall be in accordance with Test Methods D2395.

7. Evaluation

7.1 *Uniform Vertical Load Transfer Capacity*—The allowable uniform vertical load transfer capacity shall be the lower of the tested capacity of 7.1.1 or the calculated capacity of 7.1.2. The resulting design value shall be assumed to correspond with a 10-year load duration and shall not be increased for shorter durations. The allowable compression perpendicular-to-grain value for the sill plate and floor sheathing shall be included in the final analysis for the end-use application. Design of the rim board/wall detail shall include considerations for stability and transfer of vertical loads from the wall above to the wall below without imparting significant load to the joists, unless adequate performance of the detail is provided by documented assembly tests.

7.1.1 *Test-Based Allowable Uniform Vertical Load Capacity*—For material conditioned under standardized atmospheric conditions of 68 ± 11°F (20 ± 6°C) and 65 ± 5 % relative humidity, the test-based uniform vertical load design capacity shall be determined using the test results from 6.1.2 and shall be the lesser of the average ultimate load divided by a factor of 2.5 or the average load from the tests at a deformation of 0.06 in. (1.5 mm). A factor of 3.0 shall be used instead of the 2.5 factor for material tested as received and without supplemental conditioning to alter the moisture content.

7.1.2 *Calculated Uniform Allowable Vertical Load Capacity*—The calculated allowable vertical load capacity for each thickness, depth, grade and species of rim board shall be developed in accordance with the NDS using the *X*-orientation crushing strength data from 6.1.3 and stiffness data from 6.1.2, 6.1.3, or 6.1.4. The buckling length coefficient, K_e, shall not be less than 0.90 for rectangular wood based rim board and 0.65 for web buckling between flanges of an I-joist rim board. A 10-year load duration shall be assumed for the calculation for comparison with the design capacity developed in 7.1.1.

7.2 *Lateral Load Transfer Capacity*—The peak lateral load transfer capacity for each assembly is equal to the maximum load determined from the tests of 6.2 divided by the rim board length. The lateral load transfer design capacity for each rim board combination shall be the average of the peak load capacities divided by a factor of 2.8. This lateral load transfer capacity is assumed to occur with a short-term load duration, shall be compared against the performance targets of Table 1, and shall be permitted to be increased by a factor of 1.4 when used for design in wind applications.

7.3 *Concentrated Vertical Load Capacity*—The provisions of this section only apply if the manufacturer chooses to establish a concentrated vertical load capacity design value. For material conditioned under standardized atmospheric conditions of 68 ± 11°F (20 ± 6°C) and 65 ± 5 % relative humidity, the concentrated vertical load transfer design capacity shall be the lesser of the average maximum load from the tests of 6.3 divided by a factor of 2.5, or the average load from the tests at a deformation of 0.06 in. (1.5 mm). A factor of 3.0 shall be used for material that is tested as received and without supplemental conditioning to alter the moisture content. The resulting design value shall be assumed to correspond with a 10-year load duration and shall not be increased for shorter durations.

7.4 *Thickness Swell*—The thickness swell of each panel tested in 6.4 shall be calculated to the nearest 1 % in accordance with the following formula:

$$TS = 100 \cdot \left(\frac{t_{24} - t_0}{t_0} \right) \quad (1)$$

where:

TS = Thickness swell, in percent, after 24-h soak,
t_{24} = The sum of the 20 thickness measurements from each group of five specimens after the 24-h soak, and
t_0 = The sum of the 20 original thickness measurements from each group of five specimens.

7.5 *Lateral Edge Nailing Durability*—For each rim board assembly combination tested in 6.5, the average ultimate lateral load transfer capacity shall be determined in accordance with 7.2. The lateral edge nail durability ratio shall be determined as:

$$DR = \left(\frac{L_D}{L} \right) \cdot 100 \quad (2)$$

where:

DR = Lateral edge durability ratio, in percent, after 24-h soak,
L_D = The average maximum lateral load transfer capacity for the rim board assembly specimens with the water-soaked/re-dried rim board tested per 6.5, and
L = The average maximum load transfer capacity for the non-wetted rim board assembly specimens per 6.2.

7.6 *Deck Ledger Attachment Capacity*—The fastener design capacity for each deck ledger attachment configuration tested in 6.6 shall be equal to the maximum load achieved at or before 1.5 in. (38 mm) of connection deformation divided by a factor of 5.0. This design capacity shall be assumed to occur at a 10-year load duration and shall be permitted to be adjusted by the load duration factor which corresponds with the application.

7.6.1 *Bolt-Specific Provisions*—The resulting allowable loads for bolted assembly configurations derived in accordance with 7.6 shall only be used to establish deck ledger attachment design guidance for prescriptive construction. They shall not be used for engineered construction.

7.6.2 *Lag Screw-Specific Provisions*—The allowable loads for lag screw configurations derived in accordance with 7.6 shall be permitted for use in either prescriptive or engineered construction. For prescriptive construction, it is permitted to assume that the tested allowable loads for lag screws apply to bolted connections that use the same nominal diameter and connection configuration.

8. Independent Inspection

8.1 A qualified agency shall be employed by the manufacturer for the purpose of monitoring the quality assurance production process on a random unannounced basis. The qualified independent agency shall establish or approve and maintain procedures for quality assurance.

8.2 A qualified agency is defined as one that:

8.3 Has trained technical personnel to verify that the grading, measurement, species, construction, shaping, bonding, workmanship, and other characteristics of the products as determined by inspection, sampling, and testing comply with all applicable requirements specified herein;

8.4 Has procedures to be followed by its personnel in performance of the inspection and testing; and

8.5 Has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being inspected or tested; and is not owned, operated, or controlled by any such company.

9. Precision and Bias

9.1 The precision and bias of the test methods included within this Specification have not yet been established.

10. Keywords

10.1 concentrated vertical load transfer; deck ledger; deck ledger attachment; floor; I-joists; lateral load transfer; light-frame construction; oriented strand board; platform; plywood; rim board; rim board assembly; roof; structural composite lumber; thickness swell; uniform vertical load transfer; wood

APPENDIXES

(Nonmandatory Information)

X1. STANDARD DEVELOPMENT

X1.1 This standard was developed by ASTM D07.05 as a means to evaluate proprietary rim board products and assemblies. This specification does not address commodity rim board products manufactured to a national rim board standard, such as ANSI/APA PRR-410 (**1**).[3]

X1.2 The ICC Evaluation Service's *Acceptance Criteria for Rim Board Products (AC124)* (**2**) was used as an initial starting point for the development of this standard. ICC-ES AC124 was the source for the following performance criteria indicated in Table 1: minimum uniform vertical load transfer, minimum concentrated vertical load transfer, minimum retained lateral load transfer durability, and the maximum average thickness swell for rectangular rim board products. While these and some other similarities to ICC-ES AC124 remain, the final version of this Standard was significantly expanded and modified from its original content.

[3] The boldface numbers in parentheses refer to a list of references at the end of this standard.

X2. RIM BOARDS AS HEADERS, DRAG STRUTS, AND DIAPHRAGM CHORDS

X2.1 Rim board assemblies are sometimes used to span openings created by windows, doors, and other wall penetrations in light-frame construction. The rim board performance as a header or cantilever needs to be evaluated in a manner similar to other materials, including: sawn lumber, glulam, structural composite lumber, and commodity plywood and OSB. For the rim board assembly to be used as a structural header, 4.2 requires the proprietary rim board material to be evaluated for the engineering properties critical in a bending application. This evaluation should include consideration of: edgewise bending strength and stiffness, shear strength, compression perpendicular-to-grain, volume effects, and duration of load/creep performance.

X2.2 Structural composite lumber and I-joists qualified in accordance the reference standards cited in 4.4.1 and 4.4.2.1 will have been qualified for in-plane bending applications. These materials have satisfied standardized provisions that permit them to be designed in a bending application. However, proprietary plywood and OSB panel products are not specifically tested to quantify their edgewise bending attributes as part of the PS-1 or PS-2 prequalification requirement of 4.4.2.2. As a result, this standard requires the edgewise flexure attributes to be further evaluated in accordance with the relevant provisions of Specification D5456.

X2.3 This standard does not preclude the manufacture and use of rim board products that have not been qualified as header materials, provided that they are not permitted to span as a structural header. Rim board assemblies constructed with products that are not qualified as headers should be fully-supported for their entire thickness and length.

X2.4 Using a rim board as a header material in some conditions could potentially result in it serving as a "drag strut" that collects and distributes lateral load between adjacent shearwall elements or a diaphragm chord that resists floor or roof diaphragm bending. Reliance upon rim board as a drag strut or diaphragm chord would also require the axial tension and compression capabilities of the rim board product to be established.

X3. DEVELOPMENT OF FASTENER CAPACITIES

X3.1 Fabrication of a rim board assembly requires a variety of nails to be installed into the edge and face of the rim board product. This necessitates the establishment of fastener performance into the face and edge as a condition for qualification in 4.3. Pre-fabricated I-joist rim boards with sawn lumber flanges have established fastener design procedures that can be found in reference design specifications like the "National Design Specification for Wood Construction" (NDS) (**3**). Structural composite lumber, I-joists with structural composite lumber flanges, and panel products used as rim boards need to have their relevant fastener performance into the edge and face grain evaluated per standards such as Specification D5456 and Practice D7033 to provide a means to address the connection details identified in 4.3.

X4. DEPTH COMPATIBILITY AND ALTERNATIVE RIM BOARD MATERIALS

X4.1 This Specification was developed to provide a means for evaluating rim board assemblies for floor and roof systems constructed with I-joist or structural composite lumber joist framing. It applies to rim board assemblies framed with plywood, oriented strand board, structural composite lumber, and I-joist rim board products.

X4.2 The design of a wood I-joist floor system assumes that vertical loads from above are transferred into the rim material and around the ends of floor joists at their bearing locations. The floor joists themselves are assumed to transfer only their vertical shear loading. To provide vertical load transfer through the rim assembly, the height of the rim board must equal or exceed the height of the pre-fabricated I-joists for the range of moisture contents that might be expected in service.

X4.3 Structural composite lumber and I-joist joist framing materials are normally manufactured with moisture contents, nominal depths, and moisture-shrinkage relationships that differ from sawn-lumber and glulam materials. For these reasons, sawn-lumber and glulam rim board materials fall outside the scope of this specification. To successfully use sawn-lumber and glulam rim board materials with structural composite lumber and I-joist framing would require additional considerations. In addition to the qualification requirements of this standard, at a minimum, this review should ensure that the sawn lumber and glulam rim board products serve as the primary vertical load path with I-joist framing and have depths that are compatible with either joist type for the range of expected service conditions. This would likely require sawn lumber and glulam rim products to be further dried and re-sized to be compatible with engineered wood framing. They will also require relatively tight tolerances on the manufactured depth of the rim product. Even then, the differential moisture-shrinkage relationships between the rim and joist materials will likely limit the useful depths of sawn-lumber and glulam rim that can be used to provide satisfactory performance for a practical range of moisture contents.

X4.4 There are a variety of insulated rim board products in the marketplace that also fall outside the scope of this specification. To be used with structural composite lumber and I-joist framing, insulated rim board products should be required to address the fundamental qualification requirements outlined in this standard. However, given the wide variety of insulated rim board configurations and installation details currently in use, there are also additional product-specific concerns that may need to be evaluated. For example, the product thickness and configuration may require additional review of adhesive durability, fastening with conventional details, lateral stability of the rim or joists, vertical load eccentricity, joist bearing, the ability to resist negative wind pressure, long-term loading performance as a header material, cladding attachment, or combinations thereof. Due to the complexity of developing a comprehensive standard to address the variety of potential product-specific concerns for all possible insulated rim board configurations, the committee elected to exclude these products from the scope of this specification.

X5. LATERAL LOAD TRANSFER

X5.1 The lateral load transfer test, outlined in 6.2, was developed to provide an empirical confirmation that rim board products will perform as intended when sheathing nailing is applied at a diaphragm perimeter. This review was judged necessary for assemblies fabricated with rectangular rim board products since composite rim boards are typically thinner than the traditional framing considered by diaphragm design tables (**4**, **5**), can sometimes have variable density profiles through their thickness with a lower density core, and can have the potential for splitting due to fastener installation into the edge grain. With I-joist rim board materials, there is a further need to understand the suitability of the attachment between the flanges and the webs. For these materials, the test provides a means to evaluate shear transfer capabilities of the composite construction and the impact of flanges and perimeter framing materials that do not always provide for full-depth penetration of the sheathing fastener.

X5.2 The protocol outlined in 6.2 represents a monotonic lateral load test conducted on a short length of rim board assembly. Load is applied to the sheathing on the top surface, resisted in shear by the rim board assembly, and transferred out of the assembly at the bottom sill plate. The sheathing-to-rim and rim-to-plate attachments are both loaded in series during the test. Table 3 and Table 4 define sheathing, sill plate materials, and fastening schedules to be used for the baseline screening test that were chosen to be representative of conventional construction details (**6**). While a smaller diameter nail may sometimes be used in a conventional framing application, an 8d common sheathing nail with 6-in. (15-cm) spacing was selected for the baseline screening test because it represents a fastener/spacing combination that should not induce premature splitting in rim board products. While thinner floor sheathing may sometimes be used in conventional construction, the sheathing thickness specified in Table 3 was chosen to focus the test on the rim board product and reduce the possibility of a sheathing-related failure. Alternate capacities with a more intensive fastening schedule may also be tested if they are representative of the end-use application.

X5.2.1 Consideration was given to whether a cyclic or monotonic test protocol should be used for the lateral load transfer test. Monotonic lateral load tests of a lateral force resisting system are typically thought to be most representative of wind load applications and fully-reversing cyclic tests are often favored as a means to establish seismic performance.

Rim board assemblies will serve in both capacities. A monotonic test regime was ultimately selected since rim board assemblies perform as part of a diaphragm and diaphragm capacities have historically been evaluated with monotonic testing for both load conditions. Additionally, the cost and complexity of cyclic testing was judged to be an unreasonable burden to impose for rim board assemblies given that seismic performance factors for light-frame structures are normally associated with the performance of the shearwalls and not the boundary framing of a floor diaphragm. Also, it was not apparent what seismic performance attributes measured in a cyclic load test should be required for the rim board assembly when similar requirements do not exist for the diaphragm of which it is a component.

X5.2.2 The monotonic loading in the lateral load transfer test of 6.2 is terminated for practicality purposes at 0.4 in. (10 mm) of accumulated deformation across the entire rim board assembly. Rim board assemblies are generally non-linear, ductile systems that achieve the majority of their ultimate peak capacity at or before the specified displacement limit of 0.4 in. (10 mm). Continuing the load to failure typically provides only minimal additional capacity. The committee was also concerned that permitting deflections beyond this judgment-based limit would also unduly contribute to vertical load instability of a wall positioned below the rim board assembly.

X5.3 A load factor of 2.8 is specified in 7.2 to adjust between an average peak load per unit length and the short-term allowable lateral transfer design load. This load factor was selected to be consistent with what is normally expected for a light-frame wood structural panel shearwall and to provide a similar level of reliability. The resulting design loads are considered appropriate for seismic applications and should be compared against the performance targets of Table 1. To be consistent with the design of light-frame wood shearwalls and diaphragms, the capacities for wind design may be taken as the seismic capacities increased by a factor of 1.4.

X5.4 The minimum acceptable allowable lateral transfer load capacity of 180 plf (2.63 kN/m) included in Table 1 was established in two ways. First, it was recognized that an unblocked diaphragm framed with 8d common sheathing nails, 6-in. (15-cm) fastener edge spacing, and a sheathing panel with a thickness in excess of 15⁄32 in. (11.9 mm) will be considered to have an engineered short-term allowable design capacity of 180 plf (2.63 kN/m) in one diaphragm load orientation and 240 plf (3.50 kN/m) in the other (**4, 5**). Enforcing a lower limit of 180 plf (2.63 kN/m) on all rim board thicknesses was intended to ensure that the splitting resistance and fastener performance of the rim board product observed in the screening test is capable of maintaining at least the minimum performance level associated with the tested configuration. Secondly, it was thought that the rim board assembly should have a minimum allowable design capacity that is at least as strong as the attachment of a conventionally constructed structure to a foundation. Typical conventional construction details that use ½-in. (12.7-mm) diameter anchor bolts to attach 1.5 in. (38 mm) thick wood sill plates to concrete with a 6-ft. (1.8-m) anchor bolt spacing result in estimated short-term allowable design loads that range between 160 plf (2.34 kN/m) and 180 plf (2.63 kN/m). Selecting a minimum capacity of 180 plf (2.63 kN/m) for the rim board assembly lateral load transfer design value helped to ensure that the rim board assembly was reasonably matched to these prescriptive foundation framing details.

X5.5 The rim board thickness and maximum allowable load limitations outlined in Table 1 were generated based upon concerns about the constructability of rim board assemblies framed with thinner rim products. It was recognized that the thinner the rim board, the less likely it is that the sheathing and sole plate nails will be accurately installed with blind nailing that occurs in jobsite applications. To address this concern, it was judged necessary to impose upper limits on the design values that can be rationalized for thinner products. Judgment was used to rationalize that rim boards with a thickness of 1.25 in. (32 mm) or greater should be capable of achieving at least the 240-plf (3.50-kN/m) design load normally associated with the high-end diaphragm design load for the tested sheathing/fastener configuration. The upper limits on design capacities for 1-in. (25-mm) and 1.125-in. (29-mm) thick rim boards were derived by multiplying the 240-plf (3.50-kN/m) design load by a "constructability factor" that was essentially calculated as the ratio of rim board thickness to a thickness of 1.25 in. (32 mm).

X6. UNIFORM VERTICAL LOAD TRANSFER

X6.1 The uniform vertical load provisions in this Specification provide a means to establish the capacity of a rim board assembly to transfer gravity loads through the floor or roof perimeter. The design loads are established as the lower of an empirical test or a calculated value.

X6.2 The empirical test outlined in 6.1.2 is intended to establish the peak load capacity for the critical combination of rim board depth, thickness, grade, or I-joist series. The Committee recognized that the test outlined in 6.1.2 represents a practical, but imperfect simulation of the application. In the test, a relatively short piece of rim board product is concentrically squeezed between fixed steel platens in a test frame. In application, the rim board will be loaded through compressible floor sheathing and wood sill plate surfaces. With the rim board positioned at the edge of the floor or roof platform, the load from above will also be eccentrically applied to some degree.

X6.2.1 When tested after an equilibrium moisture content is reached under standardized atmospheric conditions, the empirical allowable rim board capacity is determined from the test in 7.1.1 as the lower of the average peak load per unit length of rim board divided by a factor of 2.5 or the measured average load per unit length at a deformation of 0.06 in. (1.5 mm). The deflection limit was chosen to roughly correspond with a 1⁄16-in. (1.5-mm) deformation level that was judged reasonable to avoid transferring vertical load to the floor framing. The load factor of 2.5 between an average test result and a 10-year load duration was judged reasonable given that some form of rim board buckling or crushing, or both, will typically serve as the dominant failure mode. While established provisions do not currently exist within the NDS or the related ASTM D07 standards to address the perpendicular-to-grain buckling and crushing of a slender element, wood design values for compression parallel-to-grain developed for these modes in accordance with Practice D2915 and Specification D5456 typically incorporate lower fractile characteristic value adjustments of 1.66 and 1.9 for buckling and crushing, respectively. Assuming conservatively high coefficients of variation for structural composite lumber strength and stiffness that fall in the order of 15 %, the corresponding average ratios between the tested ultimate load and the 10-year allowable design load would be approximately 2.4 for buckling and 2.8 for crushing. An intermediate factor of 2.5 was chosen for the purpose of this standard since the uniform vertical rim failure modes for slender rim board cross sections tend to be governed more by buckling than crushing. Should a rim material have expected strength or stiffness variability, or both, in excess of 15 %, then a higher factor and increased sample sizes should be considered.

X6.2.2 Historically, proprietary wood-based rim board products have used a factor of 3.0 instead of the 2.5 adopted by this standard. However, the 3.0 factor was applied to test data collected for product tested at the manufactured moisture content. The composite products addressed by this specification will typically have manufactured moisture contents that fall below those that would be achieved under environmental conditions of 68 ± 11°F (20 ± 6°C.) and 65 ± 5 % relative humidity. Given that this standard departs from historical practice by requiring conditioned material to be tested for qualification, it was judged that some of the load factor conservatism was not warranted when testing conditioned material. The requirements for material conditioning and design value adjustment were both adjusted in this specification to bring them into closer agreement with similar provisions for structural composite lumber and solid wood. The option to test material without moisture conditioning and use the 3.0 load factor was retained as a means to conservatively simplify qualification requirements and extend the applicability of historical test data.

X6.3 The intent behind the calculated capacity check in 7.1.2 is to provide an upper limit for the tested capacity given the limitations of the test method. Experience with representative products has shown that the end fixities required in 7.1.2 are typically conservative relative to the test method and often govern the allowable capacity.

X6.3.1 To calculate the uniform vertical load capacity of the rim board product in a manner consistent with the NDS requires the allowable axial crush strength in the product *X*-direction to be known. For sheathing-based rim board products and the web materials of pre-fabricated I-joists, approximate values for the allowable axial crush strength can be found in the literature and used to complete the calculation. For SCL rim board, the allowable crush strength in the *X*-direction is not typically available and will need to be established. For these products, the allowable crushing strength shall be based upon the testing outlined in 6.1.3 with the data reduced to an allowable load in a manner consistent with that outlined for compression parallel to grain in Specification D5456.

X6.3.2 Since buckling failure modes are often governed by the product stiffness, the *X*-direction stiffness will also need to be determined. Estimations for the average stiffness of sheathing products and the web materials for pre-fabricated I-joists can be found in the literature and used for the calculation. For structural composite lumber products, the axial deflection measurements taken in either 6.1.2 or 6.1.3 can be used to estimate the product stiffness in the *X*-direction. As an alternate, the cross-machine bending stiffness of 6.1.4, measured in compliance with Test Methods D198, may also be used. The weak-axis flatwise bending tests are preferred to accurately capture the out-of-plane flexibility of composite rim board products with a density that varies with product thickness. Use of the axial stiffness from 6.1.2 or 6.1.3 will conservatively underestimate the out-of-plane rigidity of a rim product with densified outer surfaces.

X6.3.3 Regardless of how they are obtained, stiffness estimates for all products will need to be reduced to the lower fractal stiffness, E_{min}, that considers the variability and a 1.66 factor of safety at the lower 5 % exclusion value. NDS Equation D-4 summarizes this calculation. A COV of not less than 12 % should be used for this reduction. Additionally, if the measured axial stiffness is used for the calculation, no increase in stiffness shall be taken to account for shear deformation since the test methods directly measured the axial stiffness. The crush strength data measured in 6.1.3 also needs to be developed into an allowable strength design value using the procedures for compression parallel-to-grain outlined by Section 7 of Specification D5456. Subject to the limitations of 7.1.2, the allowable crush strength and E_{min} are then combined to determine the allowable calculated uniform vertical load capacity using the procedures outlined in Appendix H of the NDS.

X6.4 The failure modes observed for vertical uniform load transfer are typically some form of elastic or inelastic buckling. For that reason, as outlined in 7.1, the tested allowable design values are not allowed to be further increased for load duration. With a buckling failure, it is not clear that an increased capacity will be realized with shorter duration loading.

X6.5 Table 1 provides a minimum permitted allowable uniform vertical rim design value of 2000 plf (29.2 kN/m). This value was adopted from ICC-ES AC124 and was intended to represent a minimum useful capacity. It roughly corresponds with the vertical load capacity of a 16 in. (41 cm) deep I-joist with a ⅜ in. (9.5 mm) oriented strand board web which has been used successfully for many rim board applications in the past. The 2000 plf (29.2 kN/m) load also approximates the maximum load that would be seen by a first-floor rim board in a three-story structure framed in compliance with prescriptive provisions of the United States model building codes. It is recognized that it will limit the usefulness of some rim board products like pre-fabricated I-joists to shallower depths in a rim application. It is also recognized that some applications may require greater capacities.

X6.6 The maximum permitted allowable vertical uniform load transfer of 360 psi was initially based upon the established compression perpendicular-to-grain capacity of commodity floor sheathing products. However, the current intent behind this limit is to prevent the uniform vertical load capacity of the rim from being established at a level that exceeds the capability of the sheathing and plate materials to transfer load into the rim. It is recognized that as the plate and sheathing materials compress, they have the potential to degrade the end-fixity provided to the rim board and induce vertical load eccentricities that negatively impact the performance of the rim board product. The 360 psi used by the standard serves as an assembly limit to reduce the potential for a loss of end fixity provided to the rim board product by the sheathing and plate materials. This may not simply represent a serviceability concern as the boundary conditions provided to the rim board serve to limit the uniform vertical load capacity of the assembly. Assignment of a uniform vertical load transfer design capacity in excess of 360 psi may be possible for some non-traditional floor platform framing materials or details. In these instances, Footnote F of Table 1 requires the higher capacity to be rationalized through floor platform uniform vertical load assembly tests using realistic wall plate, floor sheathing, and floor plate boundary conditions. The assembly tests should include surrounding materials and boundary conditions that provide a reasonable approximation of the lowest end-fixity support conditions anticipated in service (i.e., lower bound of framing specific gravity, moisture conditioned materials, consideration of conditions where the rim runs parallel to any floor joists, etc.). Since the end fixity provided by the surrounding construction is stress dependent, the program should bracket the range of permitted rim board slenderness ratios and include products with a low slenderness that will result in higher compressive stresses applied to the surrounding materials.

X7. CONCENTRATED VERTICAL LOAD TRANSFER

X7.1 Given their location at building perimeters, rim board assemblies are often used to transfer vertical column loads through a floor assembly. The concentrated vertical load transfer test of 6.3 is provided as an optional means for a manufacturer to develop a related design value that evaluates the potential for localized buckling or crushing beneath a point load with a relatively deep, thin rim board. Additionally, it was intended to evaluate the ability of the web-to-flange joint of an I-joist to perform in bearing at the column location.

X7.2 The test method and analysis procedure outlined in 6.3 and 7.3 are essentially the same as those used for the uniform vertical load test, with the exception that load is applied through a 4.5-in. (11.4-cm) long bearing plate. The bearing plate length represents the bearing stress from a single-ply column framed with one 1.5-in. (38-mm) thick stud transmitted at a 45° angle through a 1.5-in. (38-mm) thick sill plate.

X7.3 It should be recognized that the concentrated vertical load transfer capacity is related to the rim board. Squash blocking or alternative details can also be engineered to transfer vertical loads if a rim board assembly is not capable of transferring the entire load. Squash blocking or alternative details would also be required in those instances where a manufacturer chooses not to establish a concentrated vertical load transfer capacity. Such details should be addressed by engineering mechanics and fall outside the scope of this Specification.

X8. LATERAL LOAD DURABILITY AND THICKNESS SWELL

X8.1 The lateral load durability and thickness swell tests were selected to provide a measure of rim board durability. Many rim board products covered by this Specification are composite products bonded with adhesives under pressure. The relevant pre-qualification specifications listed in Section 4 (such as Specification D5456, Specification D5055, PS-1, and PS-2) all contain durability requirements that must be satisfied to prove that an adequate performance level will be retained after moisture exposure. The thickness swell testing of 6.4 and the lateral load resistance durability testing of 6.5 were both added to this Specification to provide a further screening for rim board product durability. This additional testing was judged to be necessary because many of the fasteners in a rim board assembly are installed into the edge of a rectangular rim board product. The thickness swell and lateral edge nail durability test provide a relative measure of bond integrity, jobsite durability, and split resistance after moisture exposure.

X8.2 The maximum thickness swell and lateral edge nail durability retained strength limitations outlined in Table 1 were chosen based upon an understanding of benchmark performance of rim board products that were produced in the 1990's. The idea was that future products and future formulations of existing products should be able to achieve at least that benchmark level of durability that had a history of satisfactory performance.

X8.3 The lateral load durability test does not specify the conditions to be used to re-dry the assemblies since the committee judged that accelerated drying cycles would tend to conservatively encourage splitting. Drying cycles with temperatures in the order of 100°F (38°C) have been employed in the past.

X9. DECK LEDGER ATTACHMENT

X9.1 Exterior deck ledgers are commonly attached to rim board assemblies constructed with rectangular rim board products. In the United States, wood connections are typically engineered using the provisions of the NDS. The provisions of the NDS are applicable and may be used to design deck ledger-to-rim connections in situations where the configuration of the deck ledger connection complies with the assumptions of the NDS. However, deck ledger attachment to some rim board products addressed by this standard fall outside the scope of the NDS. For example, many rim board products evaluated in accordance with this Specification are not thick enough to satisfy the NDS depth of penetration requirements for lag screws. In addition, the NDS does not provide a means to evaluate fastenings when a shimmed airspace is used to create a drainage gap between the rim board and the deck ledger.

X9.2 In the 1990's a small-scale, single shear test methodology was developed to empirically establish the capacity of ½-in. (12.7-mm) diameter lag screws for use as deck ledger attachment (**7**). That methodology was satisfactorily used for a number of years to evaluate and establish allowable ledger lag screw capacities for rim board products as the average load at a deformation of 0.6 in. (15 mm) across the deck ledger attachment connection divided by a factor of 4.0.

X9.3 In 2009, the prescriptive provisions of the United States building code were updated to incorporate each of the three different types of deck ledger attachment schemes addressed by this standard: ½-in. (12.7-mm) diameter ledger lag screws, ½-in.. (12.7-mm) diameter bolts, and ½-in. (12.7-mm) bolts with a ½-in. (12.7-mm) airspace (**6**). These new provisions for prescriptive construction were based upon a series of multiple-member deck ledger assembly tests that derived the allowable connection design load as the average peak shear load across the deck ledger attachment divided by a factor of 4.8 (**8, 9,** and **10**). The reports summarizing this work suggested that the peak loads were typically achieved with deformations in excess of 1.5 in. (38.1 mm) across the deck ledger connection and that splitting of deck ledger board was a relevant failure mode. The test results from these connection assembly tests were not well aligned with the single-shear fastener tests mentioned in X9.2 that were previously used to evaluate ledger lag screws for deck ledger attachment.

X9.4 The single-shear test method outlined in 6.6 was developed as a simple means to approximate the assembly tests with a single-fastener shear test that focuses upon the performance of the rim board product. The original lag screw test was modified to allow all three connection configurations permitted by the prescriptive standard to be tested, the specimen geometries were adjusted to prevent splitting, and the test was extended to a connection deformation of at least 1.5 in. (38 mm). To align with the assembly tests, the allowable design loads are established as the average peak load achieved prior to a deformation of 1.5 in. (38 mm) divided by a factor of 5.0. The 5.0 factor was chosen to correlate with the expected performance of similar bolted and lag screwed fasteners in the NDS. The 1.5-in. (38-mm) test deformation limit was chosen to align with the connection deformations where failures were observed in the assembly tests.

X9.5 The design limits established for deck ledger attachment are summarized in Table 2. The lower bounds were chosen to correlate with the design loads assumed in industry literature for rectangular rim board products (**11**). The idea is that the tested performance should be able to achieve at least this benchmark level. The upper bounds are defined by the design loads assumed for each attachment scheme by the prescriptive code for attachment to sawn lumber rim boards with a thickness of 1.5 in. (38 mm). This boundary was judged necessary, given that the simplified test method concentrates on the performance of the rim board product and does not induce the deck ledger tension perpendicular-to-grain failure mode often observed in the assembly test.

X9.6 The provisions of 7.6.1 and 7.6.2 are intended to ensure that the empirical design loads derived for ½ in. (12.7 mm) bolt and lag screw assemblies in accordance with this Specification are used in a manner consistent with the provisions for sawn lumber in the United States model building codes. 7.6.1 limits use of the bolted assembly design loads to the development of deck ledger attachment tables for prescriptive construction. This is consistent with the prescriptive code provisions described in X9.3 for sawn lumber and avoids a conflict with engineered construction where an alternative capacity would be computed using the NDS. The usage of the lag screw allowable loads derived in accordance with this specification is not similarly restricted since lag screw assembly configurations with depths of main member penetration less than 4 times the fastener diameter fall outside the scope of the NDS. The ability to apply the tested allowable load capacity for lag screws to similar bolted configurations for the development of prescriptive attachment tables was added to conservatively simplify the qualification process.

X9.7 This standard does not preclude the development of design values for alternative fasteners and deck ledger attachment details. However, alternative details should likely be tested using methods similar to those of the assembly tests to ensure that the performance of the deck ledger and its tendency to split will be evaluated in the design load establishment. The simplified test method in 6.6 is not appropriate for that purpose.

X9.8 Due to the relative thickness and geometry of their web materials, pre-fabricated I-joists are not well suited for deck ledger attachment using conventional fastening schemes. Design details and a means for evaluation of deck ledger attachment to a pre-fabricated I-joist rim assembly fall outside the scope of this specification.

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