



DrJ Research Report

DRR 1507-12

Use of Fire Retardant Treated Wood in
the Design of Walls Panels, Roof
Trusses and Floor Trusses

Structural Building Components Association

Code Compliance Process: Fire retardant treated wood (FRTW) products

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REPORT HOLDER
INFORMATION:

Structural Building Components Association

6300 Enterprise Ln
Madison, WI 53719-1190

sbcindustry.com

DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

SECTION: 06 05 83 - Shop-Applied Wood Coating

SECTION: 06 11 00 - Wood Framing

SECTION: 06 17 00 - Shop-Fabricated Structural Wood

1 CODE COMPLIANCE PROCESS EVALUATED¹

1.1 Fire retardant treated wood (FRTW) products

- 1.1.1 Lumber
- 1.1.2 Structural Sheathing

2 APPLICABLE CODES AND STANDARDS^{2,3}

2.1 Codes

- 2.1.1 *IBC—12, 15, 18: International Building Code®*
- 2.1.2 *IRC—12, 15, 18: International Residential Code®*

2.2 Standards and Referenced Documents

- 2.2.1 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*
- 2.2.2 *ASTM D2898: Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.*
- 2.2.3 *ASTM D3201: Standard Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Based Products*
- 2.2.4 *ASTM D5516: Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures*

¹ Building codes require data from valid [research reports](#) be obtained from [approved sources](#). Work of licensed [registered design professionals](#) (RDPS) meets the [code requirements](#) for approval by the [building official](#).

Building official approval of a licensed RDP is performed by verifying the RDP and/or their business entity complies with all professional engineering laws of the relevant [jurisdiction](#). Therefore, the work of licensed RDPS is accepted by [building officials](#), except when plan (i.e. peer) review finds an error with respect to a specific section of the code. Where this DRR is not approved, the [building official](#) responds in writing stating the reasons for [disapproval](#).

For more information on any of these topics or our mission, product evaluation policies, product approval process, and engineering law, visit drjengineering.org or call us at 608-310-6748.

² Unless otherwise noted, all references in this DRR are from the 2018 version of the codes and the standards referenced therein (e.g., *ASCE 7, NDS, ASTM*). This material, design, or method of construction also complies with the 2000-2015 versions of the referenced codes and the standards referenced therein.

³ All terms defined in the applicable building codes are italicized.



- 2.2.5 *ASTM D5664: Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber*
- 2.2.6 *ASTM D6305: Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing*
- 2.2.7 *ASTM D6841: Standard Practice for Calculating Design Value Treatment Adjustment Factors for Fire-Retardant-Treated Lumber*
- 2.2.8 *ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials*
- 2.2.9 *AWPA C20: Structural Lumber - Fire-Retardant Treatment by Pressure Processes*
- 2.2.10 *AWPA T1: Use Category System: Processing and Treatment Standard*
- 2.2.11 *AWPA U1: Use Category System: User Specification for Treated Wood*
- 2.2.12 *TPI 1: National Design Standard for Metal-plate-connected Wood Truss Construction*
- 2.2.13 *UL 723: Tests for Surface Burning Characteristics of Building Materials*

3 EVALUATION SCOPE

- 3.1 Code compliance requirements of fire retardant treated wood (FRTW) products have been evaluated with respect to current codes and standards where they are used in the manufacture of wall panels and metal plate connected roof and floor trusses. This evaluation is limited to FRTW use in wall panels, roof and floor trusses and considers the following code compliance issues:
 - 3.1.1 Structural performance and durability of FRTW in above ground exterior and interior applications.
 - 3.1.2 Requirements for metal connector plates when FRTW is used in the manufacture of trusses and wall panels.
 - 3.1.3 Fastener requirements for use with FRTW, other than metal connector plates.
- 3.2 Any code compliance issues not specifically addressed in this section are outside the scope of this DRR.
- 3.3 Any engineering evaluation conducted for this DRR was performed on the dates provided in this DRR and within DrJ's professional scope of work.

4 APPLICATIONS

- 4.1 *General Requirements*
 - 4.1.1 This research report provides guidance on the use of FRTW products in trusses and wall panels in above ground applications where allowed by code.
 - 4.1.2 All truss and wall assembly components shall be approved, installed, and inspected in accordance with the applicable building code, approved construction documents, manufacturer installation instructions, and good practice.
- 4.2 *Terminology*
 - 4.2.1 *Fire-retardant-treated wood (FRTW)* - Wood products that, when impregnated with chemicals by a pressure process or other means during manufacture, exhibit reduced surface-burning characteristics and resist propagation of fire.
 - 4.2.2 *Treated Wood* – Wood products that are conditioned to enhance fire-retardant or preservative properties.
- 4.3 *Allowable Uses*
 - 4.3.1 The *IBC* distinguishes several construction types based on the required combustibility level of the building materials used. [*IBC Chapter 6*](#) details how FRTW products can be included in each building type.



4.3.2 Types I and II construction have the strictest fire resistance requirements; buildings must be built with non-combustible materials in both the exterior and interior walls. Although FRTW products are not considered non-combustible, IBC Section 603.1 includes a provision for FRTW to be used in several locations in Type I and II construction:

603.1 Allowable materials. Combustible materials shall be permitted in buildings of Type I or II construction in the following applications and in accordance with Sections 603.1.1 through 603.1.3:

1. Fire-retardant-treated wood shall be permitted in:
 - 1.1. Nonbearing partitions where the required fire-resistance rating is 2 hours or less.
 - 1.2. Nonbearing exterior walls where fire-resistance rated construction is not required.
 - 1.3. Roof construction, including girders, trusses, framing and decking.

Exception: In buildings of Type IA construction exceeding two stories above grade plane, fire-retardant-treated wood is not permitted in roof construction when the vertical distance from the upper floor to the roof is less than 20 feet (6096 mm).

- 4.3.3 Type III construction requires exterior walls to be of noncombustible materials, but provides that FRTW framing complying with IBC Section 2303.2 is permitted within exterior wall assemblies of a 2-hour rating or less. (IBC Section 602.3)
- 4.3.4 Type IV construction (Heavy Timber) requires exterior walls to be of noncombustible materials, but like Type III, FRTW framing is permitted within exterior walls of 2-hour rating or less.
- 4.3.5 Type V construction allows both exterior and interior walls to be of any materials permitted by code.

4.4 Treatment

4.4.1 IBC Section 2303.2.1-4 and IRC Section R802.1.3.1-4 give identical guidelines on the treatment process, testing (where required), and labeling of FRTW products. IBC Section 2303.2 and IRC Section R802.1.3 both describe FRTW as:

2303.2 Fire-retardant-treated wood Fire-retardant-treated-wood is any wood product which, when impregnated with chemicals by a pressure process or other means during manufacture, shall have, when tested in accordance with ASTM E 84 or UL 723, a listed flame spread index of 25 or less and show no evidence of significant progressive combustion when the test is continued for an additional 20-minute period. Additionally, the flame front shall not progress more than 10 ½ feet (3200 mm) beyond the centerline of the burners at any time during the test.

4.4.1.1 There are three methods of compliance with this section.

4.4.1.1.1 One method states that the FRTW may be treated using a pressure process, as described in IBC Section 2303.2.1 and IRC Section R802.1.3.1.

4.4.1.1.2 A second method states that wood products treated in other ways are allowable, so long as the treatment is “an integral part of the manufacturing process of the wood product” and provides “permanent protection to all surfaces of the wood product” (IBC Section 2303.2.2/IRC Section R802.1.3.2). Also, wood products treated by means other than a pressure process, must be tested on all sides as described in IBC Section 2303.2/IRC Section R802.1.3 and meet the same performance requirements as wood treated by a pressure process.

4.4.1.1.3 A third way of meeting the requirement is via an alternate material, in accordance with the alternative means and methods provision of IBC Section 104.11, provided the product meets the same performance requirements as FRTW. An alternative product would not be FRTW by definition (not impregnated) but would serve as an alternative to FRTW.



4.5 Drying

- 4.5.1 The humidity experienced by the wood during both treatment and in service can have an effect on both the structural and fire performance of the wood. IBC Section 2303.2.6/IRC Section R802.1.3.6 states that FRTW in wet or damp locations must be identified as “Exterior” to indicate there is no increase in the listed flame spread index when subjected to *ASTM D2898*, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
- 4.5.1.1 FRTW in interior locations must be tested in accordance with *ASTM D3201* and must have a maximum moisture content of 28%
- 4.5.1.2 The FRTW shall be dried to a moisture content of 19% or less for lumber and 15% or less for Wood Structural Panels (WSP) before use.
- 4.5.1.3 For wood kiln-dried after treatment (KDAT), the kiln temperatures shall not exceed those used in kiln drying the lumber and plywood submitted for the tests described in IBC Section 2303.2.5.1/IRC Section R802.1.3.5.1 for plywood and IBC Section 2303.2.5.2/IRC Section R802.1.3.5.2 for lumber.
- 4.5.1.4 *TPI 1* Section 6.4.9.1⁴ is similar.

6.4.9.1 Fire Retardant Treated (FRT) Lumber. All FRT lumber used in Trusses shall be re-dried after treatment to 19 percent maximum moisture content at temperatures not to exceed 160°F (71°C). FRT lumber design values shall be developed from approved test methods and procedures that consider potential strength-reduction characteristics, including effects of elevated temperature and moisture. Design values shall be approved by the authorities having Jurisdiction.

4.6 Labeling

- 4.6.1 FRTW products must be labeled with the following items per IBC Section 2303.2.4/IRC Section R802.1.3.4, which states

2303.2.4 Labeling Fire-retardant-treated lumber and wood structural panels shall be labeled. The label shall contain the following items:

1. The identification mark of an approved agency in accordance with Section 1703.5.
2. Identification of the treating manufacturer.
3. The name of the fire-retardant treatment.
4. The species of wood treated.
5. Flame spread and smoke-developed index.
6. Method of drying after treatment.
7. Conformance with appropriate standards in accordance with Sections 2303.2.5 through 2303.2.8.
8. For fire-retardant-treated wood exposed to weather, damp or wet locations, include the word “No increase in the listed classification when subjected to the Standard Rain Test” (*ASTM D 2898*).

- 4.6.2 *TPI 1* Chapter 3 requires that FRTW lumber must be clearly identified and marked:

3.4.5 Fire Retardant Identification – Lumber Impregnated with fire retardant chemicals shall be identified by the quality mark of, or a certificate of inspection from, an approved inspection agency and shall be identified by a label affixed to the package.

⁴ 2014 *TPI 1* Section 6.4.9.1



4.6.3 The Commentary for Chapter 3 explains the reasoning behind requiring a mark on FRTW lumber:

§3.4.5 Fire Retardant Identification. The marking by an approved inspection agency is specified to assure that lumber processing during the treatment process, and subsequent processes such as kiln-drying, are conducted in accordance with the processes employed during the evaluation of the treatment's effects. Approval of an inspection agency for treated lumber is typically the authority of the local Building Official. Inspection agencies may be accredited for inspection of pressure treated wood products by the American Lumber Standard Committee, Inc. (ALSC, see www.alsc.org), the International Accreditation Service, Inc. (IAS, see www.iasonline.org), or other accrediting services

4.7 *Fastener Use*

- 4.7.1 Fastener requirements for use in contact with FRTW are discussed in [IBC Section 2304.10.5.3⁵](#) and [IRC Section R317.3.3](#) (for exterior or wet or damp applications) and [IBC Section 2304.10.5.4⁶](#) and [IRC Section R317.3.4](#) (for interior applications).
- 4.7.2 [IBC Section 2304.10.5.3⁷](#) states that fasteners, including nuts and washers, used in exterior applications or wet or damp locations shall be of hot-dipped zinc-coated galvanized steel stainless steel, silicon bronze, or copper. There is an exception made for fasteners other than nails, timber rivets, wood screws and lag screws, which are permitted to be of mechanically deposited zinc-coated steel. [IRC Section R317.3.3](#) is identical, although the *IRC* does not include wood screws and lag screws in the exception.
- 4.7.3 [IBC Section 2304.10.5.4⁸](#) states that fasteners used in interior applications shall follow the manufacturer's recommendations, or in their absence, to follow the guidelines for exterior applications found in [IBC Section 2304.10.5.3⁹](#). [IRC Section R317.3.4](#) is identical, except references [IRC Section R317.3.3](#).

4.8 *Design Adjustments*

4.8.1 *Lumber and WSP FRTW Products*

- 4.8.1.1 Adjustments to untreated wood design values must be made when using FRTW in structural applications, including in the design of trusses or wall panels. The code does not specify adjustment factors, but states that the adjustments shall be based on an approved method and must take into consideration the effects of temperature and humidity exposures from the treatment and redrying process. ([IBC Section 2303.2.5/IRC Section R802.1.3.5.2](#)) The approved methods for WSP and lumber respectively are found in [IBC Section 2303.2.5.1/IRC Section R802.1.3.5.1](#) and [IBC Section 2303.2.5.2/IRC Section R802.1.3.5.2](#):

2303.2.5.1 Wood structural panels. The effect of treatment and the method of redrying after treatment, and exposure to high temperatures and high humidities on the flexure properties of fire-retardant-treated softwood plywood shall be determined in accordance with ASTM D 5516. The test data developed by ASTM D 5516 shall be used to develop adjustment factors, maximum loads and spans, or both, for untreated plywood design values in accordance with ASTM D 6305. Each manufacturer shall publish the allowable maximum loads and spans for service as floor and roof sheathing for its treatment.

⁵ [2012 IBC Section 2304.9.5.3](#)

⁶ [2012 IBC Section 2304.9.5.4](#)

⁷ [2012 IBC Section 2304.9.5.3](#)

⁸ [2012 IBC Section 2304.9.5.4](#)

⁹ [2012 IBC Section 2304.9.5.3](#)





2303.2.5.2 Lumber. For each species of wood that is treated, the effects of the treatment, the method of redrying after treatment and exposure to high temperatures and high humidities on the allowable design properties of fire-retardant-treated lumber shall be determined in accordance with ASTM D 5664. The test data developed by ASTM D 5664 shall be used to develop modification factors for use at or near room temperature and at elevated temperatures and humidity in accordance with ASTM D 6841. Each manufacturer shall publish the modification factors for service at temperatures of not less than 80°F (27°C) and for roof framing. The roof framing modification factors shall take into consideration the climatological location.

4.8.1.2 Treated wood stress adjustments are discussed in *IBC Section 2306.1.3*. The code restates here what is found in *IBC Section 2303*, but also notes that other adjustments are applicable except that the impact load duration shall not apply.

4.9 Metal Connector Plates used with FRTW

4.9.1 The *IRC* and *IBC* do not provide any guidance on the use of Metal Connector plates used with FRTW materials. However, *TPI 1* Chapter 6 discusses this topic. 6.4.9.2 Metal Connector Plates Installed in FRT Metal Connector Plates installed in lumber pressure-impregnated with fire retardant chemicals shall have the reductions for lateral resistance values specified by the FRT chemical manufacturer. The quality mark shall indicate that the design value adjustments are in accordance with either the FRT manufacturer's specifications or based upon an approved method of investigation which takes into consideration the effects of the anticipated temperature and humidity to which the FRT will be subjected.

4.9.2 The commentary for chapter 6 further states: §6.4.9.2 Metal Connector Plates Installed in FRTW. Metal Connector Plate design values shall be adjusted per recommendations by the chemical manufacturer.

4.10 LRFD Design

4.10.1 *TPI 1* Chapter 6 notes in Table 6.4-7 Time Effect Factors, λ (LRFD Only) Footnote ** states:

**Time effect factors greater than 1.0 shall not apply to connections or to structural members pressure-treated with water-borne preservatives or fire retardant chemicals.

5 FINDINGS

5.1 Fire retardant treated materials can be incorporated into buildings to reduce the ability of lumber and lumber products to contribute to a fire. *IBC* and *IRC* requirements dictate where, and under what circumstances, fire retardant materials are appropriate.

5.2 When designing trusses with fire retardant lumber, *TPI 1* should be followed as a guide for the appropriate drying conditions for the lumber after treatment. In addition, appropriate design values reductions for the lumber or metal connector plate should be taken following the FRT manufacturer's specifications.

5.3 *IBC Section 104.11* (*IRC Section R104.11* and *IFC Section 104.9* are similar) states:

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code...Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *approved*.



6 CONDITIONS OF USE

- 6.1 Where required by the building official, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed, this DRR and the installation instructions shall be submitted at the time of permit application.
- 6.2 Any generally accepted engineering calculations needed to show compliance with this DRR shall be submitted to the AHJ for review and approval.
- 6.3 Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed and/or by the Building Designer (e.g., owner or registered design professional).
- 6.4 The actual design, suitability, and use of this DRR, for any particular building, is the responsibility of the owner or the owner's authorized agent. Therefore, the DRR shall be reviewed for code compliance by the building official for acceptance.

7 REVIEW SCHEDULE

- 7.1 For the most recent version or current status of this DRR, visit drjengineering.org or contact DrJ Engineering.