FRT Lumber Use in Type III-A Buildings

Overview
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SBCA has been the voice of the structural building components industry since 1983, providing educational programs and technical information, disseminating industry news, and facilitating networking opportunities for manufacturers of roof trusses, wall panels and floor trusses. SBCA endeavors to expand component manufacturers’ market share and enhance the professionalism of the component manufacturing industry.
Introduction

• Construction Type refers to a classification given to buildings based on the combustibility of interior and exterior building materials

• There are five different classifications: I, II, III, IV, and V
Introduction

- Each type of construction (except IV) also has a letter designation based on the fire-resistance rating required for different building elements.

\[
\begin{align*}
A &= \text{Protected} \\
B &= \text{Unprotected}
\end{align*}
\]
Introduction

- This presentation focuses on Type III-A construction:
  - Also known as “Protected Combustible”
  - Typically has brick or block walls and a wooden roof or floor assembly
  - Has the following fire ratings:
    - 2-hour exterior walls
    - 1-hour structural frame
    - 1-hour floor/ceiling/roof protection
Key Definitions

- **Type III Construction**: Building construction type where the exterior walls are required to be of noncombustible materials and all other components of the building including interior walls, roof and floors are may be combustible.
  
  - *IBC 602.3 Type III*. Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less.

- **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. *(2015 IBC Section 2302 Treated Wood)*
Key Definitions

- Fire-Resistance Rating: The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests prescribed in 2015 IBC Section 2302.
- Combustible: Readily ignitable and free-burning materials.
- Noncombustible: Nonflammable material that must pass the testing criteria from Section 8 of ASTM E 136. The commentary X1.2 of ASTM E 136 gives more background information.
- Exterior Walls: Outer most walls that enclose the structure and support more than just its own dead weight.
Background

• Many factors go into classifying buildings
• Each building type (I-V) has different allowable:
  – Height (*IBC Table 504.3*)
  – Number of stories (*504.4*)
  – Area limitations (*506.2*)
Background

• Type I is the most fire-resistant and Type V is the least fire-resistant
• The level of fire resistance is based on the materials used to build the building
Background

- The five types are divided into combustible and noncombustible
  - Non-combustible includes types I and II.
    - Example materials: concrete, brick, masonry, ceramic tiles, metals (except aluminum), magnesium, glass, mineral wool, and rock wool
  - Combustible includes types III, IV and V.
    - Example material: untreated wood
Background

• Group A (protected) and group B (unprotected) are distinguished by the required fire-resistant rating for the building’s interior structural members
• Typically group A buildings require the interior to have a one-hour fire-resistance rating while group B does not require it
• However, there are situations where a fire-resistance rating greater than one hour may be required as shown in IBC Table 601 and Table 602
### TABLE 601 FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

<table>
<thead>
<tr>
<th>BUILDING ELEMENT</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>HT</td>
</tr>
<tr>
<td>Primary structural frame(^1) (see Section 202)</td>
<td>(3^a)</td>
<td>(2^a)</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bearing walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior(^e,f)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Interior</td>
<td>(3^a)</td>
<td>(2^a)</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Nonbearing walls and partitions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nonbearing walls and partitions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior(^d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor construction and associated secondary members</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(see Section 202)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof construction and associated secondary members</td>
<td>(1\frac{1}{2})</td>
<td>(1\frac{1}{2})</td>
<td>(1\frac{1}{2})</td>
<td>(1\frac{1}{2})</td>
<td>(1\frac{1}{2})</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. Roof supports. Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).

f. Not less than the fire-resistance rating as referenced in Section 704.10.
Background

**TABLE 602 FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE**

<table>
<thead>
<tr>
<th>FIRE SEPARATION DISTANCE - X (feet)</th>
<th>TYPE OF CONSTRUCTION</th>
<th>OCCUPANCY GROUP H&lt;sup&gt;a&lt;/sup&gt;</th>
<th>OCCUPANCY GROUP F-1, M, S-1&lt;sup&gt;b&lt;/sup&gt;</th>
<th>OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>X &lt; 5&lt;sup&gt;d&lt;/sup&gt;</td>
<td>All</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5 ≤ X &lt; 10</td>
<td>IA</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10 ≤ X &lt; 30</td>
<td>IA, IB</td>
<td>2</td>
<td>1</td>
<td>1&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>IIB, VB</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>1</td>
<td>1</td>
<td>1&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>X ≥ 30</td>
<td>All</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

- **a.** Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
- **b.** See Section 706.1.1 for party walls.
- **c.** Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
- **d.** The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
- **e.** For special requirements for Group H occupancies, see Section 415.6.
- **f.** For special requirements for Group S aircraft hangars, see Section 412.4.1.
- **g.** Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
- **h.** For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1524 mm) or greater.
Background

- If a building consists of materials meeting two different construction types, the building will be classified as the lowest of the types present.
- A building only fits the classification when it meets all the requirements of that particular construction type.
Building Type III-A

- Building Type III-A may consist of both combustible and noncombustible materials as long as they meet the building code specified for that particular building.
- As stated in *IBC Section 602.3*, type III-A building construction requires the exterior walls to be of noncombustible materials and have a fire-resistance rating of 2 hours or less, but the interior building elements are of any material allowed by the code.
Building Type III-A

- Since the building is a type A building, the primary structural frame is required to have a fire-resistance rating of 1 hour.
- This requirement can be met by the framing itself or when protected with additional fire-resistant materials, including gypsum wall board or spray on fire resistance rated coatings.
Building Type III-A

• The exterior walls are required to be built of noncombustible materials.

• Although FRTW does not meet the criteria of ASTM E 136 Section 8 to be considered as a noncombustible material, it is permitted.

• The 2015 IBC Section 602.3 states that as long as the FRTW complies with IBC Section 2303.2, it shall be permitted within exterior wall assemblies of a 2 hour rating or less.

• Note also that there are other products on the market which are not FRTW, but have been approved for use in this application as an alternative material as allowed in the IBC, section 104.11.
Fire Retardant Treated Wood (FRTW)

- FRTW is treated with chemicals that react to the combustible gas released from the burning wood to create carbon dioxide, water and a carbon char layer to slow down the burning process, as shown at right.
- Overall, the chemical applied to the wood helps slow down the spreading of flames which results in a structure to be more effective for a longer period of time.
Fire Retardant Treated Wood (FRTW)

• For any FRTW to be eligible for construction, FRTW would have to meet all requirements from IBC Section 2303.2
• Treatment for FRT products should occur during manufacturing, either by using the pressure process or by other means

• Requirements and regulations are as given in the IBC:
  – 2303.2.1 Pressure process
  – 2303.2.2 Other means during manufacture
  – 2303.2.3 Testing
Fire Retardant Treated Wood (FRTW)

• The process of manufacturing FRTW will have an effect on the strength of the product
• Due to the chemicals applied, high humidity, exposure to high heat and redrying procedures of the FRT process, the strength of the FRT product will need to be adjusted from the untreated product
Fire Retardant Treated Wood (FRTW)

• Strength adjustments in the building code mainly focus on wood structural panels and lumber in the *IBC*

• FRT strength adjustment factors are found in the products’ code evaluation report based on testing as follows:
  – For wood structural panels: ASTM D 5516 and ASTM D 6305
  – For lumber: ASTM D 5664 and ASTM D 6841

• Requirements and regulations are as given in the *IBC*:
  – 2303.2.5.1 Wood structural panels
  – 2303.2.5.2 Lumber
Fire Retardant Treated Wood (FRTW)

- Prior to testing the FRT product, if the product is for interior applications \textit{IBC Section 2303.2.7} requires the moisture content to be no greater than 28 percent
- The testing must be in accordance to \textit{ASTM D 3201} procedures at 92 percent relative humidity
- Requirements and regulations are as given in the \textit{IBC}:
  - 2303.2.7 Interior applications
Fire Retardant Treated Wood (FRTW)

• If the FRT product is meant for exterior applications, it shall be marked “Exterior” and meet the requirements of *IBC Section 2303.2.6*

• FRT lumber used in exterior walls is typically classified as interior use since it is not exposed

• Requirements and regulations are as given in the *IBC*:
  – *2303.2.6 Exposure to weather, damp or wet locations*
Fire Retardant Treated Wood (FRTW)

• All FRT products must be tested in accordance with ASTM E 84 or UL 723 and must result in:
  – A listed flame spread index of 25 or less and
  – When the testing period is extended an additional 20 minutes there shall be no sign or evidence of any significant flame spread and
  – During the test, the flame front must only have a maximum of 10 ½ feet (3200mm) progression beyond the centerline of the burners
Fire Retardant Treated Wood (FRTW)

• The final FRT product should have a specific moisture content, if processed correctly

• According to IBC Section 2303.2.8, FRTW should be at moisture content of no greater than
  – 19% for lumber
  – 15% for wood structural panels

• Requirements and regulations are as given in the IBC:
  – 2303.2.8 Moisture content
Fire Retardant Treated Wood (FRTW)

- The finished product should also be labeled with the following items shown in *IBC Section 2303.2.4* (Interior FRTW Label layout example)

<table>
<thead>
<tr>
<th>Product Name and Manufacturer</th>
<th>Approved Agency Name and Logo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treating Plant</td>
<td>Product Species</td>
</tr>
<tr>
<td>Treating standards</td>
<td>Surface Burning Characteristics</td>
</tr>
<tr>
<td>Reference adjusted design values</td>
<td>Flame spread 25 or less</td>
</tr>
<tr>
<td>Conforms to IBC Sections 2303.2.5 - 8</td>
<td>Smoke developed 450 or less</td>
</tr>
<tr>
<td>Drying Method</td>
<td>Duration test (should be 30 minutes)</td>
</tr>
</tbody>
</table>
Connectors and Fasteners for FRTW

- FRTW used in exterior applications are most likely to be exposed to weather, or damp or wet conditions.
- When exposed to these conditions, corrosion in connectors and fasteners occurs frequently especially when the chemical used in FRTW can contribute to the cause of corrosion as well.

- Requirements and regulations are as given in the IBC:
  - 2304.10.5.3 Fasteners for fire-retardant-treated wood used in exterior applications or wet or damp locations
  - 2304.10.5.4 Fasteners for fire-retardant-treated wood used in interior applications
Connectors and Fasteners for FRTW

• To prevent or reduce the chances of corrosion, IBC Sections 2304.10.5.3 and 2304.10.5.4 requires the connectors and fasteners shall be of:
  – Hot-dipped zinc-coated galvanized steel
  – Stainless steel
  – Silicon bronze
  – Copper
Connectors and Fasteners for FRTW

- Fasteners other than nails, timber rivets, wood screws and lag screws shall be zinc-coated steel with coating weights in accordance with **ASTM B 695**, Class 55 minimum
Conclusion

Type III-A building:

• Must stay within the limitations of allowable height, allowable number of stories and allowable area requirements of *IBC Tables 504.3, 504.4 and 506.2*

• Are required to have exterior walls of noncombustible materials to meet a 2 hour fire-resistance rating, which permits FRTW to be used
  – The noncombustible material must meet the criteria called out in Section 8 of ASTM E 136 and
  – FRTW must comply with *IBC Section 2303.2*
Conclusion

• Different types of materials will require different specifications for connectors and fasteners
• Some buildings may consist of two different construction types but the building will be classified as the lowest of the two types present
• No matter what, a building only fits the classification when it is within the limitations and meets all the requirements of that particular construction type
References

• International Residential Code; International Code Council; 2015.