

## Fire Protection of Floors Constructed with Prefabricated Wood I-Joists for Compliance with the International Residential Code

### 1. BASIS OF THE SYSTEM REPORT

- 2012 International Residential Code (IRC): Sections R502.1.4 Prefabricated wood I-joists and R501.3 Fire Protection of Floors
- ASTM D5055-09 recognized by the 2012 IRC
- International Code Council Evaluation Service, LLC (ICC-ES) Acceptance Criteria for Prefabricated Wood I-joists (AC14), dated October 2013 (editorially revised February 2014)
- ICC-ES Evaluation Report ESR-1405

### 2. SYSTEM DESCRIPTION

Starting with the 2009 IBC and IRC, one- and two-family dwellings are required to install an automatic fire sprinkler system (IBC Section 903.2.8 and IRC Section R313.2). However, not all local jurisdictions in the U.S. have adopted these provisions for the use of sprinkler systems as an active home fire protection system. In May 2010, the International Code Council (ICC) approved the following new fire protective membrane provisions for the 2012 IRC:

**R501.3 Fire protection of floors.** *Floor assemblies, not required elsewhere in this code to be fire resistance rated, shall be provided with a 1/2 inch gypsum wallboard membrane, 5/8 inch wood structural panel membrane, or equivalent on the underside of the floor framing member.*

#### **Exceptions:**

1. Floor assemblies located directly over a space protected by an automatic sprinkler system in accordance with Section P2904, NFPA13D, or other approved equivalent sprinkler system.
2. Floor assemblies located directly over a crawl space not intended for storage or fuel-fired appliances.
3. Portions of floor assemblies can be unprotected when complying with the following:
  - 3.1 The aggregate area of the unprotected portions shall not exceed 80 square feet per story.
  - 3.2 Fire blocking in accordance with Section R302.11.1 shall be installed along the perimeter of the unprotected portion to separate the unprotected portion from the remainder of the floor assembly.
4. Wood floor assemblies using dimension lumber or structural composite lumber equal to or greater than 2-inch by 10-inch nominal dimension, or other approved floor assemblies demonstrating equivalent fire performance.

These fire protective membrane provisions apply to not only I-joist floors but all residential floor assemblies, including all floor trusses and light-gauge steel framing, and less than 2-inch by 10-inch nominal dimension lumber and structural composite lumber. They will become effective when adopted by the local jurisdiction. However, not all local jurisdictions have elected to adopt these provisions. The project designer should consult with the local jurisdiction for code requirements.

The purpose of this document is to provide prescriptive fire assemblies for fire protection of floors constructed with prefabricated wood I-joists when IRC Section R501.3 requirements are adopted by the local jurisdiction.

### 3. METHODOLOGY

After the publication of the 2012 IRC, ICC-ES developed methodologies for determining the equivalency to Exception 4 of IRC Section R501.3 for I-joists, as documented in ICC-ES AC14. Full-scale fire tests at an accredited laboratory in accordance with the standard ASTM E119 time-temperature exposure are required to demonstrate the equivalency, which is determined by the test duration that is equal to or in excess of the required minimum duration calculated using the methodology specified in Chapter 16 of the National Design Specification for Wood Construction (NDS), assuming unprotected solid-sawn 2x10 floor joists, a 3-sided fire exposure, a nominal char rate of 1.5 inches/hour, a load corresponding to 50 percent of the full allowable stress design (ASD) bending design load, and a bending strength to ASD ratio of 2.85.

The failure of the tested fire assembly is defined by the occurrence of the following conditions, whichever occurs first:

- a. An individual member within an assembly fails,
- b. Multiple members within an assembly fail,
- c. Center span deflection exceeds 1/40 of the clear span,
- d. The deflection rate of change exceeds 0.10 in./min./ft of the clear span, or
- e. The deflection rate of change decreases.

**Exception:** Item “e” does not apply when the decrease in deflection rate of change was not due to a change in the load-carrying mechanism.

In addition to the 1/2-inch gypsum or 5/8-inch wood structural panel protection (see FP-01, page 3), this document provides prescriptive fire assemblies for prefabricated wood I-joists that have demonstrated equivalency to Exception 4 of IRC Section R501.3, in accordance with ICC-ES AC14 requirements (see FP-02 through FP-04, pages 4-8).

### 4. LIMITATIONS

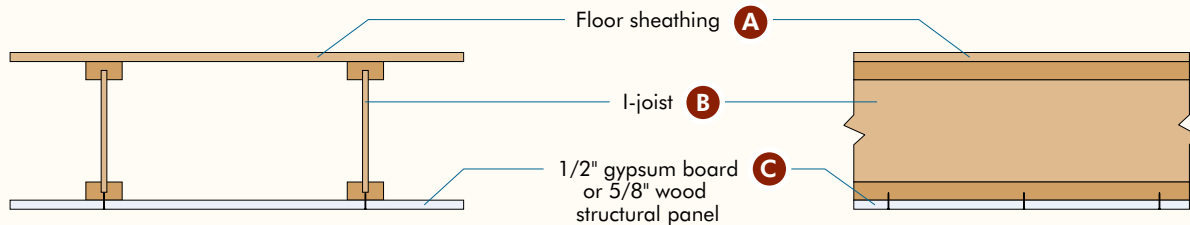
- a. The prefabricated wood I-joists shall meet the requirements of ASTM D5055, and be installed and constructed in accordance with the codes, product evaluation reports, and manufacturer's recommendations.
- b. The fire assemblies shall be installed exactly as prescribed in this document.
- c. This report is subject to periodic review. The latest version of this report is available for free download ([www.apawood.org/publications](http://www.apawood.org/publications)).

## FIRE PROTECTION OF FLOORS FP-01

### Fire Protection: 1/2-inch Gypsum Board Attached to Bottom of Flange

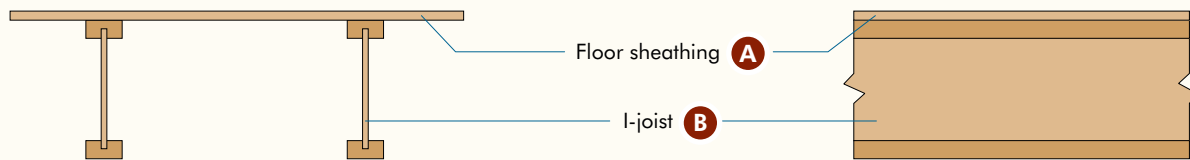
The following fire resistance design is in compliance with 2012 IRC Section R501.3.

#### 1/2-INCH GYPSUM BOARD ATTACHED TO BOTTOM OF FLANGE<sup>(a)</sup>



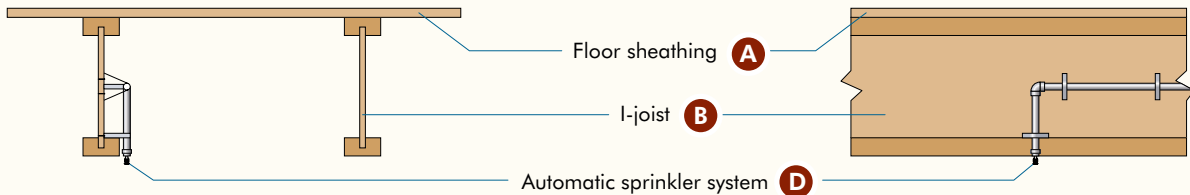
#### CRAWL SPACE EXCEPTION<sup>(b)</sup>

In accordance with Exception 2 of the 2012 IRC Section R501.3, floor assemblies located directly over a crawl space not intended for storage or fuel-fired appliances do not require membrane protection.



#### AUTOMATIC SPRINKLER EXCEPTION<sup>(c)</sup>

In accordance with Exception 1 of the 2012 IRC Section R501.3, floor assemblies located directly over a space protected by an automatic sprinkler system do not require membrane protection.



- A** Floor sheathing: Materials and installation in accordance with 2012 IRC Section R503.
- B** I-joist: Installation in accordance with Section 4.0 of this report. Applicable to all flange sizes. Minimum web thickness of 3/8 inch. Adhesives used shall be as described in the quality manual approved by APA.
- C** 1/2-inch gypsum board: Materials and installation in accordance with 2012 IRC Section R702.3.1 or equivalent. Gypsum board not required to be finished with tape and joint compound; or  
5/8-inch wood structural panel: Materials and installation in accordance with 2012 IRC Section R503.2 or equivalent. Wood structural panel not required to be finished with wood filler or sanded.
- D** Automatic sprinkler system: System in accordance with Section P2904 of the 2012 IRC, NFPA 13D, or other equivalent sprinkler systems.

#### Notes:

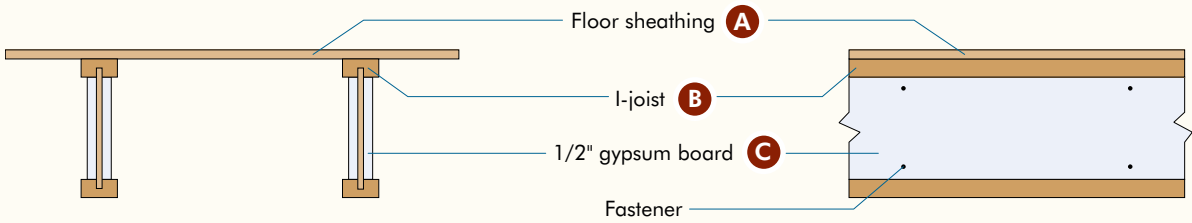
- a. In accordance with Exception 3 of the 2012 IRC Section R501.3, portions of floor assembly can be unprotected when complying with the following:
  - 1. The aggregate area of the unprotected portions shall not exceed 80 square feet.
  - 2. Fire blocking in accordance with 2012 IRC Section R302.11.1 shall be installed along the perimeter of the unprotected portion to separate the unprotected portion from the remainder of the floor assembly.
- b. Insulation may be required for energy code compliance purposes. Check with the local building official for specific jurisdictional requirements.
- c. In accordance with 2012 IRC Section P2904, partial residential sprinkler systems are permitted to be installed only when the entire dwelling unit is not required to be equipped with a residential sprinkler system. Check with the local building official for specific jurisdictional requirements.

## FIRE PROTECTION OF FLOORS FP-02

### Fire Protection: 1/2-inch Gypsum Board Attached Directly to Web

The following fire resistance design is an alternative to the 2-by-10 dimensional lumber prescribed in Exception 4 of 2012 IRC Section R501.3 with demonstrated equivalent fire performance.

**1/2-INCH GYPSUM BOARD ATTACHED TO WEB<sup>(a)</sup>**



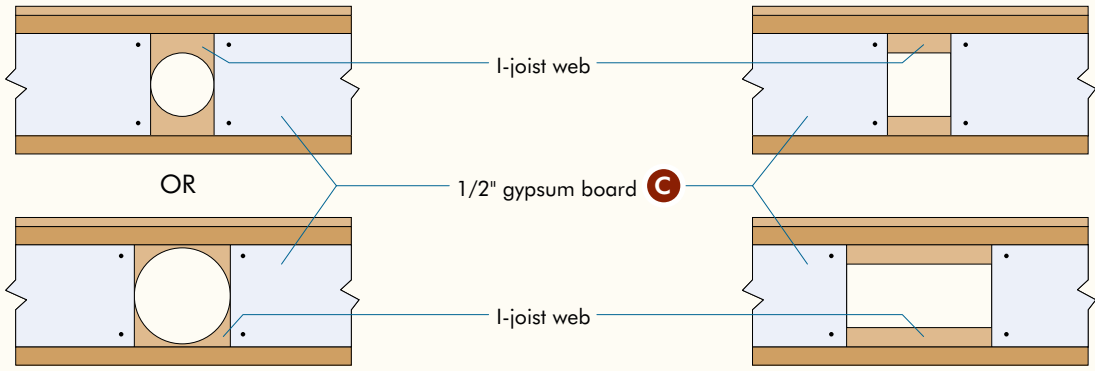
Floor sheathing **A**

I-joist **B**

1/2" gypsum board **C**

Fastener

**INSTALLATION REQUIREMENTS AT WEB HOLES**



I-joist web

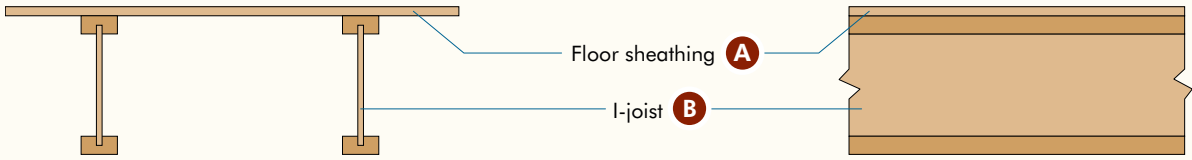
OR

1/2" gypsum board **C**

I-joist web

**CRAWL SPACE EXCEPTION<sup>(b)</sup>**

In accordance with Exception 2 of the 2012 IRC Section R501.3, floor assemblies located directly over a crawl space not intended for storage or fuel-fired appliances do not require 1/2-inch gypsum board attached to web.

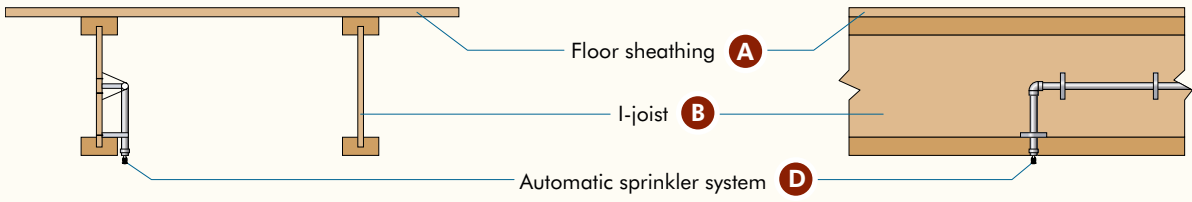


Floor sheathing **A**

I-joist **B**

**AUTOMATIC SPRINKLER EXCEPTION<sup>(c)</sup>**

In accordance with Exception 1 of the 2012 IRC Section R501.3, floor assemblies located directly over a space protected by an automatic sprinkler system do not require 1/2-inch gypsum board attached to web.



Floor sheathing **A**

I-joist **B**

Automatic sprinkler system **D**

Continued on Next Page

- A** Floor sheathing: Materials and installation in accordance with 2012 IRC Section R503.
- B** I-joist: Installation in accordance with Section 4 of this report. Minimum flange size of 1-1/2 inches thick x 2.3 inches wide. Minimum web thickness of 3/8 inch. Adhesives used shall be as described in the quality manual approved by APA. At hole location, fasteners shall be installed 1 inch from the edge of the gypsum board.
- C** 1/2-inch gypsum board: Materials (entire length of I-joist) in accordance with 2012 IRC Section R702.3.1 (not required to be finished with tape and joint compound). Fasteners: Minimum 1-inch screws (Type W or Type S) or nails installed 1 inch from edges and 16 inches on center, top and bottom. Fasteners may be staggered from top to bottom.
- D** Automatic sprinkler system: System in accordance with Section P2904 of the 2012 IRC, NFPA 13D, or other equivalent sprinkler systems.

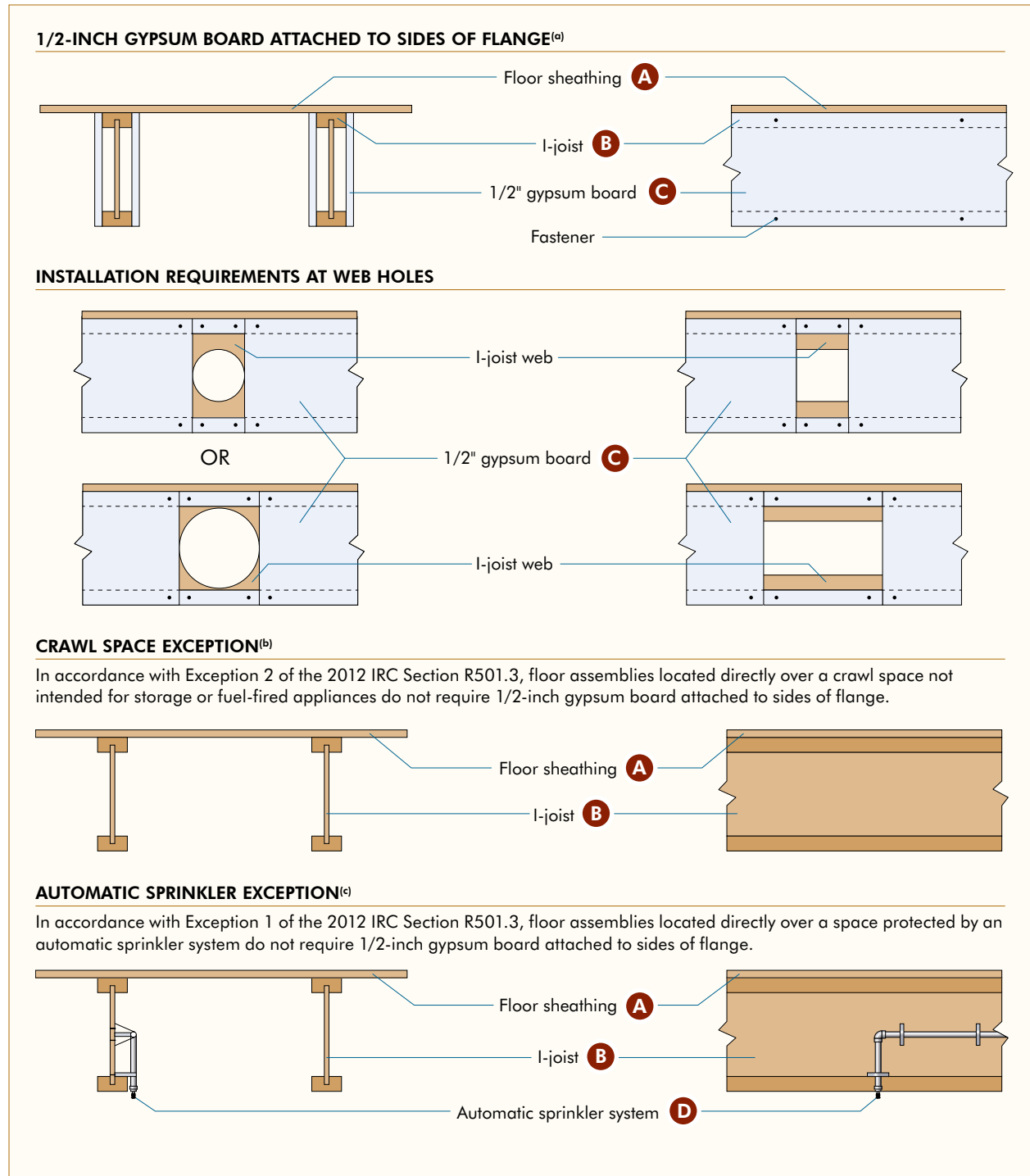
**Notes:**

- a. In accordance with Exception 3 of the 2012 IRC Section R501.3, portions of floor assembly can be unprotected when complying with the following:
  - 1. The aggregate area of the unprotected portions shall not exceed 80 square feet.
  - 2. Fire blocking in accordance with 2012 IRC Section R302.11.1 shall be installed along the perimeter of the unprotected portion to separate the unprotected portion from the remainder of the floor assembly.
- b. Insulation may be required for energy code compliance purposes. Check with the local building official for specific jurisdictional requirements.
- c. In accordance with 2012 IRC Section P2904, partial residential sprinkler systems are permitted to be installed only when the entire dwelling unit is not required to be equipped with a residential sprinkler system. Check with the local building official for specific jurisdictional requirements.

## FIRE PROTECTION OF FLOORS FP-03

### Fire Protection: 1/2-inch Gypsum Board Attached Directly to Sides of Flange

The following fire resistance design is an alternative to the 2-by-10 dimensional lumber prescribed in Exception 4 of 2012 IRC Section R501.3 with demonstrated equivalent fire performance.



Continued on Next Page

- A** Floor sheathing: Materials and installation in accordance with 2012 IRC Section R503.
- B** I-joist: Installation in accordance with Section 4.0 of this report. Minimum flange size of 1-1/8 inches thick x 1-3/4 inches wide. Minimum web thickness of 3/8 inch. Adhesives used shall be as described in the quality manual approved by APA. At hole location, fasteners shall be installed 1 inch from the edge of the gypsum board. Maximum fastener spacing shall be no more than 8 inches on gypsum board above and below the hole.
- C** 1/2-inch gypsum board: Materials (entire length of I-joist) in accordance with 2012 IRC Section R702.3.1 (not required to be finished with tape and joint compound). Fasteners: Minimum 1-inch screws (Type W or Type S) or nails installed 1/2 inch from edges and 16 inches on center, top and bottom. Fasteners may be staggered from top to bottom.
- D** Automatic sprinkler system: System in accordance with Section P2904 of the 2012 IRC, NFPA 13D, or other equivalent sprinkler systems.

**Notes:**

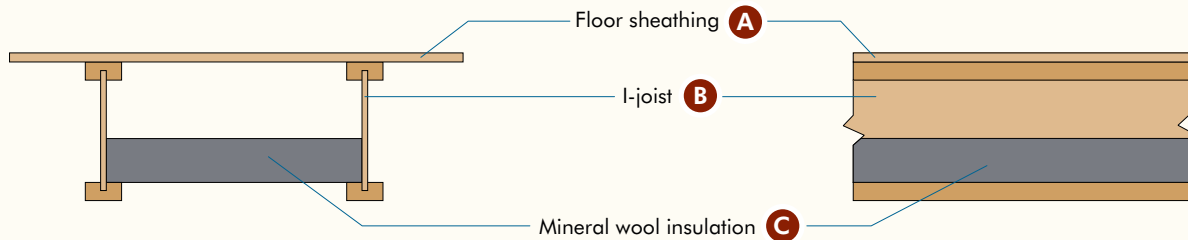
- a. In accordance with Exception 3 of the 2012 IRC Section R501.3, portions of floor assembly can be unprotected when complying with the following:
  - 1. The aggregate area of the unprotected portions shall not exceed 80 square feet.
  - 2. Fire blocking in accordance with 2012 IRC Section R302.11.1 shall be installed along the perimeter of the unprotected portion to separate the unprotected portion from the remainder of the floor assembly.
- b. Insulation may be required for energy code compliance purposes. Check with the local building official for specific jurisdictional requirements.
- c. In accordance with 2012 IRC Section P2904, partial residential sprinkler systems are permitted to be installed only when the entire dwelling unit is not required to be equipped with a residential sprinkler system. Check with the local building official for specific jurisdictional requirements.

## FIRE PROTECTION OF FLOORS FP-04

### Fire Protection: Mineral Wool Insulation

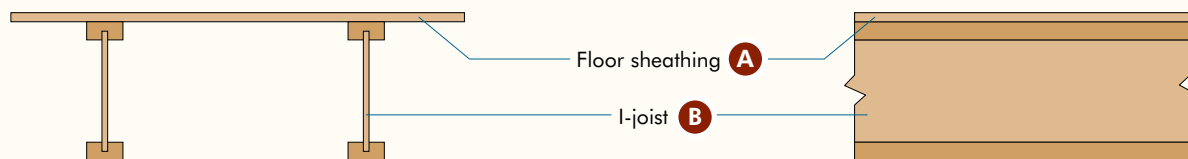
The following fire resistance design is an alternative to the 2-by-10 dimensional lumber prescribed in Exception 4 of 2012 IRC Section R501.3 with demonstrated equivalent fire performance.

#### MINERAL WOOL INSULATION<sup>(a)(b)</sup>



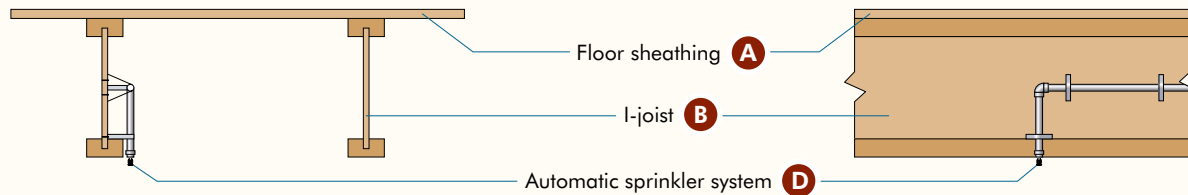
#### CRAWL SPACE EXCEPTION<sup>(c)</sup>

In accordance with Exception 2 of the 2012 IRC Section R501.3, floor assemblies located directly over a crawl space not intended for storage or fuel-fired appliances do not require mineral wool insulation for fire protection.



#### AUTOMATIC SPRINKLER EXCEPTION<sup>(d)</sup>

In accordance with Exception 1 of the 2012 IRC Section R501.3, floor assemblies located directly over a space protected by an automatic sprinkler system do not require mineral wool insulation for fire protection.



- A** Floor sheathing: Materials and installation in accordance with 2012 IRC Section R503.
- B** I-joist: Installation in accordance with Section 4 of this report. Minimum flange size of 1-1/2 inches thick x 2-5/16 inches wide. Minimum web thickness of 3/8 inch. Adhesives used shall be as described in the quality manual approved by APA.
- C** Mineral wool insulation: Minimum 2 lbf/ft<sup>3</sup> and 3-1/2 inches thick mineral wool insulation (R15) installed as shown with stay wires, spaced no more than 24 inches apart and no more than 6 inches from ends of batts. Use minimum 15.25-inch x 3.5-inch, 18.5-inch x 3.5-inch, and 23-inch x 3.5-inch batts, when I-joist spacing is 16 inches, 19.2 inches, and 24 inches on center, respectively.
- D** Automatic sprinkler system: System in accordance with Section P2904 of the 2012 IRC, NFPA 13D, or other equivalent sprinkler systems.

#### Notes:

- a. In accordance with Exception 3 of the 2012 IRC Section R501.3, portions of floor assembly can be unprotected when complying with the following:
  - 1. The aggregate area of the unprotected portions shall not exceed 80 square feet.
  - 2. Fire blocking in accordance with 2012 IRC Section R302.11.1 shall be installed along the perimeter of the unprotected portion to separate the unprotected portion from the remainder of the floor assembly.
- b. Thicker insulation may be required for energy code compliance purposes. Check with the local building official for specific jurisdictional requirements.
- c. Insulation may be required for energy code compliance purposes. Check with the local building official for specific jurisdictional requirements.
- d. In accordance with 2012 IRC Section P2904, partial residential sprinkler systems are permitted to be installed only when the entire dwelling unit is not required to be equipped with a residential sprinkler system. Check with the local building official for specific jurisdictional requirements.



## Fire Protection of Floors Constructed with Prefabricated Wood I-Joists for Compliance with the International Residential Code

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REPRESENTING THE ENGINEERED WOOD INDUSTRY