

APA

Designing to Meet IRC Fire Protection Provisions for I-Joist Floor Systems



WOOD

The Natural Choice



Engineered wood products are a good choice for the environment. They are manufactured for years of trouble-free, dependable use. They help reduce waste by decreasing disposal costs and product damage. Wood is a renewable resource that is easily manufactured into a variety of viable products.

A few facts about wood.

- **We're growing more wood every day.** Forests fully cover one-third of the United States' and one-half of Canada's land mass. American landowners plant more than two billion trees every year. In addition, millions of trees seed naturally. The forest products industry, which comprises about 15 percent of forestland ownership, is responsible for 41 percent of replanted forest acreage. That works out to more than one billion trees a year, or about three million trees planted every day. This high rate of replanting accounts for the fact that each year, 27 percent more timber is grown than is harvested. Canada's replanting record shows a fourfold increase in the number of trees planted between 1975 and 1990.



- **Life Cycle Assessment shows wood is the greenest building product.** A 2004 Consortium for Research on Renewable Industrial Materials (CORRIM) study gave scientific validation to the strength of wood as a green building product. In examining building products' life cycles – from extraction of the raw material to demolition of the building at the end of its long lifespan – CORRIM found that wood was better for the environment than steel or concrete in terms of embodied energy, global warming potential, air emissions, water emissions and solid waste production. For the complete details of the report, visit www.CORRIM.org.

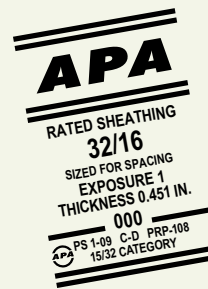
- **Manufacturing wood is energy efficient.** Wood products made up 47 percent of all industrial raw materials manufactured in the United States, yet consumed only 4 percent of the energy needed to manufacture all industrial raw materials, according to a 1987 study.

Material	Percent of Production	Percent of Energy Use
Wood	47	4
Steel	23	48
Aluminum	2	8



- **Good news for a healthy planet.** For every ton of wood grown, a young forest produces 1.07 tons of oxygen and absorbs 1.47 tons of carbon dioxide.

Wood: It's the natural choice for the environment, for design and for strong, lasting construction.



NOTICE:
The recommendations in this guide apply only to products that bear the APA trademark. Only products bearing the APA trademark are subject to the Association's quality auditing program.

Designing to Meet IRC Fire Protection Provisions for I-Joist Floor Systems

According to current builder surveys, home builders choose I-joist framing for use in about 50 percent of raised floor and first-floor-over-basement construction in U.S. single-family homes. There are many reasons for the consistent popularity of I-joist floor assemblies. They help builders realize savings as a result of reduced callbacks. The I-joist manufacturing process results in high quality, reliable joists that deliver consistent performance on the job, and that means flatter, quieter floor assemblies.

In some states and jurisdictions around the country, building materials dealers and their builder customers are facing tougher restrictions related to floor systems. Both the 2012 and 2015 versions of the International Residential Code (IRC) include fire-protective membrane provisions to enhance the fire performance of floor systems. The IRC requires that all residential floors, with several notable exceptions, need to be covered with drywall or have some other means of increased fire protection.

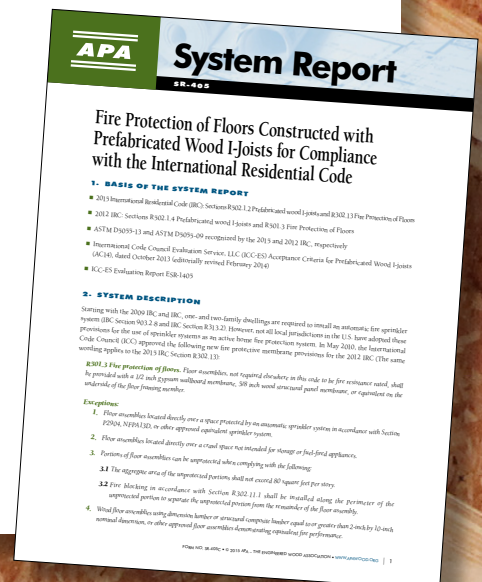
There are numerous fire protection provisions for all types of floor systems in the IRC, but designers and builders have several options on how to meet those provisions. *APA System Report SR-405* provides additional options for builders that use I-joists. SR-405 is intended to provide prescriptive fire assemblies for fire protection of floors constructed with prefabricated wood I-joists when 2012 IRC Section R501.3 and 2015 IRC Section R302.13 provisions are adopted by the local jurisdiction.

This APA publication describes the fire protective membrane provisions of the code as they specifically relate to I-joist floor systems and presents several options builders can consider.

The code-compliant options covered in this brochure include:

- Gypsum board or wood structural panel ceiling membranes
- Gypsum board attached to I-joist webs
- Gypsum board attached to the entire depth of I-joists
- Mineral wool insulation on the top of the bottom flanges
- Ceramic fiber blanket attached to I-joist webs
- Fire protective coatings

In *APA System Report SR-405*, each of these options is thoroughly explained with technical drawings and specifications to ensure code requirements are met.



EXCEPTIONS TO THE IRC FIRE PROTECTION REQUIREMENTS

Designers and builders should also note that there are some exceptions to 2012 IRC Section R501.3 and 2015 IRC Section R302.13 that make enhanced fire protection unnecessary, such as floors constructed with 2x10 dimension lumber, structural composite lumber, or their equivalent. Also, floor assemblies located directly over a space protected by an automatic sprinkler system do not require a fire protective membrane. Home sprinkler systems are currently not the norm but are gaining traction in some regions. According to the National Fire Protection Association (NFPA), residential fire sprinkler ordinances have been adopted by several hundred U.S. communities for use in single-family homes. While the high cost is a factor for sprinkler systems, NFPA reports that costs have been decreasing in communities where sprinklers are required.

Another exception is when only a small area of the floor is unprotected (less than or equal to 80 square feet per story), provided code-required fire blocking is in place to separate the unprotected portion from the remainder of the floor assembly.

Enhanced fire protection is not required for floors over crawl spaces, provided the crawl space is not intended for storage or contains fuel-fired appliances. If the crawl space is intended for storage or fuel-fired appliances, builders may want to consider installing a durable membrane, such as 5/8-inch wood structural panels, which are listed in the code.

STRATEGIES TO MEET FLOOR ASSEMBLY FIRE-PROTECTION PROVISIONS

Here are six methods that can be used in jurisdictions where 2012 IRC Section R501.3 or 2015 IRC Section R302.13 has been adopted. In each of these methods, the I-joists must meet the provisions of ASTM D5055 and be installed and constructed in accordance with codes, APA Product Reports, code evaluation reports, and manufacturer's instructions.

METHOD 1. 1/2-Inch Gypsum Board or 5/8-inch Wood Structural Panel Ceiling Membranes

Installers can add a layer of 1/2-inch gypsum board or a 5/8-inch wood structural panel to the bottom of the flange. There are several benefits to installing drywall to the underside of I-joists. Because basement insulation is now required by energy codes in most climate zones, framed basement exterior walls are becoming more common, increasing the likelihood of a finished basement. While the IRC does not require this gypsum board to be finished, combining drywall on a basement ceiling, along with framing on the basement walls, provides homeowners with opportunities to easily upgrade to a finished basement option. The addition of drywall also increases the mass of the floor and acts as a damper to floor vibrations, increasing homeowner comfort. Noise transmission is also reduced.



The IRC does not require the gypsum board applied to the underside of the I-joist floor systems to be covered with tape and joint compound.

There are some significant advantages to finished basements. Basements can be transformed into home theaters, home office spaces, children's play rooms, libraries, craft rooms, music rooms or in-home workshops, provided builders account for proper conditioning of finished rooms by providing correctly sized heating and cooling equipment and

duct work. Care should also be taken to provide electrical outlets, lighting and smoke detectors in accordance with the codes. With appropriate HVAC, plumbing and egress, basements can become additional bedrooms or apartments, creating more living space in the same house footprint. A finished basement will also bring increased value to a home.

There are other good options for unfinished basements, described below.

METHOD 2. 1/2-Inch Gypsum Board Attached to I-joist Web Only

Installers can add a layer of 1/2-inch gypsum board directly to both sides of the I-joist webs (see Figure 1). The minimum flange size for this option is 1-1/2 inches x 2 inches.

This method works well for unfinished basements where builders or homeowners prefer not to have a gypsum membrane covering the ceiling. It complies with the IRC provisions, and makes it easier to add mechanicals in the ceiling later, should the need arise. It also accommodates drop ceilings or other options in the finished space while meeting the IRC provisions. Drop ceiling options have expanded dramatically in recent years, and homeowners can now choose from a variety of new options for finished ceilings.

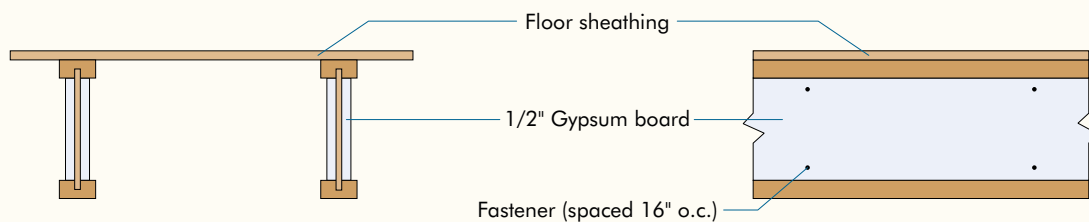


Installing 1/2-inch gypsum board to I-joist webs is one of several methods builders and installing dealers can use to meet the IRC provisions.

This solution only requires the web to be covered and does not require gypsum to be covered with tape and joint compound (see Figures 1 and 2). Fasteners shall be, at a 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. Gypsum is not required above or below web openings, no matter what the opening size is, provided that the web holes meet the structural requirements of the I-joists. See *APA Performance Rated I-Joists, Form Z725*, or I-joist manufacturer's recommendations for general guidelines on cutting holes in I-joists.

FIGURE 1

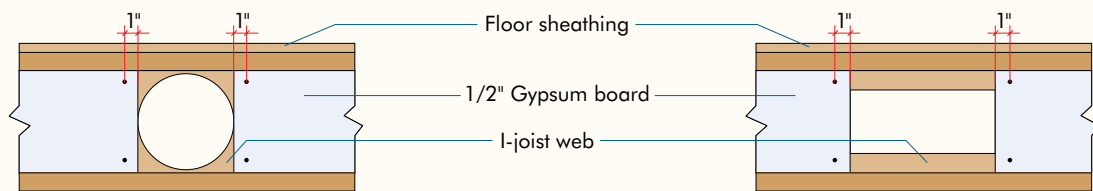
1/2-INCH GYPSUM BOARD ATTACHED TO WEB



Attach gypsum to the I-joist web where the joist has a minimum flange dimension of 1-1/2 inches deep x 2 inches wide. Most lumber flanged I-joists and some LVL-flanged I-joists meet this flange dimension requirement. There are two rows of fasteners near the top and the bottom flanges. Fasteners in each row are spaced 16 inches apart.

FIGURE 2

1/2-INCH GYPSUM BOARD ATTACHED TO WEB WITH WEB HOLES



This solution only requires the web to be covered. Fasteners should be 1 inch from the edge of the gypsum. Gypsum is not required above or below openings, no matter what the opening size is. Round, square and rectangular web holes are permitted, provided the requirements for hole placement and size meet the I-joist manufacturer's APA Product Report or code evaluation report.

METHOD 3. Add 1/2-Inch Gypsum Board Attached to Entire I-joist Depth

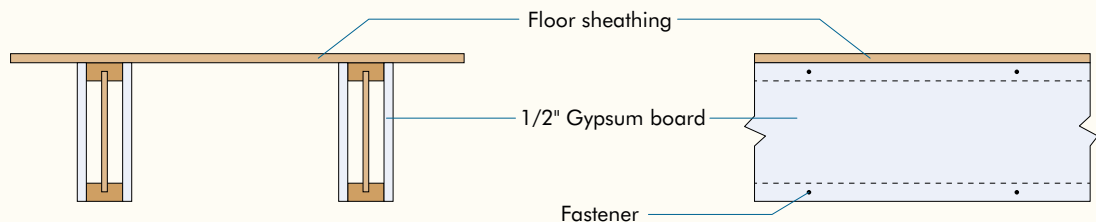
Installers can add a layer of 1/2-inch gypsum board directly to both sides of the flange to cover the entire I-joist depth (see Figure 3). This method can be used with I-joists that have a relatively small flange size (minimum 1-1/8 inches x 1-3/4 inches). Most I-joists meet this minimum flange dimension requirement.

Fasteners shall be the same as Method 2 except that the fasteners shall be installed 1/2 inch from gypsum edges and 16 inches on center, top and bottom. At the hole location, fasteners shall be installed 1 inch from the edge of the gypsum board (see Figure 4). Maximum fastener spacing shall be no more than 8 inches on gypsum board above and below the hole.

This method also works well for unfinished basements, where builders or homeowners do not want a gypsum membrane covering the ceiling for any reason, but need to comply with the IRC provisions. It also maintains the ability to add mechanicals in the ceiling later should the need arise and accommodates drop ceilings or other options in the finished space.

FIGURE 3

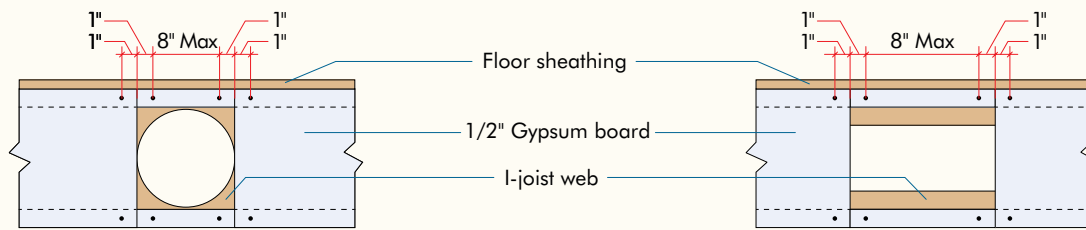
1/2-INCH GYPSUM BOARD ATTACHED TO FLANGE



The option for attaching the gypsum to the joist flanges is applicable to I-joists made with smaller flanges—a minimum flange dimension of 1-1/8 inches deep x 1-3/4 inches wide. Most I-joists meet this minimum flange dimension requirement.

FIGURE 4

1/2-INCH GYPSUM BOARD ATTACHED TO FLANGE WITH WEB HOLE



Flanges must be covered above and below web holes in this option. Fasteners shall be installed 1/2 inch from gypsum edges and 16 inches on center. At hole location, fasteners shall be installed on the flanges 1 inch from the end of the gypsum board. Gypsum at the hole location is required to be installed to protect the flanges only, but not the web. As with the round hole option, square or rectangular holes are permitted per the manufacturer's APA Product Report or code evaluation report.

METHOD 4. Mineral Wool Batts

Installers can add a 3-inch-thick layer of 2.5 lb/ft³ nominal mineral wool fiber insulation to the top of the bottom flange between I-joists with a minimum flange size of 1-1/8 inches thick x 1-3/4 inches wide (see Figure 5). In this method, the insulation is secured with insulation stay wires spaced no more than 24 inches apart and no more than 4 inches from ends of the batts. Use minimum 15-1/4-inch, 18-1/2-inch, and 23-inch-wide batts when I-joist spacing is 16 inches, 19.2 inches, and 24 inches on center, respectively. The thickness of the mineral wool insulation can be reduced to 2 inches if the joist spacing is limited to 16 inches or less.

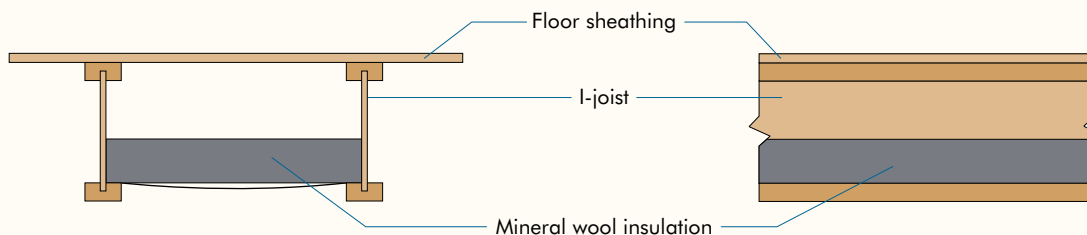


Installing mineral wool between I-joists is one of several methods builders and installing dealers can use to meet the IRC provisions.

As an option for unfinished basements, this method has some advantages in that it does not affix any other material directly to the I-joists with any kind of fasteners. Installation is simple, requiring minimal tools. While essentially closing up the cavities between the I-joists, it is relatively easy to remove the batts to add mechanical system components in the future. Mineral wool batts are readily available from a variety of manufacturers. As with Method 1, this option also helps to minimize noise transfer between the basement and the first floor living space.

FIGURE 5

1/2-INCH GYPSUM BOARD ATTACHED TO MINERAL WOOL



METHOD 5. Ceramic Fiber Blanket Insulation

Installers can add a proprietary 3/4-inch ceramic fiber blanket insulation at a minimum of 4 lb/ft³ nominal, in compliance with ASTM C892 Type III or higher (see Figures 6 and 7). This assembly can be used with I-joists having a minimum flange size of 1-1/2 inches thick x 2.3 inches wide. The fiber insulation is installed to the web and must be placed with no gaps and a snug fit inside the faces of the flanges. It is fastened with 7/8-inch long crown staples spaced 16 inches on center and staggered in two rows that are 1-3/4 inches from the I-joist flanges. The vertical staple-to-staple distance between adjacent rows of staples must be 3 inches maximum with additional rows of staples added for I-joist depths greater than 9-1/2 inches (For example, 2 rows for 9-1/2-inch, 3 rows for 11-7/8-inch, 4 rows for 14-inch, and 5 rows for 16-inch-deep I-joists).

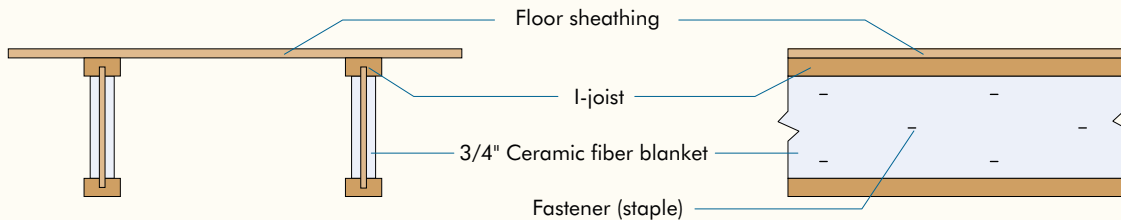


A proprietary ceramic fiber blanket insulation can be attached to the web of the I-joists to comply with IRC provisions. Photo courtesy of Mei Guo International, LLC (USA) FireBreak™.

This is a solution that works well for unfinished basements where builders or homeowners do not want to use gypsum but need to comply with the IRC provisions. The ability to add mechanicals in the ceiling later is maintained, should the need arise. It also accommodates drop ceilings or other options in the finished space while meeting the IRC provisions.

FIGURE 6

3/4-INCH PROPRIETARY^(a) CERAMIC FIBER BLANKET ATTACHED TO WEB

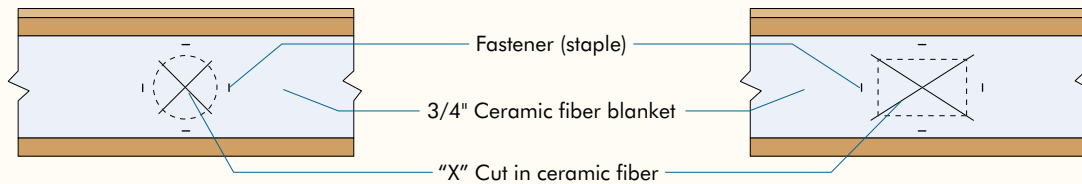


The fabric only needs to be installed to the web and must be placed with no gaps and a snug fit inside the faces of the flanges. It is fastened with 7/8-inch-long crown staples spaced 16 inches on center with 1-3/4 inches from the flanges. The vertical staple-to-staple distance between adjacent rows of staples must be 3 inches maximum with additional rows of staples added when the I-joist depths exceed 9-1/2 inches (For example, 2 rows for 9-1/2-inch, 3 rows for 11-7/8-inch, 4 rows for 14-inch, and 5 rows for 16-inch deep I-joists).

(a) Mei Guo International, LLC (USA) FireBreak™

FIGURE 7

3/4-INCH PROPRIETARY^(a) CERAMIC FIBER BLANKET ATTACHED TO WEB WITH WEB HOLES



At each hole location, the fiber blanket over the web opening is cut in an “X” shape, 1 inch past the edge of the opening. Cutting can be done with a knife. Four staples are added a distance of 1 inch from the edges of the web opening, as shown. The cutting process and fastening requirements are the same for rectangular holes, with cuts made from corner to corner as shown. Cuts can be 1 inch larger than the opening.

(a) Mei Guo International, LLC (USA) FireBreak™

METHOD 6. Fire Protective Coatings

One last option is using an approved factory-applied or field-applied fire-protective coating. APA has not evaluated factory- or field-applied coatings being sold in the U.S. A factory-applied coating must meet ICC-ES Acceptance Criteria AC14, which includes fire endurance and durability provisions. If field-applied, the coating must meet the fire endurance provisions, and the I-joist must be re-certified by the coating company or its certification agency.

ADDITIONAL RESOURCES

Additional resources are available at www.apawood.org, including:

- *APA System Report SR-405, Fire Protection of Floors Constructed with Prefabricated Wood I-Joists for Compliance with the International Residential Code, Form SR-405*

You can find APA publications specifically related to I-joists, including:

- *Technical Topics: Wood I-Joist Floors, Firefighters and Fire, TT-015*
- *APA Performance Rated I-Joists, Form Z725*
- *APA Product Reports*
- *Builder Tips*

Also reference the AWC Partial Sprinkler Guide for details on sprinkler installations:

- http://www.awc.org/pdf/Sprinkler_Guide.pdf

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We have field representatives in many major U.S. cities and in Canada who can help answer questions involving APA trademarked products. For additional assistance in specifying engineered wood products, contact us:

APA HEADQUARTERS

7011 So. 19th St. • Tacoma, Washington 98466
(253) 565-6600 • Fax: (253) 565-7265

PRODUCT SUPPORT HELP DESK

(253) 620-7400 • help@apawood.org

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