APA

Fire Protective Options for I-Joist Floor Systems

CONSTRUCTION GUIDE




Wood: The Natural Choice

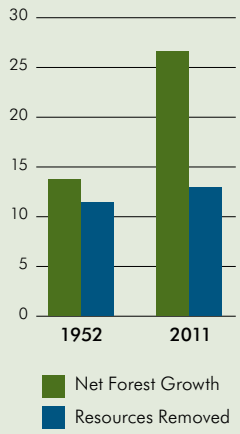
Engineered wood products are among the most beautiful and environmentally friendly building materials. In manufacture, they are produced efficiently from a renewable resource. In construction, the fact that engineered wood products are available in a wide variety of sizes and dimensions means there is less jobsite waste and lower disposal costs. In completed buildings, engineered wood products are carbon storehouses that deliver decades of strong, dependable structural performance. Plus, wood's natural properties, combined with highly efficient wood-frame construction systems, make it a top choice in energy conservation.

A few facts about wood:

We're growing more wood every day. For the past 100 years, the amount of forestland in the United States has remained stable at a level of about 755 million acres. Forests and wooded lands cover over 40 percent of North America's land mass. Net growth of forests has exceeded net removal since 1952; in 2011, net forest growth was measured at double the amount of resources removed. American landowners plant more than two-and-a-half billion new trees every year. In addition, millions of trees seed naturally. The forest products industry, which comprises about 13 percent of forestland ownership, plants more than one-and-a-half billion trees a year—about four million trees planted every day.

U.S. Forest Growth and All Forest Product Removals

Billions of cubic feet/year



Source: USDA - Forest Service, 2013.

Manufacturing wood is energy efficient. Over 50 percent of the energy consumed in manufacturing wood products comes from bioenergy such as tree bark, sawdust, and other harvesting by-products. Very little of the energy used to manufacture engineered wood comes from fossil fuels. Plus, modern methods allow manufacturers to get more out of each log, ensuring that very little of the forest resource is wasted.

Life Cycle Assessment measures the long-term green value of wood. Studies by CORRIM (Consortium for Research on Renewable Industrial Materials) give 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 had a more positive impact on 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.

Wood adds environmental value throughout the life of a structure. When the goal is energy-efficient construction, wood's low thermal conductivity makes it a superior material. As an insulator, wood is six times more efficient than an equivalent thickness of brick, 15 times more efficient than concrete, and 206 times more efficient than steel.

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 is the natural choice for the environment, for design, and for strong, resilient construction.

Better Floors. Better Fire Protection.

Wood I-joist floor assemblies are a superior choice in residential construction because the I-joists give builders and homeowners a high-quality floor system that is reliable, flatter and quieter. In fact, I-joists are now the floor framing material of choice in approximately 50 percent of framed floors in U.S. single-family homes.

Builders like I-joists because they provide consistent performance and reduce the cost of callbacks for squeaks and bouncy floors. They are readily available and easy to install, especially for long spans, including continuous spans over intermediate supports. Plus, builders have many options when it comes to constructing I-joist floor assemblies that comply with code requirements.

Some states and jurisdictions have updated their requirements related to floor system performance. Both the 2012 and 2015 versions of the International Residential Code (IRC) include provisions to enhance the fire performance of floor systems. For example, the IRC requires that all residential floor assemblies, with a few exceptions, be covered with drywall or have some other means of fire protection.

Better fire protection is essential—not only in meeting code but for homeowners' peace of mind. Code agencies and I-joist manufacturers are dedicated to safe construction and the protection of buildings and residents. The code-compliant options described in this guide give builders alternatives for design and construction of high quality floor systems that deliver superior structural performance and improved fire resistance that protects both home occupants and firefighters.

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 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 recognized in the code.

STRATEGIES TO MEET FLOOR ASSEMBLY FIRE-PROTECTION PROVISIONS

The seven methods in this guide can be used in jurisdictions where 2012 IRC Section R501.3 or 2015 IRC Section R302.13 has been adopted and implemented. 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.

Of these methods, APA recommends two simple systems that make it easier for builders to provide code-compliant fire protection for I-joist floor systems. These systems use gypsum board set on top of the bottom flanges of the joists. Both options are easy to install, do not require fasteners or adhesives and are easy to temporarily remove when necessary to access mechanical systems.

One option uses 1/2-inch gypsum board installed on top of the bottom flange for joists spaced 19.2 inches or less on center (FP-06). The second option calls for 5/8-inch gypsum board where joists are spaced up to 24 inches on center (FP-07).

These and additional assemblies that meet the requirements of the 2012 and 2015 IRC are detailed in this guide and in APA System Report SR-405, available for free download from the APA website, www.apawood.org.

The code-compliant options covered in this brochure include:

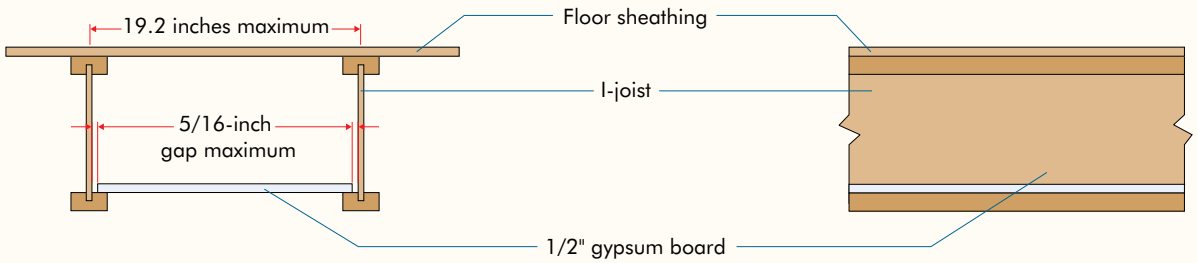
- Gypsum board installed on top of the bottom flange
- Gypsum board or wood structural panel ceiling membranes
- Gypsum board attached to I-joist webs
- Gypsum board attached to the entire depth of I-joists
- Mineral wool insulation on the top of the bottom flanges
- Ceramic fiber blanket attached to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

See page 5 for details on this assembly.

1/2-inch Gypsum Board Installed on Top of the Bottom Flange for I-joist Spacing 19.2 inches or less on center. *(FP-06 in System Report SR-405)*

FIGURE 1

1/2-INCH GYPSUM BOARD

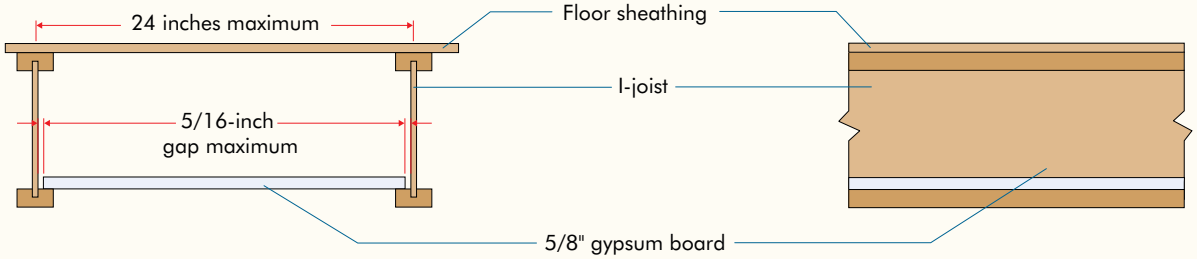


Installers can add one layer of 1/2-inch gypsum board cut to fit between the I-joist webs and sized to lie on the top of the bottom flange of the I-joist. The minimum I-joist flange dimension must be 1-1/8 inches by 2 inches. No fasteners or adhesives are required to secure the gypsum. A maximum gap of 5/16 inch between the edge of the gypsum and the I-joist web is allowed. Penetrations of I-joist webs for ducts, vents, electrical outlets, wiring, piping and the like are the same as those shown in the typical hole chart recommended by the manufacturer. This method works well for unfinished basements where builders or homeowners prefer not to have a finished gypsum membrane covering the ceiling. It complies with the IRC provisions and makes it easier to access or add mechanicals in the ceiling later, should the need arise. This option can be used when joist spacing is 19.2 inches on center or less.

5/8-inch Gypsum Board Installed on Top of the Bottom Flange for I-joist Spacing up to 24-inch I-joist on center. *(FP-07 in System Report SR-405)*

FIGURE 2

5/8-INCH GYPSUM BOARD

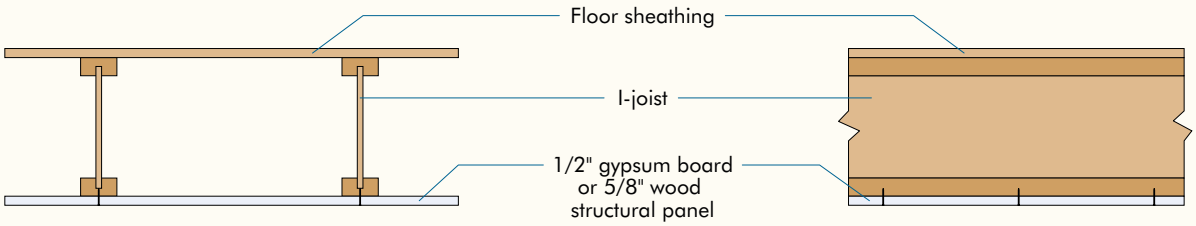


Similar to FP-06, this option calls for a layer of 5/8-inch gypsum board cut to fit between the I-joist webs and sized to lie on the top of the bottom flange of the I-joist, where joists are spaced up to 24 inches on center. The minimum I-joist flange dimension must be 1-1/8 inches by 2 inches. No fasteners or adhesives are required to secure the gypsum. A maximum gap of 5/16 inch between the edge of the gypsum and the I-joist web is allowed. Penetrations of I-joist webs for ducts, vents, electrical outlets, wiring, piping and the like are the same as those shown in the typical hole chart recommended by the manufacturer. This method also works well for unfinished basements where builders or homeowners prefer not to have a finished gypsum membrane covering the ceiling. It complies with the IRC provisions and makes it easier to access or add mechanicals in the ceiling later, should the need arise. This option can be used when joist spacing is up to 24 inches on center.

1/2-Inch Gypsum Board or 5/8-inch Wood Structural Panel Ceiling Membranes *(FP-01 in System Report SR-405)*

FIGURE 3

1/2-INCH GYPSUM BOARD ATTACHED TO BOTTOM OF FLANGE



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.

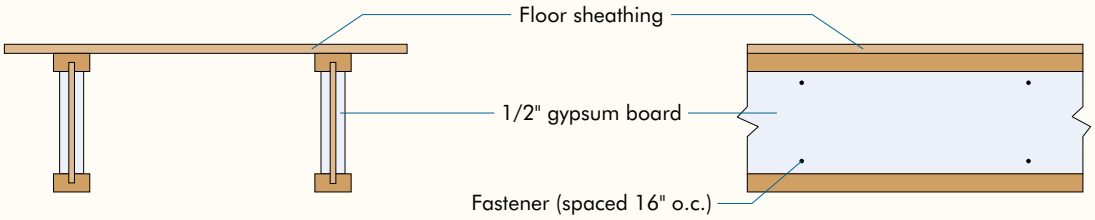
There are some significant advantages to finished basements. Basements can be transformed into home theaters, home office spaces, children's play rooms, libraries, craft rooms, music rooms or in-home workshops, provided builders account for proper conditioning of finished rooms by providing correctly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

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.

1/2-Inch Gypsum Board Attached to I-joist Web Only *(FP-02 in System Report SR-405)*

FIGURE 4

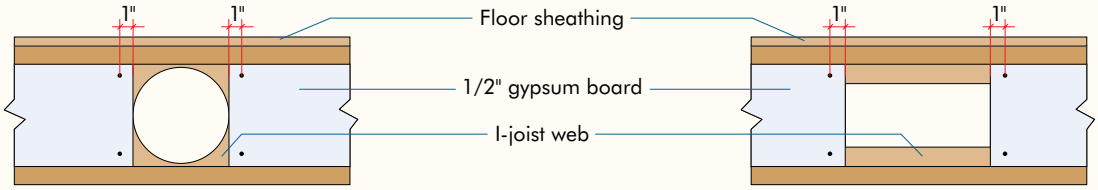
1/2-INCH GYPSUM BOARD ATTACHED TO WEB



Attach gypsum to the I-joist web where the joist has a minimum flange dimension of 1-1/2 inches deep by 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 5

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



This solution only requires the web to be covered. Fasteners (Type W or Type S screws or nails) should be 1 inch from the edge and end 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.

Installers can add a layer of 1/2-inch gypsum board directly to both sides of the I-joist webs (see Figure 4). The minimum flange size for this option is 1-1/2 inches by 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.

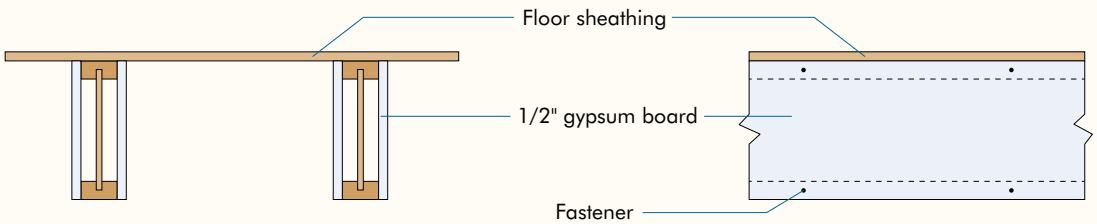
Installing 1/2-inch gypsum board to I-joist webs is one of several methods builders and installing dealers can use to meet the IRC provisions.

This solution only requires the web to be covered and does not require gypsum to be covered with tape and joint compound (see Figures 4 and 5). 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.

1/2-Inch Gypsum Board Attached to Entire I-joist Depth *(FP-03 in System Report SR-405)*

FIGURE 6

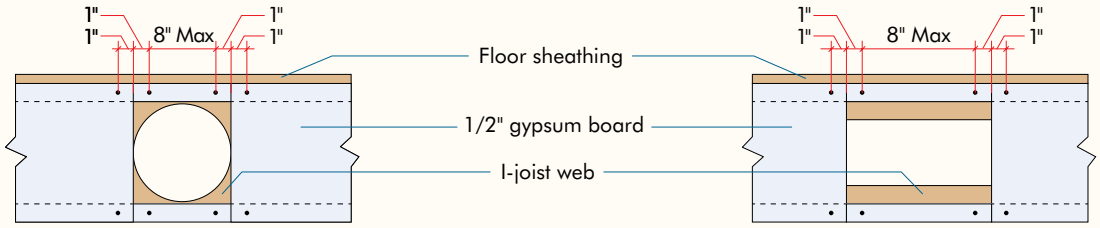
1/2-INCH GYPSUM BOARD ATTACHED TO FLANGE



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 by 1-3/4 inches wide. Most I-joists meet this minimum flange dimension requirement.

FIGURE 7

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



Flanges must be covered above and below web holes in this option. Fasteners (Type W or Type S screws or nails) shall be installed 1/2 inch from edges and 1 inch from ends and 16 inches on center. At hole location, fasteners shall be installed on the top and bottom flanges 1/2 inch from the edge and 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.

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 6). This method can be used with I-joists that have a relatively small flange size (minimum 1-1/8 inches by 1-3/4 inches). Most I-joists meet this minimum flange dimension requirement.

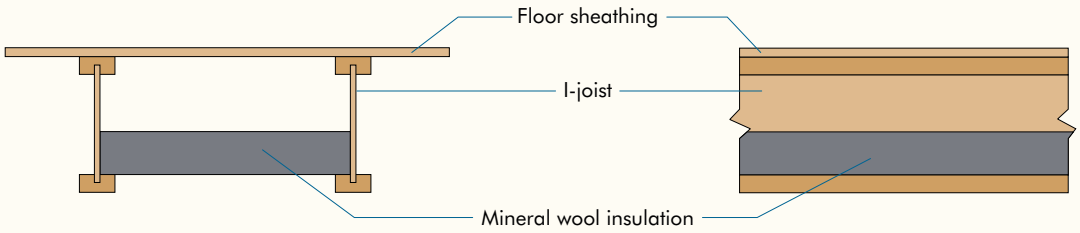
Fasteners shall be the same as shown in Figure 4 except that the fasteners shall be installed 1/2 inch from gypsum edges and 16 inches on center, top and bottom. At the hole location, fasteners shall be installed 1 inch from the edge of the gypsum board (see Figure 7). Maximum fastener spacing shall 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.

Mineral Wool Batts Installed on Top of the Bottom Flange *(FP-04 in System Report SR-405)*

FIGURE 8

2-INCH MINERAL WOOL INSULATION



Installers can add a 2-inch-thick layer of 2.9 lb/ft^3 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 by 1-3/4 inches wide at a maximum spacing of 19.2 inches on center. (see Figure 8). Minimum 2.5 lb/ft^3 (nominal) and 2-inch thick mineral wool insulation is permitted if the I-joists are spaced no more than 16 inches on center. 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 and 18-1/2-inch-wide batts when I-joist spacing is 16 inches and 19.2 inches on center, respectively.

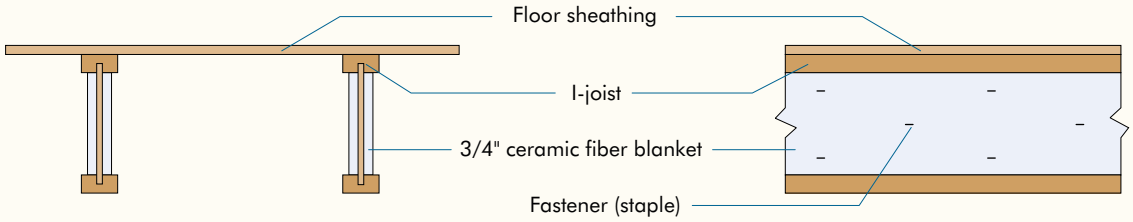
As an option for unfinished basements, this method has some advantages in that it does not affix any other material directly to the I-joists with any kind of fasteners. Installation is simple, requiring minimal tools. While essentially closing up the cavities between the I-joists, it is relatively easy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

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

Ceramic Fiber Blanket Insulation Attached to I-joist Web Only *(FP-05 in System Report SR-405)*

FIGURE 9

3/4-INCH PROPRIETARY[a] CERAMIC FIBER BLANKET ATTACHED TO WEB

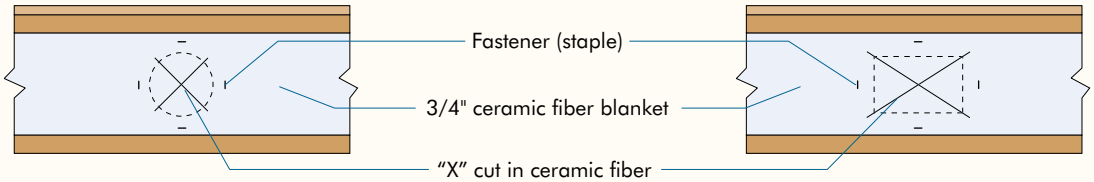


The fabric only needs to be installed to the web and must be placed with no gaps and a snug fit inside the faces of the flanges. It is fastened with 7/8-inch-long crown staples spaced 16 inches on center and 1-3/4 inches from the flanges. The vertical staple-to-staple distance between adjacent rows of 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 10

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™

Installers can add a proprietary 3/4-inch ceramic fiber blanket insulation at a minimum of 4 lb/ft^3 nominal, in compliance with ASTM C892 Type III or higher (see Figures 9 and 10). This assembly can be used with I-joists having a minimum flange size of 1-1/2 inches thick by 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

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™.*

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).

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.

Additional Options

I-joists with approved factory-applied or a field-applied fire-protective coating are also code compliant. APA has not evaluated generic 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,* Form TT-015
- *APA Performance Rated I-Joists*, Form Z725
- APA Product Reports
- Builder Tips on describing I-joist installation details

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

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

Fire Protective Options for I-Joist Floor Systems

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

DISCLAIMER

www.apawood.org

Form No. R425A/Revised January 2016

APA

REPRESENTING THE ENGINEERED WOOD INDUSTRY