Addition of Generic, Tested Fire Assemblies in the *2001 ASD Guideline for Wood I-Joists*

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Introduction

The American Forest & Paper Association's *2001 Allowable Stress Design (ASD) Manual for Engineered Wood Construction* now incorporates data and information on terms, design conditions, adjustment factors, and typical installation details for wood I-joists, as prepared by the Wood I-Joist Manufacturer's Association (WIJMA). The *ASD Guideline for Wood I-Joists* is the collaborative effort of wood I-joist producers, presenting information on design and installation procedures applicable to all wood I-joists. The remaining, proprietary wood I-joist design information is typically located in the manufacturer's product literature, design software, or code acceptance report.

Historically, wood I-joist manufacturers have provided information on the fire resistance of protected assemblies in proprietary code acceptance reports or listing in directories like the UL Fire Resistance Directory®. There currently are over a dozen protected assemblies in various code evaluation reports of various wood I-joist manufacturers; some which are nearly identical. The use of proprietary assemblies has placed the burden on specifiers and code officials to cross-reference these fire assemblies with the manufacturer's literature. Additionally, proprietary fire assemblies did not offer an industry platform to collectively gather and disseminate generic information in documents such as the *ASD Wood I-Joist Guideline*.

Wood I-Joist Industry Cooperation

The wood products industry has long recognized the benefit of generic, protected assemblies. Designers are accustomed to generic, protected assemblies in association literature or listings within the building code based on experience with other building materials. Past developments within the wood I-joist industry have demonstrated the resolve of wood I-joist manufacturers to develop industry documents such as the *ASD Guideline for Wood I-Joists*, the *Quality Assurance Guideline for Wood I-Joists* and other technical documents, which are available on web sites such as WIJMA's www.i-joist.org or APA-EWS's www.apawood.org. Generic, wood I-joist fire assemblies were the next plateau for industry cooperation.

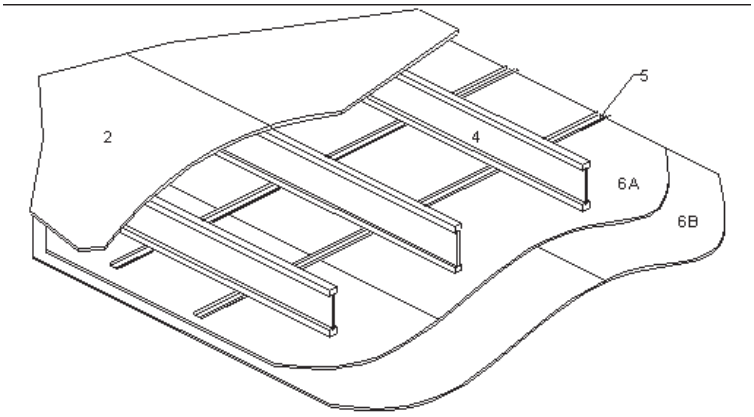
Manufacturers desired to take their tested full-scale assemblies and apply them to other wood I-joists built with similar materials deemed to have equal or greater fire resistance. In November 2001, several major wood I-joist manufacturers each agreed to share one proprietary fire assembly for inclusion int the *ASD Wood I-Joist Guideline* and AF&PA's *Design for Code Acceptance No. 3 (DCA 3), Fire Rated Wood Floor and Wall Assemblies* (available free at www.awc.org) as generic assemblies. A task group was formed to review the test reports and determine an acceptable format for presentation. There were no interpretations permitted in the generic assemblies and each assembly is presented as tested. (Note that these assemblies were already accepted in code evaluation reports of individual manufacturers). Copies of each fire test are maintained on file at the American Wood Council and are available upon request.

The design community will benefit from more choices with the combined resources of wood I-joist manufacturers. The ability to test full-scale wood I-joist assemblies is limited due to the cost of tests, which can range between $15,000 and $25,000 each. Given that the test outcome is either to accept or reject a 1- or 2-hour rating, a single test for an industry generic rating is preferred over repeated proprietary tests with multiple manufacturers.

Wood I-Joist Guideline and *DCA-3 Listings*

The generic wood I-joist assembly data is similar to the prescriptive tables showing generic fire resistance rated assemblies in the *1997 Uniform Building Code* (*UBC*) (Tables 7-A through 7-C) and the *International Building Code* (*IBC*) (Table 719.1). Fire assemblies in the building code tables are deemed to have fire resistance ratings based on analyzing results of numerous tested assemblies with similar characteristics. Already, one wood I-joist floor assembly that appears in *DCA 3* (detail WIJ-1.3) was recently approved for inclusion in the 2003 *IBC* Table 719.1(3) as a generic wood I-joist assembly (no wood I-joist manufacturer is specified). This assembly was the first to be submitted for inclusion in the *IBC*.

Figure 1.—WIJ-1.6 One-Hour Fire-Resistive Ceiling Assembly. Floor[a]/ceiling – 100% design load – 1 hour rating – ASTM E 119/NFPA 251



1. Floor Topping (optional, not shown): Gypsum concrete, lightweight or normal concrete topping.

2. Floor Sheathing: Minimum 23/32 inch thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.

3. Insulation (optional, not shown): Insulation fitted between I-joists supported by the resilient channels.

4. Structural Members: Wood I-joists spaced a maximum of 24 inches on center.

Minimum I-joist flange depth: 1-5/16 inches
Minimum I-joist flange area: 1.95 inches2
Minimum I-joist web thickness: 3/8 inch
Minimum I-joist depth: 9-1/2 inches

5. Resilient Channels[b]: Minimum 0.019 inch thick galvanized steel resilient channel attached perpendicular to the bottom flange of the I-joists with one 1-1/4 inch drywall screw. Channels spaced a maximum of 16 inches on center [24 inches on center when I-joists are spaced a maximum of 16 inches on center].

6. Gypsum Wallboard: Two layers of minimum 1/2 inch Type X gypsum wallboard attached with the long dimension perpendicular to the resilient channels as follows:

6a. Wallboard Base Layer: Base layer of wallboard attached to resilient channels using 1-1/4 inch Type S drywall screws at 12 inches on center.

6b. Wallboard Face Layer: Face layer of wallboard attached to resilient channels through base layer using 1-5/8 inch Type S drywall screws spaced 12 inches on center. Edge joints of wallboard face layer offset 24 inches from those of base layer. Additionally, wallboard face layer attached to base layer with 1-1/2 inch Type G drywall screws spaced 8 inches on center, placed 6 inches from face layer end joints.

7. Finish System (not shown): Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at National Research Council of Canada Report No: A-4440.1 June 24, 1997

STC and IIC Sound Ratings for Listed Assembly								
	Without Gypsum Concrete				With Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
With Insulation	59	50	55[c]	68[c]	65	51	63[c]	65[c]
Without Insulation	-	-	54	68	-	-	58[c]	55[c]

[a] This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

[b] Direct attachment of gypsum wallboard in lieu of attachment to resilient channels is typically deemed acceptable. When gypsum wallboard is directly attached to the I-joists, the wallboard should be installed with long dimension perpendicular to the I-joists and insulation should not be supported by the wallboard.

[c] STC and IIC values estimated by David L. Adams Associates, Inc.

Interpretation of Generic Fire Assemblies

Figure 1 illustrates one of the more common 1-hour rated fire assemblies. The figure illustrates a 2-layer system supported by resilient channels directly attached to the wood I-joist. In the description, the minimum flange depth and area, web thickness, and joist depth each describe the wood I-joist configuration. For example, this generic fire assembly would permit at least two, proprietary wood I-joist configurations per the minimum requirements:

Configuration (9-1/2 in. deep)	Flange thickness	Flange width	Web thickness	Material
Thin flange joist	1-5/16 in.	1-1/2 in.	3/8 in.	LVL
Thick flange joist	1-1/2 in.	2-1/2 in.	3/8 in.	Lumber

The first configuration is the tested assembly. The second configuration is based on engineering judgement, fire resistance design principles and known factors in fire performance, such as charring rates, etc. Both configurations have a flange area equal to or exceeding 1.95 $in.^2$. The flange material can be either solid sawn lumber or a structural composite lumber such as laminated veneer lumber (LVL), parallel strand lumber (PSL), or laminated strand lumber (LSL) with or without end joints. There may be several possible sizes and material choices permitted by the listing, that may or may not have been individually tested, but are permitted due to increased flange area, web thickness, joist depth, etc.

There also may be different adhesives between wood I-joist series. Wood I-joist adhesives are thermosetting indicating that they undergo irreversible change and on reheating, do not soften and flow again (per 1999 FPI's *Wood Handbook*). Phenolic, resorcinolic, melamine, isocyanate, and epoxy (epoxy limited to repairs) are examples of resins used in wood I-joist web and flanges that are based on thermosetting polymers.

Tests show that insulation can have a positive or negative effect on performance of an assembly in fire tests, depending on type, location and amount of insulation in an assembly. *DCA 3* contains only two assemblies that would permit full-cavity fiberglass insulation; they are details WIJ-1.6 (1-hour) and WIJ-2.1 (2-hour). Assembly WIJ-1.6 was tested with and without insulation and results indicate no significant difference in fire resistance (Sultan *et. al* 1999).

Interpretation of the Building Code

The *IBC* gives code officials the authority to accept listings in the *ASD Wood I-Joist Guideline*. Section 703.3, item 1 states, "Fire-resistance designs documented in approved sources" are acceptable as long as the design is based on ASTM E119. Alternatively, Section 703.3, item 4 permits acceptance of "engineering analysis based on a comparison of building element designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E119." The *ASD Wood I-Joist Guideline* or *DCA 3* could therefore be approved under either item 1or 4 of IBC Section 703.3 (see also UBC Section 703.1).

STC and IIC Sound Ratings

Available sound test data are also summarized for the appropriate assemblies, where STC and IIC ratings are typically applied. Data are presented as tested. Where necessary, STC and IIC values were estimated by professional sound engineers based on test regressions from wood I-joist testing at the NRC and similar floor-ceiling assemblies. Copies of the test data or assembly estimates are available from the American Wood Council.

Conclusion

Model building codes provide several ways to establish and approve fire resistance rated assemblies. Proprietary tested assemblies have been the standard method for the wood I-Joist industry to communicate fire assembly information. Several proprietary assemblies have been designated by the wood I-Joist industry as generic tested assemblies, which has facilitated their incorporation in model building codes, various fire resistance directories, and AF&PA's *ASD Wood I-Joist Guideline* and *DCA 3*. Engineers on AWC's Technical Committee, which authored *DCA 3*, have provided sound engineering analysis to support these recommendations.

References

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