The Argument for I-Joists

New products and increased competition make superior I-joist performance available at solid-lumber prices

BY PAUL FISETTE

Although Apollo 11 and Woodstock got all the attention, 1969 was also the year Trus Joist Corporation (now Trus Joist MacMillan) unveiled the first wood I-beam. The development of the I-joist was originally driven by performance, not price. High-end contemporary designs were inspired by homeowners who wanted open floor plans, which required long clear spans. I-joists, with their deep plywood webs edged by lumber flanges, were much stronger and stiffer than sawn joists, and they gave designers the free hand they needed to fashion less restrictive load-bearing strategies.

While I-joists offer many advantages over sawn lumber, unfamiliarity and high prices have kept most builders from trying them. But the truth is that I-joist installation is not that different from solid lumber (*FHB* #108, pp. 50-55). And the really good news is that the prices of I-joists are dropping. The timber crisis of the 1990s has made prices of engineered-wood products, such as I-joists, more stable than lumber. There is also a growing number of new, small companies that are fighting hard for market share; many of these companies have fine products at competitive prices.

I-joists don't waste fiber where it's not needed

To understand how an I-joist works, imagine what happens when weight is placed in the center of the floor (drawing left, facing page). As the joist deflects and bends—essentially forming an arc—the wood fibers along the top edge are compressed, while those along the bottom edge are stretched. Because the edges are moving in different directions, at some point the wood fibers in between are neither compressed nor pulled apart. I-joist designers take advantage of this fact by placing the strongest and stiffest fiber in the flanges where the stress is greatest. But they don't waste fiber in the center where it's not needed. This fact is why I-joists can get away with a web that's only ⅜ in. thick.

To understand further why I-joists are so efficient, it's important to understand the properties of solid lumber. Double the thickness of a joist, and it will carry twice the load; double the depth of a joist, and it will carry four times the load. Likewise with stiffness: Double the thickness of a joist, and the deflection is cut in half; double the depth of a joist, and the deflection is reduced to one-eighth. Adding depth to a joist increases strength, stiffness and potential clear span. With an I-joist, a minimal amount of wood fiber is all it takes to increase the depth.

One I-joist can do the work of two or more solid joists

Solid-lumber joists are typically available in maximum lengths of 16 ft., and they're usually laid out 16 in. o. c. To span the average house, separate joists are installed across the front and the back, and lapped over a girder beam at midspan.

Because I-joists are available in lengths up to 60 ft., spanning the house is not a problem, so the number of joists is instantly cut in half. In most cases, I-joists can be laid out on 19½-in. or 24-in. centers (chart p. 73). Besides material savings, fewer joists mean less handling and less nailing.

Art Pakatar, construction coordinator for Belmonte Builders in Albany, New York, expresses the views of many builders when he says, "We changed to I-joists a few years back and will never use lumber joists again. We save money, improve performance and feel like we're helping the environment." Like Pakatar, many builders appreciate the consistency that I-joists provide. I-joists are straight, so floors and ceilings lie flat. I-joists are stable because their moisture content is

TimberStrand flange

Solid-sawn flange

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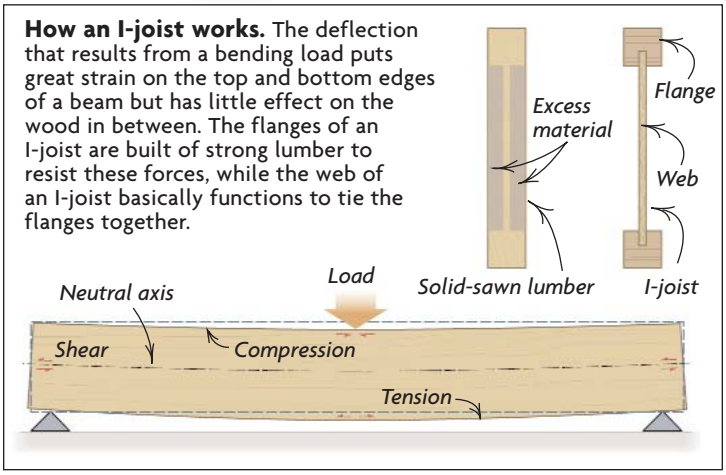
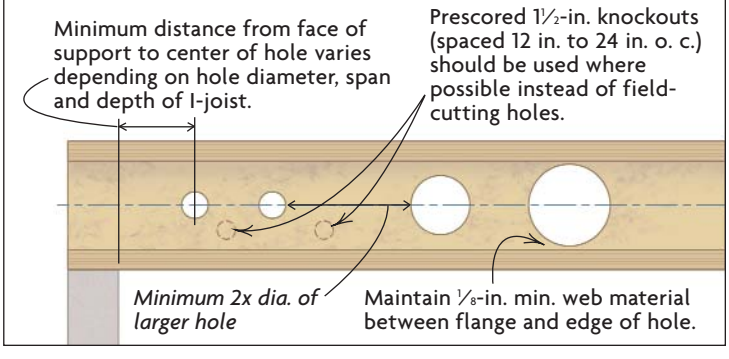
How an I-joist works. The deflection that results from a bending load puts great strain on the top and bottom edges of a beam but has little effect on the wood in between. The flanges of an I-joist are built of strong lumber to resist these forces, while the web of an I-joist basically functions to tie the flanges together.

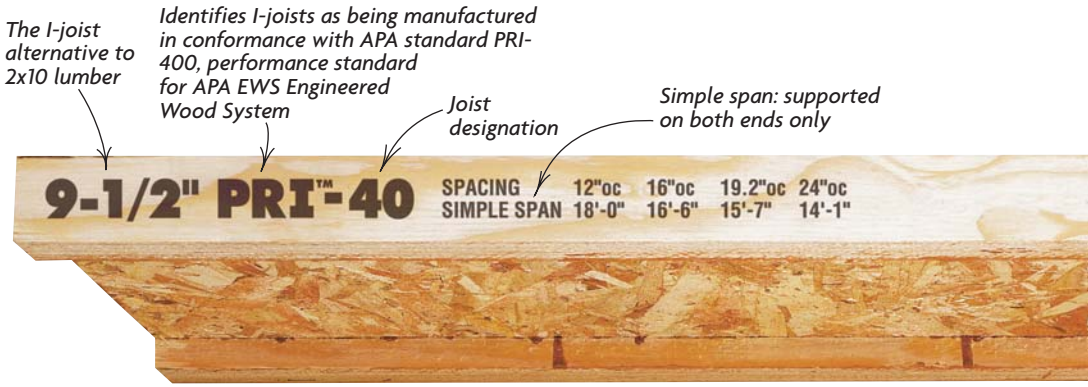


Drilling holes in I-joists. The flanges must never be cut or notched, but fairly large holes can be cut through the webs (the largest holes are permitted at midspan). Manufacturers' span tables must be consulted to determine maximum diameters for holes near supports.



Drawings: Dan Thornton

I-joist standardization: Wave of the future or passing fad?



Unlike plywood, oriented strand board and other panel products, I-joists have no universal standard. Every manufacturer issues its own specifications and span recommendations. Each time a builder buys a new product, there is a new set of rules to follow. APA (The Engineered Wood Association, Tacoma, WA; 253-565-6600; www.apawood.org) would like to change all that. Before he became APA's technical director, Tom Williamson was a Trus Joist MacMillan distributor for 15 years. He recognizes that a significant level of confusion is caused by having too many proprietary product specifications. Williamson says, "It became obvious to us that we had to standardize to make it easier for specifiers to specify, suppliers to inventory and builders to buy."

The APA performance-rated I-joist (PRI) standard was brought into the marketplace in 1997 and is recognized by all of the model building codes. The APA's standard basically creates a family of I-joist products that have similar design properties. It then develops span tables based on performance levels. The APA technical guide provides construction details for blocking, fasteners, rim joists, cantilevers and web-hole placement.

Manufacturers who like the idea can buy into the plan and adopt the PRI standard. But few of them have: So far, only 20% of the I-joists sold follow the PRI standard.

closely controlled. Shrinkage, nail pops and floor squeaks are a thing of the past.

Promotional literature does make some exaggerated claims, however. Manufacturers promise big savings when installing plumbing, electrical and mechanical systems. Thin webs are easier to drill through, and larger holes are permitted, especially in midspan (drawing right, p. 71). But the word from the field is that few subcontractors see enough difference to offer discounts for I-joist jobs.

Builders don't always save as much on labor as they're led to believe, either. Flush-mounting I-joists against the face of a beam is particularly tedious and requires the use of expensive metal hangers. Some of the more complicated framing schemes may even require crews to receive additional training. When working with I-joists, it's always good practice to provide detail sheets to the job foreman and to mark the locations for special fastening details right on the blueprints.

Ironically, the design that makes I-joists such an efficient use of lumber makes them a concern for firefighters. Because it's less beefy than a solid joist, a burning I-joist collapses faster than a solid joist does.

Solid-sawn flanges offer I-joist quality at lower costs

The evolution of I-joists has been a combination of high and low technology. The first I-joists were made with plywood webs and solid-lumber flanges. In 1977, most manufacturers followed Trus Joist's lead and began making flange stock out of laminated veneer lumber (LVL), stronger and more stable than solid lumber. Since 1990, virtually every manufacturer has abandoned plywood in favor of oriented strand board (OSB) web material. OSB is less expensive, more widely available and—because all the strands interlock—stronger than plywood in shear.

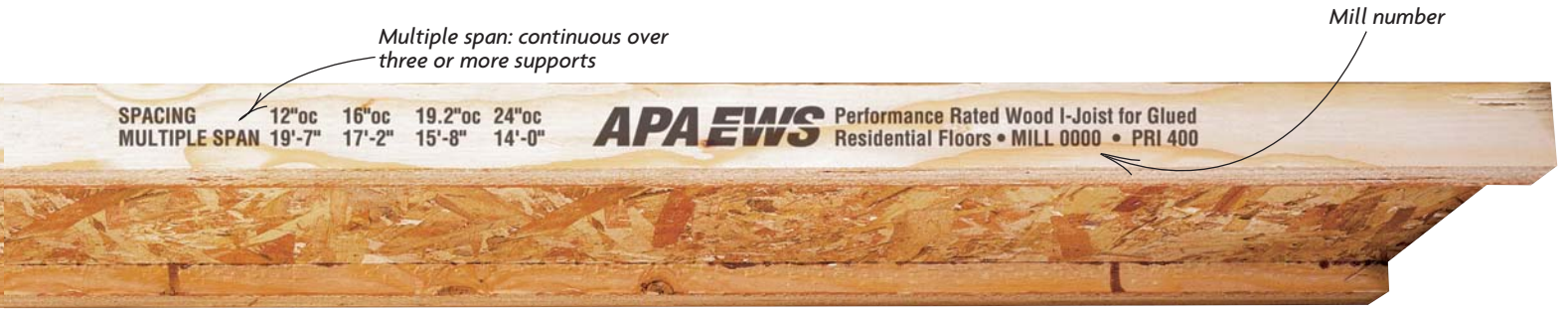
Recent I-joist technology has taken a step backward, sort of: Between 15% and 20% of I-joists are now being built with solid-lumber flanges. These days, solid-lumber flanges are made from 2x3s or 2x4s that have been specially selected and finger-jointed for high strength and stiffness. The solid flanges do not have the strength of LVL, but they make up the difference with larger cross sections. Well-made solid-flange I-joists can span distances equal to the best LVL versions. And the kicker is that they typically cost 20% less than their LVL cousins. Builder Pakatar reports that switching to ALLJoist, a solid-flange product manufactured by Alliance Forest Products (sources of supply, p. 71) "saved $1,400 off the cost of building a 3,200-sq. ft. model home."

Along with seeing material cost savings, many framers find that I-joists with wider solid-lumber flanges are easier to install: They don't wiggle like spaghetti while they're carried and laid up, and they don't easily tip over the way their thin-flanged LVL cousins do. Solid flanges make the joists run more true across the span, so they don't have to be straightened as much when decking is applied. Wider flanges provide more room for nailing and a larger surface area for gluing; they also slightly reduce the space between joists, making the subfloor a bit stiffer.

Choosing the right brand

I-joists are essentially nothing more than three pieces of wood glued together. The most efficient cross-sectional geometry and assembly methods have been mastered by engineers for years. If you look at the technical specifications of all major brands, you will find virtually no difference in sizes or span ratings. Price and service are where the differences lie.

Solid-flange I-joists, which are made by a number of different companies (sources of supply, p. 71), are the obvious price winners, but service is another story. For service and technical support, the clear leader is Trus Joist MacMillan (TJM). With a 55% share of the I-joist market, TJM has the most extensive distribution network. It also has more than 170 field representatives, while most other manufacturers have only four or five. Additionally, with the most complete



Manufacturers who make the other 80% of I-joists, including industry leader Trus Joist MacMillan, do not support APA's plan for standardization. Some argue that setting a standard will drive products to the lowest common denominator, removing the incentive for innovation and the development of new products. Others are concerned that builders may see the span listings stamped on the side of the I-joists and install them based on that recommendation alone without considering any other special requirements, including point loads, offset loads and fastening schedules.

Standardization in the world of I-joists clearly does not eliminate the need for technical support and design services. But Thomas Denig, president and chief executive officer of TJM, points out, "With price as the primary differentiator, manufacturers will most likely seek to reduce costs by reducing or eliminating sales and technical-design assistance, software, dealer and contractor training, and job-site support." Denig also warns that the proposed ability to mix I-joist brands in a floor system is a bad idea. He says, "Manufacturers will no longer be in a position to provide homeowners with warranties for the system." APA's Williamson admits that these concerns are legitimate but thinks the problems are solvable. Stay tuned.
—P. F.

line of structural products—Microllam (LVL), TimberStrand (LSL), Parallam (PSL) and TJIs (I-joists)—available to engineer virtually any floor system, TJM also offers the convenience of one-stop shopping. But you pay for this service. Even TJM field representatives admit that their product line is 10% more expensive than that of their nearest competitor.

This is not to say that you can't get adequate service from another company, but you need to ask your supplier some specific questions, such as:

- Who provides the engineering service: dealer, distributor or manufacturer?
- How long will it take to size the joists in a set of plans?
- How long will it take for delivery?
- What technical information do they provide: joist layout? hanger locations? performance specs?
- What happens if my customer changes a stair layout? Who engineers the change? How long will it take to make the changes?
- What is the policy if I receive what I think is defective material on site?
- Who is the person that I will be working directly with? □

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Comparing costs: I-joists vs. solid lumber

The chart below compares costs for two types of I-joist (an LVL-flange model from Louisiana-Pacific and a solid-flange model from Alliance Forest Products) to a standard 2x10 floor frame for a modest (44 ft. by 28 ft.) ranch. At 16 in. o. c., the cost of solid-flange I-joists is comparable to that of 2x10s. At 24 in. o. c., not even 2x12s would be strong enough, but both I-joists easily exceed load and deflection limits. Also, the wider spacing saves enough on material to make the LVL-flange product less expensive than 16-in. o. c. 2x10s. Note: Prices were quoted last summer by suppliers in western Massachusetts.

16-in. layout	Kiln-dried #2 SPF 2x10			LPI LVL-flange I-joist			AJS10 solid-flange I-joist		
	Qty.	Unit cost	Total cost	Qty.	Unit cost	Total cost	Qty.	Unit cost	Total cost
Field joists	68 @ 14 ft.	1.22/LF	1161.44	34 @ 28 ft.	1.45/LF	1380.40	34 @ 28 ft.	1.12/LF	1066.24
Blocking+misc.	56 LF	1.22/LF	68.32	120 LF	1.45/LF	174	120 LF	1.12/LF	134.40
Rim boards	96 LF	1.22/LF	117.12	96 LF	1.65/LF	158.40	96 LF	1.65/LF	158.40
Total cost			1346.88			1712.80			1359.04

24-in. layout	Kiln-dried #2 SPF 2x10			LPI LVL-flange I-joist			AJS10 solid-flange I-joist		
				Qty.	Unit cost	Total cost	Qty.	Unit cost	Total cost
Field joists	**Won't work:** maximum allowable span at 24 in. o. c. is 11 ft. 1 in.*			24 @ 28 ft.	1.45/LF	974.40	24 @ 28 ft.	1.12/LF	752.64
Blocking+misc.				102 LF	1.45/LF	147.90	102 LF	1.12/LF	114.24
Rim boards				96 LF	1.65/LF	158.40	96 LF	1.65/LF	158.40
Total cost						1280.70			1025.28

*Design parameters: 40 psf live load, 15 psf dead load, L/360 maximum deflection.

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