Roof Framing with Engineered Lumber

Tips from a custom framer make the engineered-lumber learning curve easier to negotiate

BY JOHN SPIER



A few years back, my crew switched to engineered-floor systems for most of the custom homes we build. These systems, framed with I-joists and other types of engineered lumber, have many advantages—including uniformity, straight, long lengths of lumber and no shrinkage—which reduce labor costs and improve customer satisfaction. We've often thought that these same advantages could apply to roof construction as well, especially on jobs where we've had to wrestle truckloads of wet or frozen 24-ft. Douglas-fir 2x12s up to a ridge 35 ft. in the air.

Remembering the learning curve we experienced with engineered floors, we chose simple structures for our first engineered roofs (photo above). One was a small cottage with skylights and shed dormers, and another was a simple gable structure. More complex roofs are possible with engineered lumber, but we figured we'd save those challenges for a later project.

Planning works most of the time

For a dimensional-lumber roof, I usually just figure the pitch and spans to determine the stock size and lengths. With an engineered roof (as with an engineered floor), the first step is to send the plans to the supplier for engineering and specification (drawing facing page). In some cases, it also turns out to be the second, third and fourth steps, as the plans go back and forth for revisions. When all the bugs are worked out, we can order the roof-framing material.

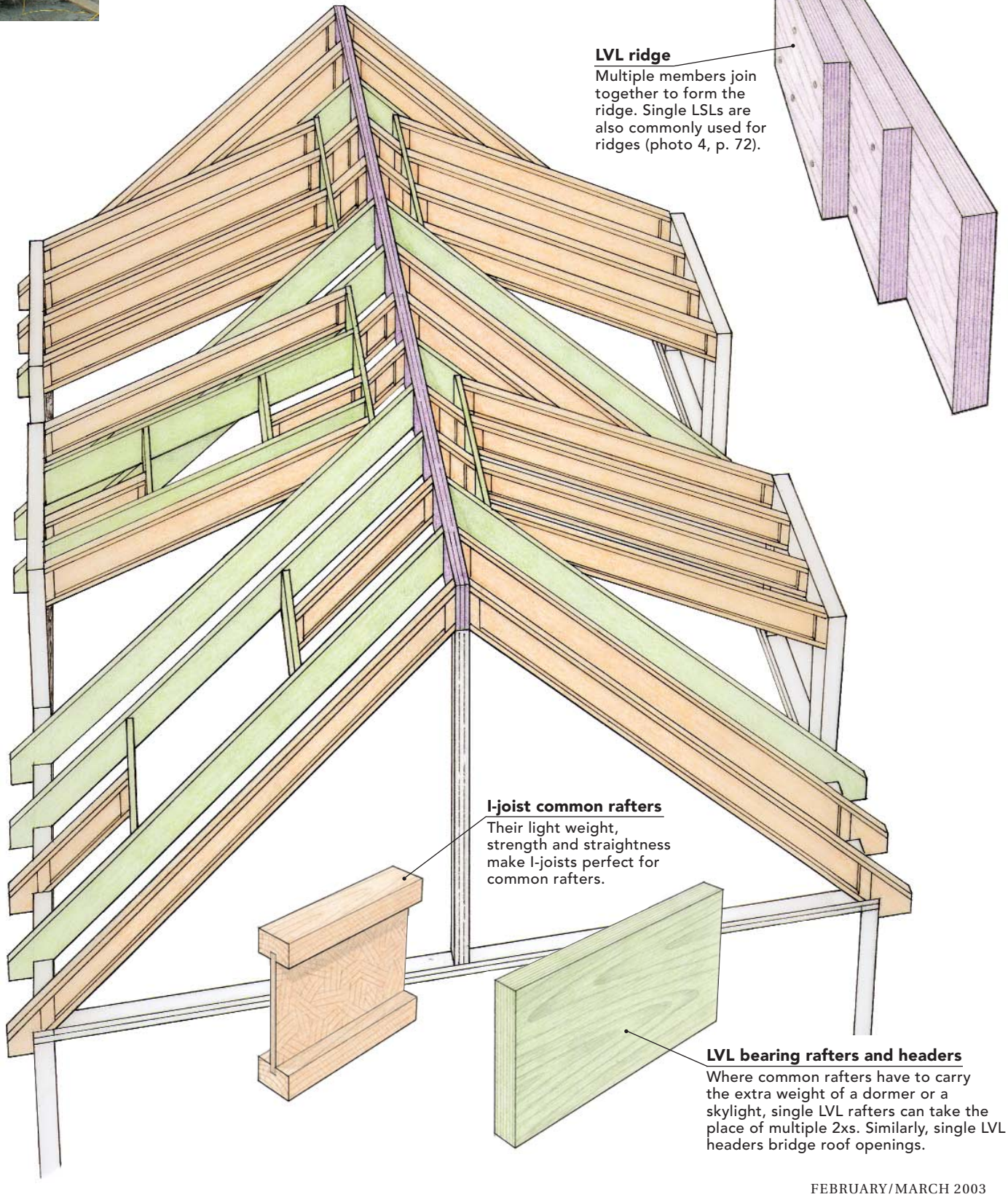
One of the big disadvantages of engineered-roof systems is that if you or the suppliers get the order wrong, a trip to the local lumberyard usually won't fix it. All the components are special-order, so you just can't go out back and pull 26-ft. LVLs (laminated veneer lum-

Drawings: Vince Babak

HOLDING UP A ROOF WITH ENGINEERED LUMBER



Engineered lumber makes for flat, straight roofs. Because of its strength, single pieces of engineered lumber often can do a job that would require multiple pieces of dimensional lumber. Plus, lightweight I-joist rafters are easier to handle than 2xs. Metal connectors (not shown in drawing) join all framing members. Although different types of engineered lumber may be specified for some areas, here is where they are typically used.



LVL ridge
Multiple members join together to form the ridge. Single LSLs are also commonly used for ridges (photo 4, p. 72).

I-joist common rafters
Their light weight, strength and straightness make I-joists perfect for common rafters.

LVL bearing rafters and headers
Where common rafters have to carry the extra weight of a dormer or a skylight, single LVL rafters can take the place of multiple 2xs. Similarly, single LVL headers bridge roof openings.





Gang-cutting I-joist common rafters saves a lot of time. To index the rafters, a saw kerf is made square across the I-joists at the bottom of the plumb cut **1**. Next, the rafters' length is measured **2**. A second index mark is made at the seat cut **3**. One crew member uses a template indexed on a saw kerf to mark the bird's mouth while another cuts the previously marked plumb cut **4**.



ber, see "Engineered Lumber," *FHB* #150, pp. 56-61) out of the rack. In our case, the local yard is a boat trip away.

The ridge and bearing rafters

Before the roof load arrives, we frame and stand the gable ends, ridge posts, kneewalls and dormer walls (see "Cutting and Setting Common Rafters," *FHB* #142, pp. 56-61). Framing the roof is then simply a matter of assembling the lumber and hardware.

One of the roofs that we built has a single LSL (laminated strand lumber) for the ridge (photo 4, p. 72). The other roof has three 26-ft. long LVLs for the ridge, which were set in place one piece at a time and then spiked together. The engineering specs provide a fastening schedule for assembling multiple structural members (such as an LVL ridge or header), and at least some hand-nailing usually is required to get them tight and to eliminate gaps.

As with any other roof, we transfer the rafter layout from the walls to the ridge, with one crew member taking the measurements along the wall and another marking them on the side of the ridge. For one of the engineered roofs, LVLs were specified for the rafters that have to carry headers, including those on each side of the dormer and skylight openings. In a conventionally framed roof, these rafters would be doubled or tripled 2xs, but because of their added strength, only single LVLs are needed to carry these headers. Some engineers specify doubled or tripled I-joists for these rafters because they are lighter and less expensive, but I've found the advantages are outweighed by increased labor costs for assembly. By the way, you can't just switch materials in the field; you need to ask the engineers to make these changes before you order the roof package.

The bearing rafters that carry the headers are cut the same as the I-joist commons, so we make a pattern rafter, test it and then cut all the LVL rafters. When these rafters are cut and hung in place, we cut and install LVL headers for the dormer roofs and the skylights. Again, single LVLs can take the place of the multiple 2x members that usually make up a header. I've learned that engineers often miss the extra depth required for a plumb header in a sloped roof, another revision that should be made when reviewing the plan.

I-joists for the rest of the rafters

For the remaining rafters in the roof, we use I-joists of the same depth as the LVLs. These rafters include the gable rafters, commons between the dormers, rafters for the shed-dormer roofs and jack rafters that fill between the headers and the ridge. In addition to being straight and strong, the I-joists' light weight is a big advantage in roof framing.

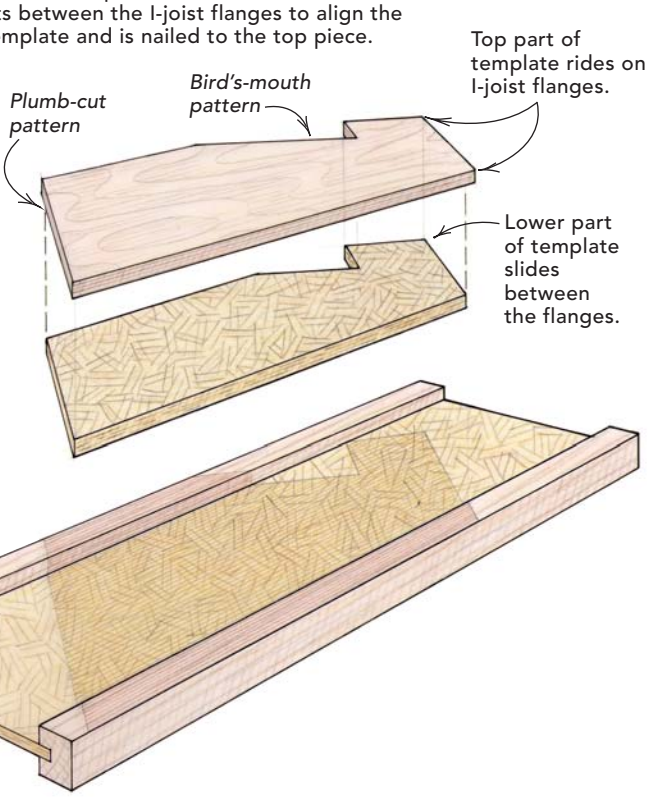
Cutting the bird's mouths on the LVLs is as straightforward as cutting those in regular di-



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I-joist rafter template speeds cutting

With index marks cut into the I-joists, a two-piece plywood template is used to mark the bird's mouth and plumb cut. The top portion of the template is the same overall width as the I-joist. The bottom portion, cut from web-stiffener stock, fits between the I-joist flanges to align the template and is nailed to the top piece.



mensional lumber. However, I-joists are a bit different. Because they are perfectly straight, they lend themselves to gang-cutting (photos above), so we make a job-site template for marking and cutting the plumb cuts and bird's mouths. We usually leave the I-joist web as the skeleton for the eaves' detail. After tacking the 2x subfascia to the end of the upper flanges, we attach blocking to the webs to give the subfascia solid nailing and to carry the soffits and exterior trim.

Every I-joist gets web stiffeners

The plan also specifies web stiffeners in many locations, typically where an I-joist is carried by a sloped hanger or where a bird's mouth is cut into it. Web stiffeners are small pieces of plywood or oriented strand board (OSB) that fill the web of the I-joist to the flanges' thickness. Web stiffeners can be cut on site from scrap plywood or OSB, but mass-producing them in the shop with a tablesaw and chopsaw is more efficient (photos p. 72). We glue up sheet stock ahead of time for the required thickness. For 1-in. flanges, we glue together two sheets of 7/16-in. OSB. As with hangers, we've found that nailing the stiffeners on before installing the rafters is more efficient.

Web-stiffener stock also can be used in longer lengths to splice or reinforce I-joists, for example, over a bearing wall or for wide overhangs. In one case, we spliced together two short joists to make a longer one for a nonstructural filler over a dormer cheek wall.

Metal hangers unite the system

As important as the engineered-lumber schedule is the hanger-and-fastener schedule. Just about every framing connection on an engineered roof involves special hangers and other fasteners. Each hanger as well as its location is keyed on the plan, so we simply sort the fasteners ahead of time and use them where they are called for. Engineers even include a schedule for how many nails are required in each location to meet the load criteria, but it seems that our building official is happiest if every hole is nailed (photos p. 73).

We've learned that it's almost always easier to mount hangers on members before placing them. Common rafters and jack rafters get a hanger on one or both ends; then they are lifted into position and nailed. Header hangers also can be attached this way, or they can be attached to the bearing rafters. For example, when laying out the rafters that flank the skylight opening, I place the two LVLs edge to edge on sawhorses. After laying out the positions for the headers, it's easiest to nail on the header hangers while the rafters are lying flat. I use a short cutoff of the header material to keep the hanger legs spaced properly (photo 1, p. 73).

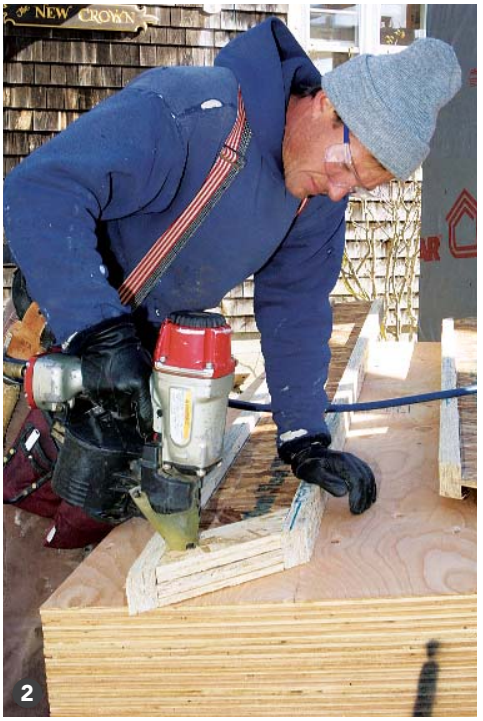
Another thing we've learned is that many of the hardware components used in engineered-roof systems have flanges that fit between the



WEB STIFFENERS LET I-JOISTS DO THEIR WORK

Web stiffeners are blocks of plywood or oriented strand board cut to fit between the flanges of an I-joist. They help to transfer loads and give a nailing base for metal hangers. Blocks for I-joist rafters can be fabricated quickly and easily in the shop **1**. The blocks then are nailed onto both ends of the rafter **2**, and the hanger is attached **3** before the rafter is lifted into place **4**. The blocks provide extra nailing for the lower ends of the rafters, and additional blocking provides attachment for a structural subfascia **5**.


1


2


3


4


5

Lessons learned about engineered lumber

SAFETY

Some engineered lumber can be slick and dangerous to walk on. Other components, LVLs in particular, have razor-sharp edges; cutting a bevel on an LVL can be an invitation for job-site injury. Also, some engineered materials have a protective wax coating. This stuff gets on your hammer head, which makes it slip, and it gets on your boots, which makes you slip. Last, the sawdust is finer, more irritating and more noxious than that of most woods, so if you're cutting engineered lumber in areas without good ventilation, use lung protection.

ENVIRONMENTAL CONCERNS

One of the best things about engineered lumber is the environmental benefits: Because of its strength, fewer members are needed, and much of the lumber comes from second-growth, scrap or recycled wood. But beware: Some of the chemicals used to hold together and treat engineered lumber can be toxic when the scrap is cut or burned, and when the ash is allowed to leach into groundwater.

PRODUCT LISTS AND ORDERING

Engineers' material takeoffs are always optimistic and sometimes wrong. For example, they often measure rim stock on the plan in linear feet, divide by 12 ft. or 16 ft., and give you what they think is enough pieces. They also specify an exact number of joists or rafters, including short pieces, all listed as approximate lengths that are then cut and shipped by the supplier. I suggest combining the short pieces into longer lengths and then ordering one extra of the longest length to allow yourself at least one mistake.

HARDWARE

The big hangers are expensive and often are special-order items, so check your list and delivery carefully. The smaller

framing member and its support. The thickness of these flanges needs to be allowed for when determining lengths of rafters. If a framing member is to be hung with one of these hangers, we subtract ⅛ in. from the overall length (¼ in. if hangers are at both ends). Because these systems are designed to be held together by hardware, a bit shorter is better than longer.

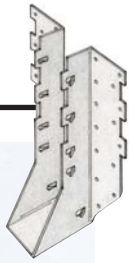
A rafter cut to the exact length and then placed in one of these hangers can push a wall out of plumb or bow the ridge or header. I-joist hangers typically require subtracting about ⅛ in. per hanger, but some specialized hangers have thicker flanges and may require subtracting more. When all the rafters and headers are installed, we double-check that the hangers were nailed off properly.

When in doubt, read the instructions

For engineered floors, and now roofs, we've used engineered-framing systems from several companies over the years. They all provide a pocket reference guide to help with installation details, covering just about any framing situation. It's worth taking one of these guides home and reading through it carefully before starting. Most manufacturers specify Simpson Strong-Tie fastening products (800-999-5099; www.strongtie.com), and the Simpson master catalog also offers a wealth of possibilities and information. □

John Spier and his wife, Kerri, own Spier Construction, a custom home-building company on Block Island, Rhode Island. Photos by Roe A. Osborn.

METAL HANGERS MAKE THE CRITICAL CONNECTIONS











Metal hangers or framing connectors are used every place where engineered-framing members meet. To lay out and attach hangers for headers, it's easiest to line up the rafters top to top on sawhorses. Metal-connector nailers, specially designed to shoot nails into the holes in framing connectors, make quick work of attaching hardware **1**. Although engineers sometimes specify the minimum number of nails needed to attach a metal connector, putting a nail in every hole is the safest bet **2**. Framing connectors such as twist straps strengthen the rafter-to-plate connection **3**. Hanger flanges on gable rafters can be bent flat and attached to the ridge end **4**.

hangers are cheap, so order extra. Keep a big box of extras on hand so that you have the right hanger if you need to change something.

FASTENING

A metal-connector nail gun is a necessity unless you have a lot of cheap labor (photo 3 above). We have had good luck with Paslode Positive Placement Strip Nailers (800-682-3428; www.paslode.com). Even though these nailers work well, they break down occasionally, so we keep a spare in the shop.

LAYOUT

The better engineers won't put rafters in the way of a plumbing vent. However, figuring out where the pipe goes is not their job. Because you can't just cut in another header, figure out where the systems are going beforehand.

MODULAR SIZING

Over the years, many products such as fans, ductwork, skylights and attic stairs have been designed to fit into standard rafter or joist bays. The flanges of engineered lumber are wider than dimensional lumber and can make a mess for you later if you don't plan for those items carefully during framing.

IF YOU MAKE A MISTAKE

Of course, we've never, ever made a mistake ourselves, but our plumber did once with his big drill. That's how we found out about the technical support offered by engineered-lumber manufacturers. Most have a toll-free number that puts you in touch with a team of qualified engineers whose sole job is to recalculate engineered systems and to help you out of your exact framing predicament. Email or fax them a plan (even send a digital photo of your problem), and they'll get right back to you with a fix that works in the field. It's a fantastic service.

—J. S.