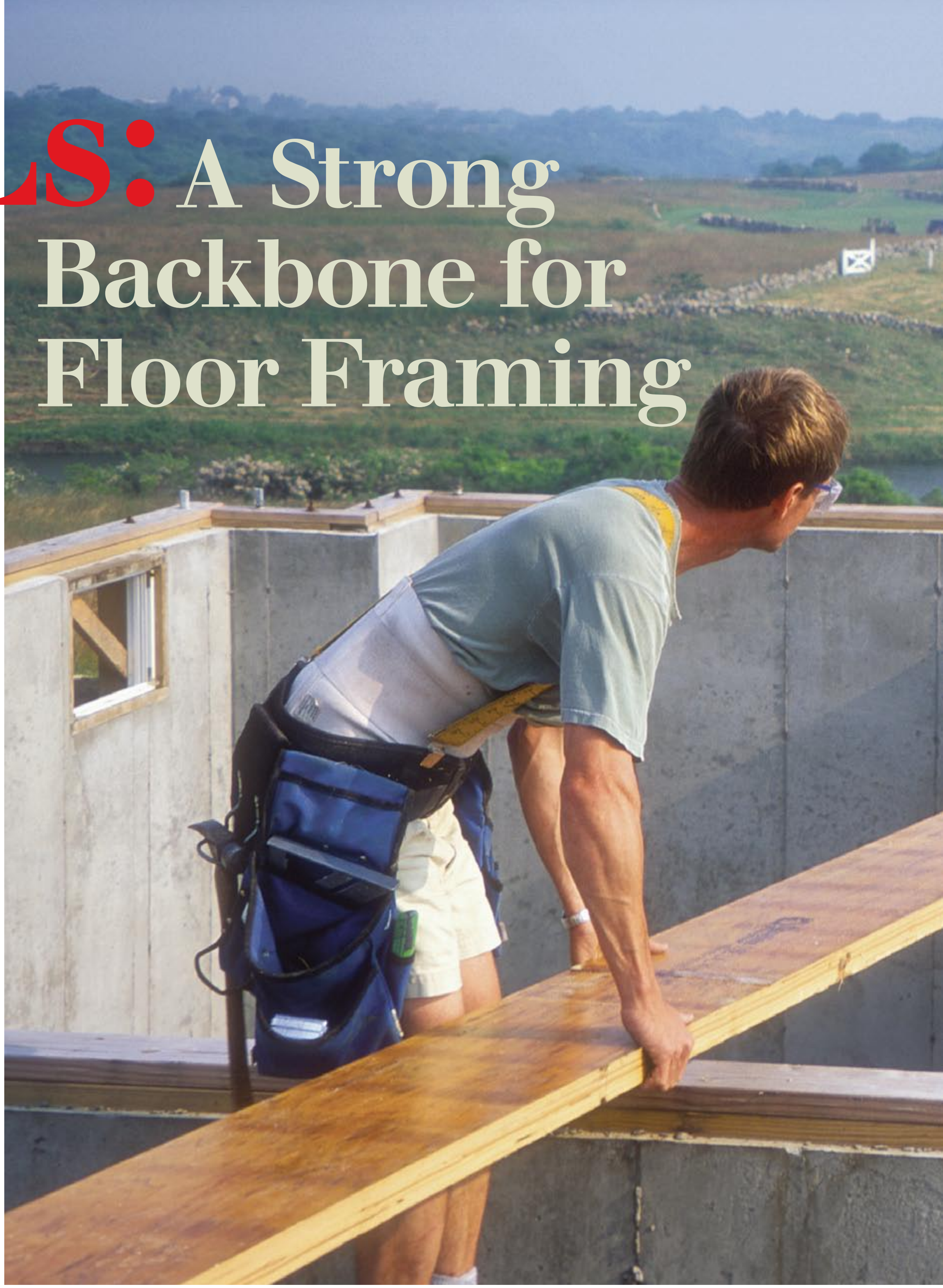
LVLs: A Strong Backbone for Floor Framing



Laminated-veneer lumber lets you assemble big beams without a big crew

BY JOHN SPIER

In the bad old days, we used solid lumber for everything. It wasn't long or light enough, but it was versatile. We could "site-engineer" a beam for almost any application. In the past 15 years, engineered-lumber beams have made it possible to build floors flatter, stronger, and more stable than ever before. Selecting the best type of engineered lumber, however, can be a confusing process. I frequently have to slow down my thinking when I am calling the folks at the lumberyard to order LVLs, PSLs, LSLs, or glulams (sidebar facing page).

For the central bearing beam of a floor system—the backbone of a wood-frame floor—I prefer to use laminated-veneer lumber (LVL) over other types of engineered lumber. With LVLs, I can build up several pieces into a beam large enough to carry almost any load. LVLs combine the versatility of solid lumber with the strength, stability, and uniformity of engineered material.

Dropped beams for basements

Carrying beams can be dropped beams (installed under floor joists) or flush beams (installed in plane with floor joists).

Dropped beams make floor framing faster because the joists run over the beam in continuous lengths. Rather than sitting on the mudsills, a dropped beam typically requires a pocket in the foundation wall to support each beam end. Dropped beams are nice because the bays between joists are open, which makes running utilities easier; the exception is where a long sewer line or HVAC trunk line needs to run under the joists and cross the beams. Another drawback to dropped beams is that they reduce

the overhead clearance, which may be a code issue if you're planning to turn the basement into living space.

Flush beams make flat ceilings

Flush beams are both labor- and hardware-intensive, but they preserve headroom and the plane of the ceiling below. Flush beams

Beam photos: Daniel S. Morrison

How LVLs compare to other options

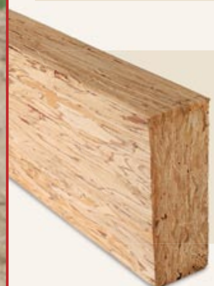
Widening the world beyond solid wood and steel, the engineered-beam kingdom offers four additional choices. Engineered lumber is longer, stronger, flatter, heavier, and more expensive than solid wood. Some beams are available pressure-treated for damp or exterior applications. For the few situations where neither solid nor engineered lumber will work, steel is still a great choice.

Laminated-veneer lumber (LVL)

The most versatile to work with. *Thin layers of wood glued together resemble high-density plywood with parallel laminations. Stronger and stiffer than glulams, LSLs, or solid lumber, LVLs can be built up for long headers or major carrying beams. Width: 1¾ in. Depths: 5½ in. to 20 in., including standard solid-lumber sizes (5¼ in., 7¼ in., 9¼ in., and 11¼ in.) and engineered-joist sizes.*

Laminated-strand lumber (LSL)

The least expensive choice. *Short strips of wood are glued together without regard for orientation, similar to oriented strand board (OSB). LSL is good for door and window headers, including garage-door headers. Also suitable for beams, LSLs aren't as stiff as the others but offer more drilling flexibility. Widths: 3½ in. for beam and header stock. Depths: 4⅜ in. to 16 in., including standard solid-lumber and engineered-joist sizes. LSLs are also available as posts and rim boards.*



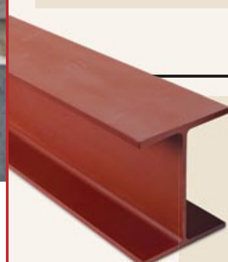
Parallel-strand lumber (PSL)

The strongest and stiffest engineered-lumber beam. *Long strips of waste-wood fiber are glued parallel to each other. Widths: 2 11/16 in., 3½ in., 5¼ in., and 7 in. Depths: 9¼ in., 9½ in., 11¼ in., 11⅞ in., 14 in., 16 in., and 18 in. Also available as posts and pressure-treated for exterior use.*

Glue-laminated timber (glulam)

The most versatile at the drawing board. *Stacked framing lumber is finger-jointed together lengthwise and laminated on top of each other. Glulams can be used in arcs, giving tremendous design flexibility. Laminating a slight camber into a beam can combat deflection. Architectural-grade glulams are suitable for exposed interior applications. Widths: 3⅛ in., 3½ in., 5⅛ in., 5½ in., and 6¾ in. Depths: Up to 50 in., including standard solid- and engineered-lumber sizes.*

THE OLD STANDBYS



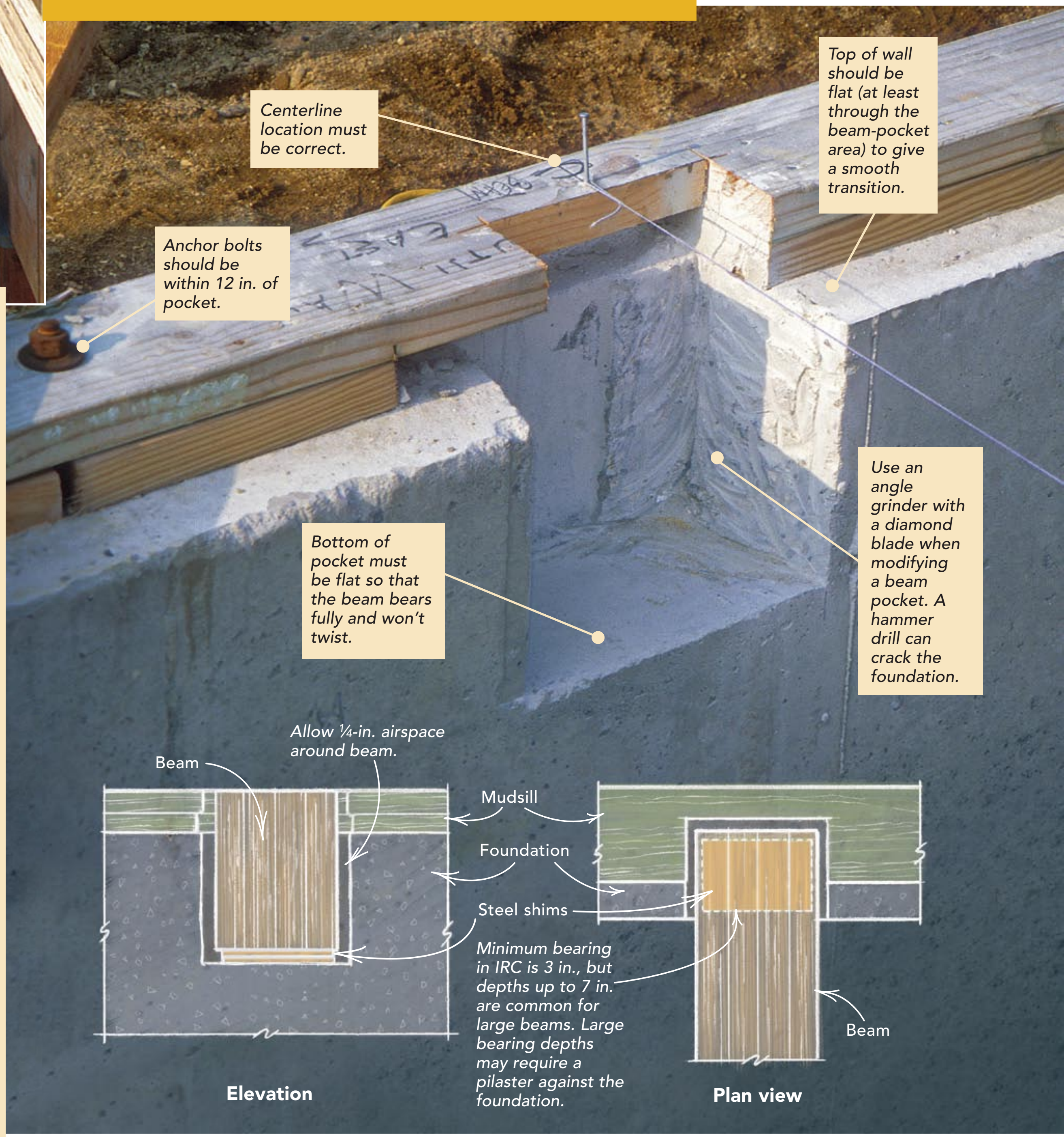
Steel I-beam

Best strength-to-depth ratio. *Available in nearly any size imaginable, steel beams can solve load puzzles where tall wooden beams can't fit. Steel is suitable for exposed interior applications. You also can beef up the load capacity of solid lumber by sandwiching a steel flitch plate between planks.*

Solid lumber

The original alternative to full-dimension beams. *Solid lumber is still strong enough to handle many load-bearing chores such as headers and floor beams, but it needs more intermediate support than engineered lumber. Solid lumber is also prone to shrinking and cracking.*

BEAM ENDS NEED SOLID SUPPORT



Beam pockets, whether formed or cut into masonry walls, need to be sized and detailed correctly. In a perfect world, accurate plans on-site before the foundation is poured would ensure a perfect pocket. The beam would sit on sill seal and be flush with the mudsill.

In the real world, trimming or shimming is usually necessary. Steel plates and solid masonry materials make great shims, but pressure-treated wood works well, too. Just keep the grain facing up and the blocks longer than about 3 in.

For the inevitable situation when a beam pocket in masonry needs to be enlarged, use an angle grinder outfitted with a diamond blade. Don't use a hammer drill with a chisel bit because you'll likely fracture the foundation at this crucial bearing point.

Use studs to make a wall pocket

When the beam ends short of a foundation wall, such as in a framed wall defining a stair opening, a post can be built up within the wall using studs. Nail a full-height stud into the side of the beam for stability.

Drawings: Chuck Lockhart

can be built and installed using most of the same techniques used for dropped beams. There are a few extra considerations and opportunities, though.

Flush beams often can be set in place with the hangers already installed, which eliminates a lot of overhead nailing. On big, heavy beams, though, I don't like to preinstall joist hangers. If the beam slips while being lifted into place, an attached joist hanger could hurt somebody.

Support the middle with columns and caps

Flush or dropped, a carrying beam usually is supported at intermediate points by columns. In a basement or crawlspace, this usually means Lally columns on concrete footings, or pads. Because LVL beams are stronger than regular beams, the supports often are farther apart. Greater spans between columns usually mean that larger footings are needed. Sometimes, these point loads require additional reinforcement in or on top of the concrete, too, so it's worth checking with your engineer.

Most building codes require built-up carrying beams supported by columns to be contained in column caps. I usually use an LCC-type cap manufactured by Simpson Strong-Tie Co. Inc. (www.strongtie.com; 800-999-5099). The saddle that is created by the cap secures the beam, ensures that the load is distributed evenly, and meets my local code requirements.

When using post caps like these, you need to incorporate them into the beam-building process because you can't slip them under the beam after it is assembled, or at least not without jacking up the beam. To determine the column height, measure down from a string pulled taut over the mudsills (photo facing page). Take the height from the footing to the string, and then subtract the beam depth and the thickness of the plates on each end of the column. Cut and label the columns. I add about ⅛ in. in the middle of a 32-ft. span to allow for string sag and column-base compression.

If the beam goes through or over an intersecting wall, it generally can be supported in the wall with multiple jack studs or an engineered PSL post.

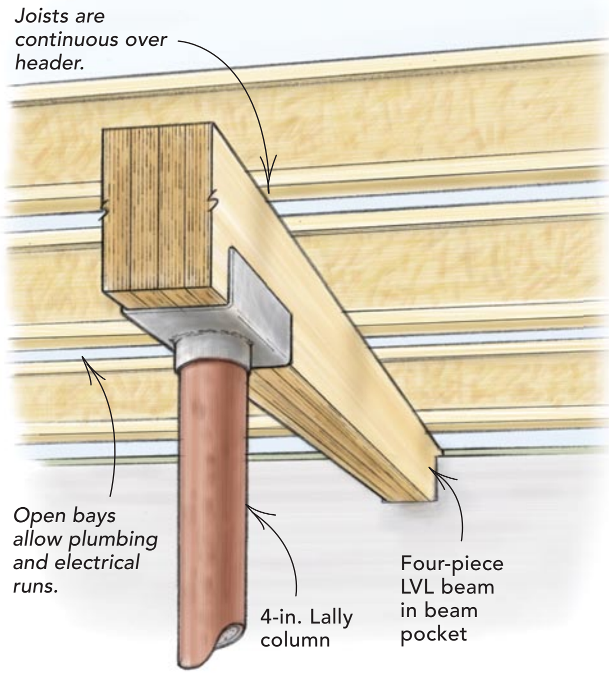
Build beams one piece at a time

A one-piece beam simply can be cut to length and dropped into place. If it is delivered on a crane truck, you often can persuade the

FLUSH BEAM OR DROPPED BEAM?

Two alternatives for placing a beam offer distinct advantages and disadvantages. Typically, dropped beams are located in the basement to support the first floor, and flush beams are concealed in ceilings for second- and third-floor framing.

Dropped beam



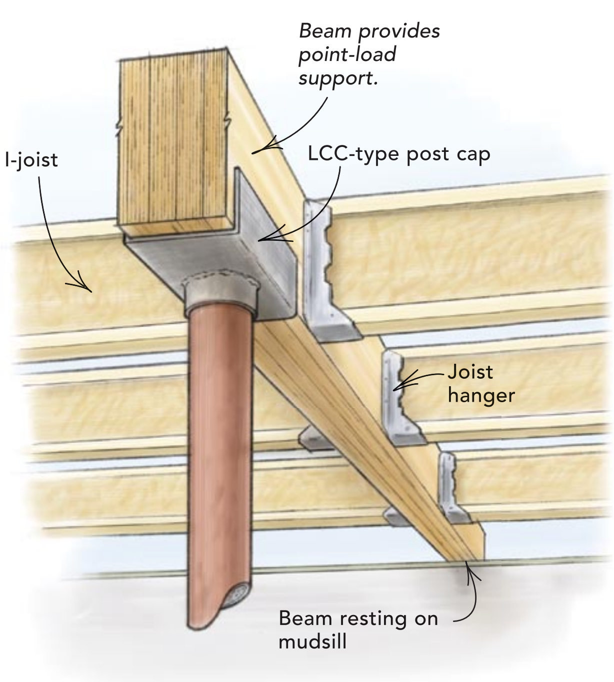
Pro

- Continuous joists are faster, stronger, and less prone to floor squeaks.
- Generally less labor intensive.
- Easier to install plumbing and electrical utility runs.

Con

- Less headroom below.
- Requires pockets in foundation or framing.
- Can interfere with large duct runs or plumbing waste lines.
- Often requires blocking above beam.
- Wrapping the beam for finished living space requires extra work.

Flush beam



Pro

- Fits within floor system to maximize headroom or to maintain an unbroken ceiling plane.
- Rests on foundation; no beam pockets needed.
- Solid bearing surface for point loads.

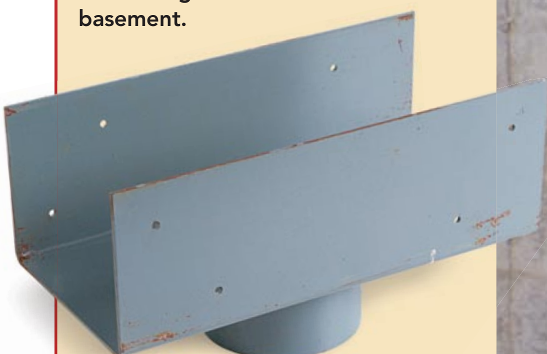
Con

- Drilling limitations restrict utility runs.
- Labor intensive; requires more cutting and nailing than dropped beam.
- Hangers often protrude below framing plane.
- Prone to floor squeaks.

SET THE COLUMNS BEFORE BUILDING UP THE BEAM

With solid end support in place, begin building the four-layer center beam. The post caps I use need to be installed before the beam is built up, so I cut the columns and set them under the first LVL layer. To cut the columns, use a large pipe cutter or a reciprocating saw to cut through the steel, and then break the concrete filling by whacking the cut with a hammer.

Some type of cap over a steel Lally column is required by building codes to protect the lumber from being sheared by the metal column. I like the Simpson Strong-Tie LCC-type post cap because it secures the beam tightly in a saddle, distributes the load evenly, and is sized to fit built-up LVL beams. These caps also look good in an unfinished basement.



Made with 12-ga. steel, they're available for beams ranging from triple 2x10s up to seven-layer LVLs and for 3½-in. or 4-in. Lally columns. The one pictured here, sized for three LVLs and a 4-in. column, weighs 5½ lb. and costs about $46.

Top photo: Roe A. Osborn. Bottom photo: Daniel S. Morrison.

STEP 1

Work from the top down. *Set the post cap first. Tack the cap to the first layer of LVL, and then slip the column into the cap. Slide the column into place on the footing below. Adjust the column for plumb from the bottom.*

STEP 2 ***Build up the beam one layer at a time.*** *Slide additional LVLs along the top of the first one, and then drop them into the saddle of the post cap.*

STEP 3 ***Spike first, then nail it off with a gun.*** *Nail guns put a lot of nails in a beam in a hurry, but they don't squeeze the layers together as well as hand-nailing does.*

STEP 4 ***Fill every hole with a nail.*** *All Simpson Strong-Tie LCC-type post caps require eight 16d nails (four per side). Use full-length 3¼-in. 16d nails rather than 1½-in. joist-hanger nails.*

crane operator to set it in place for you, but you need to respect his time. Work quickly to cut the beam to length, and have the beam pockets ready to go. A chainsaw can make cutting big beams go faster.

Because I work with a small crew, I usually choose to build up beams from more manageable layers of LVL, which are slid into place and spiked together. There are no crowns in LVLs (as with solid lumber), but I keep the lettering right side up to make my customers happy.

It's important to hand-nail the layers together before letting loose with a nail gun. Nail guns won't squeeze together the layers, but 16d sinkers and a 28-oz. framing hammer will. Even if the manufacturer's fastening schedule includes lag screws or bolts, hand-nailing first is a good idea. One more thing to keep in mind: Keep the pieces relatively straight as you nail them, or you can nail a curve into the beam.

Level, square, and secure the beam

After the beam is assembled and in place, it needs to be checked for level and secured into its final position. Make sure the top of the beam planes smoothly into the mudsills, then use a transit, laser, or carpenter's level to check that the middle of the beam is flat and level.

Height issues need to be addressed now, before loading the beam with floor joists and plywood. If intermediate supports are too high, they can be trimmed; if they are too low, they can be replaced or shimmed with correctly sized steel plates that will handle the compressive loads. Many framers set solid-lumber beams high to allow shrinkage and compression. Don't do this with LVLs, though, or you'll build a hump into the floor. LVLs won't shrink or compress the way that solid lumber will.

Check that the beam is placed squarely, especially if it defines a stair opening; then secure the ends of the beam to the mudsills with short pieces of metal strapping. Check for straightness with a careful eye or by pulling a string along one corner. Temporary braces can hold the beam straight while you secure it with the floor joists. □

This article was adapted from John Spier's upcoming book, *Building with Engineered Lumber* (The Taunton Press, 2006). Photos by John Fournier, except where noted.