CHOOSING Engineered Beams

by Dave Holbrook

There aren't many residential job sites today that don't incorporate some form of engineered lumber, a class that includes everything from plywood and OSB sheathing to trusses and I-joists. Because of the predictable spanning and load-bearing capabilities of engineered wood beams, builders, designers, architects, and engineers have made them a common framing component in buildings with wide open spaces and big daylight openings.

Defects, like knots and voids, are never more than one layer deep in laminated veneer and glulam lumber, effectively canceling them out. Predictable performance values make it a simple matter for manufacturers to publish load tables and sizing charts, available at the lumberyard, and to offer design software on their Web sites. In addition, most lumberyards offer a beam-sizing service at little or no charge to the buyer.

Engineered lumber is uniform, reliable, and available in continuous lengths (up to 80 feet in some cases) and is manufactured to a low, 7% to 8% moisture content, so frame settling due to shrinkage is minimized.

An environmentally pleasing aspect of all engineered beam types is that they are made from renewable, second-growth timber, yet far surpass solid lumber in their performance characteristics.

An engineered header above an overhead garage door opening is almost a given nowadays, but did you ever wonder why one type of beam is

Use manufactured timbers to handle heavy loads and long spans

Laminated veneer lumber (LVL), like this structural ridge beam, is stronger than comparably sized sawn lumber because any natural defects like knots and splits are only one ply deep.

Dense southern pine LVL calls for a higher pressure setting on your nail gun. Even then, you may have to pound the heads flush (right). Drill-point hex-head SDS screws from Simpson eliminate nail frustrations and provide a strong, warp-resisting connection (bottom).

specced instead of another? Does the lumberyard recommend a Parallam because it's the most expensive option, the most effective, or simply because it's what they carry? The bottom line is that, given a choice between several possible options, there's no single answer. Unless you're prepared to cross-compare solid-sawn, multiple 2-bys, doubled LVL, thick LVL, glulam, PSL, and steel for best value and performance each and every time you need a girder, you'll probably continue to rely on your personal preference, your engineer's specification, or your retailer's recommendation.

Laminated Veneer Lumber

Laminated veneer lumber (LVL), less commonly called structural composite lumber (SCL), is made from lower-grade Doug fir, southern pine, or aspen veneers taken from the outer layers of the logs. LVL is similar in appearance to plywood but, unlike cross-laminated plywood, its plies are all oriented parallel to one another. The plies are bonded with exterior exposure adhesives into a $1^3/_4$-inch-thick billet, then cut into standard widths from $7^1/_4$ to 18 inches. When ganged in multiples of two or more members, LVLs become ideal medium-span (14- to 16-foot) structural beams. Longer spans are certainly possible, using deeper beams, but not every ceiling height can accommodate a 24-inch-deep girder.

Because a built-up beam can be assembled on site, one piece at a time, LVL is often the material of choice for builders with limited manpower or on sites with restricted crane access. An LVL beam also comes in particularly handy when an opening is modified to accept a wider door or window where the existing ceiling height may restrict the header's depth.

Hammer time. On the downside, some builders curse LVLs as their guns fail to sink the nails home, common spikes bend, and arms ache from endless pounding. This puzzles Gary Dunn, an engineer at Boise Cascade, in Oregon, who claims that the laminating process increases lumber density

less than 5% and that the glue lines are too thin to pose any problem. Dunn speculates that nailing problems are specific to LVLs made from southern pine, a denser species than Doug fir; he hasn't observed unusual difficulty in nailing Versa-Lam beams made from Doug fir. (Because of the way lumber veneer is produced and distributed nationally, builders east of the Mississippi have to cope with the idiosyncrasies of southern pine, unless they special-order Doug fir stock from the West.) Trus Joist 's beam and header product manager John Grogan has heard only a few comments about the nailability of Eastern Microllam, which is made from southern pine (Western Microllam is made from Doug fir). "We run our own nail testing here and haven't encountered any problems. It may be a matter of turning up the pressure on the guns." In fact, he says, "Trus Joist receives few complaints." On the other hand, Joe Madera, engineered wood specialist at Shepley Wood Products in Hyannis, Mass., has heard this complaint "a lot."

If you do have trouble gun-nailing, you can safely predrill and nail by hand, as long as you use a drill bit of smaller diameter than the nail shank. Madera steers his customers to Simpson Strong-Tie's SDS, or Strong Drive Screw, specifically designed to stitch LVL combos together. Certain applications — for instance, when sideloading may pull laterally on the beam — call for LVLs to be lag-bolted or through-bolted together. Triple and quadruple laminations may require nails and bolts combined. Whatever method you use, it's important to follow the manufacturer's published fastener schedule, typically two or three rows of 3 1/4-inch nails spaced every 12 inches, to ensure proper beam performance. Many building inspectors will fail a beam if the fastener schedule isn't strictly adhered to. Thicker, 3 1/2-inch LVL is also available to reduce the need to laminate members.

Cupping can also be a problem with LVL beams. Even through-bolting cupped beams in opposition often fails to flatten them, leaving a protruding bulge in the framing. Cupping isn't a direct result of the manufacturing process; it happens because of moisture absorption. The extreme dryness (7% to 8% moisture content) of LVLs makes them particularly susceptible to moisture uptake. They should be protected by a shelter or wrapping during storage, and, according to Madera, that is not always sufficient to prevent cupping, even after installation. "It's a big problem with this material. We have builders returning LVLs, and I don't blame them. In some cases, the stuff is so bad, it won't even fit in the hanger," he notes. Manufacturers concede the problem to some extent but claim that most cupping can be reversed by flipping the beam over in the sunshine and allowing it to equalize. Madera says that this works on returned stock about 20 percent of the time; the rest of the returns go out as scrap and dunnage.

ROSBORO

Glulam lumber is manufactured in two grades for residential use. Framing grade (left) and architectural grade (below) differ only in their appearance; there's no difference in their fabrication or strength.

"Cupping is really only a problem with LVL made from southern pine," says John Grogan. "We apply a protective facing that we call Watershed Overlay to our LVLs. Basically, it's a resin-impregnated paper that keeps the wood dry. The resin is activated by heat and pressure and forms an excellent bond with the Microllam in the press. We also apply a sealer to the lumber's edges."

Cover up. It's a good idea to check out the storage and stock conditions in advance of purchase to avoid problems and delays. When you take delivery, pay attention to your own storage methods, too, if the beam isn't immediately installed. Keep LVL stock off the ground and wrapped in a waterproof cover.

Once installed, get the roof dried-in quickly. If you allow an LVL ridge

beam, for example, to hang up there in the rain and get soaked, it may soften and sag.

Glulam

While LVL beams are relative newcomers, glulams have been around for more than a generation. The first structural glued laminated timber members in America are said to be roof supports in the Peshtigo (Wisconsin) High School gymnasium, built in 1934. Great, boomerang-shaped architectural beams that soar from wall support to rafter in one continuous sweep are a common sight today in churches, gyms, and commercial buildings. They also appear in many residential projects, particularly as architectural elements. In fact, if you have a tricky curved wall or an arch to frame, a glulam could be the easiest, and possibly the least expensive, solution.

Glulam beams are typically made of either solid Douglas fir or southern pine, although other lumber species are also used, including Alaska cedar, California redwood, larch, hem-fir, Ponderosa pine, spruce-pine-fir, western red cedar, and some miscellaneous hardwoods, including oak, red oak, red maple, and yellow poplar.

Stack and glue. To manufacture a glulam, 2-by dimensional lumber is kiln-dried to about 15% moisture content, stacked, glued, and trimmed to form beams in practical depths of up to 72 inches and 60 feet long, although much larger beams have been produced for commercial applications. Pound for pound, a standard glulam beam weighs about the same as a comparably sized LVL. Generally, however, glulams are not quite as strong as LVLs of the same size. There are a couple of exceptions: Anthony Forest Products's Power Beam and Rosboro's Big Beam are made from machine-stress-rated lumber, with the strongest-rated pieces located at the outer edges. These proprietary glulams can be substituted for an LVL or Parallam of the same size.

In some cases, LVL, which is widely available, might be overkill. According to at least one glulam manufacturer, swapping in a glulam beam could save you up to 10 percent in material cost over an LVL or PSL beam. (In some markets, though, glulams are the higher-cost alternative.)

Surface dressing. Industry standards for glulams include "architectural" and "framing" beams, which differ only in appearance (the architectural grade has its minor defects filled and its surface cleaned up); they are the same in composition and performance.

Glulam beams are manufactured with and without built-in camber, which means that your glulam may have specific "up" and "down" edges.

Exposure. Glulams are susceptible to warping if improperly stored. Use a flat surface and block the beam to prevent

CALVERT

Unlike sawn lumber, glulam beams are uniform and straight (right). Glulam beams can be manufactured from a diverse number of lumber species, such as redwood and Alaskan cedar (below), and in arches and sweeping curves.

CALVERT

CALVERT

it from sagging and taking a set. Store long beams on edge. Like LVL, this lumber is extremely dry, so protection from moisture is critical, because surface and end checking from moisture absorption reduces the strength of the beam. Manufacturers usually apply a penetrating sealer to all surfaces before shipment — Rosboro calls its product Liquid Wrap — and individual beams are normally delivered to the site in a protective wrapper. Also, watch out for excessive exposure to sunlight, which will give the beams a tired, gray, used look. To protect the beam from damage, soiling, sun, and moisture, it's best to leave the wrapper in place until the building is dried-in. For long-term outdoor exposure, such as for deck construction or ground-contact applications, glulams can be ordered in pressure-treated southern pine.

CALVERT

Whenever possible, keep glulams in their original wrapping, even after placement, to prevent soiling and damage.

Parallel-strand lumber is stiffer than LVL and may be ordered CCA pressure-treated for three levels of outdoor exposure, including ground contact and saturated use.

Parallam

Parallel-strand lumber (PSL), sold under the brand name Parallam, is made by Trus Joist from lower-grade, defect-laden wood veneers. The Doug fir, southern pine, or yellow poplar veneer is chopped into 1-inch by 8-foot-long strips, then coated with glue. The strands are oriented with their grain parallel and extruded in billets up to 11 inches thick by 19 inches deep and theoretically unlimited length. The billets are then cut into standard beam sizes. The manufacturer has produced Parallam beams up to 54 inches deep by laminating extrusions together. Common Parallams are available in $1\frac{3}{4}$-, $2\frac{11}{16}$-, $3\frac{1}{2}$-, $5\frac{1}{4}$-, and 7-inch thicknesses.

The regular, uniform, "exotic" appearance of the bonded strands in a PSL beam is considered by many to be aesthetically pleasing, and these beams are often left exposed in architectural applications. This, combined with the fact that PSL has a higher E-value than LVL, may influence the choice of Parallam over the LVL.

Outdoor use. PSL can be ordered in pressure-treated southern pine. Because of the effects of treatment and exposure (surface checking), pressure-treated Parallams come with their own set of (lower) published design values, depending on application. Level 1 pertains to material used in dry service (19% maximum moisture content). Level 2 covers material in above-ground use and a minimum-maximum moisture range of 19% to 28%. Service level 3 applies to beams used in ground contact or saturated use — for example, in dock construction

Timberstrand

Similar to Parallam PSL, Timberstrand, also from Trus Joist, is made of chopped, parallel-oriented wood strands and is generically called laminated strand lumber (LSL). The wood used is either fast-growing aspen or yellow poplar and the strand length is typically around 12 inches. (By contrast, the strands in OSB, a related product, are about 6 inches long. Although several companies produce OSB, Trus Joist is currently the only manufacturer that converts lumber strands into structural framing lumber.) Timberstrand headers come in $3\frac{1}{2}$-inch widths and ten depths from $4\frac{3}{8}$ inches to 18 inches. LSL is a good choice for short-span headers. It's also used in the production of engineered studs, plates, posts, and rim joists. Because it's reliably straight, strong, long, wide, and stable, many builders have taken to making their stair stringers from engineered lumber. Although you can use LVL for stringers, $1\frac{3}{4}$-inch-thick Timberstrand is cheaper and is said to hold nails better without splitting. Trus Joist markets Timberstrand LSL specifically for this application.

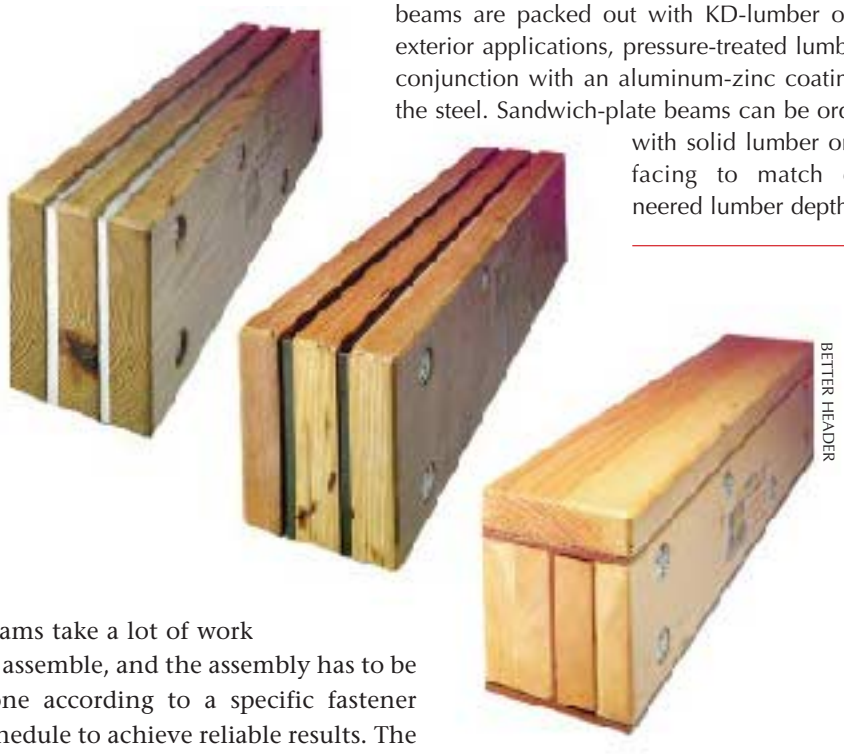
I-Joist Headers

Taking a minimalist approach to beam design, Superior Wood Systems's lightweight I-joist headers (SWII) replace conventional headers in 2x4 and 2x6 walls. Pre-installed expanded polystyrene insulation between the OSB webs provides a claimed R-value of 18 (for the 2x6 version). The header flanges are machine-stress-rated (MSR) lumber,

TRUS JOIST

Straight, strong engineered beams make ideal stair stringers. Although LVL is suitable for this application, LSL is less expensive and less prone to nail splits.

Dimensionally stable double-web I-joist headers take the place of standard site-fabricated lumber headers above window and door openings. An insulating expanded polystyrene core is a standard feature of the SWII header series.



BETTER HEADER

For flush-framed shallow-depth girders, steel can't be beat. Better Header's custom-order I-beams are packed out with KD-lumber or, for exterior applications, pressure-treated lumber in conjunction with an aluminum-zinc coating on the steel. Sandwich-plate beams can be ordered with solid lumber or LVL facing to match engineered lumber depths.

and the dimensionally stable header depths match standard 2-by dimensions at $7\frac{1}{4}$, $9\frac{1}{4}$, and $11\frac{1}{4}$ inches.

Said to cost about the same as the materials for a standard lumber header, the SWII headers eliminate the labor of site fabrication. The company's general manager, Jim Lamb, points out that if a worker cuts and preassembles all of the lumber headers for a frame at once, it might take an entire day. The same number of SWII headers would take that worker about an hour to cut. For this reason, SWII headers are popular with modular builders and frame panelizers.

The manufacturer discourages use of their header over garage door openings and limits available lengths to 14 feet as a direct precaution. Uninsulated headers can be used as clear-span joists where a double joist is specified. The 2x4 SWII, with an R-value of about 9, is also suggested for use as an insulating rim joist — not a bad idea, although to provide nailing for the floor joists, you'll have to pack out the interior web.

Sandwich Plates and Pack-Outs

A big benefit of any engineered beam can be the on-site labor it eliminates; old standby built-up and flitch-plate beams take a lot of work to assemble, and the assembly has to be done according to a specific fastener schedule to achieve reliable results. The Better Header company factory-assembles a variety of flat-stock and I-beam headers with the wood members already attached. Recessed bolt heads eliminate the problem of locating joists and hangers on layout, as well as the need for furring, and permit easy go-over with drywall or wood trim.

According to Better Header's Tom Gallina, a primary advantage of this product lies in its size-to-strength ratio relative to LVLs and glulams: "A lot of designs call for 2x8 and 2x10 floor joists, and people don't want a dropped girder in there. An engineered wood girder of comparable strength is going to stick out of the ceiling. We sell more 8- and 10-inch I-beams than any other size." With the wood facings and plates already applied, these beams won't slow down the framing process, but they will require a crane or plenty of manpower to set in place. A packed-out W8x24 beam with a top plate weighs 34.1 pounds per linear foot. Although the

solid 2-by facing contributes to the strength of the beam, its value is disregarded in the application tables; the company considers only the known performance value of the steel. However, its sandwich-plate LVL beam is rated for the combined values of the steel and the facing.

Sizing Beams

All manufacturers offer sizing and specification assistance in their product brochures and on their Web sites. Sizing software is often available online for downloading or on disk by request. Be careful, though. These calculations are only for uniform loading applications, not point-load scenarios. If you're confronting a special application, don't wing it — consult an engineer, who can direct you to the best beam for the job.

Modifications. You can drill holes in some of these beams, but not just anywhere it suits you. Just as with fastener schedules, where and how you drill affect beam integrity, so it's important to consult the manufacturer's literature or technical support before you modify the beam in any manner, whether by end-notching, beveling, ripping to width, or drilling even one little hole for one little wire.

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Manufacturers of Engineered Wood Beams

Glulams

Alamco Wood Products
800/328-8255
www.alamcowood.com

Anthony Forest Products
800/856-2372
www.anthonyforest.com

Boozer Laminated Beam
256/237-2875
www.boozerbeam.com

Calvert Company
360/693-0971
www.calvertglulam.com

Enwood Structures
800/777-8648
www.enwood.com

Filler King
208/337-5471
www.fillerking.com

G-L Industries
801/250-3391
www.xmission.com/~gl

Goodlam
514/635-6511 (CAN)
www.gdfellow.com

Imperial Laminators
520/333-5501
www.imperiallaminators.com

Laminated Timbers
606/864-5134

Mississippi Laminators
601/687-1571

Pinnacle Wood Products
250/992-9544

QB Corp
208/756-4248
www.qbcorp.com

RigidPly Rafters
717/866-6581

Rosboro Lumber
541/746-8411
www.rosboro.com

Sentinel Structures
715/582-4544
www.sentinelstructures.com

Shelton Structures
360/740-1008

Standard Structures
800/862-4936
www.ssi@standardstructures.com

Structural Wood Systems
334/382-6534

Timberweld Manufacturing
800/548-7069

Unadilla Laminated Products
607/369-9341
www.unalam.com

Unit Structures
800/333-8789
www.unitstructures.com

Wescor Forest Products
304/622-0043
www.wescorforestproducts.com

Western Archrib
780/465-9771
www.westernarchrib.com

Western Structures
888/849-8876

Willamette Industries
541/926-7771
www.wii.com

LVL

Boise Cascade Engineered Wood Products
800/232-0788
www.bcewp.com

Georgia Pacific
404/652-4000
www.gp.com

International Paper
800/223-1268
www.internationalpaper.com

Jager Industries
403/259-0700
www.jagerind.com

Louisiana-Pacific
800/648-6893
www.lpcorp.com

McCausey Wood Products
800/622-5850
www.finnforestus.com

Pacific Woodtech
888/707-2285
www.pacificwoodtech.com

Roseburg Forest Products
800/347-7260
www.rfpco.com

Trus Joist MacMillan
800/338-0515
www.tjm.com

Weldwood Engineered Wood Products
403/250-1770
www.weldwood.com

Weyerhaeuser
800/367-7296
www.weyerhaeuser.com

Willamette Industries
541/926-7771
www.wii.com

PSL and LSL

Trus Joist MacMillan (a division of Weyerhaeuser)
800/338-0515
www.tjm.com

Weyerhaeuser
800/367-7296
www.weyerhaeuser.com

Other

Better Header
877/243-2337
www.betterheader.com
Steel sandwich plate and I-beam pack-outs

Superior Wood Systems
800/375-9992
www.swi-joist.com
Insulated-core I-joist headers

Engineered Lumber Connectors

Cleveland Steel Specialty
800/251-8351
www.clevelandsteel.com

Simpson Strong-Tie
800/999-5099
www.strongtie.com

United Steel Products
800/328-5934
www.uspconnectors.com

For More Information

American Institute of Timber Construction (AITC)
303/792-9559
www.aitc-glulam.org

APA—The Engineered Wood Association
253/565-6600
www.apawood.org