by JLC Staff

Engineered Studs for Tall Walls

Increasingly, builders are reaching for high-tech lumber wherever they need a stiff, flat wall

Engineered studs are stiffer, straighter, and more dimensionally stable than solid-sawn stock. With proper blocking for lateral support, finger-jointed, LSL (shown here), and LVL studs are an excellent choice for tall walls and for applications like kitchen partitions that require a perfectly flat surface.

To strengthen stud walls for increased loading or to reduce deflection in tall walls, you can decrease stud spacing, increase stud thickness, or use doubled or tripled studs. With ordinary dimensional lumber however, achieving a stiff stud wall that is also perfectly flat is easier said than done, particularly when longer studs are needed. Typical workarounds include nailing together two studs with crowns opposed, sistering steel channels to individual studs, or, in extreme cases, fabricating a steel moment frame.

New alternatives. A better answer may be found in the latest crop of engineered wood materials. If you're framing a tall wall, or a wall with a lot of large openings in it for doors and windows, or if you just need to make sure the wall is perfectly flat (to accept cabinets and countertops, for instance), consider using one of three types of engineered studs: finger-jointed, laminated strand lumber (LSL), or laminated veneer lumber (LVL).

Although all three types of engineered studs can be used throughout a building's frame, the higher cost of these materials has led some builders to confine their use to specific

applications for which the superior strength, straightness, and stability, together with the availability in long lengths, make engineered studs a good choice (see "Design Values," below). For example, window walls are often underdesigned to resist buckling and shear forces from winds. Since these walls must be balloon-framed, you need long, stiff material. Engineered studs may fit the bill, depending on the number of studs that can be fit into the wall and on whether or not the window layout allows you to run continuous structural studs from plate to plate. Long continuous studs won't fold at the "hinge" created by platform framing, and the added strength of the engineered stud material will counter the tendency of taller balloon-framed studs to flex.

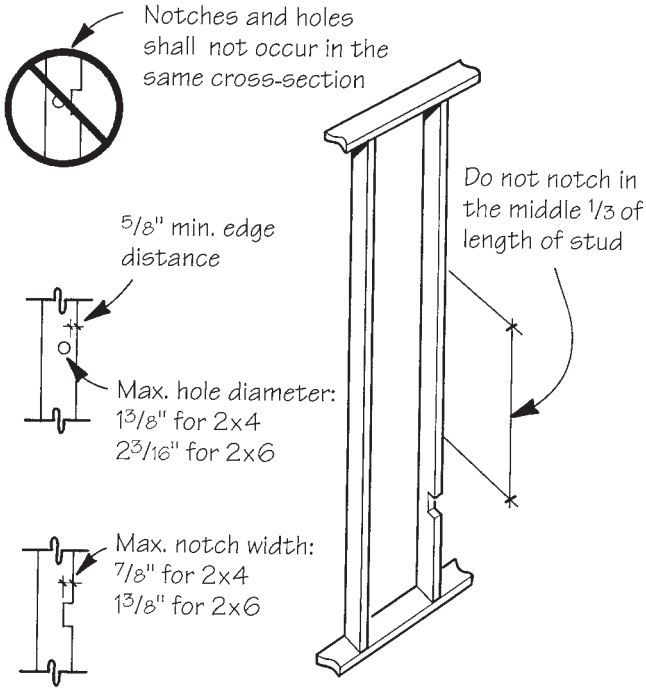
Engineered studs, especially the LVL variety, are considerably stiffer and can carry significantly more weight than dimensional lumber, making them a good choice for squeezing between window openings. The higher design values give you a fighting chance at getting enough material to make a stiff frame in a relatively small area.

Don't forget, however, that window walls must also resist shear, either with lateral and diagonal bracing or with structural sheathing. Windows reduce the area on a wall that can be used for shear bracing. If there's insufficient area for shear panel bracing, you may need to rethink the design or use a moment frame.

Kitchen Walls

John Grossman, of College City Homes in St. Paul, Minn., has been using Timberstrand studs in kitchens — about 20

Allowable Holes and Notches



Certain restrictions may apply with regard to drilling holes and cutting notches, as shown in this illustration, which is similar to one supplied with Timberstrand studs. Whenever you use engineered lumber, consult the manufacturer's specs for design values, load tables, and nailing requirements.

Design Values for Engineered Studs

	Finger-Jointed					LSL	LVL
Manuf.	Louisiana-Pacific		Georgia-Pacific			Trus Joist MacMillan	Louisiana-Pacific
Grade	Stud	Stud	Stud	No. 2	No. 1	Timberstrand	Gang-Lam
Species	S-P-F	Doug. Fir/Larch	Mixed So. Pine	Mixed So. Pine	Mixed So. Pine	Aspen/Poplar	Southern Pine
E	1,200,000	1,400,000	1,200,000	1,400,000	1,500,000	1,300,000	2,000,000
F_b	675	675	775	1,300	1,450	1,700	3,100
F_t	325	450	450	775	875	400	2,300
F_v	70	95	90	90	100	150	290
$F_{c\,\|\|}$	675	825	950	1,650	1,650	1,400	3,180
$F_{c\perp}$	425	625	565	565	565	300	1,020

Abbreviations

- E Modulus of elasticity, psi
- F_b Bending, psi. Values are for single studs; for repetitive use, multiply F_b by 1.15.
- F_t Tension parallel to grain, psi
- F_v Horizontal shear, psi
- $F_{c\,\|\|}$ Compression parallel to grain, psi
- $F_{c\perp}$ Compression perpendicular to grain, psi

Finger-jointed studs have the same design values as the species from which they are made; values for LSL and LVL are significantly higher. Bear in mind, however, that tall walls and heavy loads create specific structural requirements, so these applications should always be engineered.

TRUS JOIST MACMILLAN

Finger-Jointed Studs

Currently manufactured by Louisiana-Pacific and Georgia-Pacific, finger-jointed studs are available in 2x4s and 2x6s. The studs are made by end-glueing comparatively short pieces of lumber using a Type I polyvinyl acetate glue. (L-P uses stud-grade lumber in three species mixes: S-P-F, Western Woods, or Douglas Fir/Larch; G-P uses three grades of SYP: stud, No. 1, and No. 2). Unlike the finger joints used for glu-lam headers, which are oriented parallel to the short side of a board's cross-section, structural studs for bearing wall applications have the joints oriented parallel to the long cross-sectional dimension. The quality of the glue joint is graded by the Western Wood Products Association (WWPA), and the material is stamped "Stud Use Only," which limits use to vertical end-loaded applications. The glue is water resistant, but these studs should be protected from prolonged exposure to the weather. The glued joints meet design requirements for short-term bending loads for lateral forces such as wind, seismic, and impact.

GEORGIA-PACIFIC

Finger-jointed studs aren't any stronger than sawn lumber of the same species, but because the defects have been cut out, the studs are more dimensionally stable and are less prone to split and warp. And because the grain is interrupted by glue joints, finger-jointed studs are less likely to twist and bow. In addition to the obvious advantage of straight, stable 2-bys in long lengths, finger-jointed studs have no wane and no large knots, a real benefit when toe nailing. And while the surface of finger-jointed studs may not be finished — for example, there may be glue smears and the joints may be offset by as much as 1/16 inch — these cosmetic blemishes don't affect structural integrity.

Prices vary, but in general, finger-jointed studs cost about the same as solid-sawn lumber of the same species.

studs per house — to solve a problem he's had with exterior walls bowing and deflecting in cold temperatures (see "Wall Bowing in Cold Climates," *Eight-Penny News*, 10/93). The longer the stud, the worse the deflection, and Grossman's kitchen walls average a taller-than-standard 9 feet. With solid-sawn lumber, the bowing throws the wall out of plumb and square, making cabinet installation much more difficult. The problem usually shows up when the countertop doesn't fit. Grossman has used the stiffer Timberstrand studs in about 50 to 60 homes over the last couple of years, and while it's too early to tell how well the studs will perform over the long run, so far he reports the kitchen walls have stayed true.

Grossman switched to Timberstrand after having trouble finding straight-grained studs. Even No. 2 2x6 studs were less stable than they once were. "Dimensional material seems more squirrely," Grossman said, referring to the tendency of a stud to twist. This is often the result of uneven growth rings (created by stresses in the tree while it grows) shrinking at different rates. As the studs dry out, squirrely grain reveals itself in twists, warps, or bows, and also predisposes the wood to distortion from cross-sectional temperature differences.

Timberstrand costs Grossman from $1 to $1.25 more per stud, but he claims that price difference is easily offset by the reliability and performance of the material. The Timberstrand studs are straight and true, requiring no culling or crowning. But the material is significantly heavier, so he suggests framing walls no longer than 20 feet; otherwise, you'll have trouble lifting the wall into position. Grossman also cautions that any LSL material — whether it's stud, header stock, or rim board — has sharp edges, so it's prudent to wear gloves while handling it.

Grossman also reports that Timberstrand studs take air nails about like dimensional lumber, and seem to hold nails a little better. In addition, he has less trouble with splits at the ends and edges, as long as his crew maintains a minimum distance of 1/2 inch from the edge.

Garage Walls

Keith Baker, of G. P. Home Enterprises in Traverse City, Mich., has also noticed a change over the last few years in the quality of dimensional lumber. He's concerned not so much with the 2x6s used to frame the main house walls, but with long (10 feet and over) 2x4s that he uses for garage wall framing. Bows in these studs easily telegraph through vinyl siding and show up as ripples, and inside the garage where the walls are open, the wane and discoloration of dimensional lumber don't make a good first impression with his clients.

Baker's solution is to frame the exterior garage walls with Timberstrand 2x4s. (Like Grossman, Baker also sometimes uses 2x6 Timberstrand for kitchen walls "to get backsplashes to stay straight.") Baker confirms that Timberstrand nails about the same as solid-sawn studs, although he sometimes

has to go back and whack a few heads down. He also agrees that the edges are sharper, but says that's a small price to pay for the uniformity the LSL studs provide.

Baker hasn't had a problem with moisture affecting the studs, mostly becuase of the care he takes in handling the material. "We burn up the lumber as soon as it's delivered," Baker explains, "so it doesn't have a chance to sit around." Baker credits his supplier, Brown's Lumber of Traverse City, Mich., with doing a good job of providing framing material in phases, so he can use it up without having to store it on site. And once the LSL studs are incorporated into the frame, rain and snow have had no noticeable effect.

Brown's Lumber also provides another service that's essential to builders who want to use engineered lumber — free engineering services. If the plans need to be stamped, Brown's can send the prints out to a wholesaler with a full-scale design department and in-house engineering staff. Builders in more rural parts of the country, however, may not have these services, or a sufficient lumber volume, so readily avilable. "Availability is everything," Baker claims. "We started using Timberstrand years ago. But it was only available in short lengths, so we quit using it." Now, Baker states, "Brown's can supply whatever I want whenever I want it." Used selectively where they're appropriate, he says, the added cost of Timberstrand studs is incidental to the house package.

Heavy Loads

Architect-builder Dave Tryba, who now builds commercial structures for L-P's Commercial Development division, has had plenty of site experience with Gang-Lam studs during the construction of multi-story apartment buildings. Because the LVL studs have such a high compressive strength, Tryba uses them on the first floor of 3- and 4-story buildings. "Where the engineer calls for 3x4 SYP studs 16 inches on center," he explains, "we can use LVL 2x4s at 24 inches on center." The extra cost of the material is offset by reduced framing labor. Tryba also notes that the high resistance to crushing also makes LVL an excellent choice for sills and plates in the lower floors of multi-story structures. Another benefit of LVL cited by Tryba, who builds a lot of walls 9-feet tall or more, is that "you don't pay a premium for length. The price is the same per running foot for any length."

In Tryba's experience, nails driven directly into the laminations (toe-nails, for instance) have about the same holding capacity as those driven into ordinary dimensional stock. "If you drive the nails perpendicular to the laminations," he says, "they have about the same holding capacity as the solid-sawn species of the veneer."

Tryba claims that moisture hasn't been a problem. Of the 33,000 or so studs he's used, he's only had to replace about 50 or 60 of them. And many of those had been fastened on the wrong side of the line, then beaten into place by carpenters, causing delaminations. As was the case with others we talked to, however, Tryba tries to use up all the studs in the same day he breaks the paper-wrapped delivery bundles.

On the downside, Tryba reports that LVL studs are more difficult to drill through, and electricians have a harder time nailing on electrical boxes. The material also dulls saw blades sooner, and he's had to increase the pressure on his compressors to about 110 when nailing sheathing to LVL.

Callback Savings

Almost all of the builders we talked to use engineered studs selectively because of the cost. Some, like Merrill Polsen, of

LVL

By now, most builders are familiar with LVL beams and headers, but not many have used the material for studs. Cost is one reason — LVL studs are nearly twice as expensive as solid-sawn studs. But the extra expense is worth it for some applications. LVL studs, which are manufactured and sold by Louisiana-Pacific under the name Gang-Lam Studs, are particularly useful for bearing walls under large compression loads — the modulus of elasticity is nearly twice that of solid-sawn and S-P-F finger-jointed studs, and about 50% higher than that of LSL and SYP finger-jointed studs.

LOUISIANA-PACIFIC

Moisture can be a problem. LVL studs leave the factory at about 5% moisture content, so they are likely to wick up moisture on site. As with headers, studs may bow if one side gets significantly wetter than the other. One builder we talked with found some benefit in this, however: The slight swelling caused by the increased moisture content on site seemed to squeeze nails tighter. As with LSL, however, you should take precautions when storing LVL, and dry-in the structure as soon as possible.

LSL

Laminated strand lumber studs are manufactured by Trus Joist Macmillan as part of the company's Timberstrand Frameworks Wall System. In a manufacturing process similar to the one used for Parallam beams, strands of aspen or yellow poplar are mixed with a polyurethane adhesive and formed into billets in a steam injection press. The 3 1/2- and 5 1/2-inch-thick billets are then sawn into 1 1/2-inch strips to make nominal 2x4 and 2x6 studs of varying lengths.

The finished product is uniform and very stable. However, TJM's product literature states that the studs are "not treated and are intended for use in a protected (enclosed) condition where the maximum moisture content does not exceed 19%." In other words, Timberstrand studs need to be kept dry. We tested a 12-inch-long sample by partially immersing it in water overnight. The material initially swelled almost 3/4 inch in thickness, but after about a week of drying, it returned to within 1/8 inch of its original dimension. While an LSL stud is unlikely to get this kind of prolonged soaking on site, it's prudent to store this type of framing material under cover and to get it dried in as soon as possible after installation.

TRUS JOIST MACMILLAN

As part of an engineered wall system, Timberstrand should never be substituted one-for-one for conventional framing materials. In addition, the studs may require special treatment, depending on the situation. For example, there are strict requirements for blocking in tall walls: Walls between 10 and 18 feet tall require one row of blocking at midspan; walls between 18 and 22 feet tall require two rows of blocking, one each at the third points. Let-in bracing is allowed as long as the maximum depth of cut in the stud is 7/8 inch; studs that are notched in the middle third must be doubled.

Timberstrand studs cost about 50% more than solid sawn material of the same size. As with finger-jointed studs, this is one reason the builders we spoke with confined use of LSL studs to tall walls and to interior partitions that needed to be as flat as possible to accept cabinetry.

New Image Builders in St. Paul, Minn., find that engineered studs more than pay for themselves. Polsen uses engineered studs for all exterior and interior walls behind kitchen and bathroom countertops, and for all door trimmers. With dimensional studs, walls have moved up to 1/4 inch, leaving an unsightly gap. Using engineered studs, Polsen saves on callbacks to fix gaps behind backsplashes or sagging doors caused by shrinking trimmers. He says that saving just one callback easily justifies the cost of using engineered studs in selected parts of the house. "We estimate it costs $400 on average to get one trade out on one callback," Polsen explained. "Not to mention the inconvenience of scheduling, which in this busy day and age, can be challenging with two working homeowners. We insist that an adult be home when we go in; we won't send a trade into the house if just the kids are home."

Polson would use engineered lumber throughout the house if the cost difference were lower. Right now the added cost for engineered lumber ranges from 20% to 50% more than dimensional studs. But, he says, engineered lumber pricing is much more stable. Polson started using engineered studs a few years ago when lumber prices were high. There was little difference in cost, but because supply was low he had to discontinue using it for four or five houses. "That's when we especially noticed a big difference in quality between the engineered stock and the dimensional stock," recalled Polsen. When Polsen was the only builder in his area using engineered studs, his supplier couldn't justify keeping it in stock. But now that there's at least one other builder in Polson's area using it, it's always available. ■

Sources of Supply

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