Working on the foundation saves lifting. **When you can reach it, the top of the foundation makes a good workstation. All pieces in a built-up girder are installed crown-up, and the edges are kept flush by toenailing the members into alignment.**

Middle man steadies girder. **A built-up girder is slid along the top of the foundation into pockets formed in the concrete wall. A scrap of 2x4 nailed to the girder allows the worker in the basement to help steady and carry the girder. While being moved into place, the girder must stand on edge so that the nails stay tight.**

Installing a Built-Up Girder

From where and how you build it, to setting the columns underneath, the process goes smoother if you have a system

by Scott Knight

One time I pulled onto the job site after two days of rain, and I'm sitting in the truck, staring at the second-floor deck, trying to figure out why it looked like a swimming pool. It suddenly dawned on me: Did I set the Lally columns? Uh oh. As I trudged toward the basement, I realized the last time I saw the girder was when we were laying down the subflooring on the first-floor deck. In the basement I saw my temporary supports—A-braces, which I'll discuss in a little bit-bowed out like bananas, and the weight of two floors was sitting on the sway-backed girder. Two of us wasted half a sunny day in the basement resetting the girder, and seeing those banana-shaped braces made a lasting impression on a cocky kid framer like myself.

It's been eight years since that happened, and I still use A-braces to hold girders temporarily, but now I cross-brace A-braces to keep them from bowing. I also visit basements a lot more than I used to just to check on the girder. I guess you could say I've got a lot more respect for a part of framing I've always hated. I've even developed a few little tricks that speed up the process of building and setting a girder.

Foundation work—Most basement girders that I install are set in pockets at the top of foundation walls. The pockets are formed when the foundation is poured and are placed wherever the plans call for them. Pockets are oversized. If a girder is to be three 2x10s, for example, the pocket is probably about 1 ft. high, 6 in. wide and 4 in. deep. It's oversized because there should be an airspace all around the girder. If the girder is in direct contact with the masonry, moisture will rot the girder.

The locations of the pockets jive with the locations of piers (or footings) under the slab. The piers support Lally columns, which are steel tubes filled with concrete. The piers are often no more than 8 ft. apart, but the spacing depends on the size of the built-up girder and on the load it supports.

Building the girder—I use #2 Douglas fir for built-up girders. Some architects specify LVL (laminated veneer lumber) girders to lengthen the span between posts (see sidebar facing page). Unless you're finishing your basement, or you have abnormally high loads, I'd choose Doug fir. LVLs are expensive, and long spans still require intermediate supports.

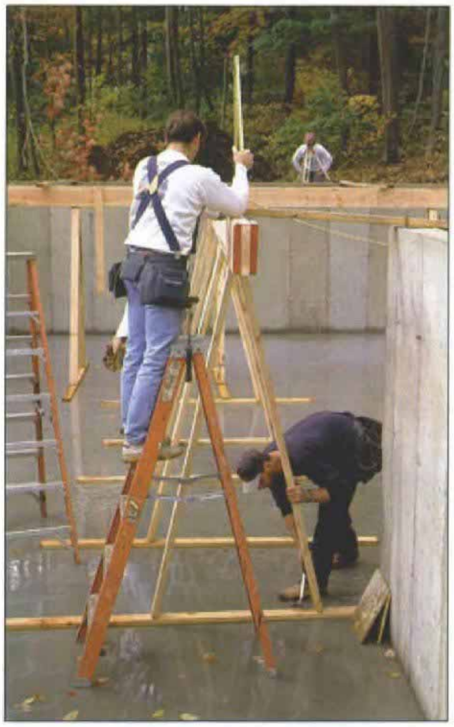
It's always nice to build a girder as close as possible to its final resting place. When a girder runs the entire length of the foundation, I like to build it up on top of the foundation wall (left photo, above) if it's accessible from ground level. Then all I do is slide the girder along the wall and drop it into its pockets. If the foundation is too high to use as a workstation, I build the girder on a flat surface, such as the basement slab, stick one end in a pocket and then the other.

I measure the girder by stretching a steel tape from the ends of the pockets and subtract about an inch or so for an airspace. If it's a really long span, I place the tape on the wall so that the

Photos this page: Kevin Ireton

Nails make a hinge. An A-brace is a pair of 2x4s or 2x6s nailed at the top only with three 16d nails so that the pieces can open and close like a giant compass.

This end's high. A tape measure is held beside the girder, and the author, in the background, reads the measurement through a builder's level. The measurement must be the same all along the girder. A third carpenter opens the A-brace's legs to lower the girder.



Straightening the girder. A-braces sit on 2x4 or 2x6 plates that can be knocked from side to side to straighten the girder. Once it's straight, the girder is braced with 2x4s nailed to the mudsill and to the girder.

Alternatives to built-up girders

by Chris DeBlois

As a structural engineer, I routinely specify the appropriate sizes for several different materials when I design a girder. Here, I've devised a hypothetical situation—a 15-ft, clear span supporting two floors plus an attic (a total of 20,000 lb. distributed evenly along the girder)—and designed five girders of different materials that will carry the load. In the table below I've listed each girder by material—its dimensions, its weight per ft., its cost per ft. (quoted in January 1994 in Atlanta, Georgia) and a description of the material. None of the girders requires intermediate supports. It would take 13 2x 12s to carry the same load without supports.

Laminated veneer lumber

Size: (3) 1¾ in. by 14 in.
Weight per ft.: 22 lb.
Cost per ft.: $15.87 (Micro-Lam, bolts not included)

LVLs consist of thin layers of structural veneer with all grain running lengthwise. LVLs come in 1¾-in. and 3½-in. widths; the maximum readily available depth is 18 in. LVLs are quite strong and often yield the smallest and lightest wood-girder solution. They are straight—no crown or camber—and they won't move with changes in moisture content nearly as much as sawn lumber or glulams.

Parallel-strand lumber

Size: 5¼ in. by 14 in.
Weight per ft.: 23 lb.
Cost per ft.: $15.87 (Parallam)

PSLs contain laminates of fir or pine strands glued together and formed under heat and pressure into beams. PSLs represent a more efficient use of the tree than do solid timbers, glulams or even LVLs, with which they share a similar dimensional stability. PSLs (which are also available pressure-treated) come in several widths and shouldn't require any bolting or nailing together. Then again, installing a 5¼-in. wide PSL may be much tougher than bolting together three 1¾-in. pieces in place.

Glulams

Size: 5⅛ in. by 15 in.
Weight per ft.: 20 lb.
Cost per ft.: $13.75

A glulam is a stack of graded framing lumber held together with structural-grade glue. Typically used where girders are exposed, glulams come in three appearance grades-industrial, architectural and premium—and they're manufactured with a built-in crown or camber. Because glulams are made from large pieces of lumber, which have more defects than the small pieces used in LVLs and PSLs, they are not as strong, so it takes bigger ones to span the same openings. Glulams are available in greater depths than LVLs or PSLs.

Wide-flange steel beams

Size: W12x19
Weight per ft.: 19 lb.
Cost per ft.: $8.36

A wide-flange steel beam is named by depth and weight. In the W12x19 I've specified for the example, "W" stands for wide flange; it means I'm talking about an I-beam. "12" is the approximate depth in inches, and "19" is the weight of the girder in pounds per lineal foot. Steel beams are often the only ones shallow enough to hide in a floor system, but they also come in very large sizes and can support awesome loads. Steel won't expand and shrink with changes in moisture content, and temperature-related changes in size are negligible.

Flitch beams

Size: (3) 2x12s, (2) 7/16 in. by 11 in. steel plates
Weight per ft.: 46 lb.
Cost per ft.: $30.76

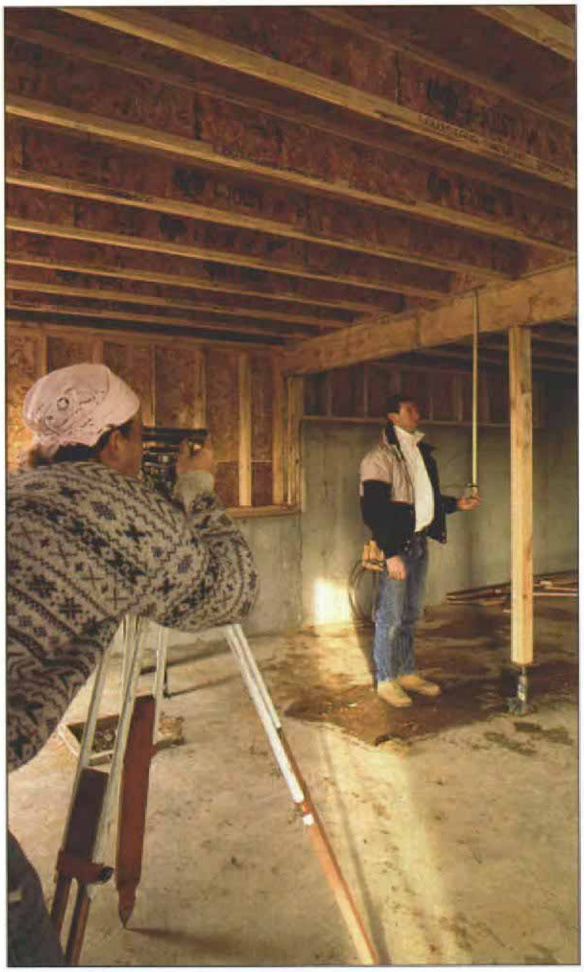
A flitch beam consists of steel plates bolted between wood members. They are heavy and labor-intensive but provide strength, stiffness and nailability. Before the advent of engineered wood products, flitch beams were limited in total strength because sawn lumber only comes in depths up to 2x12. But with deeper LVLs, you can build a flitch beam to rival a good-size steel I-beam. Lifting it into place is another matter.

—Chris DeBlois is a structural engineer with Palmer Engineering in Chambtee, Ga.

Top photos, this page: Kevin Ireton; bottom photos, this page: Robert Marsala

Establishing the benchmark. **With the first-floor deck installed, the author levels each end of the girder by reading a tape through a builder's level. Once both ends are the same, this level point, or benchmark, is duplicated along the entire girder.**

Leveling the girder. **Starting from one end of the girder, the author establishes a column's location—over a pier under the slab—and jacks up the girder to the benchmark.**



Measuring for the Lally column. **With the jack still supporting the girder, a steel plate is nailed under the girder, and another is placed directly below it on the slab. Then the distance between the plates is measured to find the length of the Lally column.**

tape won't sag, and I subtract for the pockets plus the airspace.

If the slab is already in place, I verify the locations of the column piers by referring to the plans and checking with the builder. These locations are important because they're where the joints in the girder will fall. As far as joints are concerned, the fewer the better. I order the longest timbers possible. For instance, I'd build a 32-ft. girder with a 24-ft. piece and an 8-ft. piece on the outside layers and two 16-footers in the center layer. (A typical built-up girder has three layers.) I nail the outer layers so that they oppose one another. In this case, one end goes 24 ft. and 8 ft.; the other goes 8 ft. and 24 ft.

One more thing: When ordering the material, I try to order all of the pieces in the same length, then cut my shorter pieces from that because different-length material often comes from different mills. For example, a 2x10x16 could measure 9⅜ in. wide, but a 2x10x8 might be 9⅝ in. wide.

I sight all boards and build a girder with all crowns up. I usually nail through both sides of the girder into the center, driving three 16d sinkers from top to bottom every 16 in. Sinkers are cement coated and hold really well. It's important that the girder be nailed together tightly—no gaps. A nail gun won't suck the pieces together, so I do most of the nailing by hand.

If one crown isn't flush, I toenail it into alignment. Both edges should be flush. But if I must compromise, I flush up the underside of the girder so that the columns bear on the entire girder.

Installing the girder—I make sure there's enough help. A rule of thumb is two people for the first 10 ft. of girder and one more helper for every 10 ft. thereafter. We carefully slide one end at a time into the pockets.

It's best to stand the girder up on edge when moving it so that the nails don't loosen. But the girder wants to flop over. I nail a 2-ft, or 3-ft. 2x4 somewhere around the girder's midspan. Then someone can hang onto the block to keep the girder on edge as it is moved into place (right photo, p. 64).

Sometimes one end of a girder rests on a built-up post in a kneewall (middle photo, above); this is common in a walkout basement. The post must be solid blocking, and the girder must be braced on both sides with continuous studs.

Because a girder must be flush with the top of a kneewall, you'll have to cut the double top plates to butt into the girder; don't notch the top of the girder to fit around the plates. Some towns are real sticklers about notching a girder.

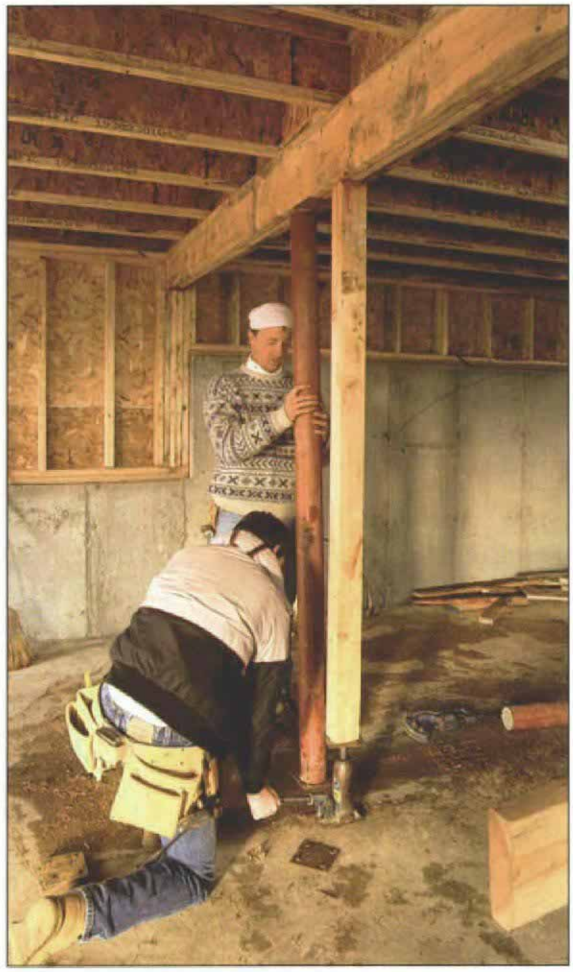
Adjustable temporary supports—I prefer to support the girder temporarily until at least the weight of the first-floor deck is on it. The weight straightens out any crown in the girder, and I can jack up the girder and set columns without some of them falling out. To support the girder temporarily, I use A-braces set on 2x4 plates. A-braces are easy to make; I measure from the floor to the girder, add an inch and cut two studs that length. Then with the studs lined up on top of each other, I nail them together with three 16ds (top left photo, p. 65) as close to the end as possible. This connection acts as a hinge.

A-braces are arranged perpendicular to the face of the girder and just off to the sides of where the Lally columns go. The legs of the A-braces are set on the 2x4 plate on the slab, and the top of the brace is toenailed to the girder.

I tap the legs of the A-brace in or out, depending on whether I need to raise or lower the girder. I get it in the ballpark, then fine-tune the girder's height by sighting it with a builder's level (top middle photo, p. 65).

The plates can be knocked side to side with a hammer to straighten the girder, which is then braced with 2x4s nailed first to the mudsill, then to the girder (top right photo, p. 65). I've learned that it's wise to nail a cross brace on the A-braces to keep them from buckling. It's also important to keep checking and adjusting the A-braces during construction to avoid excessive sagging.

At the foundation pockets, the girder is shimmed up and away from the masonry with pressure-treated blocks. These are rips, not end cuts, and they do two things: hold the girder away from the masonry and bring it flush with



Cutting the column. **Lally columns are steel tubes filled with concrete, and they're cut with a large pipe cutter. Once you cut through the pipe, knock off the end with a hammer, and chisel down any rough edges with a hammer claw.**

Installing a column. **The plates have tabs that position the column, so the girder must be jacked a bit higher for the column to clear the tabs. Then the jack is let down slowly until there's weight on the column, which is then plumbed up with a 4-ft. level.**

the mudsill. I measure from the top of the girder to the top of the mudsill to cut the blocks. Later the blocks will be mortared in place. I leave airspaces on the sides and the ends of the girder.

Leveling the girder—Once there's enough weight on the girder that I can jack up one spot and not have the entire girder lift up on me, it's time to set the Lally columns. I usually set the columns after the first-floor deck is on. I definitely want the girder level when I straighten the walls on the first deck. If the girder's got a dip in it, and I straighten the walls, leveling the girder will push out the walls.

I use a 10-ton automobile jack, but any hydraulic jack rated over 5 tons should work. A jack post—a pair of 2x4s or 2x6s nailed together—supports the girder. I make the post about 1 in. shorter than the space between the girder and the retracted jack. Typically, I set the post on a plate so that the jack doesn't ruin the bottom of the post. I also make sure the post is fairly plumb as I'm jacking it up so that it doesn't kick out.

I sight both ends of the girder with a builder's level and use the high end as my benchmark to bring the other end level (left photo, facing page). I hook a tape measure on the low end of the girder, read the measurement in the cross hairs of my builder's level, then jack up the low end until both ends are at the same height. Then I shim beneath the low end to hold it in place.

Now the rest of the girder can be leveled. With a tape measure hooked on the girder, I sight all of the column locations, looking to match the benchmark. I set up the jack about a foot from the Lally-column location and crank up the girder to the correct height (middle photo, facing page)—the same height as the ends of the girder. For the job shown in the photographs, I tore out the A-braces before setting the Lally columns. But now that I think of it, I'll leave them in next time: If one of the jack's hydraulic seals blows, at least the brace will still be there.

Installing Lally columns—Typically I use 4-in. Lally columns. I always use steel plates on both ends of the column. These steel plates have little tabs punched in them that engage the edges of the Lally column. Top plates are nailed to the girder (centered on any joints in the girder), and floor plates are plumbed from the top plates and aren't usually attached to the slab. Again, these plates are located over piers beneath the slab. If you've got columns in a garage, you should consider setting the columns before placing the slab. If a column just rests on the slab, a car could knock it out of plumb or even take it out completely.

I measure between the plates for the Lally-column lengths (right photo, facing page). Sometimes the plates aren't perfectly flat, so I'll add ⅛ in. or so and let the load on the girder flatten them. Normally, I put a gentle crown in a girder, about $^3/_{16}$ in. at the highest point. Then, when the full load is on the floor, there's no negative deflection. Most girders are between 32 ft. and 35 ft. long. If the girder is shorter, I cut down a bit on the crown.

Most lumberyards will cut Lally columns to length for you, but I prefer to cut them myself because it's more accurate. I bought a Lally-column cutter for about $150. It looks and works like a big pipe cutter.

I set the column across a pair of sawhorses, and with my hammer, I knock down any high spots on the exposed concrete end. Then I pull a measurement from that end, mark the column with a pencil and cut the column (left photo, above). I can feel when I've cut through the steel because the cutter gets sloppy and falls off easily. The end of the column breaks off with a tap of a hammer, and the newly exposed concrete must be flushed up with the metal.

Next I set the column within the tabs on the lower plate, jack up the girder a little higher to clear the top plate's tabs (right photo, above), then slowly lower the girder. I leave the column a little loose so that I can knock it into plumb. I double-check to be sure the column is sitting in the tabs, then I move on to the next column. □

Scott Knight is a framer living in New Milford, Conn. Photos by Rich Ziegner except where noted.