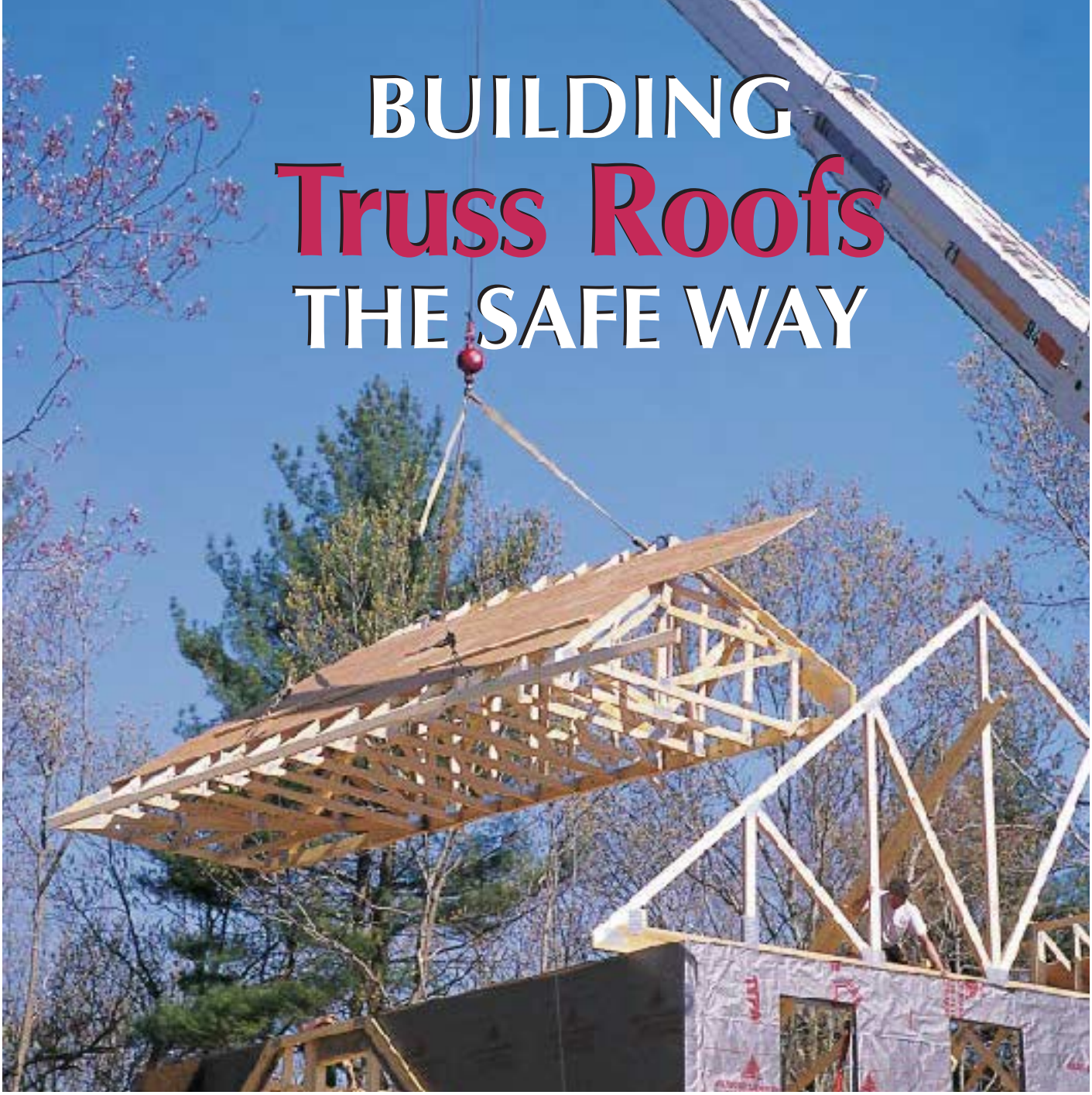

BUILDING Truss Roofs THE SAFE WAY

Save time and decrease risk by assembling roof components on the ground

by Mike Guertin

Several years ago, while discussing how to lift trusses for a hip roof, our crane operator suggested that I preassemble some of the components on the ground. I decided to give it a try, so I worked a little late that day, attaching the jack trusses to the girder trusses (see Figure 1, next page). The lift went off without a hitch. On the next hip roof house I built, I went further with the preassembly and attached the hip trusses and corner jacks while the assembly was still on the ground. Even factoring in some extra time for head scratching, the method saved us time.

Nowadays, on a single-story house, I usually just attach the jack trusses to the girder trusses before the crane lifts the assembly, since the rest of the components are easy to install in place. But on a two-story house, it's more efficient and safer to assemble as much as possible

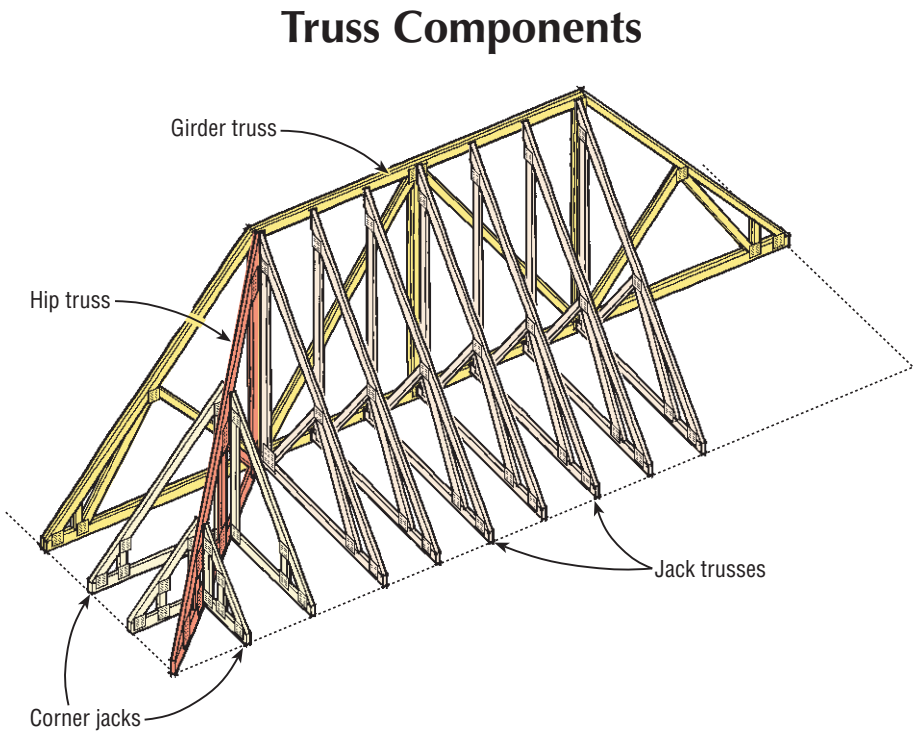

Figure 1. The girder truss (or hip girder) is the backbone of the hip roof truss assembly; most roofs require a double girder truss. Attached to the girder truss at right angles are the jack trusses (sometimes called the face jacks or end jacks). Extending at a 45-degree angle from the girder truss to the corners are the hip trusses (also called hip jacks, king trusses, or corner jacks). The short trusses that attach to the hip trusses are the corner jacks (also known, confusingly, as hip jacks or side jacks).

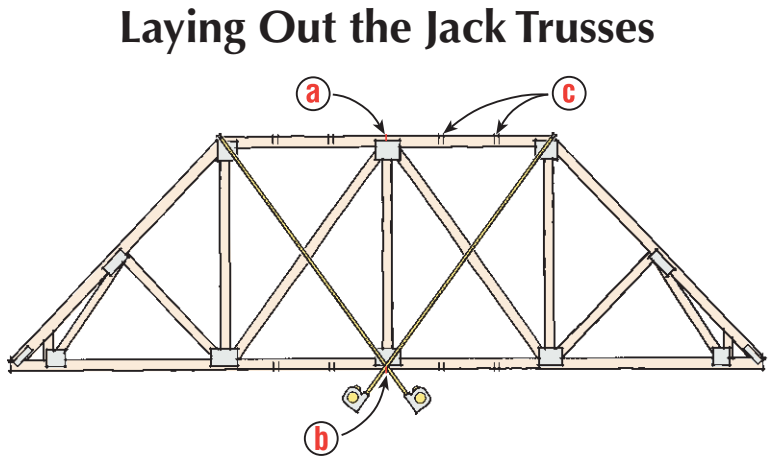

Figure 2. To establish a 90-degree angle down from the girder truss's top chord as a reference, first mark the midpoint of the top chord (a). Then pull two tape measures from the top corners of the truss, crossing the tapes at the bottom edge of the chord (b). Adjust the tapes from side to side until they register the same measurement and mark that point as the midpoint of the bottom chord. The two midpoints can then be used as reference points for laying out the locations of the jack trusses (c).

on the ground. These days I even sheathe the hip system before lifting (see "Installing Hip Roof Trusses," 6/97).

Laying Out the Girder Truss

I begin by squaring up and marking out one of the girder trusses while it's still lying flat on the pile of trusses. Trusses are sometimes fabricated out of dimension, especially at the tails, so when I lay out the jacks, I don't measure from the tails of the girder truss. Instead, I establish a line perpendicular to the top chord of the girder truss, in order to establish reference points for laying out the locations of the jack trusses (Figure 2).

Generally, roof trusses are spaced 2 feet on-center, but one of the spaces between jacks will usually be less than the typical 22 1/2 inches.

Installing the hangers. Jack trusses and hip trusses sit in hangers attached to the girder truss. Once I've marked the jack locations, I install the hangers, initially using only two 1 1/2-inch nails per hanger. Later, when the second girder truss is paired with the first, I'll finish nailing the hangers with 10d or 16d spikes that grab both girders.

To support the diagonal hip truss and the adjacent jack truss, several styles of hangers are available. I usually use a universal hanger that will fit either the left or the right hip trusses (Figure 3).

While the girder truss is still on the pile of trusses, I nail a single jack truss roughly in the middle of the girder. Then I roll the girder upright and carry it to a flat location, accessible to the crane, to continue the assembly (Figure 4). The area doesn't need to be level, as long as it's fairly flat.

Jacks and Kings to Open

Trusses with bottom chord overhangs or raised heels can be set up on the ground, because any unevenness can be corrected by blocking up the girder or jacks during assembly. But if we're assembling top-chord-overhang trusses, we have to block up the trusses on stacks of extra floor joists or wall plate stock, to keep the tails from digging into the ground.

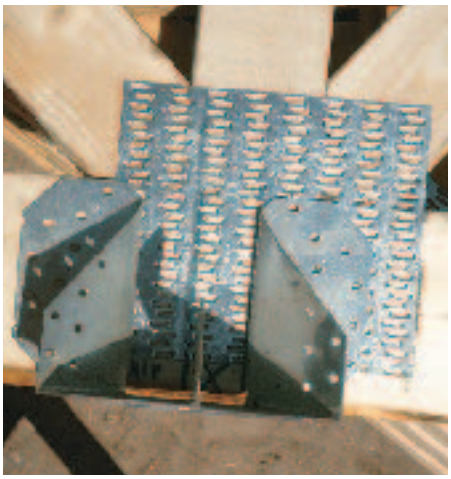

Figure 3. This universal hanger supports both the hip truss and one of the jack trusses. This type of hanger is reversible and can be used on either the left or the right side.

With the first girder truss upright at the chosen spot, I install the rest of the jack trusses to the first girder truss. I use a framing gun to nail off the jacks from behind, through the girder truss webs. When all the jack trusses are attached, I eyeball the bottom chord of the girder truss to see that it's still fairly straight, pushing it in and out until it's within 1/4 inch.

Next, I mark out a 1x3 brace to match the layout of the jack trusses, and I nail it across the bottom chords of the jacks near their tails (Figure 5).

Beveling the tail. Hip trusses are fabricated in one of two ways: The tails are either cut to length or left long. In both cases, the tails are cut square by the fabricator, so they need to be beveled at 45 degrees in the field.

If the fabricator has left the tails long, I always calculate the desired length of the hip's bottom chord. This chord is the hypotenuse of a right triangle; the other two sides of the triangle are the bottom chord of the abutting jack truss and the fascia length between the jack truss and the hip. I use the Pythagorean theorem ($a^2 + b^2 = c^2$) to calculate the length of the hypotenuse, which is the measurement to the tip of the trimmed tail. If the hip truss turns out to be too long, I trim it as necessary.

The square corners of the 2-by web are

Figure 4. A single jack truss nailed to the girder truss will hold it upright while the rest of the jack trusses are installed.

Figure 5. Once the jack trusses are fastened to the girder, a long 1x3 holds the tails of the jacks in position.

designed to nestle into the corner between the girder truss and the first jack (Figure 6). I insert the hip into the hanger, and holding the truss at roughly a 45-degree angle, I nail it home at the top, through both the girder and the jack. Again, I drive only a couple of nails through the hanger to hold the base of the hip; most of the hanger nails are installed after the second girder truss layer is assembled. To hold the tail of the hip in position, I tack a 1x3 across the tails of a couple of adjacent jack trusses.

Doubling the Girder

Before installing the second girder truss, I need to straighten the first girder, so that I don't inadvertently brace the girder while it's crooked. I eyeball the top and bottom chords of the girder truss and then either lift or lower the ends of the jack trusses and hip trusses until the girder is fairly straight. Next, I square up the position of the jacks, using two tape measures to pull diagonals (Figure 7). A 1x3 diagonal brace across the top of the jacks keeps things in place.

Now it's time to tack the second girder truss to the first, using just enough nails to close up any gaps between the top and bottom chords. One more time, I check to see if the girder trusses are straight. I use 1x3s and scrap blocks kicked into the earth to brace the bottom chords straight to a string (Figure 8). It's inevitable that the steel truss plates will hold the chords somewhat apart when the two girders are sandwiched together, so I ignore these slight bulges when lining the girders to the string.

Double-check the fastener schedule. Before I start nailing off the girders, I always reread the truss documentation. Roof trusses are an engineered system; if the documents specify nailing or bolting "by others," I know that means me. The girders on the job shown in the photos required spikes 4 inches on-center staggered along the top and bottom chords, and 9 inches on-center staggered along all the webs.

Once the girders are nailed together, I finish nailing off the hangers. The universal hangers for the hip trusses and adjacent jack trusses usually have slots rather than round holes for nailing, making it possible to angle the nails so you can swing a hammer in the tight quarters (Figure 9). A pneumatic palm nailer is handy in these locations.

If the house has only one story, at this stage I'd call the hip system complete enough to raise. Installing the corner jacks to the hip trusses is fairly easy when you can work off a ladder, and the same goes for sheathing.

Keeping things square. After nailing the girders together, I recheck the strings and make adjustments as necessary. I verify that the jack trusses are

Figure 6. The hip truss is installed tight to the corner where the outside jack truss meets the girder truss. Although the vertical web in the corner should not be trimmed with a bevel, the tail of the hip truss needs to be trimmed on site with two 45-degree bevels.

Figure 7. The jack trusses are squared to the girder truss by checking the diagonals across the top chords.

Figure 8. The second girder truss is paired with the first after the jack trusses and hip trusses have been installed. Before the two girder trusses are nailed together, they have to be straightened to a string. Diagonal 1x3s and kickers driven into the dirt are used to persuade the girder into position.

Figure 9. Once the two girder trusses are nailed together, the rest of the hanger nails can be installed.

square by checking the diagonals from the end of the bottom chord of the outermost jack truss where it meets the girder truss to the tail of the opposite outer jack truss. Once everything looks good, I nail a 1x3 diagonally across the top of the bottom chords. To prepare for sheathing, I replace the diagonal strap that I had nailed across the top chords of the jack trusses with one on the underside of the top chords.

Installing the Corner Jacks

At this point I check the position of the hip truss, bracing it in place so it's equidistant from the girder and the nearest jack. I also check that the location of the tail of the hip matches the dimension on the truss plan (Figure 10).

Before I mark the locations of the corner jacks, I need to know how they were fabricated. If I'm unsure, I call the truss fabricator. Some corner jacks are fabricated to the correct length and are designed to be installed as delivered. The top and bottom chords have a square plumb cut, not a beveled plumb cut, and those chords contact the hip only at the corners of the cut. Because there is not much contact, I think this is a cheesy way of doing it. If the trusses are delivered this way, I first nail the square ends to the hip truss. At the top chord, I then add a 2-by block with a bevel cut at the top end of the top chord to make a stronger connection with the hip truss.

If I have any say when the trusses are ordered, I ask the fabricator to leave them long. That way the top and bottom chords of the corner jacks have the same style plumb cut, but since they're long, they can be beveled on site. It's easiest if the length of the top and bot-

Figure 10. Before installing the corner jack trusses, it's important to recheck the position of the end of the girder truss and the hip truss.

Figure 11. It's handy to have two people to help position the corner jacks on the hip trusses. The corner jacks are nailed at the top through the top chord of the hip truss.

Figure 12. To hold the tails of the corner jacks at 24 inches on-center, they're nailed to the 1x3 that was used to position the hip.

Figure 13. A subfascia ties the tails of the trusses together and stabilizes the truss assembly for lifting.

tom chords corresponds to the long points of the 45-degree bevel cuts. It's important not to get the right-hand bevels and the left-hand bevels confused. To keep things organized, I pile the corner jacks near each hip by size.

Corner jack layout. Marking the positions where the corner jacks fasten to the hip trusses takes two people. The first step is to consult the "length hip or valley per foot run" line on a framing-square table. I follow the line across the table until I reach the roof pitch for the trusses I've got. The table is in inches and tenths of an inch per foot of run. Since roof trusses are generally set on 2-foot centers, I just double the number.

For example, if the trusses have a pitch of 10/12, the framing-square table would give me 19.70 inches per foot of run. For 2 feet of run (trusses on 2-foot centers), I would double the number, yielding 39.4 — about $39\frac{3}{8}$ inches. Starting from the point where the hip touches the corner jack, I would mark down the top chord of the hip $39\frac{3}{8}$ inches. Then I would place the end of my tape on that mark and measure the position for the next corner jack — again $39\frac{3}{8}$ inches. Since my starting point would be the outer face of the last jack truss, my marks would indicate the locations of the short sides of the corner jacks.

I use the same stepping method to locate the attachment points for the corner jacks along the bottom chord of the hip truss. But for the bottom chords, there's no need to look up any numbers on the framing-square tables, since all 24-inch-on-center trusses with 45-degree hip trusses have the same bottom-chord offset — about $33\frac{15}{16}$ inches.

I like to nail the corner jacks through from the hip truss as well as toe-nail them (Figure 11). After the top chords are tacked together, I check whether the bottom chords of the corner jacks and the hip truss are flush. If they're off by more than $\frac{1}{8}$ inch, I probably made a mistake with the layout.

Next I tack the tails of the corner jacks, spaced 24 inches on-center, to the 1x3 brace (Figure 12). Once the corner jacks are nailed in, I eyeball up the hip

truss to see that it's still straight. If necessary, I use 1x3s nailed back to either the jack trusses or the girder trusses to straighten it out until the sheathing goes on. If the truss plan requires hangers for the corner jacks, I install them after I've nailed the bottom chords of the corner jacks to the hip truss.

Subfascia and Sheathing

Although some builders don't install subfascias, I find them especially useful when preassembling hip trusses on the ground, because they lock the tails of the end jacks and corner jacks in place (Figure 13). Before nailing a permanent subfascia to the tails of the jack trusses, I check that the girder trusses and hip trusses are straight and that the trusses all line up fairly well along their tails. (I usually don't install the subfascia on the girder-truss tail side until the assembly is on the roof.)

On the ground, I sheathe only the end slope of the roof, not the return facets of the hip trusses. The lowest row of sheathing is either omitted entirely or tacked lightly in place, so it can be lifted up for toe-nailing the trusses to the wall plates. Sometimes I start with 24-inch rips of sheathing along the eaves, because they're easier to handle two stories up (Figure 14).

On one job, I rushed the assembly of one of the truss assemblies; once the crane dropped the assembly in place, it didn't sit evenly on the wall plates. We ended up having to pop off several sheets of sheathing to make corrections. The lesson: It's important to take the time during assembly to make sure the trusses are square and straight.

Call in the Crane

Before the crane arrives, we mark the truss layout on the wall plates, paying special attention to the girder-truss location. We attach the fabric lifting straps to the hip-truss assembly through the top corners of the girder trusses, where the hip trusses are attached. We protect the lifting straps from the sharp edges of the truss plates by first wrapping the area with rags.

To balance the weight of the assembly so it flies level during the lift, I run additional straps out from the crane hook to the subfascia or tails of the jack trusses. To make it easy to balance the assembly, I like to use adjustable straps or cable come-alongs. (There isn't nearly as much force on these straps or cables as there is on the primary straps; they're only needed to balance the load.) I have the crane operator lift the load until the girders are about a foot off the ground, and then I adjust the come-alongs until the system looks level.

I always assign one crew member to use a tag line to control the assembly until it comes within reach of the crew on the staging (Figure 15). Once it settles onto the marks for the girder trusses, we slide the girders back and forth until the overhang is equal on both sides. The hip trusses should lie flat on the plates and should extend out from the corners of the walls. Once we're satisfied, we release the crane hook and nail the girders to the plates.

An added benefit of assembling a hip system on the ground is that it gives a stable point from which to brace back the rest of the roof trusses, making installation of the remaining trusses faster and safer.

Figure 14. To facilitate fastening the trusses to the wall plates, the bottom course of sheathing can either be nailed loosely or be omitted.

Figure 15. The truss assembly is easier to control if it flies level. Secondary straps extending to the subfascia can be used to help level the trusses during the lift.

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