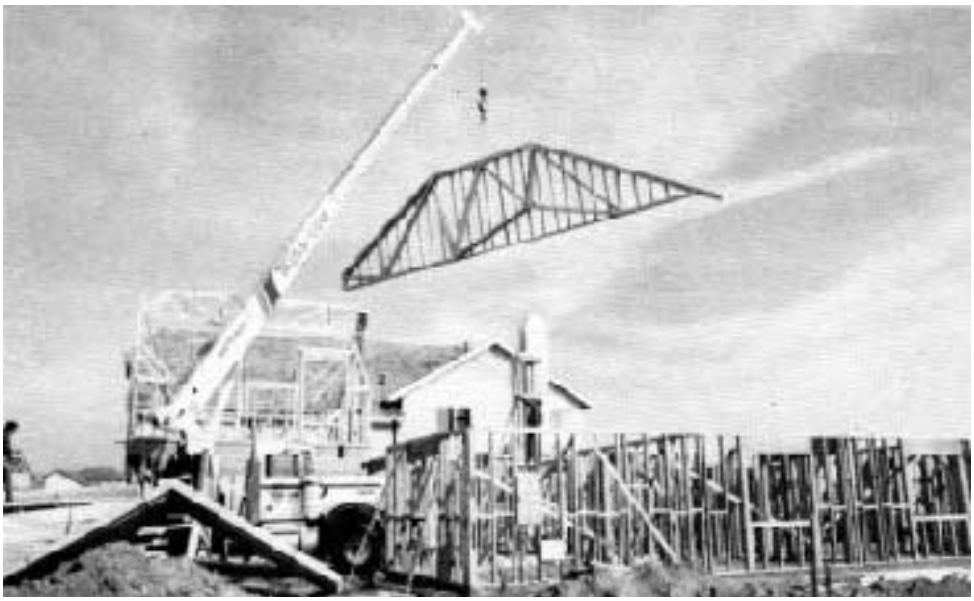
FAST FRAMING WITH TRUSSES

by Daniel Marrazzo

These engineered giants can do wonders–but only it ordered right and handled well



When trusses are set with a crane, both speed and safety depend on crew and crane operator being in sync.

Roof trusses may offer speed, economy, and a lot of open interior space, but many residential contractors view them as mysteries rather than old friends. Everyone has heard stories of truss disasters – I have one of my own – but following some simple guidelines for ordering and installation will eliminate most of the risk and give you a roof in no time at all.

Ordering

This is one of the most important phases and one of the most neglected. The big problem is procrastination. Many fabricators look for a minimum of four weeks lead time. This means ordering your trusses about the same time you pour the foundation, not when the walls are going up.

As with any other building product, you should shop around for trusses. And as with many other products and services, the lowest price often isn't the best choice. Quality varies widely, and you should talk with other contractors and erectors about which fabricator they like and what to watch out for.

Number one on my list is a fabricator that will deliver when they say they will. If you order four weeks in advance, you should expect to get your trusses within two or three days of the date agreed upon. There's nothing worse than having a crew standing around waiting for the trusses to show.

Although you can literally order trusses over the phone from the blueprints, you'll risk fewer costly errors by talking things over with the truss company representative on site and having him help you measure. Reps can often figure ways for you to save a buck. And they are trained to notice things that may escape your eye, but could come back to haunt you when the trusses are delivered.

But even with their advice, you will ultimately be asked to sign a work order for a particular number of trusses of specific lengths and pitches. Make doubly sure and measure again before you sign – you only get one chance. And remember later on as you inspect foundation forms and framing or masonry, that the top plate is going to have to be parallel and exactly where you predicted or you're going to have a serious problem. Trusses aren't like rafters – there's no cheating to adjust a soffit line.

Preparation

The safe and efficient installation of trusses begins before they ever arrive. Because crane time is expensive and truss erection is dangerous, you need to prepare as you might for a big concrete pour -–double check your layouts, clear the decks, and make sure everyone on your crew knows where they're supposed to be.

Work with your excavator so that you have a flat, compacted perimeter of at least 20 feet around the building for access by machines and crew, and make sure it has been cleared of all scraps. Have blocks cut to length and 2x4 bracing set out nearby (12-footers are easiest to handle, but some longer braces will be required).

Stud walls should be straight, plumb, and heavily braced; block walls should be plated and secure. The layout – typically 2 feet on-center – should be marked on the top plate so that it is easily visible to a carpenter who is walking the plate and dealing with the crane operator. The first truss is placed 22_ inches from the gable end. All the trusses that follow should be installed 24 inches on-center from this first layout line.

Most truss erectors around here use 25-inch long 1x3s (or sometimes 5/4 stock) called spreaders to space the top chords of the trusses. This spreader is nailed across adjoining trusses; the next spreader is alternated either above or below the end of the previous one. Spreaders are usually cut the day before, nails started in each end, and then stacked in bundles so they are out of the way yet handy.

Delivery

Often you can coordinate the delivery of the masses so the company's boom truck or mechanical arm can load the roof directly. But if you do have to store them on site briefly, pick the spot carefully. Sticker them either flat or vertically so that they aren't racked and can't slide or fall and get damaged or hurt someone. Cover them with a tarp; you don't want to handle a frozen truss, and you don't want to have to deal with one that's been sun-baked either.

Many truss manufacturers can also provide a truck-mounted crane when you're ready to erect. Whether you provide for a crane this way or find your own, planning ahead is the key. Many crane companies are booked even further ahead than are truss fabricators.

Shop crane companies both for price and experience. There is nothing more aggravating or dangerous than a crane operator who is not familiar with a crew's needs during

The Book on Bracing

I suspect that most builders secretly enjoy a little risk in their lives or they would have grown up to be engineers, who clearly have a loathing for it. But when it comes to erecting trusses, what appears to be a casual risk can turn into a large-scale game of pick-up sticks or much worse.

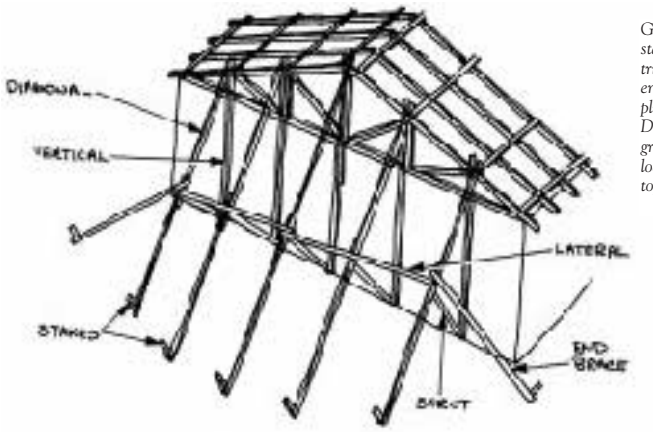
Builders who are used to working with rafters and joists sometimes forget that truss roofs are really engineered systems that rely heavily on proper bracing for integrity right from the start.

Risk prevention in this case is simple: Follow the rules when it comes to temporary bracing. They can be found in a new manual published by the Truss Plate Institute (583 D'Onofrio Drive, Suite 200, Madison, WI 53719; 608/833-5900). It's titled Recommended Specification for Temporary Bracing of Metal Plate Connected Wood Trusses, but at the Institute it's called DSB-89.

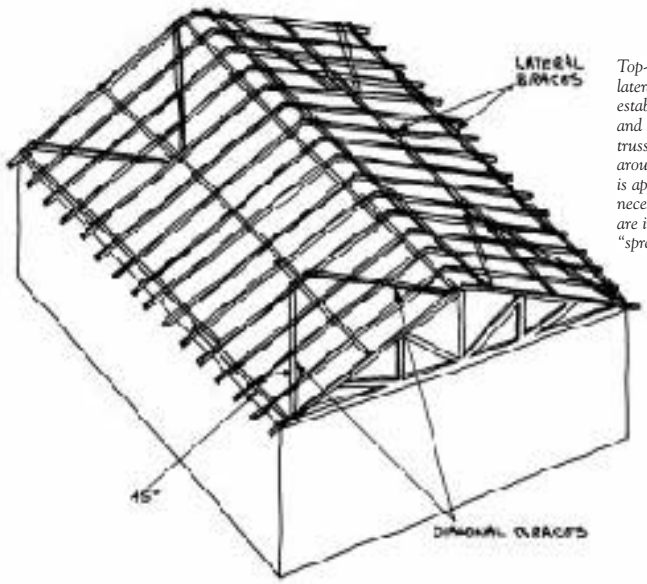
The manual won't ever make the best-seller list, but it does allow you to look up very exact specifications for a huge variety of truss types and sizes. And it's written by engineers, so it probably takes into account both the stuff you've thought of, and the summer squall or winter snowfall you weren't counting on.

But as you can see from the drawings we've included here, the specs call for a lot. A lot of labor. A lot of 2x4s. A lot of trouble to go to.

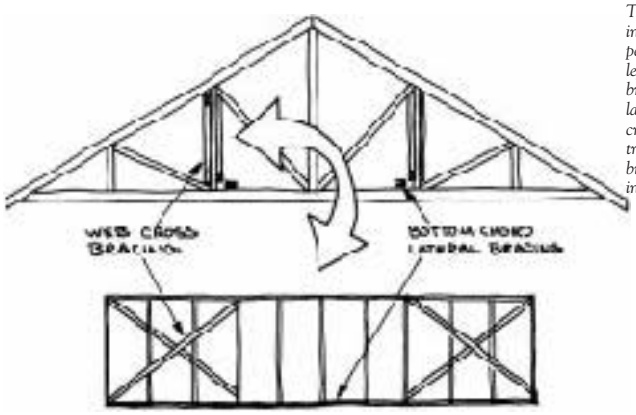
But then again, cutting it too close can also buy you a lot of trouble – including serious injuries. The risk, and the decision, is once again yours.



Ground bracing not only stabilizes the gable-end truss, but helps keep the entire complex of trusses plumb and in place. Diagonal and vertical ground braces should be located in line with lateral top-chord bracing.



Top-chord bracing, both lateral and diagonal, establishes proper spacing and keeps the tops of the trusses from moving around until the sheathing is applied. This bracing is necessary even if trusses are installed with short "spreaders."



These braces should be installed according to the permanent bracing plan and left in place. Bottom-chord bracing provides continuous lateral support; pairs of web cross-braces triangulate the trusses on each end of the building and every 20 feet in between.

Some Definitions

Temporary bracing is just what it sounds like, but in many cases you can satisfy the permanent bracing requirements shown on the plans by installing temporary bracing to those specs and leaving it in place.

Bracing falls into four categories depending on where you install it: ground-bracing, top-chord bracing, bottom-chord bracing, and web-bracing. When you're setting trusses, you are often most concerned with top-chord bracing (specifically lateral bracing – the continuous runs of 2x4 perpendicular to the trusses) because it not only provides an initial sense of stability, it establishes the necessary spacing. Bottom-chord lateral bracing does the same for the ceiling members. But it's the diagonal bracing (at 45 degrees to lateral bracing) and web cross bracing (nailed to the webs in pairs) that form an X that triangulates the trusses to prevent racking. And finally, it's the ground bracing that holds up those first few critical trusses upon which the whole premise rests.

A Few Guidelines

Although the TPI bracing requirements are specific to the type, pitch, and size of truss you're using, here are some of their guidelines that apply in most situations:

- Use grade-marked 2x4s at least 10 feet long for all braces, and at least two 16d nails at each intersection.
- Short 1x or 2x spacers or spreaders can't ever be used in place of continuous lateral bracing.
- The 2x4 bracing members must overlap at least one bay (two trusses).
- Get your spacing right the first time, so you don't have to remove lateral bracing prematurely to fix things.
- Most bracing should be placed as near panel points (the intersection of webs) as possible.
- Don't rely on scabs nailed to the end walls to restrain the gable-end truss.
- Web cross bracing and bottom-chord diagonal bracing are typically required at the ends of buildings and every 20 feet in between.
- Most roofs require web cross bracing and bottom-chord lateral bracing for permanent bracing.
- Permanent top-chord lateral and diagonal bracing is often satisfied by the sheathing.
- Even when you are fully braced, don't stack all your sheathing in one spot – but scatter it.
- Leave your ground bracing in place until you are fully sheathed and permanently braced.
- With the sheathing in place you can breather easier. It acts as a diaphragm that transfers lateral loads to sidewalks and end walls.

- Paul Spring

▲▲▲▲▲▲ Stacking a Roof: The Production Approach ▲▲▲▲▲▲

When speed is king, there is no place for a crane or a wasted move.

Production building doesn't always have the best reputation when it comes to quality, but no one can fault it for its economy of time and motion. If you want to know how quickly and efficiently you can get from A to B, spend some time watching tract piece workers. Their profit and pride are based primarily on speed, and that comes from specializing and planning every step of the job in detail. Setting trusses is one of those disciplined efforts.

The "stack." *It looks haphazard, but the bundles left by the delivery truck are carefully ordered for the stacking crew. They will tie up the trusses by hand, starting with the gable truss on top of the first bundle.*

A Matter of Balance

In some of the hot building markets in the West, experienced crane operators and their machines can run nearly $1,000 a day – an unnecessary expense in the mind of most production builders. Their framers have learned to roll trusses of all sizes and type like joists. The only crane involved is one on the delivery truck, and it only spends a few minutes stacking the banded bundles of trusses on top of the walls. In fact, the tract term around here for setting trusses is stacking a roof.

Yet a typical crew of two (in piece work, even a lone carpenter stacking isn't that unusual) will still be ready for the sheathing guys by the end of a long day.

The key is careful planning – everything is laid out, precut, has nails already started, and can be found hanging within bob-and-weave distance from the plates before a single truss is loaded.

Prepping

While one of the crew is laying out the top plates of the interior walls, another starts on the cut list. Most production framers rely on frieze blocks (finished blocking between rafters on the top plate) and vent screens of the same length for attic ventilation to hold the layout on exterior walls. Unless freize and ridge blocks are supplied by the truss fabricator, they'll be on the list. They are cut 1/8 inch short to account for the thickness of the gang nails they butt. Drywall backing should also be cut to fit unless drywall clips are used.

In fact, even barge rafters (rakes) can be plumb cut on either end, and joined if they aren't too cumbersome. Their outriggers (gable-end lookouts) can also be cut to length and laid out. Nails should be started in all of these "accessories."

To keep blocks, backing, and outriggers handy but out of the way, they are quite literally hung by their toenails on a 1x4 ledger or 16d nails on the inside of the exterior walls just below the plates.

Bracing too is cut to length, laid out, and leaned against walls, so that very little thinking, measuring or sawing takes place once the trusses start going up.

To support the gable trusses when they are set, 2x verticals are nailed securely to the end walls. A central vertical is used if the trusses are relatively tame in size. But if they extend more than 6 to 7 feet above the plate, then two or more verticals will be used as high as a hammer will reach.

Last, a catwalk should be built down the center of living rooms or garages if they involve long spans or vaulted trusses. This serves as a walkway for a point man, who can be used to help raise and steady trusses too large to be handled by the carpenters on the exterior walls.

Loading and Scattering

With luck, the truss yard has banded the trusses in the correct order and the driver is already familiar with the temperament of a production carpenter whose roof has been badly stacked.

Still, the speed and safety of the job depend on how well a crew anticipates and deals with the stack in moving and distributing the trusses on the plates. First in importance are the gable-end trusses. Because they require some preparation and are key components in bracing, they can't end up at the "bottom of the deck."

Prepping the gable end. *Working on the plates, this carpenter has preset toenails on the bottom chord of the gable truss and is cutting notches for the outriggers. Note the frieze blocks, vent screen, and outriggers hanging from the 1x4 ledger, which keeps these "accessories" in reach.*

Tipping up. *Working alone, this piece-work carpenter tips up the first 38-foot common truss, relying on careful preparation and skillful positioning. When the truss is standing, he will temporarily brace it by nailing it to the outriggers jutting out from the gable truss.*

Nailing in frieze blocks. *Vent screens and frieze blocks not only finish off the space between the truss tails in this open-soffit design; they also maintain the 2-foot on-center spacing. The plywood "special" hanging from the header will be used to keep ceiling insulation from blocking the vent.*

When working with moderate-pitch trusses in the 30-foot range, most crews will scatter them along the plates, resting the trusses on each other, like a stack of coasters that have spilled. Bigger trusses are typically left stacked and then carefully walked to their layout – these monsters are just too big and tippy to be moved twice.

Moving about on the plates while wrestling with these monsters in tandem is tricky at best, but more than strength or daring, it requires anticipation, concentration, and above all, teamwork.

Gable-End Trusses

Because the studs in gable-end trusses are often just stapled in place, production framers will sometimes nail a temporary 2x horizontally across the truss. This makes the gable-end studs safe to lean against.

This truss also has to be notched for its outriggers. At least two of these outriggers are typically nailed in place, and toenails are started along the lower chord of the truss for quick nailing into the top plate.

As soon as the truss is raised, one carpenter will steady it while the other slides it back and forth until it is positioned correctly on the plates. Then the uprights can be nailed to the truss, and the toenails driven into the top plate.

While one of the crew pulls up the drywall backing for the end wall and installs it, another can be nailing a ridge block to the peak of the next truss. After each installs a frieze-block or vent-screen on their top plates, the next truss can be raised. It will be face-nailed to the ends of the outriggers and toenailed to interior walls and exterior walls.

At this point, a 1x4 – already marked with the layout – is pulled up and nailed as high up on the top chords as possible. On large spans with steep pitches, a second row of this lateral bracing is typically used about a third of the way up from the frieze blocks.

Finishing Up

After four trusses are erected, a 2x4 or 2x6 sway brace is installed both to triangulate the roof and to plumb the gable end. The 45-degree heel of this diagonal is toenailed to the drywall backing just inside the gable-end truss, and then spiked to the face of the third ridge block out once the gable truss has been brought into the same plane as the wall below. A choker is often used for extra security. This horizontal 2x sits just below the ridge block and is often nailed to the vertical webs. The top of the swaybrace is nailed to the choker with 2 16d nails.

With these trusses braced, the barge rafters can be nailed to the outriggers that are in place, and the remaining ones can be installed.

If the trusses have been scattered or stacked in the right order, then raising the remainder will not hold any big surprises. Once all the trusses are set, one worker can install permanent bracing according to the truss manufacturer's specs, while the other backnails the trusses (toenails his way back down the plates in the opposite direction) and strings and cuts the truss tails for a straight fascia.

Installing outriggers and sway braces. *With the four-truss sway brace in place, the last of the outriggers is nailed up. Once bracing is completed and a straight line snapped on the rafter tails, the roof will be ready for sheathing.*

–Paul Spring

erection. Trusses can also be ruined by an operator who doesn't know what he's doing (see Figure 1). Trusses must always be lifted vertically from two points equally distant from the peak. This is often done with big "truss hooks" and a spreader bar. Ask around for a company that sets a lot of steel and trusses. But also remember that crane companies charge travel time – home port to home port – so shop locally.

Figure 1. *Pick trusses up from two points, not from the peak. Reason: Unbraced trusses are unstable and easily damaged under their own weight.*

Cranes in my area typically rent for $300 to $600 per day; there is usually a half-day minimum. If you think you will require more than one day's time to install your trusses, it's a good idea to reserve a second day. It beats trying to negotiate an extra hour out of a reluctant crane operator at quitting time.

Although crane installations are most common, you can load some jobs by hand or use a high-lift, job-site forklift fitted with a truss boom. Only low-slope, short-span trusses such as those used for a 24-foot garage with a 4:12 pitch should be considered for manual loading. Even then, it's taking a risk with both your crew and the trusses.

If you have a skilled operator and a high-lift forklift on site (they're very popular with the masonry trades around here and are less expensive than a crane), it does let your crew find their own pace instead of having to keep up with a crane. A high-lift forklift is also very handy after the trusses are up – for loading sheathing and even roofing materials. You may have trouble setting to the center of your building with one, however, and it takes knowledge and skill to manage loads as fragile as trusses at this height.

The Right-Sized Crew

Too many or too few can be dangerous in setting trusses, but there isn't an exact formula. Start with a carpenter on each outside wall to toenail the trusses and install spreaders and bracing. On spans over 30 feet you may want a third crew member in the middle. Last, beside the crane or lift operator, you'll need someone on the ground to rig the trusses for the crane and supply the crew with spreaders, etc.

Setting the First Trusses

The first truss set is a gable truss. Typically, a gable truss has vertical members every 16 inches for the siding and costs a good deal more. If your design will allow it, you'll find it's cheaper to order two extra standard trusses instead, and then nail vertical 2x4s to the face of these trusses to create gable trusses. You can even sheathe them down on the ground to save yourself having to do it later from scaffolding.

Bracing this first truss, which in turn will be braced in several ways to the next three or four, is the key to the success and safety of the installation. And you'll repeat this same procedure on the other end of your building with the last four or five trusses.

Typically, the first truss is braced with 2x6 (or wider) verticals that extend from the ground to well up on the gable end. These keep the first truss upright. The temporary verticals are nailed all the way up the wall and gable end and are backed by diagonal braces that run back to the ground where they are staked. It's a lot tougher on a second story, where the bracing has to be anchored to the floor on the interior of the building.

Once the gable truss is set and braced, then the next three trusses can be installed on their layout lines and toenailed through their metal truss plates (see "New Members, New Connectors," 4/89). But don't expect the trusses to line up automatically on the top plate. To keep them aligned and prevent a wavy fascia, string a line down the tails. This will keep the overhang even, and can make a real difference when you're trimming out later on.

As each truss is installed, a spreader should be nailed from the previous truss to the next one. Although these stiffen things up considerably while keeping the layout, continuous 2x4 bracing across the top chords is recommended (see "The Book on Bracing," page 24).

Once the first four trusses are set, you should install a run of 2x4s on the top edges of the top and bottom chords. This lateral bracing will help to permanently support the trusses and it is important that it is laid out and nailed uniformly.

Next, you should set diagonal 2x4 braces in the plane of the webbing. These are extremely important in keeping the trusses from moving laterally. We attach these near the lowest panel point (an intersection of web members) on the fourth truss and then the highest panel point on the gable truss. Depending on the trusses and their span, this is often a good time to install two or three sheets of sheathing to lock in these four trusses.

The Remainder

The rest of the trusses can be installed two at a time if the crane operator is skilled and your crew is working together well. It saves a lot of wear and tear on the operator and a lot of trips back to the truss pile.

It works like this. Keeping the cable taut, the operator lowers the two trusses into position so the first one can be toenailed at the plate and anchored with spreaders. Once it is secure, the cable is slacked slightly to allow the hooks to be slipped off the first truss. The remaining truss can then be raised just slightly and slid into place.

Sheathing

Once the final gable truss is set and braced, it's common to relax and assume that the trusses are now secure. That's a mistake. Let me give you an example from my very recent past:

After raising fifty-one, 60-foot trusses over a masonry warehouse and installing four courses of plywood on one side of the roof, we were caught by an unexpected rainstorm and packed it in for the day. After a night of wind and rain, we were greeted the next morning by only half the trusses we had raised – the rest had collapsed and were inside the building along with the top few courses of masonry and some interior walls. Apparently, strong winds caught hold of the sheathed side of the roof and overloaded the system. This was obviously the hard way to learn about truss failure.

I now make very sure of my bracing and run two or three courses of plywood on both sides of the roof. These sheets can usually be handed up from inside the structure and can be nailed off later with a nailgun. Then I complete the sheathing as soon as possible. This isn't much different than sheathing rafters, although you may be required to use 5/8-inch plywood and clips along unsupported edges.

But even after you're sheathed, you need to remember that you're dealing with engineered members. Unless you are making a small correction on the tails to straighten a fascia, don't even think about cutting, drilling, or modifying a truss. And watch for subs who are used to notching a joist with a reciprocating saw to accommodate a pipe, wire, or duct. If you allow this to happen to a truss, you're almost guaranteeing a failure.

One last thought that illustrates the kind of thought and precaution that trusses require: Remember to warn your clients (you can even state it at the end of your contract where they'll see it) that these are engineered systems that won't tolerate interference. This will seem a little extreme until the day you return to a house you built to complete a punchlist and find a pull-down stairway has been installed and a portable flea market loaded on the lower chords. ■

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