Scaffolding

What goes up mustn't come down accidentally

by Scott McBride

There are few subjects in construction with as little glamour or as much importance as scaffolding. Often erected in "a hurry, abused by those who literally depend on it and torn down without ceremony, a scaffold is the ugly chrysalis whose removal reveals a butterfly.

Hard-earned knowledge of construction rigging is one of my most important resources as a builder. The ability to erect a safe, effective work platform is a skill that can be acquired only through thoughtful experimentation with the different systems available. There are nearly as many types of scaffolding as there are different types of jobs, and the ideal setup for a given situation is often a combination of several. As a result, I sometimes enjoy rigging a job more than I enjoy the job itself.

A word of caution is in order before I begin. The Occupational Safety and Health Administration (OSHA) has identified scaffolding as a leading cause of accidents in construction. OSHA's standards for the construction industry include 17 pages on scaffolding. While I mention some of these regulations in my discussion, it would be impossible, in this space, for me to list them all. Therefore, I recommend that everyone read the OSHA standards before setting up or using any type of scaffold. For more on OSHA and for information on how to get a copy of their *Construction Industry Standards,* see the sidebar on p. 37.

Planks—The basic scaffold consists of two parts: a pair of supports and a horizontal platform. Wood planking is the most common platform material. The standard scaffold plank available at lumberyards is a full 2-in. by 9-in. scaffold-grade roughsawn spruce plank. The rough texture provides a non-skid surface, and the extra thickness makes a more substantial platform than ordinary 2x dimension lumber. Thirteen feet is the standard length, providing for a 12-ft. span with 6 in. of overlap at each support. Some regulations insist on even shorter spans, dropping down to a 10-ft. maximum.

All planks should be inspected carefully for defects. Small knots and some checking on the ends of planks is okay. But long spike knots and short grain are dangerous because they break the continuity of the wood fibers. Large enclosed knots and splits should also be eyed with suspicion. All of these defects are aggravated by water and dry rot, so planks should be stickered when not in use. Periodic application of wood preservative is also a good idea. If planks become the least bit punky, get rid of them.

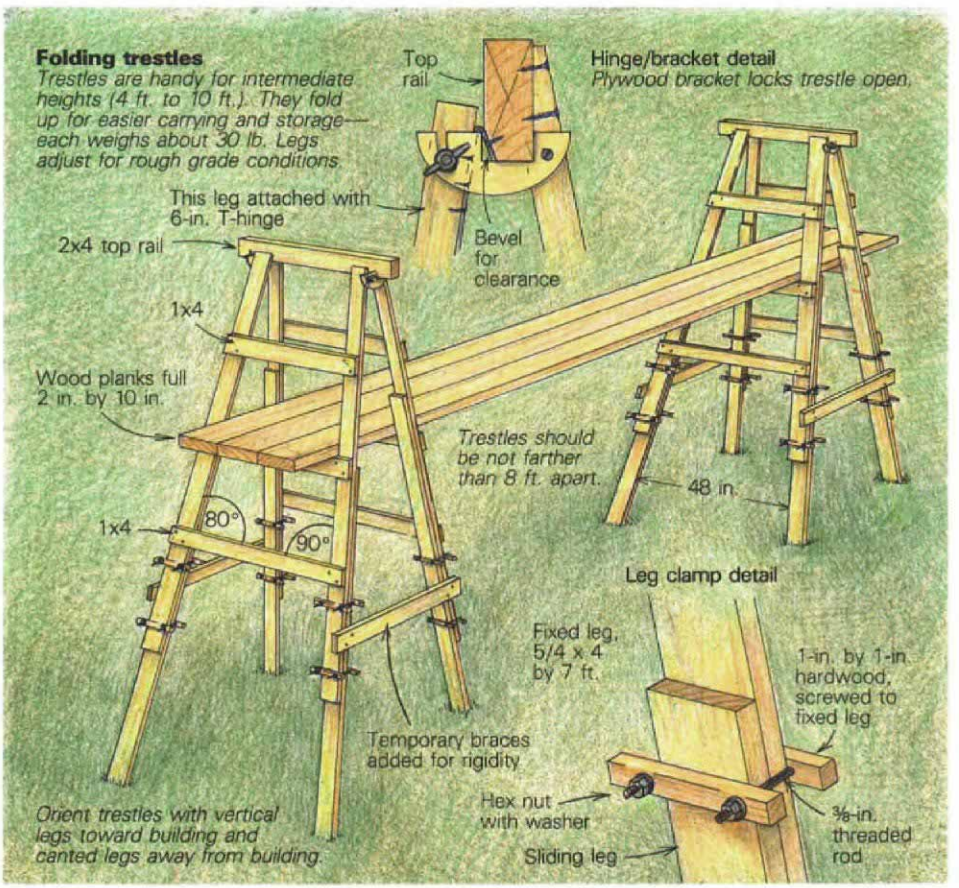
Twist should also be considered a serious defect in scaffold planks. It can make the plank roll as you step from side to side. If this sudden shift is extreme, you can lose your balance and take a fall.

Two planks side by side (18 in.) are the minimum for safety on any scaffold. The planks should be cleated together so that they bend in unison. Nail a piece of plywood on the underside every 4 ft. along the planks. Nail the cleats only into the middle of each plank, to reduce the chances of their splitting with cross-grain movement and to make them easier to disassemble. Some people make do with just one plank for sit-down work like painting or shingling, but even here a second plank is best for safety and provides more room for tools and buckets. Besides, a second plank is cheap insurance when you're risking a fall.

You can make up your own "plank" with two good Douglas fir 2x4s on edge and a 24-in. wide strip of ¾-in. plywood nailed over them. This composite plank is easily made from materials already on the job, and will stay nice and rigid under several hundred pounds.

An attractive but expensive alternative to wood planks is the extendable aluminum platform used by many contractors. These are straight, adjustable and can span longer distances than wood planks, so fewer supports are required. I have seen aluminum extension ladders used as platforms, but this is dangerous. Their rails aren't built heavy enough for this purpose and will bend.

It's a good idea to attach any scaffold platform to its supports so that it can't slip off accidentally. This is an OSHA requirement, but their standards say only that planking must be se-



Scott McBride is a carpenter and contractor in Irvington, N. Y.

Drawings: Christopher Clapp

cured and don't suggest how to do it. Depending on the type of scaffold, I use clamps, ropes or nails. The first two will work with metal supports and platforms. They also offer the advantage of not damaging the equipment in any way. The advantage of nails is that they can be installed quickly and that a toenail on the edge of a plank is unlikely to trip anyone, as a rope or C-clamp might. On the other hand, a nail head sticking up on the face of a plank becomes a real hazard when it catches a boot heel.

The end of a plank should not extend more than 1 ft. beyond its support. If this rule is observed, a false step by a worker beyond the support is unlikely to flip an unsecured plank. Planks laid in a row should overlap directly above a support and should overlap by at least 12 in.

Sawhorses and trestles—The simplest support for scaffold planks is a good pair of sawhorses. A collection of sawhorses in various heights (2 ft., 3 ft. and 4 ft.) is a worthwhile investment for any contractor or serious do-it-yourselfer. Masons require a heavy horse with 2x4 legs, but the carpenter will generally find a lighter horse of 5/4 spruce to be handier. The spread of the legs should be just enough to provide stability, about 20° to 30°. Any more than this and the horses become bulky and awkward.

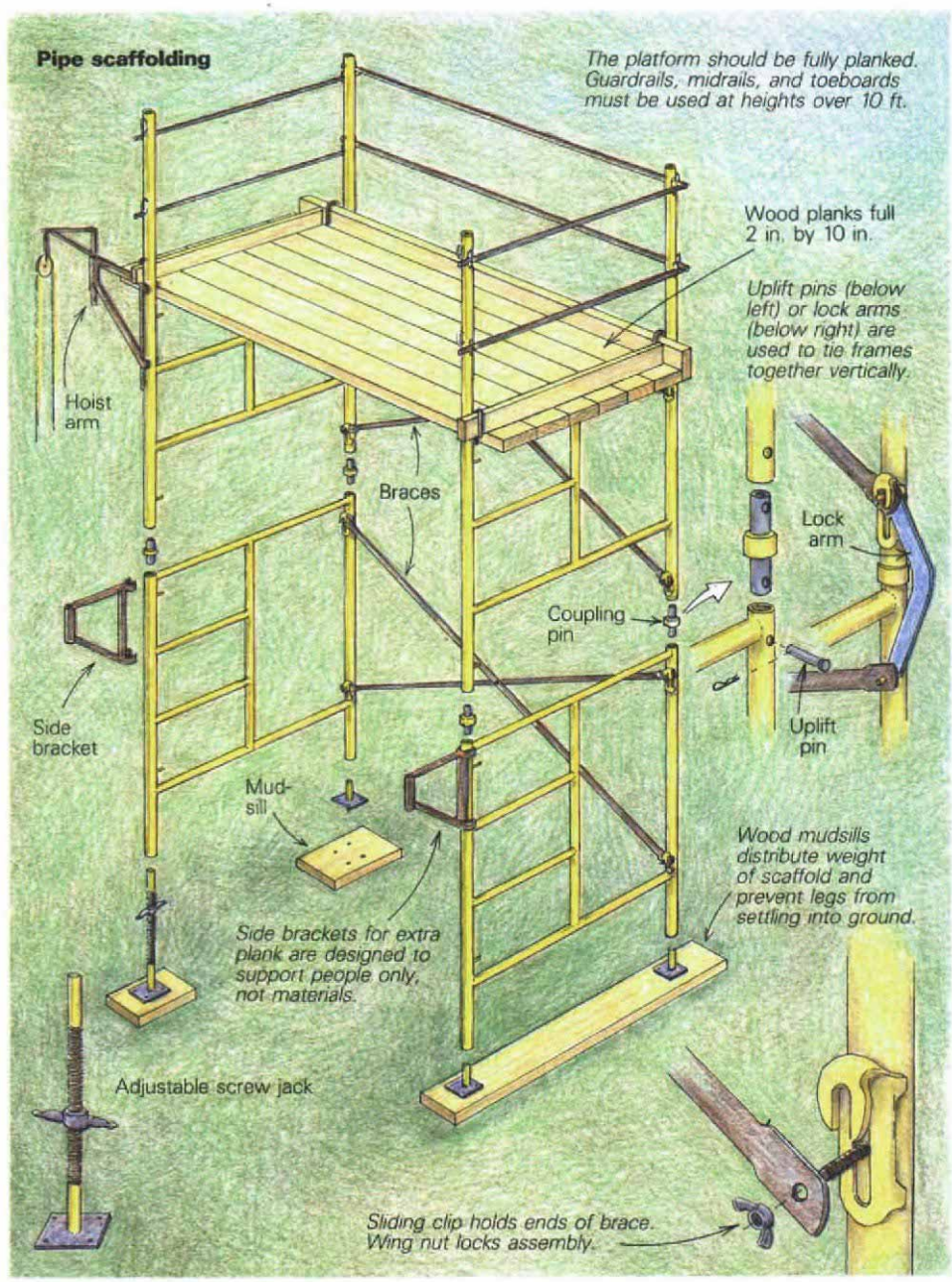
Drywall screws are the best fasteners for sawhorses because they resist the constant twisting strain that tends to work nails loose. If all the joints are gussetted with plywood, a very light and durable sawhorse can be made at little cost.

Some people use stepladders for scaffold supports. The stepladder is handy and adjustable, but its lack of spread parallel to its rungs makes it unstable. Also, it can accommodate the width of only one plank, and the portion of the stepladder above the plank gets in the way of the work. A better device for working in the 4-ft. to 10-ft., range is the wooden trestle.

The trestle is an overgrown version of the sawhorse, with extra bracing. It's useful where an intermediate height must be reached, or if pipe scaffolding isn't available.

The folding trestles that I developed for my own use have adjustable legs and a working range of 4 ft. to 10 ft. (drawing, facing page). When working above 7 ft., I nail temporary bracing between the opposing frames of each trestle. This rig works well under rough-grade conditions because the legs are independently adjustable. I use them on single-story work, where sawhorses won't quite reach and pump jacks are too much bother. The trestles are made of 5/4 clear pressure-treated yellow pine, and each unit weighs about 30 lb. They can be carried easily by one person, and when folded up will fit nicely in a van or station wagon.

Pipe scaffolding—Tubular welded frame scaffolding, called pipe scaffolding by most builders, is unsurpassed where a strong, freestanding work platform is needed (drawing, above right), it affords bountiful workspace when fully planked, and can be erected by one person. 1 was amazed and delighted the first time I set up a 24-ft. steel tower by myself in less than an hour with pipe scaffolding and planks. Pipe scaffolding is also just about the only system that can get you safely above the eaves and away from the roof at the same time, as required in chimney work.



Each unit consists of two rectangular frames and two pairs of diagonal braces. The units can be stacked vertically to considerable height, but must be attached to the building every 26 ft. Most units have a ladder as an integral part of the frame, but since it's difficult to climb straight up, 1 usually use an extension ladder to get up on the scaffold. Pipe scaffolding can be strung out horizontally as far as you like. When extending horizontally, it takes only one frame and two pairs of braces to yield one additional unit, since adjoining units share a common frame.

The frames are welded tubular steel, about 1¼-in. O. D., and the braces are either steel tubing or angle stock, with a rivet in the middle of each pair. Removable coupling pins lock the frames together when they're stacked on top of each other. The ends of the braces slip over threaded studs on the frames, and are held in place by sliding clips. For extra rigidity, a nut is used to lock the brace on the stud.

The most common pipe-scaffold unit is about 6 ft. high by 5 ft. wide by 8 ft. long, but unfortunately there is no standardization of sizes among manufacturers. If you're going to buy used pipe scaffolding, set it up and make sure it all fits together before you buy it. Two identical-looking frames can have legs that differ by a maddening inch or two from center to center, or they can have legs of slightly different diameters. This makes it impossible to stack them.

In addition to the basic units, various accessories are available to adapt the system to different situations. For uneven ground, you can get adjustable screw jacks that fit up into the legs of the frames. These jacks can level a scaffold even after it's heavily loaded. Their range of adjustment is about 12 in. to 18 in.

You can get side and end brackets that serve as outboard supports for an extra plank. They

can be hung at various heights on the scaffold's horizontal members. You can also buy hoist arms for lifting small loads. All of these attachments increase the risk of overturning the scaffold. When using them, you should always tie the scaffold frames together vertically with uplift pins or lock arms.

OSHA requires the use of guardrails, midrails and toeboards on all open sides of any scaffold over 10 ft. high. For pipe scaffolds, you can buy manufactured guardrails and gates that slip over the coupling pins.

In addition to its use as a work platform, the strength and stability of pipe scaffolding lends it to various' other applications in construction. For instance, it makes an admirable alternative to the rickety wooden A-frame often used to hold up a steel beam until its supporting Lally column is cut and welded in place.

A tower of pipe scaffolding located just outside an attic dormer job provides a useful landing for the delivery of building materials and the removal of debris, leaving the household below less affected by construction traffic. Where attic staircases are narrow, an exterior landing may be the only way to get large items like plywood and drywall into the house. Pipe scaffolding is available through many rental outfits and lumberyards, as well as from specialized dealers listed in the Yellow Pages under "Scaffolding."

Pump jacks—Pump jacks are the pre-eminent scaffolding system for residential sidewall work, since they provide access to a maximum area with minimum rigging (drawing, below right). In addition, their adjustability lets you always work at the optimum height. The basic components of the pump-jack system are jacks, poles, metal brackets and diagonal wooden braces. One well-known brand of pump jacks is Hoitsma (Adjustable Scaffold Bracket Co., P.O. Box 595, Paterson, N. J. 07544). I paid about $50 for each set of one jack and one brace.

The jack mechanism employs a pair of spring-loaded clamps that alternately bind on a pole made of doubled 2x4s. While the lower clamp bites the pole, the upper clamp is raised with a foot pedal. The upper clamp then bites the pole, and the weight of the operator, amplified through leverage, raises the lower clamp and the entire platform several inches. Like a toy monkey the jack creeps up the pole, offering the operator an infinitely variable height adjustment. If you're working alone, you can raise one jack only a foot or two before you have to walk down and pump the other to bring the platform up to level again. To lower the platform, the bottom clamp is released by pressure from the operator's heel, and the upper clamp is rotated with a crank. Since this clamp is forged with a spiral twist, the rotation causes the clamp to roll gently down the pole, without actually losing its grip. Metal rollers prevent all parts of the jack except the clamps from binding on the pole.

Okay, that's the way pump jacks are supposed to work. In reality, pump jacks have been the object of much cussing. The problems begin with rust. Because the springs and rollers are made of steel, the springs start to lose their springiness and the rollers start to lose their roliness after exposure on the job site. The clamps that are supposed to bind on the pole don't, and the parts that shouldn't bind do.

Various difficulties result, including ulcer-causing jam-ups, followed by heart-stopping free-falls of a foot or more. Then somebody discovers that rapping the jacks with a hammer here and there seems to help temporarily. But the pump jack suffers in the long run and eventually responds with ever-increasing orneriness.

An occasional treatment with penetrating oil will help immensely to prevent these problems, as will storing the jacks under shelter when not in use. Examine them regularly for signs of deterioration, paying special attention to the cotter pins (used to hold various parts in place), which are apt to rust through and fall out.

Select the best lumber you can get when choosing stock for your poles. Where I live, the choice is between Douglas fir and pressure-treated southern yellow pine. Although the fir is a little stronger than the plantation-grown yellow pine, I prefer the pine because it's less liable to decay. This danger is compounded by the rainwater that gets trapped between the 2x4s. I once had a 28-ft. pole snap in the middle while a helper and I were standing it up. It was dry on the outside, but rotten on the inside.

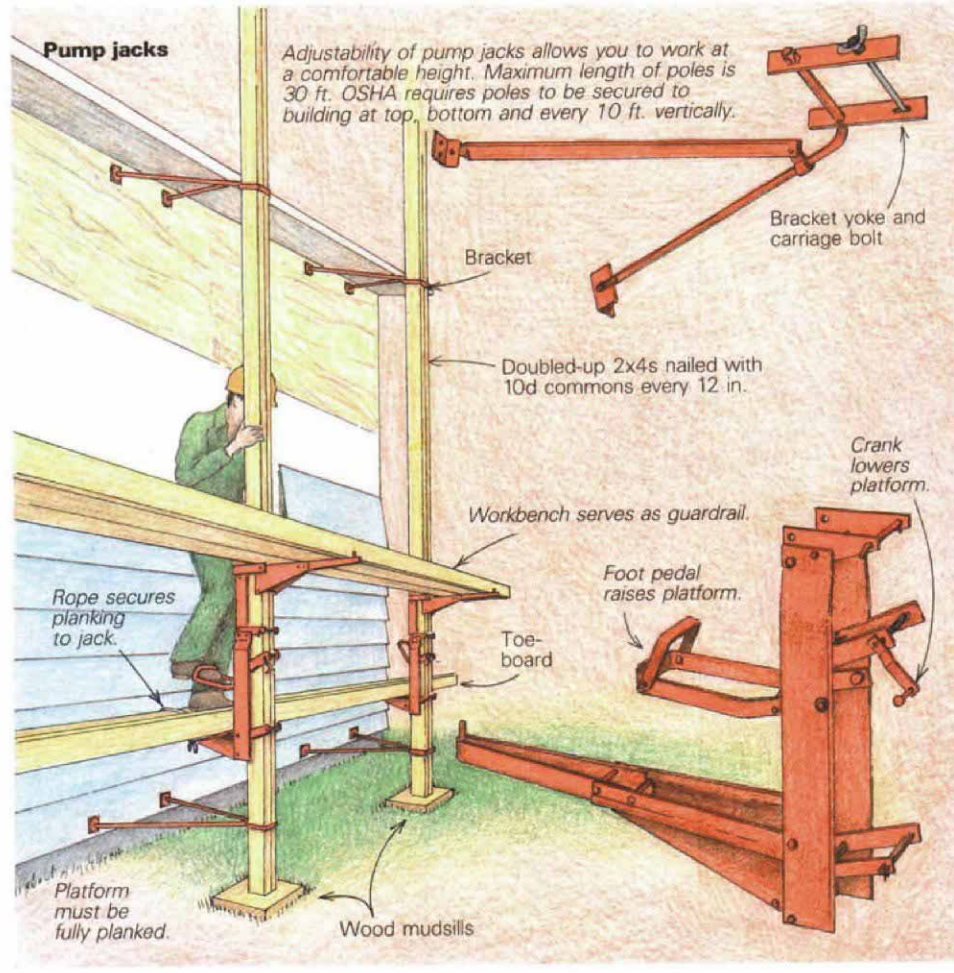
The poles should be spiked up using plenty of 10d nails, with joints staggered no closer than 4 ft. (6 ft. is better). Joints should be smoothed off, or they'll snag the pump jacks. Check the width of a new pole in several places before setting it up—extra-wide 2x4s create problems. An aluminum version of the pump-jack pole is made by Alum-A-Pole Corp. (P.O. Box 66, Staten Island, N. Y. 10303). Although I have had no experience with these, they obviously offer the advantages of stability and immunity to decay.

The first step in setting up pump jacks is to attach the brackets to the building. You can do this from a ladder or while sitting on the roof, if the pitch is low enough. The bracket, a Y-shaped affair, is made of steel. A yoke at one end holds the pole, and small pieces of angle iron at the other two ends swivel for attachment to the roof or sidewall. Locate the brackets carefully, spacing them no farther than 10 ft. apart when using wooden scaffolding planks.

In general, the brackets should be attached only to sound framing lumber. When fastening to the roof, gently lift up a shingle and hunt underneath with hammer and nail until you find a rafter. If your probing brings you too close to the edge of the shingle, skip to the one below it. You can get a clue to the rafter locations by looking for nail heads in the soffit or fascia. After you find the rafter, drive a couple of 16d nails through the bracket and sheathing into the rafter itself. Bend the last inch of the nail over, or use a duplex nail, so you can remove it later.

If you have to fasten the brackets to the rake or fascia, make sure these trim boards are well nailed to the framing, and use drywall screws to attach the brackets.

Once the brackets are attached, slip the pump



jacks over the ends of the poles. Disengage the bottom roller with your hand and pull the jack about 2 ft. up the pole. Now it's time to raise the poles, which you can do by walking them up from below, like a ladder. Or you can carry the top up a ladder, while someone else carries the bottom forward on the ground. A safer method is to hoist the pole up with a rope and a pulley.

Once the pole is standing up, remove the carriage bolt from the bracket yoke, slip the pole into the yoke, and replace the bolt. OSHA regulations require that you also attach the poles to the building at the bottom and every 10 ft. vertically, though many people don't bother. In any case, you should have several extra brackets.

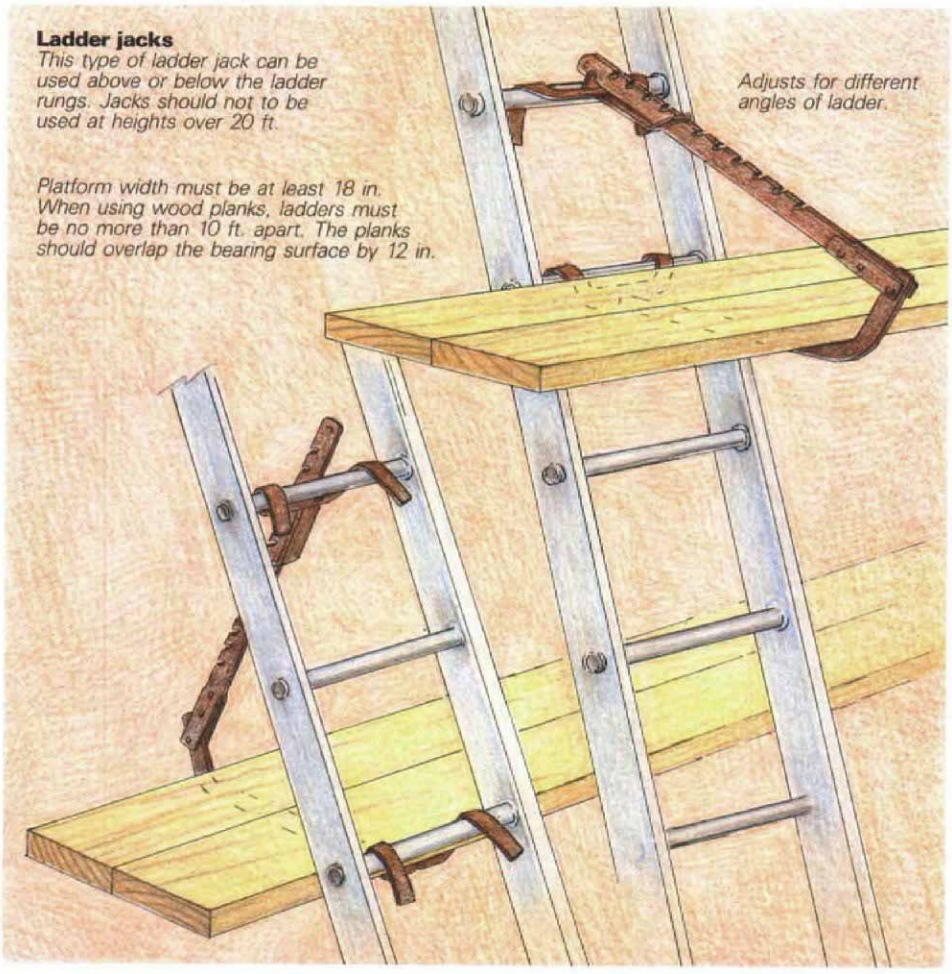
Be sure to set each pole on a wide, stable footing to keep it from sinking into the ground. A length of 2x8 works well. The jacks can now be laid with planks and pumped up to the desired working height. When the scaffold gets up around 10 ft., it will start to sway from side to side more than is comfortable. At this point, diagonal braces should be nailed from the bottom of each pole to just below the jack on the neighboring pole, forming an X. OSHA doesn't require these braces, but I think they're a good idea. A nail where the two braces cross will further stiffen the setup. The braces can be 1x4s, but 2x4s are better if you need lengths of 16 ft. or more. On tall setups (over 20 ft. high), use at least one additional pair of braces. Thirty feet is the maximum length of poles allowed by OSHA, and that's really pushing it.

Ladder jacks—When you're working at just one height (doing cornice repair, for instance), ladder jacks are the easiest setup to use. These are heavy steel brackets that hook onto the rungs of an extension ladder (drawing, below). Some types are adaptable for use both under a ladder and above it. The distance from the hooks to the crossbars that carry the planks is adjustable to fit the angle of the ladder. I prefer to use ladder jacks above the ladder because this puts me at a more comfortable distance from the wall. Also, the ladder itself can get in the way when the jacks are hung underneath.

After attaching the hooks, you carry the scaffold planks up and lay them across the jacks. This is tough to do alone, but can be managed by first throwing a 2x4 between the jacks. The 2x4 will support one end of a plank as it is slid out from one ladder jack to the next. I use C-clamps to hold the planks firmly to the crossbars and to help unify the rig.

To those accustomed to clinging to a ladder, this system is scary at first. In fact, it's a lot safer than working from a ladder, and is only a little harder to set up. Its chief disadvantage is a certain inflexibility of height adjustment, limited by the spacing of the ladder rungs. Also, where the sections of an extension ladder overlap, most ladder jacks cannot be used at all.

To work a long run of cornice, I sometimes set up a column of pipe scaffold in the middle, and run ladder jacks out to either side. The pipe scaffold provides a solid, roomy work island,



OSHA and residential construction

After looking at over 100 photographs and visiting several job sites, I gave up hope of finding a scaffold on a residential job that conformed to OSHA standards. For instance, the pump jacks I saw had their poles standing directly on the ground, the platforms usually consisted of one 10-in. plank, and there were no guardrails or toeboards. That's why no photos accompany this article. It's too bad OSHA regulations aren't more widely observed, but OSHA doesn't have the resources to inspect every construction site, so they concentrate on commercial jobs, where most accidents occur.

This doesn't mean that OSHA compliance officers never visit residential construction sites. Sometimes they do. And theoretically, their reports to the area office can lead to fines of up to $10,000 and to a shutdown of the job through a restraining order from a federal district judge. In reality, this almost never happens. If an OSHA compliance officer notices a violation on the site of a new home, he usually just tells the contractor to fix it. The contractor agrees to do so, and that's the end of it.

When I called OSHA's area office in Hartford, Conn., to ask about composite planks and homemade trestles, I was told that no regulations specifically prohibit them, and that compliance officers have the latitude to make judgment calls in such cases. Making judgment calls is just what carpenters do. But for the sake of expedience, they're usually willing to settle for something less than a scaffold that will support "four times the maximum intended load" that OSHA requires.

Safety on the job site is always a compromise between caution and expedience (see *FHB* #34, pp. 51-55). If not impossible, it would certainly be impractical to build a scaffold that was 100% safe. Even OSHA is limited by law to standards that are judged financially feasible and realistic. Unfortunately, not all contractors and carpenters agree with OSHA's definition of these terms.

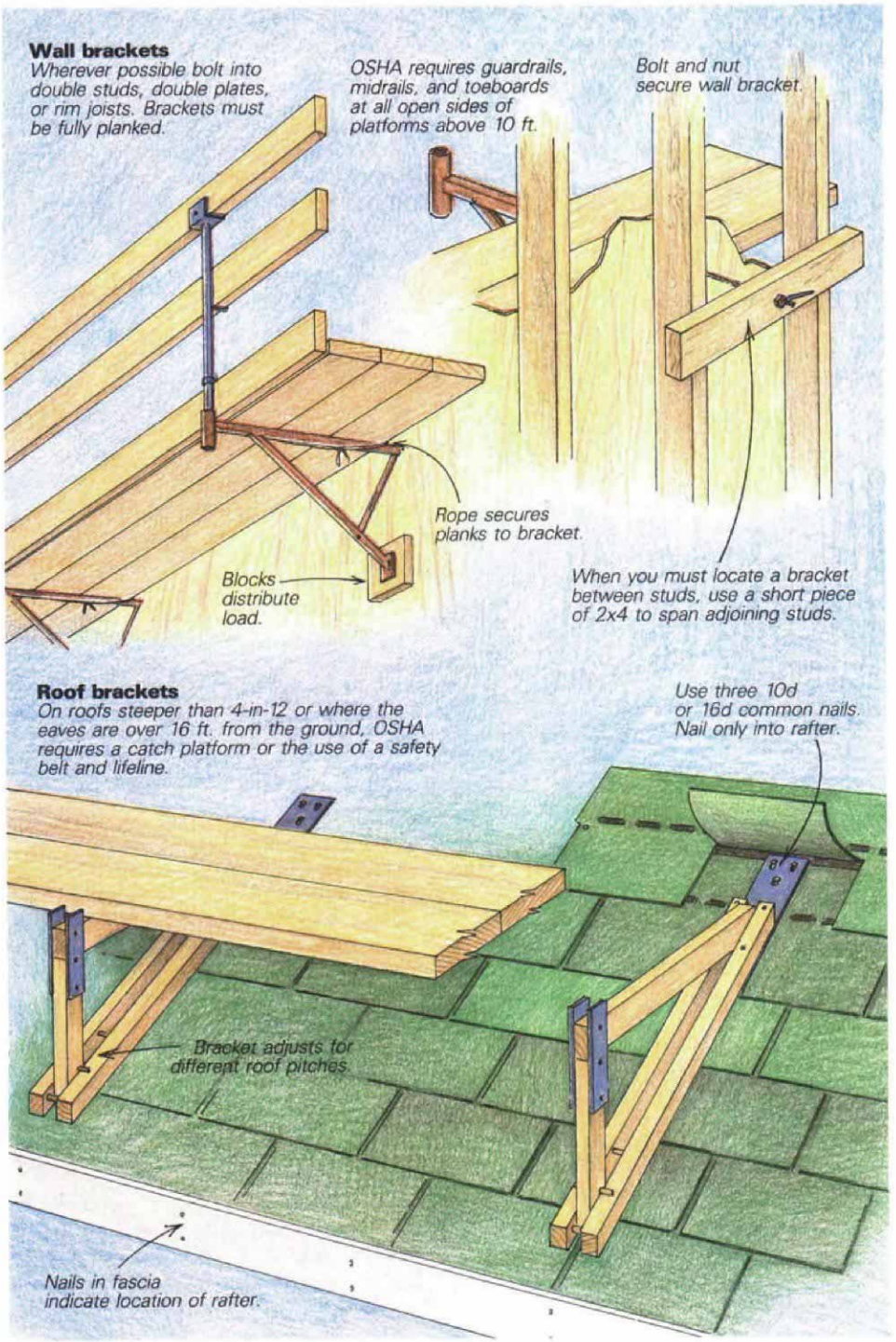
As a carpenter, I never read OSHA's standards for scaffolding. As an editor preparing an article on scaffolding for publication, I had to read them. I will admit that they seem to call for extreme measures, requiring for compliance more time, effort and material than most tradespeople that I know would be willing to give. But they also make me aware that I've taken some foolish chances with scaffolding that I've built. Now that I've read OSHA's standards, I would build safer scaffolds, which is reason enough to encourage others to read them. Call the OSHA office in your state (listed in the Blue Pages under Labor Dept.) and ask for a copy of *Construction Industry Standards (#1926)*. It's free, and the information, though occasionally tough to wade through, could save your life. — *Kevin Ireton*

and the ladder jacks let me work the entire length of the side in one shot.

Wall brackets–The wall bracket, used primarily in rough carpentry, is a steel triangle that bolts into the frame of the house and supports scaffold planks (drawing, below). Since you have to drill a hole for the bolt, this system is unsuitable for siding installation unless you're able to work from the top down. As a result, wall brackets are used mostly to install sheathing. The advantages of wall brackets are speed of installation and their complete independence from grade conditions, which can be pretty miserable around a new house.

Wall brackets can be used safely, but you have to be careful about where you bolt them. I know of two carpenters who have "gone down" on these. In both cases the scaffold failed because it was bolted into a single bad stud that either broke or tore out. The lateral strain exerted by wall brackets is considerable. Wherever possible, bolt into double studs, double plates, or rim joists. If single studs are the only choice, the bolt should pass through a short piece of clear 2x4 horizontally spanning at least two good studs, as shown in the drawing.

I've seen wall brackets that use nails instead of bolts. Although these probably work okay, they make me nervous and I avoid them. The possibility that my own weight will pry the nails out seems too real.



Roof brackets–A cousin of the wall bracket is the roof bracket, an adjustable triangle with a tongue that's nailed under a roof shingle (drawing, bottom left). The roof bracket is much more secure than the wall bracket because the roof carries most of the weight. Also, the nails that hold them are subjected mostly to shear forces, as opposed to the withdrawal forces exerted on the nails or bolts of wall brackets. Still, you should be careful to nail only into rafters, and don't skimp on the nails either. Use three 10d or 16d commons. When lifting asphalt shingles, a putty knife will help to separate the ones that have become cemented down. After removing the brackets, be sure to drive the nail heads down, or they may work their way up through the shingle. If the shingle tears, apply a dab of roof cement under the damaged area.

There is no convenient way to install guardrails on a roof-bracket scaffold. On roofs with a pitch steeper than 4-in-12 or where the eaves are over 16 ft. from the ground, OSHA requires the installation of a "catch platform" below the working area or else the use of a safety belt and lifeline. A catch platform amounts to a complete scaffolding setup, including guardrails, midrails and toeboards, located just below and extending 2 ft. beyond the eaves.

Site-built scaffolding–The high price of lumber and the availability of manufactured scaffold systems has reduced the use of site-built wood scaffolding. In a pinch, however, the carpenter may have to put something together from materials already on the job. The guiding principles of wood-scaffold construction are to use plenty of nails (duplex nails come in handy here), and to triangulate everything for rigidity.

More common than complete wood scaffolds are localized rigs built on the spot to solve a particular problem. On Victorian houses especially, the overhangs create a nightmare for the sidewall mechanic. In such places, manufactured scaffolding often doesn't work, and you have to build your own.

A trick some carpenters use at window or door openings is a simple cantilevered beam. They nail a 2x4 across the rough opening to serve as a fulcrum, and then stick a long 2x10 or similar heavy beam on edge out the window. With one end well nailed to a partition inside the house, the other end becomes a scaffold support. As much length as possible is extended inside the house to counter the weight of the scaffold load. This type of scaffold is sometimes used where many windows are arranged together at a given height, such as the south wall of solar houses.

Improvisation–I have used suspension cables, window hooks, and a host of other devices to support a platform. A nearby tree has come in handy on occasion, as has the roof of my van. Imagination is important, but creativity must always be tempered with common sense. The final consideration, of course, must be safety. You owe this not only to yourself and your loved ones, but also to the other tradespeople who place their trust in your scaffold. Their lives depend on you. ❑