Keeping Scaffolds Safe

by Paul Fisette

Scaffold failures injure thousands every year. In many cases, low-grade or damaged wooden planks are to blame.

I've been lucky. After 20 years of stretching from ladders, climbing on roofs, and bouncing across over-extended staging planks, I've never fallen. Like most conscientious builders, I always put safety first — well almost always.

Looking back, I could have easily avoided the few staging failures that occurred on my projects. They were all caused either by using the wrong material correctly or by using the right material incorrectly. So it's no surprise to me that experts blame improper material selection and misuse for most scaffold failures.

Planks

Wooden planks seem to lie at the heart of most residential scaffold failures. Some experts claim plank failures are the cause of injury in 90% of the cases they investigate. Knots and cross-grain play a role in most failures. But the real blame goes to workers unfamiliar with safe and proper use of equipment.

Misuse. Contractors often overload wooden staging planks. Think of the times you have seen a mason standing in the middle of a plank with bricks stacked up to his waist, only to have his tender sling a tub of mortar onto the pile. Or consider side-wallers who use pump staging: How often are the poles spaced less than 10 feet apart as OSHA requires? Overloading stresses wooden planks beyond their elastic range, which can cause them to fail at a later time under lighter loads. Just because staging planks have worked well in the past doesn't assure safe use in the future if the planks have been overstressed in the meantime.

One builder attempted to sue his material supplier for providing off-grade scaffold planks to his job. A crew member fell from a roof when a plank snapped at mid-span, and was permanently injured. As it turned out, the supplier *had* provided scaffold grade planks, yet the plank failed anyway. Particles of gravel were found embedded in the end grain of the plank during the investigation. It seems the workers had developed a short-cut for dismantling staging — they dropped the planks to the ground. When a plank hit the ground it whipped, which caused a partial failure in the plank.

Other cases where legitimate scaffold-grade planks have failed point to misuse as the cause of injury. In one failure, decay was found when the plank's fracture was microscopically analyzed. Later it was learned that the general contractor stored the planks outdoors under a plastic tarp.

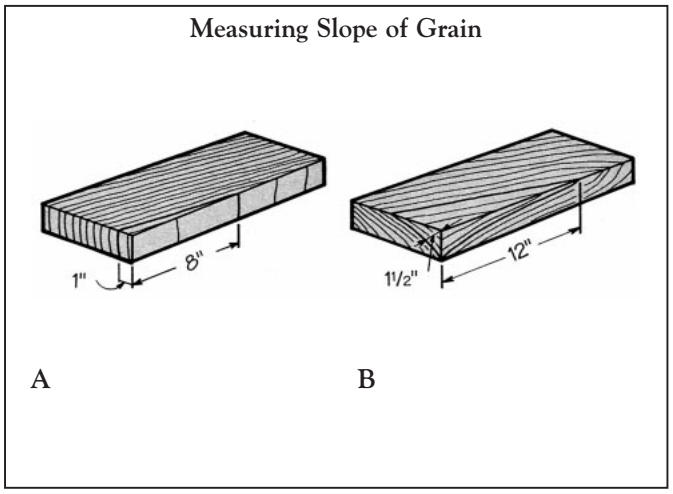
Wooden planks should be stored indoors, and should be stickered so air can circulate around the planks. Wood will rot when relative humidity reaches 80%. Stacking planks outdoors and wrapping them in plastic provides fungi with a cozy environment. Avoid this practice; it can be deadly.

Staging planks often perform secondary tasks when the need calls. I often see planks used as ramps for wheelbarrows loaded with concrete. Later the same planks may be used to support workers on a roof or sidewall. In another case planks served as a runway for trucks driving through a muddy lot. Later, they collapsed when they were put to use for staging. The injured builders sued their plank supplier, but didn't collect a cent. Negligence caused the injuries. Heavy concentrated loads like these can overstress planks.

Material selection. Call the lumberyard and order scaffold planks for your next job. If you live in the Northeast, full-sized, rough-milled 2x10 spruce planks are likely to arrive at the job site. But don't use them. Planks can be dangerous unless they are stamped with a scaffold grade stamp. The Northeastern Lumber Manufacturers Association (NELMA), the primary lumber grading agency in the Northeast, does not publish a scaffold grade. Therefore, many builders in this region use No. 2 spruce as a substitute. Number 2 of any species, however, is not good enough! Other grading agencies such as West Coast Lumber Inspection Bureau (WCLB), Western Wood Products Association (WWPA), and Southern Pine Inspection Bureau (SPIB) include scaffold grades in their rules. Insist on scaffold grade material when you order planks. They should be grade-stamped, indicating OSHA's approval.

There's one potentially dangerous loophole in OSHA's scaffold regulation, however, which says you must use scaffold grade or equivalent. It's the "equivalent" that can kill you. Technically you can get by with No. 2 spruce in some applications, but there are certain characteristics of No. 2 spruce (or No. 2 material of any species) that can prove catastrophic when used as staging plank.

While knot size is limited to $1\frac{7}{8}$ inches in scaffold grade, $4\frac{1}{4}$-inch spike knots are permitted in No. 2 Structural Joists and Planks grade. Knots of that size are surrounded by weak cross grain. The next time you look at a plank, notice how the



To measure slope of grain, first determine what kind of cross grain the plank has. With diagonal grain (A), which occurs in quarter-sawn lumber, you can measure slope of grain along one face of the board. With spiral grain (B), found in flat-sawn lumber, you must measure on the end of the board, perpendicular to the growth rings. Both boards have a slopoe of grain of 1 inch in 8 inches.

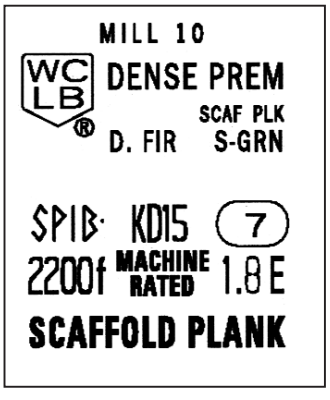
wood's grain bulges in the area around a knot.

If you place large spike knots on the underside (tension side) of a plank, you can bet the plank will break right at one of the knots when it's overloaded. Workers typically walk out to a point on the plank where it creates the maximum bending moment at the defect, and bang! The failure is sudden and can be catastrophic.

All things being equal, the strongest wood is straight-grained wood. Top scaffold grades restrict "slope of grain" to 1 inch in 20 inches, while No. 2 grades permit grain angles as steep as 1 inch in 8 inches, which is much weaker.

Pith and juvenile wood are also allowed in No. 2 grades. This wood is very light and weak. Scaffold grades prohibit the presence of these features.

Laminated veneer lumber (LVL) scaffold planks provide builders with an attractive alternative. They are stronger and much more predictable than solid-sawn material. Every plank is proof-loaded and OSHA-recognized. There are no knots, cross-grain, juvenile wood, or other strength-reducing characteristics to worry about. Two companies that make these are Trus Joist Corporation (P.O. Box 60, Boise, ID 83707; 800/338-0515), which manufactures Micro-Lam LVL scaffold planks, and McCausey Lumber (P.O. Box 545, Roseville, MI 48066-0545; 313/294-9663), which makes the Master Plank LVL scaffold plank. (Be sure to specify scaffold grade, since both companies make less rigid header stock.) A 1½ x 9½-inch x 16-foot LVL scaffold plank goes for around $32. Aluminum planks are another option, but they are pricey. A 16-foot aluminum plank will set you back about $300.



When buying scaffold planks, insist on scaffold grade lumber. Look for the grade stamp, such as these by the West Coast Lumber Inspection Bureau and the Southern Pine Inspection Bureau, or ask to see a certification document indicating a scaffold grade.

Pump Jacks

Pump-jack scaffolding is a favorite among builders and remodelers. It is efficient, goes up quickly, and adapts easily to out-of-level job sites. But anyone who has "pumped up" has also wondered whether the insurance policy is paid. The shaky nature of the beast, especially when working 25 feet above grade, should command the ultimate respect from workers. But amazingly, this is rarely true.

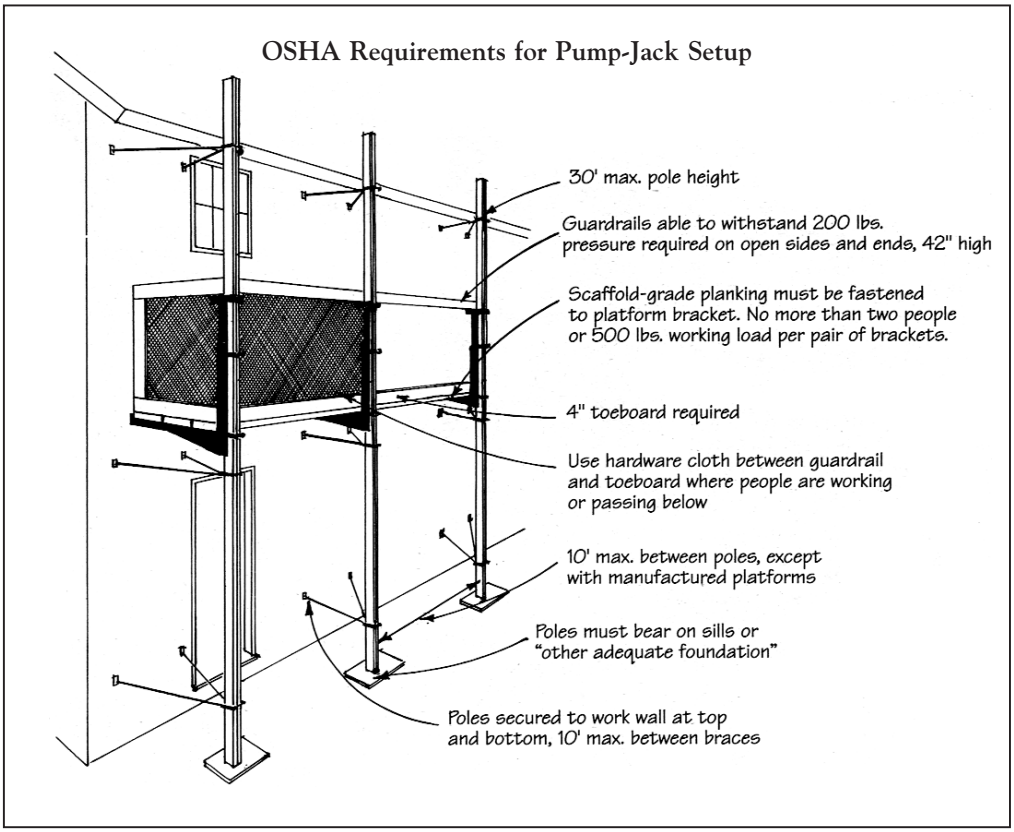
I've seen pump-jack setups where the planks were cantilevered dangerously past the last support, and more than once watched as one stretching worker yelled to a partner, "Don't move off the end of the plank while I nail this end of the trim."

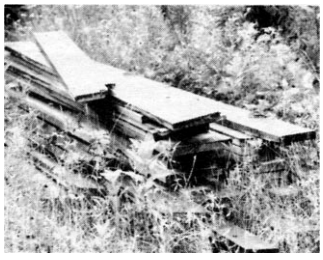
There are many jobs where pump poles are left unbraced — or run to heights well above the 30-foot OSHA limit. And workers often cleat planks together to create a wider walkway. That's a good idea, but why nail the cleats to the top surface of the planks where they can be tripped over? Careless behavior causes most pump-jack accidents.

OSHA insists that pump poles must be spaced less than 10 feet apart when wooden planks are used. Typically, builders purchase 16-foot planks and space the poles 14 feet apart. Seldom are the prescribed guardrails, midrails, endrails, and toeboards installed on residential applications. Poles must be braced at the top, bottom, and every 10 feet along the height of the pole. And the plank ends must be secured to the pump foot. Have you done this lately?

Poles are a weak link in pump staging. They should be made from full-length, doubled Douglas fir 2x4s (or equivalent) that are *straight-grained, clear, and free of cross-grain*. In cases where a pump-jack pole has to be longer than available 2x4 stock, OSHA regulations specify that the spliced poles must develop the full

Pump jacks are popular because they're inexpensive and set up quickly. Many setups, however, like this one, contain safety violations: no guard rail, undersized planks, and no support at the bottom. OSHA requirements for pump jack setup are shown below.





Storing scaffold planks outdoors will cause them to deteriorate from rot and mold. They should be kept in the dry and stickered.

strength of an unspliced member. Good luck here. The only way to do that is by attaching a steel plate or a third 2x4 to the outside of the pole over each splice — something few builders will take the time to do.

Improper materials and inadequate joint design cause many pole failures. In a typical case, two workers had loaded a metal scaffold plank with roof shingles and pumped up to the eaves of a split-level home. A third worker stepped from the roof onto the plank, rocked the staging, and the double 2x4 pole snapped. Short lengths of 2x4 had been spliced to make the pole. A knot located in the adjoining 2x4, opposite the butt-joint splice, caused the failure. The knot, and weak cross-grain associated with the knot, provided little lateral resistance to the unbraced scaffold. The sub-standard pole could probably have survived if proper crossbracing had been installed.

In a similar case, two painters fell from pump staging attached to the back side of a full-dormered cape. Again, the pole snapped at a joint. The 2x4s used to build the pole were relatively clear and straight-grained. However, the painters had left the poles outdoors, uncovered for extended periods of time. Moisture collected in the seams between the 2x4s and caused the poles to rot.

Contractor, Carl Anderson worried enough about the safety of wooden pump staging that he invented an aluminum pump-staging system. His company, Alum-A-Pole Corp. (P.O. Box 030066, Staten Island, NY 10303-0002; 800/421-2586), makes a modular system that is recognized by OSHA. Alum-A-Pole planks can span up to 24 feet and poles can safely support scaffold platforms to a 50-foot shoulder working height. A typical 24-foot-high x 24-foot-wide Alum-A-Pole system retails for about $2,200. A 24x48 version costs $3740. It's costly, but may be a solid investment when you factor in the added level of safety and life-cycle cost.

Ladders

Driving home from work the other night I spotted a construction site and stopped to take some photos. As I walked around the back of the house, there it was — the perfect picture: a carpenter standing on a 16-foot spruce plank supported by a step ladder on each end. He was friendly enough, but no photographs thank you.

A friend who has investigated dozens of ladder accidents claims that he has yet to find a defective step ladder as the cause of injury. Rather he finds that step ladders are misused or used in a broken condition.

Because most people feel secure using step ladders, it is very easy to get into trouble with them. Workers stretch too far from them, climb too high on them, and use them outdoors on soft ground where they can easily tip over.

On the other hand, builders respect the potential harm that comes with the misuse of long ladders. So here they act prudently. Most long-ladder injuries are caused by defective material.

Cross grain is the most treacherous defect that a ladder can have. As with wooden planks, cross-grain failure is sudden and total. I recently heard about a worker who suffered permanent brain damage from a fall when the rail of his ladder snapped. Cross grain caused the failure. His settlement will never compensate for the permanent disability he received.

Standards control how ladders are made, but given the critical importance of the tool, be on guard for defects. Inspect ladders carefully, rails and rungs. Look for knots and cross grain (slope no more than 1 inch in 12 inches). Look for a bulge in the grain that indicates that a knot might have been nearby in the original piece of lumber. Look for chipped grain, and discard ladders that have checked and split from weathering. With metal ladders check for corrosion on the inside of the hollow metal rungs.

Wooden ladders should never be stored outdoors. No matter how well you seal or treat the ladder, moisture will collect in the mortise between the rung and rail. High-quality ash rungs will simply rot at the tenons when a ladder is kept in a damp location.

Scaffold failures are all too common. But most can be avoided. Sensible use, careful maintenance and regular inspection are musts. The most dangerous element is the staging plank. Don't settle for planks that aren't recognized by OSHA. And get your hands on a copy of the scaffolding regulations from OSHA. These are included in OSHA's Construction Industry Standards, Part 1926, available for $12 from the U.S. Government Printing Office (Superintendent of Documents, U.S.G.P.O., Washington, DC 20402; 202/783-3238). ■

Paul Fisette is a wood technologist and director of the Building Materials Technology and Management Program at the University of Massachusetts in Amherst.