When the Framing Shrinks

Detail for wood shrinkage, and avoid callbacks for cracked plaster, stuck doors, and popped nails.

by Henry Spies

Wood is the most common building material in the U.S., but it is also one of the most unstable. Wood shrinkage (and expansion) has been the bane of builders since Noah. Basically, wood shrinks dimensionally as it loses moisture. Most of the shrinkage is across the grain, but there is some along the grain as well. The amount of shrinkage varies with the species of wood and with the specific moisture-content range.

For instance, as Douglas fir dries, the cells close and lock the opening, making it difficult for moisture to be reabsorbed. At the other end of the spectrum, Southern-yellow-pine cells are shaped like a bellows, and absorb and give off moisture like a sponge.

The amount of movement is also directly related to the portion of the log from which the lumber is cut. So-called juvenile wood, wood from the first 10 or so years of the life of the tree, is more unstable than mature wood. For the same change in moisture content, juvenile wood may expand or contract three times as much as mature wood. As first-growth timber has almost vanished from the scene, the lumber now marketed is from the smaller logs of second- and even third-growth trees, and contains a much greater proportion of juvenile wood.

As an example, consider the common 2x10 floor joist. When it is purchased at 19 percent moisture content, the federal standard for "dry" lumber it is 9 1/4 inches high. As the moisture content drops to the 9 to 11 percent range that is common in heated buildings, the vertical dimension will shrink as much as 1/4 to 3/4 inch, and that 2x10 may now be only 8 1/2 inches high! That amount of shrinkage is enough to cause many types of problems. And due to the increasing use of juvenile wood in construction, those problems appear to be on the rise.

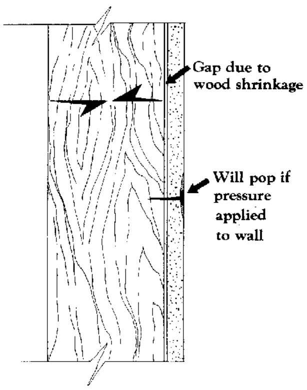
Nail Pops

The most common problem associated with wood shrinkage is the nail pop. When a drywall nail or screw is driven into a stud, the drywall is pressed tight against the face of the stud. As the stud dries, the point of the nail stays exactly where it was driven. However, the wood between that point and the surface of the stud shrinks—as much as 1/16 of an inch for a nail penetration of 1 inch. This creates a gap between the drywall and the face of the stud (Figure 1).

If anything applies pressure to the drywall, it will slide down the shank of the nail or screw, and the head will put enough pressure on the taping compound to "pop" the surfacing off the head. (The reason there are fewer problems with drywall screws is because it takes more pressure to slide the drywall on the screw shank.)

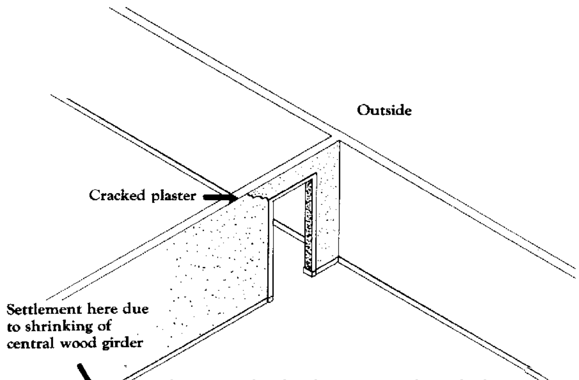
Nail pops most often appear near the intersection of the wall and ceiling drywall. As the studs shrink slightly in length, they allow the top plate and trusses to move downward, forcing the wall drywall to push against the ceiling. This pressure makes the ceiling drywall slide on the nail shanks and cause the pops on the ceiling. Nail pops can begin with the first heating season, but they can also occur several years later if there was no previous pressure on the drywall to cause it to slide.

FIGURE 1. NAIL POPS



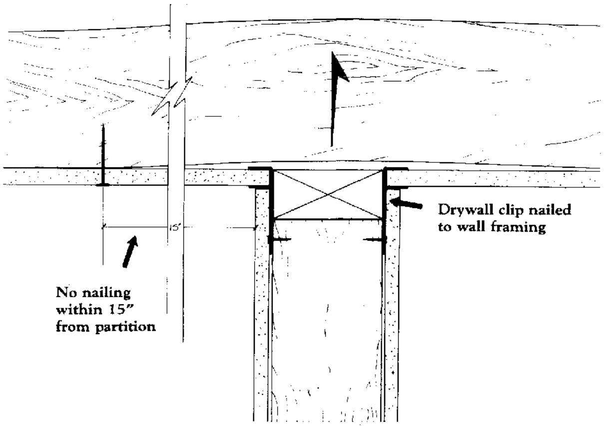
The cure: Use screws with 3/4-inch penetration into the wood, a screw gun, dry wood, and, if necessary, a control joint between the wall and the ceiling.

FIGURE 2. CORNER CRACKS



The cure: Steel girders, hung joists, or shimmed columns (after the fact).

FIGURE 3. TRUSS RISE



The solution: Drywall clips and floating corners on the ceiling drywall.

Corner Cracks at Openings

Perhaps the second most common problem caused by shrinkage is cracks in the plaster or drywall. These are usually diagonal, extending from the corner of the first opening in from the outside wall to the ceiling in any partition (Figure 2). As the floor joists shrink in a platform-framed house, the frame of the house is lowered fairly uniformly. However, one end of the floor joist is supported on a concrete foundation, which is stable. The other end usually rests on a wood girder, which shrinks about as much as the joist. The result is a shallow bowl in the floor that causes the diagonal cracks and sticking doors in the partitions.

In some cases, it is necessary to shim the columns in the basement or crawl space to re-level the house frame. The problem will not occur with a steel girder, of course, or if the floor joists are hung on the sides of the girder with joist hangers. The latter approach, however, may lead to a discussion of your ancestry by a heating contractor who is trying to run the ductwork.

Sheathing and Subfloors

As Douglas-fir plywood began to disappear from the eastern and midwestern markets, it was replaced by Southern-yellow-pine plywood. Due to the wood's cellular structure, as discussed above, the pine plywood tended to move with variations in moisture content. Each piece of pine plywood was marked with instructions to leave at least 1/8 inch of clearance on all sides, and 1/4 inch in areas exposed to extreme moisture conditions.

If the plywood sheets were spaced apart as instructed and the framing was on standard 16- and 24-inch centers, the joints no longer fill on the framing after the first two or three sheets, and the plywood couldn't be nailed. As a result, most carpenters butted the sheets tightly together, as they had always done with fir plywood. As the humidity increased, the sheets of plywood "grew," and the only way they could expand was to buckle away from the framing.

I have found subfloors that rose off the joists more than 1/2 inch, and roof sheathing that buckled enough for my hand to fit between the sheathing and the shingles. The answer was simple, and is now available—sheets that are cut slightly undersized and marked "sized for spacing."

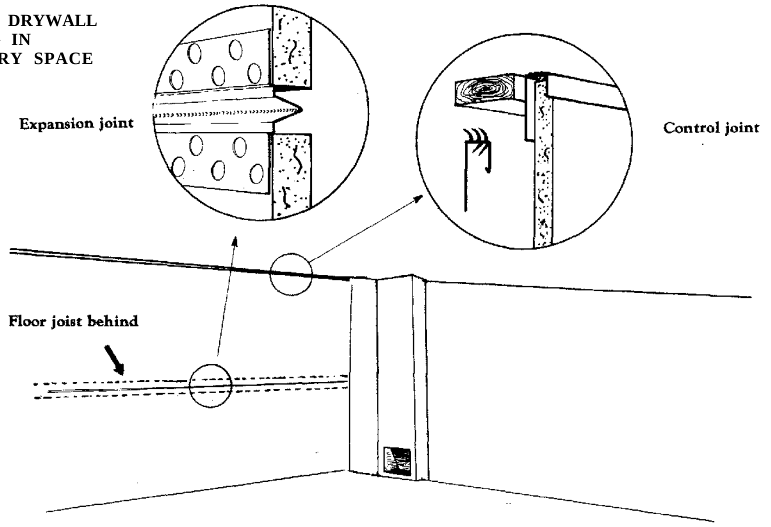
Truss Rise

Another phenomenon of the energy-conserving age is truss rise. When insulation is installed so that it completely covers the bottom chord of the truss, that member is much warmer in the winter than the top chords. As a result, it dries more and there is some longitudinal shrinkage.

If one member of a triangular structure—such as a truss—is shortened and the other two remain the same length, the peak will rise. Since the bottom chord of a truss is connected to the peak by the web members, the bottom chord is raised also, thereby lifting the ceiling off the partitions in the center of the house (Figure 3). This usually takes place during the first winter that the house is heated and, in most cases, occurs only once. If the bottom chord is pine and is juvenile wood, however, it will probably recur.

The forces are rather strong. One builder used metal angles and lag bolts to fasten the truss to the top plate of the wall after the first year's problem. The next winter, the rising truss lifted the wall right off the floor.

FIGURE 4. DRYWALL CRUSHING IN TWO–STORY SPACE



When the second-floor joists of an adjoining space shrink, the drywall in a two-story space can buckle. The cure: Use an expansion joint over joist, and a control joint (such as USG's P-I vinyl trim) at the ceiling.

I've found subfloors a half inch off the joists, and roof sheathing that buckled enough for my hand to fit under the shingles.

In new construction, the best answer is to refrain from nailing the ceiling drywall to the truss for about 15 inches on each side of the partition, and to support the ceiling drywall with corner clips attached to the studs. Then, as the ceiling rises, the drywall flexes but does not break the taped joint between wall and ceiling. About the only after-the-fact remedy is to nail a cove or other molding to the ceiling, and allow it to slide up and down the wall as the ceiling moves.

Drywall Crushing

In the multistory living areas with cathedral ceilings that are popular today, it is not unusual for the end-wall framing of the open area to include a band of horizontal wood—the second-floor joists of the adjoining space. If the drywall extends from floor to ceiling in the multistory area, it will be nailed to studs on both the first and second floors of the adjoining structure. As the floor joists of the second-floor platform shrink, the drywall will buckle and crush in the area of the floor joist (Figure 4) unless an expansion joint (such as a wood molding over an open drywall joint) is provided.

Another alternative is to apply the drywall to resilient channels, which will allow the studs and joists to move without affecting the drywall. At the ceiling, a control joint rather than a taped joint is almost a necessity.

Siding

The effects of wood shrinkage are just as evident on the outside of the house. The wood siding available today, particularly the cedar coming in from Canada, often has a very high moisture content, perhaps as much as 35 percent. If there is more than one nail across the width of the siding board, splits are inevitable as the wood shrinks. That is why the nail in the face of the siding must be high enough to miss the top of the siding board beneath it (Figure 5). The top of the board should be held by friction, not by the nail.

Also, the amount of overlap should be increased as the moisture content of the siding increases. I have seen siding shrink enough to come unlocked from the piece above.

Veneers

In many parts of the country, it is common practice to add a belt of masonry veneer about four feet high across the front of the house for the sake of appearance. The veneer is capped with a stone coping or a brick cap course, and the siding is brought down to the veneer with a metal flashing that extends from the sheathing out over the cap.

To make a neat joint, the builder typically fits the siding carefully to the cap course and, when the floor system shrinks the inevitable 1/2 inch, the siding is pushed down, perhaps even behind, the cap and forces it away from the house (Figure 6). At a minimum, the flashing will be bent, forming a channel to hold water against the bottom of the siding.

To avoid this problem, the siding should be stopped a full inch above the cap, and the flashing installed accordingly. Then, when the wood shrinks, the joint will close to a permanent position with the appropriate clearance. Incidentally, if vertical siding is used above the cap, the ends should be beveled (not square cut) to provide a drip edge on the outside surface.

Perhaps the most spectacular and disastrous example of this type occurred when someone built a three-story, wood-frame apartment building with full brick veneer. After the three floor platforms had shrunk during the first winter, none of the casement windows on the third floor could be opened, because the windows no longer matched the opening in the brick veneer. The through-the-wall air conditioners were all tipped inward, causing the condensate to drain inside rather than outside. It was an expensive demonstration of the folly of neglecting the effects of wood shrinkage in design and construction. ■

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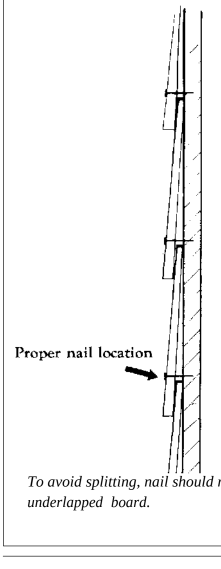
FIGURE 5. WOOD SIDING



To avoid splitting, nail should miss the top of underlapped board.

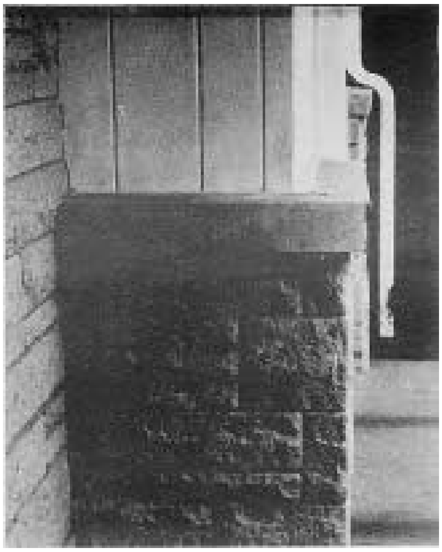
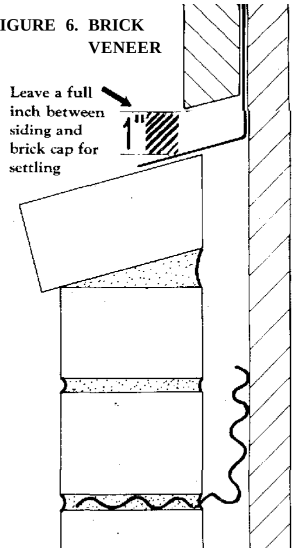


FIGURE 6. BRICK VENEER



When the floor joists shrink, the siding will fall and can force the brick cap away from the building (left). Proper detailing (right) leaves room for movement in the flashing.