

CEILING-FLOOR PARTITION SEPARATION: *What Is It and Why Is It Occurring?*

by DONALD H. PERCIVAL

In many cases, the cracking or separation of finish materials found in light-frame wood construction is caused by shrinking or swelling of the wood framing members due to changes in moisture content. Although unsightly, these cracks and separations are basically cosmetic and pose no structural problems. It is important to be able to differentiate between movement caused by the instability of wood and that caused by foundation movement or structural failure, which can cause major problems.

With the advent of the energy crisis in the 1970's, the use of large amounts of insulation became common. At about the same time, the cracking problem evolved, which I generally call Ceiling-Floor Partition Separation (CFPS). Cracks developed in the finish materials or between the ceiling and partition walls, or between the floor and the partitions.

Even though the wood roof truss is by far the most common method of roof framing, cracks and separations cannot be attributed exclusively to wood trusses. Other types of wood construction, such as joist and rafter framing, and the more recent wood I-joists, can show cracking or bowing. CFPS is found predominantly in the colder climates and where greater depths of insulation have been used. CFPS has been reported from Denmark, Sweden, England, and Canada, as well as in the United States.

CFPS can be the result of one factor or a combination of things happening at the same time. Because cracks or separations caused by changes in dimension of the wood components are temporary, required corrective measures should not include replacement of the roof system.

Attic Moisture

High humidity in the attic space will cause wood framing members to absorb moisture. If the humidity increases to the point of condensation on roof sheathing and framing members, the wood can approach saturation. The top chord of a truss can absorb moisture and

expand, while the bottom chord, buried in insulation and absorbing heat from the living areas below, can dry to a low moisture content and shrink. The primary change in dimension of wood with change in moisture content is in width and thickness. However, there is also some dimensional change in length as well, the amount depending upon the species and where in the log the member originated. Therefore, the combination of these two opposing actions, reduction of moisture in the bottom chord and absorption in the upper chord, can cause the truss to bow or arch upward. In the summer, the solar heating of the attic can dry the exposed framing, causing the truss to return to its original position. The same action can occur in ceiling joists partially imbedded in insulation.

Humidity problems can be caused from improperly venting the bathroom and kitchen vents into the attic space. Even more serious is the discharge of moisture from the clothes dryer into the attic. Venting moisture sources into the attic should not be allowed.

When adding insulation to an existing attic, soffit vents are often inadvertently closed off or covered, which blocks the path of air movement through the attic, as shown in *Figure 1*. Adequate ventilation of the attic is essential to control attic humidity.

Another significant source of moisture in the attic can be the crawl space, because moisture moves not only

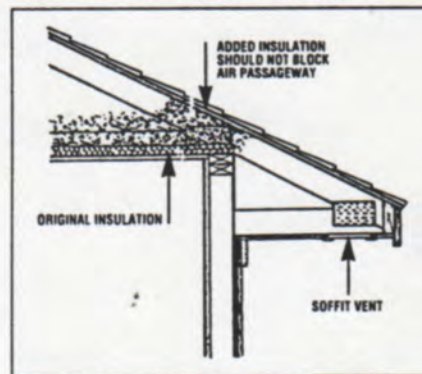


Figure 1. Insulation may block air movement from the soffit vents into the attic space.

through the living area, but also through the stud spaces of the walls and interior partitions, particularly plumbing walls. The crawl space should be vented through foundation vents if there is a moisture problem, and the soil surface should be covered with a polyethylene vapor retarder. Providing proper outside grading (six inches of slope away from the foundation in the first ten feet) will move rain water away from the structure and reduce seepage through the foundation walls.

Ceiling Drywall Nailing

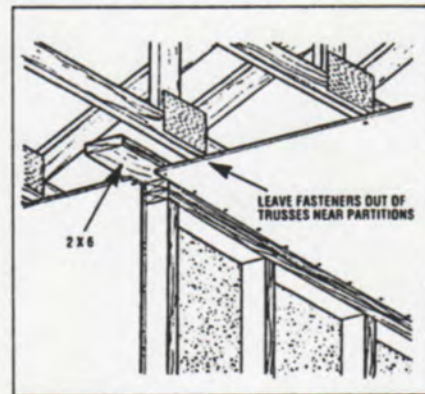


Figure 2. When the trusses are parallel to the partitions, install 2x6 nailers for fastening the ceiling materials. Do not nail the ceiling material to the bottom chords near partitions.

Nailing the ceiling drywall directly to the bottom chord of the truss near the partition can increase the probability of visible cracking. If any shrinkage or movement occurs, cracks can develop at the partition line. One suggested construction practice is to install "deadwood" blocking to the top of the partition wall plates between the trusses. These blocks provide a nailing surface for the drywall. The drywall is not nailed to the bottom chord of the trusses for 12 - 16 inches from the partition, as shown in *Figures 2 and 3*. Several proprietary clip-type devices have been developed to take the place of "deadwood" blocking, but I have no first-hand personal evaluation or research information on these devices.

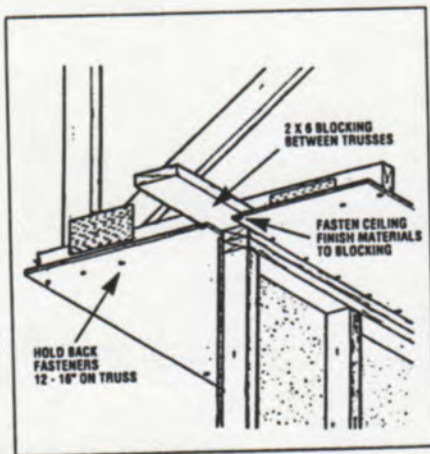


Figure 3. When the trusses are perpendicular to the partitions, install "dead wood" blocking to attach the ceiling finish material. Do not nail the finish material to the truss chord for 12-16 inches on either side of the partition.

The amount of heat absorbed by the lower chord of the truss or ceiling joist can be reduced by installing rigid insulation board between the drywall and the chord or joist. The insulation should be fastened to the blocking as well.

Other Causes

While research has shown that some ceiling joists, I-joists, and trusses actually do bow or arch upward, there are several reasons not necessarily associated with trusses which can cause CFPS to occur. Following is a list of other known causes, which do have implications of structural problems, with some recommendations to reduce the possibility of cracks and separations.

Foundation Settlement. Settlement of the floor girder support pads and the effects of freezing/thawing on the perimeter foundation can produce the same effect at the junction of the ceiling and partition walls as truss arching. Foundation details are important. Footings which extend below the frost or freeze line are essential to prevent frost heave, particularly if the building is left unheated during part of a winter season. A second source of movement may be the method of supporting the floor girders in crawl-space construction, especially in areas with a high water table. The footings under the girder columns should be large enough to prevent settlement or tipping in the soft soil, which may become plastic under load.

Expansive Soils. Movement of concrete slabs built on expansive-type clay soils also can cause cracks and separa-

tions. Shrinking or swelling of expansive clay soils can cause a concrete slab to either bow upward near the center or raise around the perimeter of the structure. This is caused by differences in the moisture content of the soil. These expansive soils are most prevalent in the semi-arid regions of the country, running from the eastern two-thirds of Texas into Louisiana and northwest through the great plains. They also occur in some parts of California. Expansive clay soils exhibit the most extreme movement in areas which have relatively heavy rainfall for short periods of time followed by lengthy periods of dryness or only slight rainfall.

In truss-roof structures with partitions essentially near the center, cracks can occur at the ceiling line of the exterior walls if the slab bows up, as shown in Figure 4a. On the other hand, if the soil around the perimeter expands, one or both ends of the truss can be raised, causing cracks to develop at the ceiling line of the partition walls and the truss, as in Figure 4b. As the soil moisture equalizes, the slab may return to its normal position and the cracks close.

Wood shrinkage. Excessive shrinkage of the wood framing members, including the girders, girder shims, sill and perimeter wall plates, floor joists, and partition wall plates, can also cause symptoms similar to truss rise. Figure 5

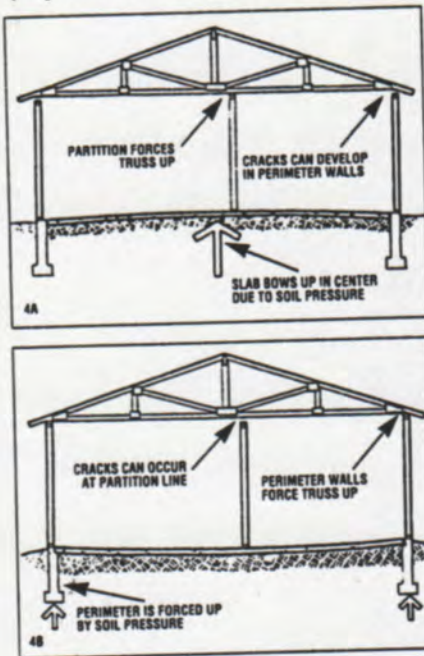


Figure 4. A concrete floor slab over an expansive-type clay solid can (a) bow up the center, or (b) rise at the perimeter. Either can cause CFPS.

shows a typical crawl-space detail where excessive shrinkage and settlement can cause cracks and separations.

To prevent problems from this source, the builder should use lumber that has been properly dried, then properly protected during shipment, storage, and handling. When preservative-treated lumber is used for sill plates, less shrinkage occurs if the material has been redried after treatment.

Deliveries to the job site should be carefully scheduled to reduce the length of time the components are exposed to the elements. The higher the moisture content of the lumber at the time the building is covered, the greater the percentage of shrinkage and the greater the possibility of CFPS. The use of joist hangers can reduce the effects of cumulative shrinkage because the joists are in the same plane as the girder and not stacked on the girder as shown in Figure 5.

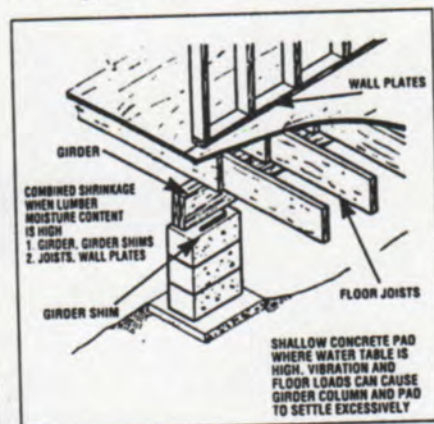


Figure 5. Crawl-space details such as this have the potential for cracks and separations.

Camber. Some truss firms fabricate trusses with a slight upward bow or camber in the lower chord. In theory, the lower chord is supposed to flatten out as the truss is loaded with the weight of the construction materials, but this rarely happens with roof trusses. If the field carpenters "pull out" the camber during attachment of the truss to the partition, the truss may tend to return to its cambered position during the first heating season. If the attachment is strong enough to prevent the truss from lifting off the partition, a separation could occur at the partition-floor line.

If the trusses are fabricated with a camber, the recommended practice is to install thin shims or spacer blocks

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between the bottom chord and the partition plate, as shown in *Figure 6*, to prevent pulling out the camber. Shorter roof trusses should not be built with camber.

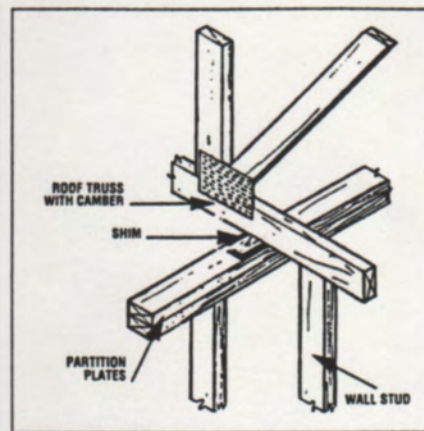


Figure 6. If the roof trusses are fabricated with a camber, shims should be installed between the bottom chords and the partition plates to prevent pulling out the camber.

Corrective Measures if CFPS has Occurred

1. Recommendations suggest waiting through at least the first heating season, preferably two, to determine what is causing the cracks or separations to develop.
2. Check the attic and crawl space for adequate ventilation. Remove any exhaust openings vented into the attic or crawl space. Vent them to the outside. Move any insulation covering the soffit vent system in the attic.
3. If the truss is arching or bowing upward, remove the ceiling drywall fasteners 12–16 inches from the wall and install blocking for re-attaching the edges of the drywall.
4. Install crown molding at the ceiling line. (Note: fasten the molding to the ceiling, not walls.) Subsequent repainting should be done during the heating season or when the cracking or separation is at the maximum.
5. Do not cut the web members of the truss. This action destroys the structural integrity of the truss. Furthermore, there are known incidents where CFPS has recurred after web members had been cut. ■

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Truss Uplift Solutions

Q. What would cause the sole plate of a nonbearing partition wall to pull away from the subfloor? The wall is nailed into roof trusses where they cross it above. There is no sag in the floor system below.

A. David Utterback responds: If your floor is framed with green lumber, shrinkage of the floor joists could contribute to the problem you describe. But the primary cause is probably truss uplift. Lower truss chords that touch the warm ceiling dry out and shrink during the heating season, while the cold upper chords gain moisture and expand. The whole truss then curves

like a bow, rising at the center. If the truss is nailed to the wall, it pulls the wall with it. The moving truss can also create drywall finish cracks in the corners where walls and ceilings meet (see illustration, below).

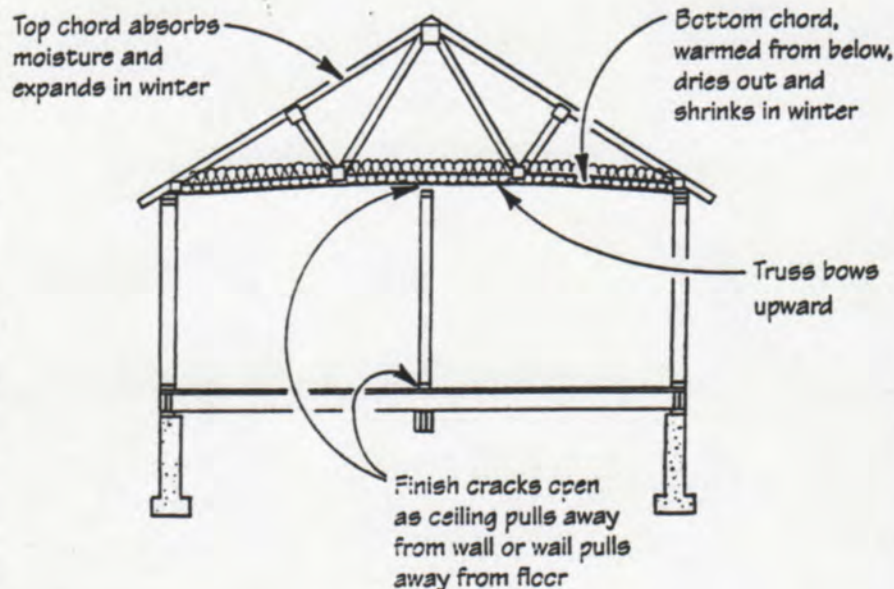
Whether floor joist shrinkage or truss uplift is causing the problem, the way to prevent it is the same: Instead of nailing trusses to wall plates, use truss clips as shown in the photo below (available from Simpson Strong Tie, 4637 Chabot Dr., Suite 200, Pleasanton, CA 94588; 800/999-5099). The clips allow each truss to flex up and down freely, while preventing it

from moving side to side.

Also, don't screw the ceiling drywall to the truss where it passes over the partition. Instead, hold your screws 12 to 16 inches back from the partition and screw the edge of the ceiling drywall to 2-by nailer blocks that have been fastened to the wall top plate between the trusses. This gives the drywall enough room to flex at the joint and prevents a crack from forming.

We usually see these movement problems in the first couple of heating seasons. After that, the houses seem to settle down and the problems lessen. In any case, the wall should drop back down in the spring, so wait until then to fix the problem. Whatever you do, don't shim under the wall during winter when the crack appears — if you do, when the roof settles back down in spring, you'll have created a bearing situation in the center of the truss where there isn't supposed to be one.

Truss Uplift



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Bending Wood Shingles

Q. I'm about to take on a wood-shingle roofing job on an unusual roof with a lot of sinuous curves. I'm planning on steaming and bending strapping to provide a nailing base for the shingles, then steaming and bending the shingles, too. But isn't there an easier way?

A. Martin Obando responds: You can make slight bends in shingles by just soaking them. But for serious curves, you've got to steam them. Get a book on wooden boat building or visit a boatyard if you want to learn how to steam wood — the same techniques that work for big timbers work for shingles. I've seen people rig up a steaming apparatus from an old beer keg, a piece of waste pipe, and a propane heater — if you're handy, it's not too hard.

Ten or 15 minutes of steaming will soften up shingles. Once they're soft and you've bent them into the shape you want, douse them with cold water

Shrinkage in bottom chords and expansion in top chords cause trusses to flex upward at the center, lifting walls and ceilings with them. Prevent the problem with truss clips (left), which allow the truss to move up and down with seasonal moisture changes, while restraining movement in any other direction.

