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Common Failures in Wood Structures

by Paul Fisette - © 2002

Disgruntled customers sometimes call long after a job is complete. Complaints about misaligned wood moldings, roof leaks, floor squeaks and plaster cracks are common in wood frame construction. Customer dissatisfaction can threaten a builder's reputation and settling claims requires delicate negotiation. The outcome of a negotiation is not predictable, and you can count on one thing: the cure will cost the customer and builder money. Prevention is always the least expensive and strongest remedy.

It is easy for a builder to become defensive when his or her level of workmanship is called into question. When the builder leaves a job things may be in showroom condition. Materials were carefully selected. And the customer probably spoke volumes about the quality of the crew's workmanship during the walk-through. But the way materials and products perform can change over time.

Here is a selection of problems that I have seen over and over again. Most are predictable, but not obvious. Some are obvious, but not always predictable. All of the problems upset customer relations and cost time, money and good will.

Mitered Casings

Symptom: Mitered window casings meet tightly at the short point of the mitered joint (edge toward the opening), but are spaced apart at the long point (edge away from the opening).

Investigation: It appears that the length of the casing was calculated accurately since the casing meets along part of the joint. But the angle of the mitered joints seems to be miscut. The openings developed during the early summer months.

Fluctuations in relative humidity drives dimensional instability of wood. Wood shrinks and swells most in the direction tangent to the growth rings and about half as much perpendicular to them. Dimensional change is insignificant in the direction along the grain. A dry piece of wood casing, tightly mitered and installed during the winter months can look much different during the summer months. Picture what happens to the casings as the humidity in the home swings.

Indoor relative humidity can drop to 20% during cold periods and rise above 75% during humid summer months. Moisture content of wood casings swing from 4% to 16% under these conditions. And 6-inch wide casings can grow more than 5/32". But it is the way they grow that causes the problem. Because wood swells by different amounts in each direction, mitered connections remain tight at the bottom, but separate at the top as the casing swells.

Prevention/Cure: Lead the customer on a careful walk-through after the job is completed. Point out the level of craftsmanship as you inspect the job. Install high-quality wood casing that is at 8%-12% MC. Keep records showing the MC of the wood when it arrived and what the humidity conditions in the home were during storage and installation. Educate the customer. Encourage them to maintain indoor humidity levels between 40% - 60%. This range is healthy and will help keep your work looking good.

Wood Flooring

Symptom: Floor boards have developed unsightly gaps 6 months after a home is occupied. Several individual boards appear to have shrunk significantly while large areas of flooring remain tightly arranged.
Investigation: Several 1/2"-gaps separate large sections of the tongue-and-groove strip flooring. The occurrence seems random, but the separations run in a connecting zigzag pattern across the room. The humidity in the room is 50%, a reasonable level. The manufacturer's and distributor's records show that the material was delivered at a moisture content between 6% - 9%, also an appropriate level. And you know the material was installed correctly. Could there have been a few wet boards mixed into the shipment? Possibly, but not likely since the separations are continuous across the room. Checking your construction records you realize that the basement slab was poured a week before the flooring was delivered, installed and finished.
Dry flooring was installed, but it took on moisture provided by the curing slab. Wood fibers at the edges of the boards were pressed against each other and compressed as the boards increased in size. As indoor humidity dropped, the boards shrunk to a size smaller than their installed size("compression set"). Polyurethane finish dripped between the floor boards during finishing effectively gluing the boards together. The wood flooring shrunk as a monolith, separating along a few planes of weakness. It only appeared that a few boards had shrunk. In reality, all the boards had swelled and then shrunk.
Prevention/Cure: Prevention in this case is the only cure. Relaying the floor is the fix. To avoid similar problems: Only install flooring that has equalized to its in-use moisture content. Control indoor humidity levels and do not introduce powerful sources of moisture into the home. Record and document humidity levels in the home and moisture content of the flooring during storage and installation. Good record-keeping helps assign liability when problems arise.
Contrary to conventional wisdom, I do not believe that leaving a 3/4" gap around the perimeter of the room solves the problem. Flooring nails would have to be sheared off or pulled out of the subfloor in order for flooring to fill the recommended 3/4" perimeter gap. It's simple, either you stabilize your floor or you have problems.

Wood Doors

Symptom: Interior passage doors no longer close within their openings. The doors closed properly when they were installed, but after a couple of months the doors began to rub against the strike jamb as they were closed. Now they are too wide to be forced closed.
Investigation: In this case the series of events is obvious. Have the jambs moved? Unlikely. The doors adsorbed moisture and swelled. However the root cause requires further investigation.
Good record keeping allows you to determine the moisture content of the doors when they were delivered and installed. Were they too dry, below 6% MC, when delivered? Check the moisture content of the doors now. Find out when the doors were sealed. Determine whether all doors have swollen or just certain ones like the bathroom or basement doors. Isolated swelling suggests local humidity problems.
Prevention/Cure: Wood doors should be manufactured to a moisture content from 6% - 12% and installed at that level. But doors can become unstable in houses with fluctuating humidity levels. For best results, doors

should be sealed right after they are made. The undercut edge and all hardware cutouts, including butt routs and basket bores, should be sealed immediately. End-grain is very absorbent so an unsealed edge will suck up moisture rapidly under humid conditions. If doors arrive at the jobsite unsealed check the moisture content by inserting the probes of a moisture meter into the end-grain and seal it when conditions are correct.
To solve the immediate problem: Plane the door to size and reseal the edges. Also, as with most dimensional stability problems, control the indoor humidity.

Garage Doors

Symptom: The bottom panel of a sectional garage door is rotting within 3 years of installation.
Investigation: Inspection shows that the paint on the bottom door panel is peeling and the lower edge of the door is decayed. The lower edge of the door contacts a concrete curb when it is fully closed. A wide overhang protects the door and sidewalls of the garage from exposure to weather.
Prevention/Cure: This problem occurs very often - just look at the garage doors in your neighborhood. The doors might be protected from direct exposure to rain, but if there is no capillary break separating the bottom of edge of wood-based doors from the concrete, the door will rot. The solution is to attach a rubber gasket along the bottom edge of the door when it is installed. Splash-back against the lower portion of the door should be minimized by a substantial overhang.
The fix for the problem is to replace the bottom section of the door, paint it and add a gasket to its lower edge.

Front Entrance

Symptom: A customer complains their front entryway is rotting away. Paint on the expensive wood-door assembly is peeling and wood fiber is actually flaking away.
Investigation: The stile and rail door unit was installed only a couple of years ago. Manufacturer's recommendations and instructions were followed to the letter. But still: the paint on the lower rail and bottom of the stiles is peeling; the joint between the lower rail and stiles is decayed; and the kickboard beneath the metal sill is rotting. The door swings inward and there is no storm door attached to the unit. A pre-cast concrete stoop rests against the house beneath the entrance.
Prevention/Cure: Unfortunately, variations of this theme are common. Several conditions lead to the failures described. First of all, reliable overhead protection should be part of the entryway design. Have you ever fumbled your keys trying to enter your home on a rainy night? But more important than convenience, overhead protection eliminates splash-back. Rain or roof run-off splashes vigorously off masonry surfaces like brick walkways and concrete steps, wetting adjacent wall surfaces. North-facing walls are particularly prone to decay. They remain wet longer than other walls.
As a minimum protective measure, install a storm door or hang the entry door so it swings outward. Otherwise, the door sill acts like a catch basin collecting rain water. Wind forces collected water against the door bottom where absorbent end-grain of the stile sucks up water and passes it along to the end grain of the abutting rail. Decay and peeling paint is worst at this connection.
Another point worth mentioning involves the front stoop. Many pre-cast concrete stoops are installed directly against the wood frame of the house. Since the step-up to the house is limited to around 7 inches, builders are forced to hold the top level of the stoop to a height above the wood frame of the deck. Carefully flash this point. Space the stoop away from the house and use a pressure treated kickboard under the sill.
As for fixing the rotted entrance - replace the door and trim!

Faux Truss Uplift

Symptom: The center partition in a second-floor hallway has separated from the ceiling, leaving an unsightly crack along this taped drywall connection.
Investigation: The roof is framed with trusses. And after reading several reports about truss uplift it's reasonable to blame truss uplift for the ceiling separation. But a trip to the attic may suggest another cause.
String a line end-to-end along the bottom chord of the truss. In this case the bottom chord is dead straight, but a 3/8" gap is clearly visible between the lower chord and the top plate of the center partition.
A triple-laminated 2x12 drop beam supports 2x10 floor joists in the basement. The girder is located directly beneath the center partitions of the first and second floors. All lumber is grade-stamped "S-DRY" meaning that it was surfaced at a moisture content of 19% or lower. The moisture content of the girder and joists is 11% at the time of the inspection. It is assumed that the lumber used to frame the center partitions is at least as dry. A quick calculation shows that cumulative shrinkage of the center bearing system could easily equal the 3/8-inch gap found under the truss.
Prevention/Cure: Normally, ceiling joists lap-join over the center partition. This lap-joint mimics a hinged connection allowing the ceiling to drop as the center bearing system shrinks. On the other hand, bottom chords of trusses are not "hinged" at mid-span so they can not drop as the bearing system shrinks.
There are several ways to avoid cracking at the ceiling/wall juncture. Don't use trusses. If you use trusses, fasten them with hardware that allows the drywall fastened to the ceiling to float in unison with the drywall fastened to the wall. Another option is to use dry framing lumber. Lumber stamped "MC 15" is a good choice.
The fix is obvious. Patch the crack and hope the system remains stable. Or apply a molding to cover the crack. Be sure to fasten the molding to the ceiling only. This will allow the wall to slide up and down without developing a noticeable separation.

Cracked Drywall

Symptom: A customer complains that their drywall is cracked at the upper corners of several windows and doors.
Investigation: Inspection reveals that hairline cracks have developed in the drywall above the upper corners of several windows and doors. The cracks run straight up from the top of the openings to a height just below the ceiling. A conversation with the drywall contractor and review of the lumber delivery list provides critical insight.
Prevention/Cure: The drywall contractor installed the drywall so that the edges of the sheets run straight up, past the corners of the window and door openings. A single piece of drywall was used to plug the entire area above each opening. This practice should be avoided.
Headers with a moisture content of 19% can shrink 1/4" across their width while studs don't change in length. The differential shrinkage between the headers and the king studs attached to the side the headers can cause the drywall to crack .
It is best to cut the drywall in an L-shape around the windows and doors so that the seams are located in the region above the openings. Do not fasten the drywall to the header. Screw the drywall into the cripples and wall plate above the headers. Let the wallboard float down over the header. Use the interior window casing to hold the loose edge of the drywall secure.

A Leak That's Not A Leak

Symptom: The cry is heard: " My roof is leaking." The north-facing slope of a cathedral ceiling is dripping small amounts of water and the v-groove ceiling boards are stained with water spots at several mid-span locations.
Investigation: No penetrations or potential roof leaks are found during the inspection. However, the customer's report proves accurate. Wet spots are found in the ceiling. It is a cold winter day, but there is no snow on the roof. And it hasn't rained or snowed in at least a week.
The roof is framed with 2x12 rafters and decked with 1/2" plywood roof sheathing. Nine-inch thick batts with an attached vapor retarder were used to insulate the sloped ceiling. Insulation batts were inset stapled so the face of the rafters was left exposed, providing an easy target for nailing the v-groove boards in place. The continuous soffit and ridge vent system was installed to code. A 2-inch gap was maintained between the insulation and the underside of the roof deck. Yet the plywood roof sheathing and insulation was wet in spots.
The upstairs room is kept at 70 degrees and has a relative humidity of 50%. A psychometric chart shows that the dew point temperature for this condition is 50 degrees. So the water vapor in the indoor air turns to liquid water as it cools to a temperature below 50 degrees. The plywood roof surface is estimated to be well below the dew point temperature since the outdoor air is 25 degrees. Condensation will form on the underside of the plywood roof sheathing if indoor air reaches that surface.
Prevention/Cure: There are several approaches worth considering: Raise the temperature of the plywood surface to a level above the dew point temperature; reduce or eliminate the source of moisture; evacuate the water vapor from the ceiling cavity before it can condense; or prevent water vapor from entering the ceiling cavity.
The continuous soffit-to-ridge ventilation system is obviously failing to exhaust the water vapor effectively. Inset stapling of batt insulation compounds the problem. It creates puckers along the edge of the batt where it is fastened to the rafter. Moist indoor air easily passes through the seams in the v-groove ceiling boards and enters the rafter bays through the puckers (called bird's mouths). The moist air cools and liquid water condenses out of the air as it strikes the cold plywood surface.
Edges of the vapor retarder should be overlapped and fastened to the bottom face of the rafters creating a tighter, more continuous surface.
Better yet - install a continuous vapor retarder/air barrier membrane over the entire surface of the ceiling before installing (or reinstalling) the ceiling boards. Make sure to seal the edges. Also, lower the indoor relative humidity to 30% using mechanical ventilation. This will reduce the dew point temperature to 37 degrees limiting the frequency of the problem. The combination of proper roof ventilation, tight construction and low indoor humidity levels will help minimize the chance this problem will occur.

Squeaky Floors

Symptom: Floor boards squeak as homeowners walk across the floor. Squeaky floors rank high in nuisance value. Customers usually hold their complaints until the squeak has exploded their nerve endings, placing the attempted fix under the closest scrutiny.
Investigation: Measure to locate the source of the noise.
Prevention/Cure: Squeaks result from wood rubbing against wood. So the cure is simple: prevent or eliminate the movement of one surface against another. But effecting that theory may be difficult.
A common source of noise arises when a floor joist shrinks after it is installed. A space develops between the sub-floor and the top of the floor joist. When a homeowner walks over this spot, the sub-floor moves against the joist and squeaks.
If squeaks are located in the first floor, you're in luck. Identify the spot and eliminate the movement from the

basement or crawlspace. One cure is to attach a length of 1x3 to the side of the offending floor joist. Attach the strip along the top edge of the joist using screws and glue. Make sure you also spread adhesive between the top of the 1x3 strip and the sub-floor. The adhesive will help prevent future rubbing action.

The solution is not so simple when the squeak is located on a second or third level of a home. Usually a finished ceiling blocks access to the underside of the floor deck. Use common sense and imagination in these situations.

Another common cause of squeaks is under-layment rubbing against the sub-floor. The best cure for this situation is prevention. Spread a layer of adhesive onto the sub-floor before screwing the under-layment in place. General advice: use dry wood, keep it dry, apply construction adhesive between all wooden surfaces and use screws - not nails - to fasten sub-floors and under-layment.