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CRACKING AND OTHER DEFECTS
IN HARDWOOD FLOORS, CAUSE
PREVENTION AND CORRECTION

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III. CRACKING AND OTHER DEFECTS IN HARDWOOD FLOORS - CAUSE, PREVENTION, AND CORRECTION

Cracking in new hardwood floors within the first year of construction of a new home has long been a discouraging happening for a new homeowner, who has just completed the biggest investment of his life. Most builders have likewise been perplexed and generally frustrated as to why this has happened in the great home they just built to standards which they consider outstanding and worthy of a crack-free, tight hardwood floor.

Over the past 15 years, I have been inspecting completed homes, and the dominant complaint of the homeowner has been - ***"Why are my hardwood floors cracking and can they be fixed?"***

Some years ago, I discovered what I believe to be the reason for this cracking and have developed some corrective means to repair. The methods of prevention are a part of my "Standard Residential Framing Notes." Many of my customers have requested publication of these notes, and this article is the response to these many requests.

The cause of the cracking is floor framing shrinkage which isn't resisted uniformly across an expanse of hardwood floors.

Hardwood flooring is nailed uniformly to the floor joists at intervals equal to the width of the hardwood floor boards. Generally, this nailing to the joists is done with tightness of boards at installation. This nailing of the joists, if done with tightness of boards at installation will remain tightly together over each joist, and the shrinkage of the floor joists will not open up the finished boards.

Joists are in lengths up to about 16', and open floor areas can be many times that. Therefore, as the short joists shrink (contract) en route to their stable length, the joist shrinkage force must be resisted across the girders at each end of the joists. This restraint must be sufficient to distribute each joist shrinkage across its support into the adjacent joist spans. If the floor is so nailed that it is tied together as one, from outside band to outside band in both directions, no cracks should develop in the finished hardwood floor.

The Great Commandment of Floor Framing is ***"Tie it together to act as if it were one solid piece of wood without joints."***

There are a number of practical things to do and a number of common practices that must be avoided. It has been my experience that very few framers understand why cracks occur and why some common practices are not good practices.

To effectively tie a many-pieced floor together from outside band to outside band, follow these procedures:

- 1) For in-line girders:

- a) Toenail each joist at each end with a minimum of 3-8d nails into the girder and at the outside band. End nailing is worthless and should never be used. However, this is a common practice to avoid. Nails larger than 8d should not be used due to the danger of ends splitting. All three toenails must be solid and not have split the joist. If any of the 3-8d's is ineffective, it must be replaced with an added nail to leave 3-8d nail fasteners which are fully effective.
 - b) The multiple girder, if two-ply, can be nailed with either two rows of 16d nails at 32" on center in each row, 2" up from the bottom and 2" down from the top, or 3-16d nails vertically at 32" on center. At each joint in the plies, 3-16d nails must be nailed at each end of the piece. This nail pattern should be for each ply; that is, from each side. If it is a three-ply member, then each ply as applied should be nailed. All nails from each side should be staggered with respect to the opposite ply pattern, and all nails in the girders should be angled, not perpendicular to the ply. The angle nailing gives the girder its resistance to pulling apart from its sistered member.
- 2) For dropped girders:
- a) Floor joists are lapped in this framing system. The ends of each sistered joist must be nailed to its sistered joist with 3-16d nails. This means 3-16d nails in each end from each side. Many times, I see one or two nails and not three. The floor cracking oftentimes spreads out over an area 3'-4' removed from the girders due to this partially effective nail pattern. It is important to use 3-16d's on each side and at each end to be completely effective.
 - b) The dropped girders should also be nailed the same as the in-line girder. This ensures a tight floor. If the girders are not nailed at all, cracks as wide as $\frac{1}{4}$ " can open up over the girder line within six months after occupancy. Some old-timers have told me that they haven't experienced this cracking problem. This is probably true, but today, our lumber is greener, has a generally higher moisture content, and our houses are being built in much shorter times, such that the framing can't dry out and shrink prior to the installation of the finished flooring. Very little effort is undertaken to have the framing dry out prior to hardwood installation. Approximately 90% of all new homes require 12 months or one complete heating and cooling cycle to reach stability of shrinkage and temperature. The balance generally takes 24 months. The two-year houses I've found are ones built during excessively rainy periods and were generally subject to more rain and wetness in the framing stage.

Another problem creating high moisture in the framing of the crawl is the poor practice of letting rain water collect and pond in the crawl due to the poor exterior drainage during construction. As Boy Scouts, we were taught that the first thing you did when you set up your tent was to ditch it on the outside, in order to keep your tent dry. If contractors would ditch their building sites at the foundation perimeter and keep it ditched during construction until final grading, most high moisture problems would disappear, and shrinkage of the crawl framing would decrease considerably.

Where steel beams are used, with joists framing into them, blocking to support either ledgers or metal joist hangers must be thru-bolted with a minimum of ½" round bolts at 24" on center.

Metal joist hangers should have all nail holes, and nails should always be at an angle.

At floors where the joists change directions, you should install bridging at approximately 6' on center for a minimum of six joist spacings beyond any joist direction change. This will ensure shrinkage distribution over the floor and not let it accumulate at the girder and result in a crack in the finished hardwood at this joist change of direction.

The repair to jointing of hardwood floors is dependent upon the general condition of the floor with respect to joint width and timing after construction. I categorize cracking as follows:

- 1) **Severe** - One or two large open joints over the girder lines of the framing below, joint width varies from $\frac{1}{16}$ " to $\frac{1}{4}$ ". The balance of the floor over the joist is tight. This condition is almost always the result of no nails or only one or two nails fastening the two- or three-ply girders together. If a house has already completed one cycle of heating and cooling, then about the only solution is to remove one board at the joint or joints, trim a new wider board to fit, and face nail it into position. Refinish the new board and its neighbor, stain it to match, and apply one or two coats of finish to the newly sanded area. This may be satisfactory in appearance, but we have found that you generally need to apply one additional finish coat over the entire floor to make the difference in appearance of the repair go away. You generally do not have to resand the entire floor.
- 2) **Moderate** - Joints generally centered over the girder line, but narrower ($\frac{1}{32}$ " or less) over a 3'-5' band. This is generally the result of partial nailing of the girders together and partial nailing of the joists to the girder or each other, if lapped. If this occurs after one complete cycle of heating and cooling, partial removal of the floor and again refinishing as previously described is about the only way to achieve a good-looking floor.

Generally, no removal and refinishing should ever be undertaken until one complete cycle of cooling and heating has been completed, because the floors often

correct themselves within one to two years following the stabilization of the structure for temperature and humidity.

There are two conditions of "cupping", a common complaint. One is when the board cups upwards and the other is when the board cups downward.

If a floor cups either upward or downward with all joints tight, and the floor has not completed at least one complete cycle of heating and cooling, then do nothing. I have found that in about 90% of the cases, the boards will flatten out and look good after becoming stable for temperature and humidity.

Boards cup up from water reaching the top of the floor from whatever source, leaks, rain, etc. Boards which cup downward generally do so from excessive crawl moisture. If after two complete cycles of heating and cooling, the cupping is still objectionable, and yet the boards are tight, then refinishing with whatever joint repair might be indicated is the only satisfactory means to repair.

In the thousands of hardwood floors that I have seen, I have never seen a suitable, acceptable-appearing floor in which the joints have been filled. Filling almost always looks terrible after one or two years and is not a recommended practice, even though it is often used.

If a floor has moderate cracking, and it has only completed a heating cycle or partial heating cycle, we have often waited until July or August, when the humidity is greatest, and then renailed the floor framing properly after the cracks close. We have found that if the crawl vents are closed for the summer and any poly previously placed following construction is temporarily removed, a good number of the joints will close in July or August following initial construction, only requiring proper nailing as the proper repair, after which the vents can be opened and the poly replaced.

Contractors are often plagued by new homeowners after only one or two months of occupancy demanding the refinishing of their cupped and jointed floors. I usually recommend against any type of refinishing in less than one year, because oftentimes refinishing of cupped floors within six months will only result in recupping shortly thereafter, because the floor hasn't stabilized yet with respect to moisture and temperature, and shrinkage is still in the process of happening.

Joints, cupping, and discoloration at doors to decks and patios is a continuing problem. Generally, this is the result of inadequate bottom door weatherstripping. In order to correct this floor condition, you must correct the door weatherstripping first. I find that many contractors in the Charlotte are using a multiple-flap, rubber strip weatherstripping on the bottoms of doors. After a few months of use, these flaps flatten out, leaving a gap which allows moisture to enter. Interlocking weatherstripping or other permanent-type weatherstripping must be used. After repairing the weatherstripping, replacement of the cupped, gapped boards will correct this defect. Usually no other repair is satisfactory. Weatherstripping of the bottom of the doors is a major problem. I do not advocate flap stripping on door bottoms. I have found none which are satisfactory after one year or more of use.

Finally, after ten years of thousands of house inspections, I have only found three houses where an entire floor was open jointed and objectionable. Each of these cases had very poor framing nailing and were loose finish board installations. In general, almost all hardwood floor installers do a good job of tight floor installation. One case was the result of hardwood boards getting wet prior to installation, with extreme shrinkage resulting. **Never, ever** allow boards to get wet prior to installation. If they do, reject them and replace them with new, dry boards.

To prevent objectionable staining prior to finishing, a technique that works is to apply one thinly sprayed-on coat of pure lacquer as soon as the floor is placed. This protects the floor until sanding and results in little or no staining from spilled soft drinks, rain, etc.

In conclusion, the best hardwood floor is only as good as the framing supporting it. If you frame tightly and properly from outside band to outside band, your floor won't crack.