Hardwood and Moisture

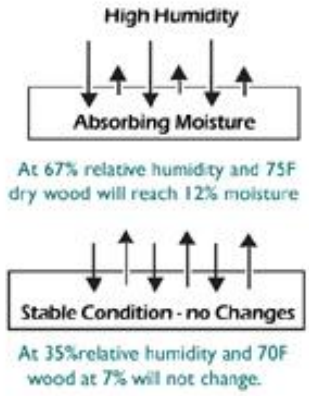
Wood has always been sensitive to moisture. It absorbs and looses moisture until an equilibrium with the surrounding air has been reached. For each relative humidity and temperature there is one stable moisture content, when the wood does not gain or loose any moisture. This moisture content is called the EMC (equilibrium moisture content).

Once the EMC has been reached and the relative humidity and ambient temperature are not changing, wood is stable.

When wood absorbs and looses moisture below the Fiber Saturation Point (around 25-30%) wood expands or shrinks. To make matters worse shrinking and swelling is often accompanied by warping. Following are examples showing the difference in the equilibrium moisture content (EMC) between dry winters and moist summers.

At 70°F and 75% relative humidity, wood moisture will reach 14%.
At 70°F and 35% relative humidity, wood moisture will reach 7%.
At 70°F and 20% relative humidity, wood moisture will reach 5%.

If wood pieces at different moisture levels were placed in a constant climate of 70°F and 35% relative humidity, all pieces would end up with a moisture content of 7%, independent of wood species or initial moisture content. Since in-house conditions are usually between 30-45% relative humidity, the magical moisture content for stable hardwood floors inside a building is 6-8%. Using a moisture meter will confirm, if the wood is dry enough. Having a Thermo-Hygrometer will help to determine if the wood moisture will stay the same.



Wood is not a homogeneous material, but structured by growth rings, which form a series of more or less concentric cylinders. The cylinders consist of irregular tubes which support the tree and transport the nutrients. When wood absorbs or looses moisture the tubes expand or contract, causing wood to swell or shrink.

How much or how little a piece of wood shrinks, depends on the wood species, wood grain orientation and changes in moisture content.

Wood Species: Some species such as Oak, Beech and Hickory shrink more than Teak, Mesquite and Cedar. If you want to know more about different shrinkage factors, check the Internet and type "shrinkage factor followed by the wood species"

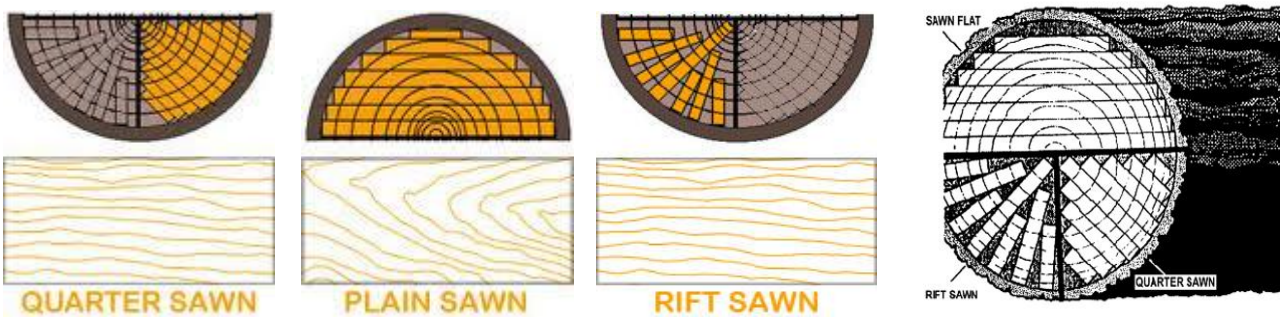
Old Growth Lumber: Not only the species determines the amount of shrinking. Within the same species the distance between the growth rings has an impact. Lumber with wide growth rings is dimensionally not stable. It is like a sponge, soaking up or loosing moisture fast.

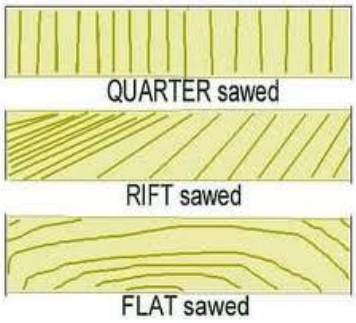
This becomes obvious when working with old growth lumber, which is usually more stable with tighter year rings than the faster grown lumber available today. This is one of the reasons why today more people working with wood are using moisture meters to prevent problems such as loose joints, cupped floors, cracked table tops, foggy finishes.

Orientation of Growth Rings: Boards with similar growth ring orientation show similar shrinking and warping tendencies. Otherwise every board moves different and in most cases unpredictably.

The orientation of the growth rings determines the amount and the direction of shrinking. Most shrinkage occurs in the direction of the growth rings - flat grain. Minimal shrinkage occurs across the growth rings - vertical grain or quarter-sawn. Usually boards have mixed grain. The different shrinkage factors within a board cause warping by pulling the edges and sides of a board in different directions.

The perfect Board: Vertical grain or quarter-sawn boards have straight growth rings parallel to their edges. When changes in moisture content occur, these boards swell and shrink the least and do not warp.





End Grain View of Hardwood cuts

Quarter Sawn Cut: In this situation the boards are all cut just like the name states " Quarters ". The wood grain of this specific method of cutting is more consistent and tight. When the grains are more tight together, it makes the material more sturdy. And in the case if you refer to the diagram below, all the grains run more in an upright direction, meaning the wood will not shrink or expand as much, compared to the plain sawn cut.

Plain or Flat Sawn cut: The most basic way to cut lumber is by slicing the lumber in a continuous parallel motion. This method of cutting produces different grain patterns depending on location it was cut on the log. Plain sawn wood are known to shrink and expand the most because the grains runs left to right on the width of the board

Rift Sawn: Similar to quarter sawn, this cut also displays the linear pattern of the growth rings of the tree, but they are cut in a very careful way to create more uniformity in the floor being laid. This is the most expensive cut of wood available for hardwood flooring planks as there is a great deal of wasted wood left over from the cutting process.

Even if trees would grow perfectly straight, only a small number of quarter-sawn boards can be cut out of a tree. That makes those perfect boards rare and expensive.

Drying and Uneven Drying: Shrinking, warping and twisting of lumber cannot be avoided during lumber drying. The most careful drying process cannot eliminate these deformations. Once rough sawn lumber has been dried, it will go through the planer to be made into a flat board. If no more changes in moisture content occur the board will remain flat.

All of the above described deformations are more severe, when the changes in moisture content happen only in one part of the board. For instance, a flat and not-perfectly-dry board has been laying overnight on a workbench. During the night the side facing the air has been drying out and shrinking. The side facing the workbench did not dry at all. As a result the board has cupped and can be moved like a teeter-totter. Even after both sides of the boards have dried out, there will still be the deformations caused by the reduction in moisture content.

When a once beautiful wood floor all of a sudden shows defects, changes in wood moisture are most likely the reason. Even small changes in each board can have a large impact, when hundreds of boards are laid side by side.

Cracks between floor planks: Even if the floor was installed properly and the floor planks were dry at the time of installation, some wood movement can occur when the relative humidity changes with the seasons. Floor planks may shrink and small cracks appear during the dry winter months with the heat turned on. The cracks disappear during the wetter summer months. Controlling the relative humidity within the room will eliminate this problem.

Cupping: The edges of the floor planks are pulled up and the center remains lower. This happens when the up-side of the floor planks loose moisture and shrink, but the down-side does not follow. It can also happen when the down-side of the floor absorbs moisture from the sub floor and expands. Cupping becomes very obvious when looking across a floor against the light. Minor cupping could be the result from seasonal changes of relative humidity. Hardwood flooring will cup for one reason and one only -- from gaining or losing moisture on one side faster than on the other.

Cupped Hardwood

Crowned Hardwood

Often the floor will naturally reabsorb moisture again and flatten out. If the problem is more severe and re-sanding is considered, be careful. Sanding will leave the edges on the down-side of the floor planks unsupported.

Crowning: The center of the floor planks are higher and the edges lower. This happens when the up-side of the floor planks absorb moisture and expand.

Buckling: Extreme expansion of the flooring. Usually caused by a water leak, or severe moisture conditions.