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ABSTRACT:

Wood flooring, like all wood products is affected by moisture. It swells. It shrinks. And it is expected to always look as perfect as the day it is installed. But what happens when the wood is not installed in perfect conditions? What range of conditions must designers accommodate for a successful installation?

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KEYWORDS:

Flooring, Wood, Moisture, Equilibrium Moisture Content, Cupping, Delamination

REFERENCES:

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www.fpl.fs.fed.us/documnts/fplrn/fplrn268.pdf

RH Effects on Wood Flooring

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Issue

Wood flooring is becoming a popular choice for multifamily housing, especially for market rate apartments and condominiums. Wood appeals to renters and buyers because of the warmth and rich look it adds to the residence.

Because wood is a natural, hygroscopic material it is affected by moisture. Wood absorbs and releases moisture continuously, trying to achieve equilibrium with its surroundings. When wood absorbs moisture, it swells or expands. When it releases moisture, it shrinks or contracts.

Investigation

Conspectus was asked to investigate a "failed" wood floor installation in Philadelphia, PA and to make corrective recommendations as a result. The site observation occurred in February. So winter conditions prevailed: low temperatures and dry air.

Ambient conditions within the unoccupied apartment:

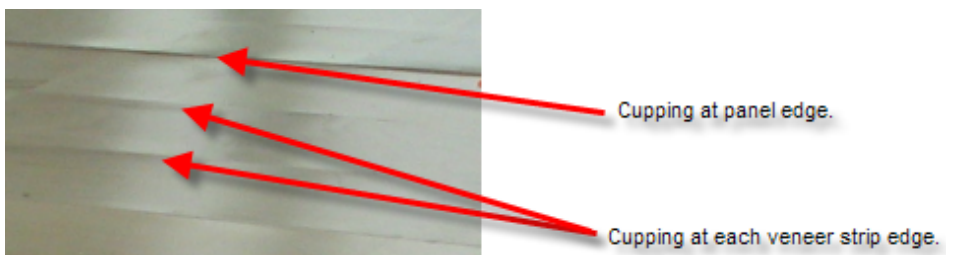
- Air Temperature: 68 degrees F
- Relative Humidity: less than 20%
- Wood Moisture Content: less than 4.5%

Conditions were reported "less than" because the actual value was less than the lower limit of the instruments used to make the measurements. The installed flooring was a 3-ply construction, tongue and groove engineered wood 7-1/2 inch wide plank with three strips of natural maple veneer as the finished surface. Both heartwood and sap wood appeared in the veneers. The veneer included plain, quartered, and possibly rift cuts assembled as the face on a single plank. The flooring was installed over a plastic acoustic mat loose laid on a structural concrete floor slab. Several defects were observed in the completed construction.

- Cupping
- Side joint separation
- Veneer delamination

Discussion

Cupping occurs when the flooring moisture content is unbalanced through the flooring thickness. The condition is caused by the exposed surface drying or by the concealed surface absorbing moisture, possibly from the concrete slab. The condition can be temporary. If the flooring moisture content is returned to an as



installed equilibrium condition, the cupping effect will be reduced, maybe eliminated. When the surface veneer delaminates from the backing the flooring must be replaced. Moisture affects the dimension across the wood grain most. The dimension along the length is affected little by changes in moisture content. Solid maple has a thermal expansion coefficient of 2.7×10^{-6} inches/inch/degree F. Assuming a 40 foot long flooring installation and a 40 degree temperature differential, the wood will expand only 0.05 inches. So temperature has minimal effect. Changing the moisture content from green (saturated condition) to oven dry will cause solid maple to shrink across the grain, 3-5 percent for quarter sawn veneer and 7-10 percent for plain sawn veneer. There is little dimensional change when the wood moisture content is greater than the fiber saturation point (25 to 30 percent moisture content). As a composite, engineered maple flooring will exhibit shrinkage values less than solid lumber content before being manufactured into flooring. Reducing the moisture content in the wood before manufacturing helps minimize dimensional changes as a result of drying when the wood achieves equilibrium with the surrounding environment after installation.

Therefore the wood when properly handled, transported, and delivered to the site should be dimensionally stable. The observed conditions indicate that the moisture content in the wood veneer changed dramatically after the flooring was manufactured. The wood equilibrium moisture content (EMC) is a function of relative humidity and temperature of the surrounding air. As a rule of thumb, a relative humidity of 30 percent gives an EMC of 6 percent and a relative humidity of 65 percent gives an EMC of 12 percent, irrespective of temperature. These ranges are within the maximum moisture content range for milling wood, and they correspond to the recommended relative humidity range for installing engineered wood floors. Observed relative humidity was less than 20 percent. If the flooring was at equilibrium at 20%, the EMC would be 4.5, less than recommended lower limit. The cupping is likely the result of the excessively low EMC.

Recommendations

When selecting wood flooring or any other interior wood products consider the atmosphere in which they will be installed. Will humidity be controlled to remain within the recommended 30 - 65% RH range?

Specify that HVAC systems must be operational and maintaining the facility at design conditions before starting wood flooring installation. Ensure the systems continue to maintain conditions after installation. Require wood products to be delivered to the site and stored with environmental conditions the same as the final construction. Allow time to achieve equilibrium before installation. Size the expansion space at the perimeter of the floor installation to accommodate seasonal dimensional changes from variations in moisture content. The expansion space must be continuous and large enough to accommodate the movement for the size room in which the flooring is installed.

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