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THEY MAY BE WARPED, BUT THEY'RE NOT FUNNY

By Bob Cusumano

The garage doors on a recently completed home in south Florida were experiencing warping problems. The general contractor on the project believed that the cause was insufficient application of the specified finish system by the painting contractor. The garage doors in question are aluminum doors with 18 inch long cypress tongue and groove 1" x 6" boards vertically laminated to the exterior side. The wood was stored in the garage for approximately two and a half months prior to installation. The boards were then attached to the door using a two-part epoxy adhesive. The exterior side of the boards were stained on that same date with two coats of alkyd semi-transparent stain. The rear side of the boards were reported sealed at the mill. Approximately one month later, it was noticed that some warping and delamination of the wood had begun to occur.

The three garage doors have a southern exposure meaning that they are exposed to the heat of the sun for several hours each day. As shown in photo #1, there is only a one-foot return over the doors, so they are directly exposed to the weather. A visual inspection of the doors revealed that the boards are warping exposing the edges as shown by the blue arrows in photo #2. A close up view is shown in photo #3.



Photo 1



Photo 2



Photo 3

The red arrows in photo #2 and the yellow arrows in photo #4 show that gaps have opened where the boards join at the tongue and groove. Similar conditions were visible on all three doors, but were worse on the easternmost door. The red arrows in photo #5 point to cracks and splits that have developed in the wood.

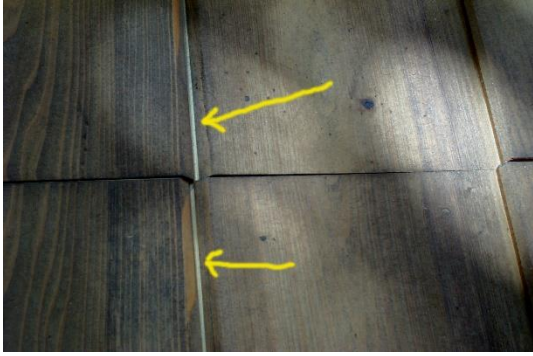


Photo 4

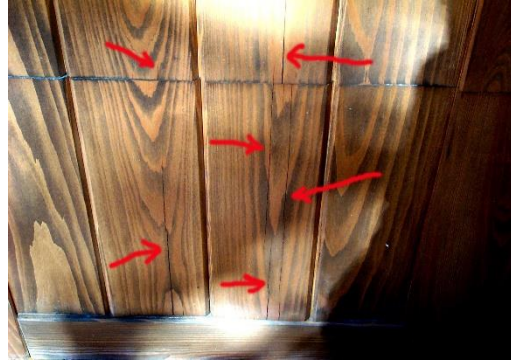


Photo 5

The amount of moisture present in the wood substrate was measured using an electronic moisture meter. The readings were taken on the wood scale of the meter. The wood was found to be totally dry.

A board was removed from one of the doors in for examination and further testing. The board was examined using a stereo zoom microscope. Photo #6 shows the stained exposed face of the board at a magnification of 60X. The white round specks in the photo appear to be paint over spray on the surface of the door that occurred when nearby surfaces were painted. Photo #7 is a side view showing the penetration of the stain into the wood. The yellow line delineates the outer exposed face of the wood, while the green line indicates the depth of penetration of the stain into the wood. Upon examination, the rear, unexposed face of the wood does have a clear sealer as specified. The ends of the boards have been stained, but are obviously porous due to an open grain.



Photo 6

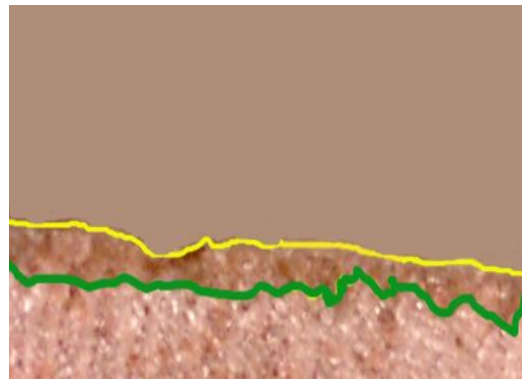


Photo 7

The exposed face of the board was found to be somewhat concave due to warping of the wood. The amount of deflection was measured to be between 1/16 and 1/8 of an inch.

Rilem tubes, clear plastic tubes with graduated volumetric markings, were attached to both the stained face and the rear face of the board using a special putty. The Rilem tubes were filled with distilled water and the time of the day was noted. A piece of plastic wrap was placed over each container so that the water could not evaporate. The amount of water that had penetrated from the Rilem tube into the wood was recorded after a noted time interval.

After a period of 7 hours, a volume of 0.5 cc had penetrated into the stained exposed face and 0.75 cc had penetrated into the rear side. Absorption rates were calculated to be 4.48 cubic inches per hour per square foot and 6.72 cubic inches per hour per square foot respectively. These rates are relatively low and any small defects can be a factor.

A sample of the adhesive used to laminate the wood boards to the aluminum was removed and tested with solvent. There was no softening in either denatured alcohol or methyl ethyl ketone, substantiating that it is indeed an epoxy.

Based on the observations made and the testing performed, it was concluded that the cause of the delamination, cracking, and warping of the wood is due to moisture, however is not due to defective application of stain by the painting contractor.

The moisture may be of two sources. The first, and most likely, potential cause is that the cypress was "green" when installed. Green is used to describe any wood which is freshly sawn and has not been kiln dried. Cypress is very difficult to dry because if it is placed in a high temperature kiln, the integrity of the wood can be damaged. The weight of the water in a piece of green wood may constitute more than half of its total weight. Drying may take from a month to a year or longer depending on the species, wall thickness, and storage conditions. Over time the water will migrate out of the wood, and because of this, green wood is unstable. In its attempt to equalize its moisture content with the moisture content of the surrounding air, it gives up moisture to the air. There would be no problems if all parts of the wood gave up moisture equally, but that doesn't happen -- the end grain face gives up moisture more quickly than the plain sawn or quarter sawn face, the sapwood usually gives up moisture more readily than the heartwood, and the wood nearer to the surface will dry more quickly than the wood farther from the surface. As the moisture migrates from the wood, the wood can crack, twist, and check. Also, the wood will shrink after it is fastened in place (a 6-inch piece will shrink as much as 1/4 inch), creating gaps between the pieces. Because the boards were fastened to the aluminum door using an epoxy adhesive which is rigid rather than elastic, delamination of the wood has occurred as a response to warping.

Unfortunately, no moisture readings were made until a site inspection in five months after the wood was installed and stained. At that time, the wood was found to be dry and it can only be speculated that the wood was wet at earlier dates immediately after installation. This drying out of the wood would account for the warping and cracking damage experienced.

The second, but less likely source of moisture, is by the cyclical wetting and drying out of the wood. The Rilem tube tests conducted on the stained exposed face and rear sealed face have approximately the same water transmission rates, which are relatively low. Due to geometrical considerations, the test could not be conducted on the ends of boards, where the absorption rate would have undoubtedly been found to be much higher.

Although it is not possible to determine whether the damage to the wood was caused by initial "green" moisture or later cyclical wetting and drying, the former cause is more likely to cause the damage observed.

Using an adhesive sealant that has some flexibility, instead of the rigid epoxy used, may have eliminated some of the delamination. It would not, however, lessened the warping. It may have just accommodated it. Sealing the both ends of the boards would lessen the ability for water to enter into the wood and would lessen any damage due to cyclical wetting.

Thus it was concluded that the painting contractor had provided the specified stain system and it had performed as expected. The damage to the garage doors in this instance was due to the wood itself and job site conditions.