

# **SPLITS AND CRACKS IN WOOD**

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## **INTRODUCTION**

Splits and cracks in wood are ruptures or separations in the grain of the wood which reduce the quality as measured by appearance, strength, or utility. Many people assume that all splits and cracks in wood are caused by the dry kiln or the drying operations. Thus, these wood failures are assumed to be the responsibility (or fault) of the kiln operator. In fact, there are four categories or origins for splits and cracks in wood:

- Resource Based
- Processing Based
- Changing Moisture Content Based
- Use based

Proper identification regarding the cause of the splits and cracks is critical if the appropriate corrective action is to be taken to actually solve the problem. A wrong diagnosis insures a wrong course of action and thus, a continuation of the problem.

## **RESOURCE BASED SPLITS AND CRACKS**

These are ruptures in the wood that occur in the standing tree or in the log. They are usually the result of various factors such as site or environmental conditions, growth stresses, or the activities of various microorganisms. The names applied to these various splits and cracks vary widely. In some cases, the same name may be applied to different defects, while in other situations, the same defect may have many different names.

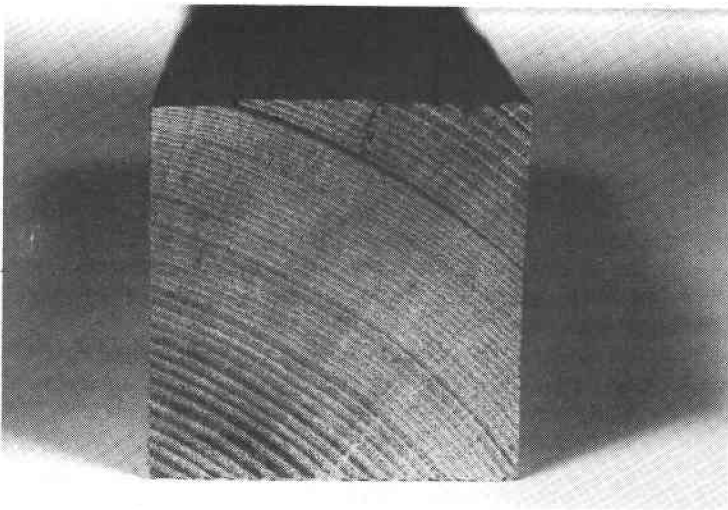
One of the more typical ruptures of this type is called ring shake (also known as cup shake or wind shake). Ring shake is a longitudinal separation of wood fibers in the tangential direction, that is, the rupture runs parallel to the growth rings. Figures 1 and 2 are wood components exhibiting ring shake. Ring shakes can be so fine that they are not visible in green logs or lumber. They may only become visible after drying. The occurrence of ring shake in the standing tree has been related to numerous factors depending upon the species and conditions. Some of the major factors are as follows:

- Bacteria - Wetwood - Microorganisms
- Tree Wounds
- Tree Age
- Site and Environmental Conditions
- Wood Structure and Chemical Composition

For some species, conditions such as large, overmature timber; excessive crook or sweep; or poor site conditions are important factors regarding the formation of ring shake. In other species, it may associated with wounds, injuries, or disease. For



**Figure 1. Ring shake in a bacterial infected red oak board.**



**Figure 2. Ring shake in an ash square.**

still other species such as oaks, it may be related to the action of microorganisms especially bacteria.

The important point is that ring shake is a wood quality condition not a drying defect. The split or crack did not originate in the dry kiln or the drying process. Instead, it originated in the standing tree. It is also important to note that shake may not be easily detected in green logs and lumber. It may only become apparent after drying.

## PROCESSING BASED SPLITS AND CRACKS

Processing based splits and cracks are those that arise from the conversion of rough, green lumber into finished products. The two major areas of processing based wood failures are (1) drying related damage and (2) machining related damage.

### Machining Related Damage

The major splitting or rupturing of the wood that happens during machining is called loosened grain. It usually occurs in moulders and planers, but may also happen in other machines that use rotating knives. It is more likely to occur on the pith side of flatsawn lumber or wood components than on the bark side of the material.

Loosened grain is an actual separation of the wood along the growth ring on the surface of the wood. It has a shelling appearance (Figure 3). This rupturing is the result of the denser latewood part of the growth ring being pounded or pushed into the softer earlywood underneath. The earlywood is crushed and ruptured. A slight decrease in surface moisture after machining will aggravate the defect. Loosened grain can occur in softwoods and ring porous hardwoods such as oak, ash, and elm (Figures 4 and 5).

Loosened grain is caused by the pounding action of dull knives, knives with too small a clearance angle, or excessively jointed knives. Excessive pressure by certain machine parts such as feed rolls, pressure bar, or chipbreaker can also cause this cracking in the wood. As mentioned above, a slight decrease in surface moisture after machining will cause the damage to be more apparent.

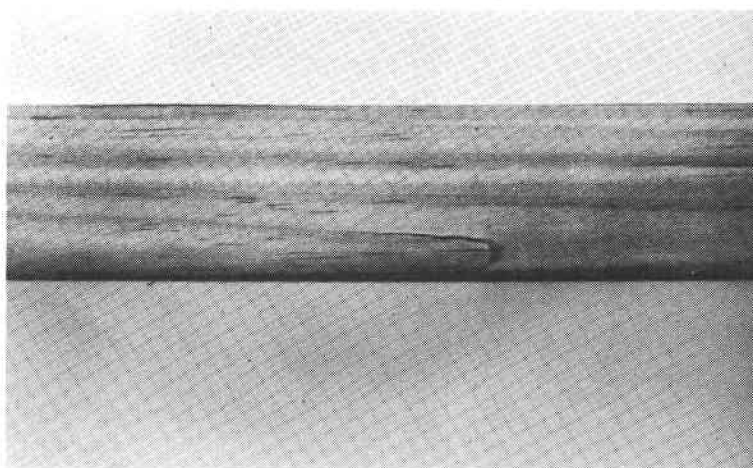
It is important to note that loosened grain, like ring shake, is a rupture in the tangential direction (parallel to the growth ring).

### Drying Related Damage

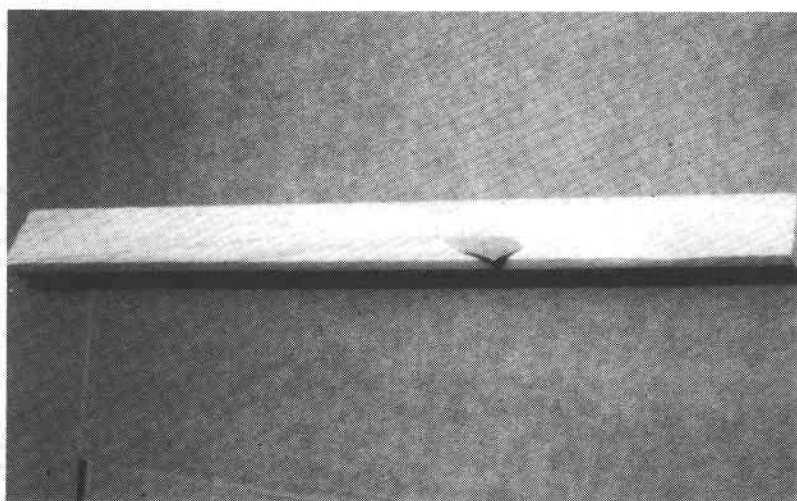
The types of splits and cracks that occur during lumber drying fall into three major categories:

- Surface Checks
- End Checks or Splits
- Internal Checking or Honeycomb

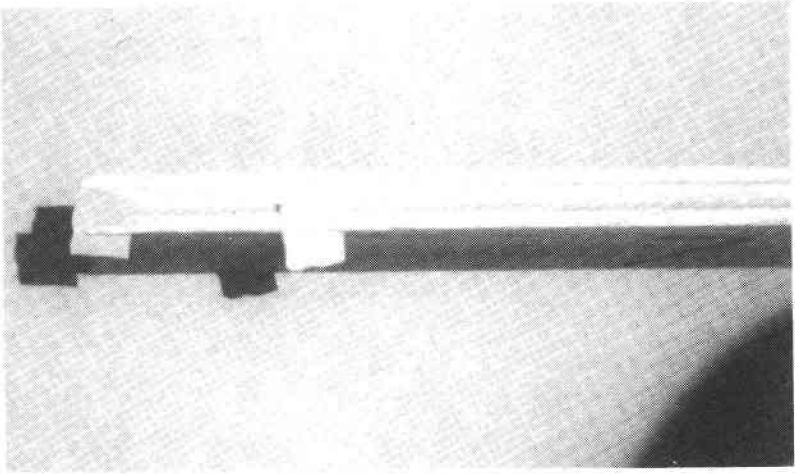
Figure 6 shows the end of an oak board that has both deep surface checks and internal checking. Figure 7 shows the ripped edge of an oak board that has internal checking. What sets apart the splits and cracks caused by drying from either shake or loosened grain is the fact that drying ruptures occur in the radial direction



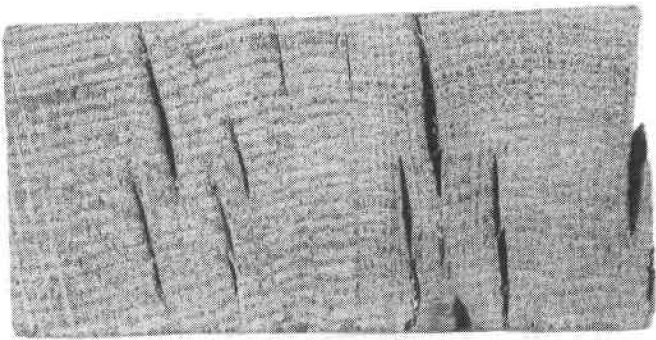
**Figure 3. Loosened grain in a pine moulding.**



**Figure 4. Loosened grain in a pine moulding.**



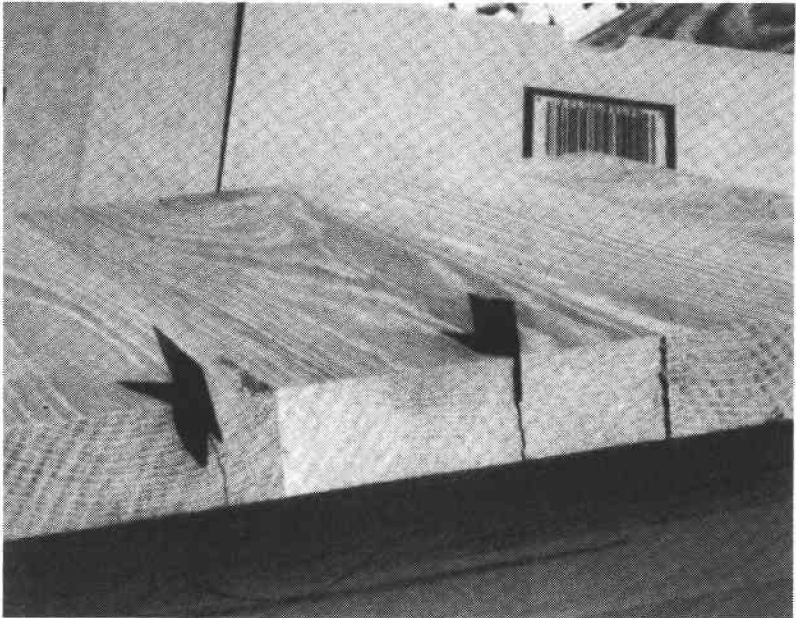
**Figure 5. Loosened grain in a red oak moulding.**



**Figure 6. Deep surface checks and internal checking  
in a red oak board.**



**Figure 7. The ripped edge of a red oak board showing extensive internal checking or honeycomb.**



**Figure 8. End splits in an edge-glued panel.**

(across the growth ring) not parallel to it. Compare the drying splits in Figure 6 with the shake in Figure 2. In all drying defects (surface checks, internal checking, and end checking) the rupture will extend across one or more growth rings. In shake and loosened grain, the ruptures extend parallel to the growth ring.

## **CHANGING MOISTURE CONTENT BASED SPLITS AND CRACKS**

Splits and cracks in wood that occur due to changing moisture content (MC) can be grouped into three classes:

- Environment Drier than the MC to which the Lumber Was Dried
- Environment Wetter than the MC to which the Lumber Was Dried
- Cycling Environment

Environment means the conditions to which the wood was exposed (1) in the processing plant, (2) in all storage areas, (3) during shipment, or (4) in final use of finished products.

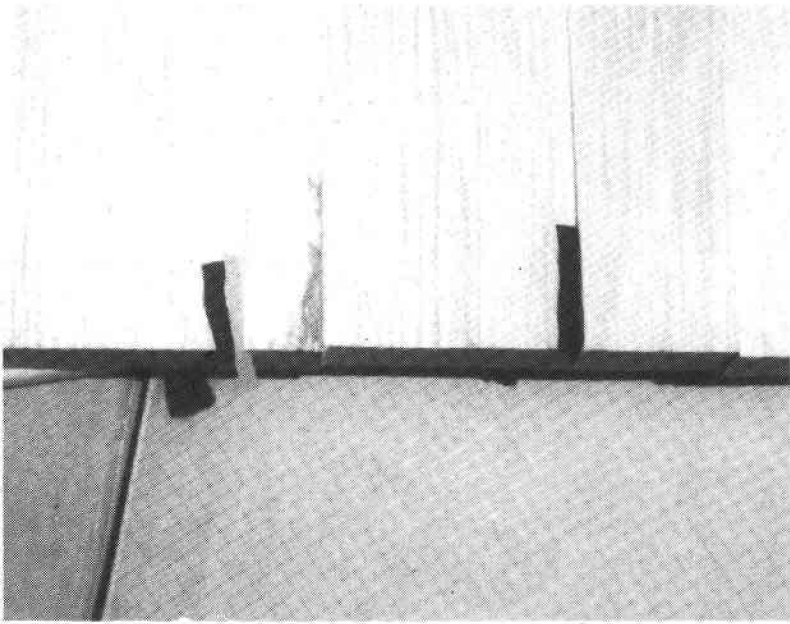
Figures 8 and 9 show the classic end splits in edged glued panels. This occurs when the equilibrium moisture content (EMC) of the environment to which the panels were exposed was lower (drier) than the moisture content of the wood in the panels. When this happens, the wood starts to lose moisture. Since water moves through the end grain much faster than through the sides and faces, the ends begin drying quickly and try to shrink. The ends are restrained from shrinking by the rest of the panel, thus tension stresses are set up in the ends. If the stresses exceed the strength of the wood or the gluelines, a split will occur. If the gluelines are very good and the wood is of light to moderate density, the split will occur in the wood. If the gluelines are only marginal in strength and the wood is heavy and dense, the split will usually occur in the glueline. In any case, the splits will occur in the weakest spots at the ends of the panel. Splits like these are similar to the splits and cracks that occur in drying, however, they are caused by an imbalance between the MC of the wood and the EMC of the environment. If the EMC of the environment is about two percent lower than the MC of the wood, the potential for this problem exists. This condition is somewhat species dependent, as some woods are more forgiving than others. However, the risk of end splits in panels occurs when the difference between the EMC of the environment and the MC of the wood exceeds two percent. The greater the difference, the greater the risk.

## **USE BASED SPLITS AND CRACKS**

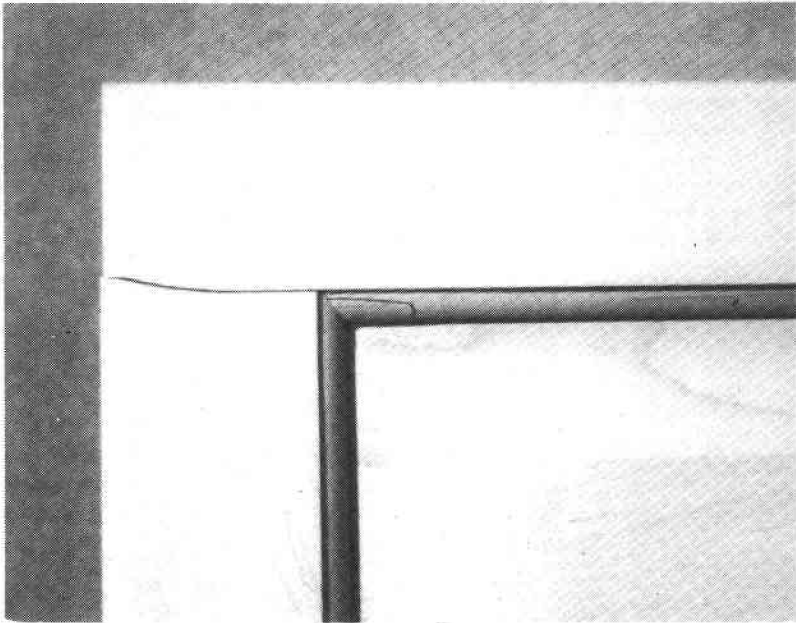
Split and cracks that occur in use usually result from one of two major reasons:

- Mechanical Damage (during handling, transporting, erecting, or installing)
- Improper Design

Many times, panels or other wood products are dropped, banged, or in other ways damaged during their handling, transporting, or installing. These damages, many times, look like splits or cracks in the grain of the wood. Figure 10 shows a split in a door due to dropping and other rough handling. Often, the splits and cracks that result from mechanical damage will run at various angles to the growth rings or they will rupture the grain in a more jagged or ragged manner.



**Figure 9. End splits in an edge-glued panel.**



**Figure 10. Mechanical damage on a door assembly.**



In some cases, a wood product is designed and installed in such a manner that it is restrained from the normal shrinking and swelling that accompanies changes in relative humidity. When this happens, the panel or product will develop splits or cracks for much the same reasons that they occur in edge-glued panels. However, in the case of restrained panels, the splits are usually much more severe.

### **DIAGNOSIS**

All splits and cracks in wood are not the result of the drying process or the dry kiln. It is important to properly examine and analyze the split and crack to see what was the actual cause. One important rule to remember is that splits and cracks caused by drying extend across one or more growth rings (radial direction). Many other ruptures extend parallel to the growth ring or, as in the case of mechanical damage, run at various angles to the grain and growth rings.