

AITC TECHNICAL NOTE 11

CHECKING IN GLUED LAMINATED TIMBER

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CHECKING

One of the advantages of glued laminated timber construction is that while seasoning checks may occur for the same reasons that they do in sawn members, checking in glued laminated timber will generally occur to a much lesser degree because of careful control of the moisture content of lumber used for laminating. Checks in wood are separations along the fibers normally occurring across the rings of annual growth resulting from stresses developed during changes in moisture content. Checks in glued laminated timber may appear as openings parallel to the grain on the sides of members.

As wood loses moisture to the surrounding atmosphere, the outer fibers of the member lose moisture at a more rapid rate than do the inner fibers. As outer fibers try to shrink, they are restrained by the inner portion of the member that has a higher moisture content. The more rapid the rate of drying, the greater will be the differential in shrinkage between the outer and inner fibers resulting in higher shrinkage stresses. These resultant stresses perpendicular to the grain of the wood can cause characteristic wood seasoning checks. The influence of checks on the structural performance of glued laminated timber members is generally minor. Checking can be minimized by careful installation practices that avoid prolonged exposure of the members during construction.

IDENTIFICATION OF CHECKING

Checks occur as transverse separations or opening that are nearly parallel to the grain direction in glued laminated timber and generally follow the grain direction around knots and along sloping grain. Differences in the shrinkage rate of individual laminations used in glued laminated timber tend to concentrate shrinkage stresses at or near glue lines, resulting in checks.

Checks are often confused with delamination that occurs when the glue bond is not adequate. The presence of wood fiber separation in these openings is the key distinguishing characteristic of seasoning checks. Openings due to inadequate adhesive bonding may appear as smooth wood surface separations, possibly darkened by the adhesive film, or as glossy surface areas of adhesive with an absence of torn wood fiber.

Checking often occurs along the first glue line adjacent to the outer lamination that may dry more rapidly because a larger surface area of that lamination is exposed to the air. This condition is sometimes aggravated when the outer lamination tends to cup, creating tension perpendicular to grain stresses along or near the first glue line.

SIGNIFICANCE OF CHECKING

In general, checks have little effect on the strength of glued laminated members. Glued laminated members are made from laminations that are thin enough to season readily in kiln drying schedules without developing checks. Checks usually appear on the wide faces of the lumber and do not materially affect the shear strength of the laminations. In cases where members are designed for loading parallel to the wide face of the laminations, checks may affect the shear strength of a beam. Their effect may be evaluated in the same manner as for sawn lumber. Seasoning checks in bending members affect only the horizontal shear capacity. In establishing allowable horizontal shear values, normal checking due to seasoning has been considered. Checks are usually not of structural importance unless they are significant in depth, occur in the mid-height of the member near the supports, and the design of the member is governed by shear. If these conditions exist, the reduction in shear strength is directly proportional to the ratio of the depth of checks to the width of the bending member. Checks in columns are not of structural importance unless the check develops into a split, thereby increasing the l/d ratio of the column.

MINIMIZING CHECKING

The size of the checks relates directly to the shrinkage stresses induced that are a function of several factors related to properties of both the member and the environment. Member properties influencing checks are size, species, exposed surface area and initial moisture content. When the moisture content of wood is in balance with its environment, it is at an equilibrium moisture content (EMC) level. The EMC of wood varies with the temperature and relative humidity of the environment and of the two, change in the relative humidity is the most critical variable. For example, the EMC varies by 16% over a relative humidity range of 20-90% at a constant temperature of 70°F. In contrast, at a constant relative humidity of 50%, the EMC varies by only one percent through a temperature range of 20-90°F.

Proper initial moisture content specifications, shipping considerations, and jobsite storage procedures can significantly affect the moisture content of the wood. The wood's moisture content at the time of gluing is important in the control of checking in service. When laminated members are manufactured with lumber limited to the 16% maximum moisture content indicated in AITC standards, they will generally perform satisfactorily for most end use conditions. However, if glued laminated timber members are to be installed in arid or semi-arid desert environments, or other end use conditions of low relative humidity exist, a maximum lumber moisture content of 12% at time of gluing of is recommended to minimize in-service drying.

JOBSITE STORAGE AND INSTALLATION

Jobsite storage should be such that the members are protected from direct exposure to the elements. Members should be stored to insure that there is no ground contact, and blocked to provide ventilation around the members. Protective wrappings should be maintained intact but slit on the bottom side to allow for drainage of any entrapped water. AITC Standard 11 1-79, 'Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection' has been developed as a guideline.

After the building is enclosed, it is critical that rapid lowering of the relative humidity be avoided. A gradual seasoning period of moderate temperature should be provided to allow the glued laminated timbers to slowly reach their equilibrium moisture content level and thus minimize checking. Direct blowing of heat on the members using temporary heating units should be avoided. Permanent heating outlets should be designed to deflect heat away from glued laminated members.

FINISHING CONSIDERATIONS

Checking which occurs in members in enclosed buildings is usually completed within the first full cycle of environmental conditioning of the space. However, changes in the end use of the structure may effect future checking. If seasoning checks are to be cosmetically concealed for purposes of appearance, application of a matching stain to the openings that will blend with the finish of the members may be considered. Filling seasoning checks with either rigid fillers or elastomeric fillers is not recommended. Rigid fillers may tend to propagate the openings through a wedge action and may loosen and dislodge with normal cyclical change in moisture content. Flexible fillers are frequently not compatible with the desired finish of the wood and will typically shrink and swell as they undergo both daily and seasonal changes in moisture content based on the relative humidity of the surrounding atmosphere.

ADDITIONAL INFORMATION

While checking is not considered to be of structural significance, the reason for the checking and the means by which further checking may be minimized should be determined. If there is concern regarding structural adequacy, a person qualified in glued laminated timber technology should evaluate the significance of the checking.

