

# **DURABILITY OF GLUED LAMINATED BARN RAFTERS**

**Revised April 1945**



**No. R1232**

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FOREST SERVICE  
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Madison, Wisconsin**

**In Cooperation with the University of Wisconsin**

## DURABILITY OF GLUED LAMINATED BARN RAFTERS

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The appearance on the market of glued laminated wood barn rafters (and members in which studs and rafters are combined in one continuous piece) has given rise to a number of questions, dealing mainly with the durability of this type of construction. These rafters are made by gluing together laminations or boards (usually of inch lumber) one on top of the other, with the direction of the grain of each lamination parallel to the length of the rafters. In gluing, the rafters or rafter-and-stud members are bent to the required curvature and this curvature is retained when the glue sets.

The following questions are those which have most frequently reached the Forest Products Laboratory of the Forest Service, U. S. Department of Agriculture, where the engineering of laminated wood structural members, both straight and curved, was pioneered in this country. The answers represent the judgment of Laboratory engineers and are based partly on test data and partly on observations of laminated construction in this country and abroad.

QUESTION: Are the glue joints in glued laminated barn rafters dependable?

ANSWER: Laminated barn rafters at present are glued with casein glue. Joints properly made with this glue will last as long as the rafters if the wood remains dry in service. If the wood becomes wet or damp, however, even for relatively short periods of time, the glue will gradually deteriorate and the joints weaken.

Improved casein glues containing preservatives, such as chlorinated phenols and their sodium salts have recently been developed and their use should be encouraged. The chief advantage of a casein glue containing a preservative lies in its ability to resist deterioration caused by molds and other micro-organisms when exposed to damp conditions. Low-temperature-setting phenol and resorcinol resin glues have higher water resistance than casein glues and will give greater permanence under prolonged exposure to severe moisture conditions. It should be pointed out, however, that conditions unfavorable to casein glue joints in barn rafters, if maintained for long periods, are also harmful to untreated wood either in solid members or in laminations, regardless of the type of glue employed.

QUESTION: Will condensed moisture in the barn cause the rafter laminations to separate?

ANSWER: No barn owner can afford to tolerate for an appreciable period conditions that cause moisture condensation in barn walls or roofs, regardless of whether laminated or solid members are used as framing, especially in cases where studs, rafters, and other framing lumber are enclosed by sheathing and lining and possibly insulating materials. In other words, even if rafters have been glued with casein glues containing a suitable preservative, prolonged exposure to damp conditions will in time cause rotting of ~~solid~~

~~studs and rafters~~ <sup>the wood</sup> perhaps even to the point where a severe wind storm would lift the barn off the foundation due to rotting through of the studs near the plate.

Casein glue has a good moisture resistance, but it is not recommended for use in wood members in which the moisture content exceeds 20 percent for extended periods, nor for members in contact with the ground. Where such conditions are likely to occur the use of low-temperature-setting phenol and resorcinol glues would give greater assurance of durable glue joints. It should be pointed out emphatically that conditions likely to cause the moisture content of the wood to remain over 20 percent for long periods favor decay of untreated wood as well as deterioration of casein glue, just as contact with the ground prohibits the successful use of most structural woods without thorough preservative treatment in any permanent structure.

In the northern states the modern dairy or stock barn with high humidities caused by the large amount of moisture given off by livestock, should be safeguarded against moisture condensation within or on the wall or roof structure in cold weather. Studies at the Forest Products Laboratory on various types of wall sections have shown that, apart from ventilation, the most positive and least expensive method of preventing condensation of moisture within the walls is to provide vapor-resistant barriers at or near the inner face of exterior walls, or at or on the under face of stable ceilings. Among the materials which have been tested and found to be highly resistant to the passage of water vapor are: (1) asphalt-impregnated and glossy surface-coated sheathing paper, weighing 35 to 50 pounds per roll of 500 square feet; (2) the better grades of laminated sheathing paper made of two or more sheets of kraft paper cemented together with asphalt; and (3) double-faced reflective insulation mounted on paper.

QUESTION: Can any species of wood suitable for barn rafters be glued?

ANSWER: Yes. Recommendations for the choice of species for laminated rafters would be the same as for solid rafters. Some barn rafter species glue more easily than others, but all can be satisfactorily glued.

NOTE: For more detailed discussion of moisture condensation, selection of barn rafter species, and the gluing of wood see the following publications:

Report No. R1231, "Moisture Condensation in Barns," single copies obtainable at the Forest Products Laboratory, Madison 5, Wis., without charge.

USDA Farmers' Bul. 1756, "Selection	)	Obtainable from the
of Lumber for Farm and Home Use," 5¢	)	Superintendent of Documents,
	)	Government Printing Office,
USDA Bul. 1500, "Gluing of Wood," 25¢	)	Washington 25, D. C.
	)	(stamps not accepted)