NEW ENGLAND EASTERN WHITE PINE AS A HOUSE FRAMING MATERIAL

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Importance of Eastern White Pine

It was but a few decades ago when eastern white pine (Pinus strubus) from the magnificent forests of the Lake States dominated the lumber market. The excellent properties of this species -- light weight, low shrinkage, moderate strength and stiffness, and ease of working -- gained for it an enviable reputation that made it a favorite for innumerable uses. Eastern white pine was used extensively for house construction, and furnished much of the material for farm and urban buildings during the rapid growth of the Middle West.

With the practical exhaustion of what was once deemed the inexhaustible stands of virgin-growth eastern white pine, the seat of lumber production moved to the South, and then to the West Coast, with the introduction of additional species. The end of the eastern white pine era brought many questions regarding substitutes in connection with the demand for species having such generally desirable properties.

Interest in eastern white pine has again gained the spotlight as a result of the hurricane damage to the forest areas of the New England States in September 1938. Salvage of the distressed timber in the accessible areas has gone forward rapidly, and large quantities of this second-growth eastern white pine have been put on the market.

Wall-Panel Tests Made

Eastern white pine, because of its excellent record in service, needs in itself no extensive research to promote its use. However, in view of the fact that blow-down material is second growth and slightly inferior to the virgin growth in its mechanical properties, and because it is of lower average grade, a number of wall-panel tests were made to determine the strength and rigidity when used for frame house construction. The object was to determine the resistance of wall sections to racking forces in comparison with panels framed with the denser softwoods, and to develop methods of nailing and bracing to afford equal strength and rigidity with the commonly-used denser softwoods. This article describes and summarizes these tests, and presents suggestions for the bracing of house framing.

The eastern white pine used for the tests was obtained in log form from Conway, N. H., and was converted and kiln-dried at the Forest Products Laboratory. The average grade of the material used in the test panels based on the 1937 standard grading rules of the Northeastern Lumber Manufacturers' Association was No. 2 Common for the framing and No. 3 Common for the sheathing.

The panels were 7 feet 4 inches by 12 feet 1-5/8 inches in size, without openings, representing room-sized wall sections. The frame consisted of single upper and lower plates, with 2 by 4-inch studs on 16-inch centers. One by 8-inch sheathing was used throughout.

Sheathing and bracing types investigated included frames with horizontal sheathing only, with diagonal sheathing only, and with horizontal sheathing in combination with let-in diagonal bracing. Several variations in the nailing of each type were also investigated.

Method of Test

The racking test employed was made to simulate the action of forces on one wall of a frame building, as transmitted by the wind action on an adjacent wall perpendicular thereto. Strength and rigidity in a frame wall is desirable and essential to resist these racking forces. In the tests, wall panels of different constructions were subjected to racking forces by attaching the wall section at the base to a rigid plate, and applying a horizontal load to the upper plate, acting in the plane of the panels (fig. 1). Both the construction and testing conformed as nearly as possible to that in previous tests on similar panels of a dense softwood.

Results of Tests

The results of the racking tests are summarized graphically in figures 2 and 3, and are presented in more detail in table 1. Data on both strength and on rigidity or stiffness are given, as both of these factors are of importance in wall construction. Rigidity is especially desirable in preserving alignment, and in better enabling the building to resist external forces without damage.

Comparison of Different Construction Details

Figure 2 shows how the rigidity and strength of eastern white pine wall panels vary with different constructions and nailing details. The greater efficiency of diagonal over horizontal sheathing has long been recognized, but these test results show quantitatively an over four-fold advantage in rigidity for diagonal sheathing, and an over six-fold advantage in strength. It may be noted also that the strength and rigidity of eastern white pine sheathing, when place diagonally, may be almost doubled by increasing the nailing from two eightpenny to three tenpenny common nails per stud crossing.

Of particular interest is the fact that the efficiency of horizontal sheathing can be greatly improved by diagonal bracing. In fact, horizontal sheating in combination with let-in bracing diagonally placed, compares favorably with diagonal sheathing in rigidity and strength, and offers an effective practical construction method. As is shown in figure 2, further improvement with diagonal let-in braces is obtained when the braces are nailed to the sheathing as well as to the studs. Very high rigidity also accompanies the use of plaster and wood lath.

The results in figure 2 are in close conformity to previously published data of wall-panel tests on southern yellow pine, and support the general recommendations as to the desirability of diagonal sheathing or let-in braces. The let-in braces are continuous members that are notched into the studs and plates, and are far more efficient than the so-called cut-in braces, which consist of short pieces set in between the studs. Cut-in braces are not to be recommended as a means of supplying resistance to racking.

Eastern White Pine Compared with Dense Softwoods

The question may be asked, how does New England eastern white pine compare in strength and rigidity with panels of the denser softwoods? Although well-nailed and braced eastern white pine house framing provides adequate rigidity and strength for house construction, a number of tests were made to develop methods by which rigidity and strength may be obtained comparable with that for dense softwood. The results of these tests are presented in figure 3.

It may be noted that eastern white pine diagonal sheathing, nailed to a dense softwood frame with three eightpenny nails, is higher in strength and rigidity than a standard construction with a dense softwood, consisting of 1 by 4 let-in braces with horizontal sheathing. Likewise, the strength and rigidity of the braced dense softwood construction (B, fig. 3), can be approximated with eastern white pine horizontal sheathing and framing, when proper between-stud nailing is used with 1 by 4 let-in braces (D, fig. 3). Other effective methods employing diagonal sheathing with various nailing details are suggested (F, fig. 3).

The general need for increased housing facilities should result in increased construction of frame dwellings, which in turn should provide outlets for considerable quantities of the New England white pine which is now on the market as a result of the 1938 hurricane. The results of these tests demonstrate the feasibility of obtaining wall construction of any desired rigidity with dimension and sheathing of blow-down eastern white pine.

Table 1.--Results of tests of wall panels without door or window openings

Panel Number	Description[1] Sheathing-Nailing-Bracing-Brace nailing	Eastern white pine panels: Moisture content[2]: Framing	Moisture content[2]: Sheathing and braces	Load at 1/2-inch deflection	Rigidity factor	Maximum load	Strength factor	Southern yellow pine panels[3] (Data from previous tests): Load at 1/2-inch deflection	Rigidity factor	Maximum load	Strength factor
	(1)	Percent (2)	Percent (3)	Pounds (4)	(5)	Pounds (6)	(7)	Pounds (8)	(9)	Pounds (10)	(11)
1	Horizontal, two 8d, no braces	15.2	7.0	925	1.0	1,600	1.0	1,362	1.0	2,588	1.0
7	Horizontal, two 8d, no braces	8.7	7.0	1,005	1.1	—	—				
2	Horizontal, two 10d, no braces	15.2	7.0	1,200	1.3	2,230	1.4	2,045	1.5	3,500	1.4
4	Horizontal, two 8d, 1 by 4-inch-let-in-braces, two 10d	11.9	7.0	3,420	3.7	5,930	3.7	6,000	4.2	9,000	3.5
12	Horizontal, two 8d, 1 by 4-inch-let-in-braces, two 10d	8.1	7.0	3,400	3.7	6,040	3.8				
9	Horizontal, two 8d, 1 by 6-inch-let-in-braces, three 10d	10.0	7.0	4,080	4.4	10,300	6.4				
8	Horizontal, two 8d, 1 by 4-inch-let-in-braces, two 10d; Sheathing nailed to braces -- six 8d between studs	9.6	7.0	5,170	5.6	9,340	5.8				
3	Diagonal, two 8d, boards in tension	13.2	7.0	4,060	4.4	10,900	6.8	5,730	4.3	[4]20,000	[4]Over 8
5	Diagonal, three 8d, boards in tension	11.4	7.0	5,200	5.6	15,160	9.5	7,400	5.2	[4]20,000	[4]Over 8
11	Diagonal, three 8d, boards in tension	8.1	7.0	5,120	5.5	[4]13,600	[4]Over 8.5				
6	Diagonal, two 10d, boards in tension	12.4	7.0	4,980	5.4	13,970	8.7	6,800	5.1	[4]20,000	[4]Over 8
10	Diagonal, three 10d, boards in tension	9.2	7.0	7,320	7.9	19,370	12.1				
13	Horizontal, two 8d, no braces	11.3	8.5	1,070	1.2	[4]2,200	[4]Over 1.4				
14	Diagonal, three 8d, boards in tension	10.5	7.5	6,700	7.2	19,040	11.9				

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[1] Panels 11 and 12 were 9 feet high by 14 feet long. Others were 7 feet 4 inches high by 12 feet 1-5/8 inches long. Panels 13 and 14 consisted of eastern white pine sheathing on southern yellow pine framing. Others were eastern white pine throughout.

[2] Corrected readings from Hart Moisture Gauge.

[3] Results of previous tests of 9 by 14-foot panels built entirely of southern yellow pine. Presented on the same line of the table as the eastern white pine panel of the same construction.

[4] Test stopped -- not carried to maximum load.

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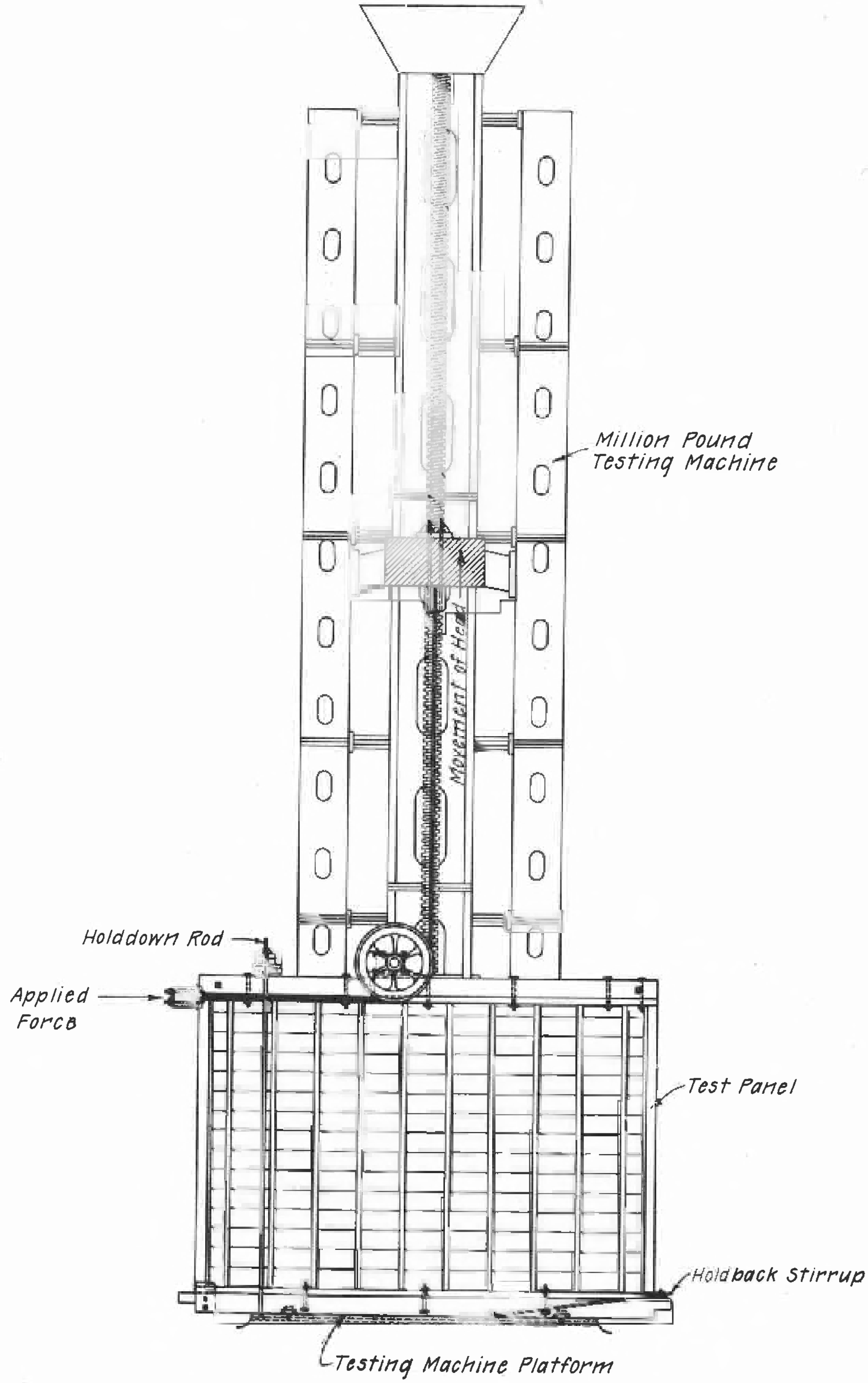

Figure 1.--Diagrammatic sketch of panel mounted for test.

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Figure 2.--Strength and rigidity of wall panels framed and sheathed with New England eastern white pine.

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