Bevel Siding

FROM

COMMON LUMBER

By

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SUMMARY

Need for increased outlets for common boards led to a study of laminated bevel siding.

Low-grade boards of Douglas fir and ponderosa pine were bonded with exterior glue to veneer covering and resin-fiber overlay to form panels subsequently ripped to width and bevel-sawed into siding.

Grooves in the lumber core, number of veneer plies, and stress relief of the lumber core were principal variables assessed for influence on warping in, and appearance of, the siding.

A test house sided with experimental constructions was exposed for a year while high relative humidity and temperature were maintained within.

Exposure demonstrated resistance to paint blistering of all laminated siding, and only slight cupping in pieces with grooved lumber backing covered with two plies of veneer. Patches and rough grain showed somewhat through the overlay when inspected closely.

Tests indicated an attractive, serviceable siding can be laminated from common grades of lumber, veneer, and resin-fiber overlay.

BEVEL SIDING FROM COMMON LUMBER

R. G. Frashour
W. H. Cooke

INTRODUCTION

Dwindling markets for boards in common grades led, in 1955, to a study at the Oregon Forest Products Laboratory of means for converting boards into products to sell in large volume at increased price.

Competition from other building materials has lowered the demand for common boards and reduced their production, but some common boards are inevitable in ordinary sawing, even if sold at a loss.

About 15 per cent of Douglas fir lumber is common boards, of which almost half are Utility or Economy grades. About half the ponderosa pine lumber sawed in Oregon and Washington is one-inch boards, 38 per cent of which are No. 4 and No. 5 grade.

Bevel siding was chosen as a possible outlet for common boards. Here was available a wood product with a fairly large market at an attractive price, but facing competition from other materials and beset by rising raw-material costs as logs capable of yielding high-grade siding in wide widths become scarce.

Several laminated sidings have been marketed. Some had veneer or fiber overlays on a lumber base, others were made entirely of veneers with resin-fiber overlays (Figure 1). Warping in lumber-base products, excessive production costs, or rapid dulling and clogging of saws by glue lines in veneers, have been handicaps to their manufacture.

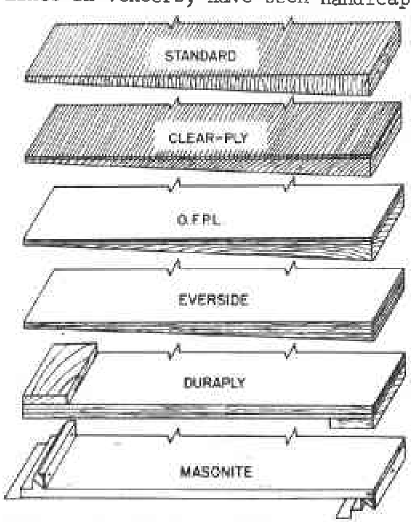


Figure 1. Various siding products.

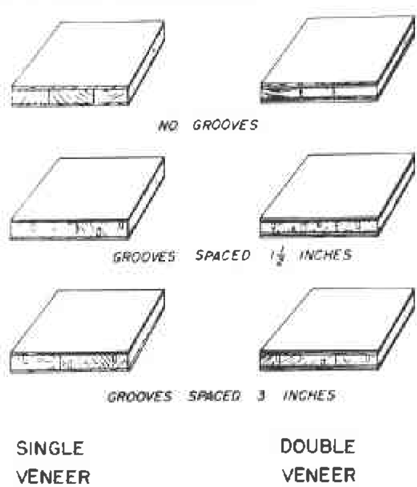


Figure 2. Combinations of veneer and lumber in siding panels tested.

Development of lumber-base siding that would not warp would provide an outlet for common lumber and would eliminate trouble from glue lines in bevel sawing all-veneer siding, as the saw would cut entirely within the lumber core. Other desirable features would be wide widths, uniform lengths, smooth paintable surfaces, no splitting, and a selling price no higher than that of solid wood siding.

EXPERIMENTAL WORK

Raw Materials

The siding was bonded as panels with lumber cores, 1 or 2 veneers on both sides, and resin-fiber overlays (Figure 2).

Lumber

Study lumber was either Douglas fir Utility and Economy grades or ponderosa pine No. 4 and No. 5 Common, of nominal one-inch thickness, kiln-dried to 9-12 per cent moisture content. It was thought if a satisfactory siding could be made from these grades, then other common grades would present no additional problems. Most lumber was full-length in the siding, but some 8-foot siding contained butt-jointed short lengths.

Veneer

Rotary-cut Douglas fir veneer in tenth-inch thickness was chosen in grade C (repaired) for face plies and in utility grade, with white speck, for crossbands (Figure 3). All the veneer was dried to 3-5 per cent moisture content before assembly.

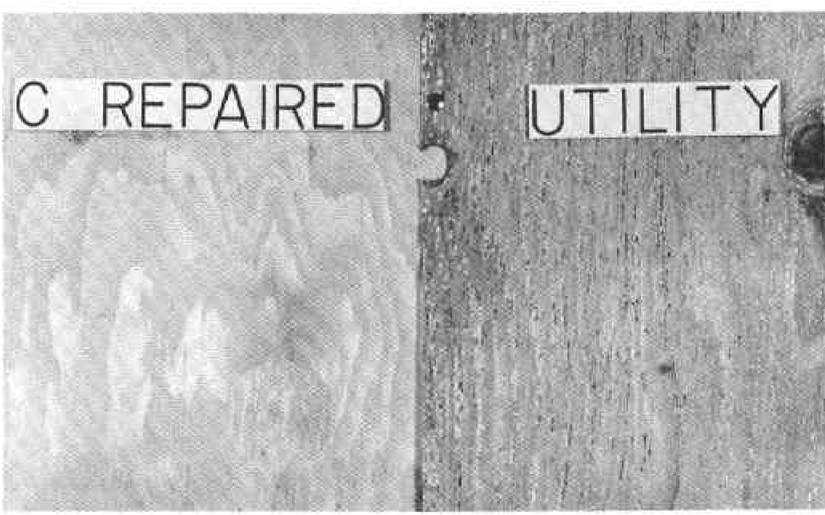


Figure 3. Typical pieces of veneer in siding panel; faces (left) and crossbands (right).

Resin-fiber overlay

Overlay material was a medium-density product, about 0.016 inch thick, containing 17-19 per cent phenol-formaldehyde resin added to the wood in the beater. The resin-fiber sheets had a dry coating of 8 1/2 pounds phenolic glue per thousand square feet of surface.

Glue

An exterior phenolic resin mix bonded the veneer and lumber. A spread of 55 pounds per thousand square feet of double glue line was applied.

Treatments Studied

Experimental composite siding pieces of various raw materials and constructions were subjected to several treatments to assess their influence on surface characteristics or dimensional stability.

Surface characteristics

In preliminary tests, resin-fiber sheets applied with a wet glue line were compared with the same fiber sheets applied with a dry glue coating. The resin-fiber overlay with dry glue line was applied to all subsequent siding.

Ability to mask grain figure, splits, or small holes and present a smooth, paintable surface was studied for the fiber overlay.

Ability of the veneer to mask splits, knots, and holes in lumber was judged.

Dimensional stability

Several treatments were applied to two-foot siding with ponderosa pine core to judge their effect on cupping:

- Conditioning or not conditioning the lumber core.
- Back grooving the siding after bevel sawing (Figure 4).
- Grooves sawed in each face of lumber core before assembly (Figure 5).
- Spacing of grooves in lumber core--1 1/2 or 3 inches (Figure 2).
- Water-repellent dip of siding pieces.
- Aluminum paint on resawed surface.

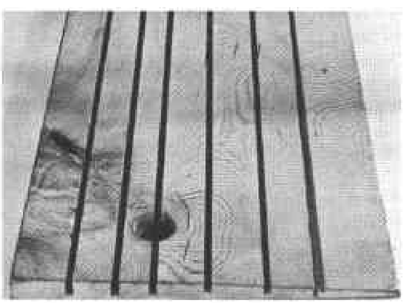


Figure 4. Siding had increased stability when back-grooved.

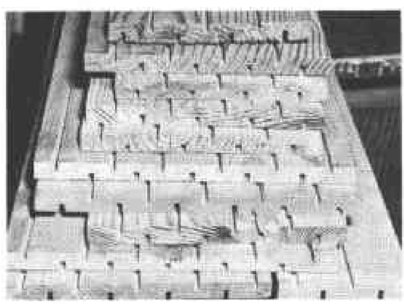


Figure 5. Lumber grooved on alternate sides before panel assembly.

Eight-foot siding with Douglas fir or ponderosa pine backing was studied for effect on warping of two treatments:

- Feather-edge thickness--3/16 or 5/16 inch.
- Tenderizing the crossband veneer by incising.

Constructions Chosen

Over thirty combinations of materials and treatments were tried in making the siding (Table 1). Other combinations were possible among variables studied, but, as the work progressed, it was found possible to eliminate some treatments from further consideration as they obviously were ineffective in improving appearance or preventing warping.

Number of veneers, effect of conditioning the lumber core, and effect of grooving were studied most extensively among the variables (Figure 2).

Table 1. Principal Constructions Chosen in Study of Laminated Siding.

Primary variables	Secondary variables
Lumber; stress relieved or not	Water-repellent dip
Veneer; 1 or 2 plies	Back priming with aluminum paint
Grooves; none, or spaced 1 1/2 or 3 inches apart	Feather-edge thickness; 3/16 or 5/16 inch
	Crossband incising
	Overlay glue line; wet or dry

Siding Manufacture

The siding materials were assembled without edge-gluing into panels of three sizes; 2 feet square, 4 feet square, and 2 by 8 feet. A lumber core was laid between face, or face and crossband, sheets of veneer, with resin-fiber overlay on all panels.

The lumber core was planed for 4-foot-square and 2- by 8-foot panels to achieve a finished thickness of 1 1/16 inches, regardless of panel construction. Thickness of the 2-foot-square panels varied with number of plies of veneer added.

Two-foot-square panels were pressed at 290 F and 200 psi (pounds per square inch) pressure for 6 or 10 minutes with single or double veneers each side, respectively.

Eight-foot-long panels were pressed at 260-270 F for 10 minutes. Panels with Douglas fir cores were pressed at 200 psi; those with ponderosa pine cores at 185 psi.

All panels were bonded with 55 pounds adhesive per thousand square feet of double glue line.

Saw grooves in grooved cores were about 1/8 inch wide, spaced 1 1/2 or

3 inches apart, and penetrated about half the thickness of the core (Figure 5).

After bonding, each panel was ripped to siding width, then resawed on a bevel. Panels 2 and 8 feet long were ripped to the width of nominal 12-inch siding, and panels 4 feet long were ripped to the width of 10-inch siding.

Tests Made

Effect on warping of the various constructions and treatments, durability of glue bonds, and reaction to simulated extreme service conditions were tested.

Warping

Cupping was measured in 252 eleven-inch-long pieces of siding from the 2-foot-square panels (Figure 6). After they had come to equilibrium under 12 per cent EMC (equilibrium moisture content) conditions, half were conditioned under 5 per cent EMC conditions, and the remainder under 20 per cent EMC conditions. Each construction or treatment was represented by at least 9 pieces of siding. Cupping was measured as deflection across 8 inches of the width of the siding between conditions at 12 per cent EMC and conditions at 5 or 20 per cent EMC (Figure 7).

Endwise bowing was measured in siding from the 8-foot-long panels. Forty pieces were equalized at room conditions and endwise bow determined as deviation from a straight line between the ends while held upright on the thick edge (Figure 8). One piece from each resawed pair was conditioned to 5 per cent EMC, the other piece to 20 per cent EMC, and the bowing was remeasured.

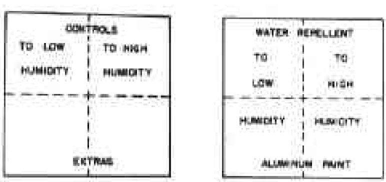


Figure 6. Distribution of test pieces from two-foot panels of given construction.

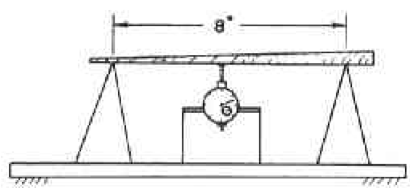


Figure 7. Apparatus for measuring cupping in siding.

Glue-bond durability

Quality of the glue bonds was assessed by repeated cycles of 4 hours boiling in water followed by 20 hours drying at 145 F. The test pieces were 2-inch-wide strips of siding and 2- by 6-inch pieces of panel. Tests continued to 37 or more cycles, or until failure.

Service test

An 8- by 12-foot house was built in March 1956 to test various sidings under simulated severe use conditions (Figure 9). The house was built of standard frame construction, with a plywood floor and shiplap sheathing on the walls (Figure 10). The roof was sheathed with plywood with a vapor barrier on the inner surface. Instruments were installed to maintain

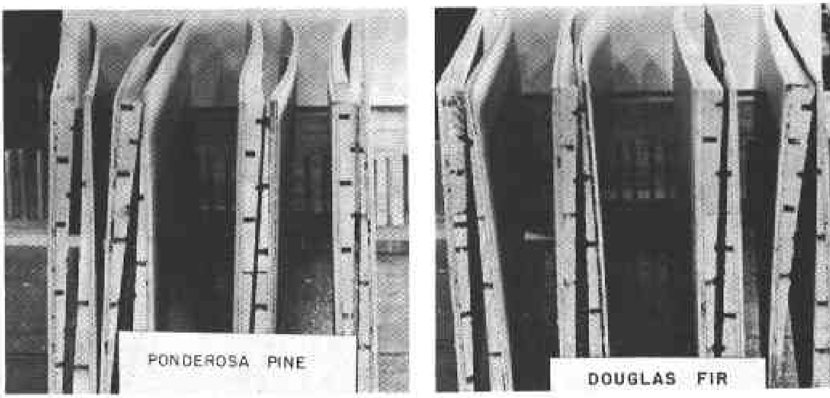


Figure 8. Endwise bowing in eight-foot pieces of siding was judged unimportant (see tops of pages 11 and 15).

65 per cent relative humidity at 80 F; severe conditions under which much water vapor would pass through walls, with probable blistering of exterior paint.

Six of the laminated siding types were included for study on the test house. In addition, standard bevel siding of Douglas fir, West Coast hemlock, and western red cedar was included for comparison. All siding pieces on the house were dipped for one minute in a water-repellent preservative solution, but none were back-primed.

Each type siding, in 44-inch lengths, was applied as a group of four pieces, the location of groups on each wall determined at random. Eightpenny finish nails were driven through the siding two inches above the butt edge to allow freedom of movement of the overlapped feather edge.

Two coats commercial white house paint of lead-titanium-zinc base were sprayed on all siding pieces on the house.

RESULTS AND DISCUSSION

Tests made indicated wide differences in effect of constructions or treatments on appearance and warping. Early exploratory study showed overlay fiber with wet glue line did not mask minor surface irregularities satisfactorily, but resin-fiber with dry glue line masked half-inch holes and eighth-inch-wide splits in veneer. However, subsequent exposure on the test house showed some loss of masking ability after a year. A single layer of veneer proved adequate to mask holes in the lumber core up to two inches diameter. The only apparent difference between Douglas fir and ponderosa pine as core material was the large volume of pitch permitted in No. 4 and No. 5 Common pine, which might interfere with bonding some pieces.

Warping

Saw-groove spacing aided materially in reducing cupping with changes in moisture content. When conditioned to 5 per cent moisture content or

Figure 9. East wall of house covered with test sidings, after a year's exposure.

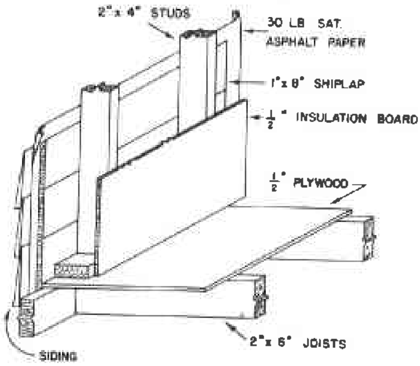


Figure 10. Floor and wall construction of test house.

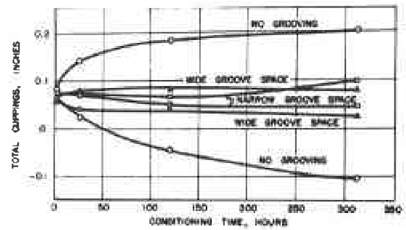


Figure 11. Total cupping across 8-inch width of siding with stress-relieved lumber core and double veneer surface. Pieces were conditioned from 12 per cent to either 5 or 20 per cent moisture content.

20 per cent moisture content, sum of cupping movements at the center of 11 1/4-inch siding with two veneers and no grooves was 3/10 inch, but with 1 1/2-inch spacing between grooves the combined movement was only 5/100 inch (Figure 11). Groove spacing of three inches also reduced cupping.

Number of veneer plies also was influential in warping. With moisture change to 5 per cent and 20 per cent, siding grooved at 1 1/2-inch intervals and with one veneer had combined center movement of 2/10 inch (Figure 12) compared to only 5/100-inch movement in closely grooved siding with two veneers (Figure 13).

Note in Figure 14 how grooved sidings with two veneers (numbered 5 and 6) cupped less with moisture change than did sidings with no grooves or with single veneers.

Dipping with water repellent or covering the resawed surface with aluminum paint did not reduce cupping (Figure 15). Such treatment might, however, reduce capillary movement of free water along the siding backs, and possibly improve appearance and merchantability.

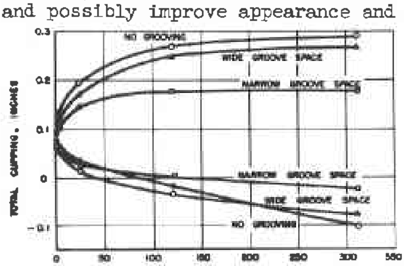


Figure 12. Total cupping across 8-inch width of siding with unrelieved lumber core and single veneer surface. Pieces were conditioned from 12 per cent to 5 or 20 per cent moisture content.

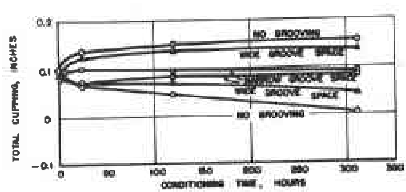


Figure 13. Total cupping across 8-inch width of siding with unrelieved lumber core and double veneer surface. Pieces were conditioned from 12 per cent to 5 or 20 per cent moisture content.

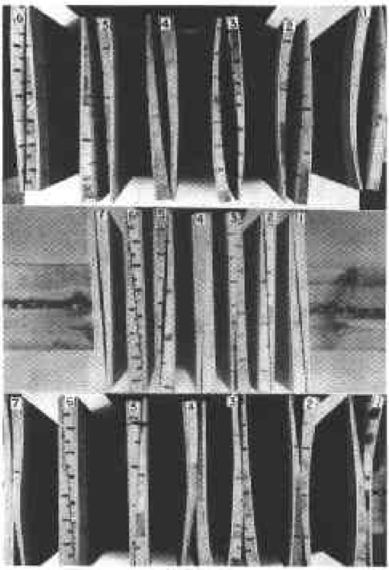


Figure 14. Siding pieces cupped with moisture contents of 4 per cent (top), 12 per cent (middle), and 20 per cent (bottom). Pieces with grooved backs and two veneers on a face (5 and 6) were most stable.

Several pieces of 4-foot siding developed endwise bow in storage. Many 8-foot pieces of siding with ponderosa pine core bowed lengthwise before and after conditioning, but none seriously (Figure 8). Only a few pieces with Douglas fir core bowed, none seriously. The relationship of wood from near the pith to bowing in the siding was not consistent; some pieces with juvenile wood bowed, some did not.

Thickness of the feather edge was related to endwise bow. Siding with 5/16-inch feather edge bowed less than did pieces with 3/16-inch edge. This relationship was apparent for siding with cores of both species.

Siding with crossband veneer incised demonstrated increased bowing. No benefit was found from incising the veneer.

Many 8-foot siding pieces showed evidence of local over-compression. The press platens apparently were warped, causing excessive pressure in some areas. Unequal recovery of springwood and summerwood when subjected to high humidity allowed the veneer grain to show through the resin-fiber overlay.

Advantages of grooving

In addition to pronounced influence in lessening cupping, grooves in the lumber core decrease shipping weights by 6-8 per cent and aid in bonding common lumber of uneven moisture distribution.

Common lumber for core stock likely would have uneven moisture content because it is not economical to dry such lumber with the care given to high-value grades. Wet spots in the lumber core may cause weak bonds unless press time is extended to allow steam escape. Such steam can escape quickly through grooves in the core, allowing shortened press time.

Glue-bond durability

The first appearance of delamination started in some siding pieces after 19 cycles of boil-dry testing. Most pieces were intact at the end of cycling, which was 37 cycles for one group and 42 for a second group. Results indicated no serious problem in bonding, even in areas of high pitch concentration and many large knots.

Figure 15. Effect of water repellent and back priming on cupping of siding when conditioned from 12 per cent to either 5 or 20 per cent moisture content.

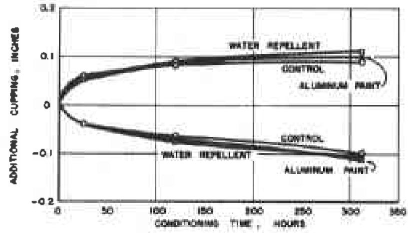


Figure 16. With inside wallboard pulled back, dark areas of condensed moisture were evident in sheathing, showing severe conditions of test.

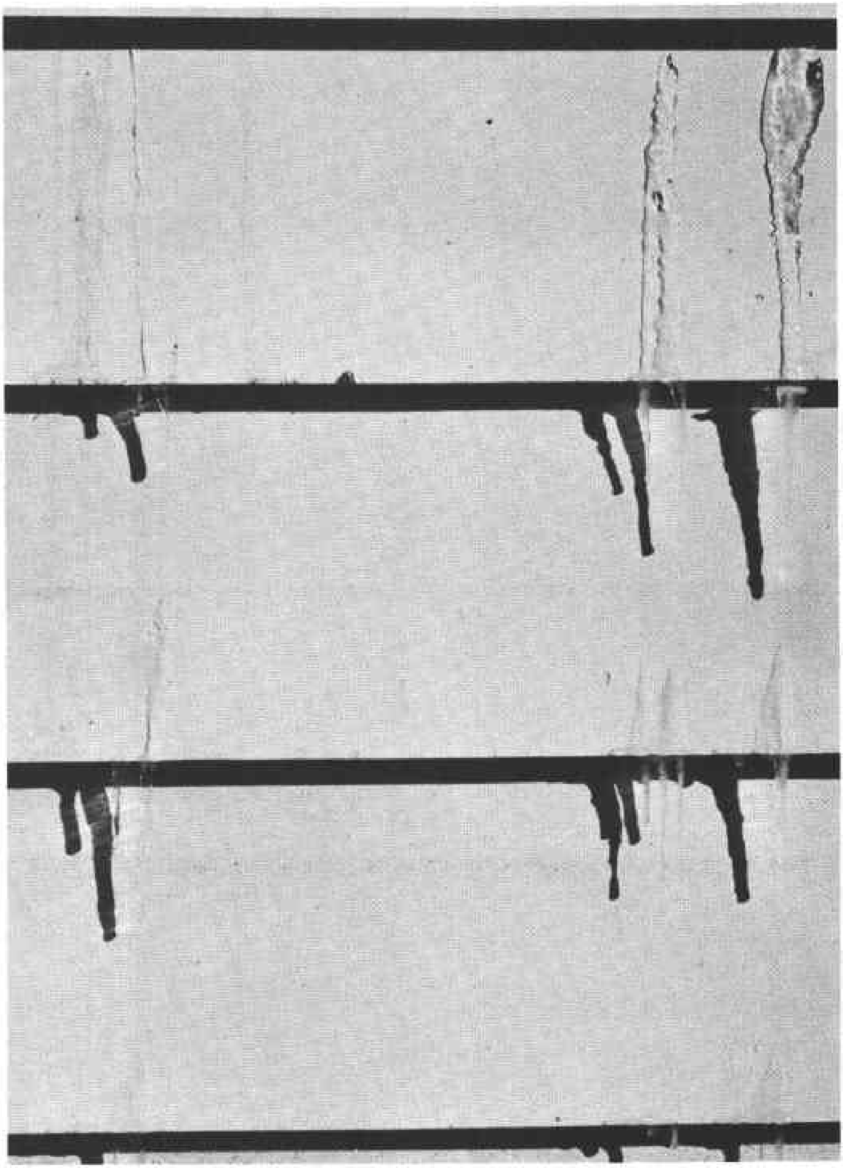


Figure 17. Icicles formed on siding during winter when escaping water vapor condensed and froze. Surfaces of laminated siding were undamaged.

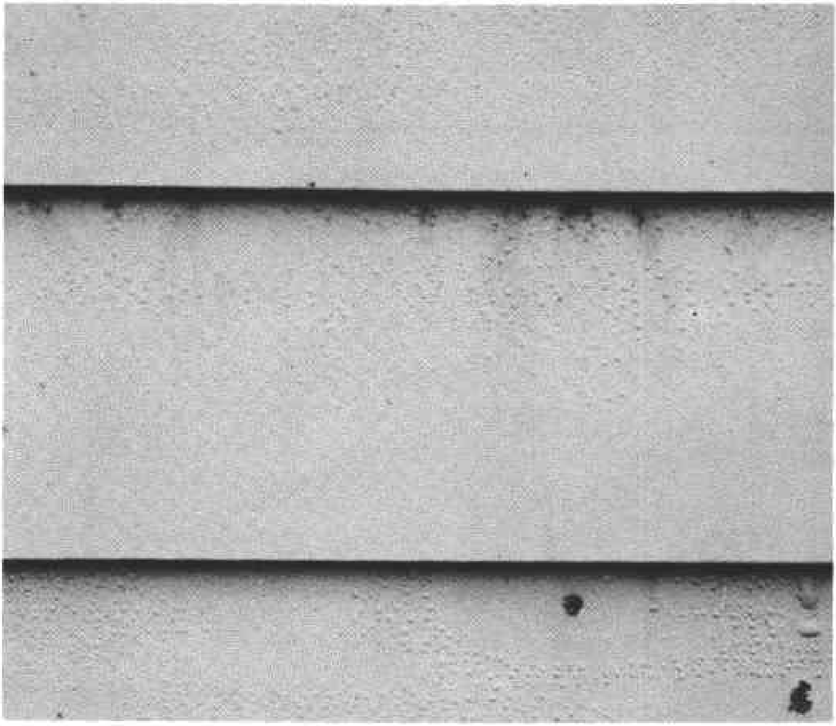


Figure 18. Paint blistering on standard wood siding where absence of synthetic resin glue lines allowed unimpeded passage of water vapor.

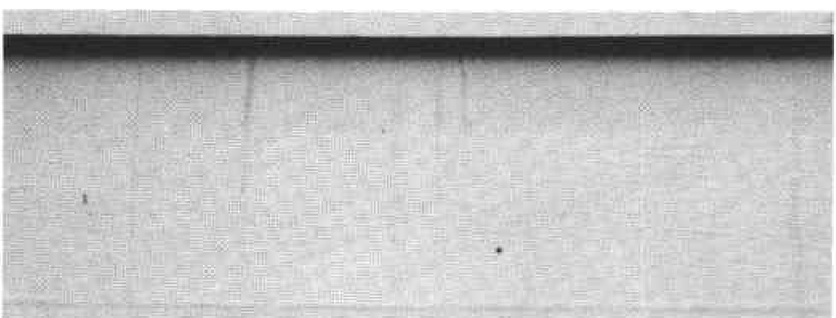


Figure 19. Some horizontal ridges developed from exposure, possibly at unglued joints in face veneer.

Test house

It was apparent in nailing siding on the test house that slight bowing in the laminated product gave no trouble. Cupping present also was easily pulled out by nail pressure. Cupping in solid siding, on the other hand, was difficult to overcome without splitting the siding.

A year of exposure since assembly had effect on the various sidings. High humidity and high temperature inside the test house caused local condensation (Figure 16) or rapid passage of water vapor through walls where such passage was possible (Figure 17). Since nowhere in the walls was a vapor barrier installed, it was expected that outside paint would suffer from blistering. The two or more glue lines of synthetic resin in laminated sidings may have acted somewhat as vapor barriers, however, and contributed toward lack of paint failure in these pieces. Solid wood sidings lacked such glue lines and covering paint blistered, as shown in Figure 18.

Close inspection revealed that cookie patches, rough grain, and unglued edge joints in the face veneer were not masked completely by the resin-fiber overlay, although most were not evident to casual glance (see Figures 19, 20).

No apparent ill effects were caused by large knots, splits, and other characteristics of the low-grade lumber backing. No delaminations were found.

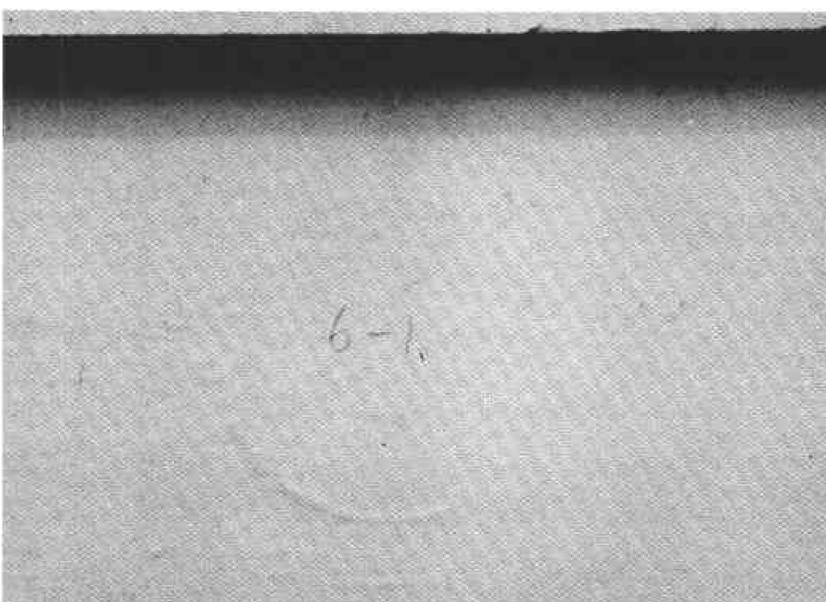


Figure 20. Cookie patches and rough grain were visible under close inspection after a year's exposure.

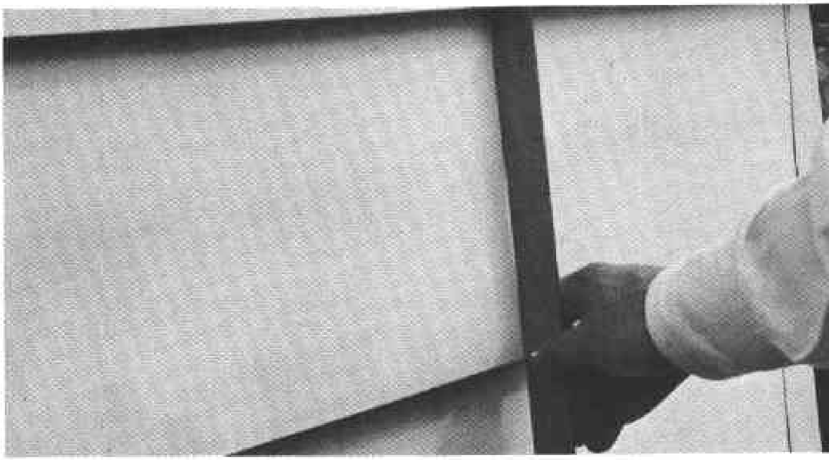


Figure 21. Siding with grooved lumber backing and two veneers on the surface showed little warping after a year's exposure.

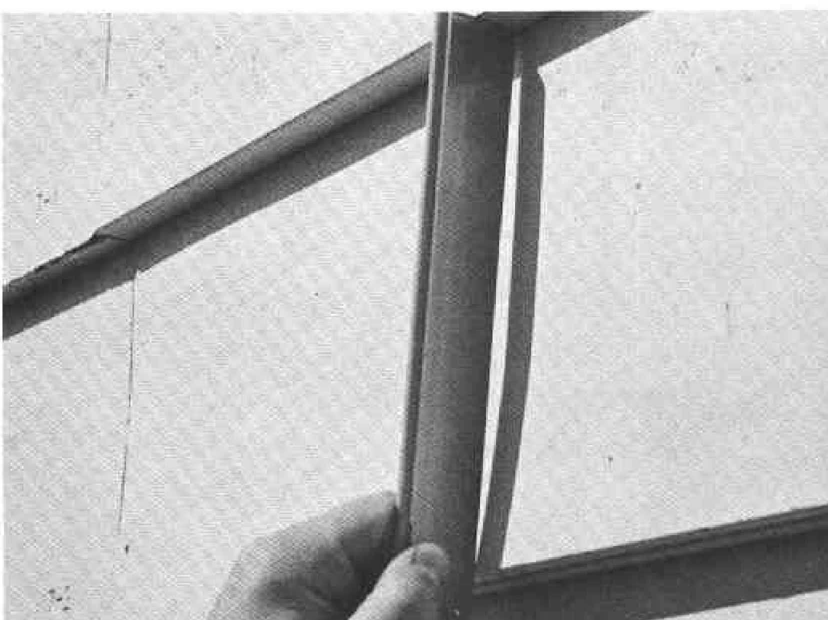


Figure 22. Siding with one veneer on the surface showed lack of dimensional stability during the year's exposure.

Siding with two plies of veneer and close spacing of saw grooves in the lumber core showed greatest stability (Figure 21) when compared with other laminated constructions (Figure 22; siding with one veneer). While most pieces were cupped or bowed slightly, nowhere was warping serious in the construction shown in Figure 21.

All sidings, solid and laminated, were warped to some degree. Bowing and cupping were rated as present if the gap between a straightedge and the siding was more than 0.06 inch. Concave cupping, which increased the gap between sidings, was much more prevalent in all laminated siding than in the solid wood siding. The solid Douglas fir siding had considerable convex cupping, but such warp had the advantage of closing, rather than opening, gaps between siding.

Surface appearance of the laminated siding was attractive, but it is possible experience will show the advisability of choosing smooth-cut, edge-glued veneer for face ply, perhaps in a grade better than chosen for the present study (C repaired). Furthermore, the appearance of low-grade lumber in the siding base might constitute a sales problem that could be overcome by selecting a better grade of common lumber for the core than that in siding tested (Figure 23).

No evidence is yet at hand to suggest that a well-manufactured laminated siding from common lumber, veneers, and fiber overlay (Figure 24) will not serve usefully and attractively in modern home construction.

Figure 23. Low-grade lumber presented no serious problems in making the laminated siding, but its appearance might cause sales resistance.

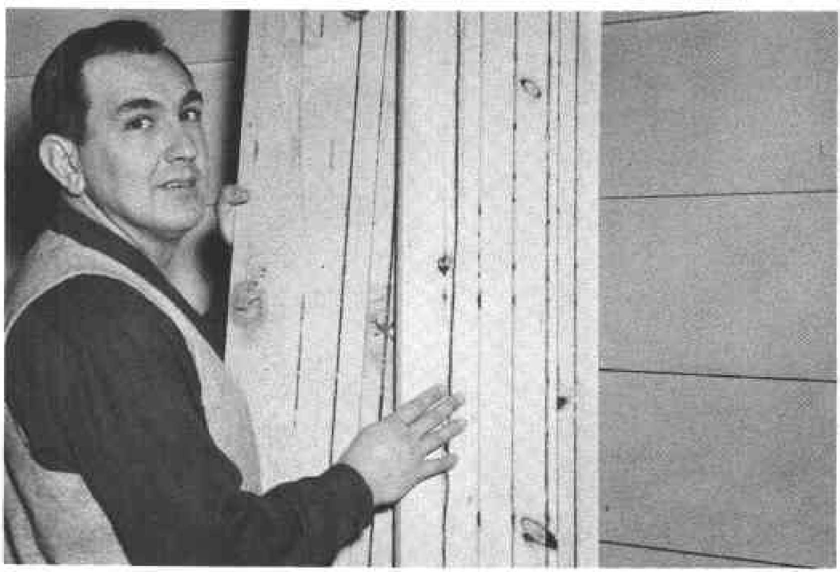
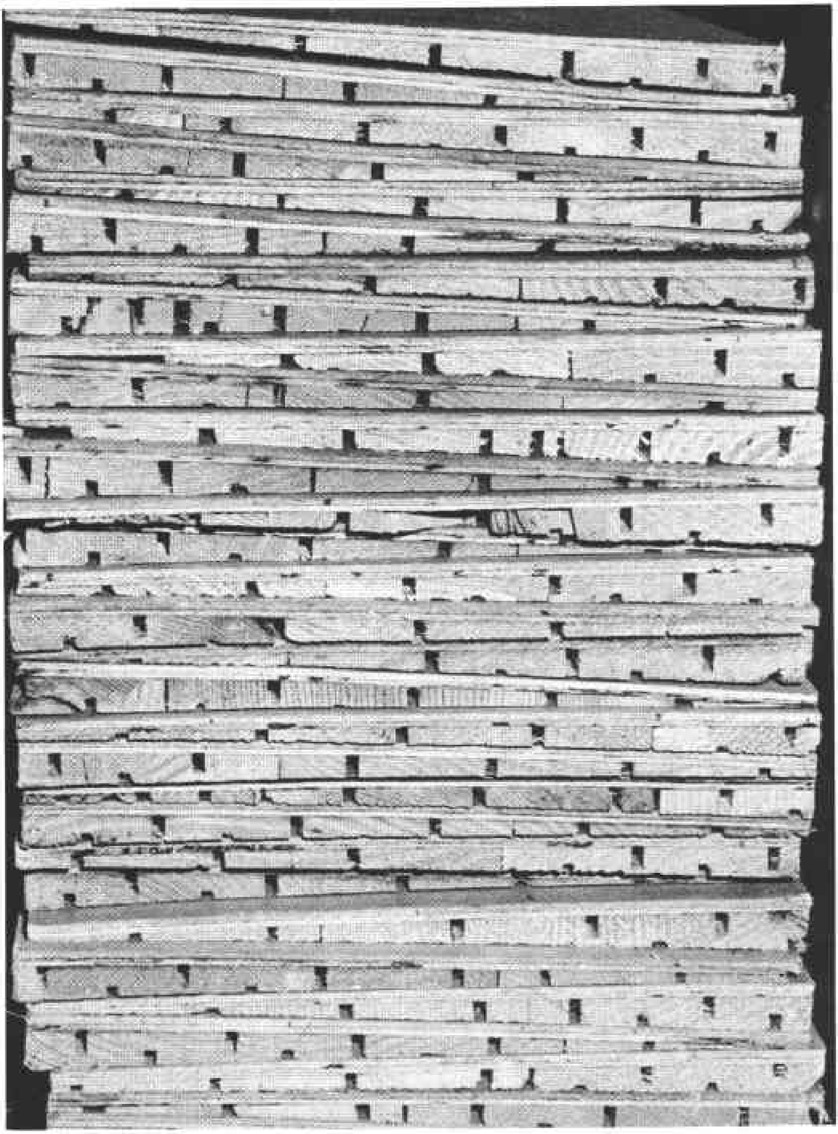


Figure 24. Grooved lumber, two plies of veneer for each surface, and a resin-fiber overlay can be laminated with exterior glue mix into handsome and serviceable siding.



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An Advisory Committee composed of men from representative interests guides the research program that is directly pointed toward the fuller utilization of Oregon's forest resources. The following men constitute the present membership of the Advisory Committee:

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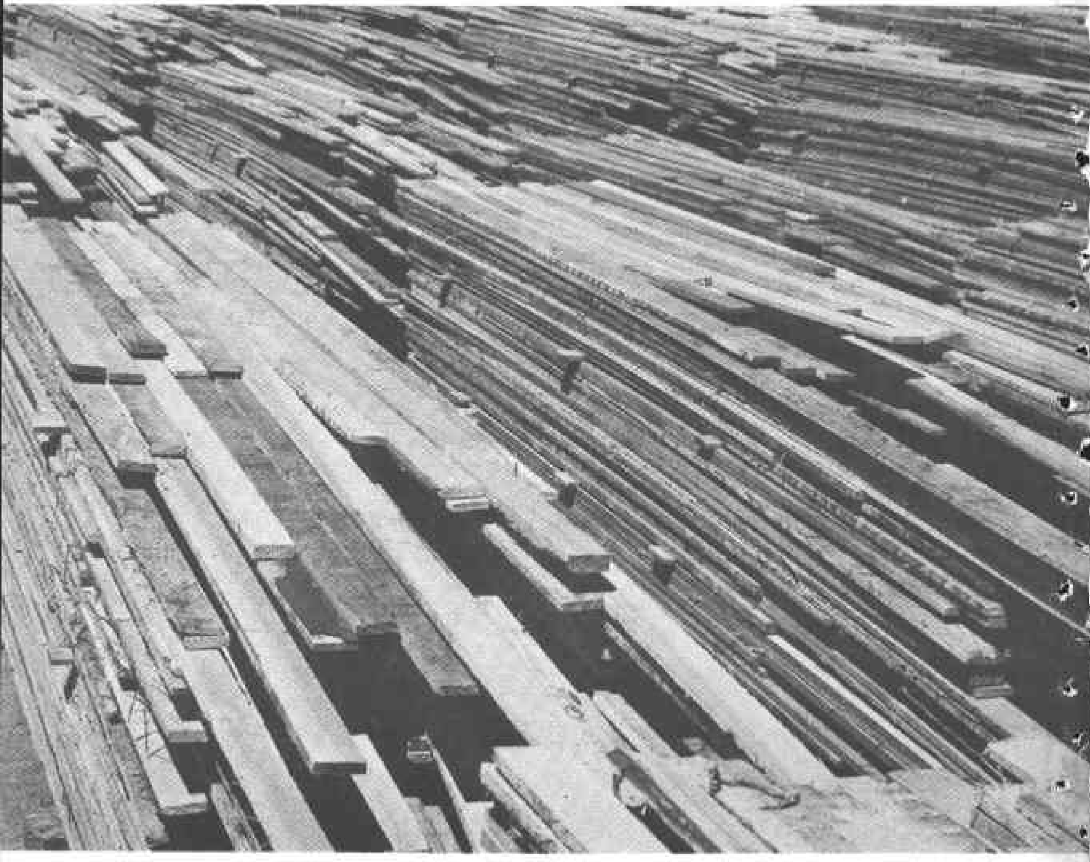

↑ Common boards must be produced to saw logs efficiently, yet such lumber frequently must be sold at a loss.

Bevel siding made from a lumber core laminate offers an outlet for common boards in a handsome product now made from scarce high-quality logs. →