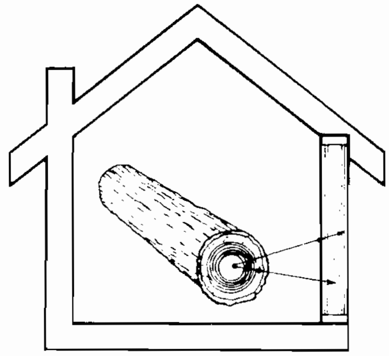
USDA Forest Service Research Paper SE-177 December 1977



COM-PLY REPORT 10

DEMONSTRATION HOUSES BUILT WITH COM-PLY PRODUCTS

AMERICAN PLYWOOD ASSOCIATION

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

NATIONAL FOREST SYSTEM · COOPERATIVE FORESTRY · FORESTRY RESEARCH
FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

COOPERATIVE RESEARCH

DEMONSTRATION HOUSES BUILT WITH COM-PLY PRODUCTS

by

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Washington, D.C.

Cooperative Research by

U.S. Department of Agriculture, Forest Service

Southeastern Forest Experiment Station

and

U.S. Department of Housing and Urban Development

Division of Energy, Building Technology

and Standards

"Research sponsored by the Office of
Policy Development and Research, U.S.
Department of Housing and Urban Development."

PREFACE

This report is one of a series on the possibilities of producing house framing and structural panels with particleboard cores and veneer facings. These COM-PLY or composite materials were designed to be used interchangeably with conventional lumber and plywood in homes. Research on structural framing is presently limited to COM-PLY studs but will be extended to include larger members such as floor joists.

In 1973, the home-building industry faced a shortage of lumber and plywood and consequent rising prices. Both industry and government recognized that this situation was not a temporary problem, and that long-range plans for better using the Nation's available forest resources would be necessary.

The USDA Forest Service and the U.S. Department of Housing and Urban Development accelerated cooperative research on ways to utilize the whole tree. They concentrated on composite wood products made with particleboard and veneer as a way of using not only more of the tree stem, but also using less desirable trees and a greater variety of tree species than would conventional wood products. The particleboard which comprises a large portion of the COM-PLY stud is made from ground-up wood that comes from forest residues, mill residues, or low-quality timber. Thus, such composites could greatly increase the amount of lumber and plywood available for residential construction, our major use of wood, without eroding the Nation's timber supply.

Research on composite wall framing was performed by the Wood Products Research Unit, Southeastern Forest Experiment Station, Athens, Georgia. The American Plywood Association cooperated in these studies by designing and testing composite panel products that are interchangeable with plywood. Both types of products have been incorporated in demonstration houses through HUD's Experimental Housing Program.

Included in this series will be reports on structural properties, durability, dimensional stability, strength, and stiffness of composite studs. Other reports will describe the overall project, compare the strength of composite and solid wood studs, suggest performance standards for composite studs, and provide construction details on houses incorporating such studs. Still others will explore the economic feasibility of manufacturing composite studs and panels and estimate the amount and quality of veneer available from southern pines. These reports, called the COM-PLY series, will be available from the Southeastern Forest Experiment Station and the U.S. Department of Housing and Urban Development.

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ACKNOWLEDGMENT

The Forestry Sciences Laboratory, Wood Products Research Unit, acknowledges the valuable assistance and guidance of:

Howard C. Hilbrand, PE
U.S. Department of Housing and Urban Development

Diane H. O'Connor
Office of Information, Forest Service
U.S. Department of Agriculture

DEMONSTRATION HOUSES BUILT WITH COM-PLY PRODUCTS

Abstract.--Composite studs and panels developed in the laboratory were used to build six demonstration houses in all kinds of weather. Builders found they could cut, nail, and install the composite products just like lumber studs and plywood. Composite products proved to be adaptable to various uses. Builders liked the straightness of composite studs because this quality resulted in straighter walls, tighter joints, and less waste on the job site. Carpenters generally felt composite panels were stiffer than the plywood they were accustomed to. The houses were built under the Experimental Housing Program of the Department of Housing and Urban Development.

KEYWORDS: Plywood, composite studs and panels, sheathing, flooring, siding, framing, experimental housing.

The Forest Service, the U.S. Department of Housing and Urban Development (HUD), and the American Plywood Association (APA) have developed two new wood products for home building. Both are composite products. COM-PLY studs are designed for framing the walls of houses (fig. 1); COM-PLY panels are designed for sheathing the roofs and floors of houses (fig. 2).

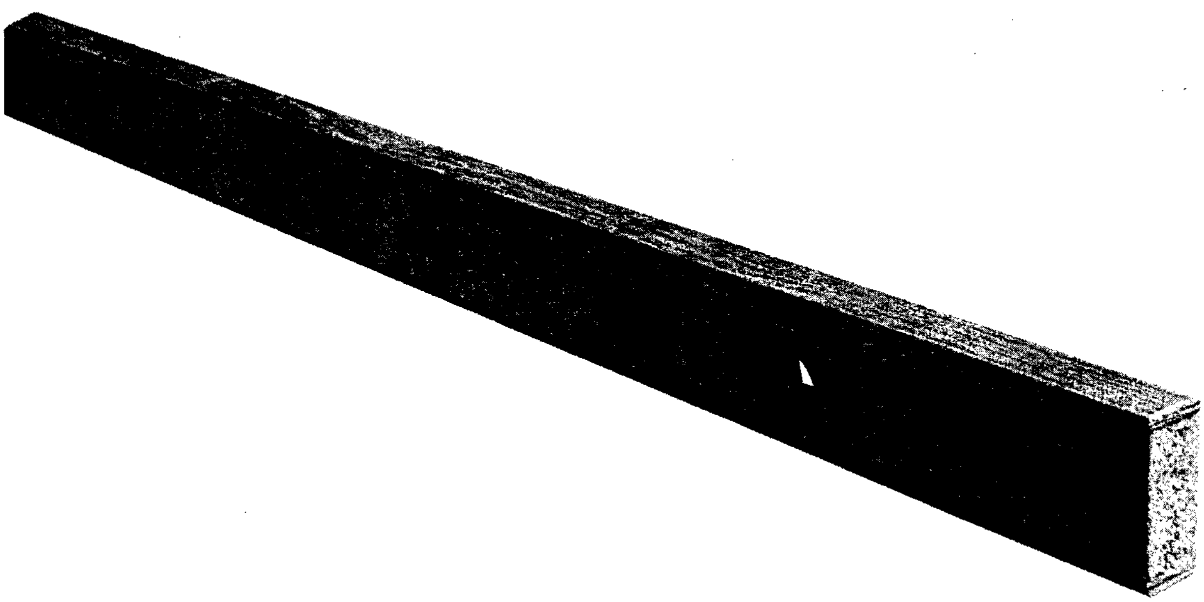

Figure 1.--A COM-PLY 2 x 4 stud.

Wood framing and sheathing are used in most single-family and garden-apartment housing in the United States. With the composite concept, only half the trees used by conventional sawing methods are needed to manufacture a given amount of lumber and plywood, a reduction that will allow our diminishing forest resources to stretch much further. The new composite products have been designed and thoroughly tested in the laboratory, but the real test is to use them in homes. The Forest Service and APA have now successfully demonstrated that the two composite products can be used for this purpose.

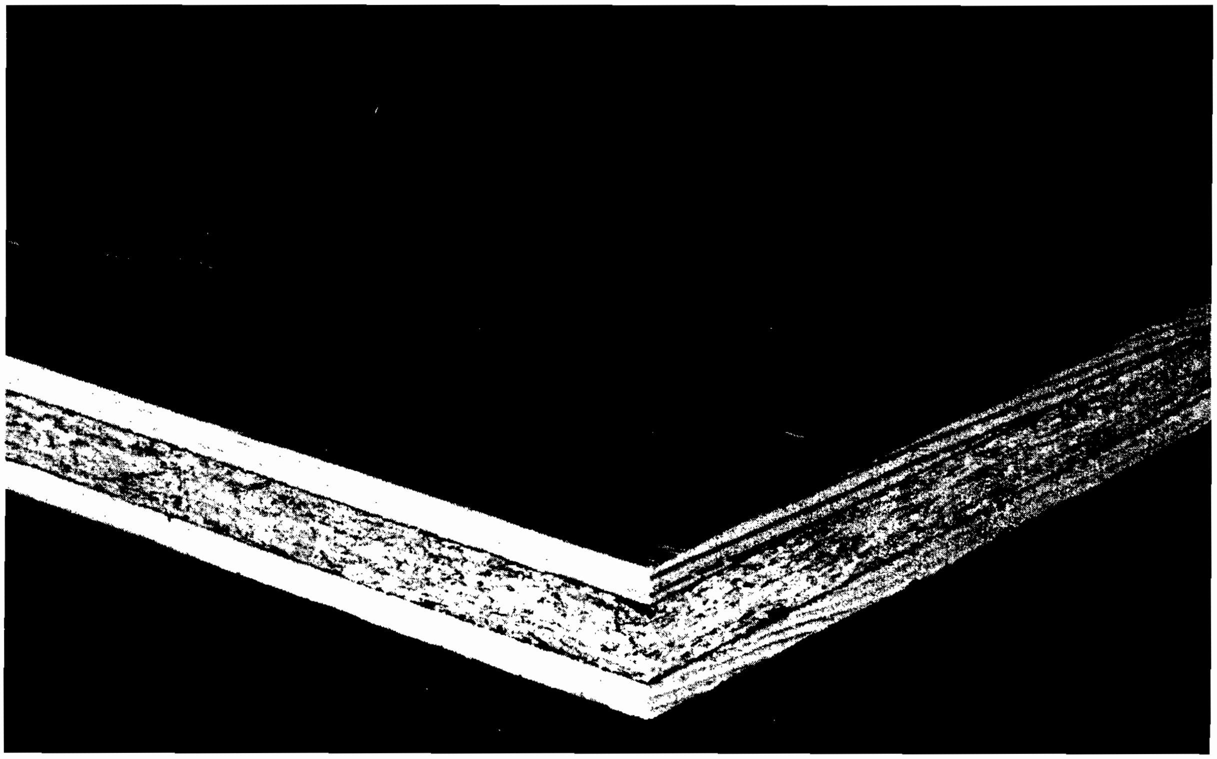

Figure 2.--Corner view of a COM-PLY panel.

This report describes the building of the demonstration houses, the composite products used, and the reactions of the people involved.

HUD'S EXPERIMENTAL HOUSING PROGRAM

The demonstration houses were made available through HUD's Experimental Housing Program as authorized under Section 233 of the National Housing Act of 1961. The program was conceived to encourage the development of new designs, materials, and techniques in housing construction. Under the program, mortgages may be insured by HUD on properties that incorporate new or untried construction concepts aimed at reducing housing costs, raising living standards, or improving neighborhood design. Research funds are used to improve materials and components for residential units and to demonstrate their use under actual or simulated field conditions (fig. 3). The Experimental Housing Program allows builders to try new or advanced technologies not yet recognized in HUD's Minimum Property Standards.

It is difficult to evaluate a new material or system without having seen it in use. Laboratory tests never tell the final story. New materials must be shipped, stored, sawed, installed, and used before an evaluation is valid. In the case of COM-PLY products, it was necessary to use them in both prefabricated and conventional houses. The prefabricator could evaluate ease of handling in the plant, fitting in the jigs, power nailing, and factory gluing. Carpenters at the building site could evaluate ease of sawing, nailing, gluing at the site, and lifting into position. The builder could reveal any problems created by storing the material outdoors in bad weather and the attitudes of the building crew and the local inspector.

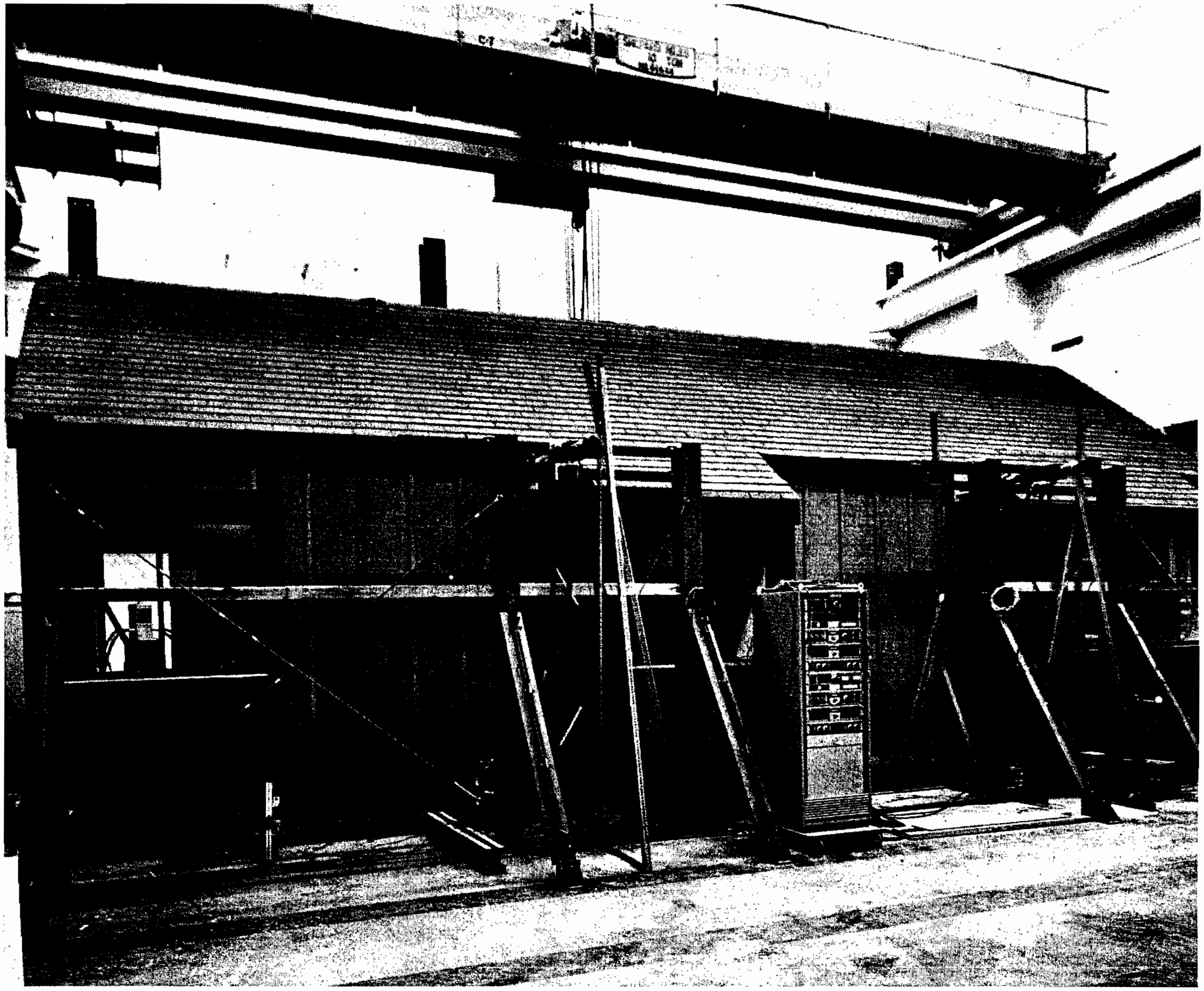

Figure 3.--Full-scale structural test of house being performed for HUD in the National Bureau of Standards Research Laboratory. Final test for research houses is in the field.

The demonstrations have also drawn public attention to the COM-PLY program. The houses were publicized and opened for display during construction. Such demonstrations serve to inform potential homeowners of the new technologies under development.

DEMONSTRATION HOUSE NO. 1

Late in 1974, Ryland Homes of Columbia, Maryland, built the United States' first demonstration house incorporating COM-PLY studs. The house was located in the Riverdale Subdivision of Severna Park, Maryland, near Annapolis.

SHOP FABRICATION WITH COM-PLY STUDS

When a shipment of 400 COM-PLY studs arrived at the Ryland Homes factory, they were stored outdoors without protection. Some were stacked on end and leaned against stored lumber; others were placed directly on pavement or on top of lumber piles.

Product Engineering Manager Joe Drobney explained that conventional studs sometimes warp after a few days' exposure to weathering and become unusable. Plant and Processing Manager Walley Borger pointed out that Ryland Homes had ceased using studs made from veneer cores and conventional 2 x 3 partition studs because they were not straight and strong enough. He indicated that his firm would be willing to pay more for COM-PLY studs if they would overcome these problems.

On November 18, Ryland Homes fabricated the exterior walls and interior partitions for the demonstration house (fig. 4). Cutting, nailing, and assembling the COM-PLY studs into wall panels moved smoothly on the production line. The straightness of COM-PLY studs proved to have many advantages for shop fabrication. Workers saved time because crooked studs did not have to be sorted out and cut into shorter lengths for use as blocking, sills, or cripples. When wood siding was being automatically machine-nailed to the stud framing, the straight COM-PLY studs gave greater assurance that the siding staples had a solid stud surface to hit. Wherever the siding was routed out for a window opening, COM-PLY studs provided a more accurate rectangular opening, according to the workmen. An accurate fit is important, especially when one wall panel joins with another and at corners (fig. 5). A poor fit at these points could cause a bad joint in on-site construction. In turn, this bad joint could cause a costly repair at the job site or lower the quality of construction.

End-nailing panel studs with power nailers was as easy as conventional nailing, and no end splits occurred. However, nailing into the 3-1/2-inch width of COM-PLY studs required greater force than when sawn lumber was used. Double studs for window and door openings and studs with blocking between them for corners were assembled by side-nailing. The air pressure on the nailing machine at these subassembly stations had to be increased slightly for COM-PLY studs.

The workmen noticed that the new studs were heavier than the white fir and spruce studs they were used to. Drobney thought the increased weight could be a disadvantage for wall panels that had to be lifted to the upper floor of two-story houses.

For shop fabrications, the Ryland staff felt that COM-PLY studs had advantages over conventional sawn studs. They agreed that they would prefer purchasing COM-PLY studs for production and would be willing to pay more for them.

FINISHING THE HOUSE

All house components were delivered on a flat-bed truck and dumped at the job site, where they were directly exposed to intermittent rain and snow. A few panels were set in mud puddles, and a few were covered by a pile of crushed stone during construction.

A subcontractor built the 1,470-square-foot, two-story house by his usual methods. Although the subcontractor did not mention it, the workmen found that more force was required to side-nail COM-PLY studs together at panel joints than when studs of sawn lumber were used. Nailing COM-PLY studs to plates at the floor and ceiling was no more difficult than with framing of sawn studs (fig. 6).

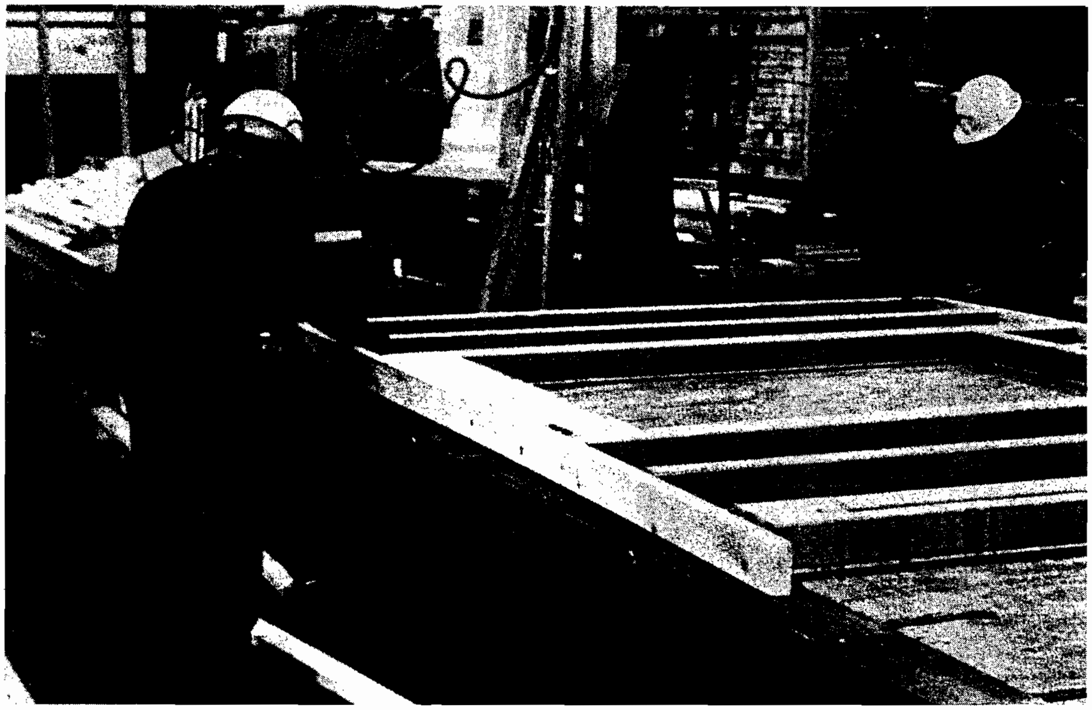

Figure 4.--Assembling a wall panel with COM-PLY studs in a factory.

Bracing was attached to COM-PLY studs with 16d common nails. Occasionally, a small piece of particleboard about the size of a 50-cent piece popped out when the point of the bracing nail penetrated completely through the stud (fig. 7). Even though this spalling did not affect the stud's strength, the appearance was objectionable. Of course, the wall covering eventually hid such areas.

The carpenters said that interior partition panels made with COM-PLY studs withstood handling in the field better than those with studs of sawn lumber. With COM-PLY studs, there was less tendency for joints between plates and studs to come apart during erection.

Figure 5.--Two wall panels made with COM-PLY studs join snugly at a corner.

Freezing rain and snow halted work for one day. However, this bad weather did not affect strength or dimensional stability of the COM-PLY studs.

During construction, the house was featured on national TV news and inspected by officials with the local building code. John R. McGuire, Chief of the Forest Service, Michael H. Moskow, assistant secretary for policy development and research at HUD, and numerous officials from wood-related trade associations around Washington, D.C., inspected the house (fig. 8). The house was subsequently sold and occupied.

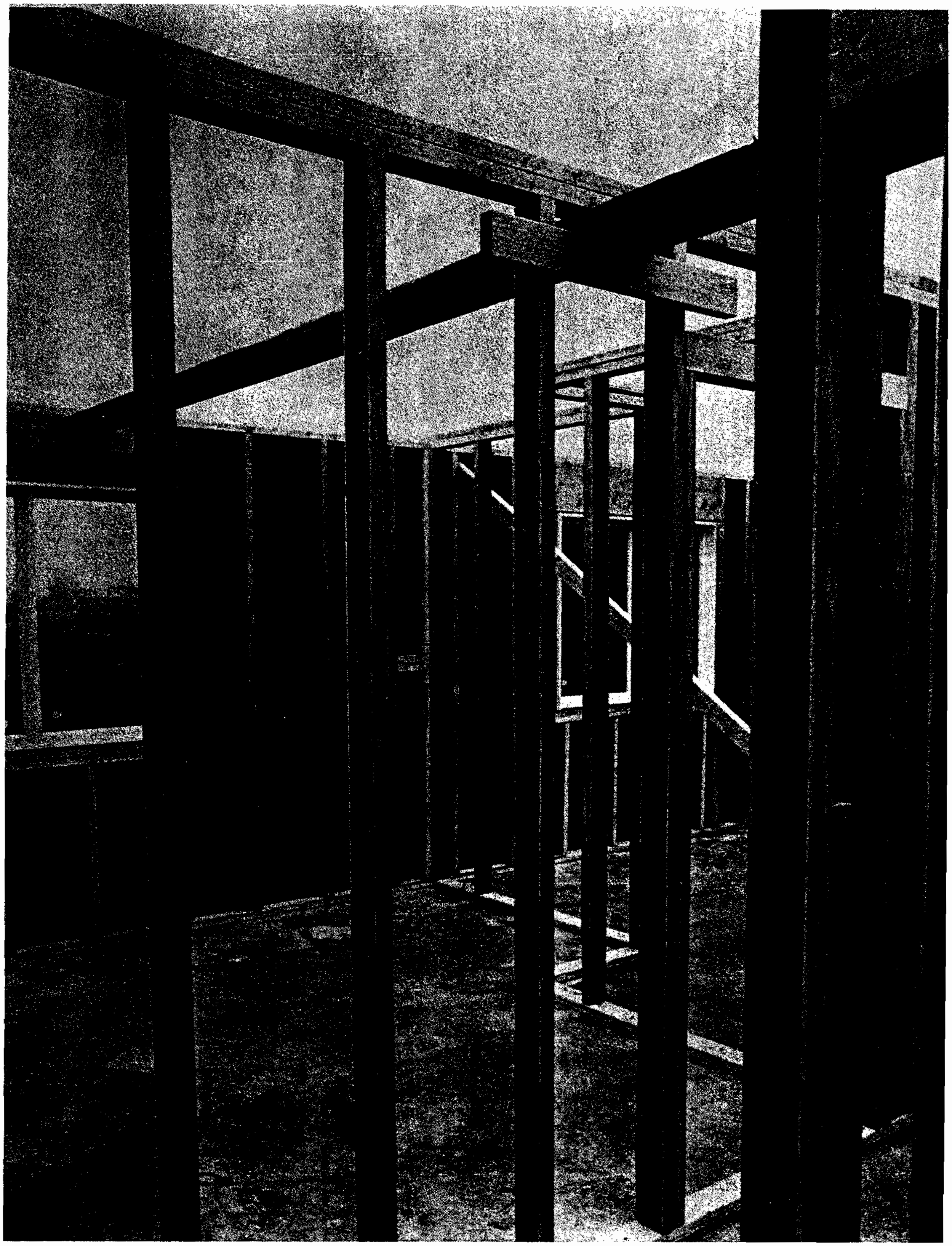

Figure 6.--COM-PLY studs nailed to floor and top plates.

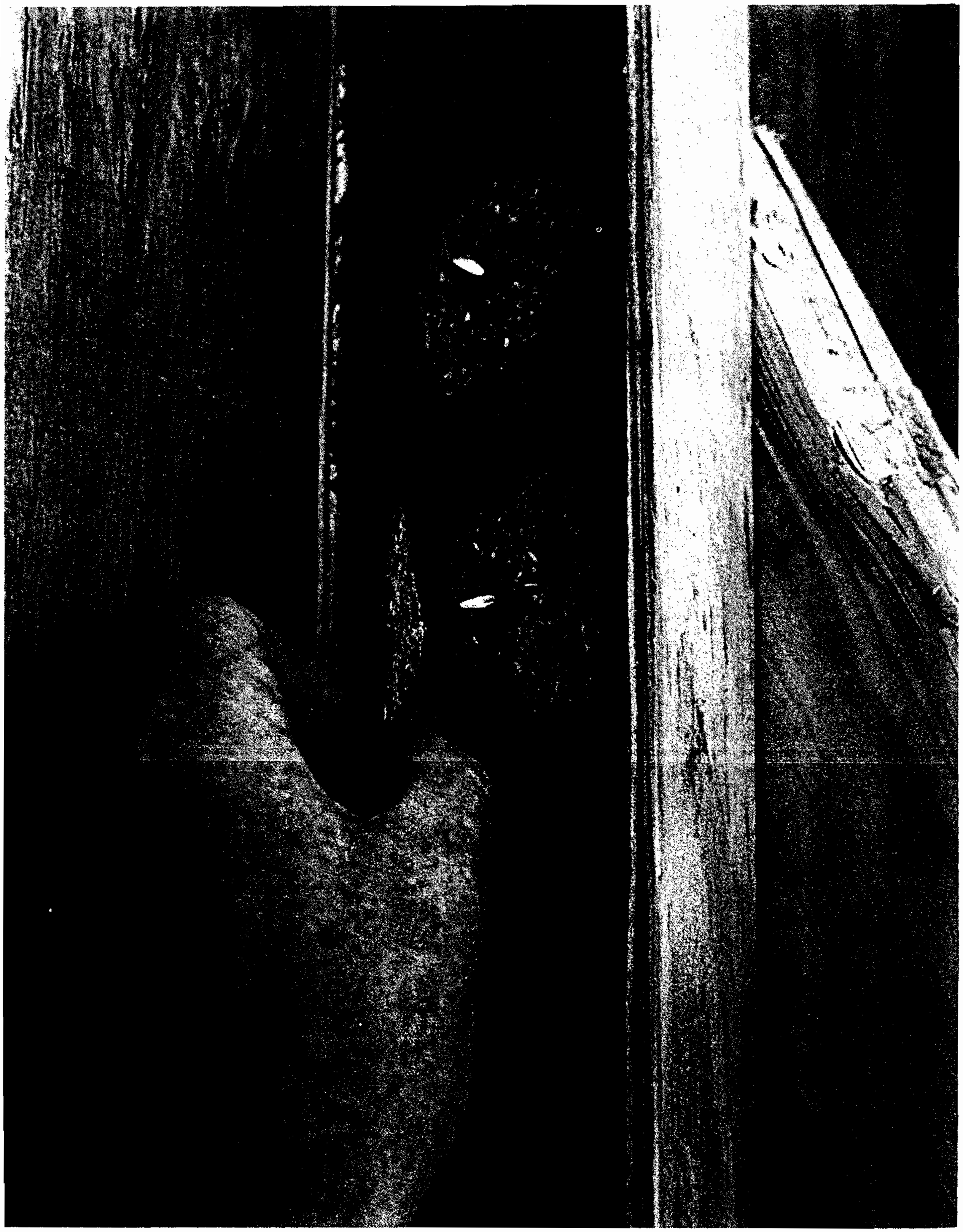

Figure 7.--Spalling occasionally occurred when nails penetrated the particleboard of COM-PLY studs.

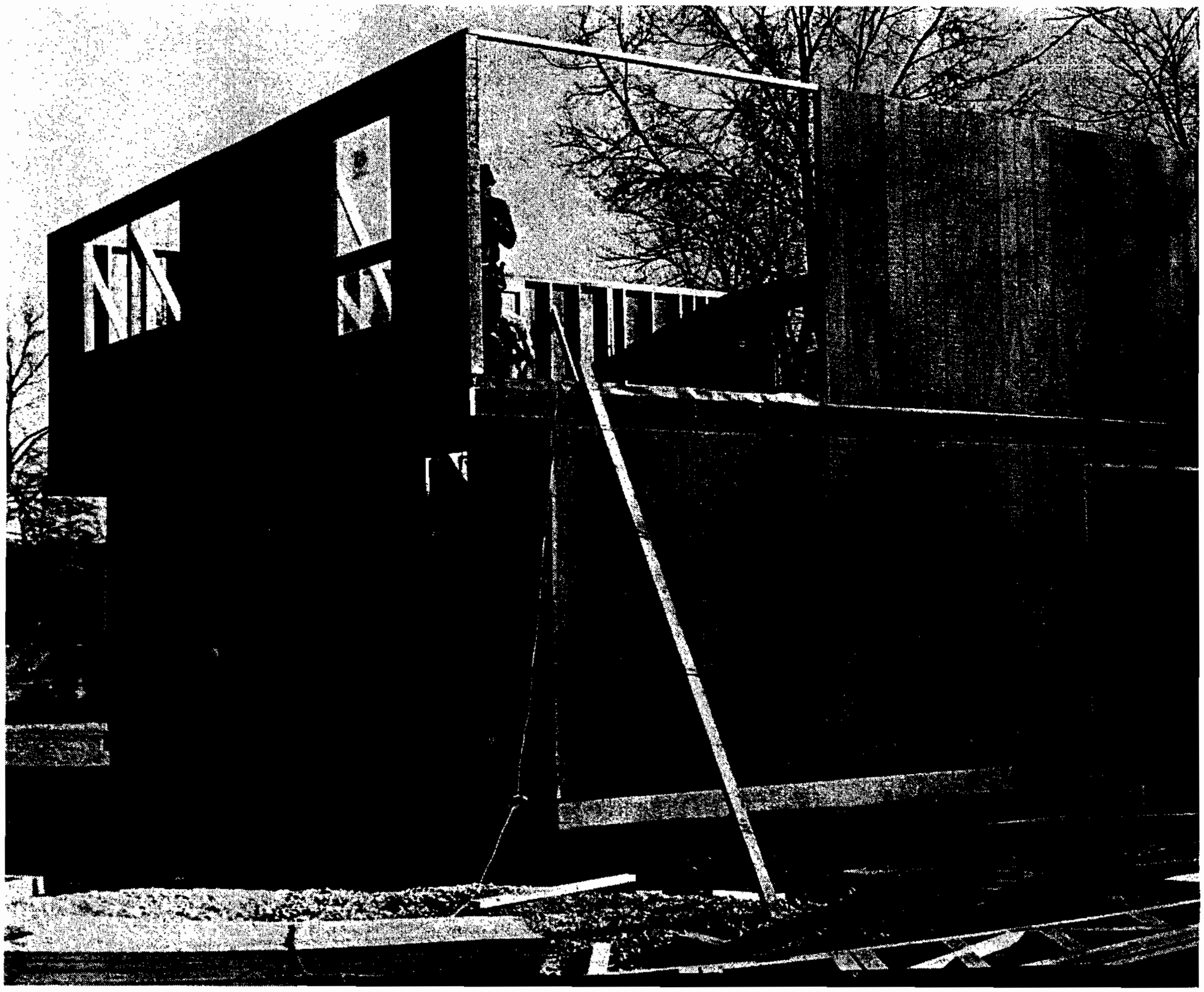

Figure 8.--Demonstration house built with COM-PLY studs near Annapolis, Maryland.

DEMONSTRATION HOUSE NO. 2

In early February 1975, Don L. Dise, Inc., built the second demonstration house in Aurora, Illinois (fig. 9). Four hundred COM-PLY studs were delivered to the builder in early December 1974. The 1,150-square-foot, single-story house was built on lot 126, 129 Heathgate Street, in Boulder Hill Subdivision. The house had a concrete slab foundation. At the site, two carpenters and an apprentice framed the exterior walls and interior partitions and installed doors and windows in 1-1/2 days. Although most of the studs were COM-PLY, the carpenters used some spruce 2 x 4's for framing under window sills. The carpenters always used COM-PLY studs at corners and for framing doors and windows. They liked the straightness of COM-PLY studs and used them when making corners or openings.

The carpenters noticed that COM-PLY studs were heavier than the spruce studs they normally used, and they said that COM-PLY studs tended to dull their saws quicker than spruce studs. However, Don L. Dise, the builder, pointed out that if COM-PLY studs were lighter than regular studs, people might think they were being cheated. He saw no disadvantage in the extra weight of the new studs.

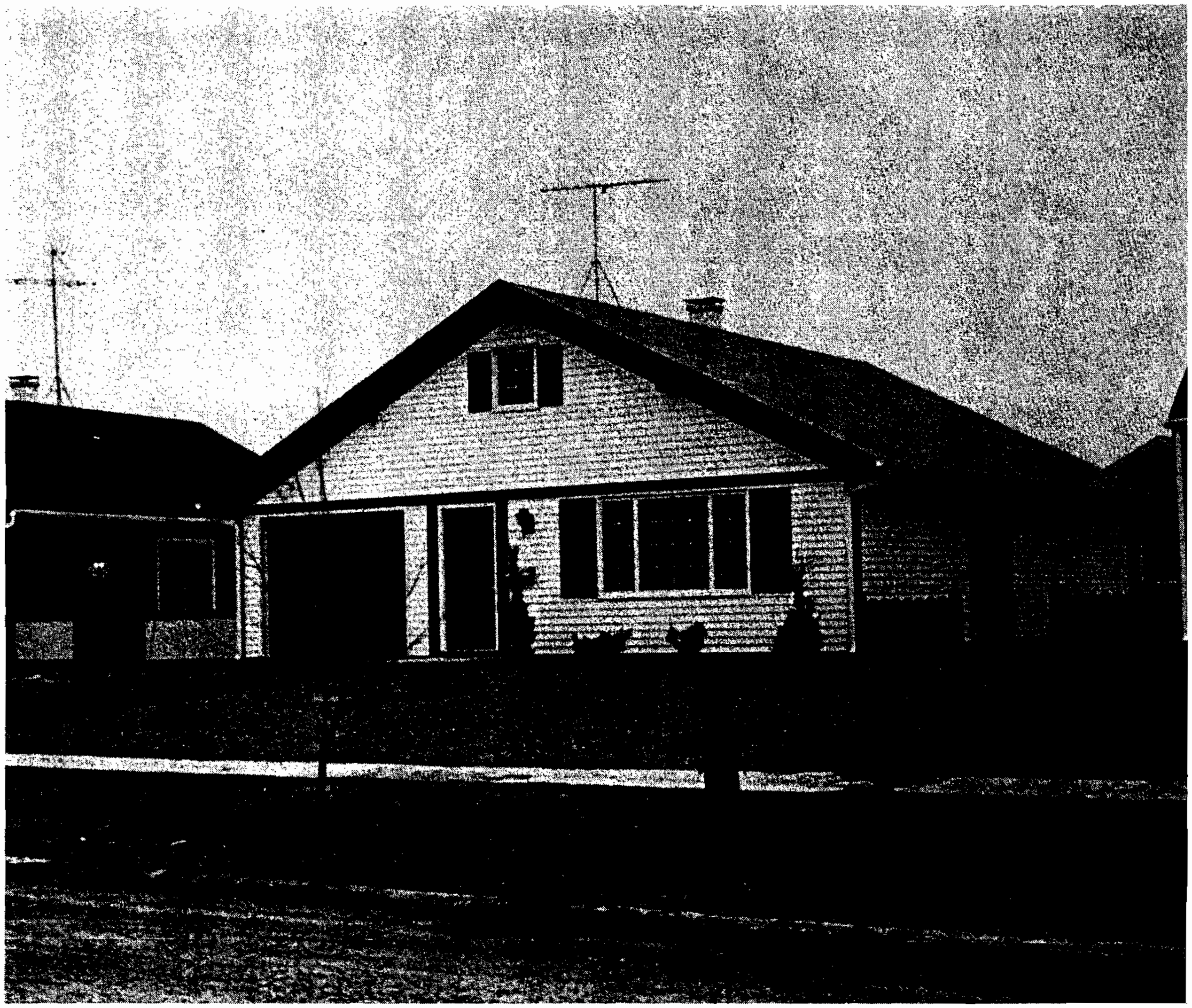

Figure 9.--Demonstration house incorporating composite studs in Aurora, Illinois.

This house was built stud by stud and involved more toe-nailing than a factory-built home. The carpenters found they had to start driving toe nails a full inch from the end of the stud to prevent cracking or breaking the stud's particleboard core.

One partition framed with COM-PLY studs was used to support kitchen cabinets. The builder followed his usual method of supporting cabinets by notching the studs on one side of the partition and inserting horizontal 2 x 4 cabinet supports (fig. 10). Such notching considerably weakens any stud, but it weakens COM-PLY studs more than solid wood studs. Although the wall covering, kitchen cabinets, and careful workmanship provided a satisfactory wall in this house, a warning against notching should be marked on the veneer face of COM-PLY studs during manufacture. There are ways to install cabinets without notching studs, and builders should be required to follow them.

Four to six inches of snow often covered the COM-PLY studs while they were stored at the site (fig. 11). In addition, the wall framing of the demonstration house was exposed to freezing rain and snow for several days before the roof was installed. This severe weather did not visibly deteriorate the COM-PLY studs.

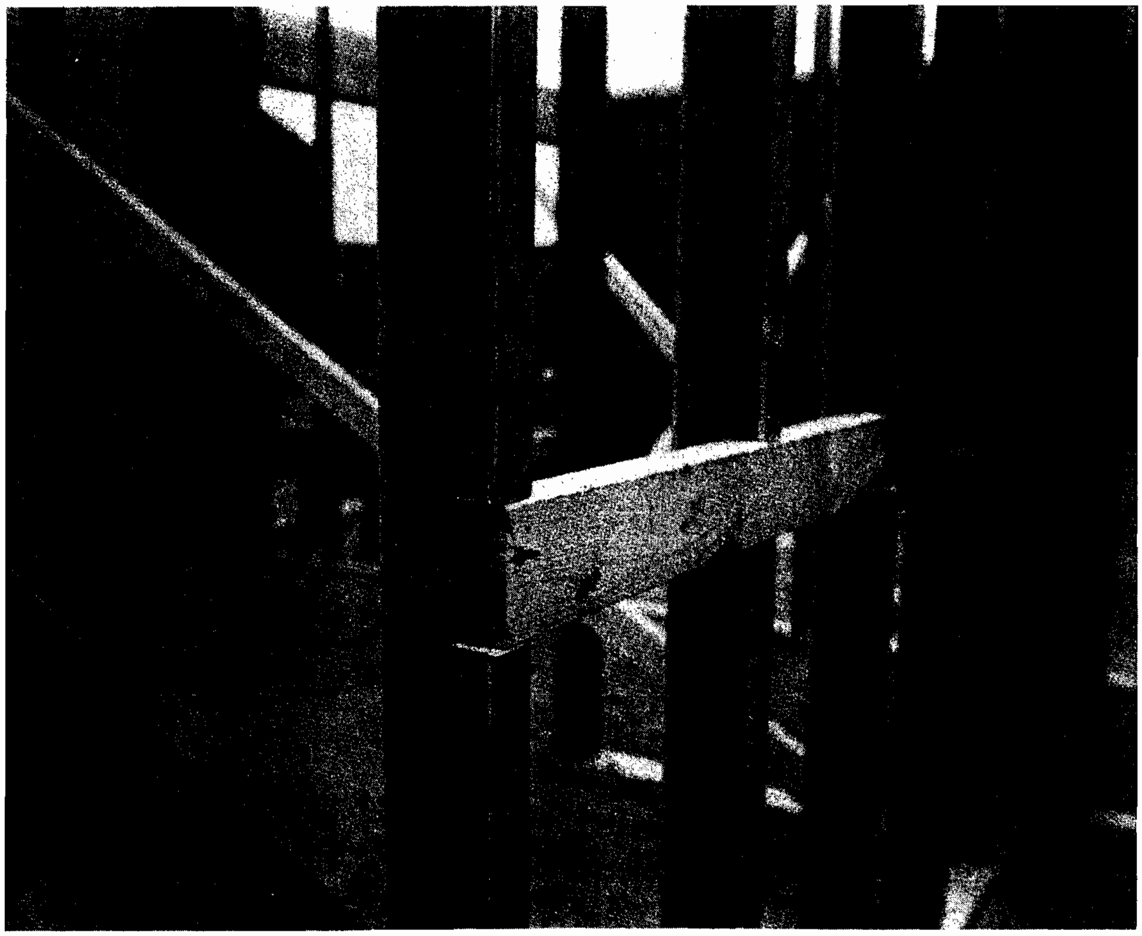

Figure 10.--The builder notched COM-PLY studs to install kitchen cabinets.

Building this house demonstrated that carpenters could use the new studs for house framing essentially as they have used sawn studs for over a hundred years. The Dise house was visited by officials with the local building code, lumber retailers and manufacturers, and other interested persons in the Chicago area.

Figure 11.--Snow-covered COM-PLY studs at the building site.

DEMONSTRATION HOUSE NO. 3

In late June 1975, approximately 300 people including plywood manufacturers, wood-product scientists, building code officials, and news reporters visited the third demonstration house incorporating composite products. These people had come from all parts of the Nation to see the first house built with composite roof sheathing, floor sheathing, siding, and stud framing.

The 2,320-square-foot, two-story house was constructed during April, May, and early June 1975 (fig. 12). It was built on lot 15 in Heathwood II Subdivision at the corner of N.E. 7th Street and N.E. 145th Avenue in Vancouver, Washington, across the Columbia River from Portland, Oregon. Pruitt Construction Company of Vancouver, Washington, constructed the house; and HUD insured the mortgage under Section 233 of the National Housing Act. The Pruitt Construction Company built the house piece by piece and completed it in 2 months, amid intermittent periods of heavy rain and hot, dry weather.

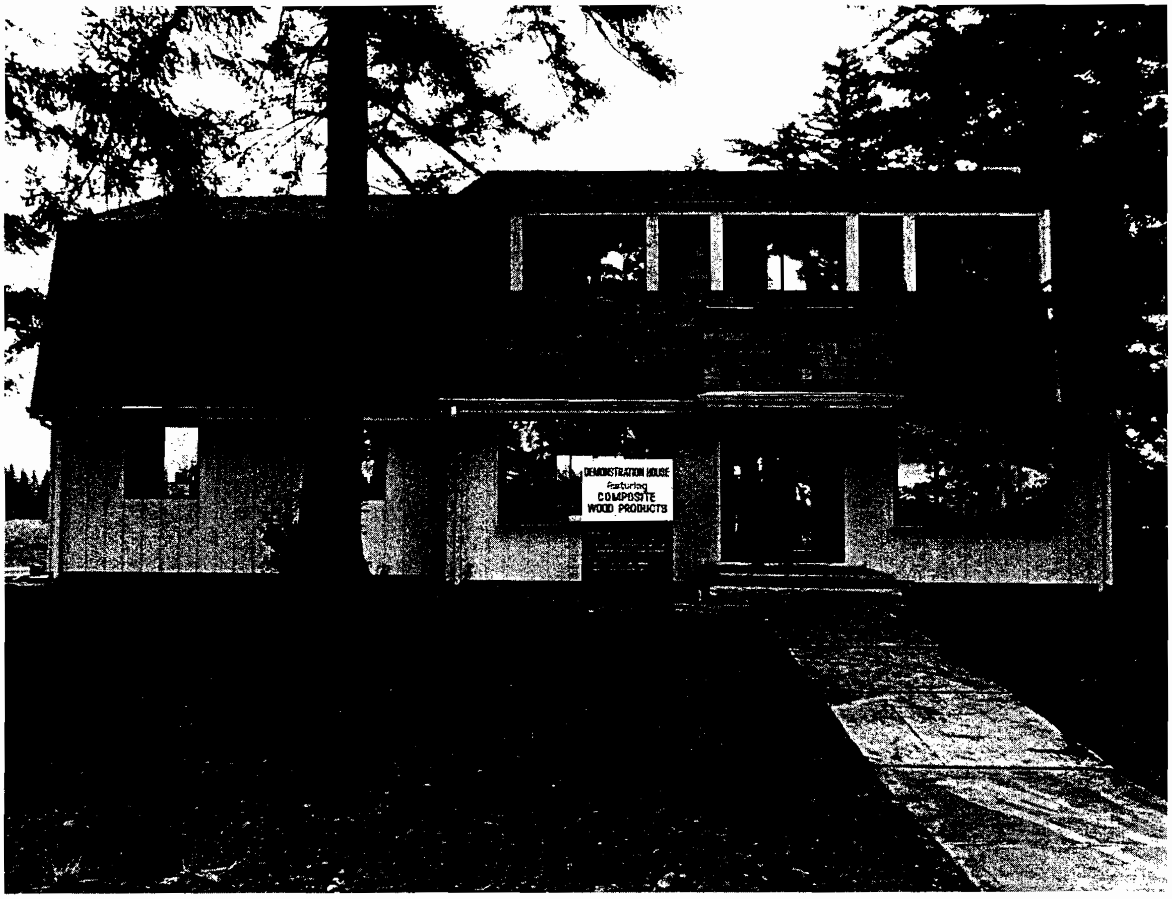

Figure 12.--The first demonstration house built with composite roof sheathing, floor sheathing, siding, and stud framing.

INSTALLATION OF COMPOSITE STUDS

Composite studs for this house were supplied by U.S. Plywood and Georgia Pacific Corporation. It proved as easy to cut, nail, and install walls and partitions with these COM-PLY studs as with conventional studs. The builder was especially pleased with the straightness of COM-PLY studs and said that they had a distinct advantage over conventional ones. The plumbers used right-angle drills to bore holes as large as 2-1/2 inches in diameter through the cores of the studs. These holes accommodated short, horizontal runs in the plumbing and electrical wiring. Laboratory tests at Athens, Georgia, had previously shown that such large holes could be bored through COM-PLY studs without an appreciable loss of strength and stiffness (Wittenberg, in press). The house built by Pruitt Construction Company confirmed this finding.

The ends of the studs occasionally split when end nails were driven too close to the edges of the particleboard cores. The builder took Forest Service representatives through an uncompleted house built with conventional studs of sawn lumber and pointed out the end splits and crooked studs. He emphasized that these defects far outnumbered those in the COM-PLY studs used in the demonstration house. COM-PLY studs were used for blocking at a stairwell in the demonstration house. This blocking was cut on a 45° angle at each end and toe-nailed into place (fig. 13). No splitting occurred in the extensive toe-nailing used in the demonstration house, and the carpenters were pleased with the performance of the COM-PLY studs.

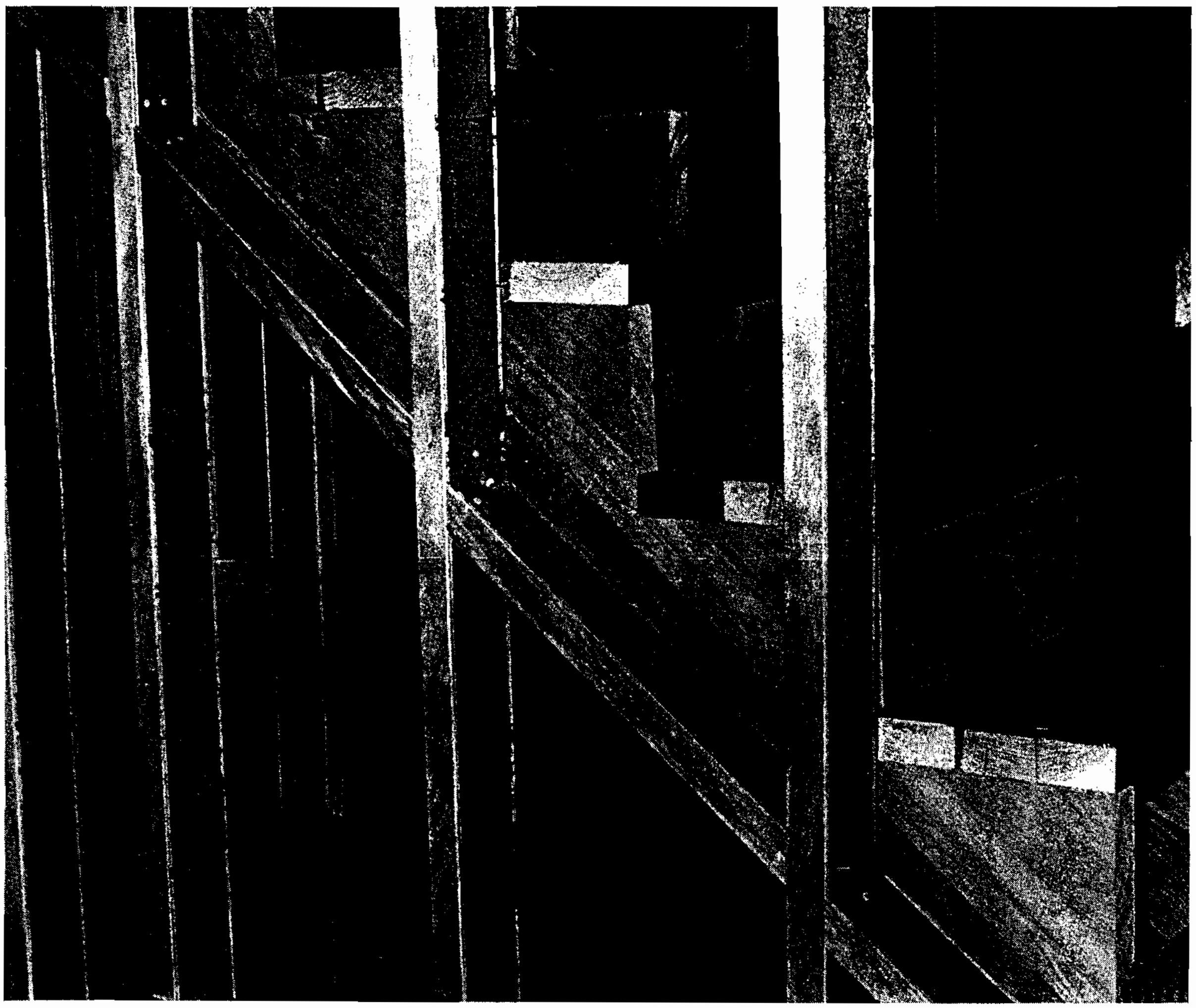

Figure 13.--COM-PLY studs used for blocking at a stairwell.

INSTALLATION OF COMPOSITE SHEATHING AND SIDING

Three major manufacturers of forest products cooperated in supplying the composite panels for the third demonstration house. Combination subflooring and underlayment was supplied by Potlatch Corporation; roof sheathing by Weyerhaeuser Company; and combination sheathing and siding by Evans Products Company.

Prior to construction, production panels typical of those used in the demonstration house were evaluated by laboratory tests. Included were an evaluation of glueline quality in the roof sheathing and floor underlayment and evaluations of structural and dimensional stability in the roof sheathing, underlayment, and siding. The roof sheathing and underlayment carried the American Plywood Association's (APA) grade-trademark, signifying that they had qualified under glue-bond testing as "APA Special-Use Panels."

The 7/16-inch-thick roof sheathing, made by Weyerhaeuser, consisted of a 1/4-inch particleboard core and a 1/10-inch face and back veneers of Douglas-fir. The core was made in Weyerhaeuser's particleboard plant in Marshfield, Wisconsin, with nonoriented flakes and a phenolic-resin binder.

The floors on the first and second stories consisted of a 5/8-inch, tongue-and-groove, single-layer floor system. The panels, produced by Potlatch Corporation, had a core of 3/8-inch oriented particleboard overlaid with 1/8-inch face and back veneers of Douglas-fir. The panels were tongued and grooved along the long edges.

The siding for the demonstration house was 5/8 inch thick with a reverse board-and-batten pattern. The panels were produced by Evans Products Company; the cores of these panels were produced by Potlatch Corporation from oriented wood particles. This particleboard core was made in a single step and consisted of a three-layered mat of wood particles bonded with phenolic resin. Evans Products Company overlaid the core with 1/8-inch face and back veneers of cedar. The panels were then milled with a rough-sawn surface and a reverse board-and-batten pattern, with grooves spaced 12 inches on center (fig. 14). The edges of the panels were shiplapped.

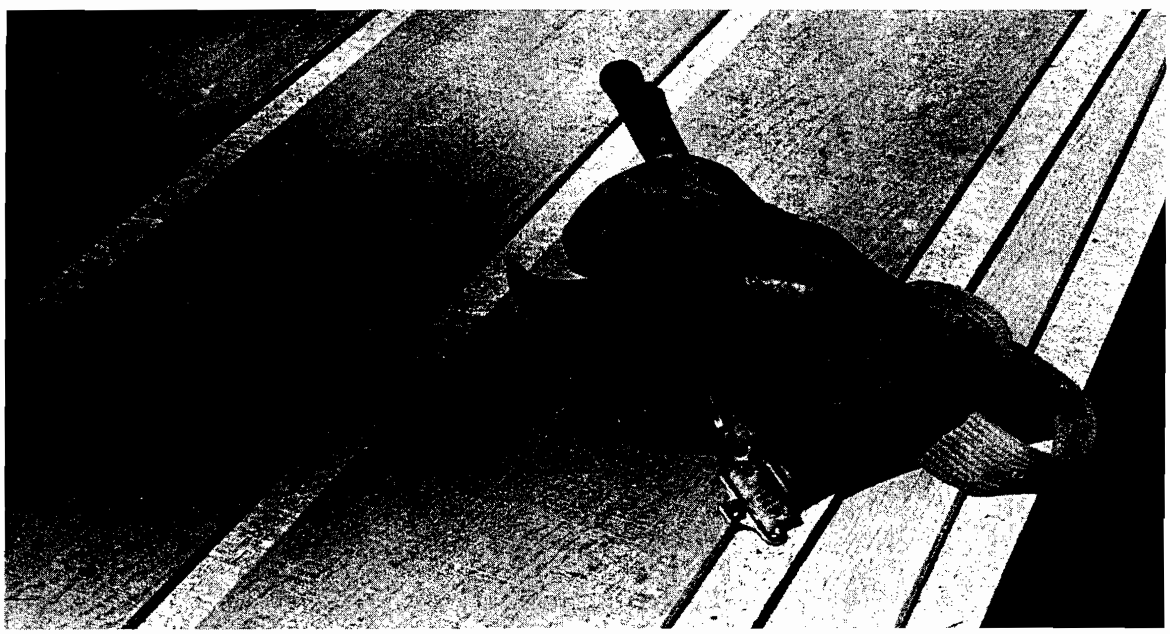

Figure 14.--Panels of rough-sawn siding with a reverse board-and-batten pattern and grooves spaced 12 inches on center.

The three types of composite panels were shipped directly to the contractor. APA, HUD, and Forest Service staff members observed, and at times participated in, the installation of the composite panels. Figures 15 through 19 illustrate the construction process.

The first composite panels to go into place were the floor underlayment (fig. 15). They were attached to the floor joists with nails spaced 12 inches on center and construction adhesive (fig. 16). During installation, adhesive was also applied to the tongue-and-groove joints of the panels (fig. 17).

Figure 15.--Laying the composite floor panels. Note the tongue-and-groove joints.

The carpenters found that the composite panels could be handled and installed as easily as regular plywood panels. The tongue-and-groove joints fitted properly and went into place easily. Nails were as easy to drive through the composite panels as through regular plywood.

The siding panels were installed next. They were attached to the wall framing while in a horizontal position, as shown in figure 18. After assembly on the deck, the walls were tilted into place with wall jacks (fig. 19). The wall framing consisted of regular 2 x 4 lumber plates and COM-PLY studs. All studs were spaced 16 inches on center, and the siding panels were attached directly to the framing. The builder used no wall sheathing or exterior wall bracing. All panels were nailed to the wall framing with 8d galvanized box nails spaced 6 inches on center around the perimeter of the panel and 12 inches on center at intermediate studs.

The last panels to go in place were the roof sheathing. Because this house had a gambrel roof, the 7/16-inch panels were used for both roof sheathing and the combined wall and roof surfaces of the second story. The panels used on the steep portion of the roof were attached to the framing while in a horizontal position, and the studs were spaced 16 inches on center. The walls were then tilted into place and the roof trusses installed. The remaining roof sheathing was then installed on trusses spaced 24 inches on center.

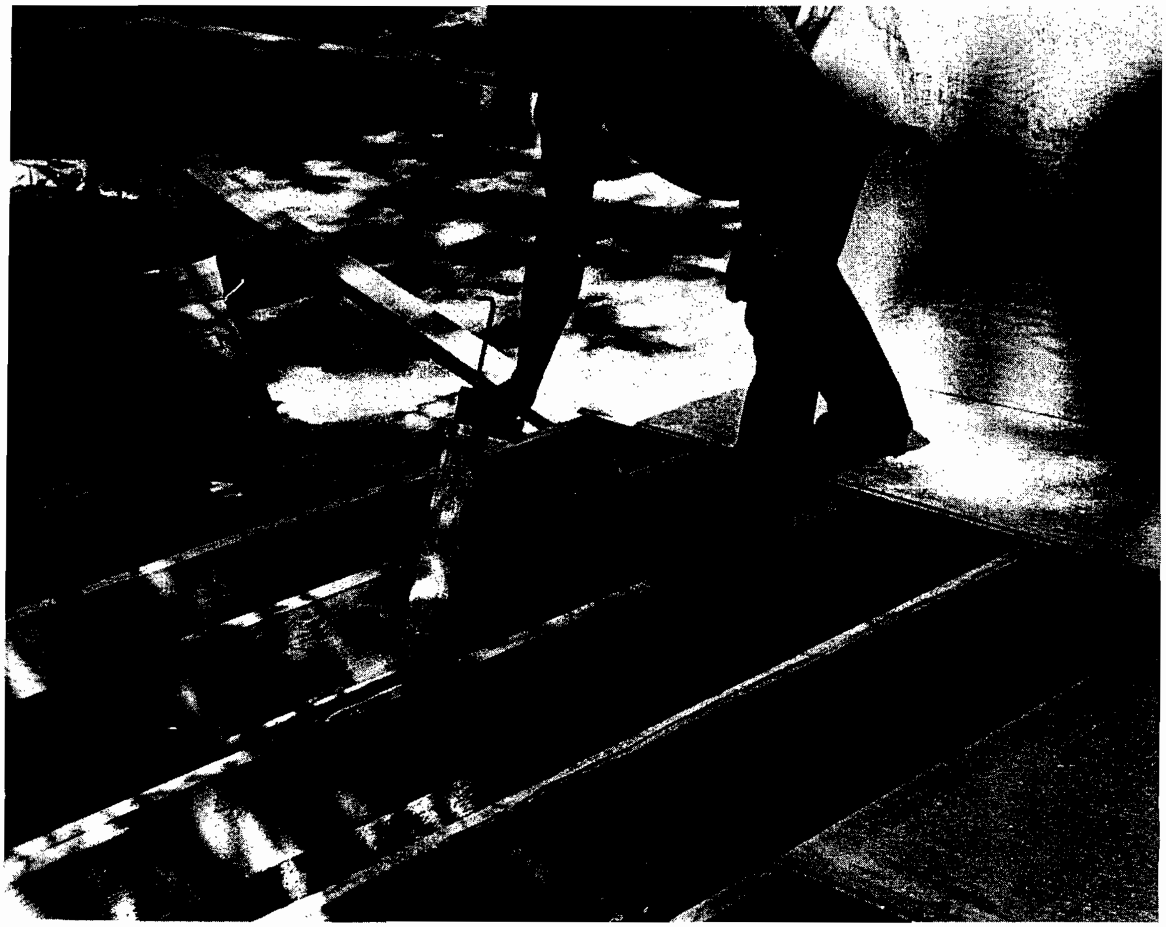

Figure 16.--Applying construction adhesive to the joists.

Laboratory tests indicated that metal clips and wood blocking were unnecessary at adjacent edges of the sheathing. The roof sheathing was attached to the framing with pneumatically driven staples spaced 6 inches on center at the perimeter and 12 inches on center at intermediate supports (fig. 20).

On the steep portion of the gambrel roof, commercially pre-assembled panels of cedar shingles were attached according to the manufacturer's recommendations. On the flatter portion, regular cedar shingles were attached according to normal construction procedures.

No problems were encountered during the installation of any of the three types of composite panels. All panels went into place easily, just as though they were made entirely of veneer. When interviewed, the carpentry superintendent was enthusiastic about the new panels. The builder was also satisfied with the panels and expressed a willingness to use them again. Such panels could be used interchangeably with regular plywood panels, which have long been accepted in residential and commercial construction.

Figure 17.--Applying adhesive to the tongue-and-groove joints of a panel.

Figure 18.--Attaching the siding panels to the framing.

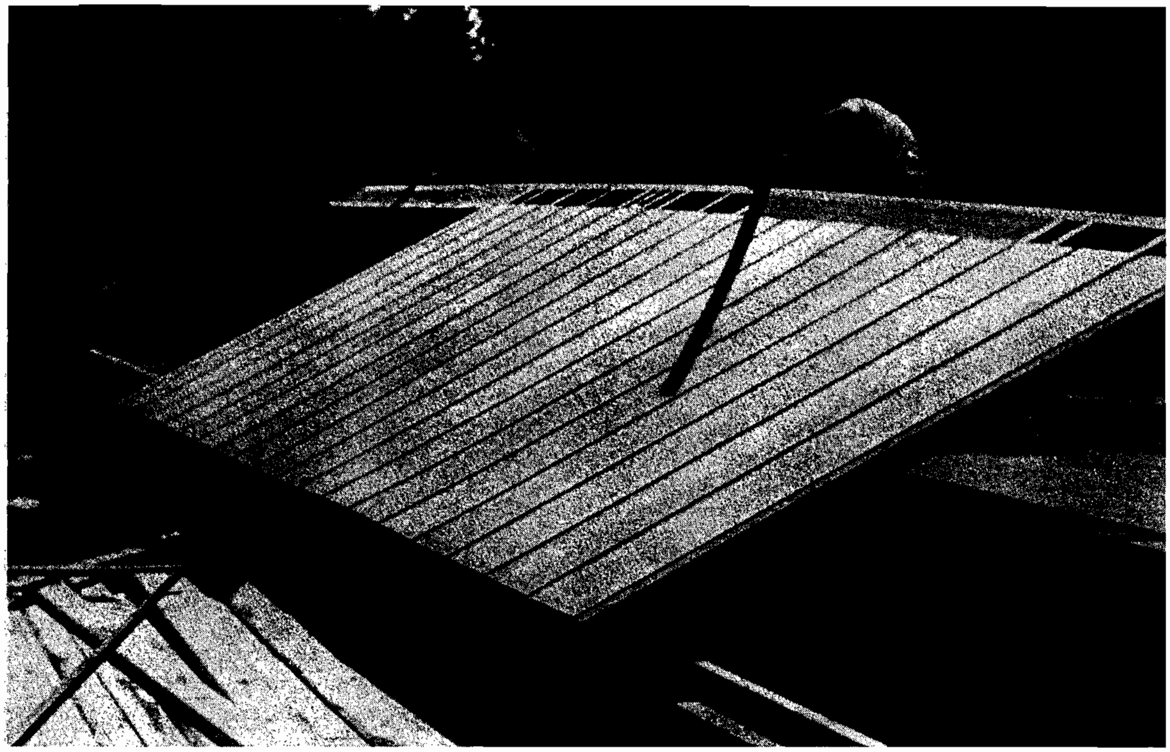

Figure 19.--Raising a wall panel into place.

Figure 20.--Roof sheathing in position for stapling to the rafters.

Although it rained before and during construction, the tongue-and-groove joints went together easily, indicating that the new panels will perform similarly to plywood even when wet. Rain also fell on the roof sheathing after it was installed. As a result, the panels expanded in width and length as regular plywood would. A few of the panels over two roof trusses buckled because fasteners had missed the framing for as much as 44 inches. Such buckling would not have occurred if the panels had been adequately nailed.

DEMONSTRATION HOUSE NO. 4

In late summer 1975, Kettler Brothers, Inc., of Gaithersburg, Maryland, built the fourth demonstration house incorporating composite products. The two-story house, containing 2,400 square feet of living space and a 460-square-foot, two-car garage, was located at 10 Masten Brook Court in the Fairidge Subdivision, Montgomery Village, Maryland, near Washington, D.C. Kettler Brothers started construction in August 1975.

The two types of composite panels used were both produced by the Potlatch Corporation. One type was 7/16-inch-thick roof sheathing that looked like ordinary C-D, exterior-grade plywood. It had 1/10-inch face and back veneers of Douglas-fir and was a direct substitute for the 1/2-inch-thick plywood normally used for roof sheathing by the builder. The other type was single-layer floor underlayment 3/4 inch thick. These panels had 1/8-inch-thick face and back veneers of Douglas-fir. The long edges of the floor panels were tongued and grooved so that the edges joined firmly together. This was the first time composite floor panels 3/4 inch thick had been used within the United States.

The first panels to go into place were the floor underlayment. A construction adhesive conforming to Specification AFG-01 of the American Plywood Association (1974) and nails spaced 12 inches on center were used to fasten the panels to joists spaced 16 inches apart. The glue was applied to the joists but not to the tongue-and-groove joints. One of the carpenters noted that the panels were easy to cut and nail and that they fitted together easier than most plywood panels.

After the first-floor walls and joists were put into place, the second-floor joists were installed at a spacing of 24 inches on center, and 3/4-inch underlayment panels were attached to the joists. As in the first floor, the panels went into place easily and were glued to the framing.

The last step of construction was to apply the 7/16-inch roof sheathing. These panels were attached to trusses spaced 24 inches on center and nailed at 6 inches on center at the perimeter of the panels and 12 inches on center at intermediate supports. No clips or blocking were used with the 7/16-inch sheathing.

During construction, there were intermittent periods of rain followed by hot, dry weather. There were no problems in installing the composite roof or floor panels. The panels went into place just like plywood.

DEMONSTRATION HOUSE NO. 5

In mid-December 1975, Mr. Jack Bowles of Augusta, Georgia, built a demonstration house incorporating COM-PLY studs. The one-story, 1,144-square-foot house was located at 2308 Old Boston Chapel Road in the Cherry Hill Subdivision, Augusta, Georgia (fig. 21).

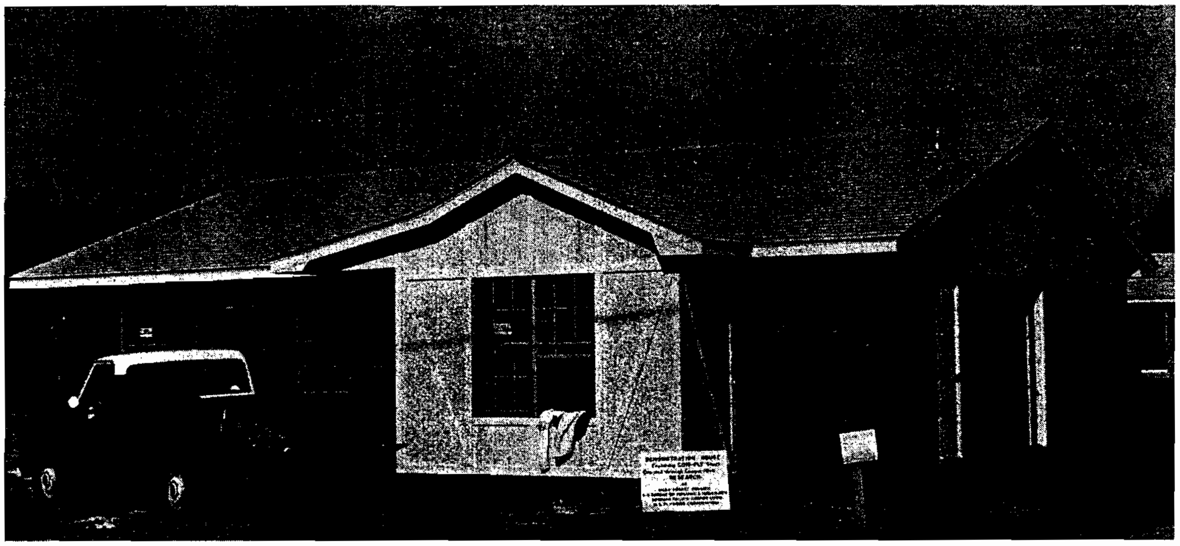

Figure 21.--The demonstration house in Augusta, Georgia.

A subcontractor framed the house at the site. The framing carpenters had no difficulty in cutting, nailing, and installing the COM-PLY studs (fig. 22). They were impressed by the straightness and uniformity of the new studs.

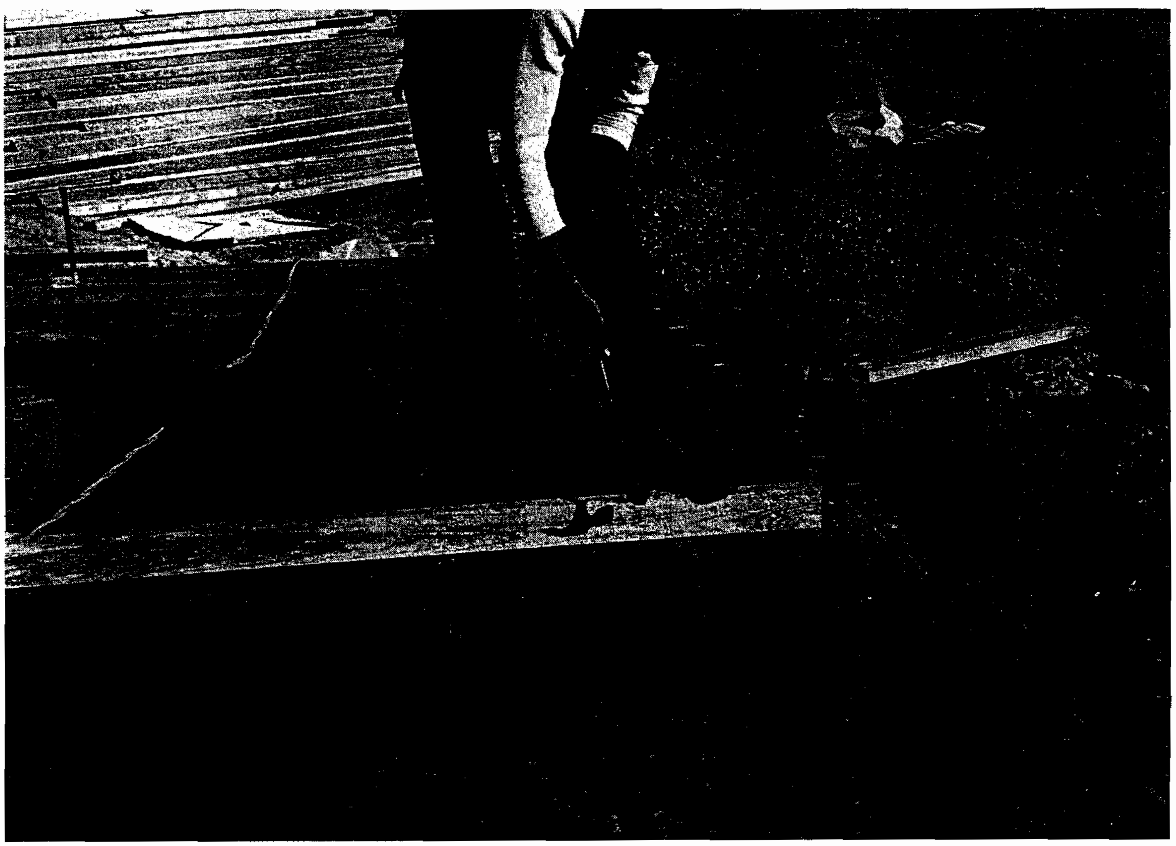

Figure 22.--Carpenter framing the walls.

The framing crew used COM-PLY studs for blocking, corner posts, window sills, window cripples (fig. 23), door heads (fig. 24), and other framing. There was no comment about the weight of the studs or about the difficulty of driving nails into the 3-1/2-inch-wide faces of the studs. Most of the framing was completed on December 15 under clear, sunny skies. Soon after, the house was deluged with 2-1/2 days of rain. As in the previously built houses, the COM-PLY studs showed their resistance to warpage. They remained straight and dimensionally stable during the 4 weeks after construction when the house was open for inspection.

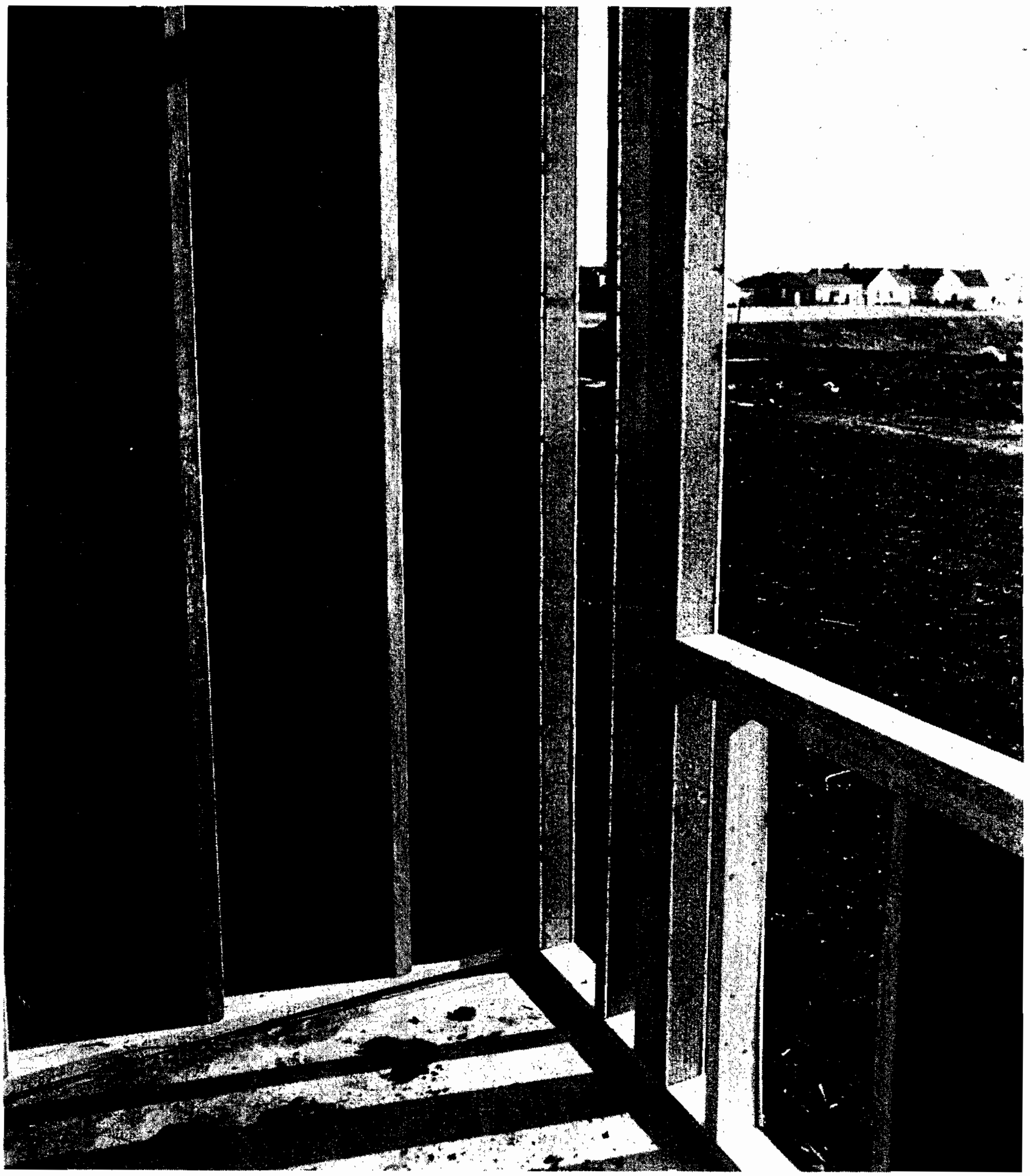

Figure 23.--COM-PLY studs used for window cripples.

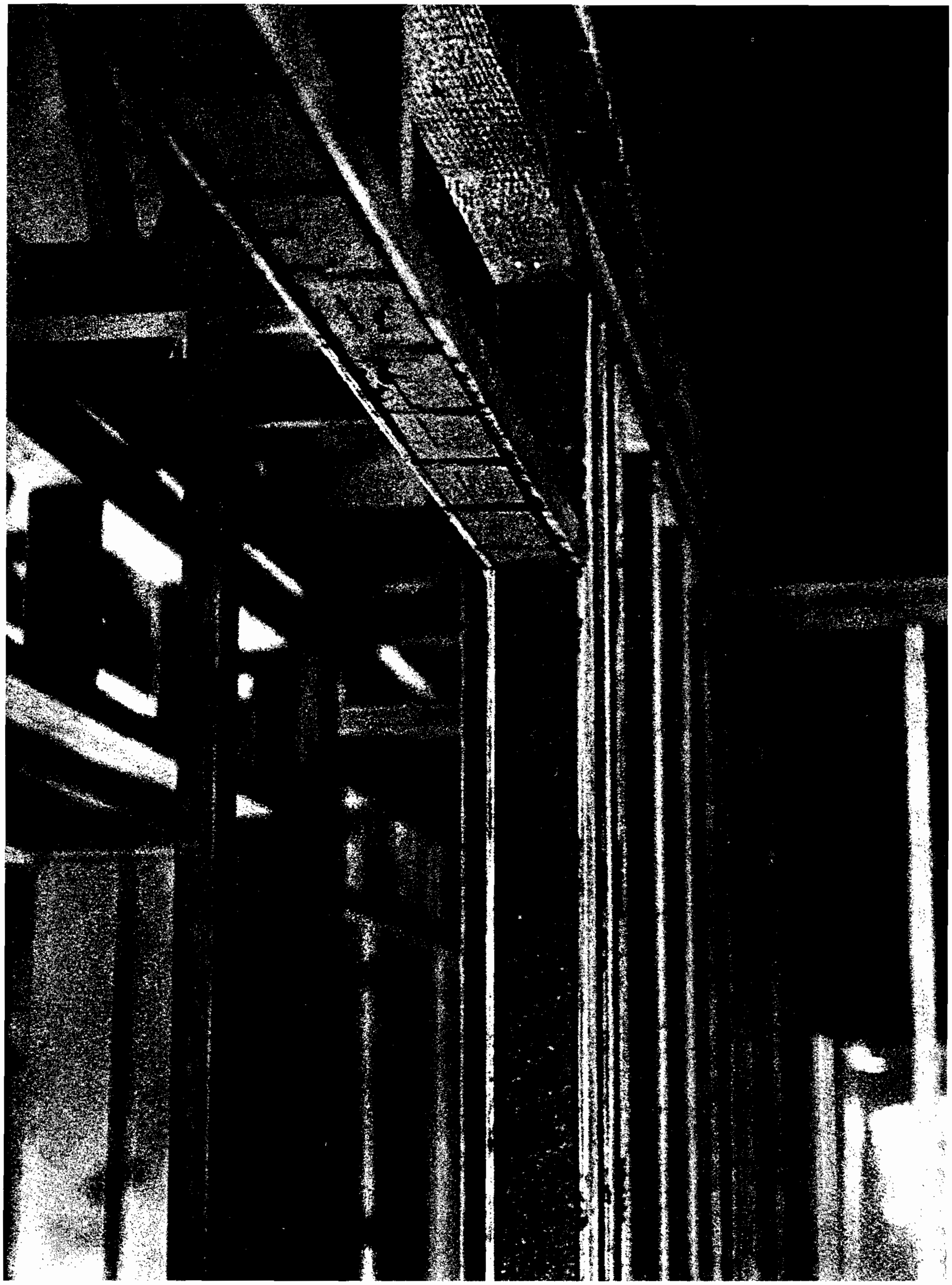

Figure 24.--COM-PLY studs used for door heads.

The plumbing and heating subcontractors notched the faces of some of the COM-PLY studs for plumbing and air-conditioning pipes (fig. 25). Only a few studs were notched, mostly in nonload-bearing partitions where structural strength was not critical. The notching was unnecessary because holes drilled through the stud cores would have worked just as well (fig. 26).

The house was visited by building code officials, home builders, lumber dealers, wood products manufacturers, and others from throughout the Southeastern United States. The project received press coverage by newspapers, TV, and trade journals.

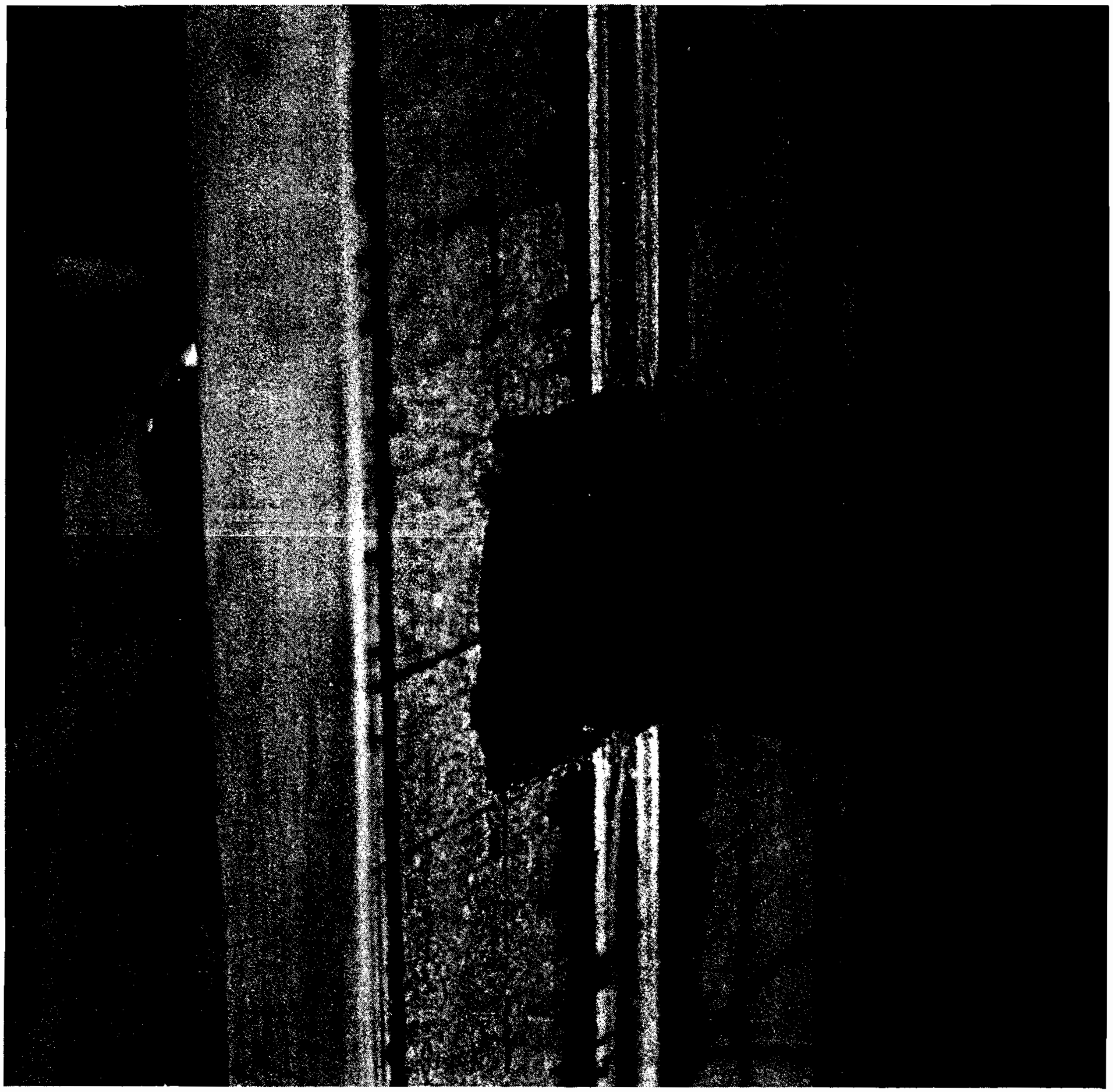

Figure 25.--Composite studs notched for plumbing pipes.

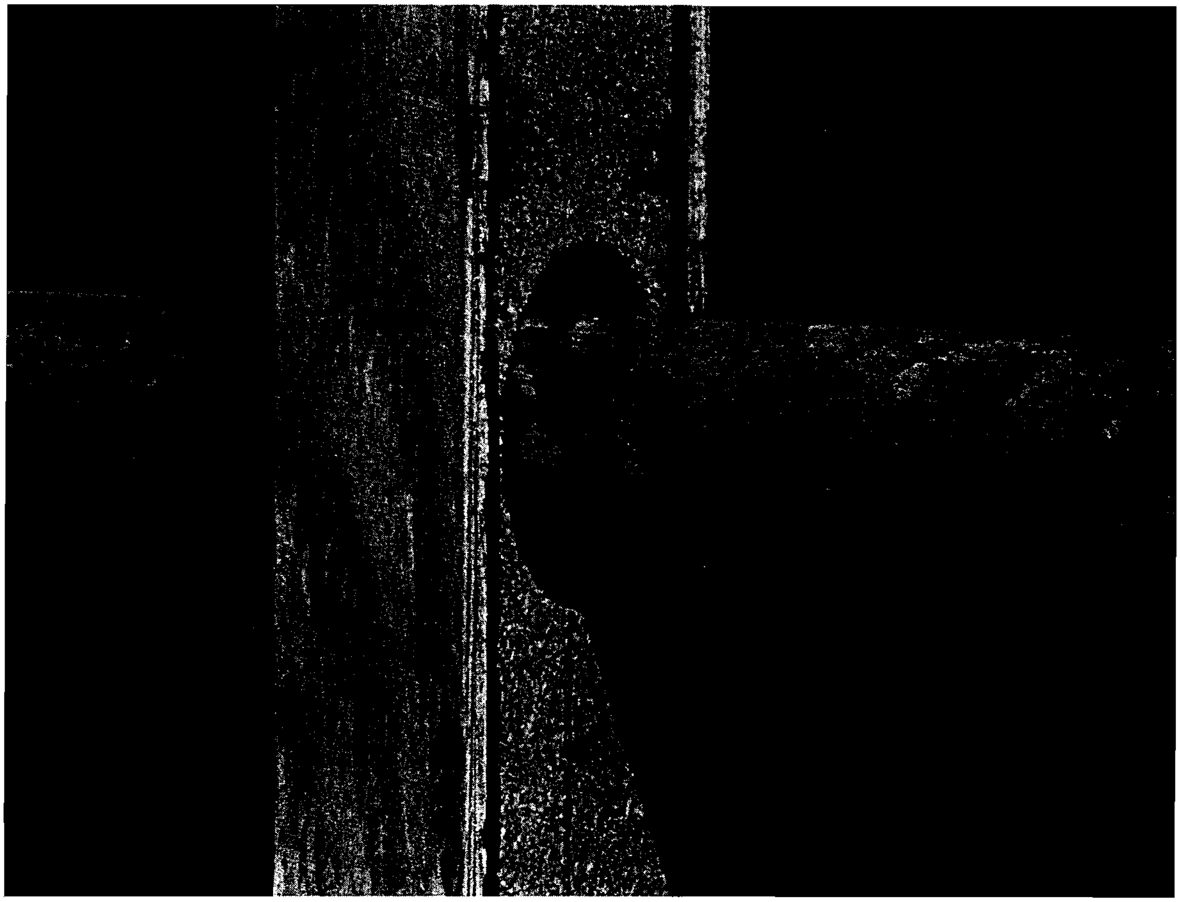

Figure 26.--Holes for plumbing pipes were drilled in the cores of COM-PLY studs.

DEMONSTRATION HOUSE NO. 6

In commemoration of the American Revolution Bicentennial, the National Aeronautics and Space Administration (NASA) started planning in early 1975 for the design and construction of a house to be ready for display at the Langley Research Center in Langley, Virginia. It was NASA's theory that the techniques and components developed for the aerospace program are applicable to the building industry.

The objectives of NASA's Project TECH house were to demonstrate the application of advanced technology and to help influence future development in home construction (fig. 27). Emphasis was placed on minimizing the requirement for energy and other utilities and integrating energy and water systems with building configuration and construction materials.

Studies were made of various components and methods believed to have a good chance of being cost-effective over the period of a typical home mortgage, assuming the generally accepted figure of a 10 percent increase in energy cost each year. Components chosen for the TECH house were those available to the building industry in 1976 or likely to be available before 1981.

The exterior walls of the house were framed with 2 x 6 wood studs so that they could be heavily insulated. COM-PLY studs were chosen for all interior partitions (fig. 28).

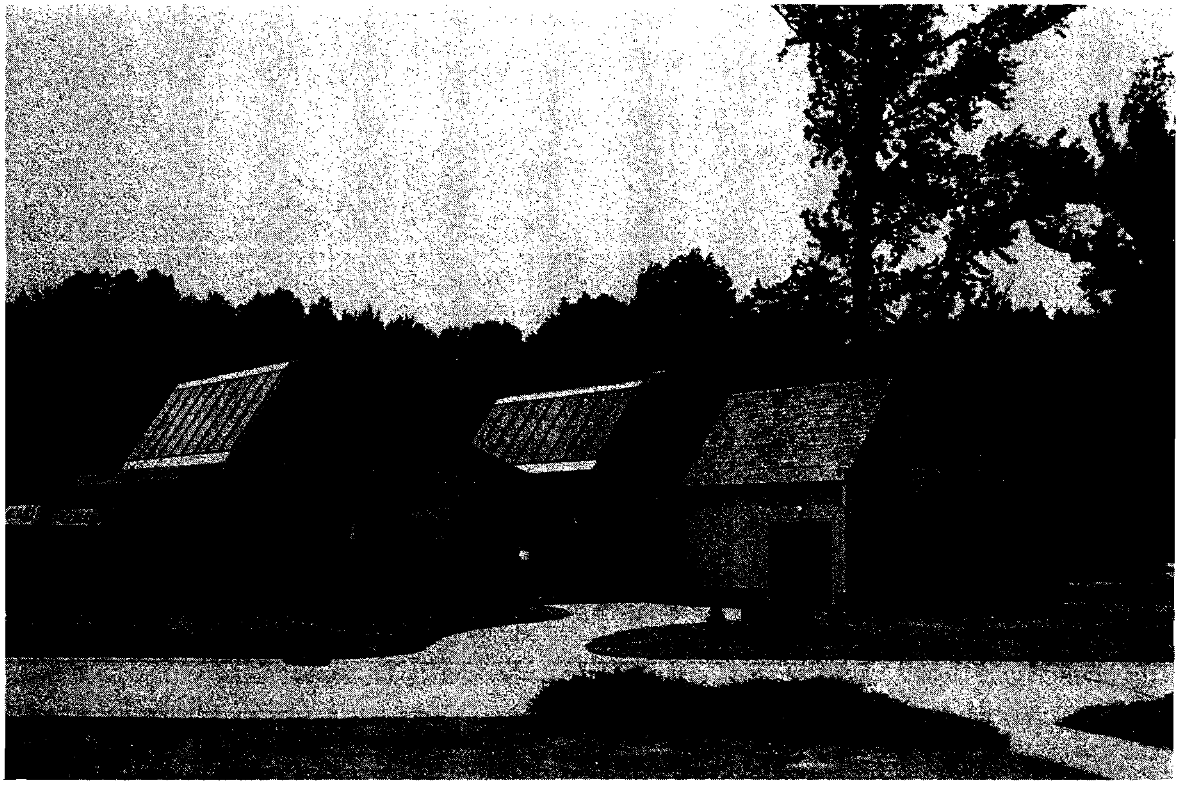

Figure 27.--NASA's Project TECH house at Langley Research Center in Langley, Virginia.

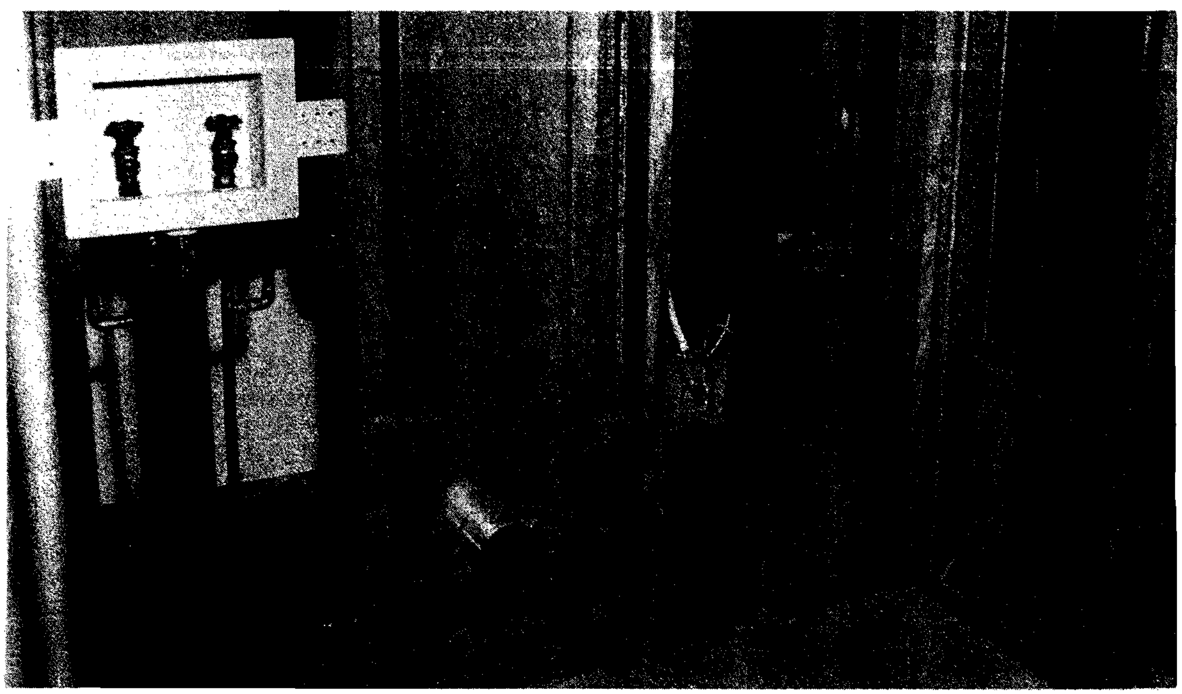

Figure 28.--COM-PLY studs were used to frame the interior partitions of NASA's Project TECH house. Large holes were drilled through the cores of the studs to accommodate plumbing.

The house was highly instrumented to allow for a detailed evaluation of its components during 1977. Recommendations will then be made about performance, cost-effectiveness, and interaction of the various systems.

CONCLUSIONS AND RECOMMENDATIONS

All builders interviewed were impressed with the straightness and dimensional stability of COM-PLY studs. They said that, if prices were equal, they would prefer using COM-PLY studs instead of sawn studs because there would be less waste from warping and the studs would be of uniform quality. The new studs were easily end- or toe-nailed, with less splitting than occurs with sawn studs.

Although COM-PLY studs and panels were heavier than conventional products, the builders decided that the greater weight and resistance to side-nailing would not deter them from using the new products. COM-PLY studs withstood extremes in heat and cold and in wetness and dryness with no apparent loss in strength, stiffness, or dimensional stability. Drilling holes through the cores of COM-PLY studs for plumbing and electrical wiring did not affect their strength and stiffness or the appearance of the finished walls.

Carpenters detected the superior stiffness of composite panels along the grain. Generally, they believed that the 7/16-inch-thick, composite roof sheathing was as stiff as or stiffer than 1/2-inch-thick plywood. They pointed out that the cores of composite panels were solid and free from the knot holes that sometimes occur in plywood. Furthermore, they also noted that composite roof sheathing, floor sheathing, and wall siding did not buckle even when subjected to heavy rain.

Construction of the demonstration houses proved that composite floor panels can be effectively tongued and grooved. None of the tongued and grooved edges broke, crumbled, or became distorted. Construction of the houses also showed that composite floor panels can be glued to floor joists in the same manner as plywood floor underlayment.

We recommend that the face veneers of COM-PLY studs be marked with a prohibition against cutting or notching. In addition, COM-PLY studs should be marked to indicate that their only intended use is for framing exterior walls of houses. We also recommend that composite panels be marked with a quality symbol such as the American Plywood Association's grade-trademark.

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