The Utilization of Lumber
and its Byproducts
in
Small Home Construction
by
Jimmie Henry

A Thesis
Presented to the Faculty
of the
School of Forestry
Oregon State College

In Partial Fulfillment
of the Requirements for the Degree
Bachelor of Science
June 1939.

Approved:

Professor of Forestry

SCHOOL OF FORESTRY
OREGON STATE COLLEGE
CORVALLIS, OREGON
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INTRODUCTION

Because of the lack of uniformity in building codes and methods in various sections of the United States, it has been a difficult matter to suggest definite procedures in regard to building practices. The fact that so-called standard sizes of lumber varied in different localities has hindered the adoption of similar methods in all parts of the country.

During the last five years, a number of radical changes have been made, among which has been the adoption of size and grading standards by many large lumber manufacturers. Today it is practically impossible to get an order for lumber if it is not grade marked by the West Coast Lumbermans Ass. This line of endeavor has been carried out for hard as well as soft woods, and will, in my opinion, continue until there is a complete standardization of the lumber industry.

This paper is written around the utilization and standardization of lumber and its by products in reference to the construction of small homes. In writing this I have had to review Grading rules, seasoning of lumber, Utilization of lumber, and many other subjects that I shall incorporate in this report.
CHAPTER I

HISTORY OF SHELTER

Primitive Shelter:

In primitive times man had to seek any type of shelter that nature could give to him, and these were at first caves. At length, however, man triumphed over his environment and learned how to construct himself a house. These houses varied as to climate, location, and materials from which to build the house. In these we have a range from the grass and brush huts of the bushman of Africa, to the ice igloos of the Eskimos. As man found a more specialized occupation for himself he built more permanent homes. In these permanent homes we find that there were only three main types of structures: a- a house to shelter himself, b- a temple for his gods, and d- a tomb for his earthly remains.

The primitive houses were very crude and unlike our homes today only a place to sleep, and stay when absolutely forced to.

The roof of the primitive house is a typical example of how most parts of the house are taken from the human stature. In order to protect the walls from heat and rain the primitive man learned to project the roof out over the walls just as the brow projects out over the eyes of a human.

We can trace the use of lath and plaster back to the primitive huts that were woven twigs plastered with mud. In other places the people learned to make sun dried bricks and where there was lime people learned to make mortar and use it to cement the stones together.
In wooded areas primitive man seeking the line of least resistance, has invariably utilized wood, and this is where the use of wood first started in home building. This often operated to denude of tree growth many of our early centres of culture, such as Greece.

Historic Styles:

The three early centres of human culture were the Nile Valley (Egypt), the Tigris-Euphrates Basin (Babylonia-Assyria), and the Grecian Archipelago.

Perrot and Chipiez in their History of Art in Ancient Egypt, tell us that the early Egyptian villas were constructed of a composit of materials. The walls were built of crude bricks of loam and chopped straw. The ceilings of the rooms were of wood, as were the locks on the wooden doors and windows. The floors were made of woven mats.

The next period finds the Babylonian-Assyrian house constructed of sun-dried brick and wood. The wood being used mainly for doors, and beams to hold the ceilings up. One can see that even in those early times wood was used for strength and decorative purposes.

The last of the early periods was the Greek house. The early Greek homes were of plaster and woven sticks, which finally gave way to crude stone, laid in mortar, and wooden construction.

We find that there was a predominate use of stone up till the last of the mediaeval period, where they started to make carved oak staircases, and found out that wood was easily worked into designs desired.
Homes from the last of the mediaeval period started to use more and more lumber in their construction. It was used for both decorative purposes and strength purposes. This tendency came to an almost complete use of wood in our early American homes, which were wood from top to bottom.

As time has progressed and many new materials have been found wood is still being used more than any other building material, especially in our small home construction.
CHAPTER II

SPECIES AND GRADES OF LUMBER USED IN CONSTRUCTION

Softwoods and Hardwoods:

All lumber is divided as a matter of convenience into two great groups, softwoods and hardwoods.

The softwoods in general are the coniferous cone-bearing trees, such as the various pines, spruces, hemlocks, firs, and cedars.

The hardwoods are the noncone-bearing trees, such as the maple, oak, poplar, and the like.

These terms are used mainly as a matter of custom, for not all so-called softwoods are soft nor are all so-called hardwoods necessarily hard. As a matter of fact, such so-called softwoods as longleaf southern pine, and Douglas fir are much harder than poplar, basswood, etc., which are called hardwoods.

Other and perhaps more accurate terms often used for these two groups are the needle-bearing trees and the broad-leaved trees, referring to the softwoods and hardwoods, respectively.

In general, the softwoods are more commonly used for structural purposes, such as for joists, studs, girders, posts, etc., while the hardwoods are more likely to be used for interior finish and in many cases for floors, but are not often used for furniture.

We find that the softwoods are much cheaper than are the hardwoods, while the density of the hardwoods cannot be equaled by many of the softwoods.
History of Lumber Standardization

For many years the lumber industry has been faced with a variety of trade practices in nomenclature, grades, and sizes of lumber. Individuals felt satisfied that lumber, having similar characteristics and intended to be used for similar purposes, even though cut from different species, could be manufactured, sold, and used according to definite standards.

The sentiments mentioned above resulted in a series of lumber conferences, beginning with the convention of the American Lumber Congress in 1919. In May, 1922, under the auspices of the Division of Simplified Practice of the Department of Commerce, a conference of 110 representatives of manufacturers, distributors, wholesalers, retailers, users of lumber, architects, engineers, and general contractors, though the Bureau of Standards of the United States Department of Commerce, recommended classification, nomenclature, basic grades, specific sizes, certain descriptions, measurements, tallies, shipping provisions, grade marking, and inspection of softwood lumber according to established standards.

Two major objectives were attained through these series of conferences:

1. The actual finished yard lumber items were reduced nearly 60 per cent in number, thus eliminating a large percentage of unnecessary and wasteful sizes.

2. The builders of homes in the United States can now be assured that the industry as a united force will give them standard lumber and by products.
Advantages to the Home Builder

Just as the customer who buys silver with a "sterling" mark knows that he is receiving the proper fineness of silver, so will the purchaser of conscientiously grade-marked lumber know that he is getting a certified standard quality. Many builders, using grade-marked lumber will find that a less expensive grade of lumber will do for many purposes where a more expensive grade has previously been used. Many architects and contractors have testified that they have always specified or ordered No.1 common, where lower grades would have served the purpose equally well. It was the uncertainty as to receiving the grade specified that made them demand better quality than was actually needed for their purpose. The difference in price between the various grades may be 30 to 60 per cent, and more in some instances. Intelligent specification of grades naturally depends on a knowledge of defects permissible in each grade, and grade marks will aid builders in obtaining a better understanding of lumber that is to be used in their homes.

Builders should also remember that when asking for bids on grade-marked lumber they place dealers on a fair competitive basis, because it would not be possible to secure an order and then without detection substitute one grade for another. Grade-marks protect the honest builder and contractor against unfair practices by people who take advantage of the consumers' ignorance of lumber species and grades.
Chapter III
Suitability of Woods for Home Construction

Exterior Trim

The woods used for the exterior trim of the small home should have a medium decay resistance, good painting and weathering characteristics, easy-working qualities, and maximum freedom from warp. The woods best suited for the requirements are the soft woods, except one, yellow poplar.

Some woods that are very good where the decay hazard is very high are: Cedars, cypress, and redwood. These are used on the porch, balcony, blinds and rails for trim as these places have the maximum decay hazard. It might be stated that heartwood only is used for trim in these places.

In other places on the exterior where drainage is good hemlocks, ponderosa pine, spruces, and white fir are used to a large degree. Douglas fir, western larch, and southern yellow pine are all very good woods to use except that they need special priming treatment to improve paint-holding qualities.

The grades that are used in the best construction jobs are A, B, or B and Better finish. C and D finish in more economical construction, and No. 1 or No. 2 boards where appearance is not important.

Flooring of the house
Living and Bedrooms:
Usual requirements:

High resistance to wear, attractive figure of color, minimum warp and shrinkage.
Woods combining usual requirements in a high degree:

Hard maple, red and white oak. (Most commonly used of all the hard woods). White ash, beech, birch, and walnut are not so commonly used. Then we have hickory, black locust, pecan, and a few others that are not worth mentioning, that are not commonly available, and are hard to work and nail.

Woods combining usual requirements in a good degree:

Cypress, Douglas fir, western hemlock, western larch, redwood, southern yellow pine are all fairly good if obtained in the vertical grain.

Grades Used:

In beech, birch, and maple flooring the grade of Firsts is ordinarily used for the better class of homes and seconds and sometimes Thirds in low-cost jobs. In oak the grade of Clear (either plain or quartered) is used in better class work and Selects and sometimes No.1 Common in low-cost work. Other hardwoods are ordinarily used in the same grades as oak. When softwood flooring is used (without covering in better class homes grade A or B and Better vertical grain is used. Grade D or C (vertical grain) is used in more economical and low-cost homes.

According to the latest information in the book "American hardwood Flooring and its Uses", a good floor should come up to the following specifications:

1. It should have suitable structural strength.
2. It should have high resistance to wear.
3. It should resist such natural elements as aging and sunlight.
4. It should be comfortable.
5. It should have a pleasing appearance.
6. It should be economical to install and readily available.
7. It should be restorable to the original condition at a moderate cost.

All of the grades and species that have been mentioned on the preceding page come under the proper specifications.

The modern trend for flooring is to use the pattern, (also often referred to as parquetry or design floors), in which the lumber industry has combined both beauty and closer utilization of their product, into one very merchantable product. In Figure 1. will be seen the beauty and method of laying this pattern flooring.

Another form of parquetry flooring is the prefabricated block. In manufacturing this type, the individual pieces are assembled in square of rectangular blocks at the factory and fastened of the back or at ends, with a metal spline or other type of fastener. The blocks are accurately squared and often prefinished at the factory so they are ready to be laid as a floor. Such blocks can be either nailed or set in mastic.

Even though the pattern type of flooring is gaining in its popularity, the type of hardweed flooring most extensively used is strip flooring. The fact that it is so widely used does not, however, make it "commonplace" in the true sense of the word, because no two hardwood floors are ever exactly alike in character and beauty of grain.
Innumerable designs are readily obtainable with parquet flooring. Figured hardwoods, such as shown in the above pictures, are often used for this purpose.
Furthermore, it is a simple matter to obtain interesting patterns in ordinary strip flooring by using a random mixture of widths, or variation of stock selected for color, thus achieving, in effect, a form of patterned floor.

Strip flooring obtains its name from the narrowness of the pieces of which the most frequent width is 2 1/4 inches wide. Most strip flooring is almost one inch thick, although other thicknesses ranging from three-eights to about one and a half inches thick.

![Figure No. 2.](image)

This picture shows men laying hardwood strip flooring in a skating rink, which shows its wear resistance qualities.
The next and last type of flooring that is commonly used is the plank flooring. Plank floors go back to the hand-craft era, when floors and other interior trim were the product of individual craftsmen. The plank floors of today are manufactured on modern machines. However, they retain the appearance and beauty and irregularities of the original types. They are usually of random width. Frequently the edges of the pieces are "eased" or rounded to give the effect of large cracks which were characteristic of the old-fashioned hand-hewn plank floor. Plank flooring is blind-nailed and also fastened on the ends with screws through the face of the material. The screws are countersunk and wood plugs are glued in the holes, thus simulating the effect of the old-fashioned wood pegs, which was the usual method of fastening the plank flooring of bygone days.

Figure No. 3.
Laying plank flooring in a home.
Softwood flooring.

In our softwood floorings there is only one that is used extensively in small homes construction, and that is Douglas fir. The grades that are suitable for flooring are: A and B and Better vertical grain, No. 1 and No.2 selects, are dervlicable in low-cost construction, but wear unevenly around the knots. In all of these grades it is advisable to use the standard matched flooring, and then when the time comes for surfacing, there will be plenty of surface to sand down.

The Framing of The House.

Usual requirements:

High stiffness, good bending strength, good nail-holding power, hardness, freedom from pronounced warp. For this use dryness and size are more important factors than inherent properties of the different woods.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine.

( extensively used.)

Ash, beech, birch, maple, oak. ( Sometimes used but more difficult to obtain in straight pieces and harder to nail and saw than preceding groupe.)

Cypress and redwood. (Seldom used.)

Grades used:

No. 1 Dimension is the usual softwood grade for all framing items in both high-and medium-class construction. No. 2 Dimensionrenders satisfactory service once it is in place, but is not so straight or easily fabricated as No.1.
No. 3 dimension is serviceable for studs and joists in the more economical and low-cost homes, especially when warped pieces and short lengths resulting from cutting out defects can be used to advantage. When hardwoods are used for framing, sound square edge is used in the better types of construction and for such items as joists, rafter, and sills. Hardwood Common Dimension is used in the more economical type of buildings and for studding in all types.

**Framing Methods:**

The best of materials and workmanship for plaster and interior trim will fail to give satisfactory results unless the underlying framework of a building is strong and rigid. Durability, tornado and earthquake resistance, freedom from cracks and settlement, all depend in part on a good framework.

No two men will frame a building in the same manner, nor is there general agreement among carpenters as to which is the best framing for a given condition. Light frame construction, however, may be classified into three more or less distinct types:

1. Balloon frame.
2. Western or platform frame.

Combinations of these types in one building are sometimes made, but usually are not advisable for reasons which will appear hereafter.
Ballon Framing;

The principal characteristic of balloon framing is the use of studs extending in one piece from the foundation to the roof; the joist ends being nailed to the studs, and also supported by a ribbon or ledger board let into the studs.

Platform Framing.

This type of framing is distinguished by floor platforms independently framed; the second and third floors being supported by studs one story in height. Its chief merit, in strictly all-lumber construction, lies in the fact that if any settlement, due to shrinkage, occurs, it will be even and uniform throughout and so be unnoticeable. This type should be avoided with brick veneer or with masonry-walled buildings for either outside or inside construction. Special framing methods are necessary around chimneys, whether interior or exterior, and special precautions should be taken in flashing around chimneys and vents.

Braced Framing:

The braced frame is the oldest type in this country, having been brought over from England in colonial times. Though in considerably modified form, it is still followed in certain sections, notably in the New England States. Originally, this type was characterized by heavy timber posts at the corners, often with intermediate posts between, all of which extended continuously from a heavy foundation sill to an equally heavy plate at the roof line.
At the second story, were introduced heavy timber girts running from post to post, carefully mortised and tenoned with oak pins. The studs, therefore, served merely as fillers, making what we now call curtain walls. They were not intended to carry any weight, and served merely as a support for plaster and exterior finish.

With the introduction of cheap nails, modern tools and hardware, the type has gradually been modified and is still undergoing change. While still much heavier than other methods of framing, it is lighter than in colonial times. The girts now used are too light to act as beams, and the studs have become an integral part of the structure, supporting the floors and roof about as they do in the other types.

The Use of Short Lengths of Lumber:

"Short-length lumber" is that which is less than 8 feet long. Pieces of 6 and 7 feet form part of the standard output of practically every saw and planing mill; lengths of 4 and 5 feet are less frequently regarded as a salable portion of the mill output; lengths of 2 and 3 feet are discarded except by those lumber manufacturers who handle the more valuable species of wood or who have worked up specialized markets for these pieces; yet all of this material is of high intrinsic value as respects quality and accuracy of manufacture, is admirably suited to many uses, and under present market conditions is economical. Notwithstanding which, lengths less than 8 feet seldom are specified in standard commercial practice.
"To the consumer the use of short lengths would mean an appreciable saving, since it is the general practice of mills throughout the United States to quote short lengths 15 to 35 per cent below the prices asked for standard lengths of equal grade.

The industries of the United States manufacturing wood articles now absorb about one-tenth of the present short-length lumber output of the mills. They could without difficulty absorb five times as much; that is, 50 per cent of the present short-length output. This would, however, still leave 50 per cent of the present unavoidable production and all of the potential mill production of short lengths for consumption in other avenues; and outlets for it lie chiefly in the building and construction industries, inasmuch as they consume the two-thirds of all softwood lumber sawn in the United States. In expansion of the demand for short-length lumber for construction work, then, lies the solution of the short-length marketing problem."

It will be seen in Figure No. 4, that the short-lumber will add a great saving to the consumer no matter what type of house he builds.

1. "The Marketing of Short-length Lumber" PP. 3
## Figure 4

<table>
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<th>Items and types</th>
<th>Short lengths specified in bill of material</th>
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**Weighted average**:

- **ALL ITEMS**: 0.01, 0.01, 0.04, 0.20, 1.32, 1.58
- **One-story box**: 0.02, 0.02, 0.08, 0.22, 1.32, 1.58
- **Two-story box**: 0.11, 0.11, 0.49, 3.02, 8.55, 1.99
- **One-story L**: 0.09, 0.09, 0.49, 3.02, 8.55, 1.99
- **One-story T**: 0.09, 0.09, 0.49, 3.02, 8.55, 1.99
- **One-and-one-half-story box**: 0.12, 0.12, 0.50, 3.02, 8.55, 1.99
- **Two-story L**: 0.11, 0.11, 0.49, 3.02, 8.55, 1.99
- **Two-story T**: 0.09, 0.09, 0.49, 3.02, 8.55, 1.99
- **One-and-one-half-story T**: 0.12, 0.12, 0.50, 3.02, 8.55, 1.99
- **Weighted average**: 0.01, 0.01, 0.04, 0.20, 1.32, 1.58
INTERIOR TRIM

Interior trim with natural finish:

Usual requirements:

- Pleasing figure, hardness, freedom from warp.

Woods combining usual requirements in a high degree:

- Ash, birch, cherry, chestnut, oak, cypress, and walnut.

Woods adaptable to special selection and architectural treatment:

- Pecky cypress; etched or special-grain cypress,
- Douglas fir, western larch, southern yellow pine; curly
  or bird's-eye maple. Knotty cedars, ponderosa pine,
  spruces, sugar pine, white pine, all lack hardness of the
  preceding group.

Grades used:

High-class hardwood interior trim is usually of A grade. The softwood grade A or B and Better is commonly used in high-class construction. In the more economical types of construction C grade is serviceable. D grade requires special selection or some cutting to obtain clear material. Special grades of knotty pine, pecky cypress, and sound wormy oak and chestnut are available to meet special architectural requirements in some types of high-class construction.

The beauty that is obtained from natural finished interior trim is in the grain, or the odity. In this day and age the home wants odity along with beauty; so the lumber manufacturers have put their heads together and obtained both in the forms of No.2 common knotty pine, pecky cypress, and blue stained fir.
This picture shows the method of utilization that can be put to clear edge-grain sugar. This type of built up paneling is preferred by quite a few home owners. This sugar pine paneling is both beautiful and practical, even though it is quite soft.
The growing use of Douglas fir plywood is well founded, as its beauty and practical qualities are not equaled by any wooden material in the same price range. Here are shown the decorative effects with Douglas fir plywood that may be obtained from the selection of molding patterns and the outlines followed in applying them.
Here is an artistic and modern, knotty Idaho pine paneled bar room for the small home. This is a very good utilization of the sound knotty No. 2 common white pine. It gives the required beauty and also the oddity that is in demand. The white pine is a soft wood, but is ideal for panel work, and any other type work where hardness is not so important.
In this distinctive living room the panels are band sawn to create the effect desired; and rubbed down with wax. Note the pattern of straight parallel lines, vertical and horizontal, formed by the closely fitted boards of 1x12 redwood. Redwood in this case is the natural choice—warmth of color, distinctive grain, ability to take any finish, solid texture that cuts to the sharp edges for accurate joining.

We all know that redwood is a very durable wood and used more for outside trim than inside trim, but the above and many other beautiful effects can be obtained from its rich color and beautiful grain.
A "dry-built" wood-paneled home of character-marked hardwoods. American hardwood paneling is now available for medium and lower-priced homes. Note the beautiful floor and mantle. The beauty of grain that is obtained in hardwoods cannot be equaled by any of softwoods, but the price in the past, which has been so high, has retarded its use in anything but the more expensive homes.
This beautiful and neat kitchen is built of western white pine. The grade is select, of course, and has been painted, but the effect and utility of the wood is not lessened by this. Most of our modern homes have cabined work that is of this same western white pine.
Figure No. 11.

Pecky cypress used for interior wall panels
Roof Boards

Usual requirements:

Low shrinkage, easy nailing, high stiffness, small tendency to warp, ease of working.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine, are commonly used. The cypress is not commonly used because of its adaptability to more exacting uses.

Ash, beech, birch, chestnut, elm, hackberry, maple, oak, tupelo, are seldom used because they are not readily available and also hard to work.

Grades Used:

No. 2 boards are used extensively in higher type homes. In more economical construction both No. 2 and No. 3 is serviceable but not so tight as No. 2. No. 4 and No. 5 are available in some species but entail waste in cutting. When hardwoods are used No. 2 Common is adapted to the better class homes and No. 3 Common to the more economical.

Roof sheathing may be of boards of varying width with edges tightly botted or matched. It is usually laid squarely across the rafters and butted only over rafters. Where a rigid roof structure with good wind resistance is desirable, it should be put on deagonally to the rafters, as recommended for wall sheathing. End-matched roof boards need not be butted over rafters if the general rules for location of end joints, which are given in connection with subflooring, are carefully observed.
It is considered good practice in many parts of the country to use 1 by 4 inch or 1 by 6 inch or 1 by 3 inch strips for roof boards, spacing them the same distance on centers as the singles are laid to weather. The reason often given for this is that a tight deck, such as described above, may cause shingles to rot. From all information available, it appears that the tight deck will cause no difficulties in localities north of the Mason-Dixon line or in the dry climate of the Southwest, but that a slat deck, one of strips spaced slightly apart, may be desirable to afford the singles good ventilation in more humid localities farther south. The tight deck makes a building much warmer and prevents a roof fire, such as caused by sparks or cinders from the chimney or by brands from a distant fire, from burning through the roof as quickly as it may with the slat type of deck. The increase in time required to burn through the roof with the tight deck is about 15 minutes and often means that the fire department can be summoned and the fire successfully extinguished, whereas with a slat deck, under similar circumstances, discovery might come too late.

**Shingles:**

Usual requirements:

High decay resistance, small tendency to curl or check freedom from splitting in nailing.

Woods combining usual requirements in a high degree:

Cedars, cypress, redwood. (Principal shingle woods; heartwood only, edge grain.)
Northern white pine, ponderosa pine, sugar pine, western white pine. (Hand-made shingles or shakes from locally grown timber; require goon preservative treatment.)

Grades Used;

In western red cedar, cypress, and redwood No.1 shingles (all heart, edge-grain clear stock) should be used for the longest life and greatest ultimate economy in dwelling roofs. Other all-heart but not edge-grain grades; such as No.2 in redwood and western red cedar and Bests in cypress, are frequently used to reduce the first cost. Other grades permitting sapwood and flat grain are available and are used where low initial cost is the determining factor.

Placing and Nailing of shingles:

Wood shingles come in four lengths, and on a roof of good pitch should be laid with the following exposure to the weather:

- Shingles 16" long 5" to the weather
- Shingles 18" long 5 and one half inches to the weather.
- Shingles 24" long 7 and one half inches to the weather.

Joints between shingles in any one course should be not less than 1 and one quarter inches from the course next below, (Fig. No.12.) so that a driving rain will not work across underneath the single sufficiently to penetrate the roof. Wood shingles may be nailed over 1 to 3 inch oral by 4 inch strips, spaced the same distance apart on centers as the shingles are exposed to the weather, or may be nailed on a tight deck of square-edge or matched boards.
The correct side lap and proper breaking of joints is important, but easily accomplished.

**Figure No. 12.**

Nails should never be more than 2 inches above the butt-line of the next course.

**Figure No. 13.**
A double course should be used to start the roof at the eaves and the roof should be finished at the ridge with the butts of shingles cut off for the purpose; not with the upper half of shingles cut at the eaves.

It is also very important that wood shingles be nailed on with hot-dipped, galvanized or copper or bronze nails and not with steel or iron nails. These nails are necessary because the ordinary iron shingle nail will rust and loosen the shingle long before the wood itself is rotted. This has caused failure of many shingle roofs. If obtainable, the round nail (threepenny for 5/2 shingles and three and one-half penny or fourpenny for thicker shingles) with blunted 3-cornered point is preferable for putting on shingles, as it is less likely to split the wood. Shingles which come to the job very dry should have the bands loosened on the bundles and an opportunity given, if possible, for the shingles to take on a little moisture before they are nailed to the roof. The proper nailing procedure is shown in Figure No.13 on page 30.

Siding:

Usual requirements:

Good painting characteristics, easy working qualities, freedom from warp.

Woods combining usual requirements in a high degree:

Cedars, cypress, northern white pine, sugar pine, western white pine, redwood. It will be noted that Douglas fir, western larch, and southern yellow pine, are only fair woods for the purpose of siding.
Grades Used:

Redwood and cypress are available in special siding grades of clear heart, and western red and Port Orford cedar in a siding grade of Clear. In other softwoods the B and Better siding is used in the highest class of construction. Siding in more economical types of construction is usually of C or D grade, but No. 1 and No. 2 are available in a number of species.

The outside layer of boards which forms the weather-resistant surface of a frame wall is known as siding. Its purposes are to keep out the wind and weather and to help keep the interior of the house warm.

Siding is variously known as drop or rabbeted, rustic, and beveled or bungalow siding. Except in southern climates where there is little cold weather, or where other measures have been taken to insulate the house against heat and cold, or where heating conditions are not a consideration, as in a summer residence or in some types of farm housed the use of siding without sheathing can be excused only on grounds of rigid economy. In all other cases the use of sheathing under the siding is a necessity.

The weather-protection function of siding is considerably improved if sheathing is used; the siding is reinforced, the house is strengthened, and the heat-insulating qualities are improved by the presence of sheathing.

Where sheathing is omitted the wall should be braced, at each corner and beside each doorway, with let-in strips
running diagonally from the floor line above to the plate or sill below, and nailed strongly at the upper and lower ends as well as at each intervening stud.

Drop siding is more suitable than bevel or common siding for direct application to studs without sheathing. With this in mind the drop siding, or the heavier patterns of bevel siding, should be used. The width of siding used depends on architectural taste and considerations of economy. Wider sidings usually give a better appearance; narrow sidings are usually less expensive.

The B and Better grade of any of the softwoods will be suitable for high-class work, while C or D, or even No.1 common siding may be used if a few knots will not be objectionable.

Wall Sheathing:
Usual requirements:

Easy working, easy nailing, moderate shrinkage. All woods can be used for sheathing with satisfactory results although some woods are less time-consuming to work than are others.

Woods combining usual requirements in a high degree:

Cedar, cypress, hemlocks, northern white pine, ponderosa pine, sugar pine, western white pine, redwood, spruce, white fir, basswood, chestnut, yellow poplar. Also Douglas fir, western larch, southern yellow pine, and cottonwood and used.
Grades used:

No. 3 grade of softwoods makes a serviceable sheathing when covered with good building paper. No. 1 and No. 2 make a tighter coverage but do not warrant omitting use of building paper. No. 4 and No. 5 are used in low-cost homes but are not generally available. They both entail some waste in cutting. When a hardwood is used for sheathing, No. 2 Common is adapted to the better type homes, and No. 3 Common to the more economical.

End Matched and Short Length Lumber in Wall Sheathing:

Generally, subfloors are laid diagonally, giving greater bracing strength and a better surface for the finish flooring; and this is also recommended practice for wall sheathing, particularly on balloon frames. End-matched wall sheathing is especially convenient for diagonal application, as the shorter lengths are easier to handle than the longer standard lengths and the wall openings can be blocked out with little waste. The chief deterrent to diagonal application of wall sheathing in the past has been the higher labor cost, but the labor item will be appreciably less if end-matched boards are used. Fig. 14.

In the installation of the wall sheathing, the use of the before mentioned short lengths of lumber, can be practiced to a great degree, and to the advantage of the consumer. The end matching and use of short lengths go hand in hand, as both are essential to each other.
Figure No. 14.

Display booth erected to demonstrate diagonally applied end-matched sheathing and subfloors at plant of J. F. Prettyman and Sons, Summerville, S. C. Made from cull lumber and grade raised by cutting out defects and endmatching. This also shows the utilization of the short lengths of lumber.
CHAPTER IV

INSULATION IN THE HOME

Since it is a good heat insulator, wood has become a widely used raw material for insulating products. It is economical and readily available. In instances where the manufacturing plant is operator in connection with a saw-mill or paper mill, the slabs, edgings, and trimmings of logs and screenings from pulp are utilized as raw material. Formerly much of this material was burned or otherwise destroyed. In other cases, trees that can not be utilized economically for lumber are employed in the manufacture of insulating materials.

Types of insulation:

The various insulating materials commonly used in building construction fall into four general classes, namely, (1) rigid, (2) semirigid, (3) flexible, and (4) fill. The names of these types are descriptive of the materials themselves.

General Considerations:

Most building materials possess heat-resisting properties to some degree. Those products known as commercial insulating materials, however, have these properties to such an extent that even relatively thin layers will retard effectively the passage of heat.

It is a recognized fact that differences exist in the insulating values of the respective heat-resisting materials. In fibrous products these differences are attributed to such factors as the kind of raw material, the size and arrangement of fibers, the moisture content, and the density with which the fibers are packed.
In determining the relative insulating value of the various commercial heat-resisting materials, density is probably the most important consideration, and it may be said that "in general, the lighter the material per unit of total volume, the better its insulating value per inch of thickness."  

Greater effectiveness results when the insulating material is used in addition to the standard construction, rather than to replace another product such as wood lath or sheathing. This is obvious when it is considered that the building products replaced usually have insulating values which necessarily are lost when those materials are omitted from the construction.

Insulating materials show greater effectiveness when applied in the middle of an air space, such as that between the studs in a frame wall, than when placed in contact with another material such as sheathing, lath, or plaster. The reason is that an additional air pocket is formed, which is in itself somewhat of an insulator. A 3/8-inch layer of insulation applied in the center of an air space is the equivalent of a little more than three-quarters of an inch added at some other place in the wall; a 1-inch layer is the equivalent of a little more than 1 1/2 inches.

Although the purpose of this thesis is to set forth the facts concerning the advantages of wood insulating properties, rather than the different types of insulating materials, the question remains as to the type of material used.

In the choice of any insulating material, utility, durability, insulating efficiency, and the thickness are important considerations.

With reference to utility, the rigid type of insulation serves other than strictly insulating purposes. As pointed out before, this type lends itself to many other uses.

Long life in insulation is just as important as in other building materials. The hidden parts of the construction unquestionably should be of a permanent character. So far as is known, most forms of insulation do not disintegrate under normal conditions of temperature and do not attract insects or vermin.

Insulating materials often are specially treated to make them moisture resistant either by coating the fibers themselves with water repellent material or by covering the matted fibers with waterproof paper. Such processing has been found desirable because insulating value decreases rapidly when moisture enters.

Statements concerning comparative insulating efficiencies are usually based upon the heat-resisting ability of 1 inch layers of materials in still air and in an "air-dry" condition. Under these conditions, some materials have greater inherent heat-resisting properties than others and are therefore more efficient.

From a practical standpoint, however, the effectiveness of the thickness in question is important. For example,
material A may be a poorer insulation than B when products of equal thickness are compared, but because the actual thickness of A is greater than that of B, A may offer greater resistance to heat passage.

A simple rule for estimating the relative insulating values of different thicknesses of materials is as follows: Multiply the resistance (determined by a testing laboratory and available from the manufacturer) of a 1-inch layer of the product in question by the actual thickness (in inches) of the product. The result will be the heat resistance of the product in question; the larger the number, the greater the resistance or insulating value.

Wood Insulating Products:

Nu-Wood:

Nu-Wood is processed wood. Clean, new wood is separated into individual fibres which are assembled under pressure to form and insulating board of many uses. This board is used as Nu-wood Insulating Interior Finish (Figure 15.), Nu-Wood Insulating Lath, (Figure 16), and Nu-Wood Insulating Sheathing (Figure 17).

The thermal conductivity as determined by Professor J.C. Peebles, Armour Institute of Technology, expressed in Btu per hour per sq. ft. per degree difference in temperature of 72 degrees F.

While this product is very good for insulating purposes and interior beauty, it is also used for acoustical purposes. (Figure 18.)
Decoration in keeping with the striking Indian design of New Mexico has been achieved in this theatre at Las Vegas. In this theatre, proper acoustical control has been combined with decoration economically.

In the dining room of this attractive Californis home, Nu-Wood plank in variegated colors is used horizontally. Ceilings are decorated with Nu-Wood Board in Ivory color. Insulation and decoration are achieved at one low cost.
Nu-Wood Insulating Lath is easier to handle, fits snugly, adds structural strength. V joints assure rigidity and uniform insulation value.

Plaster is easily, quickly, and evenly applied over the Nu-Wood Insulating Lath. This Lath has many times the bonding strength of ordinary materials.
Nu-Wood Insulating sheathing provides economical insulation that replaces ordinary sheathing and building paper. For economy and complete protection against moisture, wind infiltration and outside temperatures; it is moisture-proofed on both sides and on edges with a coating of special asphalt. Large sheets are marked for nailing, are easier to handle and fit snug over framing members and against windows and door openings.
Fig. No. 16.

Nu-Wood Plank in bariegated colors used on the walls, and Nu-Wood tile in the ceiling. A quiet restful effect is attained with these materials which also combine insulation value.
Fir-Tex.

Another product that is very similar to the Nu-Wood, is Fir-Tex. This also is an insulating and sound deadening type of material. It is made entirely of wood from the giant trees of the Northwest where stands the largest forest area in the nation. Fir-Tex shreds this sound, clean wood into fibers, then "felts" those fibers into strong yet light-weight boards which contain myriads of air cells (the basis of insulation). Each square inch of Fir-Tex contains millions of these insulating air pockets.

Fir-Tex is sold in about the same patterns and colors as is the Nu-Wood products. There is not enough difference to enumerate the Fir-Tex ones here.

Balsam-Wool:

Still another byproduct of wood that is an excellent insulating material, is Balsam-Wool. Balsam-Wool is made of pure wood fibers chemically treated to be fire-resistant and vermin-proof. The tough asphalt-coated creped paper liners make it extremely flexible, puncture-proof, wind proof and water-proof.

Each square foot of Balsam-Wool contains millions of dead air cells which account for its recognized efficiency as a heat insulator and sound deadener.(Fig. No.19).
Fig. 19.

Cut section of Balsam-Wool showing new Spacer Flange which fits over, and is nailed or stapled to face of stud, joist or rafter. This Flange assures tight fit and proper air space from and back.
CHAPTER V.

SUMMARY

Wood is the most versatile material that has yet been adapted to small home construction. The advantages of woods in the construction of small homes is unequaled by any other material in the same price range. It is far better than some materials and above some in higher price groups.

It can be nailed with ease because of the softness yet it is strong because of the placement of its elements. Its modulus of elasticity is very high which makes it invaluable in certain types of construction where repeated and varying stresses are placed upon the members.

Wood is composed of thousands of tiny cells that are filled with air which displaces the water in drying. This construction makes it serve in another form, that of insulating. It is still the best insulation for the price that has been found.

Wood lends itself admirably to the cutting of different shapes, and the construction of members on the job; as exemplified by laminated construction augmented by steel timber connectors. "Windows can also be constructed readily; in fact most any part of a small home can be cut out or made right on the job.

With the modern process of treating lumber it becomes decay resistant. Even insects and larve do not bother it. The treatment of lumber has increased its use to a large degree.
Another remarkable quality of wood is that it can either be painted or stained with its natural finish.

We have expounded upon the advantages of wood in small home construction; so now let us summarize the trends and uses of it.

To-day is the day of more complete utilization of our natural resources and in the respect the lumber industry has and is cooperating to the fullest extent of its resources.

Formerly all scraps such as slab, trimmings, and decayed or knotty lumber was sent to the burner, but not so to-day. The slabs are run thru a chipper and made into paper. Also the bifers of the scrap wood may be exploded and made into insulating material. Such products are now on the market as Nu-Wood or Fir Tex.

Some of the worse grades of yesterday are now appealing to the aesthetic ideas of the great populars. Pecky cypress, knotty pine, blue stained fir, and many others are upon the market and are being used.

It was not enough to just use the lumber as it came from the log but they now make veneer out of it and use it as qall paper, and ply wood, where beauty and strength are both obtained with less cost and weight.

It is the one desire of most sales managers to create a larger demand for their product, and to do this there must be a product to fit the circumstances. The lumbermen of to-day are adapting their product to fit these circumstances.
They meet the demand with a product that cannot be equaled; beauty, strength, durability, insulating and acoustical properties, easy in handling, and a score of other properties that have proven themselves.

Quoting Mr. Stevens of the West Gosat Lumbermans Association "Lumber is bought not sold.". This has been the trend in the past, but the modern trend is selling the product upon its own merits.

The End,
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