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Note

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EXTENDING THE STATE'S TIMBER SUPPLY THROUGH LUMBER CONSERVATION PRACTICES

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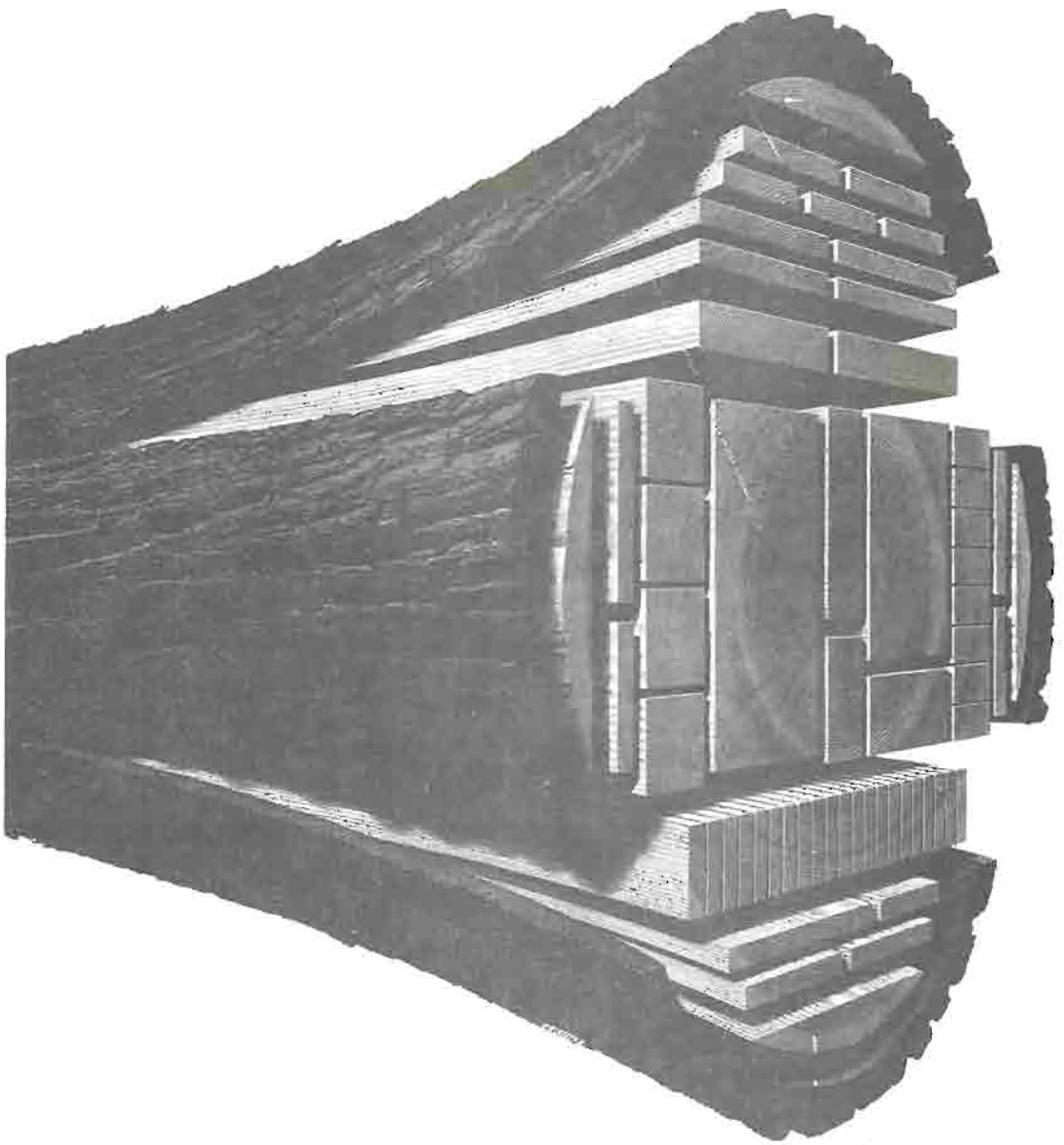

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SUMMARY

At the present time, approximately 27 percent of the lumber and plywood used in the state is imported. By the year 2020, more than 60 percent of the State's requirements will need to be met by imports.

Approximately 50 percent of the total quantity of lumber and plywood consumed is used in the construction, remodeling and upkeep of single and multi-unit dwellings.

Two-thirds of the total housing starts are single family units. The roof, floor, and exterior wall components require more than 80 percent of the total quantity of lumber and plywood consumed per unit. Single family units in California use, on the average, 15,000 board feet of lumber and 5,000 square feet of plywood (3/8" basis). This is less than the national average requirements.

Improved utilization of lumber and plywood is essential in order to meet the future demands for housing. Wood saving construction techniques and methods which do not require extensive engineering analysis or structural testing are available and generally acceptable for light frame construction. For the most part, they do not rely on the use of substitute or alternate materials.

Single family dwellings in California use 20-30 precent less lumber and plywood than the national average. Less material is required for the floor system due to the prevalence of slab construction and less in the roof-ceiling system which generally does not have to be engineered to accommodate snow loads. In addition, heavy use is made of traditional, non-wood materials such as stucco for exterior wall coverings. The resultant savings in material can be further augmented by adoption of the techniques described in this section.

Approximately 140,000 single family dwellings will be constructed annually in California for the next three decades. If material saving techniques were to be utilized in the construction of these houses, an annual savings of approximately 140,000 MBF of lumber and 56,000 M Sq. Ft. (3/8" basis) of plywood could be realized. Additional savings could result by adoption of these techniques, where applicable, in construction of multi-unit dwellings and on remodeling projects.

OVERVIEW

Production - Consumption (Table 1)

According to information contained in the Economic Report of the Governor, 1978, which was based in part on estimates developed by the U.S. Forest Service, the total quantity of lumber used in single-unit conventional home construction in California in 1976 was 1.857 billion board feet. An additional 599 million square feet of plywood was used.

Forecasts indicate that by the year 2010, building starts are expected to be 141.1 thousand, and peak demand of 2.154 billion board feet of lumber and 731 million square feet of plywood will be required annually.

U.S. Forest Service forecasts based on national ratios indicate that an additional 1.266 billion board feet of lumber and 658 million square feet of plywood will be used annually for the upkeep and remodeling of residential structures.

At the present time, the State imports about 27 percent of the lumber and plywood used. Barrette et al, Timber Projections for California Production vs. Consumption, State Forest Note No. 71, reports that by 2020 more than 60 percent of the State's requirements will need to be met by imports.

TABLE 1

Estimated Production and Consumption in California

	Lumber MMBF Lumber Scale		Plywood MMBF Lumber Scale		Total MMBF Lumber Scale	
	1985	2000	1985	2000	1985	2000
Production	5,066	4,762	416	387	5,482	5,149
Shipped Out-of-State	1,520	1,191	219	204	1,739	1,395
Shipped Into State	4,334	5,362	929	1,204	5,263	6,566
Consumption	7,880	8,933	1,126	1,387	9,006	10,020

Forecasts made by the U.S. Forest Service reveal that lumber and plywood will be consumed in the approximate proportions shown in Table 2.

Based on the projected increase in consumption of lumber and plywood, present state timber supplies are inadequate to fulfill the future need for lumber and plywood. California is, after all, still cutting old growth timber and consequently reducing its existing inventory. Reports from the Pacific North-west Forest and Range Experiment Station predict a 1.231 million acre decrease by 2010 of commercial timberland devoted to the growing and harvesting of timber. Additionally, the U.S. Forest Service non-declining yield policy will ultimately result in a substantial reduction in the annual harvest from Forest Service lands.

Concurrent with the decline in state timber supplies and production, and the predicted increase in consumption, competition for wood products supplied by traditional exporters will accelerate. This will likely result in a substantial increase in the price of lumber and plywood which in turn will almost certainly have a negative impact on the state's housing industry. Any reduction in the quantity of building materials used in the construction of conventional single family dwellings could, therefore, serve to reduce imports and help to relieve the possible economic impact on the consumer.

BACKGROUND

Influence Factors

The amount of wood material used in a new single family house is influenced by a large number of factors, not all of which are obvious to the casual observer. Physical attributes such

TABLE 2

Lumber and Plywood Consumption by Type of Dwelling in California

End Use	Lumber Percent of Total Use			Lumber Percent of Total Use		
	1990	2000	2020	1990	2000	2020
Single Unit Homes	26	24	23	22	20	20
Multi-Unit Homes	10	8	8	14	12	12
Mobile Homes	2	2	3	4	3	3
Remodeling & Upkeep	12	14	13	16	18	19
Shipping	12	14	14	14	5	4
Miscellaneous	38	38	39	40	42	42

as size, style, and design have an easily quantifiable relationship to wood requirements. The mix of economic, social, technical and institutional factors that determine the physical attributes are less clear.

The primary factors determining the volume of wood used in single-family homes can be grouped into four major classes of variables; consumer, builder, technical and institutional. In 1962, two-story FHA insured houses in the Lake States region required 1,536 board feet more lumber than one-story homes, but used 483 square feet less plywood.

The amount of wood required of a structure often varies markedly between different architectural designs. For example, as the pitch of a roof increases, the quantity of plywood sheathing required increases. Changes in the pitch also force changes in the volume of rafter material in the roof frame and the wood material required for gable studs.

The technical design of a house influences the volume of wood required, especially in the way in which materials are assembled to form a component of the structure or in the size of material used. All of the following design features will, for example, lessen the quantity of wood used.

1. Use of a truss system in place of a rafter joist system.
2. Use of sandwich wall panels instead of a framed wall system.
3. Elimination of corner bracing by use of plywood or fiberboard sheathing.
4. Spacing roof trusses 24 inches on center.
5. Use of 4 x 4 inch studs spaced 48 inches on center for non-load bearing partition walls.
6. Use of slab instead of perimeter wall foundations.

Seemingly minor variations in technical design can cause significant changes in wood requirements. For example, 2 x 12 inch floor joists spaced 16 inches on center require about 205 board feet of lumber per 100 square feet of floor area. If the floor system design changes so that the same size joists are spaced 24 inches on center, the amount of wood needed decreases by almost 40 board feet per 100 square feet of floor area. A 2 x 10 joist system 16 inches on center requires 35 board feet more lumber per 100 square feet of floor area than the same system using 2 x 8 lumber. A truss roof for a 1,120 square foot house uses 1,800 board feet less lumber than a conventional rafter-joist system. In the Lake-Central region, FHA houses constructed in 1962 using slab foundations required 3.6 board feet of lumber less per square foot of floor area than houses built on perimeter wall foundations. Based on just these design differences, the total quantity of lumber required to construct a house with 1,200 square feet of floor area can vary from 7,320 to 11,640 board feet.

The amount of wood material required to construct a single family structure is presumed to be a function of the structure's "size". Theoretically, any change in house "size" should reflect a change in wood use. Thus, the definition most commonly used is floor area. This definition implies that changes in the volume of wood material used will be reflected by changes in floor area. Past studies indicate this assumption is valid.

Changes in the blend of construction materials used in a house affect the amount of wood required. Wood products can replace or substitute for other wood products or non-wood products. The change in the wood requirements of a structure due to a change in the material blend can be sizeable. One hundred square feet of floor area covered by 1 x 8 shiplap installed horizontally requires ten cubic feet of wood. Use of 5/8-inch fir plywood for a floor cover requires only 5.2 cubic feet of wood per 100 square feet. If steel joists are substituted for 2 x 8 wood joists spaced 16 inches on center, approximately 136 board feet less wood is required per 100 square feet of floor area. Likewise, if aluminum siding is used in place of wooden bevel siding, 123 board feet less wood per 100 square feet of wall area is required.

The influence of building codes on construction costs has been debated at great length. In many cities, building codes prohibit the use of advanced, economically feasible technical knowledge in construction and, consequently, cause unnecessarily high building costs. For example, nearly 2/3 of the nation's localities prohibit 2 x 4 studs on 24-inch centers for non-bearing partitions. Zoining ordinances may be as important as building codes and labor unions in defining the physical makeup of the house. Zoning typically defines the bulk, height, and area of permissible buildings.

Wood Requirements and Use

During the past few decades, more than a third of all lumber and plywood consumed in the United States has been used in the construction of new housing. In 1970, the average single family dwelling used 17,000 board feet of lumber, plywood and other wood products. Six thousand board feet per unit was used in multi-family housing, while mobile home construction required 3,400 board feet per unit. By 1985, 19,555 board feet of lumber and 7,252 square feet of plywood are expected to be used in construction of conventional single family dwellings.

The geographic location of construction appears to be a basic determinant of housing characteristics. The volume of lumber products used in single family houses in 1968 ranged from 7,271 board feet in Florida to 12,096 board feet in the southwest.

Forecasts based on estimates by the U.S. Forest Service, adjusted for net migration to California, reveal that single family homes in California use less lumber and plywood than the forecasted national average for 1985. This is due in part to the extensive use of slabs rather than perimeter foundations, the absence of roof sheathing in many houses, and the extensive use of stucco rather than wood for exterior finishes.

Approximately two-thirds of the total housing starts are single family units. The roof is the most important component of this dwelling unit in terms of actual wood consumption followed by the floor, exterior walls and interior walls. These four components account for more than 80 percent of the lumber and plywood consumed per unit.

Barring any major changes in structural style, technical design, size, and material blend, over the next several decades the quantity of wood used in construction of single family dwellings in California can be expected to approximate 15,000 board feet of lumber and 5,000 square feet (3/8" basis) of plywood. (Tables 3 and 4.)

Figure 1. Approximately two-thirds of the total housing starts are single family units.

TABLE 3

Estimated Wood Use in Single-Unit Conventional Home Construction in California

	1990	2000	2010	2020
1. Number of Units to be Constructed (Thousands)	148.0	140.4	141.1	132.9
2. Wood Use Per Unit (Bd. Ft. of Lumber)	14,160	14,725	15,267	15,785
3. Square Feet of Plywood (3/8" Basis)	4,663	4,921	5,178	5,435

TABLE 4

Quantity of Lumber and Plywood Used in Single Family Dwellings by Component

	Lumber (Bd.Ft.)		Plywood (Sq. Ft. 3/8" Basis)	
	Percent	Quantity	Percent	Quantity
Floor	23	3,450	39	1,950
Walls	34	5,100	6	300
Roof-Ceiling	31	4,650	42	2,100
Millwork-Trim	12	1,800	13	650
All Systems	100	15,000	100	5,000

MATERIAL CONSERVATION

General

Approximately 140,000 single family dwellings will be constructed annually in California for the next three decades. If all or even a part of the wood saving construction techniques available were to be utilized in the construction of these houses, an annual savings of approximately 140,000 MBF of lumber and 56,000 M square feet (3/8" basis) of plywood could be realized. For the most part, these techniques do not rely on the use of substitutes or alternate materials. They do, however, presume adherence to good quality control and sound building practices. It is not within the scope of this report to provide a detailed, lengthy description of them, but rather to reference the fact that they do exist.

Good engineering design and application of sound material and labor management practices can also result in additional savings. Many building practices used in framing a house are traditional. Those responsible for the contruction are not expected to be highly educated technicians, but they can be trained to use techniques which can save up to ten percent on items such as pre-finished siding and trim lumber. Studies by the American Plywood Association and the National Forest Products Association have shown that the dollar value of plywood roof sheathing scrap may approach or exceed the total labor cost for installing the material. Lumber and plywood framing scrap and waste consistently ranges from three to seven percent and can be cut in half by training employees to utilize techniques such as modular dimensioning, in-line joist installation, plywood layout, etc.

Many of the dwellings built today use roof truss systems. Because these highly engineered designs utilize lumber and plywood efficiently, most of the material savings will be realized in the floor and wall systems. However, some savings in material can still be made in roofs using a truss system by adaptation of some rather simple modifications in construction techniques.

Specific Techniques

Adherence to some very basic principles can help reduce the amount of lumber and plywood used in the construction of single family dwellings. Generally, they may be grouped under the broad headings of planned material use and engineering design. Drawings showing size, grade, or quality, and location of all floor, wall, and roof components should be prepared before construction begins. Use of a mterials schedule listing exact quantities required, along with a description of the necessary sizes and quality or grades, should be included with the drawings or plans.

Engineering design of the various systems provides the best opportunity for material savings in most dwellings. Careful selection of the size, grade, and spacing of structural components can result in substantial reductions in the quantity of lumber and plywood used. The floor system probably provides the maximum opportunity for material savings.

Incorporation of any combination of the following techniques in the engineering design will result in material savings.

1. Floors

    A. Utilize modular dimensions, preferably the 48-inch major module for the "out-to-out" floor dimension.

    B. Utilize an "in-line" floor joist system.

    C. Use joist spacing of 13.7 or 19.2 inches with modular dimensions.

D. Reduce the size of or eliminate band joists, sill plates, and bottom wall plates.

E. Cantilever floor joists over the center support.

F. Substitute nailing strips for solid blocking between joists over center supports.

G. Eliminate sill plates on steel girders.

H. Utilize minimum thickness single layer plywood flooring.

I. Glue subfloor to floor joists.

2. Exterior Walls

A. Utilize modular dimensions, preferably the 48-inch module for length and width dimensions.

B. Use a stud spacing of 24 inches for one-story houses or the second story of two-story houses.

C. Coordinate window and door openings with the modular stud wall framing.

D. Eliminate mid-height exterior wall blocking.

E. Eliminate lintels and headers on non-load bearing exterior walls.

F. Use the minimum size lintels and headers to accomplish the job.

G. Substitute nail-glued plywood headers for lumber for exterior wall openings when wall sheathing is over one-half inch thick.

H. Use minimum thickness plywood siding and/or sheathing.

I. Eliminate exterior wall sheathing.

J. Reduce lap for horizontal siding.

K. Eliminate corner bracing when using sheathing.

3. Interior Walls and Ceilings

A. Utilize "sandwich" wall construction.

B. Utilize 2" x 3" wall framing members.

C. Use 1" top and bottom plates for non-load bearing partition walls.

D. Eliminate mid-height interior wall blocking.

E. Increase stud spacing when using 1/2" thick gypsum wallboard.

F. Use nominal 2" x 2" lumber for non-load bearing closet wall framing.

G. Elinimate 2" x 3" and 2" x 4" bulkhead framing.

4. Roofs

A. Substitute metal fasteners for edge blocking for plywood roof sheathing.

B. Eliminate wood sill plates on top of masonary block walls.

C. Use the minimum required thickness of plywood roof sheathing.

D. Eliminate eave and gable-end overhangs.

E. Use an open soffit or gable system on wide box overhangs.

One of the most promising recent innovations is the development and testing of a lightweight truss-framed house by personnel of the U.S. Forest

Service Forest Products Laboratory in Madison, Wisconsin. The lightweight truss-framed house is a new framing system that incorporates a trussed floor system, trussed roof rafters, and conventional wall studs into a unitized frame. Improved structural performance results because every loaded member shares its load with other elements in the system. Advantages include less framing lumber, fast on-site erection, elimination of support beams and columns, reduction of ductwork for heating and cooling, plus the use of only one lumber size (2 x 4) for fabrication. Estimates of materials show a 20 to 30 percent savings in structural framing lumber requirements over a conventional house with the same floor plan. Some fairly extensive changes will have to be made in some of the building construction codes in order for this innovation to gain ready acceptance in the market place.

Figure 2. Trus-framed structures save time in construction and use up to 30 percent less lumber in framing than conventional homes.

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