

Wood products used in new single-family house construction: 1950 to 1992

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Abstract

The construction of houses, apartment buildings, mobile homes, and manufactured housing is the single largest market for solid wood products in the United States, followed closely by residential repair and remodeling. Studies to quantify wood products consumption for new residential construction have been conducted over the years by the USDA Forest Service and others to provide information needed by government and industry to effectively manage the nation's timber resource and provide needed wood products. This study evaluates consumption estimates made by the Forest Service in 1959, 1962, 1968, and 1988; develops estimates of lumber and wood panel consumption for single-family residential construction from 1950 through 1992; and compares these estimates with those reported in the most recent detailed Forest Service timber assessment research report. Results indicate that overall wood products consumption for new residential construction in the 1970s and 1980s was greater than previously calculated.

Residential construction, which includes single-family, multifamily, and manufactured housing, is an important market for timber products. More than 33 percent of the lumber and structural wood panels and more than 25 percent of the nonstructural wood panels consumed annually in the United States are used in building housing units. More than 75 percent of wood products used for all residential construction were used in single-family houses (14). Structural wood panels (referred to as structural panels throughout this report) include softwood plywood, oriented strandboard (OSB), and waferboard. Nonstructural wood panels (referred to as nonstructural panels throughout this report) include hardboard, particleboard (including medium density fiberboard (MDF)), insulating board, and hardwood plywood. Timely,

reliable information on the types and quantities of wood products used in new residential construction, and particularly in new single-family construction, is important to both forest resource planners and the timber products industry. This information will help ensure adequate supplies of wood products in this important market.

The use of wood in new single-family houses has changed markedly during the past 40 years. Changes have resulted from complex interactions between the number and size of houses built and the use of wood products per unit of house size. Changes in structural and architectural characteristics and the types of wood products used for various house components and applications have also affected the use of wood in new single-family houses.

To quantify wood products used for new single-family house construction, the USDA Forest Service conducted studies of houses built in 1959, 1962, 1968, and 1988 (4,6). These studies collected detailed information on the use of wood products, by type of product, for specific building components and applications. Results of the first three studies (5) formed the basis of estimating wood products use for new single-family houses in numerous Forest Service timber assessment research reports through the 1970s and 1980s (9-14). New information (3) indicates that wood-use estimates made during the previous 20 years, particularly for the late 1980s, were low.

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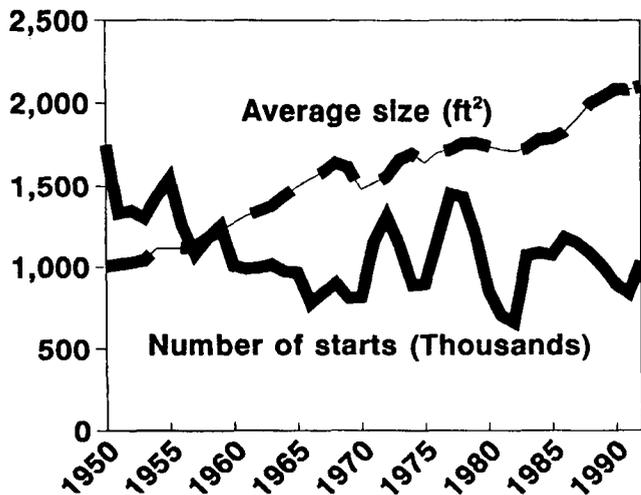


Figure 1.— Number of single-family housing starts and average size per house.

This report compares wood-use estimates by type of wood product and building application from Phelps (5) and McKeever and Anderson (3). It also compares the effect of increased wood use reported by McKeever and Anderson to the estimates reported in the most recent Forest Service timber assessment research paper (12). Annual estimates of lumber and structural and nonstructural panel consumption from 1950 through 1992 were developed from these reports and the U.S. Department of Commerce, Bureau of the Census, on the number of new single-family housing units started and average size and characteristics of houses completed.

Throughout this report, unless otherwise indicated, lumber is measured in board feet (BF) and structural and nonstructural panels in square feet, 3/8-inch basis (ft.²). The following conversion factors for these and other units of measure are used in this report (4):

Lumber	1 BF	- 0.0024 m ³
Panel products	1 ft. ² , 1/8-inch basis	- 0.0003 m ³
	1 ft. ² , 1/4-inch basis	- 0.0006 m ³
	1 ft. ² , 3/8-inch basis	- 0.0009 m ³
	1 ft. ² , 3/4-inch basis	- 0.0018 m ³
House size	1 ft. ²	- 0.0929 m ²

Information sources

Total wood products consumption for new single-family houses in a specific year is determined largely by the number of houses built, the average size of these houses, and the average amount of wood used per unit of house size. Information on the number of housing units started and the average size of housing units completed annually since the mid-1960s is available from the Bureau of the Census (16, 17). Information prior to the early 1960s for both starts and average size is limited.

Comprehensive studies of wood products used in new single-family housing for specific years have been done infrequently. As mentioned, the Forest Service conducted studies of houses built in 1959, 1962, 1968, and 1988. Other non-Forest Service studies have been conducted, but they have limited coverage, lack the detailed wood use information needed to estimate total wood products consumption, or are proprietary studies of limited availability.

Studies of the size and magnitude required to collect reliable, new information on wood products consumption for specific end uses, such as new single-family house construction, are expensive and time consuming to conduct. The Forest Service recognized that important changes were taking place in both the construction characteristics of new single-family houses and in the types and quantities of wood products being used during the 1970s and 1980s. However, budgetary and other constraints and an emphasis in other end-use markets during this period precluded new residential construction studies. In 1988, the need for new data and cooperation with the Wood Products Promotion Council (WPPC) resulted in the re-examination of the new residential construction market. The WPPC is a consortium of forest products associations that promotes the use of wood products in major end-use markets. Members of WPPC are: the American Plywood Association, the American Wood Council of the American Forest Products Association (formerly the National Forest Products Association), the Southern Forest Products Association, and the Western Wood Products Association.

Specific sources and availability of data on new single-family housing starts, average single-family house size, and wood products use for new single-family house construction follow.

Housing starts

Single-family housing units, as defined by the Bureau of the Census, are conventionally built, pre-fabricated, panelized, componentized, sectional or modular units and are fully detached, semidetached, rowhouses, or townhouses. Each unit, if semi- or fully attached, must be separated from the adjacent unit by a ground-to-roof wall and must not share heating and cooling systems or public utilities. Farm and second or vacation home starts are included; mobile homes are excluded. Single-family units are designed for occupancy by a family, a group of unrelated persons living together, or by a person living alone. Reliable, consistent information on the number of such units started annually has been collected since 1959 (15,17).

Prior to 1959, the U.S. Department of Labor, Bureau of Labor Statistics, was responsible for reporting statistics on housing starts (19). These estimates included privately and publicly owned housing units but excluded farm and second or vacation homes. In the mid- 1960s, the Bureau of the Census revised these estimates to include farm house starts. Al-

though it is unclear from the data, it is believed that the Bureau of the Census revision also included second or vacation home starts (7).

Based on this information, annual housing starts, by type of unit, were developed by Phelps for 1920 through 1992 (6). New single-family starts for 1950 through 1992 are shown in Figure 1. Detailed information on the estimation procedures is in the Phelps report.

Average house size

The Bureau of the Census has collected information on the average size of new houses completed annually since 1962. Average size is expressed in square feet of finished floor area and includes space in basements and attics with finished walls, floors, and ceilings. Excluded are unfinished basements, attics, and garages.

The U.S. Department of Housing and Urban Development collected data annually from 1950 through 1971 on the size of single-family houses built and financed under its jurisdiction (18). However, these houses tended to be smaller than average because of the limitations on total costs that could be financed. Limited information was also collected by other public and private organizations.

Based on this and additional information, annual estimates of the average size of housing units built from 1920 through 1992, by type of unit, were developed by Phelps (6). New single-family average house size from 1950 through 1992 is shown in Figure 1.

Wood products use

The Forest Service is the principal source of publicly available information on the use of wood products in new single-family house construction. Forest Service studies conducted in 1959, 1962, 1968, and 1988 provided detailed information on the use of wood products, by type of product, for specific building components and applications. The first three studies examined the use of wood in houses inspected by the Federal Housing Administration (FHA). These studies formed the basis for estimating wood products consumption for new single-family house construction in Forest Service timber assessment research reports conducted in the 1970s and 1980s. The 1988 study examined all single-family houses built.

Use in 1959, 1962, and 1968. — Lumber use per square foot of finished floor area in FHA-inspected houses decreased from 9.23 to 7.38 BF between 1959 and 1968. During the same period, plywood (combined softwood and hardwood) use increased from 1.60 ft.² (3/8-in. basis) to 2.99 ft.²; hardboard increased from 0.34 ft.² (1/8-in. basis) to 0.76 ft.²; and particleboard use increased from 0.04 ft.² (3/4-in. basis) to 0.12 ft.². Insulating board use per square foot of floor area remained constant at 0.53 ft.² (1/2-in. basis). No OSB/waferboard use was reported.

Many factors contributed to the loss in lumber use

per square foot of floor area between 1959 and 1968. These factors include architectural changes, structural building changes, product substitution, and increased house size. Architectural changes, such as the increased popularity of houses built with concrete slab foundations rather than conventional basement or crawl space foundations, greatly reduced the usage rate of lumber in new single-family houses. The concrete slab foundation eliminated the need for wood-framed floor systems on the first floor of two-story houses and completely eliminated the need in one-story houses. Structural building changes, such as the increased use of wider stud spacing, increased use of roof trusses, and omission of wall corner bracing also contributed to the decrease of lumber used. A large-scale substitution of plywood for lumber in roof sheathing and subflooring and particleboard and hardboard for lumber in millwork occurred during this period, further reducing the use of lumber. And finally, the amount of lumber required to frame the exterior walls of a house increased proportionally slower than did the increase in total floor area. Thus, other factors being equal, increases in house size resulted in less lumber used per square foot of floor area for wall framing.

As noted, much of the increase in plywood and other wood panel use came at the expense of lumber. The use of carpeting in lieu of hardwood flooring greatly increased and necessitated the use of panel-type underpayment over the subfloor for both strength and smoothness. Also, hardboard and softwood plywood for exterior siding and particleboard for shelving, countertops, and cabinets increased.

Use in 1988. — Results from the McKeever and Anderson study (3) show that 7.92 BF of lumber, 4.22 ft.² of structural panels, and 1.49 ft.² of nonstructural panels were used per square foot of finished floor area in 1988. These statistics are averages for all single-family houses built, not just FHA-inspected houses as in 1959, 1962, and 1969.

Consumption estimates for the 1970s and 1980s

Data from Phelps (5) for 1959, 1962, and 1969 were based on houses inspected by the FHA. To represent all single-family units built, these data were modified to account for known differences between FHA-inspected houses and other types of single-family houses. For example, over the period examined, FHA-inspected houses, on average, were smaller, less expensive, had fewer and smaller garages, were more likely to be one-story construction, and were more likely to use wood for exterior siding. Also, a much larger percentage of these units were built on slab foundations. These differences were quantified and use factors were adjusted to account for these differences.

In making estimates for 1970 and subsequent years for the various Forest Service timber assessment reports (9-12, 14), recognized trends that impacted wood products use per square foot of floor area in the 1960s were used to modify use per square foot of floor

TABLE 2. — Characteristics of new single-family houses, 1962 to 1992.^a

Year	Levels			Foundation			Exterior wall covering		Parking facility ^b			
	One	Two or more	Split	Base-ment	Slab	Crawl space	Wood based	Nonwood based	One-car garage	Two- or more car garage	Car-port	None
	(%)											
1962	79	11	10	41	36	22	26	74		63	19	18
1963	78	11	11	41	36	22	26	74		63	19	18
1964	78	12	10	44	36	20	26	74		67	16	17
1965	75	15	10	43	34	23	26	74		70	16	14
1966	72	18	10	44	28	28	27	73		64	17	19
1967	71	19	10	44	29	28	27	73		65	16	19
1968	70	20	10	43	29	28	27	73	18		48	15
1969	69	19	11	42	32	26	27	73	16		49	16
1970	74	17	10	37	36	27	27	73	19		39	17
1971	73	17	10	36	38	26	28	72	18		39	17
1972	72	18	9	37	39	24	29	71	19		42	17
1973	67	23	10	41	38	21	30	70	17		48	13
1974	65	25	10	45	36	19	32	68	16		52	10
1975	65	23	12	45	35	20	36	64	14		53	9
1976	63	25	12	45	36	19	38	62	13		59	8
1977	63	26	11	44	38	18	38	62	14		60	7
1978	61	28	11	42	40	18	40	60	12		62	7
1979	59	31	11	42	39	19	42	58	12		62	7
1980	60	31	8	36	45	19	42	58	13		56	7
1981	61	32	8	33	47	20	44	56	13		53	8
1982	61	33	6	31	49	20	44	56	15		50	8
1983	58	36	6	32	51	17	43	57	14		54	7
1984	54	40	6	32	50	18	42	58	14		56	5
1985	52	42	6	35	48	18	43	57	15		55	5
1986	51	44	5	37	45	18	43	57	14		60	4
1987	49	46	5	39	43	18	41	59	14		65	3
1988	46	49	4	39	41	19	42	58	12		66	3
1989	46	49	4	37	43	19	39	61	10		70	3
1990	46	49	4	38	40	21	39	61	10		72	2
1991	48	47	5	40	38	22	38	62	10		71	3
1992	48	47	5	42	38	20	33	67	8		75	2

^a Source: (16).

^b 1962 to 1967: data for all garages.

area through the 1970s and 1980s. The combined impact on the use of wood products was assumed to become less important over time as full product use or adoption of a particular construction practice was approached.¹ Additional information from various sources (1) was used to modify, usually on a judgmental basis, general trends in calculated wood product consumption.

Using this procedure, average lumber use per square foot of finished floor area was estimated to be 7.51 BF in 1970, with a slow decline to 7.28 BF in 1976, and 7.11 BF in 1986 (14). Average structural panel use per square foot of floor area was estimated to be 3.09 ft.² in 1970, 3.27 ft.² in 1976, and 3.71 ft.²

¹This is a phenomenon commonly encountered in the introduction of new products or technology, characterized by a slow initial rate of growth or adaptation, followed by more rapid growth, and subsequent slowing as a maximum product or technology, adoption, or saturation is approached. This can be illustrated by a family of S-shaped curves, including, for example, the Gompertz, double-exponential, slow-exponential, and logistic curves. The major differences between these various curves are in the rapidity of growth in the middle phase or period (2,8).

TABLE 1. — Estimated wood products use per square foot of finished floor area in 1988 for single-family houses, based on 1989 Timber Analysis trends and reported by McKeever and Anderson (3).

Wood product group	1989 Timber Analysis trend estimate	McKeever/Anderson estimate	Difference (%)
Lumber (BF)	7.09	7.92	11.8
Structural panels (ft. ² , 3/8-in. basis)	3.79	4.22	11.3
Nonstructural panels (ft. ² , 3/8-in. basis)	1.48	1.49	0.7

in 1986. Nonstructural use was 1.71 ft.² in 1970, 1.68 ft.² in 1976, and 1.51 ft.² in 1986.

To compare results from the McKeever and Anderson study (3) with those from the 1989 Timber Analysis, 1988 wood products consumption for new single-family housing was estimated using the data and trends noted. Results of the comparison show that the use of lumber, structural panels, and nonstructural panels per square foot of finished floor area was actually greater in 1988 than was previously esti-

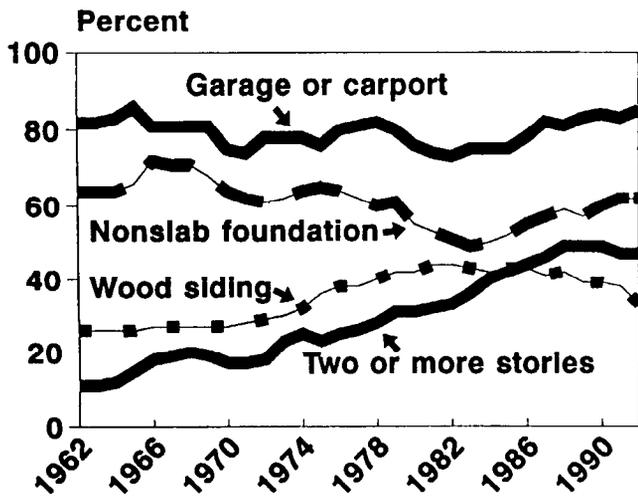


Figure 2.— Percentage of new single-family houses with specified characteristic present.

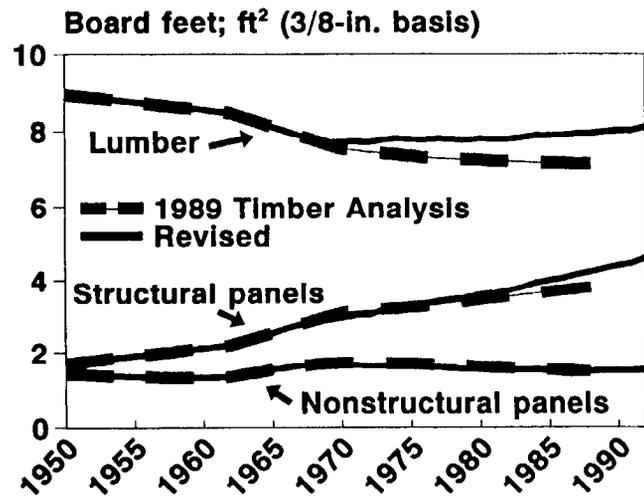


Figure 3.— Average lumber (BF) and panel (ft.²) use per square foot of finished floor area in new single-family houses, 1989 Timber Analysis and revised estimates.

mated (Table 1). Lumber use per square foot of floor area from McKeever and Anderson was 12 percent greater than that derived from the Timber Analysis. Structural panel use was 11 percent greater, and nonstructural panel use was less than 1 percent greater.

Revised consumption estimates

Simple trending between estimates from Phelps (5) for 1968 and McKeever and Anderson (3) for 1988 would lead to an assumed continuous increase in both lumber and structural panel use per square foot of finished floor area between the late 1960s and late 1980s. Data from the "Characteristics of New Housing" reports published in 1962 and subsequent years (16) and from other sources, make this assumption unlikely. For example, the Bureau of the Census data indicate that the percentage of houses with basement or crawl space foundations increased between 1962 and 1968, generally decreased through 1982, and then increased again after 1983 (Table 2, Fig. 2). The percentage of houses with garages or carports fluctuated until the mid-1970s, leveled off and decreased until 1982, and increased thereafter. The percentage of multistory houses generally increased during 1962 to 1992, and the instance of wood-sided houses increased until the early 1980s and subsequently decreased.

An increase in the percentage of houses with most of these characteristics would tend to increase average wood products use per square foot of floor area, other factors being equal. For example, unpublished data from the Phelps 1970 (5) study show that lumber use per square foot of floor area in houses with basements or crawl spaces was much greater than that in slab houses. This was largely due to the elimination of most of the flooring system in slab houses, but was also partially due to less use in nearly all other major house systems and millwork items, such as stairs and trim normally associated with basements. In contrast,

multistory houses, primarily because of a smaller roof-to-floor area ratio, used about 2 percent less lumber per square foot of floor area than did those with one story. According to McKeever and Anderson (3), an average of 1.04 BF of lumber per square foot of finished floor area (2,079 BF per house) was used in garages, carports, porches, and decks in 1988, somewhat larger than was used in garages in 1968. Lumber use for porches and decks in 1968 was not specifically identified, so direct comparisons between 1968 and 1988 are not possible. However, porches and decks grew rapidly in number during the 1980s, resulting in increased lumber use per house and per square foot of finished floor area. Changes in house characteristics were also reflected in changes in plywood and nonstructural panel usage rates.

Revised estimates of wood products use per square foot of finished floor area for the late 1960s, 1970s, and 1980s were made to incorporate changes in use reported by McKeever and Anderson (3). A three-step estimation procedure was used. First, a simple trend between 1968 and 1988 was developed using estimates of use per square foot of floor area from Phelps (5) and McKeever and Anderson (3). Estimated use for each year was then adjusted to reflect overall characteristics of the houses built, as reported by the Bureau of the Census (16). These adjustments were based on relative differences in wood products use attributable to specific house characteristics. For example, if the number of multistory houses increased relative to the number of one-story houses, average wood products use per square foot of floor area for all houses was reduced to reflect the increase in the proportion of multistory houses built. An annual series of lumber, structural panel, and nonstructural panel use per square foot of floor area was calculated. Next, these estimates were benchmarked to wood products use per square foot of floor area for the years studied (1959,

1962, 1968, and 1988) to ensure consistency with reported data. Finally, the new estimates were smoothed using a 3-year moving average to remove random variation in the series. Wood products use per house was then calculated by multiplying the use per square foot of floor area by the average floor area per house. Total wood products consumption for new single-family residential construction was calculated by multiplying use per house by total number of single-family housing starts. Use per square foot of floor area of softwood and hardwood lumber and structural and nonstructural panels by panel type was estimated based on trends exhibited from 1976 through 1988.

Table 3 shows the average lumber use per square foot of floor area, per house, and total use for new single-family house construction from 1950 through 1992, by species group. Tables 4 and 5 present similar information for structural and nonstructural panels, respectively. Figure 3 compares use per square foot of floor area from the 1989 Timber Analysis and revised estimates from this report.

Comparison of 1989 Timber Analysis and revised estimates

In the 1989 Timber Analysis, lumber use per square foot of finished floor area was estimated to be 7.14 BF in 1986, structural panel consumption 3.71

TABLE 3. — Average lumber use per square foot of finished floor area and per house, and total lumber use for new single-family houses, 1950 to 1992.

Year	All species			Softwoods			Hardwoods		
	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use
	----- (BF) ^a -----		(MMBF) ^b	----- (BF) -----		(MMBF)	----- (BF) -----		(MMBF)
1950	8.95	8,986	15,716	8.05	8,082	14,136	0.90	904	1,580
1951	8.91	9,050	12,037	8.03	8,156	10,847	0.88	894	1,189
1952	8.87	9,113	12,294	8.01	8,229	11,101	0.86	884	1,193
1953	8.83	9,186	11,951	7.98	8,302	10,801	0.85	884	1,150
1954	8.79	9,792	14,101	7.96	8,867	12,769	0.83	925	1,331
1955	8.75	9,727	15,029	7.94	8,827	13,637	0.81	901	1,392
1956	8.71	9,689	12,091	7.92	8,809	10,994	0.79	879	1,097
1957	8.66	9,745	10,515	7.89	8,879	9,581	0.77	866	935
1958	8.62	10,163	11,952	7.87	9,279	10,912	0.75	884	1,040
1959	8.59	10,511	13,149	7.85	9,605	12,016	0.74	906	1,133
1960	8.55	10,844	10,941	7.83	9,930	10,019	0.72	914	922
1961	8.50	11,198	11,075	7.80	10,276	10,163	0.70	922	912
1962	8.46	11,387	11,342	7.78	10,472	10,430	0.68	915	912
1963	8.34	11,481	11,630	7.70	10,599	10,737	0.64	881	893
1964	8.23	11,852	11,532	7.62	10,973	10,677	0.61	879	855
1965	8.10	12,138	11,713	7.53	11,284	10,889	0.57	854	824
1966	7.99	12,337	9,623	7.45	11,503	8,972	0.54	834	650
1967	7.87	12,470	10,537	7.37	11,677	9,867	0.50	793	670
1968	7.75	12,717	1,446	7.29	11,962	10,766	0.46	755	680
1969	7.69	12,428	10,079	7.26	11,733	9,515	0.43	695	564
1970	7.70	11,411	9,300	7.30	10,814	8,814	0.40	597	486
1971	7.71	11,714	13,506	7.34	11,160	12,868	0.36	553	638
1972	7.69	11,959	15,678	7.36	11,441	14,999	0.33	518	679
1973	7.76	12,875	14,587	7.45	12,371	14,016	0.30	504	571
1974	7.79	13,201	11,736	7.52	12,740	11,326	0.27	461	410
1975	7.77	12,788	11,458	7.54	12,409	11,119	0.23	379	339
1976	7.76	13,193	15,384	7.56	12,853	14,987	0.20	340	396
1977	7.78	13,387	19,438	7.57	13,023	18,909	0.21	364	529
1978	7.77	13,637	19,542	7.55	13,247	18,982	0.22	391	560
1979	7.75	13,646	16,294	7.52	13,238	15,806	0.23	409	488
1980	7.78	13,546	11,541	7.54	13,122	11,180	0.24	424	361
1981	7.76	13,341	9,405	7.50	12,907	9,099	0.25	434	306
1982	7.77	13,288	8,810	7.51	12,836	8,511	0.26	451	299
1983	7.81	13,469	14,384	7.53	12,992	13,876	0.28	476	509
1984	7.87	14,005	15,181	7.58	13,488	14,621	0.29	517	560
1985	7.87	14,041	15,052	7.56	13,501	14,473	0.30	540	579
1986	7.88	14,379	16,953	7.56	13,804	16,275	0.32	575	678
1987	7.92	15,085	17,288	7.59	14,460	16,571	0.33	625	716
1988	7.92	15,806	17,087	7.58	15,129	16,355	0.34	677	732
1989	7.97	16,217	16,266	7.63	15,499	15,546	0.35	718	720
1990	7.99	16,621	14,876	7.63	15,862	14,197	0.36	759	679
1991	8.00	16,594	13,939	7.62	15,813	13,283	0.38	781	656
1992	8.09	16,946	17,455	7.70	16,125	16,609	0.39	821	846

^a BF=board feet.

^b MMBF=million board feet.

ft. ², and nonstructural panel consumption 1.51 ft. ² As previously mentioned, these estimates were partially based on trends reported by Phelps (5) for the years 1959, 1962, and 1968 and changing new house characteristics reported by the Bureau of the Census (16). Based on new information for 1988 (3), lumber use per square foot of finished floor area was revised upward to 7.88 BF, structural panel use upward to 4.05 ft. ², and nonstructural panel use downward to 1.50 ft. ² These revisions resulted in estimated increases of 1,590 million BF of lumber and 740 million ft. ² of structural panels more than the 1989 Timber Analysis estimates. Total nonstructural panel consumption estimates decreased 21 million ft. ² Overall, an estimated 16,953 million BF of lumber, 8,723 million ft. ²

of structural panels, and 3,232 million ft. ² of non-structural panels were consumed in 1986 to build single-family houses.

Wood products consumption in 1992

In 1992, an estimated 17,455 million BF of lumber, 9,958 million ft. ² of structural panels, and 3,295 million ft. ² of nonstructural panels were consumed for the construction of single-family houses in the United States (Tables 3,4,5). Although less than levels recorded in the late 1970s, lumber consumption in 1992 exceeded mid-1980s consumption. Structural panel consumption in 1992 was at an all-time high, exceeding previous highs in the mid-1970s and 1980s. Nonstructural panel consumption increased slightly from levels in the 1980s and appeared to have stabi-

TABLE 4. — Average structural panel use per square foot of finished floor area and per house, and total structural panel use for new single-family houses, 1950 to 1992 (3/8-in. basis).

Year	All types			Softwood plywood			OSB/waferboard		
	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use
	----- (ft. ²) -----		(million ft. ²)	----- (ft. ²) -----		(million ft. ²)	----- (ft. ²) -----		(million ft. ²)
1950	1.70	1,707	2,985	1.70	1,707	2,985	0.00	0	0
1951	1.74	1,770	2,354	1.74	1,770	2,354	0.00	0	0
1952	1.78	1,833	2,473	1.78	1,833	2,473	0.00	0	0
1953	1.83	1,898	2,469	1.83	1,898	2,469	0.00	0	0
1954	1.87	2,080	2,995	1.87	2,080	2,995	0.00	0	0
1955	1.91	2,122	3,278	1.91	2,122	3,278	0.00	0	0
1956	1.95	2,170	2,709	1.95	2,170	2,709	0.00	0	0
1957	1.99	2,241	2,418	1.99	2,241	2,418	0.00	0	0
1958	2.03	2,397	2,819	2.03	2,397	2,819	0.00	0	0
1959	2.08	2,540	3,177	2.08	2,540	3,177	0.00	0	0
1960	2.12	2,686	2,711	2.12	2,686	2,711	0.00	0	0
1961	2.16	2,842	2,811	2.16	2,842	2,811	0.00	0	0
1962	2.20	2,961	2,949	2.20	2,961	2,949	0.00	0	0
1963	2.31	3,182	3,224	2.31	3,182	3,224	0.00	0	0
1964	2.42	3,490	3,396	2.42	3,490	3,396	0.00	0	0
1965	2.53	3,796	3,663	2.53	3,796	3,663	0.00	0	0
1966	2.65	4,084	3,185	2.65	4,084	3,185	0.00	0	0
1967	2.76	4,368	3,691	2.76	4,368	3,691	0.00	0	0
1968	2.87	4,708	4,237	2.87	4,708	4,237	0.00	0	0
1969	2.88	4,651	3,772	2.88	4,651	3,772	0.00	0	0
1970	2.94	4,361	3,554	2.94	4,358	3,552	0.00	4	3
1971	3.01	4,571	5,271	3.00	4,557	5,254	0.01	14	17
1972	3.04	4,720	6,188	3.03	4,706	6,170	0.01	14	19
1973	3.17	5,266	5,967	3.15	5,236	5,932	0.02	31	35
1974	3.27	5,539	4,925	3.23	5,478	4,870	0.04	62	55
1975	3.31	5,448	4,882	3.25	5,346	4,790	0.06	103	92
1976	3.34	5,686	6,630	3.30	5,604	6,534	0.05	82	96
1977	3.42	5,879	8,536	3.31	5,690	8,261	0.11	189	275
1978	3.46	6,076	8,707	3.29	5,781	8,284	0.17	296	424
1979	3.51	6,173	7,371	3.30	5,810	6,937	0.21	363	434
1980	3.60	6,262	5,335	3.35	5,836	4,972	0.24	426	363
1981	3.63	6,236	4,396	3.36	5,777	4,073	0.27	459	324
1982	3.70	6,322	4,191	3.38	5,778	3,831	0.32	543	360
1983	3.79	6,540	6,985	3.41	5,877	6,277	0.38	663	708
1984	3.92	6,983	7,569	3.45	6,146	6,663	0.47	836	906
1985	3.99	7,117	7,630	3.43	6,131	6,572	0.55	986	1,057
1986	4.05	7,399	8,723	3.42	6,242	7,360	0.63	1,156	1,363
1987	4.15	7,905	9,059	3.43	6,540	7,495	0.72	1,365	1,564
1988	4.22	8,425	9,107	3.43	6,845	7,399	0.79	1,580	1,708
1989	4.32	8,791	8,818	3.43	6,989	7,010	0.89	1,803	1,808
1990	4.40	9,152	8,191	3.42	7,111	6,364	0.98	2,041	1,827
1991	4.46	9,261	7,779	3.39	7,024	5,900	0.08	2,237	1,879
1992	4.61	9,668	9,958	3.41	7,144	7,358	1.20	2,524	2,600

lized at about 3,200 million ft. ²These revised estimates for single-family housing do not affect the total wood products consumption data reported in the 1989 Timber Analysis, because the reported totals were based on published production and trade information. However, revised estimates do indicate that single-family housing is an even more important wood products market than previously believed.

Compared to U.S. consumption of wood products for all uses, lumber consumption for new single-family houses was about 32 percent of total consumption,

structural panel consumption about 38 percent, and nonstructural panel consumption about 20 percent.

In 1992, 95 percent of all lumber consumed for new single-family houses was from softwood species. The remaining 5 percent was hardwood, primarily in millwork, finished flooring, and other similar products (Fig. 4). Softwood plywood accounted for 74 percent of all structural panels consumed in 1992 and OSB/waferboard for the remaining 26 percent. More insulating board was consumed in 1992 than any nonstructural panel type: 42 percent of all nonstructural panels were insulating board, 28 percent parti-

TABLE 5. — Average nonstructural panel use per square foot of finished floor area and per house, and total nonstructural panel use in new single-family houses, 1950 to 1992 (3/8-in. basis).

Year	All types			Hardwood plywood			Insulating board			Hardboard			Particleboard ^a		
	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use	Per ft. ²	Per house	Total use
	---	(ft. ²) ---	(million ft. ²)	---	(ft. ²) ---	(million ft. ²)	---	(ft. ²) ---	(million ft. ²)	---	(ft. ²) ---	(million ft. ²)	---	(ft. ²) ---	(million ft. ²)
1950	1.42	1,428	2,497	0.08	80	140	1.25	1,257	2,199	0.09	90	158	0.00	0	0
1951	1.41	1,428	1,900	0.08	81	108	1.23	1,251	1,663	0.10	97	128	0.00	0	0
1952	1.39	1,429	1,928	0.08	82	111	1.21	1,244	1,678	0.10	103	139	0.00	0	0
1953	1.37	1,429	1,859	0.08	83	108	1.19	1,237	1,609	0.11	109	142	0.00	0	0
1954	1.36	1,515	2,182	0.08	89	128	1.17	1,301	1,874	0.11	121	175	0.00	3	5
1955	1.35	1,498	2,314	0.08	89	137	1.15	1,275	1,971	0.11	127	196	0.01	7	10
1956	1.34	1,486	1,854	0.08	91	114	1.13	1,253	1,564	0.12	132	165	0.01	9	11
1957	1.33	1,497	1,616	0.09	96	103	1.11	1,243	1,341	0.13	145	157	0.01	14	15
1958	1.32	1,557	1,832	0.09	108	128	1.08	1,278	1,503	0.13	151	177	0.02	20	24
1959	1.32	1,612	2,017	0.10	122	153	1.06	1,302	1,629	0.13	163	204	0.02	24	31
1960	1.32	1,674	1,689	0.11	143	145	1.04	1,322	1,334	0.14	174	175	0.03	34	35
1961	1.33	1,754	1,735	0.12	161	159	1.02	1,345	1,330	0.14	190	188	0.05	59	59
1962	1.34	1,804	1,796	0.13	175	174	1.00	1,346	1,341	0.15	202	201	0.06	81	80
1963	1.41	1,935	1,960	0.18	248	251	0.99	1,359	1,377	0.16	213	216	0.08	114	116
1964	1.46	2,105	2,048	0.22	317	308	0.98	1,405	1,367	0.16	231	224	0.11	153	149
1965	1.53	2,287	2,207	0.27	404	390	0.96	1,441	1,391	0.17	247	239	0.13	195	188
1966	1.58	2,438	1,902	0.31	479	373	0.95	1,465	1,143	0.17	262	205	0.15	232	181
1967	1.63	2,576	2,176	0.34	539	455	0.94	1,487	1,256	0.18	277	234	0.17	273	230
1968	1.67	2,744	2,469	0.37	608	547	0.93	1,520	1,368	0.18	296	266	0.20	320	288
1969	1.66	2,681	2,174	0.37	601	487	0.89	1,443	1,170	0.18	293	237	0.21	345	280
1970	1.65	2,453	1,999	0.37	545	444	0.87	1,291	1,052	0.18	273	222	0.23	344	281
1971	1.65	2,512	2,896	0.37	558	643	0.85	1,286	1,483	0.19	286	330	0.25	382	440
1972	1.63	2,542	3,333	0.35	551	722	0.82	1,271	1,666	0.19	298	391	0.27	422	553
1973	1.64	2,716	3,077	0.34	570	646	0.80	1,321	1,497	0.20	328	372	0.30	497	563
1974	1.63	2,764	2,457	0.33	563	501	0.77	1,309	1,164	0.20	342	304	0.32	550	489
1975	1.62	2,669	2,392	0.33	536	480	0.73	1,203	1,078	0.21	341	305	0.36	590	528
1976	1.60	2,724	3,176	0.30	518	603	0.71	1,212	1,413	0.21	361	420	0.37	634	739
1977	1.60	2,749	3,991	0.30	509	740	0.71	1,218	1,768	0.22	374	543	0.38	648	941
1978	1.58	2,773	3,974	0.29	501	717	0.70	1,224	1,754	0.22	386	554	0.38	662	948
1979	1.55	2,734	3,265	0.27	480	574	0.68	1,199	1,431	0.22	394	471	0.38	661	790
1980	1.56	2,713	2,312	0.27	463	394	0.68	1,181	1,006	0.23	404	344	0.38	665	567
1981	1.53	2,637	1,859	0.25	436	307	0.66	1,140	804	0.24	405	286	0.38	656	462
1982	1.53	2,611	1,731	0.24	418	277	0.66	1,124	745	0.24	412	273	0.38	658	436
1983	1.53	2,634	2,813	0.24	408	435	0.65	1,129	1,206	0.25	425	454	0.39	672	718
1984	1.53	2,726	2,955	0.23	407	441	0.65	1,163	1,261	0.25	451	489	0.40	705	764
1985	1.52	2,705	2,900	0.22	389	417	0.64	1,150	1,233	0.26	457	490	0.40	709	760
1986	1.50	2,742	3,232	0.21	380	448	0.64	1,161	1,369	0.26	473	558	0.40	727	857
1987	1.50	2,864	3,283	0.20	381	437	0.63	1,208	1,384	0.27	505	579	0.40	770	882
1988	1.49	2,971	3,211	0.19	379	410	0.63	1,247	1,348	0.27	536	579	0.41	809	874
1989	1.50	3,056	3,065	0.18	375	376	0.63	1,281	1,285	0.27	559	561	0.41	841	843
1990	1.50	3,118	2,790	0.18	366	327	0.63	1,302	1,165	0.28	582	521	0.42	868	777
1991	1.50	3,106	2,609	0.17	348	292	0.62	1,292	1,086	0.28	591	496	0.42	875	735
1992	1.53	3,199	3,295	0.16	346	356	0.64	1,333	1,373	0.29	612	630	0.43	908	936

^a Includes medium density fiberboard.

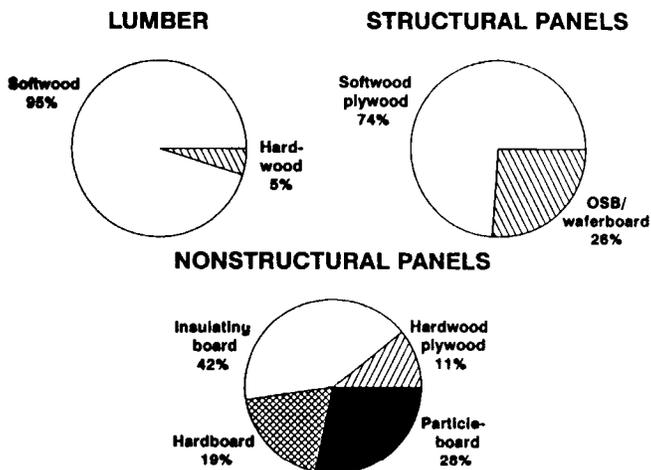


Figure 4. — Wood products consumption for new single-family housing, by product type, 1992.

cleboard, 19 percent hardboard, and 11 percent hardwood plywood.

Conclusions

Estimates of lumber, structural panel, and non-structural panel consumption for new single-family house construction used by the Forest Service during the 1970s and 1980s were based on information from three studies of timber products used for new single-family house construction (5). These studies were conducted in 1959, 1962, and 1969. Information from a residential construction study conducted in 1988 showed that estimated wood products use per square foot of finished floor area used during these 20 years was low, by as much as 12 percent. Data from the 1988 study were used in conjunction with data from the previous three studies, the U.S. Department of Commerce, Bureau of the Census, and various sources to develop new annual estimates of consumption from 1950 through 1992. Estimated were use per square foot of floor area, use per house, and total wood products use. Estimates were made by wood product type and species group/panel type.

Literature Cited

1. Carney, M.J. 1977. Softwood plywood used in new residential construction — 1976. Market Res. Rept. No. R38. American Plywood Assoc., Tacoma, Wash. 45 pp.
2. Lanford, H.W. 1972. Technological forecasting methodologies: a synthesis. American Management Assoc., Inc., New York. 187 pp.
3. McKeever, D.B. and R.G. Anderson. 1992. Timber products used to build U.S. single-family houses in 1988. *Forest Prod. J.* 42(4):11-18.
4. National Forest Products Association. 1989. International trade report, December 1988-January 1989. NFFPA, Washington, D.C. p. 7.
5. Phelps, R.B. 1970. Wood products used in single-family houses inspected by the Federal Housing Administration, 1959, 1962, and 1968. Stat. Bull. No. 452. USDA Forest Serv., Washington, D.C. 29 pp.
6. _____. 1993. Residential construction in the United States, by structure type and size, 1920-90. Unpubl. manuscript on file with the USDA Forest Serv., Forest Inventory, Econ., and Recreation Res. Staff, Washington, D.C.
7. Siskind, D. 1982. Housing starts: background and derivation of estimates 1945-82. U.S. Dept. of Commerce, Bureau of Ind. Relations, Ind. Econ., Washington, D.C. *Construction Review* 28(3):4-16.
8. Spelter, H. 1985. Modeling the demand for wood products in the context of technological change. In: Proc. Third North American Inter. Institute for Applied Systems Analysis (IIASA) Network Mtg. M.J. Hadley and D.H. Williams, eds. Forest Econ. and Policy Analysis Project, Vancouver, B.C. pp. 113-122.
9. USDA Forest Service. 1974. The outlook for timber in the United States. Forest Res. Rept. No. 20. Washington, D.C. 367 pp.
10. _____. 1977. The nation's renewable resources — an assessment, 1975. Washington, D.C. 243 pp.
11. _____. 1980. An assessment of the forest and range land situation in the United States. Washington, D.C. 631 pp.
12. _____. 1982. An analysis of the timber situation in the United States: 1952-2030. Forest Res. Rept. No. 23. Washington, D.C. 499 pp.
13. _____. 1988. The South's fourth forest: alternatives for the future. Forest Res. Rept. No. 24. Washington, D.C. 512 pp.
14. _____. 1990. An analysis of the timber situation in the United States: 1989-2040. A technical document supporting the 1989 USDA Forest Serv. RPA Assessment. Gen. Tech. Rept. RM-199. R.W. Haynes, coordinator. Rocky Mountain Forest and Range Expt. Sta., Fort Collins, Colo. 269 pp.
15. U.S. Department of Commerce, Bureau of the Census. 1972. Housing starts 1959-71. Const. Repts. C-20 Supp. Washington, D.C. 75 pp.
16. _____. 1992. Characteristics of new housing: 1991. Current Const. Repts. C25/91-A. Washington, D.C. 24 pp.
17. _____. 1993. Housing starts: January 1993. Const. Repts. C20/93-1. Washington, D.C. 24 pp.
18. U.S. Dept. of Housing and Urban Development. 1980. 1978 statistical yearbook. HUD-338-7-UD. Washington, D.C.
19. U.S. Dept. of Labor, Bureau of Labor Statistics. 1959. Nonfarm housing starts 1889-1958. Bull. No. 1260. Washington, D.C. 37 pp.