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labor and material requirements for private one-family house construction

Bulletin No. 1404

UNITED STATES DEPARTMENT OF LABOR W. Willard Wirtz, Secretary

BUREAU OF LABOR STATISTICS Ewan Clague, Commissioner



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Preface

This study of total labor and material requirements for the construction of private, nonfarm, one-family houses is one of a series of such studies for various types of construction that might be affected by governmental action. Previous studies have been made of labor requirements for schools, highways, Federal office buildings, hospitals, civil works activities of the Army Corps of Engineers, and public housing. Currently in various stages of preparation are studies of college student housing and sewage disposal works.

The studies are being conducted in the Bureau's Division of Productivity Measurement under the general direction of Leon Greenberg, Assistant Commissioner for Productivity and Technological Developments. This bulletin was prepared by Herman J. Rothberg, who also directed the collection and tabulation of the statistical data, under the supervision of James F. Walker.

The Bureau is indebted to the Federal Housing Administration, a constituent of the Housing and Home Finance Agency, and its personnel in the various regional offices throughout the United States, for the generous cooperation and invaluable assistance given the Bureau's field representatives in the selection of specific sample projects and the furnishing of some of the basic data. The Bureau also appreciates the cooperation of the many builders and construction contractors who supplied the on-site man-hour and wage rate data and the materials information on which the estimates for indirect requirements are based.

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LABOR AND MATERIAL REQUIREMENTS FOR PRIVATE ONE-FAMILY HOUSE CONSTRUCTION

Introduction

New construction is a major component of the Nation's output of goods and services and an important source of employment. Jobs are created not only at construction sites but also in the many manufacturing, trade, and transportation industries which make, sell, and deliver materials required in construction processes. Because of its far-reaching impact, a vigorous construction industry is regarded as a significant stimulus to employment and sometimes as an aid in countering cyclical unemployment.

To measure the labor requirements of various types of construction, the Bureau of Labor Statistics has undertaken a series of studies. This study of the labor requirements for private, nonfarm, new, one-family house construction is the first in the series in which the construction is financed entirely with private funds; in the preceding studies, all or part of the construction was either financed directly with Federal funds or federally assisted through loans or grants. However, the Federal Government has played an important role in fostering private home construction.

The significance of private, new, one-family house construction is evident from the following: Annual expenditures for the construction of such houses exceed those of any other type of construction; homebuilding activity exerts an important influence on many other kinds of construction, particularly as suburban areas mushroom and create the need for schools, hospitals, and other public and private facilities; new home purchases engender considerable activity in the industries manufacturing and selling home furnishings and appliances; the need for housing is a continuing one and is expected to become greater in the last few years of the 1960's and through the 1970's as the young adults of the World War II "baby crop" create an increased demand for new housing.

In 1962, expenditures for the construction of private, nonfarm, new, one-family houses amounted to approximately \$14 billion, and accounted for about 75 percent of all private nonfarm new housing construction and 23 percent of all construction.¹ About two-thirds of the 1.43 million private, nonfarm, new dwelling units started for the year were one-family dwelling units.

Although these one-family houses are financed entirely with private funds, the Federal Government, through some of its programs, has had a profound effect upon the homebuilding industry since the passage of the first

¹U.S. Department of Commerce, Construction Review, June 1963.

National Housing Act (1934). This act provided for government home loan insurance and established the Federal Housing Administration (FHA) to administer the program. It was enacted to awaken a depressed industry, to provide construction workers with jobs, to enable more people to become homeowners, and to stimulate the economy generally.

Subsequent amendments and other legislation resulted in the extension of the home mortgage insurance principle to veterans housing under the Veterans Administration (VA). FHA insured mortgage loans and VA guaranteed mortgage loans were involved in the private financing of approximately 25 percent of the private nonfarm new one-family houses started in 1962. While neither agency makes loans or builds houses, they have had a significant impact on home purchases and, therefore, on homebuilding. In order to make home buying easier as economic conditions have varied, the FHA has liberalized downpayment requirements, raised maximum insurable mortgage amounts, and extended mortgage maturities.

Nature of Study

This report is based on a survey of selected private, new, one-family houses constructed in various localities of the United States, exclusive of Alaska and Hawaii. Data were collected for 101 houses chosen as a representative sample of new one-family houses constructed between the latter part of 1961 and the first quarter of 1963. Most of the construction, however, occurred during 1962. The effective sample is actually larger than indicated, as some of the reports for individual houses represented the average man-hours and expenditures for many similar homes within a large housing development. The sample, stratified by price, broad geographical area, and degree of urbanization, is considered adequate for measuring labor requirements and other information, on the average, which was the objective of this survey. However, the sampling error is larger for specific types of houses, methods of construction, or material requirements, particularly subgroups of materials components.

Selection of the specific sample houses studied was made through the use of the facilities of FHA regional offices. As a result, the sample houses, with few exceptions, were either FHA appraised or mortgage insured. Reasons for the use of FHA sources are indicated in appendix $A.^2$

The survey was designed primarily to determine the number of manhours utilized for each \$1,000 of one-family house construction. For this study, the \$1,000 or other dollar volume figures refer to "construction price"--i.e., the construction cost to the purchaser. This was determined

²For a more detailed description of method and for a list of States included in each region, see appendix A.

to be the FHA estimated replacement cost of the property or the actual (or asking) sales price, whichever was lower, less the FHA estimated market price or value of the improved lot on which the house was built.

Man-hours as defined by the survey, include both on-site construction employment and the off-site employment required to produce and deliver materials used in the construction and to sell the house. Data for on-site labor include total man-hours for the supervisory, engineering, clerical, and custodial employees at the site, as well as those for workers in each construction trade. Data for off-site labor include employment in the offsite (e.g., office and warehousing) activities of builders and construction contractors; in the activities resulting from expenditures for builders' or contractors' overhead for such items as real estate commissions and other sales expense, rent, bonds, insurance and financing, utilities and business services, legal and professional services, repair services, and office supplies; in building materials and equipment manufacture and distribution (including household appliances and furnishings covered by the construction price); and, finally, employment in all the other industries which are affected directly or indirectly by the production and distribution of home building materials from raw material to the final manufacturing stage.³

Certain types of employment are not covered by the survey. Excluded from the man-hour requirements estimates is the labor time involved in inspection by government employees during construction, in the installations by public utility employees, as well as any site preparation, landscaping, and street work not covered by the construction price as defined. Also excluded is the labor generated by the money expended by builders or contractors for taxes (including payroll taxes) and welfare payments. These payments are believed to generate relatively little direct employment. Employment created by the respending of wages and profits of the workers and their employers-the multiplier effect--was not considered within the scope of the study.

General Survey Findings and Characteristics

For every \$1,000 of construction price concerned with the building of private one-family houses in 1962, 204 man-hours of employment were created. Of these, 72 were for employment at the construction site and 132 were required for various off-site activities. (See chart 1.) The latter included all labor needed to produce and deliver materials and equipment used by the on-site workers; employment by the construction builders and contractors in administrative, warehousing, and other off-site operations; and man-hours generated by home selling and the other builder-contractor overhead costs noted previously. Total man-hours were allocated as follows:

	Man-hours of construc	per \$1,000 tion price
	Number	Percent
Total man-hours	204	100
Construction:		
On-site	72	35
Off-site	12	6
Manufacturing	58	29
Transportation, trade, and services	49	24
Other industry employment	13	6

In 1962, approximately \$14 billion was spent for the construction of one-family houses. On the basis of the average on-site and off-site hours required per \$1,000 of construction price for the 101 sample houses studied, this would indicate that one-family house construction was responsible for about 1.5 million jobs that year--approximately 575 thousand on-site and 925 thousand off-site.⁴

The survey disclosed wide ranges of man-hour and material requirements among individual house projects, reflecting among other factors, differences in construction price and size, geographical location, annual builders' volume, and local preferences and practices. There were also marked variations in such related matters as average hourly pay rates and site wages as percentages of construction price. On the average, however, 48 cents of

⁴The annual employment estimate of construction workers is based on 50 times the 1962 average workweek in general and special trades contract building construction work of 35.6 and 36.3 hours a week, respectively, as reported in the Bureau's Earnings and Hours series. For other than construction workers, 2,000 hours were considered a year's employment.



the construction dollar was spent for the purchase of materials, supplies, and equipment and 22 cents for wages to on-site workers. (See chart 2.) The difference between the total construction price and the sum of the materials and wages, i.e., 30 percent, represents overhead costs such as administrative off-site salaries, central office and yard operation expenses, sales expenses, insurance and taxes, plus other overhead and profit. An estimate of the various overhead costs was made to compute the off-site man-hours attributable to such costs.

This study of labor requirements also provided several types of information relating to the kinds of material used, the types of employment generated, and the share of total employment used by the various special trades contractors. These are discussed in later sections of this report.

Characteristics of the Houses Surveyed

The size and cost of the 101 houses surveyed averaged as follows:

Floor space (calculated area ⁵)	1,240 square feet
Cost per square foot	\$11.76
Market value (including land ⁶)	\$17,712
Construction price	\$14,585

The size and cost (market value and construction) of individual houses, of course, varied considerably and reflect regional and local area preferences and needs in design and type of structural materials used. (See table 1.) However, despite the differences in costs and house plans and materials, there was a "typical" house which predominated. It was a detached, one-story house with three bedrooms and at least one and one-half bathrooms. It was wood framed, ⁷ had a dry-wall interior, was warm-air heated, and had a garage or carport.

⁵Calculated area is the area of living spaces in the main building above the basement or foundations, measured at the outside surfaces of exterior walls. Garage space, finished spaces in attics when less than 50 percent of the ground floor area, and areas with ceiling heights of less than 5 feet are excluded.

⁶Market value was either the actual or proposed selling price of the house or the FHA estimate of replacement cost of the property, whichever was less.

⁷Constructed with a supporting framework of wooden studs, usually connected by an outer sheathing of wooden boards, plywood or other material, which serves as a bracing to the structure and provides a solid surface to which one or more of a variety of outer facing materials can be attached.



	U	nited Stat	es	Northeast		North Central		South			West				
Characteristic		Const price	Construction price per		Const price	Construction price per		Construction price per			Construction price per		Nuchar	Construction price per	
	Number	Square foot	House	Number	Square foot	House	Number	Square foot	House	Number	Square foot	House	Number	Square foot	House
All houses	101	\$11.76	\$14,585	18	\$12.54	\$16,143	24	\$12.63	\$15,004	34	\$11.24	\$13,565	25	\$11.12	\$14,449
In metropolitan areas In nonmetropolitan areas	81 20	\$11.61 12.45	\$14,656 14,296	15 3	\$12.51	\$16,511 	19 5	\$12.29 14.15	\$15,102 14,630	26 8	\$11.08 11.79	\$13,597 13,461	21 4	\$10.99 	\$14,240
Construction price group: \$18,000 and over \$15,000-\$17,999 \$12,000-\$14,999 Under \$12,000	14 26 32 29	12.76. 12.23 11.64 10.54	21,949 16,328 13,537 10,623	3 7 5 3	12.94 13.00	16,407 13,612	4 5 9 6	14.03 11.67 11.30	16,419 13,514 10,578	4 8 8 14	11.36 11.53 10.48	15,919 13,557 10,336	3 6 10 6	11.44 11.11 9.60	16,706 13,505 10,808
Average wage rate paid (on-site); \$ 3.50 and over \$ 2.50-\$ 3.49 Under \$ 2.50	39 38 24	11.50 12.60 10.90	14,765 15,274 13,200	5 12 1	11.64 12.86 	15,249 16,689 	12 11 1	12.45 13.20	15,049 15,068 	12 22	11.88 10.89	14, 351 13, 136	22 3 	10.99 	14,501
Number of square feet: 1,400 and over 1,200-1,399 1,000-1,199 Under 1,000	25 17 37 22	11.19 11.74 12.47 11.59	18,895 15,156 13,554 10,980	5 2 8 3	11.49 13.34 	20, 921 14, 353 	5 2 9 8	11.92 14.07 12.02	20, 348 15, 388 11, 178	7 6 12 9	10.53 12.05 11.97 10.41	17,975 15,209 12,862 9,976	8 7 8 2	11.11 11.26 10.56 	17,524 14,619 11,731
One story Two stories Split level	85 4 12	11.53 14.08	13,807 18,944	13 2 3	13.08	15,035 	18 6	11.57	13,464 19,621	31 2 1	11.39	13, 290 	23 2	10.90 	14,077
2 bedrooms 3 bedrooms 4 bedrooms	2 82 17	12.05 10.78	13,917 18,118	14 4	12.97	14,984 	21 3	13.04	14,617	1 29 4	11.41	2,882	1 18 6	11.31 10.61	13,938 16,357
l bathroom l-1/2 bathrooms 2 bathrooms 2-1/2 bathrooms	34 24 34 9	11.96 12.77 11.04 11.74	11,992 14,963 15,436 20,160	8 4 1 5	13.12	13,852 18,769	9 11 3 1	12.20 12.97 	11,655 15,178 	12 8 12 2	11.21 12.51 10.77	11,167 14,062 15,271 	5 1 18 1	11.37 11.10	11,599 15,066
Basement or partial basement No basement	47 54	12.96 10.75	15,792 13,534	16 2	12.87	16,160 	17 7	13.23 11.28	13,229 14,238	9 25	12.81 10.65	15,956 12,704	5 20	12.73 10.73	15,929 14,079

8

Table 1. Number and Construction Price of Surveyed Private One-Family Houses, by Selected Characteristics and Region, 1962

	United States		Northeast		North Central		South			West					
Characteristic	Number	Construction price per		Number	Construction price per		Number	Construction price per		Nuclear	Construction price per		Number	Construction price per	
		Square foot	House	Number	Square House	House	Number	Square foot House	Number	Square foot	re House	Number	Square foot	House	
Garage Carport Neither garage nor carport	64 16 21	\$11.67 11.35 12.40	\$15,108 13,103 14,122	14 4	\$12.66	\$16,790 	13 1 10	\$12.30 12.64	\$15,999 13,370	16 12 6	\$10.89 11.02 12.52	\$13,523 12,371 16,067	21 3 1	\$11.18 	\$14,642
Type of framing: Wood Masonry ¹	87 14	11.88 11.02	14,713 13,792	17 1	12.48	15,533	24	12.63	15,004	25 9	11.41 10.73	13,935 12,539	21 4	11.18	14,642
Exterior wall material: Masonry Wood Stucco Other ²	33 17 14 37	11.70 11.98 11.15 11.98	14,777 12,786 14,940 15,106	2 6 10	13.34 	13,735	7 3 14	12.38	17,647 14,472	20 4 4 6	11.38 10.72	13,478 13,762	4 4 10 7	11.06 10.96	14,593 15,585
Interior wall material: Drywall Plaster	82 19	11.63 12.28	14,099 16,682	13 5	11.98 14.08	15,746 17,172	22 2	12.25	14,133	24 10	11.38 10.93	13,259 14,301	23 2	11.11	14,012
Type of heating system: Warm air Hot water Electric	85 13 3	11.60	14,363 16,702 	9 9 	12.48 12.60	16,447 15,838 	21 2 1	12.68	14,814 	30 2 2	11.02 	13,350	25 	11.12	14,449
Type of floors: Wood Resilient tile Other ³	67 25 9	12.36 10.55 10.75	15,244 13,342 13,131	18 	12.54 	16, 142 	17 6 1	13.25 11.23	15, 301 14, 924 	18 9 7	11.82 10.05 11.10	14,744 11,246 13,514	14 10 1	11.82 10.53 	14,662 14,280

Table 1. Number and Construction Price of Surveyed Private One-Family Houses, by Selected Characteristics and Region, 1962 -- Continued

¹Includes 1 combination wood and masonry framed house.
 ²Includes 8 houses with exterior walls of asbestos, 5 with aluminum, and 24 with a combination of materials.
 ³Includes 7 floors covered with terrazzo and 2 uncovered slab floors.

Notes: Data not shown where less than 5 projects are indicated. Differences in average prices by type or characteristic are also influenced by the presence of other factors determining cost; consequently, the data shown cannot be utilized to assess the precise influence on average price per square foot of a given characteristic.

Structural Features

Except for variations in the types of exterior wall materials used, there was considerable uniformity in most of the house plans and construction features of the one-family houses studied, as evidenced by the "typical" house described above.

With regard to house plan and layout, 84 percent of the houses were one-storied, 12 percent were split-level type. Eighty-two percent of the houses had three bedrooms and two-thirds had one and one-half or more bathrooms. Eighty percent had either a garage or carport. Basementless houses comprised 53 percent of those surveyed. They were predominant in the South and West. Sixty percent of the one-story houses were without basements and most split-level homes had partial basements.

Eighty-six percent of the houses were framed with wood. The remainder were masonry framed. The frames were faced with a number of different exterior wall materials. One-third of the houses had masonry exteriors with about four-fifths of these using brick (veneer, mainly). Approximately 24 percent of the houses were faced with two or more types of exterior construction materials, each of which covered substantial portions of the outside wall areas. For the most part, these involved the use of brick veneer in conjunction with wood (shingles, siding or panels), asbestos shingles, or stucco. About 17 percent were covered with wood in various forms. Stucco was the exterior wall for about 14 percent of the houses and these were confined to the West and the South. In the West, the stucco was applied to wire mesh on wood frames. In the South, stucco covered concrete block frames. Asbestos shingles or aluminum siding covered the walls of the rest of the houses.

Interior walls were of dry-wall construction in over four-fifths of the houses. The balance were of plaster. Warm-air heating systems were used in about 84 percent of the houses.

Wood floors on joists were present in all of the houses with basements and about 16 percent of those without basements. The remaining houses without basements, about 40 percent of the houses studied, had concrete slab floors which were covered mainly with resilient tile (asphalt or vinyl) or terrazo.

All of the houses had roofs with wood bases (plywood, generally). About 80 percent of the roofs were covered with asphalt shingles.

Approximately 11 percent of all the houses surveyed were substantially factory produced "prefabricated or package" homes. All but two of these houses were located in the North Central region. "Shell" houses were not included in the survey.

Costs: Total and Square Foot

Houses built in metropolitan areas--about 80 percent of the houses studied--varied relatively little in total construction price and general design from those erected in nonmetropolitan locations. However, basements were featured to a greater extent in the houses built in the nonmetropolitan areas and their square foot floor area was not included in the calculated area of the houses studied. As a result, the construction price per square foot was higher in the nonmetropolitan areas than in the more urbanized areas. On the other hand, houses in metropolitan areas were generally larger in size in terms of calculated area, averaging 1, 262 square feet, as compared with houses in nonmetropolitan areas, which averaged 1, 149 square feet. Consequently, although the houses in metropolitan areas had a lower construction price per square foot, the average total construction price for houses in metropolitan areas was slightly higher than in the less populated areas.

The exclusion of basements from the calculated area provides an explanation for other seemingly incongruous per square foot cost data. For example, in table 1, houses in the study without garages or carports are shown as having a higher average per square foot cost than those with such facilities. When this house characteristic is examined in relation to the presence or absence of basements, the following is revealed:

	Hous	ses with	Houses			
	full o	r partial	without			
	bas	ements	basements			
	Number	Cost per square foot	Number	Cost per square foot		
Garage	26		38	\$10.83		
Carport	4		12	10.28		
Neither carport nor garage .	17		4	(1/)		

¹Insufficient coverage

Without exception, examination of a structural feature or characteristic of the houses in relation to the existence or nonexistence of basements indicated that those houses with basements had a higher per square foot cost. This reflects, mainly, the inclusion of costs invested in the construction of a basement without a compensating allowance for its square foot area.

Thus, while there was uniformity in many structural features of the houses studied, analysis of the square foot cost data must be made with an

awareness of the many possible combinations of features which may affect this cost, in addition to regional influences.

Forty-two percent of the houses studied were built by builders with an annual building volume of 100 or more homes. The number of houses studied, the average per square foot cost and construction price, by annual builder volume, was as follows:

Annual volume of builder	Number	Cost per	Cost
	of houses	square foot	per house
200 and over	19	\$11.09	\$13,487
50 to 99	16	11.83	15, 309
Under 50	43		15, 302

As noted previously, the estimates of cost (and man-hours required) are related to the construction price of the house--i.e., the market value less the improved land or lot value. For all the houses studied, the average market value and improved lot value as a percent of market value, by degree of urbanization, were as follows:

	Average market value	Percent lot valu		
All houses	\$17,712	17.7		
In metropolitan areas	17,923	18.2		
In nonmetropolitan areas	16,860	15.2		

Real estate commissions and other sales expense in connection with sale of the houses averaged about 3.5 percent of the market value and 4.5 percent of the construction price.

On-Site Man-Hour Requirements

Man-hours at the construction site, obtained by dividing total manhours by total construction price, averaged 72 per \$1,000 of construction price, for all the houses studied.

Almost half of the individual houses ranged from 60 to 80 man-hours. However, the overall range was much wider, reflecting special circumstances associated with the houses which tended to decrease or increase their unit labor requirements. The survey disclosed the existence of marked differences in group averages when the data were analyzed by various criteria such as construction price, location, annual builders' volume, and construction characteristics. (See table 2.) Comparisons are affected by differences in design, materials and relative costs, particularly between regions.

On-site man-hour requirements per \$1,000 of construction price increased as the construction price of the houses increased. This reflects, in part, the inclusion at each successively higher construction price level, additional, more expensive, custom-built luxury features which the more affluent homebuyer seeks. Generally, the inclusion of these features requires more exacting craftsmanship, a higher degree of quality control, and, consequently, more on-site time per \$1,000 of construction price.

Homes built in metropolitan areas required 70 man-hours per \$1,000 of construction price and those in nonmetropolitan areas, 81. The higher man-hours required for the houses built in the latter area appear to reflect several factors. These involved some differences in structural features and some regional influences. Structurally, the presence of a larger proportion of houses in the nonmetropolitan areas with masonry facing and with basements contributed to the increased requirements for these areas. Forty-five percent of the houses in the less urbanized areas were faced with masonry. Only 30 percent of the metropolitan area homes had such exteriors. Analysis of the man-hours by type of exterior wall revealed that houses with masonry outer walls had the highest man-hour requirements per \$1,000. Sixty percent of the nonmetropolitan area houses had basements while only 43 percent of those in metropolitan area were built with this feature. Basements involve excavating and floor and wall finishing.

Generally, for most houses surveyed, lower man-hour requirements were associated with greater than average use of skilled craftsmen. Higher proportions of laborers and helpers were usually related to higher man-hour requirements per \$1,000 of construction price (table 3).

Regional Group Comparisons

On-site man-hour requirements per \$1,000 varied by region. (See table 4.) Compared with the average for all the houses studied, they were

Characteristic	United States	Northeast	North Central	South	West
All houses	72.1	73.5	61.4	91.4	56.8
In metropolitan areas In nonmetropolitan areas	70.0 80.6	74.5 (<u>1</u> /)	59.8 68.0	87.7 103.6	55.2 (<u>1</u> /)
Construction price groups: \$18,000 and over \$15,000-\$17,999 \$12,000-\$14,999 Under \$12,000	77.7 72.8 70.0 68.4	(1/) 74.8 72.0 (1/)	(1/) 63.5 55.6 57.9	(1/) 86.9 106.8 80.7	(1/) 60.0 52.5 54.0
Annual volume of builder: 200 and over 100-199 50-99 Under 50	55.7 67.7 67.6 82.2	(1/) (<u>1</u> /) 68.5 73.9	54.0 51.4 (1/) 75.5	(1/) 87.6 (1/) 93.9	51.4 55.5 59.0 64.8
Construction price per square foot: \$13.00 and over \$12.00-\$12.99 \$11.00-\$11.99 \$10.00-\$10.99 Under \$10.00	72.9 83.5 65.7 67.0 72.1	74.5(1/)59.1(1/)(1/)(1/)	$\begin{array}{c} 68.1 \\ (1/) \\ (\overline{1}/) \\ (\overline{1}/) \\ (\underline{1}/) \\ (\underline{1}/) \end{array}$	(1/) 115.7 89.8 76.6 88.0	(1/) (1/) 52.8 51.9 56.8
Average wage rate paid (on-site): \$ 3.50 and over \$ 2.50-\$ 3.49 Under \$ 2.50	55.9 73.3 99.2	57.8 77.4 (<u>1</u> /)	55.0 68.2 (<u>1</u> /)	75.9 100.6	55.9 (<u>1</u> /)

Table 2. On-Site Man-Hour Requirements per \$1,000 of Construction Price for Surveyed Private One-Family Houses, by Selected Characteristics and Region, 1962

See footnote at end of table.

Table 2. On-Site Man-Hour Requirements per \$1,000 of Construction Price for Surveyed Private One-Family Houses, by Selected Characteristics and Region, 1962--Continued

Characteristic	United States	Northeast	North Central	South	West	
Number of square feet: 1,400 and over 1,200-1,399 1,000-1,999 Under 1,000	73.3 63.6 77.5 67.5	79.5 (1/) 72.3 (1/)	64.8 (1/) 64.3 56.9	89.7 78.0 106.1 82.3	59.9 53.5 56.3 $(\underline{1}/)$	
One story Two stories Split level	$\begin{array}{c} 69.9 \\ (1/) \\ 77.9 \end{array}$	69.9 (1/) (1/)	56.3 71.9	$89.4 \\ (1/) \\ (1/) \\ (1/)$	55.2 (<u>1</u> /)	
2 bedrooms 3 bedrooms 4 bedrooms	(1/) 73.2 66.9	74.6 (<u>1</u> /)	62.8 (<u>1</u> /)	(1/) 91.9 (1/)	(1/) 57.0 55.0	
<pre>1 bathroom 1-1/2 bathrooms 2 bathrooms 2-1/2 bathrooms</pre>	70.8 76.8 67.1 80.0	$74.4 \\ (1/) \\ (1/) \\ 77.6$	$ \begin{array}{c} 60.0 \\ 60.4 \\ (\underline{1}/) \\ (\underline{1}/) \end{array} $	82.2110.684.4(1/)	57.3 $(\underline{1}/)$ 57.1 $(\underline{1}/)$	
Basement or partial basement No basement	75.4 68.7	72.3 (<u>1</u> /)	62.8 57.8	108.2 83.8	67.0 53.9	
Garage Carport Neither garage nor carport	66.8 86.0 79.3	74.1 (<u>1</u> /)	60.7 (<u>1</u> /) 58.9	80.3 92.5 114.6	55.9 (1/) (<u>1</u> /)	
Type of framing: Wood Masonry ²	72.0 72.6	73.3 (<u>1</u> /)	61.4	96.1 76.9	55.9 (<u>1</u> /)	

See footnotes at end of table.

Characteristic	United States	Northeast	North Central	South	West
Exterior wall material: Masonry Wood Stucco Other ³	82.7 70.9 59.9 67.8	(1/) 71.9 73.1	61.3 (1/) 61.6	96.7 (1/) ($\overline{1}$ /) 88.6	(1/) (1/) 53.7 55.4
Interior wall material: Drywall Plaster	68.7 84.3	70.8 80.0	59.6 (<u>1</u> /)	87.6 99.9	57.5 (<u>1</u> /)
Type of heating system: Warm air Hot water Electric	71.5 74.6 $(\underline{1}/)$	75.4 71.6 	$ \begin{array}{c} 63.1 \\ (1/) \\ (\underline{1}/) \end{array} $	89.9 (1/) (1/) (1/)	56.8
Type of floors: Wood Resilient tile Other ⁴	76.5 59.0 70.6	73.5 	62.8 59.4 (<u>1</u> /)	105.0 71.4 74.8	$61.4 \\ 49.8 \\ (\underline{1}/)$

Table 2.	On-Site Ma	n-Hour	Requirements	per \$1	,000 d	of C	Construction	Price	for S	Surveyed
Private	One-Family	/ Houses	, by Selected	Charact	cerist	ics	and Region,	1962-	-Coi	ntinued

¹Insufficient coverage to warrant presentation. ²Includes 1 combination wood and masonry framed house. ³Includes houses with exterior walls of asbestos shingles or aluminum siding and houses where a combination of materials were used.

⁴Terrazzo and uncovered slab.

Table	3.	On-Site Man-Hour Requirements per \$1,000 of Construction	
Price	of	Surveyed Private One-Family Houses, by Proportion of Lower	r
		Skilled Labor Employed ¹ and Region, 1962	

Percent lower skilled workers of total	Man-hours per \$1,000 of construction price								
	United States	Northeast	North Central	South	West				
All workers	72.1	73.5	61.4	91.4	56.8				
20.0 and under 20.1 and over	64.0 82.8	70.7 76.0	62.7 61.4	87.2 92.4	56.1 61.7				

¹For purposes of this comparison, laborers, helpers, and tenders were considered lower skilled.

Table 4. Distribution of Surveyed Private One-Family Houses, by Number of On-Site Man-Hours Required for Each \$1,000 of Construction Price, by Region, 1962

Percent of man-hours required	United States	Northeast	North Central	South	West				
Average man-hours for all projects	72.1	73.5	61.4	91.4	56.8				
Man-hour range	Percent of projects								
Under 60.0	32.7 19.8 21.8 9.9 3.0 12.9	16.7 22.2 38.9 11.1 5.6 5.6	54.2 20.8 12.5 12.5 	5.9 11.8 26.5 14.7 5.9 35.3	60.0 28.0 12.0 				

Note: Because of rounding, sums of individual items may not add to 100.

somewhat higher in the Northeast and substantially higher in the South; they were considerably lower in both the West and North Central regions.

The higher man-hours per \$1,000 of construction price in the South reflected some of the following influences. Almost 60 percent of the houses in that region had exterior walls of masonry. The stucco-walled houses in the region, generally lower in man-hour requirements, had concrete block frames. Moreover, there was a more frequent use of laborers and helpers, contributing to a higher man-hour usage.

In the Northeast, a higher than average construction price, a greater admixture of different types of exterior walls, frequently in combination with brick, and the presence of basements in close to 90 percent of the houses, seem to have contributed to the higher man-hours.

In the West, the region with the lowest man-hour requirements, 40 percent of the houses were built with stucco exteriors applied to wire mesh over wood frames. Eighty percent of the houses were without basements. Forty percent were built by builders with a homebuilding volume of 200 or more houses yearly. These builders represented almost half of all the 200-or-more volume homebuilders in the study.

In the North Central region, the most important factor contributing to its lower man-hour requirements was the presence of over 80 percent of the substantially "prefabricated or package" houses in the sample. In these homes, a considerable amount of the time which would usually have been devoted to on-site activity would obviously have been performed off-site. This region was second to the West in the number of homebuilders with an annual volume of 200 or more houses--almost a third of all such builders studied.

Requirements by Occupation

Workers in the skilled trades accounted for 73 percent of the total on-site man-hours. Semiskilled and unskilled workers accounted for 24 percent of the hours and nonproduction employees (supervisors, engineers, clerks), 3 percent (table 5).

Within the skilled trades, the workers in four predominant crafts-carpenters, painters, bricklayers (and masons), and plumbers--accounted for 75 percent of all the skilled man-hours. Carpenters were by far the largest group of skilled workers employed at the site. They were responsible for 47 percent of the skilled hours and 35 percent of total on-site hours, exceeding the combined hours of work of the semiskilled and unskilled workers. Painters were next in occupational importance with 13 percent of the skilled hours; bricklayers and plumbers followed, each working about the same amount of time--slightly over 7 percent. Although there were variations among projects in the proportion of hours worked by each of these crafts, as well as the others, there were relatively few exceptions in the order of skilled craft importance.

_	United States		Northe	Northeast		North Central		South		West	
Occupation	Man-hours worked	Percent	Man-hours worked	Percent	Man-hours worked	Percent	Man-hours worked	Percent	Man-hours worked	Percent	
All occupations	72.1	100.0	73.5	100.0	61.4	100.0	91.4	100.0	56.8	100.0	
Supervisory, professional, technical, and clerical	2.1	3.0	1.7	2.3	1.3	2.1	3.1	3.4	2.1	3.8	
Carpenters Painters Bricklayers Plumbers Cement finishers Electricians Plasterers Sheet-metal workers Roofers Operating engineers Tile setters Soft floor layers All other skilled workers ¹ Helpers and tenders	24.9 6.9 3.9 3.8 2.8 2.0 1.4 1.3 1.0 1.0 7 .6 2.4 10.7 6.1	34.6 9.5 5.5 5.2 3.9 2.8 2.0 1.8 1.4 1.4 1.0 .8 3.3 14.8 8.5	22.9 7.4 4.5 4.4 3.4 2.0 1.4 1.2 1.3 1.5 .9 .5 1.5 1.2 7.3	$\begin{array}{c} 31.2 \\ 10.1 \\ 6.2 \\ 6.0 \\ 4.6 \\ 2.7 \\ 1.9 \\ 1.6 \\ 1.8 \\ 2.1 \\ 1.3 \\ .7 \\ 2.1 \\ 15.2 \\ 10.0 \end{array}$	$\begin{array}{c} 24.7\\ 4.9\\ 3.4\\ 4.0\\ 3.9\\ 2.0\\ .4\\ 2.0\\ .7\\ 1.2\\ .5\\ .6\\ 2.4\\ 7.0\\ 2.2\end{array}$	40.2 8.0 5.6 6.5 3.3 .7 3.2 1.2 1.9 .8 1.0 3.9 11.3 3.6	29.1 8.6 5.4 2.4 2.1 2.2 .9 .8 .8 .8 .5 2.9 17.0 11.3	31.8 9.4 6.0 3.6 2.6 2.3 2.4 1.0 .8 .8 .9 .5 3.1 18.6 12.4	$\begin{array}{c} 21.3\\ 6.2\\ 2.0\\ 3.6\\ 1.8\\ 1.9\\ 1.4\\ 1.3\\ 1.5\\ .8\\ .6\\ .8\\ 2.3\\ 6.0\\ 2.4\end{array}$	$\begin{array}{c} 37.6\\ 11.0\\ 3.6\\ 6.3\\ 3.2\\ 3.4\\ 2.5\\ 2.4\\ 2.6\\ 1.4\\ 1.0\\ 1.4\\ 4.1\\ 10.6\\ 4.2 \end{array}$	

Table 5. On-Site Man-Hour Requirements per \$1,000 of Construction Price for Surveyed Private One-Family Houses, by Occupation and Region, 1962

¹Includes lathers, terrazzo workers, sheet rock installers and finishers, insulators, glaziers, and ironworkers.

Note: Because of rounding, sums of individual items may not add to totals.

With wood used so extensively to frame, cover (whole or in part), floor, and trim one-family houses, it is not difficult to appreciate the reason for the importance of carpenters. Moreover, carpenters are used in many areas to install drywall interiors and to perform other tasks. With the use of paint indicated on some part or all of the exteriors and interiors for all the sample houses, the importance of the painters is also readily understood.

Variations from region to region in ratios of man-hours worked by different trades reflect differences in regional design and construction needs as well as work practices. The proportion of bricklayers used in each of the regions appears to reflect the previously noted substantially greater use of masonry exteriors in the South and the Northeast, as compared with the West, and, to a lesser degree, the North Central region. The considerably lower proportion of plasterers in the North Central region than in the other regions appears to be related to the more extensive use of substantially prefabricated or package homes in that region. This would also account for the higher percentage of carpenters' hours in the same region, reflecting an increased use of these journeymen in assembling such homes. The higher proportion of plasterers used in the West and South than in either the Northeast or North Central regions reflects the presence of the stucco houses in the former. The extensive use of drywall interiors obviously had its impact on the extent of plasterer man-hours used in all the regions.

In the matter of work practices, a number of factors affect the regional distribution by occupation, apart from the construction requirements. For example, organization of work crews and job classification may be affected by the relative participation of local unions. Local custom may influence the opportunity of union membership and journeyman jobs for minority groups. Finally, local availability of lower paid labor may affect the extent to which laborsaving construction methods or equipment are employed.

These factors particularly influence the division between skilled and unskilled workers. In the South, unskilled and semiskilled employees accounted for 31 percent of the man-hours, compared with 16 percent in the West; the percentages for skilled trades were 65 and 81 percent, respectively.

Builder or General and Special Trade Contractors' Share

Employees of the builder (or developer or general contractor) and four special trade contractors, <u>Carpentry</u>, <u>Plumbing and Heating</u>, <u>Painting</u>, and <u>Masonry</u>, accounted for 76 percent of the total man-hours required for the construction of all the houses surveyed. (See table 6.) The builders' share, averaging 46 percent of all the projects, was highest in the South (53 percent). In the South, the builders assumed a large share of the construction duties, thereby limiting the subcontracting need. With over 80 percent of the prefabricated or package houses studied located in the North Central region, the 50.6 percent on-site man-hour share of the builders reflects a lesser dependence on subcontracting due to the amount of work performed off-site by the manufacturers of such houses. In the Northeast and West, the

Type of contractor	United States	Northeast	North Central	South	West
All types	100.0	100.0	100.0	100.0	100.0
General Carpentry Plumbing and heating Painting Masonry Concrete work Electrical Plastering and lathing Roofing and sheetmetal Tile and terrazzo work Excavation Wood flooring Other flooring All other types	$\begin{array}{r} 45.6\\ 9.4\\ 8.6\\ 6.6\\ 5.6\\ 4.2\\ 2.8\\ 2.6\\ 2.0\\ 1.6\\ 1.6\\ 1.2\\ .8\\ 7.5\end{array}$	32.4 15.8 8.5 7.4 5.7 5.0 2.8 3.5 3.2 1.3 3.2 1.9 .5 8.8	50.6 3.5 10.1 6.6 6.7 5.1 3.3 1.1 .9 .7 2.4 .9 1.0 7.0	53.0 9.5 7.5 5.2 2.4 2.4 2.8 1.5 2.3 .4 .9 .5 6.0	38.6 9.0 9.4 7.7 5.1 6.1 3.3 2.7 2.8 1.8 1.4 1.3 1.3 9.6

Table 6. Percent of Total On-Site Man-Hour Requirements for Surveyed Private One-Family Houses, by Type of Contractor and Region, 1962

Note: Because of rounding, sums of individual items may not add to 100.

builders used more special trades contractors. Thus, on-site man-hour percentages for each of the contractor categories, by region, are affected by the extent to which the builder performed any of the operations or purchased prefabricated components which substantially lessened the need for the on-site performance of such operations.

The average number of contractors for each house studied was 14. (See table 7.)

Construction Time

Average construction time required for the one-family houses surveyed was about 15 weeks. (See table 8.) One substantially prefabricated home took 1 week to build and be made ready for the prospective buyer. Another house, which encountered a number of construction delays took 31 weeks to build. For most of the houses, however, construction time ranged from 10 to 20 weeks, and this is reflected in the relative closeness of the averages by region. The average for the North Central region, the lowest at 13 weeks of construction time, indicates the influence of the prefabricated houses in that region.

The Cost of Direct Wages⁸

Wage payments to on-site labor averaged 22.1 percent of the total construction price. (See table 9.) The percentage reflects the combined effect of man-hour requirements and wage rates for individual houses. For the individual houses, the percentage ranged from 14.3 to 32.5. Generally, when considered by cost class, the percentage rose as the construction price of the houses rose.

There was substantial variation among the houses studied, in the ratio of on-site wages to total construction price. The range of wages as a percent of construction price and the average wage rate, by range, for all the houses studied was as follows:

Percent on-site wages were of construction price	Average wage rate	Percent of houses studied
15.0 and under	\$2.52	3.0
15. 1 to 20.0	3.05	31.7
20.1 to 25.0	3.03	45.5
25.1 to 30.0	3.22	16.8
30.1 and over	3.08	3.0

⁸For this study, "direct wages" were computed by multiplying the hours worked by the hourly wage rate. This was necessary in order to obtain information for the specific sample houses studied. Excluded are vacation and holiday pay or other labor costs such as employer contributions to social security, unemployment insurance, workmen's compensation, and nongovernmental employee welfare and pension funds.

Cost group	United States	Northeast	North Central	South	West
All groups	14	16	11	12	19
<pre>\$ 18,000 and over \$ 15,000-\$17,999 \$ 12,000-\$ 14,999 Under \$ 12,000</pre>	15 15 15 12	17 17 17 14	12 13 10 9	13 12 12 11	19 21 20 17

Table 7. Average Number of Contractors per Private One-Family House,by Cost Group and Region, 1962

Table 8. Average Number of Weeks Required for Construction of SurveyedPrivate One-Family Houses, by Cost Group and Region, 1962

Cost group	United States	Northeast	North Central	South	West
All groups	15	15	13	16	17
\$18,000 and over \$15,000-\$17,999 \$12,000-\$14,999 Under \$12,000	16 16 15 14	17 16 16 11	13 18 10 12	17 13 20 14	16 20 15 19

	United States		Northeast		North Central		South		West	
Area	Average hourly wage	Wages as percent of construc- tion price								
All houses	\$3.07	22.1	\$3.21	23.6	\$3.42	21.0	\$2.35	21.5	\$4.05	23.0
In a metropolitan area In a nonmetro- politan area	\$3.14 2.85	22.0 22.9	\$3.22 3.11	24.0 21.0	\$3.54 3.00	21.1 20.4	\$ 2. 37 2. 30	20.8 23.9	\$4.06 3.99	22.5 25.7

Table 9. Average On-Site Straight-Time Hourly Earnings and Wages as a Percent of Construction Price on Surveyed Private One-Family Houses, by Region and Metropolitan or Nonmetropolitan Location, 1962

Off-Site Employment

For each man-hour of employment performed on the construction sites, an additional 1.8 man-hours were required to produce and distribute the necessary construction materials, supplies, and equipment used in construction and to perform those functions associated with the selling costs of one-family houses. These projects, thus, gave rise to 132 man-hours of such off-site employment per \$1,000 of construction price, compared with 72 hours on-site.

Off-site employment is generated in many places, but can be classified in the following categories:

1. Construction industry--off-site: Administrative, estimating, and warehousing functions.

2. Manufacturing activities producing raw materials, fabricated materials, and equipment.

3. Transportation, warehousing, and distribution of fabricated and raw materials and equipment and all other related service industries, including real estate.

4. All other industries directly or indirectly affected by the production of fabricated and raw materials. Various interindustry transactions eventually affect all additional industries such as agriculture, forestry, and mining.

There are, of course, other people affected in types of employment which this study did not attempt to cover. Some of these are mentioned on page 3. Of the workers omitted, the most numerically important groups, who would be directly affected by construction of one-family houses, were employees in utility companies and local governments. These employees and their functions were excluded from the man-hour estimates. A large area of employment also excluded from the calculations of man-hour effects, as mentioned earlier, is that created by the respending and investing of wages and profits arising in various areas of economic activity as a result of construction expenditures.

Although the ratio of on-site to off-site employment requirements is commonly used in analyzing employment requirements in the construction industry, another type of distinction based upon the economic relations of the labor generating areas is also useful. Therefore, employment requirements have also been divided into primary and secondary man-hour needs. As shown in the following tabulation and chart 1, the primary man-hour requirements, estimated at 157, arise in the activities at the site and those most directly related to the construction activity. Included in these, in addition to on-site employment, are off-site construction employment, employees of manufacturing industries represented at the "last stage of manufacturing" for materials prior to shipment to the site, employees in transportation, trade, and service organizations dealing in materials used at the site, and employees in other related service industries.

Secondary man-hour requirements have been defined as those associated with all other requirements indirectly related to the needs at the site. Such activities totaling 47 hours or 23 percent of total man-hour requirements affect all parts of the economy as the impact of primary activity is reflected in demand for basic materials and related transportation, trade, and services. The following tabulation shows man-hours of employment associated with \$1,000 of one-family house construction.

	Total	Primary activities	Secondary activities
All industry groups	204	157	47
Construction	84	84	
On-site	72	72	
Off-site	12	12	
Manufacturing	58	38	20
Transportation, trade, and service	49	35	14
Other	13		13

Some industries are represented in both the primary and secondary sectors. For example, the flat glass industry furnishes material directly to the construction industry and also to the metal or wood window frame and sash industries which in turn sell preglazed window frames to the construction industry.

Builders' Off-Site Employment

An exact study of off-site employment of contractors was not attempted, since it was impossible to relate accurately such employment to the houses being studied. Builders' off-site employment was occupied not only with the projects studied but also with other current or future projects of the builders.

The estimate of 12 man-hours of such work for each \$1,000 of construction price is based on the difference between construction worker employment and total employment in the contract construction industry.⁹

⁹Administrative, engineering, estimating, and clerical workers accounted for about 14 percent of total employment in the construction industry. About one-fourth of this employment was involved at the site.

Combining this employment with on-site employment results in an estimate of 84 hours of employment in the construction industry for each \$1,000 of one-family house construction.

Employment in Transportation, Trade, and Service

Distribution of construction materials from the producing industries requires employment of workers in the transportation, warehousing, trade, and service industries. The estimate of 35 hours of primary employment per \$1,000 of construction price includes labor time based on the difference between producer's value and delivered value of materials used at the site. This covers the distribution of materials from the producers to construction site but does not include the distribution of materials among industries prior to shipment of the completed products. In addition, the estimate includes labor generated by selling and other overhead costs.

"Last Manufacturing Stage" Employment

The sector of the economy most affected by one-family house construction, other than the construction industry, is manufacturing. An estimated 38 man-hours were required for each \$1,000 of construction price for production of construction materials used in the building of onefamily houses. This estimate includes the employment required in the last manufacturing process of the materials and that created by expenditures for overhead cost.¹⁰ Employment generated by these activities is distributed in many industries directly affected by construction work. For example, it includes sawmills cutting rough lumber for forms, and establishments making millwork items from lumber, but does not include employment in sawmills producing lumber for millwork products. The latter is included in the estimate of secondary employment discussed below.

Employment in Secondary Activities

In addition to the 38 man-hours previously noted for primary employment for each \$1,000 of construction price, an additional 20 hours were required in secondary manufacturing activities.

Transportation, trade, and service industries as a group required 14 hours of employment for each \$1,000 of one-family house construction price to meet the needs of secondary business activity.

Other activities, primarily agriculture, forestry, and mining accounted for the remaining 13 hours of secondary manpower requirements.

¹⁰Included in the bill of materials were the supplies and the expended value of the equipment used by builders and other construction contractors.

Materials Used

Costs of materials represented 48.2 percent of the total construction price of all the houses surveyed. This includes depreciation charges or rental costs for construction equipment used and the small amounts of supplies consumed, in addition to the materials incorporated in the houses. It also includes distribution costs and represents materials cost delivered to the site. The majority of the houses were within 5 percent of the overall average for materials costs:

Percent materials cost of total construction price	Percent of houses			
Under 40	9			
40 to 44	22			
45 to 49	33			
50 to 54	22			
55 to 59	8			
60 and over	6			

Table 10 presents the costs of major materials and groups of materials used in each \$1,000 of construction price for all the houses studied, by region. The groups and the items within the groups are ranked by amounts spent for the products, on all the houses. Although the table presents the costs of materials in terms of their dollar value, the individual items may readily be reduced to the familiar magnitudes of percentages. Thus, the sum of \$115.30 shown for the United States under stone, clay, and glass products would be 11.5 percent of the construction price.

The most important broad materials category, lumber and lumber products, accounted for about 19 percent of the total construction price of all the houses studied.¹¹ Within the category, rough and dressed lumber represented 40 percent, millwork, 27 percent, and prefabricated or package houses, 17 percent.

The largest single item among stone, clay, and glass products, the next most important broad materials group, was ready-mixed concrete, which comprised one-third of the group.

¹¹Each percent of the total construction price represents about \$140 million of annual expenditures at the current (1962) annual rate of new private nonfarm one-family house construction (e.g., \$2.7 billion of lumber products, including prefabricated or package houses is represented by the 19.3 percent).

Table 10.	Cost of Material	Components for Each	\$1,000 of Construction	Price of Survey	ed Private One-Fami	ly Houses, b	y Region,	1962
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	United States		Northeast		North Central		South		West	
Selected products and product groups	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting
All products ¹	\$482.20	100	\$504.00	100	\$501.60	100	\$496.10	100	\$427.80	100
Lumber and lumber products Rough and dressed lumber Millwork Prefabricated or package houses Plywood Flooring Fabricated laminates, roof trusses Wood shingles	\$193.10 77.40 51.30 32.70 11.40 9.10 8.10 3.10	100 94 95 11 70 62 31 14	\$ 206.00 85.30 67.50 14.80 16.00 15.50 2.70 4.30	100 100 6 89 100 11 28	$\begin{array}{c} \$ 255.30 \\ 52.30 \\ 40.70 \\ 112.60 \\ 8.30 \\ 7.00 \\ 4.50 \\ (2/) \end{array}$	$ \begin{array}{r} 100\\ 71\\ 75\\ 38\\ 54\\ 54\\ 21\\ (\underline{2}/) \end{array} $	\$183.40 80.90 57.80 7.30 15.30 8.90 13.20 (2/)	100 94 97 3 79 59 41 (<u>2</u> /)	\$163.10 91.50 40.40 (2/) 6.00 6.30 9.70 9.30	$ \begin{array}{c} 100\\ 100\\ (2/)\\ 60\\ 48\\ 44\\ 36 \end{array} $
Stone, clay, and glass products Cement, concrete, and gypsum products Ready-mix concrete Gypsum products Concrete block and brick Cement Precast concrete products Lime Concrete pipe	115.30 76.40 38.20 19.60 9.00 5.30 2.90 .90 .40	100 100 100 96 51 99 41 64 10 10 10 10 10 10 10 10 10 10 10	120.20 78.90 38.00 19.00 8.50 5.40 6.60 .80 .50	100 100 100 56 100 78 78 6	109.00 75.30 41.70 16.20 9.00 4.40 2.70 .80 .60	100 100 88 54 100 46 21 17	127.80 81.20 37.00 19.80 14.50 5.90 2.00 1.50 .50	100 100 97 71 97 21 91 15	101.90 69.30 36.50 23.10 2.50 5.60 1.40 .30 (2/)	$ \begin{array}{r} 100 \\ 100 \\ 100 \\ 20 \\ 100 \\ 36 \\ 60 \\ (2/) \end{array} $
Structural clay products Brick Ceramic tile Clay sewer pipe and draintile	19.70 12.20 5.60 1.90	98 73 83 61	19.90 11.20 7.40 1.30	100 78 100 44	16.80 10.50 3.30 3.00	96 58 67 88	26.80 18.60 6.70 1.40	100 76 88 35	13.30 6.70 4.80 1.80	96 80 80 84
Other stone, clay, and glass products Sand and gravel Fiber glass insulation Asphalt tile Vinyl and vinyl asbestos tile Marble and other cut stone Window glass Crushed rock and aggregate Glass doors and enclosures Mirrors	19.30 3.80 3.50 2.30 1.40 1.40 1.20 .90 .80	100 93 85 61 56 32 19 32 21 10	$ \begin{array}{c} 21.50\\ 3.40\\ 6.40\\ 2.60\\ 1.80\\ 1.30\\ 2.50\\ 3.20\\ .40\\ (\underline{2}/) \end{array} $	$ \begin{array}{c c} 100 \\ 94 \\ 94 \\ 72 \\ 33 \\ 44 \\ 11 \\ 78 \\ 17 \\ (\underline{2}/) \end{array} $	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c} 100\\ 92\\ 71\\ 71\\ 46\\ 21\\ 12\\ 33\\ (2/)\\ 12 \end{array} $	19.80 5.60 3.00 1.50 2.50 2.00 1.10 .70 1.40 1.30	100 97 91 26 56 35 18 18 21 6	19.30 2.90 2.60 5.50 2.60 1.40 .90 .30 1.70 1.00	100 88 84 92 36 28 32 17 40 20

See footnotes at end of table.

Table 10. Cost of Material Components for Each \$1,000 of Construction Price of Surveyed Private One-Family Houses, by Region, 1962 -- Continued

	United States		Northeast		North Central		South		West	
Selected products and product groups	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting
Metal products (except plumbing and heating)	\$ 52, 80	100	\$49.40	100	\$48.00	100	\$56.60	100	\$55.30	100
Fabricated metal products	34.80	100	27.10	100	31.30	100	40.50	100	37.30	100
Metal windows	11.70	76	11.90	72	10.30	62	11.30	74	13.50	96
Builders hardware	7.20	92	6.70	100	5.30	79	7.70	91	8.60	100
Expricated sheetmetal products	5.80	91	3, 10	78	5.00	88	8.10	94	5.90	100
Reinforcing bars rods etc	2 70	50	. 90	17	2,10	29	4.30	68	2.90	68
Metal doors frames accessories	2.70	44	1.60	28	3, 20	33	2.60	44	3.20	64
Structural steel	2.00	35	. 70	22	4.50	67	2.10	35	.60	12
Wire mesh	1.40	52	. 40	33	. 20	8	2.30	76	2.20	76
Ornamental metal	1.30	37	1.90	39	.60	17	2.20	59	.40	24
Other metal products	17.90	97	22.30	100	16.70	100	16.10	100	18.00	100
Copper	7.80	95	11.00	100	7,10	96	7.40	94	6.50	92
Nails	4.80	95	4.60	100	3.90	83	5.60	97	4.80	100
Galvanized sheet metal	2,90	67	4.20	78	2.90	67	1.70	59	3.40	72
Aluminum sheet metal	1.40	40	1.90	39	2.30	25	. 70	41	1.10	52
Plumbing products	26.80	100	22.00	100	25.80	100	31.10	100	26.00	100
Fixtures	14.60	100	12.40	100	15.00	100	16.60	100	13.40	100
Cast iron pipe	5.30	93	3.90	83	3.90	83	6.90	100	5.80	100
Valves and specialties	4.30	100	4.40	100	3.90	100	4.30	100	4.80	100
Steel and galvanized pipe	2.20	90	1.40	83	2.70	92	2.80	91	1.70	92
Heating and ventilating equipment	19.60	100	26.80	100	20.80	100	20.40	100	11.40	100
Radiators, boilers, hot water heaters	6.80	85	14.30	94	5.80	79	6.00	91	2.90	76
Warm air furnaces	6.60	71	5.80	50	8.00	83	5.70	59	6.80	92
Oil burners ³	1.60	10	3.40	22	.80	4	2.00	12	.60	4
Electric heaters	1.10	10	(2/)	(2/)	.50	4	3.00	24	(2/)	(2/)
Blowers and exhaust fans	.90	36	T.00	50	1.10	38	. 70	21	80	44
Air conditioning equipment ³	.80	3	(2/)	(2/)	1.20	4	1.50	6	(2/)	(2/)
Pumps	.50	8	70	-6	1.50	25	(2/)	(2/)	$(\overline{2}/)$	(2/)
Unit heater and ventilators	.50	8	(2/)	(2/)	1.00	21	50	-6	20	-4
Electrical equipment, fixtures, and wire	16.50	100	13.20	100	17.90	100	16.70	100	17.70	100
Lighting fixtures	4.70	100	3.80	100	5.60	100	4.90	100	4.30	100
Wire and cable	4.60	100	3.20	100	4.90	100	5.40	100	4.50	100
Switchboard and panels	3.60	100	2.80	100	3.90	100	3.20	100	4.40	100
Current carrying wiring devices	1.60	100	1.30	100	1.70	100	1.50	100	1.90	100
Noncurrent carrying devices	1.30	100	1.10	100	1.20	1 100	1.30	100	1.40	100

See footnotes at end of table.

Table 10. Cost of Material Components for Each \$1,000 of Construction Price of Surveyed Private One-Family Houses, by Region, 1962 -- Continued

	United	l States	North	least	North	North Central		South		West	
Selected products and product groups	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting	Cost	Percent of units reporting	
Fixed house equipment Ovens and ranges Refrigerators Other kitchen appliances	\$13.70 9.10 1.40 2.90	72 65 10 34	\$10.80 7.20 (2/) 3.50	78 67 (2/) 39	\$ 14.40 9.30 2.70 2.20	58 54 8 29	\$14.10 10.10 2.30 1.50	71 68 21 18	\$14.90 9.40 .20 4.90	80 72 4 48	
Petroleum products Asphalt shingles Asphalt felt Asphalt paving Oil and fuel Asphalt and tar pitches	11.10 7.40 1.30 1.10 .70 .60	100 67 59 25 85 32	13.20 8.30 .20 3.50 1.20 (<u>2</u> /)	$ \begin{array}{c} 100 \\ 94 \\ 22 \\ 61 \\ 100 \\ (\underline{2}/) \end{array} $	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	100 79 42 (2/) 75 25	11.90 8.30 1.90 .50 .50 .70	100 68 79 9 76 29	9.30 4.90 1.90 1.20 .70 .80	100 36 96 40 80 56	
Paints and other chemicals Paints Adhesives Putty and caulking compounds	10.30 8.50 .90 .30	100 97 97 49	7.90 6.70 .80 .20	100 94 100 28	9.30 7.50 1.10 .40	100 100 96 54	11.70 9.50 .80 .50	100 97 100 71	11.30 9.50 1.00 (2/)	100 96 92 (2/)	
Construction equipment (depreciation) Tractors and bulldozers Power cranes, backhoes, and shovels Trucks Scrapers, graders, and rollers Small construction equipment Trenchers	9.80 2.90 2.30 1.90 .90 .70 .70	91 64 50 55 34 40 35	16.00 4.80 5.50 1.20 3.10 (2/) .80	100 89 83 39 72 (2/) 22	7.40 2.20 2.00 .80 .30 1.00 .70	83 62 62 38 8 21 33	8.00 3.00 1.40 1.90 .30 .60 .70	85 44 24 59 18 41 26	9.40 1.90 1.30 3.30 .50 1.10 .50	100 76 52 80 52 72 56	
All other categories . Nursery products . Laminated plastics Asbestos shingles . Lead . Carpet . Wallpaper . Construction papers . Polyethylene plastic . Oakum . Insulating board . Nonmetallic pipe	$ \begin{vmatrix} 13.30\\3.50\\2.60\\2.20\\1.10\\1.00\\.80\\.40\\.40\\.30\\.30\\.30 \end{vmatrix} $	100 65 53 16 99 7 25 59 23 23 98 5 8	18.50 4.20 2.00 7.30 1.10 (2/) 2.30 (2/) .40 (2/) .20	$ \begin{array}{c} 100\\ 83\\ 39\\ 56\\ 100\\ (2/)\\ 44\\ 50\\ (2/)\\ 100\\ (2/)\\ 17\\ \end{array} $	$ \begin{vmatrix} 13.60\\ 3.80\\ 2.20\\ 1.60\\ .90\\ 1.30\\ .60\\ .70\\ .40\\ .90\\ .60 \end{vmatrix} $	$ \begin{array}{r} 100 \\ 67 \\ 12 \\ 100 \\ 8 \\ 17 \\ 46 \\ 29 \\ 96 \\ 8 \\ 4 \end{array} $	$\begin{array}{c} 14.40 \\ 5.00 \\ 3.40 \\ 1.10 \\ 1.60 \\ .30 \\ .20 \\ .50 \\ (2/) \\ (\underline{2}/) \end{array}$	$ \begin{array}{c} 100\\ 76\\ 41\\ 9\\ 100\\ 12\\ 15\\ 53\\ 12\\ 100\\ (2/)\\ (\underline{2}/)\\ (\underline{2}/) \end{array} $	$\begin{array}{c} 7.50 \\ .70 \\ 2.30 \\ (2/) \\ .70 \\ .60 \\ .50 \\ .60 \\ .60 \\ .30 \\ .20 \\ (\underline{2}/) \end{array}$	$ \begin{array}{c} 100\\ 36\\ 68\\ (2/)\\ 96\\ 4\\ 32\\ 88\\ 40\\ 96\\ 8\\ (2/) \end{array} $	

¹In general, the classification of materials was directed toward industry classification rather than product classification. ²Amount less than 15 cents or could not be separated from other items. ³In some homes, air conditioning was an integral part of the heating unit and is included with the value of the heating unit.

Note: Group totals include products not shown separately. Because of this and rounding, sums of components may not add to totals.

Metal products made up 5.3 percent of the construction price. Fabricated metal products accounted for two-thirds of this group. Metal windows; doors, frames, and accessories; and builders' hardware represented about 62 percent of the fabricated metal products. The broad group does not represent the total contribution of the metalworking industries, since it excludes the metal products shown separately in the equipment categories.

Plumbing products totalled almost 3 percent of the total construction price; heating and ventilating equipment, including air conditioning equipment, 2 percent. The duct materials required for air-exchange throughout a house were excluded from the latter equipment group. They are included in fabricated sheet metal products or in galvanized sheet metal under the other metal products category. Electrical equipment, fixtures, and wire used a little less than 2 percent.

Materials requirements varied somewhat by geographic area, reflecting differences arising from local preferences in house design and characteristics, and for certain materials. For example, in the North Central region, the average cost of lumber and lumber products per \$1,000 of construction price was higher than that for the United States and any of the other three regions. This was due to the substantially greater usage of prefabricated or package houses than in the other regions. While included in the lumber and lumber products grouping, on an industry basis, this materials component includes the cost of material items which are not made of lumber. The much higher cost per \$1,000 for brick in the South reflects the predominance of exterior walls of masonry in that region. However, despite some regional differences in materials requirements, a relative uniformity of materials costs and component composition is indicated for one-family house construction.

The overall averages on material requirements may not fully reflect industry practices in the purchase and use of building materials assembled off-site. For example, expenditures for rough and dressed lumber do not include such materials consumed in substantially prefabricated or package houses. Similarly, expenditures for window glass do not include glass in purchased preglazed windows. This results from the fact that materials were generally classified on an industry rather than a product basis. The averages are also affected by variation of local practices in providing installed appliances which are included in the construction price. Electric refrigerators were installed in relatively few homes as part of the price. Only a few homes had air-conditioning and some of these had combination heating and cooling units. The averages, therefore, do not represent typical expenditures, for any particular home, of all the items listed.

APPENDIX A. Scope and Method of Survey

This study was designed to develop estimates of man-hour requirements associated with the construction of private, nonfarm, new one-family houses. Project data obtained from or relating to activity at the construction site, as well as information based on secondary data such as the Census of Manufactures, were utilized.

Characteristics of the Universe and Selection of the Sample

The selection of the sample for this study was in two distinct parts:

First, the number and value of the houses to be surveyed in each area was determined on the basis of Bureau of the Census data.

Second, the specific houses to be studied in each area were selected from FHA records.

The methods and sources used in each step were as follows:

The basic source of the universe for the study was Bureau of the Census construction reports¹² containing a summary of residential building permit area data for the year 1960. These reports provided the means for selection of a sample of projects by location (four geographic regions,¹³ by State, and locality) and by presence in a metropolitan or nonmetropolitan area as controlling factors. The sample ratio was approximately 1 out of each 7,400 private one-family dwelling units. Selection was made separately in metropolitan and nonmetropolitan areas by starting with a random number and counting to the sample area. One hundred and one units or house projects

¹²Bureau of the Census, <u>Construction Reports</u>, <u>Building Permits</u>, <u>New Housing Units Authorized by Local Building Permits</u>, <u>Annual Summary</u>, <u>1959-60</u>, <u>C 40-28</u>, <u>October 1961</u>, and <u>Construction Reports</u>, <u>Building Per-</u> <u>mits</u>, <u>New Residential Construction Authorized in Permit-Issuing Places</u>, <u>Calender year 1960</u>, <u>C 42-14</u>, <u>August 1961</u>.

¹³The States included in each of the regions were as follows: Northeast--Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; North Central--Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; South--Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; and West--Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

were selected for the sample. The selected sample units were then assigned sales price ranges on the basis of unpublished data furnished by the Bureau of the Census showing price class distribution by region and metropolitan and nonmetropolitan area.

Final selection of the specific or actual houses to be studied in the sample areas were made by Bureau of Labor Statistics field representatives from records made available in the various regional offices of the FHA. The field representatives, provided with location, area, and sales price range information for each of the projects in their regions, called upon FHA officials at the local offices and obtained assistance in locating the most recently completed one-family house meeting the sample criteria, from the records. Alternate projects were selected in like fashion, to allow for required substitutions at the field data collection stage, in the event of inadequate data or lack of cooperation from the respondents of the originally selected projects. A substantial amount of project characteristics and cost data were also made available from FHA records.

Selection of the "most recently completed house" from FHA records made possible the coverage of houses built during the different seasons.of the year, as the field representatives proceeded with data collection which extended over the period of a little more than one year.

Use of FHA records for sample project selections arose from the need for a source of unbiased and relatively constant valuation data. It is believed that these records provided such a source. Their use resulted, with few exceptions, in the study of sample project houses either appraised for valuation purposes or mortgage insured by FHA.

Although construction of the projects studied extended over a period of less than 1-1/2 years, most of the construction took place during the calendar year 1962.

Man-Hour Estimates

The customary presentation of employment data for construction projects includes estimates for on-site and off-site employment. Such a presentation is followed by this study. In addition, however, there is an economic distinction which can be made in analyzing man-hour requirements for construction. The basic grouping in this instance would be the primary and secondary labor effects of construction expenditures.

Primary man-hour requirements, for purposes of this report, include, in addition to all on-site labor, the builder's or construction contractor's office employment and the labor required in those manufacturing industries which fabricate the construction materials used on the site-that is, the "last stage of manufacturing" plus all trade, distribution, and services involved in placing the construction materials at the site. They also include the "selling" employment (salesmen and real estate office clerical employees) generated by real estate sales commissions.

Secondary employment includes all other labor requirements necessary to produce and transport the raw materials and semifinished products to the factories which finally produce the items used at the site. For this study of one-family houses, it also includes the indirect employment arising from such selling costs as newspaper and billboard advertising.

On-Site Man-Hours

On-site labor requirements data for the construction of the new onefamily houses in this study were obtained by field representatives from builders (owners, developers, brokers), architects, contractors, and other direct participants in the projects. Information for on-site man-hours and occupational wage rate data were generally derived from payroll or labor cost records, or daily work force reports. Only summary man-hour results, by occupation and wage rate, were requested. For some contractors whose records could not be used to isolate the data for specific house projects, estimated hours and materials costs were substituted. The selfemployed contractor-journeymen on the projects also provided estimates of their hours at the site in the absence of adequate records for the purpose.

Off-Site Man-Hours

From the builders, contractors, and subcontractors cooperating in the study, a list was obtained of the value of each type of material used in the sample house projects. These material listings were classified into categories consistent with 4-digit <u>Census of Manufactures</u> product groups. For each of these product groups, the average amount used per \$1,000 of construction price was determined. Once the average use was calculated, each figure was reduced by a specific ratio to determine the difference between valuation by the purchaser and valuation by the producer.¹⁴ Since all data reported by the builders or contractors were in purchasers' value, reduction to producers' value made the figures consistent with Census data published on these various components.

Primary Distribution Industries Employment

Primary man-hours in the trade, transportation, and service industries were estimated from the difference between producer and purchaser value for each construction material. The value differences were allotted

¹⁴This ratio is based on data provided by U.S. Department of Commerce, Office of Business Economics.

to trade and transportation, and primary man-hours for each component of transportation and trade were then estimated from labor factors included in the 200-order interindustry analysis.

Primary Manufacturing Employment

Primary employment in manufacturing was considered to be that required to produce items in the construction bill of materials in their final stage of fabrication. In this stage, man-hours resulting from private one-family house construction were developed by multiplying average value of each construction component by a ratio of manufacturing manhours to \$1,000 of production.¹⁵

Secondary Employment in All Industries

Secondary employment is defined as employment in all industries involved in production and transportation of building materials and equipment, from basic extraction to, but not including, the final manufacturing stage.

To calculate all secondary man-hours involved in construction materials and equipment, a 200-interindustry system of classification was used. The 200-order was adjusted to 1960 prices and productivity levels.¹⁶ The 200-order interindustry system is also constructed on a six-sector determination of associated employment needed to produce a given bill of goods. Each of the six sectors--agriculture, mining, manufacturing, transportation, trade, and all other--has an individual employment factor for each product group. By multiplying the value of each component by the six individual employment factors, it was possible to determine employment required in agriculture, mining, and the other sectors to produce each given material. Price and productivity adjustments were made to arrive at data for the year consistent with the bill of materials.

Total Man-Hour Requirements

From each off-site stage (primary distribution, primary manufacturing, and secondary industry), man-hours per \$1,000 of private onefamily housing construction were obtained. When these were combined

¹⁵This ratio was established by using the 1961 <u>Survey of Manufactures</u> adjusted for price and productivity change to provide comparable 1962 data.

¹⁶While updated to reflect 1960 prices and productivity, the secondary man-hours were estimated on the basis of the 1947 interindustry relationships study made by the Bureau. See W. Duane Evans and Marvin Hoffenberg, "Interindustry Relations Study for 1947," <u>Review of Economics and</u> Statistics, Vol. XXXIV (1952), Cambridge, Mass.

with direct or on-site man-hours, the total employment effect, within the definition used by the study, was determined. However, procedures used in estimating employment generated by private one-family housing construction did not include all such employment. The technique used for the off-site segment covers only employment generated by direct purchases of materials and supplies and that implicit in depreciation of construction equipment. The following areas of employment related to volume of construction activity were not covered: (1) Inspection by government employees during construction; (2) labor time involved in installations by public utility employees; (3) labor generated by money expended by builders and contractors for taxes (including payroll taxes) and welfare payments; (4) the "multiplier" effect of respending of wages and profits; and (5) the construction and equipment of new production facilities, if needed to supply construction materials.