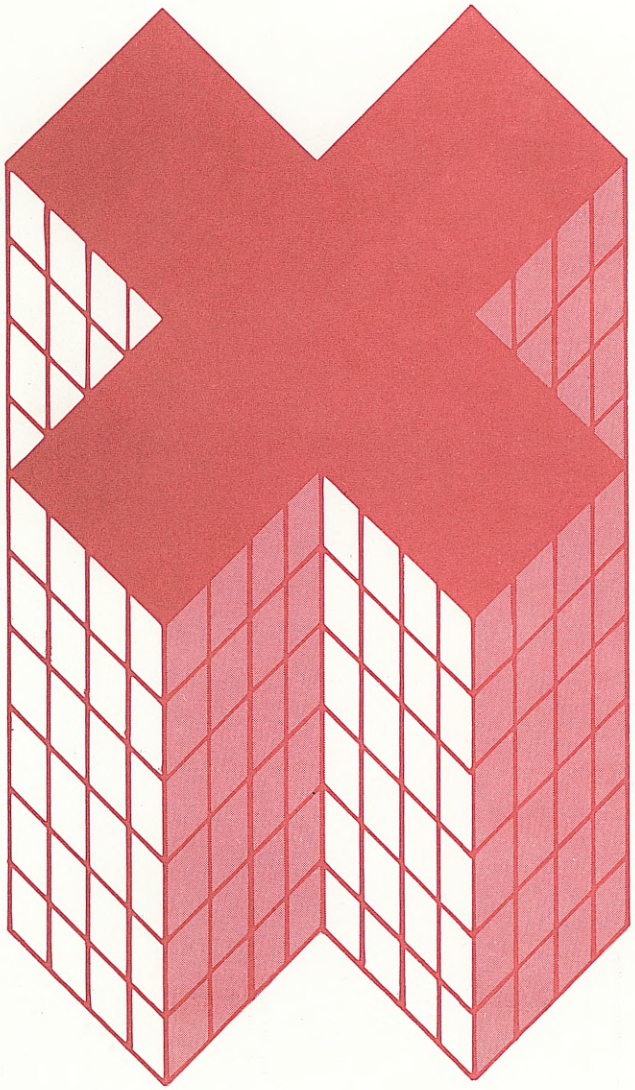
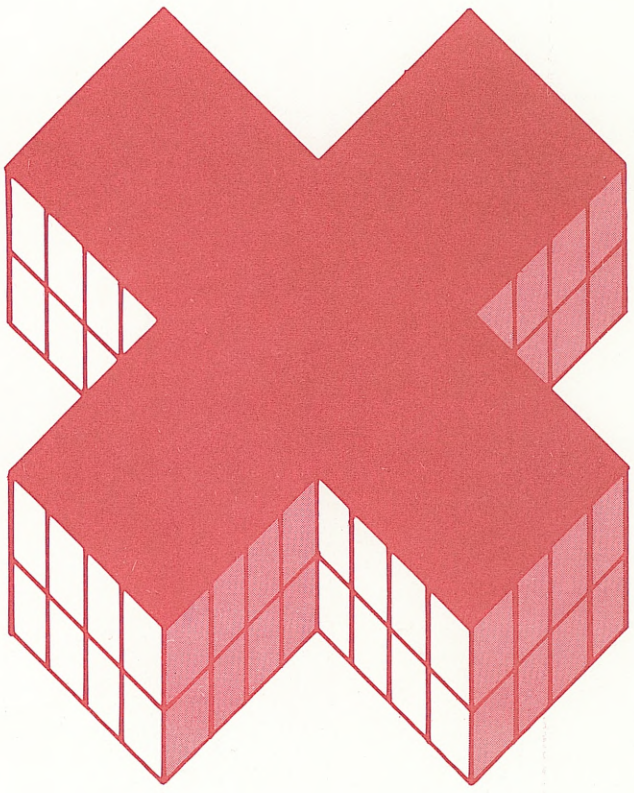
Labor and Material Requirements for Hospital and Nursing Home Construction

U.S. Department of Labor
Bureau of Labor Statistics
January 1983

Bulletin 2154





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U.S. Department of Labor
Raymond J. Donovan, Secretary

Bureau of Labor Statistics
Janet L. Norwood, Commissioner

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For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price $5.00

Preface

This bulletin presents the findings of a Bureau of Labor Statistics survey of labor and material requirements for hospital and nursing home construction. The bulletin provides data on employee hours, building characteristics, costs, and material requirements for hospitals and nursing homes completed in 1976. Estimates are also provided on the 1981 level of employee-hour requirements and the number of jobs generated by hospital construction per billion dollars of expenditure. A summary was published in the March 1982 issue of the *Monthly Labor Review*.

Congress established the Bureau of Labor Statistics Construction Labor and Material Requirements program in 1959 to determine the impact on employment of various construction activities. This is the third study of hospital construction, and the second to include data on nursing homes. Other published studies in the series include highways, civil works, college housing, private single-family housing, private multifamily housing, public housing, Federal office buildings, and commercial office buildings.

The results of the studies serve several purposes in addition to providing information on total employment requirements. Data on occupational requirements are used to determine training needs; information on the types and costs of materials used are valuable to material manufacturers and market research analysts; data from resurveys of various types of construction are used to develop cost indexes and to provide estimates of trends in onsite labor productivity.

The Bureau gratefully acknowledges the cooperation of the general and special trade contractors, owners, and developers who provided data for the survey. The Bureau also acknowledges the assistance of the Office of Facilities Engineering within the Office of Federally Assisted Construction of the former Department of Health, Education, and Welfare in drawing the sample frame.

The study was prepared by Dawn E. Dougherty, assisted by Barbara J. Bingham, under the supervision of Robert Ball in the Bureau's Office of Productivity and Technology, Jerome A. Mark, Assistant Commissioner. Karen J. Horowitz and Margaret Long of the Office of Economic Growth assisted in the development of indirect employee-hour estimates.

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Chapter I. Introduction

Construction activity has a major impact on employment in the United States. Construction expenditures provide thousands of jobs, both in the construction industry and in industries which produce and deliver equipment and materials used in construction. Information concerning the employment-generating effects of public and private hospital construction is useful to Federal and State governments as well as private industry.

Expenditures for hospital construction, which grew steadily throughout the 1960's and early 1970's, reached a peak in 1972. Since that time, however, the volume of hospital construction (measured in constant dollars) has declined. In 1980, the value put in place for public and private hospital construction was $5.83 billion.[1] In constant dollars, the 1980 figure represents only about 64 percent of the value put in place in 1972.[2] Hospital construction accounted for approximately 12 percent of total expenditures for nonresidential building construction in 1972; in 1980, it represented only 8 percent.

The decline in new hospital construction can be attributed to a growing emphasis on controlling hospital costs through the elimination of excess bed space. Under the Health Planning Act of 1974, individual health planning agencies were created to coordinate planning efforts in each State. Since then, proposals for new hospitals have been subject to a more stringent review. As part of the effort to contain costs, planners have encouraged modernization and consolidation of existing facilities over new construction.

Scope and methods of survey

The survey was designed to measure labor and material requirements for hospitals and nursing homes completed during 1976.[3] Most of the construction occurred during 1974-75; therefore, survey data refer to 1975.

The survey was based on a sample of 34 hospitals and 8 nursing homes, which represented a universe of 90 hospitals and 16 nursing homes.[4] All projects were stratified by cost class, and hospital projects were further stratified by broad geographic region.[5] Because the nursing home sample contained only 8 projects, data on nursing homes are presented for the United States only. All projects in the study were funded under the Hill-Burton program of the former Department of Health, Education, and Welfare.[6] The survey included both public and privately owned facilities, and covered additions to existing facilities as well as new construction. Projects primarily designed to serve as living quarters for either students or staff and projects involving a large amount of rehabilitation work were outside the scope of this study. A more detailed description of sampling techniques and a discussion of sample variances are included in appendix B.

BLS personnel obtained data on onsite employee-hour requirements, costs, and project characteristics through visits with general and special trade contractors. Offsite employee hours were estimated from the ratio of (nonconstruction) employees to total employees for special

[1] See table 1 of Bureau of the Census, U.S. Department of Commerce, *Construction Report*, C30-80-5 (May 1980).

[2] See table 2 of Bureau of the Census, U.S. Department of Commerce, *Construction Report*, C30-81-3 (May 1981) and table 1A of Bureau of the Census, U.S. Department of Commerce, *Construction Report*, C30-78-5 (May—issued July 1978).

[3] The length of time between the data year and the year of publication is due to several factors. A considerable amount of time was needed to define and refine the universe, design and select the sample, and collect, compile, and verify the data. Each surveyed project required many visits to contractors and subcontractors. Additional time was required for preparation and publication of the results. Nevertheless, the data presented indicate trends in labor requirements and are useful in analyzing changes in the factors over time. Data also serve as benchmarks for updating estimates of the employment-generating effects of construction expenditures to the current years.

[4] Data on certain project characteristics are not published due to the small sample size.

[5] Data were provided for the United States and four broad geographic regions. States included in each region were: *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.

[6] The Hospital Survey and Construction (or Hill-Burton) Act was passed by Congress in 1946. It provides funds to construct and modernize hospitals and other types of health care facilities.

trade contractors in the contract construction industry.[7] Indirect labor requirements were developed from the material and equipment cost data obtained in the survey. Material and equipment values were first grouped by type, and dollar amounts for each group were adjusted by the appropriate producer price index. Adjusted data were then processed through the Bureau's input-output tables to generate estimates of final demand. Industry productivity factors were applied to determine the number of employee hours required per $1,000 of contract cost for manufacturing industries; trade, transportation, and service industries; and mining and all other industries.[8] Employment generated by the spending of wages, salaries, or profits (the multiplier effect) is not within the scope of this study.

Highlights

Labor requirements. For each $1,000 of contract cost for hospitals completed in 1976, 87.7 employee hours were required. Of that total, 39.2 hours were in the construction industry-34.7 for onsite construction work and 4.5 for builders' offsite activities. The remaining 48.5 hours were in industries that manufacture and deliver materials, equipment, and supplies used in hospital construction: 29.3 in manufacturing; 15.1 in trade, transportation, and services; and 4.1 in mining and all other industries. Estimates based on survey data indicate that in 1981, each $1,000 of expenditure for hospital construction generated 48 hours of work.[9] Of these, 22 were in the construction industry (20 onsite and 2 offsite). Employee-hour requirements for related industries were distributed as follows: 15 for manufacturing; 8 for trade, transportation, and services; and 2 for mining and all other industries. (Note: Detail may not add to totals due to rounding.)

Survey results indicate that each $1 billion spent on hospital construction in 1975 would provide an estimated 45,800 jobs—21,500 in construction alone.[10] The Bureau estimates that in 1981, $1 billion of expenditure would create 12,100 jobs in construction and 13,100 in related industries. The following tabulation compares job estimates for 1975 and 1981 by industry:

	Jobs per billion	
	1975	*1981*
Total	45,800	25,300
Construction	21,500	12,100
Onsite	19,300	10,800
Offsite	2,200	1,200
Manufacturing	14,100	7,300
Trade, transportation, and services	8,100	4,800
Mining and all other	2,000	1,100

Data for nursing home construction show that 87.1 employee hours were required per $1,000 of expenditure in 1975. The distribution of employee hours by industry is as follows: 34.4 for construction (31.3 onsite and 3.1 offsite); 32.2 for manufacturing; 15.5 for trade, transportation, and services; and 5.0 for mining and all other industries. Based on these data, each $1 billion spent on nursing home construction in 1975 would generate an estimated 45,300 jobs—18,900 in construction and 26,300 in other industries.

Changes in employee-hour requirements. These survey results, when compared with previous BLS studies of hospitals built in 1960 and 1966, show that em-

[7] Offsite hours in the construction industry, which represent builders' office, warehousing, and administrative duties, were developed from survey data. First, hours worked by administrative personnel were subtracted from the onsite hour figure obtained from the survey. To calculate total hours, the ratio of nonconstruction employees to total employees for special trade contractors in the contract construction industry, as reported in *Employment and Earnings, United States 1908-78*, Bulletin 1312-11 (Bureau of Labor Statistics, 1979), was applied to the adjusted hour figure. Onsite hours were then subtracted from this total hour figure to obtain the offsite hour estimate. Hours worked by administrative personnel were subtracted from onsite hours because they are not included in the construction employee figures in *Employment and Earnings*. These hours are included in tables showing onsite hour data.

Employment and Earnings data from SIC's 15 and 17 were used to calculate offsite hours for building surveys. SIC 161 was used for highways; 162 for civil works; all contract construction for sewer works; and SIC 17 for housing surveys. However, some SIC series did not extend back far enough to be used for several older surveys, including both of the earlier hospital studies. Because of this, all contract construction data were used for older highways and civil works surveys, and SIC 17 was used in some older building construction surveys.

[8] The Office of Economic Growth and Employment Projections, Bureau of Labor Statistics, uses the input-output tables of the Bureau of Economic Analysis, U.S. Department of Commerce, to generate indirect hours from material and equipment cost data obtained in the survey.

[9] Employee-hour estimates for 1981 were based on 1975 onsite employee-hour data adjusted for price and productivity change. The deflator used to adjust onsite hours for price change was the Bureau of the Census' cost index for nonresidential buildings (1972 = 100):

1965-66 = 65.6
1974-75 = 134.65
1981 = 224.7

Productivity change was calculated from the change in onsite hours, adjusted for price change, between the 1966 study and the latest study. The average annual rate of change used was 0.7 percent.

[10] Employment estimates were derived using 1,800 hours per year for onsite construction and 2,000 hours per year for offsite construction. Average hours per job in 1974-75 for other industries were as follows: 2,074 for manufacturing; 1862 for trade, transportation, and services; and 2,031 for mining and all other industries.

Table 1. Onsite and indirect employee-hour requirements per $1,000 of contract cost for hospital construction by industry, 1960, 1966, and 1975

Industry	Current dollars			Constant (1972) dollars		
	1960	1966	1975	1960	1966	1975
All industries	226.0	190.2	87.7	134.1	124.7	118.1
Construction	101.1	87.1	39.2	60.0	57.1	52.8
Onsite	88.8	76.1	34.7	52.7	49.9	46.7
Offsite	1/12.3	1/11.0	4.5	7.3	7.2	6.1
Other industries 2/	124.9	103.1	48.5	74.1	67.6	65.3
Manufacturing	78.0	64.0	29.3	46.3	42.0	39.5
Trade, transportation, and services	34.2	29.6	15.1	20.3	19.4	20.3
Mining and other	12.7	9.5	4.1	7.5	6.2	5.5

[1] Revised based on adjustment to 1979 benchmark of *Employment and Earnings* series.

[2] Data revised from original study due to reprocessing of material items through improved input-output tables.

ployee-hour requirements have declined.[11] Each $1,000 of contract cost for hospitals constructed in 1960 and 1966 required 226.0 and 190.2 employee hours, respectively, compared with 87.7 hours in 1975 (table 1). In constant (1972) dollars, employee-hour requirements decreased from 134.1 in 1960 to 124.7 in 1966, and to 118.1 in 1975. Onsite hours decreased from 88.8 per 1,000 current dollars in 1960 to 34.7 in 1975. This decline is due to a number of factors, including changes in onsite labor productivity, project characteristics, and construction techniques.

Onsite employee hours per 1,000 current dollars of expenditure for nursing home construction decreased from 73.7 in 1966 to 31.3 in 1975. Because the 1966 study of nursing homes was based on a case study of 12 projects, the two studies may not be strictly comparable. However, data indicate the downward trend in labor requirements for nursing home construction.

[11] The first two studies are referred to as the 1960 and 1966 studies; however, most of the construction value was put in place during 1959/60 and 1965/66, respectively.

Chapter II. Employee-hour Requirements

Employee hours generated by hospital construction fall into two major categories: Direct and indirect. Direct labor requirements are further divided into onsite and offsite hours. Onsite hours represent hours expended directly at the construction site, while offsite labor requirements represent builders' office, administrative, and warehousing activities. Indirect hours were developed from survey data for the following industry groups: 1) Manufacturing; 2) trade, transportation, and services; and 3) mining and all other industries. These hours represent the labor required to produce and deliver materials, equipment, and supplies used in construction.

Onsite

Approximately 89 percent of the 39.2 employee hours required in the construction industry were expended at the construction site. Each $1,000 of contract cost for hospitals built in 1975 required 34.7 onsite hours.[12] In comparison, hospitals built in 1960 and 1966 required 88.8 and 76.1 onsite hours, respectively. In constant (1972) dollars, onsite hours declined at an average annual rate of 0.8 percent between 1960 and 1975 and 0.7 percent between 1966 and 1975, as shown below:

Study year	*Onsite hours per $1,000 (1972 dollars)*
1960	52.7
1966	49.9
1975	46.7

Factors contributing to the decline in onsite employee hours include: Improved construction methods, changes in types of materials used, differences in project characteristics, and increased productivity. Although onsite hours cannot be used as an exact measure of productivity, changes in onsite hours indicate productivity trends in the construction industry.

Nursing homes required fewer onsite hours than hospitals. Nursing homes built in 1975 required 31.3 employee hours per $1,000, 3.4 fewer hours than that required for hospitals. Onsite labor requirements also decreased between the two nursing home surveys: In 1966, 73.7 hours were required.

By occupation. Hospital survey data show that skilled workers contributed 68.6 percent of all hours in 1975, compared with 67.8 percent in 1960 and 70.3 percent in 1966 (table 2). Plumbers (including pipefitters and steamfitters), carpenters, and electricians accounted for the largest proportion of skilled employee hours in all three studies. The proportion of hours contributed by electricians increased with each study, reflecting a growing sophistication and complexity in the electrical equipment and lighting systems used by hospitals.

Semiskilled and unskilled workers accounted for 22.4 percent of all hours in 1975; in 1960 and 1966 they represented 28.4 percent and 26.4 percent, respectively. Among semiskilled and unskilled workers, the proportion of hours contributed by laborers, helpers, and tenders decreased from 26.7 percent in 1960 to 20.6 percent in 1975. This is due to several factors, including the increased complexity of hospital equipment and the mechanization of materials handling, excavation, and other jobs.

The proportion of hours worked by professional, technical, clerical, and supervisory workers, which was 3.9 percent in 1960 and 3.2 percent in 1966, increased to 8.7 percent in 1975. Accounting for most of this increase was the proportion of hours contributed by supervisory workers, which jumped from 3.1 percent in 1960 to 7.4 percent in 1975.

The distribution of onsite hours by occupational group for nursing homes built in 1975 was similar to that for hospitals. Skilled workers accounted for 66.6 percent of all onsite hours. Carpenters contributed the largest proportion of skilled hours, followed by plumbers and electricians. Semiskilled and unskilled workers contributed 22.3 percent of all hours, and professional, technical, clerical, and supervisory workers accounted for 11.1 percent. In the 1966 survey, onsite hours were distributed as follows: 68.6 percent for skilled workers; 27.1 percent for semiskilled and unskilled workers; and 4.4 percent for professional, technical, clerical, and supervisory workers.

By type of contractor. General contractors accounted for the greatest proportion of onsite hours with 26.6 percent. In comparison, general contractors contributed

[12] Imputation was not done for missing detailed data when the contract value was less than 0.3 percent of the total project amount. The effect on survey data, particularly employee-hour ratios and component cost percentages, is not significant.

Table 2. Onsite employee-hour requirements per $1,000 of contract cost for hospital and nursing home construction by occupation, 1960, 1966, and 1975

Occupation	Hospitals						Nursing homes	
	1960		1966		1975		1975	
	Employee hours per $1,000	Percent distribution	Employee hours per $1,000	Percent distribution	Employee hours per $1,000	Percent distribution	Employee hours per $1,000	Percent distribution
All occupations	88.8	100.0	76.1	100.0	34.7	100.0	31.3	100.0
Skilled workers:								
Brickmasons	4.8	5.4	3.8	5.0	1.2	3.5	2.3	7.3
Carpenters	11.7	13.2	9.9	13.0	4.3	12.5	4.3	13.7
Carpet and soft tile installers	0.4	0.4	0.3	0.4	0.1	0.4	0.1	0.4
Concrete finishers	1.3	1.5	1.0	1.4	0.9	2.5	0.3	1.1
Drywall installers	(1/)	(1/)	(1/)	(1/)	0.4	1.0	0.3	0.9
Electricians	7.8	8.8	7.5	9.9	4.1	11.9	3.5	11.1
Elevator mechanics	0.6	0.7	0.7	0.9	0.2	0.7	0.2	0.6
Glaziers	0.5	0.6	0.3	0.4	0.2	0.5	0.2	0.5
Heating, air-conditioning, and refrigeration mechanics	(1/)	(1/)	(1/)	(1/)	0.1	0.4	0.3	0.9
Insulation workers	1.5	1.7	1.5	1.9	0.8	2.2	0.4	1.3
Lathers	2.7	3.0	2.2	2.9	0.7	2.1	0.4	1.4
Operating engineers	1.4	1.6	1.4	1.8	0.7	2.1	0.4	1.3
Painters	2.5	2.8	2.0	2.6	0.6	1.6	1.1	3.5
Paperhangers	(1/)	(1/)	(1/)	(1/)	0.1	0.2	--	--
Pipefitters and steamfitters	(1/)	(1/)	(1/)	(1/)	2.1	6.0	1.5	4.9
Plasterers	2.9	3.2	2.5	3.2	0.5	1.5	0.2	0.7
Plumbers	12.7	14.3	11.9	15.6	2.3	6.6	2.7	8.5
Reinforcing ironworkers	1.4	1.6	1.2	1.6	0.5	1.6	0.1	0.3
Roofers	0.6	0.7	0.5	0.6	0.2	0.6	0.5	1.6
Sheet-metal workers	4.3	4.8	4.2	5.5	1.9	5.4	0.9	3.0
Structural metal and ornamental ironworkers	1.7	2.0	1.1	1.5	0.9	2.6	0.5	1.7
Tile setters and terrazzo workers	1.4	1.6	1.2	1.7	0.2	0.6	0.3	1.1
Other skilled workers	(1/)	(1/)	0.3	0.4	0.7	2.1	0.2	0.8
Semiskilled and unskilled workers								
Laborers, helpers, and tenders	23.7	26.7	19.6	25.7	7.2	20.6	6.8	21.7
Truckdrivers	0.6	0.7	0.4	0.5	0.1	0.4	0.1	0.2
Other	0.8	1.0	0.1	0.2	0.5	1.4	0.1	0.4
Office and administrative workers								
Professional, technical, and clerical workers	0.7	0.8	0.8	0.9	0.5	1.3	0.1	0.4
Supervisors	2.8	3.1	1.7	2.3	2.6	7.4	3.4	10.7

[1] Not available

-- = No data reported.

NOTE: Detail may not add to totals due to rounding.

Table 3. Percent distribution of onsite employee-hour requirements per $1,000 of cost for hospital and nursing home construction by type of contractor, 1960, 1966, and 1975

Type of contractor	Hospitals			Nursing homes	
	1960 1/	1966	1975	1966	1975
Total	100.0	100.0	100.0	100.0	100.0
General contractor	39.1	36.5	26.6	37.0	24.8
Excavations, footings, foundations, and grading	0.8	1.3	1.4	1.0	0.4
Concrete reinforcement	(2/)	(2/)	0.4	(2/)	0.4
Concrete work	(2/)	0.5	4.4	0.5	2.6
Structural steel and ornamental iron	2.7	2.2	2.2	1.8	0.9
Structural steel	(2/)	1.5	1.9	1.5	0.4
Ornamental iron	(2/)	0.7	0.3	0.3	0.5
Masonry	4.1	2.1	5.5	4.7	8.4
Carpentry	(2/)	0.2	1.6	0.1	1.7
Plumbing and heating, ventilating, and air-conditioning	22.1	24.7	23.7	21.3	24.0
Plumbing	(2/)	(2/)	4.9	(2/)	14.0
Heating, ventilating, and air-conditioning	(2/)	(2/)	18.8	(2/)	10.0
Electrical	9.2	10.1	13.0	8.7	14.3
Insulation	(2/)	(2/)	1.1	(2/)	0.7
Plastering and lathing	8.1	8.5	6.5	7.5	2.2
Wallboard	(2/)	(2/)	2.1	(2/)	6.7
Sheet-metal work and roofing	1.3	1.1	2.3	2.3	2.5
Sheet-metal work	(2/)	(2/)	1.2	(2/)	0.3
Roofing	(2/)	(2/)	1.1	(2/)	2.2
Elevators	(2/)	(2/)	1.2	(2/)	1.0
Glass and glazing	(2/)	0.5	0.6	0.7	1.5
Painting and wallpapering	2.5	2.5	1.9	4.7	2.6
Ceramic tile and terrazzo work	4.0	3.1	1.7	3.9	1.4
Linoleum, vinyl tile, and vinyl/asbestos tile	(2/)	0.8	0.6	0.9	1.0
Building equipment installation	(2/)	1.9	0.7	0.8	0.2
Other	6.0	4.0	2.3	4.1	2.7

[1] Based on data from federally aided hospital projects only.

[2] Not available.

NOTE: Detail may not add to totals due to rounding.

Table 4. Employee-hour requirements by cost group for hospital construction, 1975

Cost groups	Number of projects	Employee hours per:	
		$1,000 of cost	100 square feet
All projects	90	34.7	172
$1,000,000 - 1,999,999 ..	15	41.3	214
$2,000,000 - 4,999,999 ..	27	38.5	216
$5,000,000 - 9,999,999 ..	19	36.2	208
$10,000,000 - 14,999,999 ..	8	31.1	124
$15,000,000 - 19,999,999 ..	18	32.1	156
$20,000,000 and over	4	39.2	192
Hospital additions:			
All projects	74	33.1	170
$1,000,000 - 1,999,999 ..	13	42.8	218
$2,000,000 - 4,999,999 ..	27	38.5	216
$5,000,000 - 9,999,999 ..	13	36.9	213
$10,000,000 - 14,999,999 ..	4	25.4	97
$15,000,000 - 19,999,999 ..	16	30.4	152
$20,000,000 and over	(1/)	(1/)	(1/)
New hospitals:			
All projects	16	39.0	177
$1,000,000 - 1,999,999 ..	(1/)	(1/)	(1/)
$2,000,000 - 4,999,999 ..	--	--	--
$5,000,000 - 9,999,999 ..	6	34.7	197
$10,000,000 - 14,999,999 ..	4	36.0	147
$15,000,000 - 19,999,999 ..	2	42.8	177
$20,000,000 and over	2	42.2	196

[1] Insufficient data. See text footnote 4.
-- Survey had no sample projects in this cell.

NOTE: Detail may not add to totals due to rounding.

Table 5. Indirect employee-hour requirements per $1,000 of contract cost for hospital and nursing home construction by industry, 1960, 1966, and 1975

Industry	Hospitals			Nursing homes
	1960 1/	1966 1/	1975	1975
Total indirect employee hours.	124.9	103.1	48.5	52.7
Manufacturing	78.0	64.0	29.3	32.2
Trade, transportation, and services	34.2	29.6	15.1	15.5
Trade	22.3	19.5	8.7	8.7
Wholesale trade	13.1	10.2	4.8	5.3
Retail trade	9.2	9.3	3.9	3.4
Transportation	8.3	6.0	3.3	3.5
Services	3.6	4.1	3.1	3.3
Mining and other	12.7	9.5	4.1	5.0
Agriculture	1.6	0.9	0.3	0.5
Mining	4.1	2.8	1.1	1.6
Communications	1.1	0.9	0.4	0.4
Public utilities	1.1	0.8	0.4	0.5
Finance, insurance, and real estate	2.7	2.2	1.0	1.1
Government enterprises	1.2	1.1	0.5	0.5
Construction	0.9	0.8	0.4	0.4

[1] Data revised from original study due to reprocessing of material items through improved input-output tables.

NOTE: Detail may not add to totals due to rounding.

39.1 percent in 1960 and 36.5 percent in 1966 (table 3). This decline indicates that general contractors are subcontracting more onsite duties to special trade contractors. Of special trade contractors, plumbing and heating, ventilating, and air-conditioning contractors had the largest proportion of onsite hours in all three studies. This reflects the extensive amount of plumbing work required in hospital construction.

Electrical contractors had the second greatest proportion of onsite labor requirements for special trade contractors in all three studies. The proportion of hours contributed by electricians increased from 9.2 percent of all hours in 1960 to 13.0 percent in 1975, another indication of the increasing complexity of the electrical systems used by hospitals. Other changes include a decreased proportion of hours contributed by plastering and lathing contractors, which is probably due to the increasing use of drywall for interior walls. The majority of hospitals built in 1975 had drywall interior walls, while plaster was used most commonly in both of the earlier studies.

Although general contractors accounted for the largest proportion of onsite hours for nursing homes built in 1975, the proportion of hours contributed by general contractors decreased between the two studies. Plumbing and heating, ventilating, and air-conditioning contractors had the highest proportion of hours for the special trade contractors, followed by electrical contractors. Nursing homes built in 1975 differed from hospitals in that masonry contractors contributed the third largest proportion of onsite hours. Masonry was the major type of material used in nursing home construction for both exterior and interior walls.

By selected project characteristics. Onsite employee hours by cost class show that requirements per $1,000 were highest for the least expensive projects (table 4). Projects that cost between $1 and $2 million required 41.3 employee hours, while projects in the $10 to $15 million range required 31.1 hours. The number of employee hours decreased as cost increased, except for the two highest cost classes. Several projects in the highest cost classes included rehabilitation work, which is relatively labor intensive. These hospitals, which required more employee hours than any other project surveyed, raised the average for the two cost classes.

Approximately one-third of the projects cost between $2 and $5 million. Projects in this class had labor requirements of 38.5 hours per $1,000 of expenditure.

On a square foot basis, the distribution of employee-hour requirements by cost class followed the same general pattern as the distribution of hours per $1,000. Onsite employee-hour requirements per 100 square feet were higher for less expensive projects, and decreased up to projects in the $15 to $20 million range. Overall, surveyed hospitals required 172 employee hours per 100 square feet. Projects costing from $2 to $5 million required 216 employee hours, while projects in the $10 to $15 million range required 124 hours.

The majority of projects in the survey were additions to existing hospitals. These projects required 33.1 employee hours per $1,000, compared to the 39.0 hours for new hospitals. Employee-hour requirements per 100 square feet for additions and new hospitals were 170 and 177, respectively.

Nursing homes required an average of 31.3 onsite hours per $1,000 of cost. Approximately one-half of the nursing home projects cost between $1 and $2 million. On average, these nursing homes required 39.1 onsite hours per $1,000, which is similar to the average number of hours required for new hospital buildings. Onsite hours per 100 square feet for nursing homes were also lower than those for hospitals. Every 100 square feet of nursing home construction required 129 employee hours.

Offsite and indirect

Builders' offsite employment. Offsite hours in the construction industry represent builders' estimating, warehousing, administrative, maintenance, and office activities. Offsite construction hours were estimated from the ratio of nonconstruction workers to total workers for special trade constractors in the contract construction industry. Builders' offsite labor requirements averaged 4.5 hours per $1,000 of contract costs for hospitals constructed in 1975. In comparsion, builder's offsite hours for hospitals built in 1960 and 1966 were much higher at 12.3 and 11.0, respectively. Although offsite construction hours per $1,000 decreased between the last two studies, the proportion of total hours that they represent declined only slightly. Builders' offsite employee-hour requirements accounted for 5.1 percent of all hours in 1975, compared with 5.8 percent in 1966.

Indirect employee hours. Indirect employee-hour requirements represent the labor required to produce and distribute the materials, equipment, and supplies used in construction. Indirect employee hours declined at about the same rate as onsite hours between the first and most recent studies. Each $1,000 of contract cost for hospitals built in 1975 required 48.5 indirect employee hours, compared with 124.9 in 1960 and 103.1 in 1966 (table 5). Indirect hours accounted for approximately 55 percent of all hours in 1975. This means that for each hour spent at the construction site, almost 1.4 additional hours were required to produce and deliver the materials and equipment used in construction. This ratio was about the same in the previous studies.

The manufacturing sector accounted for the largest proportion of indirect labor requirements in all three studies. Hospital construction generated 29.3 employee

hours in manufacturing industries in 1975, or 60 percent of total indirect hours. Although the hours required in manufacturing decreased between the three studies, manufacturing hours as a proportion of total hours declined only slightly—from 34.5 percent in 1960 to 33.4 percent in 1975.

In the trade, transportation, and service sectors, labor requirements decreased from 34.2 hours in 1960 to 15.1 hours in 1975. However, as a proportion of the total, the hours required in these industries increased from 15.1 percent in 1960 to 17.2 percent in 1975. Most of this increase occurred in the service industries.

The third industry group includes agriculture, mining, communications, public utilities, finance, insurance, real estate, government enterprises, and maintenance construction. These sectors accounted for 8.5 percent of all indirect hours in the 1975 survey, compared with 10.2 percent in 1960.

Indirect labor requirements were greater for nursing homes than for hospitals. The largest difference was in manufacturing. Because material requirements were greater for nursing homes than for hospitals, each $1,000 of nursing home construction expenditure generated almost 3 additional employee hours in manufacturing.

Chapter III. Components of Cost and Contractor Costs

Construction contract costs include material and labor costs, equipment and overhead expenses, and contractors' profit. Survey data show that materials, built-in equipment, and supplies accounted for the largest proportion of total contract cost for hospitals built in 1975 (table 6). This held true for both of the earlier studies; however, the proportion of cost for materials decreased from 53.2 percent in 1960 to 42.2 percent in 1975. The proportion of total hospital contract cost represented by onsite wages and salaries declined between 1966 and 1975, after increasing between the first and second studies. The proportion of hospital cost for contractors' equipment continued to increase between the second and most recent studies, while profit and overhead jumped from 17.4 percent in 1960 to 27.7 percent in 1975.

The proportion of materials and supplies to total contract cost was greater for nursing homes than for hospitals, but the proportions for labor and profit and overhead were both smaller. Contract costs for nursing homes built in 1975 were distributed as follows: 48.3 percent for materials, built-in equipment, and supplies; 24.5 percent for onsite wages and salaries; 2.2 percent for contractors' equipment; and 25.0 percent for overhead and profit expenses.

Material and equipment costs

Of the materials used in hospital construction, fabricated metal products had the highest cost per $1,000 in all three studies (table 7). Three items, fabricated sheet-metal products, prefabricated structural steel, and metal reinforcing bars, accounted for over half of the fabricated metal products used in 1975. Between the 1966 and 1975 studies, the proportion for metal reinforcing bars and metal doors and windows decreased, while the proportion for fabricated sheet-metal products increased. Prefabricated structural steel, which was not found in either of the earlier studies, accounted for almost 4 percent of the total material cost in 1975.

Stone, clay, glass, and concrete products accounted for the second largest proportion of material cost in all three studies. The proportion represented by stone, clay, glass, and concrete products was similar for the three studies; however, several shifts occurred within this product group. For example, decreased use of clay brick and marble and other cut stone was offset by increased use of precast concrete products.

Electrical machinery and equipment had the third highest cost per $1,000 of construction value for hospitals built in 1975. The proportion of total material cost for electrical products increased by over 6 percent between 1966 and 1975, replacing built-in equipment and nonelectrical machinery as the third most important product group. Communication and transmitting devices, electric light fixtures, and current-carrying devices had the largest cost in this group.

The cost of materials, built-in equipment, and supplies per $1,000 of nursing home construction was slightly higher than that for hospitals (table 8). As in hospitals, fabricated metal products had the highest cost per $1,000 of nursing home construction value, followed by stone, clay, glass, and concrete products. Built-in machinery and nonelectrical equipment accounted for the third largest proportion of total material cost for nursing homes. Because hospitals generally require more complex electrical equipment, material requirements for electrical products and measuring instruments were higher for hospitals than for nursing homes. On the other hand, building items (such as lumber and wood products and stone, clay, glass, and concrete products) accounted for a larger proportion of materials cost for nursing homes than for hospitals.

Wages and salaries

In 1975, the average hourly wage for hospital construction workers was $7.99 (table 9). Survey data show that onsite wages and salaries, excluding employer-paid benefits, accounted for 27.7 percent of hospital contract cost in 1975, a slight decrease from the previous studies. As in both of the earlier studies, average hourly earnings were higher for additions and for projects built in metropolitan (rather than nonmetropolitan) areas. Data for the latest study differ from previous survey results in that the ratio of wages to contract cost did not necessarily correspond with wage rates. In both the 1960 and 1966 studies, higher average hourly wages were generally accompanied by a higher ratio of wages

Table 6. Percent distribution of contract costs for hospital construction, 1960, 1966, and 1975

Type of cost	1960	1966	1975
Total	100.0	100.0	100.0
Construction equipment	1.2	1.3	2.4
Materials, built-in equipment, and supplies	53.2	50.4	42.2
Onsite wages and salaries	28.2	29.6	27.7
Overhead and profit	17.4	18.7	27.7

Table 7. Distribution of costs of materials, built-in equipment, and supplies for hospital construction, 1960, 1966, and 1975

Item	Percent			Value per $1,000 of contract cost, 1975
	1960	1966	1975	
All materials, equipment, and supplies	100.00	100.00	100.00	$442.24
Materials, built-in equipment, and supplies	97.86	97.50	94.48	417.84
Agricultural products	--	--	.09	.40
Mining and quarrying of nonmetallic minerals, except fuels	.42	.51	.33	1.44
Sand and gravel	.42	.51	.28	1.24
Miscellaneous mining and quarrying of nonmetallic minerals	--	--	.05	.20
Textile mill products	--	.29	.24	1.06
Carpeting, rugs, mats, and pads	--	--	.23	1.01
Miscellaneous textile mill products	--	.29	.01	.05
Apparel and other textile products	--	--	--	.02
Lumber and wood products, except furniture	4.22	4.81	2.98	13.18
Kitchen cabinets, vanities, prebuilt	--	--	.14	.64
Dressed and rough boards, and dimension lumber	.99	1.55	.81	3.60
Hardwood flooring and other hardwood	--	--	.04	.16
Wood shingles and excelsior	--	--	.09	.40
Millwork	2.99	2.88	1.42	6.30
Plywood, softwood	.18	.20	.09	.41
Acoustical tile, cork	--	--	.33	1.46
Miscellaneous lumber and wood products	.05	.18	.06	.21
Furniture and fixtures	3.19	2.82	2.28	10.06
Household furniture and fixtures	--	--	.24	1.07
Office furniture and fixtures	2.49	2.39	.44	1.96
Public buildings furniture and fixtures	--	--	.87	3.87
Store furniture and fixtures	.69	.44	.56	2.46
Venetian blinds, curtain and drapery rods	--	--	.04	.16
Miscellaneous furniture and fixtures	--	--	.12	.54

See footnotes at end of table.

Table 7. Continued—Distribution of costs of materials, built-in equipment, and supplies for hospital construction, 1960, 1966, and 1975

Item	Percent			Value per $1,000 of contract cost, 1975
	1960	1966	1975	
Paper and allied products	.09	--	.39	$1.73
Masking tape	--	--	.03	.15
Construction paper and building board products	.09	--	.35	1.54
Miscellaneous paper and allied products	--	--	.01	.04
Chemicals and allied products	.81	.77	1.01	4.48
Paint and allied products	.46	.77	.42	1.84
Miscellaneous industrial organic chemicals	--	--	.04	.18
Adhesives, sealants, and caulking	--	--	.23	1.02
Chemicals and chemical preparations, n.e.c.	.35	--	.26	1.13
Miscellaneous chemicals and allied products	--	--	.07	.31
Petroleum refining and related products	.90	.80	1.12	4.96
Fuels, diesel fuel, gas, oil, grease	.23	.09	.18	.80
Asphalt paving	.27	.30	.30	1.34
Asphalt tar and pitches	.40	.40	.64	2.82
Rubber and miscellaneous plastics products	.11	.15	1.05	4.65
Fabricated rubber products	--	--	.09	.39
Miscellaneous plastics products	.11	.15	.96	4.25
Miscellaneous rubber and plastics products	--	--	--	.01
Stone, clay, glass, and concrete products	18.94	18.40	18.52	81.90
Window glass	.59	.51	.42	1.84
Pressed and blown glass	--	--	.05	.23
Mirrors	--	--	.14	.61
Cement	.71	.56	.47	2.08
Brick (clay)	2.24	1.96	.81	3.57
Ceramic tile	1.49	1.25	.82	3.63
Clay sewer pipe	.20	.13	.08	.34
Plumbing fixtures and accessories, vitreous china	--	--	1.15	5.08
Concrete block and brick	1.13	1.27	.99	4.36
Precast concrete products	.77	1.42	3.38	14.95
Ready-mix concrete	5.15	5.53	5.62	24.84
Lime	.14	.12	.07	.31
Gypsum products	1.62	1.10	1.47	6.52
Marble and other cut stone	1.28	.74	.36	1.60
Asbestos cement products	1.47	1.00	.54	2.37
Crushed rock, slag, miscellaneous aggregate	.40	--	.74	3.26
Mineral and glass wool products	1.76	2.19	1.31	5.81
Nonmetallic mineral products, n.e.c.	--	.49	.06	.26
Miscellaneous stone, clay, glass, and concrete products	--	.13	.05	.24
Primary metal industries	12.05	12.35	9.89	43.73
Structural steel	7.57	5.53	5.38	23.77
Seamless steel pipe and tubing	--	--	.17	.75
Nails, staples, cable, and wire, ferrous	--	--	.21	.92
Cast iron products	1.07	1.50	.86	3.80
Lead	.09	.38	.04	.16
Copper pipe and tubing	1.53	1.54	1.15	5.10
Aluminum sheet, plate, and foil	.34	.54	.04	.19
Nonferrous rolled, drawn, and extruded metal	--	1.61	.11	.50
Cable and wire, nonferrous	.94	1.06	1.75	7.74
Primary metal products, n.e.c.	.23	.20	.11	.49
Miscellaneous primary metal products	.29	--	.07	.31
Fabricated metal products	24.25	21.75	23.80	105.26
Builders' hardware	1.94	2.01	1.63	7.26
Plumbing fixtures, metal and enameled iron	2.84	2.49	.74	3.26
Plumbing accessories, fittings, and trim, brass	--	.41	.34	1.52
Radiators and heaters (nonelectric)	3.45	2.81	.85	3.75
Prefabricated structural steel	--	--	3.98	17.58

See footnotes at end of table.

Table 7. Continued—Distribution of costs of materials, built-in equipment, and supplies for hospital construction, 1960, 1966, and 1975

Item	Percent			Value per $1,000 of contract cost, 1975
	1960	1966	1975	
Metal doors and windows	3.60	2.43	1.96	$8.67
Fabricated metal plate products	.33	--	.79	3.49
Fabricated sheet metal products	2.63	2.70	4.48	19.81
Ornamental and architectural metal work	.73	.79	1.41	6.23
Prefabricated metal buildings, curtain walls	--	--	.57	2.51
Metal reinforcing bars	6.76	4.52	3.78	16.71
Metal nuts, bolts, washers, screws, rivets	--	.48	.23	1.01
Metal stampings, n.e.c.	--	--	.11	.49
Plumbing accessories, metal other than brass	1.83	1.92	2.29	10.13
Miscellaneous fabricated wire products	.15	--	.50	2.22
Miscellaneous fabricated metal products	--	1.18	.15	.66
Machinery, except electrical	14.48	16.81	13.29	58.77
Elevators, escalators, and dumbwaiters	4.16	4.57	3.03	13.41
Conveyors and conveying equipment	.38	.91	.61	2.70
Special industry machinery, n.e.c.	--	--	.15	.68
Pumps	.85	1.35	.66	2.93
Compressors	--	--	.05	.22
Blowers, exhaust and ventilating fans	.88	.90	.89	3.94
Sprinkler systems (fire prevention)	--	--	.85	3.77
Air-conditioning equipment	3.93	4.08	5.72	25.30
Service industry machines, n.e.c.	1.96	2.99	1.06	4.68
Miscellaneous machinery, except electrical	2.32	2.01	.26	1.14
Electrical machinery, equipment, and supplies	13.44	14.14	15.09	66.74
Transformers	.60	.21	.79	3.50
Electrical switchboards and panel boards	1.96	1.95	1.65	7.28
Electrical motors and generators	1.06	.78	1.34	5.94
Electric motor controls	--	--	.15	.68
Welding supplies	--	--	.03	.13
Electric housewares and fans	--	--	.04	.19
Household appliances, n.e.c.	--	--	.07	.29
Electric lamps and bulbs	--	--	.20	.90
Lighting equipment, n.e.c.	--	--	.48	2.14
Current-carrying devices	.53	.74	2.00	8.83
Noncurrent-carrying devices	1.99	1.72	1.64	7.25
Commercial, industrial, and institutional light fixtures	2.83	3.02	2.18	9.64
Radio and TV receiving sets	.35	.24	.05	.23
Radio and TV communication and transmitting devices	1.10	2.08	2.24	9.92
X-ray and photofluorographic equipment	2.36	2.97	1.69	7.46
Miscellaneous electrical machinery, equipment, and supplies	.67	.43	.53	2.36
Instruments and related products	4.70	3.44	3.42	15.11
Engineering, laboratory, and research instruments	.54	.28	.07	.30
Temperature controls	1.91	1.48	.92	4.08
Industrial measuring and controlling instruments	--	--	.20	.90
Electrical meters and measuring equipment	--	--	.04	.16
Measuring and controlling devices, n.e.c.	--	--	.15	.67
Surgical supplies and equipment	2.24	1.68	1.92	8.50
Photographic supplies and equipment	--	--	.07	.32
Miscellaneous instruments and related products	--	--	.04	.18
Miscellaneous manufacturing industries products	.26	.44	.98	4.34
Total contractors' construction equipment	2.14	2.50	5.52	24.40
Lumber and wood products, except furniture	--	--	.14	.64
Fabricated metal products	--	--	.85	3.75
Machinery, except electrical	--	--	4.11	18.17
Electrical machinery and equipment	--	--	.10	.45
Transportation equipment	--	--	.25	1.12
Measuring, analyzing, and controlling instruments	--	--	.03	.12
Miscellaneous construction equipment	--	--	.04	.15

NOTE: All individual items under 10 cents are included in the last line in each group. Detail may not add to totals due to rounding.

Table 8. Value of materials, built-in equipment, and supplies per $1,000 of contract cost and percent distribution for nursing home construction, 1975

Type of material	Value per $1,000 of contract cost	Percent distribution
All materials, equipment, and supplies	$491.99	100.0
Materials, built-in equipment, supplies	470.35	95.6
Agricultural products	0.68	0.1
Mining of nonmetallic minerals, except fuels ...	4.13	0.8
Textile mill products	1.22	0.2
Lumber and wood products, except furniture	33.28	6.8
Furniture and fixtures	9.71	2.0
Paper and allied products	2.13	0.4
Chemicals and allied products	8.11	1.6
Petroleum refining and related products	10.50	2.1
Rubber and miscellaneous plastics products	6.79	1.4
Stone, clay, glass, and concrete products	95.35	19.4
Primary metal products	54.13	11.0
Fabricated metal products	114.24	23.2
Machinery, except electrical	61.01	12.4
Electrical machinery, equipment, and supplies ..	60.06	12.2
Measuring, analyzing, and controlling instruments	7.51	1.5
Other materials and supplies	1.49	0.3
Construction equipment	21.64	4.4

NOTE: Detail may not add to totals due to rounding.

Table 9. Average onsite hourly earnings for hospital and nursing home construction by selected characteristics, 1960, 1966, and 1975

Characteristic	Hospitals						Nursing homes			
	1960		1966		1975		1966		1975	
	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract
All projects	$3.18	28.8	$3.89	29.6	$7.99	27.7	$3.48	25.6	$7.84	24.5
New	3.15	27.8	3.75	28.0	7.40	28.9	3.48	25.6	7.84	24.5
Additions	3.26	31.6	3.99	30.8	8.25	27.3	--	--	--	--
In metropolitan area ...	3.31	30.6	4.10	30.5	8.39	27.7	3.53	26.5	9.60	26.6
In nonmetropolitan area	2.94	25.6	3.39	27.2	6.96	27.8	3.43	24.9	5.33	20.4
Type of framing:										
Steel	3.20	26.2	4.04	27.1	8.29	25.5	3.68	25.3	6.23	21.9
Reinforced concrete ...	3.14	30.6	3.85	30.7	7.81	30.9	(1/)	(1/)	10.52	27.7
Load bearing masonry ..	3.35	28.9	3.74	30.8	(1/)	(1/)	3.09	24.1	--	--
1-story	2.94	24.8	3.28	25.0	8.41	19.6	3.22	24.7	5.33	20.4
2-4 stories	3.11	30.1	3.75	29.1	7.52	28.4	(1/)	(1/)	8.50	25.1
5 or more stories	3.29	29.7	4.06	30.5	7.79	29.8	--	--	10.78	28.1

[1] Insufficient data.

-- Survey had no sample projects in this cell.

to contract cost. In 1975, however, the proportion of hospital contract cost for wages and salaries appears to have been affected more by employee-hour requirements than by wage rates. Thus, the ratio of wages to contract cost was greater for new hospitals than for additions even though the wage rate was lower.

Average hourly earnings for nursing home construction workers were similar to those for hospital construction employees. As a percent of contract cost, however, wages and salaries accounted for a much smaller proportion for nursing homes (24.5 percent) than for hospitals. Nursing homes' lower labor requirements may explain this difference. As in hospital construction, employees in metropolitan areas received higher hourly wages than those in nonmetropolitan areas.

Profit and overhead

The profit and overhead component of contract cost includes items such as interest expenses, salaries of offsite workers, supplementary wage benefits, taxes, employer-paid insurance, office and other overhead expenses, and profits. Of the four components of hospital contract cost, the proportion for profit and overhead changed the most between the three studies. Although profit and overhead's share increased only 1.3 percentage points to 18.7 percent between the first two studies, it increased to 27.7 percent in 1975 (table 6). This increase is significant: In both of the earlier studies, the proportion of hospital construction value for profit and overhead was much smaller than the proportion for onsite labor. In the latest study, however, profit and overhead accounted for the same proportion of contract cost as wages and salaries. Higher interest rates and increases in both offsite salaries and supplemental benefits were major factors contributing to this rise.

Contractor costs

General contractors accounted for the largest proportion of total hospital contract cost in 1975 (table 10). Plumbing and heating, ventilating, and air-conditioning contractors had the second greatest share, followed by electrical contractors. These contractors alone accounted for over 65 percent of total hospital construction value. The distribution of contract cost by type of contractor differed slightly from the distribution of onsite employee hours. Concrete, elevator, and building equipment contractors accounted for a greater proportion of total contract cost than of labor requirements, whereas masonry, plastering and lathing, and wallboard contractors had a smaller proportion of contract cost than of onsite hours.

General, electrical, and plumbing, heating, ventilating, and air-conditioning contractors accounted for the largest proportion of nursing home construction value as well. Compared with hospitals, masonry and wallboard contractors accounted for a much greater proportion of nursing home contract cost, while the proportions of nursing home cost for concrete and structural steel contractors were much lower. The distribution of contract cost followed the same pattern as the distribution of onsite employee hours: Labor requirements for masonry and wallboard contractors were greater for nursing homes than for hospitals, while onsite hours for concrete and structural steel contractors were lower.

Table 10. Percent distribution of contract cost by type of operation for hospital and nursing home construction, 1975

Type of operation	Hospitals	Nursing homes
All operations	100.0	100.0
General contractor	28.5	28.6
Plumbing and heating, ventilating, and air-conditioning	24.2	24.7
Electrical	12.6	12.9
Concrete and stucco work	5.3	3.0
Plastering and lathing	3.8	0.9
Masonry	3.3	6.3
Structural steel erection	2.4	0.2
Building equipment installation	2.2	1.6
Carpentry	2.1	2.4
Elevators	2.0	1.8
Excavation, footings, foundations, and grading	1.4	1.1
Wallboard	1.4	4.2
Sheet-metal work	1.2	0.3
Painting	1.1	0.8
Roofing, gutter work, flashing, and siding	1.0	2.2
Glass and glazing	0.8	2.0
Ceramic tile and terrazzo	1.1	1.4
Acoustical	0.6	1.0
Linoleum, vinyl tile, and vinyl/asbestos tile	0.6	0.8
Insulating	0.5	0.4
All other	3.9	3.1

NOTE: Detail may not add to totals due to rounding.

Chapter IV. Labor Requirements and Costs by Region

Onsite employee-hour requirements

Survey data show that employee-hour requirements per $1,000 of hospital contract cost were highest in the South (table 11). Hospitals built in the South required 36.3 onsite hours per $1,000, compared with 34.7 for the United States as a whole. These results are consistent with those found in other BLS construction studies, which all show that construction methods tend to be more labor intensive in the South. In comparison, hospitals in the Northeast required the lowest number of onsite hours with 32.0 per $1,000. One reason for the lower-than-average labor requirements may be that the majority of hospital projects in the Northeast were located in metropolitan areas, where the pool of skilled labor is usually greater. Onsite labor requirements for hospitals in the North Central and West were close to the national average at 33.8 and 35.4, respectively.

By occupation. Overall, skilled workers contributed 68.6 percent of the total onsite employee-hour requirements for hospital construction. On a regional basis, hospitals built in the West required the largest number of skilled employee hours, while those built in the South required the least. Skilled workers, who accounted for 75.9 percent of all onsite hours in the West, contributed only 63.9 percent in the South. In the North Central and Northeast, skilled workers represented 71.0 percent and 72.3 percent, respectively. In both of these regions, plumbers (including pipefitters and steamfitters) accounted for the greatest proportion of onsite skilled hours. Carpenters had the largest share of onsite skilled labor requirements in the West, and were tied with electricians for the greatest proportion in the South.

Projects in the South required a larger proportion of semiskilled and unskilled employee hours than any other region. Although laborers, helpers, and tenders accounted for almost 25 percent of all hours in the South, they represented only 16.5 percent in the West. The proportion of hours contributed by office and administrative workers was also highest in the South, where supervisory workers accounted for over 8 percent of all hours. In comparison, supervisory workers contributed only 5.7 percent in the Northeast.

By type of contractor. The proportion of onsite labor requirements contributed by general contractors ranged from a high of 32.9 percent in the South to a low of 17.6 percent in the North Central region (table 12). In all four regions, plumbing and heating, ventilating, and air-conditioning contractors accounted for the largest proportion of hours for the special trades, followed by electrical contractors. Because masonry was used for a greater proportion of projects in the Northeast and North Central regions, masonry contractors accounted for more hours in these regions than in the South and West. In the latter two regions, the proportion of hours for plastering and lathing contractors was higher than that for masons. Although carpenters had a large share of total onsite hours, the proportion of hours contributed by carpentry contractors was rather small because many special trade contractors (such as acoustical tile, concrete formwork, roofing, and insulation contractors) employ carpenters to perform certain carpentry-related tasks.

By selected project characteristics. Data on selected project characteristics reveal that labor requirements for hospital construction differ depending on the type of construction involved, the type of owner, project location, and project size.[13] Labor requirements were lower for additions than for new hospitals in all regions except the North Central (table 13). In all but the Southern region, publicly owned hospitals required fewer construction hours than privately owned facilities. The majority of hospital projects had two to four stories. These hospitals required more employee hours than those with one floor; however, only 6 percent of the projects were one-storied buildings. In all regions, employee-hour requirements were greater for projects built in nonmetropolitan areas, which is probably due to the

[13] Employee-hour requirements may vary because of a combination of these factors. No data are available to prove which characteristic had the greatest effect on onsite labor requirements.

Table 11. Onsite employee-hour requirements per $1,000 of contract cost for hospital construction by occupation and region, 1975

Occupation	United States		Northeast		North Central		South		West	
	Employee hours per $1,000	Percent distribution	Employee hours per $1,000	Percent distribution	Employee hours per $1,000	Percent distribution	Employee hours per $1,000	Percent distribution	Employee hours per $1,000	Percent distribution
All occupations ..	34.7	100.0	32.0	100.0	33.8	100.0	36.3	100.0	35.4	100.0
Skilled workers:										
Brickmasons	1.2	3.5	1.5	4.6	1.3	3.8	1.2	3.3	0.3	0.9
Carpenters	4.3	12.5	4.3	13.5	3.8	11.4	4.4	12.2	6.7	18.8
Carpet and soft file installers	0.1	0.4	0.2	0.7	0.1	0.2	0.1	0.2	0.4	1.1
Concrete finishers	0.9	2.5	2.2	7.0	0.5	1.6	0.7	1.9	0.7	1.9
Drywall installers	0.4	1.0	0.7	2.0	0.3	1.0	0.3	0.8	0.2	0.5
Electricians	4.1	11.9	2.9	9.0	4.4	13.0	4.4	12.2	3.6	10.2
Elevator installers	0.2	0.7	0.3	0.9	0.2	0.6	0.2	0.6	0.3	0.9
Glaziers	0.2	0.5	0.2	0.6	0.2	0.5	0.2	0.4	0.2	0.4
Heating, air-conditioning, and refrigerator mechanics	0.1	0.4	0.1	0.2	--	--	0.3	0.9	0.0	0.0
Insulation workers	0.8	2.2	0.7	2.2	0.7	1.9	0.8	2.2	1.2	3.3
Lathers	0.7	2.1	0.2	0.6	0.8	2.4	0.8	2.2	1.2	3.4
Operating engineers	0.7	2.1	0.7	2.0	0.8	2.3	0.8	2.1	0.4	1.2
Painters	0.6	1.6	0.5	1.4	0.5	1.5	0.7	1.8	0.6	1.6
Paperhangers	0.1	0.2	0.1	0.4	0.1	0.3	--	--	0.1	0.4
Pipefitters and steamfitters	2.1	6.0	2.3	7.3	3.1	9.2	1.1	3.0	2.2	6.3
Plasterers	0.5	1.5	0.4	1.4	0.5	1.5	0.5	1.4	0.7	2.0
Plumbers	2.3	6.6	2.9	9.2	1.8	5.4	2.4	6.5	3.1	8.9
Reinforcing ironworkers ...	0.5	1.6	0.5	1.5	0.6	1.7	0.5	1.4	0.7	1.9
Roofers	0.2	0.6	0.3	0.8	0.3	0.7	0.2	0.4	0.2	0.7
Sheet-metal workers	1.9	5.4	1.3	4.0	2.4	6.9	1.6	4.2	2.6	7.3
Stonemasons	0.1	0.2	--	--	0.1	0.3	0.0	0.1	0.1	0.1
Structural metal and ornamental iron workers	0.9	2.6	0.7	2.2	1.1	3.3	0.8	2.1	0.7	2.0
Tile setters and terrazzo workers	0.2	0.6	0.1	0.4	0.2	0.6	0.3	0.7	0.2	0.6
Welders and cutters	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.3
Other skilled workers ...	0.5	1.7	0.1	0.2	0.1	0.7	1.0	3.0	0.4	1.2
Semiskilled and unskilled workers:										
Laborers, helpers, and tenders	7.2	20.6	5.9	18.5	5.8	17.3	8.9	24.7	5.8	16.5
Truckdrivers	0.1	0.4	0.1	0.3	0.2	0.5	0.1	0.3	0.0	0.1
Other	0.5	1.4	0.1	0.2	0.5	1.6	0.6	1.7	0.1	0.5
Office and administrative workers:										
Professional, technical, and clerical workers	0.5	1.3	0.8	2.4	0.4	1.2	0.3	1.0	0.4	0.9
Supervisors	2.6	7.4	1.9	5.7	2.5	7.4	3.0	8.1	2.2	6.2

-- No data reported.

NOTE: Detail may not add to totals due to rounding.

Table 12. Percent distribution of onsite employee hours per $1,000 of cost for hospital construction by type of contractor and region, 1975

Type of contractor	United States	Northeast	North Central	South	West
Total	100.0	100.0	100.0	100.0	100.0
General contractor	26.6	27.0	17.6	32.9	32.0
Excavating, footings, foundations and grading	1.4	1.6	1.7	1.2	0.6
Concrete reinforcement	0.4	(1/)	0.6	0.1	2.3
Concrete work	4.4	2.8	8.4	2.0	1.8
Structural steel	1.9	1.8	3.2	1.2	0.6
Masonry	5.5	6.8	7.5	4.1	1.8
Carpentry	1.6	3.5	1.5	1.0	2.1
Plumbing	4.9	9.3	4.3	2.7	14.0
Heating, ventilating, and air-conditioning	18.8	15.2	22.2	18.6	10.6
Electrical	13.0	11.0	14.1	13.1	10.9
Insulation	1.1	1.8	0.8	1.1	1.6
Plastering and lathing	6.5	1.2	5.2	9.0	7.6
Wallboard	2.1	6.6	2.0	0.9	2.1
Sheet-metal work	1.2	0.4	0.7	1.8	2.6
Ornamental ironwork	0.3	1.0	0.3	0.1	(1/)
Roofing and gutter work	1.1	1.3	1.0	1.1	1.3
Elevators	1.2	1.2	1.2	1.2	1.7
Glass and glazing	0.6	0.6	0.6	0.5	0.5
Painting and wallpapering	1.9	1.9	1.8	2.0	1.9
Ceramic tile and terrazzo work ...	1.7	1.1	2.5	1.4	0.5
Linoleum, vinyl tile, and vinyl/asbestos tile	0.6	0.8	0.4	0.4	1.5
Acoustical tile	0.8	0.9	0.8	0.8	0.7
Building equipment installation ..	0.7	0.3	0.6	0.9	0.2
Other	1.6	1.8	1.1	1.9	1.3

[1] Insufficient data. See text footnote 4.

NOTE: Detail may not add to totals due to rounding.

Table 13. Onsite employee-hour requirements for hospital construction by selected characteristics and region, 1975

Characteristic 1/	United States		Northeast		North Central		South		West	
	Employee hours per:		Employee hours per:		Employee hours per:		Employee hours per:		Employee hours per:	
	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet
Project characteristics										
All hospital projects:	34.7	172	32.0	239	33.8	149	36.3	174	35.4	195
New	39.0	177	(2/)	(2/)	31.3	138	52.6	221	35.9	187
Additions	33.1	170	31.8	242	35.0	155	32.2	160	34.7	207
Publicly owned	42.1	203	--	--	31.1	156	48.8	225	34.7	211
Privately owned	31.7	159	32.0	239	34.7	147	27.3	134	35.6	191
Metropolitan area	33.0	159	31.4	242	32.6	141	34.0	159	33.0	202
Nonmetropolitan area	40.0	214	34.5	229	40.8	212	43.1	222	36.2	192
Number of stories:										
1	23.4	162	(2/)	(2/)	--	--	--	--	28.1	172
2-4	37.8	198	34.0	221	35.2	180	43.0	213	36.6	198
5 and above	33.5	160	32.5	255	33.1	137	34.2	162	--	--
Building characteristics										
Conveyor systems:										
Elevators	34.8	170	32.1	232	33.8	149	36.3	174	36.6	198
No elevators	30.7	242	31.8	284	--	--	--	--	28.1	172
Escalators	45.9	212	(2/)	(2/)	--	--	(2/)	(2/)	--	--
No escalators	33.9	168	32.8	270	33.8	149	34.1	165	35.4	195
Type of heat:										
Forced air	32.8	155	32.7	248	33.0	138	32.4	152	35.6	202
Hot water	36.2	195	31.2	233	34.4	160	43.3	242	35.2	219
Other	39.8	169	35.2	250	--	--	(2/)	(2/)	(2/)	(2/)
Type of fuel:										
Electricity	41.1	247	(2/)	(2/)	(2/)	(2/)	--	--	--	--
Gas	34.3	164	32.3	224	33.1	144	34.9	166	35.4	195
Oil	35.7	186	30.8	227	35.6	149	44.3	219	--	--
Air-conditioning:										
Central air-conditioning	35.1	173	32.0	239	34.6	150	36.5	174	35.4	195
Framing:										
Steel	30.7	145	32.0	243	28.1	114	31.6	137	33.1	174
Concrete: precast or poured	39.6	210	32.3	224	37.9	180	43.3	245	37.4	213
Exterior wall:										
Concrete: precast or poured	34.5	165	(2/)	(2/)	28.3	116	40.3	212	35.1	184
Load bearing masonry	34.6	167	31.9	282	36.2	160	34.3	153	--	--
Curtain wall	35.5	208	31.5	171	(2/)	(2/)	(2/)	(2/)	37.3	213
Interior wall:										
Drywall	33.1	167	31.0	231	32.4	151	34.1	161	33.8	203
Plaster	37.9	170	(2/)	(2/)	34.1	134	47.8	244	36.7	189
Masonry: brick or block	39.0	282	34.9	292	(2/)	(2/)	--	--	--	--
Floor base:										
Concrete	34.7	172	32.0	239	33.8	149	36.3	174	35.4	195

See footnotes at end of table.

Table 13. Continued—Onsite employee-hour requirements for hospital construction by selected characteristics and region, 1975

Characteristic 1/	United States		Northeast		North Central		South		West	
	Employee hours per:		Employee hours per:		Employee hours per:		Employee hours per:		Employee hours per:	
	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet	$1,000 of cost	100 square feet
Floor covering:										
Terrazzo	35.6	155	(2/)	(2/)	(2/)	(2/)	--	--	--	--
Carpet	39.6	236	--	--	--	--	41.0	254	36.9	207
Vinyl/vinyl asbestos tile	34.1	168	32.8	270	32.5	144	35.6	165	34.3	185
Ceiling:										
Acoustical tile	34.4	169	32.0	239	33.1	144	36.3	174	35.0	190
Roof base:										
Steel decking	37.7	180	--	--	32.7	166	47.0	199	28.1	172
Concrete	34.4	170	32.9	244	34.0	146	34.9	170	36.6	198
Roof cover:										
Built-up	35.0	173	32.0	239	34.6	150	36.3	174	35.4	195
Basement:										
Basement	33.7	155	31.7	189	33.1	143	34.3	157	37.1	196
No basement	37.2	227	32.3	304	38.2	200	40.7	217	32.1	191
Parking:										
Outdoor	33.7	170	31.3	227	35.0	157	33.3	164	35.0	190
None	38.7	175	35.5	306	28.6	113	47.8	208	(2/)	(2/)

[1] Table shows only characteristics for which there were 2 or more projects in sample. See table 19 for complete listing of project characteristics.

[2] Insufficient data. See text footnote 4.

-- Survey had no sample projects in this cell.

Table 14. Average onsite hourly earnings and wages as a percent of contract cost for hospital construction projects by selected characteristics and region, 1975

Characteristic 1/	United States		Northeast		North Central		South		West	
	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract
All hospital projects:	$7.99	27.7	$8.60	27.5	$8.70	29.4	$7.18	26.1	$8.29	29.4
New	7.40	28.9	(2/)	(2/)	8.96	28.1	5.70	30.0	8.41	30.2
Additions	8.25	27.3	8.73	27.7	8.59	30.0	7.79	25.1	8.10	28.1
Number of stories:										
1	8.41	19.6	(2/)	(2/)	--	--	--	--	8.38	23.6
2-4	7.51	28.4	8.22	28.0	8.36	29.4	6.12	26.3	8.28	30.3
5 and above	7.79	29.8	8.55	27.0	8.90	31.1	6.27	29.7	--	--
Conveyor systems:										
Elevators	7.97	27.7	8.51	27.3	8.70	29.4	7.18	26.1	8.28	30.3
No elevators	8.92	27.4	9.11	29.0	--	--	--	--	8.38	23.6
Escalators	6.93	31.8	(2/)	(2/)	--	--	(2/)	(2/)	--	--
No escalators	8.10	27.4	8.57	28.2	8.70	29.4	7.34	25.0	8.29	29.4
Basement:										
Basement	8.22	27.7	8.42	26.7	8.91	29.5	7.43	25.5	8.24	30.6
No basement	7.48	27.8	8.74	28.2	7.52	28.7	6.72	27.4	8.41	26.9
Parking:										
Outdoor	7.99	26.9	8.44	26.4	8.61	30.2	7.21	24.0	8.41	29.4
None	7.85	30.4	9.30	33.1	8.81	25.2	7.10	33.9	(2/)	(2/)
Type of heat:										
Forced air	7.87	25.8	8.47	27.7	8.30	27.4	7.45	24.1	8.33	29.7
Hot water	8.15	29.5	8.61	26.9	9.02	31.0	6.78	29.4	7.49	26.4
Other	7.87	31.3	8.87	31.2	--	--	(2/)	(2/)	(2/)	(2/)

See footnotes at end of table.

Table 14. Continued—Average onsite hourly earnings and wages as a percent of contract cost for hospital construction projects by selected characteristics and region, 1975

Characteristic 1/	United States		Northeast		North Central		South		West	
	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract	Average hourly wage	Wages as percent of contract
Type of fuel:										
Electricity	$7.15	29.3	(2/)	(2/)	(2/)	(2/)	--	--	--	--
Gas	7.99	27.4	$8.87	28.7	$8.97	29.7	$7.39	25.8	$8.29	29.4
Oil	8.05	28.8	8.39	25.8	9.03	32.1	6.25	27.7	--	--
Framing:										
Steel	8.29	25.5	8.52	27.2	8.95	25.1	7.78	24.6	8.51	28.2
Concrete: precast or poured	7.81	30.9	8.87	28.7	8.96	34.0	6.53	28.3	8.12	30.3
Exterior wall:										
Concrete: precast or poured	7.64	26.4	(2/)	(2/)	8.99	25.5	6.46	26.0	8.51	29.8
Load bearing masonry	8.26	28.6	8.76	27.9	8.68	31.4	7.72	26.5	--	--
Curtain wall	7.45	26.4	8.62	27.2	(2/)	(2/)	(2/)	(2/)	7.99	29.8
Interior wall:										
Drywall	7.77	25.7	8.67	26.9	8.34	27.0	7.17	24.5	8.11	27.4
Plaster	8.34	31.6	(2/)	(2/)	9.18	31.3	7.19	34.4	8.41	30.9
Masonry: brick or block	8.90	34.7	8.92	31.1	(2/)	(2/)	--	--	--	--
Floor base:										
Concrete	7.99	27.7	8.60	27.5	8.70	29.4	7.18	26.1	8.29	29.4
Floor covering:										
Terrazzo	8.88	31.6	(2/)	(2/)	(2/)	(2/)	--	--	--	--
Carpet	7.56	29.9	--	--	--	--	7.18	29.5	8.32	30.7
Vinyl/vinyl asbestos tile	7.90	26.9	8.57	28.2	8.68	28.2	7.18	25.6	8.26	28.3
Ceiling:										
Acoustical tile	7.97	27.4	8.60	27.5	8.69	28.7	7.18	26.1	8.41	29.4
Roof base:										
Steel decking	6.45	24.3	--	--	7.45	24.4	5.20	24.4	8.38	23.6
Concrete	8.25	28.4	8.60	28.3	9.00	30.6	7.53	26.3	8.28	30.3
Roof cover:										
Built-up	7.97	27.9	8.60	27.5	8.71	30.1	7.18	26.1	8.29	29.4
Metropolitan area	8.39	27.7	8.71	27.3	9.04	29.5	7.68	26.1	7.84	25.9
Nonmetropolitan area	6.96	27.8	8.24	28.4	7.00	28.6	6.03	26.0	8.42	30.5
Publicly owned	6.57	27.7	--	--	8.65	26.9	5.77	28.1	7.79	27.0
Privately owned	8.75	27.7	8.60	27.5	8.72	30.3	9.01	24.6	8.41	30.0

[1] Table shows only characteristics for which there were 2 or more projects in sample. See table 19 for complete listing of project characteristics.

[2] Insufficient data. See text footnote 4.

-- Survey had no sample projects in this cell.

Table 15. Average hourly earnings for selected onsite construction workers by occupation and region for hospital construction, 1975

Occupation	United States	Northeast	North Central	South	West
Skilled workers:					
Brickmasons	$8.83	$8.80	$9.67	$8.04	$8.98
Carpenters	8.30	8.98	8.98	7.66	7.87
Carpet and soft tile installers	8.06	9.06	7.76	7.50	7.82
Concrete finishers	8.18	8.06	9.32	7.51	8.51
Drywall installers	8.11	8.85	8.77	6.77	8.58
Electricians	8.91	10.04	9.37	8.24	8.88
Elevator installers	9.37	9.89	9.72	8.88	9.20
Glaziers	7.93	7.59	8.66	7.00	10.17
Insulation workers	9.68	9.10	10.00	9.85	8.74
Lathers	8.16	8.76	9.22	7.08	8.68
Operating engineers	8.53	9.41	9.05	7.85	7.99
Painters	7.75	8.64	8.85	6.72	8.37
Pipefitter and steamfitters	9.05	9.01	9.32	8.30	9.35
Plasterers	8.32	9.44	9.14	7.10	9.15
Plumbers	8.43	8.86	9.37	7.43	9.23
Reinforcing ironworkers	8.18	8.62	9.09	6.98	8.79
Roofers	7.28	8.28	8.01	5.51	8.16
Sheet-metal workers	8.50	8.27	8.89	7.98	9.41
Structural metal and ornamental ironworkers	9.20	10.11	9.01	9.33	7.95
Tilesetters, hard	7.91	8.34	8.42	7.44	8.30
Semiskilled and unskilled workers:					
Laborers	5.52	6.23	6.48	4.73	6.25
Helpers	6.32	7.25	7.25	5.35	6.78
Truckdrivers, heavy and light	6.25	3.89	6.87	5.82	12.00
Office and administrative workers:					
Clerical workers	3.94	4.25	3.93	3.48	4.99
Professional and technical workers	8.09	9.26	7.41	8.11	9.41
Supervisors	9.48	11.23	9.92	8.87	9.06

NOTE: Detail may not add to totals due to rounding.

greater use of unskilled labor and less intensive capitalization in these areas.

By selected building characteristics. Labor requirements varied more between regions when arrayed by selected building characteristics than when arrayed by project characteristics. In all regions, labor requirements were lowest for hospitals with steel frames and drywall interior walls. Only in the North Central region did projects without elevators require more employee hours than those with elevators. Data for other building characteristics, however, were not as consistent. The distribution of hours by type of heat, exterior wall material, and floor covering varied by region, with no general trend evident.

The regional distribution of onsite employee hours per 100 square feet differed from the distribution of hours per $1,000. Although employee hours per $1,000 were lowest in the Northeast, requirements per 100 square feet were the highest. Because onsite employee hours per 100 square feet may be affected by other project characteristics, such as size, cost, and location, they are not necessarily comparable to hours per $1,000. For example, the difference in the Northeast between requirements per $1,000 and requirements per 100 square feet may be due to the average size of these projects, which was smallest in the United States (on a square foot basis).

Wages and salaries

The South had the lowest average hourly earnings for hospital construction workers and the smallest ratio of wages to contract cost (table 14). These low wage rates are thought to be responsible for the South having the smallest wage to cost ratio, even though employee-hour requirements were highest. The North Central region had the highest average hourly wage, and was tied with the West for the greatest ratio of wages to total cost. Throughout the United States, average hourly earnings were greater for projects constructed in metropolitan than in nonmetropolitan areas.

The extent of unionization within a region often affects regional wage rates. Survey data show that average hourly earnings were higher in regions where a large proportion of contractors were unionized. In the Northeast and West, over 90 percent of the contractors who reported data on labor agreements were unionized, compared with only 73.5 percent in the South. The following tabulation shows the percentage of union and nonunion contractors in each region:[14]

	United States	*Northeast*	*North Central*	*South*	*West*
Contractors having formal agreements ...	83.6	94.2	84.5	73.5	91.7
Contractors not having formal labor agreements	16.4	5.8	15.5	26.5	8.3

By occupation. Overall, the highest wage rates for all occupations were in the Northeast and North Central regions, while the lowest were in the South (table 15). This was especially true for laborers: The average hourly wage for laborers in the South was approximately 14 percent less than the national average. For the United States as a whole, insulation workers, elevator installers, and structural and ornamental ironworkers received the highest hourly wage among skilled workers; roofers and painters received the lowest.

[14] The proportion of contractors in each region who did not provide data on labor agreements is as follows: 5.5 percent in the Northeast, 15.3 percent in the North Central, 21.7 percent in the South, and 9.4 percent in the West.

Chapter V. Project Characteristics and Trends in Hospital Design

Project characteristics

Hospitals completed in 1976 were larger and cost more to build than those previously studied (table 16). Between the first and most recent surveys, the average number of square feet per project increased twice as much as the number of beds. Although cost per square foot nearly doubled between the first and latest studies, cost per bed more than tripled. Even on a constant (1972) dollar basis, the average cost per bed increased 40 percent between 1960 and 1975. This suggests that newer hospitals contain more space for equipment and special purpose areas (such as diagnostic and therapy rooms, laboratories, and X ray rooms) than hospitals in earlier studies. Largely because of this increase in size, the average length of construction time grew from 77 weeks in 1960 to 154 weeks in 1975.

Additions to existing hospitals continued to outnumber new hospital buildings. Survey data show that the number of additions increased from 57.4 percent of all projects in 1966 to 81.9 percent in 1975. This trend reflects the increasing use of additions and rehabilitation as a method of cutting hospital costs: Overall construction costs for renovations and additions are lower than those for new hospitals, even though cost per square foot may be higher. Hospital projects also shifted in location. In the 1975 study, hospitals were evenly divided between metropolitan and nonmetropolitan areas; in 1966, the majority of projects were located in metropolitan areas.

Nursing homes constructed in 1975 cost almost 75 percent less and had 70 percent less floor space than hospitals built the same year. They also took approximately 85 fewer weeks to build than hospitals. Even though nursing homes were much smaller than hospitals, they contained almost as many beds. The average cost per bed for hospitals was over three times greater than that for nursing homes, while cost per square foot was similar. Because nursing homes generally contain less equipment than hospitals, more space is devoted to beds; thus, the large cost-per-bed differential.

Nursing homes built in 1975 were larger and more expensive than those constructed in 1966. In constant (1972) dollars, however, the cost per bed remained relatively unchanged between the two surveys. The following tabulation shows the average project size and costs for nursing homes built in 1966 and 1975:

	1966	*1975*
Floor space (in thousand square feet)	29.5	48.9
Cost per square foot	$20.89	$41.35
Average total cost:		
Current dollars	615,388	2,023,268
Constant (1972) dollars	938,091	1,502,613
Number of beds	65	104
Cost per bed (thousands):		
Current dollars	9.4	19.4
Constant (1972) dollars	14.4	14.4

By region. Survey data show regional differences in hospital design, size, and cost (table 17). On average, the largest projects were in the South. Hospitals built in the South had the highest average project cost, the most floor space, and took longer to build than hospitals in all other regions. Hospitals in the Northeast were the smallest and most expensive per square foot. Several projects in the Northeast were small additions to existing hospitals which contained relatively little floor space, and one included extensive rehabilitation work. (Cost per square foot is generally higher for additions than for new hospitals, because extensive alterations to the original building are often required before new construction can begin.) Fewer hospitals were built in the West than in any of the other regions, which may explain the difference between the proportion of additions and new buildings for that region and the United States as a whole.

Building characteristics

Reinforced concrete was the principal type of framing material used in all three studies; however, the proportion of hospitals with concrete frames decreased between 1966 and 1975 (table 18). In comparison, the proportion of hospitals with steel frames increased from 30 percent in both of the earlier studies to almost 40 percent in 1975. The proportion of hospitals with masonry frames increased slightly between 1966 and 1975, after

Table 16. Selected project characteristics for hospital construction, 1960, 1966, and 1975

Characteristic	1960	1966	1975
Number of projects	46	61	90
Additions	14	35	74
New hospitals	32	26	16
Metropolitan area	20	38	45
Nonmetropolitan area	26	23	45
Floor space (in thousand square feet)	56.5	63.5	163.6
Average total cost:			
Current dollars	$1,463,723	$1,811,459	$8,097,826
Constant (1972) dollars	$2,466,256	$2,761,370	$6,013,981
Cost per square foot	$25.93	$28.51	$49.48
Number of beds per project	86	82	128
Cost per bed (in thousands)	$16.9	$22.2	$63.4
Average number of weeks of construction	77	91	154

Table 17. Selected project characteristics for hospital construction, by region, 1975

Characteristic	United States	Northeast	North Central	South	West
Average number of square feet per project (in hundred square feet)	1,636.4	859.5	1,798.9	2,091.1	990.0
Average cost per project	$8,097,826	$6,400,883	$7,963,530	$10,009,634	$5,435,938
Average cost per square foot	$49.48	$74.48	$44.27	$47.87	$54.91
New	$45.29	(1/)	$43.93	$41.97	$52.14
Additions	$51.18	$76.31	$44.44	$49.65	$59.63
Number of beds per project	128	80	128	159	103
Cost per bed (in thousands)	$63.4	$79.5	$50.2	$78.5	$52.6
Additions as percent of all projects	81.9	87.7	85.7	84.3	49.5
New buildings as percent of all projects	18.3	12.3	14.6	15.7	49.5
Percent of projects in metropolitan areas	49.9	62.6	44.5	48.9	49.5
Percent of projects in non-metropolitan areas	50.1	37.4	55.5	51.1	49.5
Average number of weeks of construction	154	145	149	174	121

[1] Insufficient data. See text footnote 4.

Table 18. Percent distribution of hospital and nursing home construction projects by selected building characteristics, 1960, 1966, and 1975

Characteristic	Hospitals			Nursing homes	
	1960	1966	1975	1966	1975
Number of stories:					
1 story	52.2	19.7	5.8	75.0	63.5
2-4	23.9	36.1	58.3	25.0	28.8
5 and above	23.9	44.3	36.0	--	8.3
Type of framing:					
Steel	30.4	29.5	39.9	41.7	80.8
Reinforced concrete	37.0	59.0	47.7	8.3	19.9
Load bearing masonry	28.3	8.2	12.5	41.7	--
Wood and other	4.3	3.3	--	8.3	--
Exterior wall:					
Masonry	84.8	90.2	63.5	100.0	83.3
Curtain wall	10.9	1.6	17.7	--	--
Concrete	--	--	17.1	--	17.3
Other	4.3	8.2	1.7	--	--
Conveyor systems:					
Elevators	63.0	85.2	91.9	50.0	44.9
No elevators	37.0	14.8	8.2	50.0	55.1
Basement:					
Basement	60.9	72.1	51.7	33.3	34.0
No basement	39.1	27.9	48.5	66.7	66.0

-- Survey had no sample projects in this cell.

Table 19. Number and costs of hospital construction projects by selected characteristics and region, 1975

Characteristic	United States			Northeast			North Central			South			West		
	Number of projects	Cost per:		Number of projects	Cost per:		Number of projects	Cost per:		Number of projects	Cost per:		Number of projects	Cost per:	
		Square foot	Bed (thousands)		Square foot	Bed (thousands)		Square foot	Bed (thousands)		Square foot	Bed (thousands)		Square foot	Bed (thousands)
All hospital projects	90	$49.48	$63.4	17	$74.48	$79.5	34	$44.27	$50.2	30	$47.87	$78.5	9	$54.91	$52.6
Number of stories:															
1	5	69.21	88.6	2	(1/)	(1/)	--	--	--	--	--	--	3	61.04	85.9
2-4	53	52.43	49.9	6	64.84	48.6	24	51.18	46.9	16	49.43	54.7	6	54.05	49.6
5 and above	32	47.81	72.2	9	78.28	102.4	10	41.55	52.0	14	47.39	91.2	--	--	--
Conveyor systems:															
Elevators	83	48.88	62.7	13	72.29	76.7	34	44.27	50.2	30	47.87	78.5	6	54.05	49.6
No elevators	7	78.74	95.1	4	89.40	99.6	--	--	--	--	--	--	3	61.04	85.9
Escalators	3	46.28	362.7	2	(1/)	(1/)	--	--	--	1	(1/)	(1/)	--	--	--
No escalators	87	49.73	59.9	15	82.37	68.2	34	44.27	50.2	29	48.59	72.4	9	54.91	52.6
Basement:															
Basement	47	45.99	63.6	9	59.49	74.7	21	43.24	49.0	13	45.79	98.5	5	52.86	46.0
No basement	44	61.21	63.1	9	94.19	84.0	13	52.37	59.7	18	53.16	54.4	5	59.55	73.7
Parking area:															
Outdoor	73	50.47	62.3	13	72.52	84.5	29	44.93	46.0	23	49.13	76.6	8	54.23	64.2
In or under building and outdoor	2	(1/)	(1/)	--	--	--	2	(1/)	(1/)	--	--	--	--	--	--
None	15	45.27	66.4	4	86.21	61.3	2	39.53	64.2	7	43.62	86.7	2	(1/)	(1/)
Type of heat:															
Forced air	50	47.16	72.6	6	75.72	84.5	24	41.76	59.8	15	47.06	83.7	5	56.77	60.5
Hot water	30	53.89	57.3	6	74.52	105.9	9	46.54	44.4	11	55.88	74.0	3	62.30	25.0
Other	10	42.46	47.6	4	70.96	28.6	--	--	--	5	(1/)	(1/)	2	(1/)	(1/)
Type of fuel:															
Electricity	13	60.20	58.5	2	(1/)	(1/)	11	(1/)	(1/)	--	--	--	--	--	--
Gas	60	47.79	68.4	6	69.40	38.9	17	43.64	55.5	28	47.61	90.8	9	54.91	52.6
Oil	16	52.13	55.6	9	73.84	110.3	4	41.82	41.8	3	49.36	44.5	--	--	--
Other	1	(1/)	(1/)	--	--	--	1	(1/)	(1/)	--	--	--	--	--	--
Air-conditioning:															
Central air-conditioning	87	49.34	64.0	17	74.48	79.5	32	43.42	49.2	28	47.68	80.5	9	54.91	52.6
Other than central	2	(1/)	(1/)	--	--	--	--	--	--	2	(1/)	(1/)	--	--	--
None	1	(1/)	(1/)	--	--	--	1	(1/)	(1/)	--	--	--	--	--	--
Framing:															
Steel	36	47.16	82.0	11	75.94	109.8	6	40.59	63.2	14	43.37	89.3	5	52.49	75.5
Concrete: pre-cast or poured	43	52.98	49.4	6	69.40	38.9	16	47.43	42.6	16	56.56	66.6	5	57.06	42.2
Load bearing masonry	11	(1/)	(1/)	--	--	--	11	(1/)	(1/)	--	--	--	--	--	--
Exterior wall:															
Concrete: pre-cast or poured	16	47.97	56.3	2	(1/)	(1/)	4	40.99	64.6	7	52.74	45.9	3	52.59	69.9
Load bearing masonry	57	48.32	68.9	11	88.43	77.6	29	44.30	45.3	18	44.52	114.3	--	--	--
Curtain wall	16	58.73	55.5	4	54.36	92.3	1	(1/)	(1/)	6	(1/)	(1/)	5	56.95	36.5
Other	2	(1/)	(1/)	--	--	--	--	--	--	--	--	--	2	(1/)	(1/)
Interior wall:															
Drywall	68	50.39	65.4	9	74.64	90.5	26	46.67	50.6	28	47.30	74.7	6	60.01	45.7
Plaster	14	44.67	58.2	2	(1/)	(1/)	6	39.32	46.5	3	51.10	107.4	3	51.51	59.6
Masonry: brick or block	8	72.25	66.8	6	83.78	56.8	1	(1/)	(1/)	--	--	--	--	--	--
Floor base:															
Concrete	90	49.48	63.4	17	74.48	79.5	34	44.27	50.2	30	47.87	78.5	9	54.91	52.6
Floor covering:															
Terrazzo	6	43.52	48.2	2	(1/)	(1/)	3	(1/)	(1/)	--	--	--	--	--	--
Carpet	8	59.72	55.4	--	--	--	--	--	--	5	61.97	55.2	3	56.10	55.7
Vinyl/vinyl-asbestos tile	76	49.29	68.2	15	82.37	68.2	29	44.23	55.8	26	46.27	83.9	6	53.99	50.3
Other	1	(1/)	(1/)	--	--	--	1	(1/)	(1/)	--	--	--	--	--	--
Ceiling:															
Drywall	2	(1/)	(1/)	--	--	--	--	--	--	--	--	--	2	(1/)	(1/)
Plaster	1	(1/)	(1/)	--	--	--	1	(1/)	(1/)	--	--	--	--	--	--
Acoustical tile	88	49.17	64.1	17	74.48	79.5	32	43.41	48.9	30	47.87	78.5	8	54.23	64.2
Roof base:															
Steel decking	19	$47.79	$49.7	--	--	--	12	$50.76	$53.9	4	$42.37	$41.5	3	$61.04	$85.9
Concrete	69	49.54	66.0	15	$74.13	$78.8	21	42.93	49.4	27	48.70	89.0	6	54.05	49.6
Other	2	(1/)	(1/)	2	(1/)	(1/)	--	--	--	--	--	--	--	--	--
Roof cover:															
Asphalt/asbestos-shingles	1	(1/)	(1/)	--	--	--	1	(1/)	(1/)	--	--	--	--	--	--
Built-up	89	49.40	63.7	17	74.48	79.5	32	43.42	49.2	30	47.87	78.5	9	54.91	52.6
Metropolitan area	45	48.33	68.3	11	77.03	104.6	15	43.26	50.8	15	46.76	92.8	5	61.25	36.3
Nonmetropolitan area	45	53.53	51.9	6	66.48	42.5	19	51.95	46.6	16	51.40	54.2	5	53.16	61.4
Publicly owned	31	48.12	57.3	--	--	--	10	50.35	56.3	18	46.23	61.3	3	60.70	33.8
Privately owned	59	50.05	66.3	17	74.48	79.5	24	42.44	48.3	12	49.13	93.7	6	53.58	61.5

1/ Insufficient data. See text footnote 4.
-- Survey had no sample projects in this cell.

NOTE: Detail may not add to totals due to rounding.

decreasing between the first two studies. The use of masonry for exterior walls decreased between the second and most recent studies. Although masonry was the primary wall material used in all studies, the proportion of hospitals with masonry exterior walls fell from 90.2 percent in 1966 to 63.5 percent in 1975. One reason for this decline was the introduction of precast and cast-in-place-concrete as an exterior wall material. While concrete was not used for exterior walls in either of the earlier surveys, 17.1 percent of the hospitals built in 1975 had concrete exterior walls.

Building characteristics of nursing homes constructed in 1975 differed from those of hospitals built at the same time. Over 80 percent of the surveyed nursing homes had steel frames, compared with 40 percent of hospitals. The remaining 20 percent of nursing homes had concrete frames. Although masonry was not used for framing, the proportion of nursing homes with masonry exterior walls was greater than that for hospitals. In addition, the majority of nursing homes were one-storied buildings, while the majority of hospitals had two to four floors.

By region. Hospital building characteristics also varied by region (table 19). Projects in the Northeast, which had the highest cost per square foot, differed from the other projects in certain characteristics. Even though almost half of the hospitals in the North Central, South, and West had concrete frames, only 35 percent of the projects in the Northeast used concrete for framing. The Northeast had the largest number of projects with masonry interior walls, whose cost per square foot was almost 40 percent greater than the U.S. average for hospitals with drywall. In addition, the cost per square foot for buildings with five or more stories in the Northeast was over $30 greater than the national average. Project characteristics in other regions differed as well. For example, only in the North Central region was masonry used as a framing material. And although 36 percent of the surveyed projects had five or more stories, no hospital in the West contained more than four floors.

Trends in hospital construction

Because medical technology changes rapidly, hospitals must continually update their facilities. At the same time, they are faced with tight budgets and increasing costs. Most of the current trends in hospital construction are attempts to meet these two challenges.

The most visible result of rising construction costs and budget constraints is a change in the type of health care construction taking place. Hospitals are increasingly relying on renovations and additions (as opposed to new construction) to replace obsolete facilities. Throughout the 1970's, additions to existing facilities represented approximately 50 percent of total contract value, while construction of new hospitals decreased from 45 to 35 percent.[15] This trend should continue in the 1980's, since many new hospitals contain features which make remodeling easier and less costly.

Other trends reflect changes in society's health care needs. Health care is becoming more specialized, and so are health care facilities. An increasing elderly population, for example, needs more extended care facilities (such as nursing and convalescent homes and hospices). Special short-term care facilities, such as ambulatory care centers, offer an alternative to the traditional outpatient care in hospitals. In addition, emphasis is being placed on improving the hospital's physical surroundings. Greater attention to lighting, color schemes, and space allocation results in better conditions for both patients and staff.

Hospital design. One design feature employed to facilitate remodeling is the use of interstitial space. Interstitial space is the area between floors which contains all of the hospital's mechanical systems. This space is usually large enough for workers to repair or replace equipment without disrupting activities on the floors above or below. Although material requirements are usually greater for buildings with interstitial space, overall construction costs are often lower due to reduced labor requirements for installation of the mechanical systems.[16] Potentially higher initial costs often are offset by savings in cost and time for maintenance and remodeling (if needed). Another trend involves using design to reduce energy consumption. Because of the type of services they provide, hospitals use three times more energy per square foot than large office or apartment buildings.[17] Furthermore, hospital energy systems (particularly heating, ventilating, and air-conditioning systems) must comply with strict codes and standards designed to insure a sterile environment.[18] These include air exchange standards for operating rooms, and regulations covering air and water temperatures and lighting levels. Skyrocketing energy costs have compelled hospital planners to develop methods for decreasing energy usage without sacrificing patient safety.

The majority of conservation methods that are currently being used are passive, which are generally less expensive than active conservation methods. A greater focus on building orientation and window placement helps to reduce heating and/or cooling requirements. Other design features include: Reduction of glass on exterior walls; improved insulation; double- and triple-glazed windows; special window treatments such as overhangs, recessed and clerestory windows, and

[15] Phillip E. Kidd, "Finding Opportunities in Health Care Construction," *Architectural Record*, June 1980, p. 59.

[16] "Interstitial Space Cuts Costs," *Engineering News Record*, June 11, 1981, p. 22.

[17] Ronald L. Skaggs, "Energy Savings Opportunities in Facility Design," *Hospitals*, October 16, 1980, p. 85.

[18] Marvin F. Gough, and James V. McLarney, "Planning Is Key to Energy Management," *Hospitals*, October 16, 1980, p. 80.

skylights; and construction materials that reflect or attract sunlight.

Many of the active conservation systems are expensive to install; therefore, they are not as widespread as the features previously mentioned. Once installed, however, features such as solar-generated and heat recovery systems help to reduce energy costs. A 126,000-square-foot hospital in Prince Frederick, Maryland, contains both types of conservation systems.[19] Solar panels are used to heat both hot water and patient rooms. The heat recovery system collects and recycles much of the heat emanating from equipment, kitchen appliances, and hospital occupants. The building also has double-glazed windows and energy saving light fixtures. The hospital consumed only 169,479 Btu's per square foot during its first year, which is 54,521 fewer than the annual national average for all hospitals.[20] (The Btu, or British thermal unit, is the standard measure of heating requirements or efficiency.)

Although construction of new hospitals has declined in recent years, health care construction remains an important sector of the construction industry. It should continue to play a major role, as health care facilities adapt to changes in medical technology and population needs.

[19] "All-electric Hospital Uses Energy-saving Systems," *Hospitals*, October 16, 1980, p.47.

[20] *Ibid.*, p.48.

Chapter VI. Comparison of BLS Construction Surveys

The BLS series of construction labor and material requirements studies covers three different categories of construction activity—heavy, residential, and nonresidential. Heavy construction surveys include highways, civil works (land and dredging projects), and sewer works (lines and plants). Residential construction studies cover single-family housing, multifamily housing, and public housing. The third and largest category is nonresidential building construction which includes hospitals, Federal office buildings, commercial office buildings, schools, and college housing.[21]

Heavy construction

The processes used to dredge and to construct sewer lines and plants, civil works land projects, and highways are very different from those used in residential and nonresidential building construction. One major difference is the amount of machinery and equipment required. The proportion of total contract cost spent on contractors' equipment was much greater for heavy construction projects than for the other two types surveyed. This, in turn, had an impact on occupational requirements: The proportion of hours for operating engineers and supervisory workers was much greater for heavy construction projects than for residential and nonresidential buildings. Heavy construction projects also required several trades not found in the other surveys, such as dredge operators and oilers. The types of materials used for heavy construction also varied considerably from those used in building construction. For example, highway and dredging projects required a large amount of petroleum products, while sewer plants required a large amount of machinery and built-in equipment.

Residential construction

Projects in the residential construction category ranged from small single-family homes to large public and private multifamily housing units. The difference between residential and heavy construction is obvious. The difference between residential and nonresidential construction is less apparent but just as important. Because they are designed as primary residences, single-family, multifamily, and public housing construction projects have many characteristics (such as individual kitchen and bathroom facilities) not found in nonresidential buildings. Material requirements for the two kinds of building construction also differ. More lumber and wood products were used in surveyed residential construction than in nonresidential (and heavy) construction projects; accordingly, the proportion of hours for carpenters was greater for residential construction projects than for projects in the other two categories.

Nonresidential building construction

Because hospital construction is included in the nonresidential category, the remainder of this chapter will focus on comparisons among the most recent nonresidential building surveys.[22] (See tables 20 and 21.) Data for all BLS construction surveys are given in appendix A.

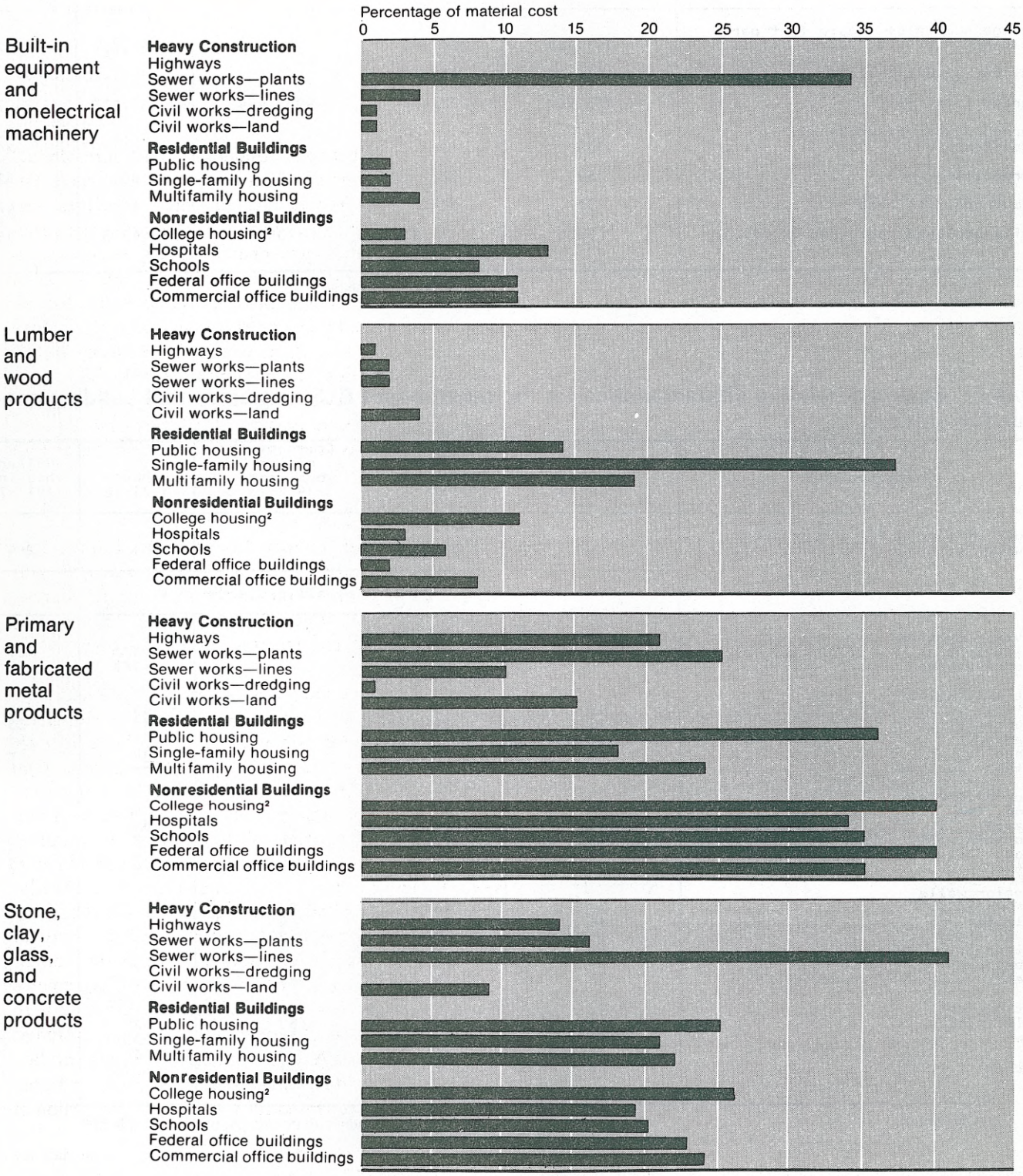
commercial office buildings, schools, and college dormitories appear to have little in common. However, these buildings share several characteristics which set them apart from projects in the other categories.[23] One important similarity is that all of these buildings are constructed in the same manner. The construction process—excavation, pouring of the foundation, framing, placement of exterior walls, installation of mechanical systems, and finishing—is the same regardless of building type. These buildings are constructed with the same basic construction materials and by the same kinds of workers. Because of this common construction process, cost components and labor and material requirements for the five surveys were very close compared with those for heavy and residential construction studies (Chart 1 and tables A-1 through A-4). Primary and fabricated metal products and stone, clay, glass, and concrete products accounted for the greatest proportion of

[21] College housing is usually considered residential construction; however, college housing projects differ from those in the residential category in that they are nonpermanent or nonhousekeeping residences. Because characteristics of the surveyed projects are closer to those of nonresidential buildings, college housing is classified as nonresidential in this study for purposes of comparison.

[22] Because surveys cover different time periods, all cost data are given in constant (1972) dollars.

[23] Although not included in construction labor and material requirements studies, hotels and motels and military barracks would also fit in this category.

Chart 1. Percent distribution of material costs for selected products, all construction surveys[1]



[1]Data are from the latest survey for which material cost information is available.

[2]Classified with nonresidential for purposes of this chart. See text.

Table 20. Selected project characteristics for the most recent BLS nonresidential building construction surveys

Characteristic	Hospitals 1974-75	Federal office buildings 1976	Commercial office buildings 1972-73	Schools 1971-72	College housing 1971-72
Average number of square feet per project	163,600	226,100	13,883	81,200	74,796
Cost per square foot 1/	$36.75	$34.87	$21.38	$24.47	$28.40
Average total cost 1/	$6,013,981	$9,278,070	$905,434	$1,985,823	$2,123,725
Average number of weeks of construction	154	130	47	67	74
Metropolitan area	50	(2/)	82	56	52
Nonmetropolitan area	50	(2/)	18	44	47
Onsite employee hours per $1,000 1/	25.8	21.8	35.6	42.5	49.6

[1] In constant (1972) dollars.

[2] Not available.

Table 21. Selected building characteristics for the most recent BLS nonresidential building construction surveys

Characteristic	Hospitals 1974-75	Federal office buildings 1976	Commercial office buildings 1972-73	Schools 1971-72	College housing 1971-72
Number of floors for the greatest number of projects	2-4	4 or more	1-3	1	2-4
	Percent of all projects				
Conveyor systems:					
Elevators	92	72	36	(1/)	38
No elevators	8	28	64	(1/)	62
Type of framing:					
Steel	40	77	44	65	8
Concrete	48	20	12	11	35
Masonry	12	4	20	14	41
Wood	--	--	24	10	--
Other	--	--	--	--	16
Exterior walls:					
Concrete	17	37	16	4	22
Masonry	63	28	56	84	59
Curtain wall	18	13	--	2	5
Wood	--	--	18	2	5
Other	2	22	10	9	8
Interior walls:					
Drywall	76	66	91	39	(1/)
Plaster	16	7	4	11	(1/)
Partitions	--	6	2	--	(1/)
Other	--	6	3	41	(1/)
Masonry	9	9	--	--	(1/)
Metal	--	6	--	9	(1/)
Heating fuel:					
Electricity	15	49	59	33	(1/)
Gas	66	35	39	53	(1/)
Oil	17	6	2	13	(1/)
Other	1	10	1	2	(1/)

[1] Not available.

-- Survey had no sample projects in this cell.

material cost for all nonresidential buildings surveyed. Nonresidential buildings also required a large amount of built-in equipment and machinery; only sewer plants required more built-in equipment than these five building types.

From the outside, there is not much to differentiate a Federal office building from a commercial one, or a dormitory from a hospital building because the exterior, or building shell, is fundamentally the same. Their rectangular or "box-like" design differs considerably from that of a single-family home or a sports arena. Thus, the five surveyed buildings share a common design—another factor which distinguishes nonresidential construction projects from those in the other two categories.

Nonresidential buildings included in the surveys—office, health, and educational buildings—have several features which distinguish them from other nonresidential buildings. Unlike buildings for storage or production purposes, such as warehouses and manufacturing plants, all surveyed buildings were designed primarily for people rather than machinery and equipment. This has an impact on both project characteristics and material requirements.

Of course, differences exist between individual projects within each category. Despite the many similarities among Federal office buildings, commercial office buildings, hospitals, schools, and college housing projects, their costs, characteristics, and labor and material requirements do vary, in part because each building is designed to provide a different type of service. A hospital, for example, offers health care, which requires more complex equipment than does a school or office building. In addition, both hospitals and dormitories require additional plumbing and other support systems because they are used 24 hours a day.

Although exteriors of these buildings are similar, interiors often differ according to building type. The amount of fixed wall space (compared with open, undivided space) has a major impact on costs and construction requirements, as does the amount of finishing work included in the original contract. One major distinguishing factor is the degree to which interiors vary. Commercial office building projects were the most diverse: Surveyed buildings ranged from nothing more than finished shells to completely finished buildings with a large percentage of fixed-wall space. The amount of interior finishing included in the construction contract for commercial office buildings often depends on whether the project was built for a particular owner or for speculation. Speculative buildings usually contain fewer fixed walls as much of the finishing is completed at a later date by contractors of occupants. Federal office buildings constructed under contract for the General Services Administration (GSA) are more homogeneous, contain more fixed walls, and vary more in room size than commercial office buildings. In addition, most finishing work is included in the contract let by GSA. Health and educational buildings in BLS surveys are more uniform than both Federal and commercial office buildings. Although office buildings usually contain rooms of varying sizes, health and educational buildings are made up of repetitive, uniform units or cells with more fixed-wall space. Because they contain a large amount of specialized equipment and other features not found in office buildings (such as gymnasium and laboratory equipment, intercom systems, and chalkboards), health and educational buildings require more finishing.

These factors affecting nonresidential buildings all relate to building use. However, other factors which affect costs and requirements are unrelated to use. The effects of these factors (building size or height, building amenities, geographic location, and changes in the construction process) found in all nonresidential building surveys are responsible for data variation within each survey.

The first factor, building size and height, has an impact on both construction costs and labor and material requirements. In all building surveys, the average number of contractors per project was much greater for larger, more expensive and complex projects than for smaller, less costly ones. Cost per square foot generally decreased as building height increased (except for the tallest buildings), reflecting economies of scale in large projects and excessive "wrap" in many small buildings. (Wrap is ratio of exterior wall area to total square footage.) In addition, fast-track construction methods, which are often used in taller buildings, reduce construction time and cost.

Another factor which influenced costs and requirements without regard to building type was a variation in the percentage of building space for special-use, or ancillary areas (such as cafeterias, auditoriums, lobbies, operating rooms, libraries, or gyms). In general, costs were much higher for buildings which contained several of these amenities. For example, cost per square foot was above average for hospitals, Federal office buildings, and combination dormitory/student union/dining hall buildings in which special use areas were usually a significant portion of the building. Conversely, small, inexpensive projects (such as most dormitories and commercial office buildings) contained relatively few amenities and were less costly per square foot.

In all studies, projects in the Northeast had characteristics which differed significantly and fairly uniformly from those in the other three regions. On average, buildings in the Northeast are taller and more expensive per square foot than buildings in the other regions. Wage rates, and thus labor costs, also tend to be higher in the Northeast. These differences are due to many factors, including a dense population and a high concentration of metropolitan areas.

Since all five building types are constructed similarly, deviations from the usual construction process resulted in differences in labor and material requirements. For example, costs and requirements for a new, freestanding building are quite different from those for an addition to an existing building. Additions are usually more expensive and difficult to build due to constraints placed on the design and construction by the existing building. Only the hospital survey included additions, but this would hold true for the other building types as well.

Cost differences due to building use and to factors unrelated to use usually are not separable because they often occur in combination. In addition, each of the five surveys often was dominated by projects that fell into one size class or region or had a similar number of amenities which obscured their fundamental link. Nonetheless, selected data for the five nonresidential surveys show how various factors affect project characteristics, costs, and requirements (Chart 2).

Comparison of types of nonresidential buildings

Hospitals. Hospitals were larger and had a higher average contract cost than any other type of project except Federal office buildings. On a square footage basis, however, hospital projects were the most costly, perhaps because 82 percent of the projects were additions to existing hospitals: Cost per square foot for additions was much higher than that for new hospital buildings. Also, hospitals usually contain many amenities and ancillary areas (such as operating rooms, cafeterias, and laboratories), which add to project costs.

The design requirements for medical care services had a major impact on labor and material requirements for hospitals. Approximately 92 percent of the surveyed projects had elevators, which are a necessity in hospitals with more than one floor. Because complex and sophisticated mechanical systems are needed, hospitals required a greater proportion of electricians and electrical products than other building types. The hospital survey had the smallest proportion of semiskilled and unskilled workers, and was the only study in which plumbers accounted for the largest proportion of onsite skilled hours. Because hospitals require a great deal of built-in equipment, finishing work is much more involved than that for other projects. This factor, combined with their large size, may explain why hospitals took longer to build than any other building..

Federal office buildings. Federal office buildings were larger, taller, more expensive, and had a higher number of contractors per project than any other building. Several buildings cost more than $45 per square foot. Almost 55 percent of the surveyed projects had 4 or more floors, including one 44 story building. Because of their height, 77 percent of projects were steel-framed. Thus, these buildings required larger proportions of steel contractors, structural metal workers, and primary metal products than other buildings. Only 28 percent of the Federal office buildings had masonry exterior walls, which was the primary wall type in all other surveys. The majority of Federal office buildings had concrete exterior walls. Several projects used relatively expensive wall materials, such as limestone panels and ceramic tile, which added to project costs.

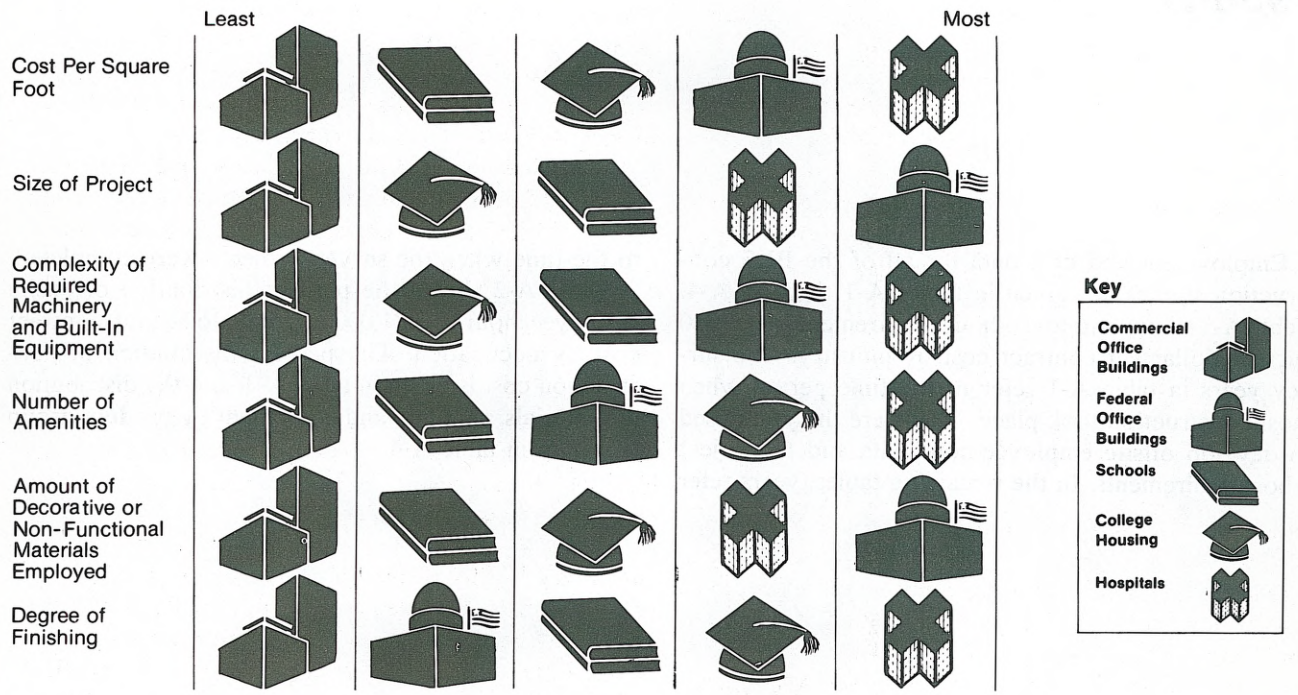
Although 80 percent of the projects were "Federal" and Social Security Administration office buildings, the survey did include border stations, correctional facilities, and other Federal buildings whose characteristics differed from the majority of projects.[24] For example, one very small border station, which probably had too much "wrap", cost over $80 per square foot. Federal office buildings, unlike commercial office buildings, generally contain a high percentage of fixed-wall space, more special features such as large lobbies, auditoriums, libraries, and cafeterias, and sometimes even courtrooms and postal stations.

Commercial office buildings. The commercial office building survey consisted primarily of small professional offices and headquarters for local companies and banks. Commercial office building projects were the smallest and the least expensive, on both a square foot and project basis, of all surveyed buildings. Surprisingly, only 4 percent of the projects cost more than $3 million, while 40 percent cost less than $250,000. Commercial office buildings required the fewest contractors per project (although the number of contractors per project increased as cost increased). The majority of projects were under 3 stories (85 percent contained only 1 to 2 floors), and only 36 percent had elevators. The low building height was responsible for the commercial office building survey having the greatest proportion of projects in the nonresidential category with wood frames and wood exterior walls. Commercial office buildings also required a larger proportion of wood products and carpenters than any of the other buildings.

Because the majority of projects in this survey were built for a particular owner, most finishing work was included in the construction contract. Nonetheless, commercial office buildings took less time to build than any of the other projects. Commercial office buildings, particularly the small projects, generally contained little "special use" areas. Of the buildings surveyed, at least 75 percent of the available space was for office use; however, some commercial office buildings, especially office-apartment complexes, contained retail stores and banks on the ground floor. These larger combination

[24] The 1973 Federal office building survey included "Federal office buildings," Social Security office buildings, laboratory-office buildings, and border stations.

Chart 2. Ranking of nonresidential building surveys by factors affecting cost per square foot[1]



[1]Rankings for size of project and cost per square foot are based on survey data. Rankings for all other factors are based on judgment.

projects, which also had amenities such as cafeterias and large lobbies, required more hours per $1,000 than buildings which contained offices only.

Schools. Data on costs and requirements for school construction fell between those for other buildings primarily due to design characteristics of most school buildings. Schools usually contain several amenities (74 percent of the projects had libraries and 37 percent had multipurpose gyms) which added to project costs. Even with increased use of demountable partitions and open-space classrooms, most school buildings still contain the traditional fixed-wall classrooms which require a greater degree of finishing work (in the original contract) than commercial office buildings. On the other hand, schools are much smaller and more uniform than Federal office buildings and do not require the additional plumbing and mechanical systems found in college dormitories or hospitals.

Most schools were one-story buildings, although the survey did include several multistory secondary schools. The average secondary school contained 134,900 square feet, while elementary schools averaged only 51,600 square feet. Despite their low height, the majority of school buildings were steel-framed. Steel framing may have been necessary to support the wide gym and cafeteria areas, and to meet fire safety codes at a reasonable cost. Only the school survey, which had the largest proportion of projects with masonry exterior walls, included projects with concrete block interior walls. Newer school buildings contain several features usually not associated with school buildings, such as carpeting and central air-conditioning. In 1972, for example, 70 percent of the school projects had central air-conditioning, compared with only 27 percent in 1965.

College housing. The college housing survey consisted of three types of projects: Dormitories, student union/dining halls, and combination projects. The least expensive were dormitories (at $22 per square foot) which contained few amenities and took less time to build than the other two types. The repetitive design of college dormitory rooms lends itself to the use of systems building techniques. Modular components, such as walls with built-in beds and desks, often save construction time. In contrast, larger combination projects took the most time to build. The most expensive projects ($34 per square foot) were the student union-dining hall buildings which generally contain more amenities (including kitchens, cafeterias, and meeting rooms) and less uniform, repetitive rooms than dormitory buildings.

The average square footage for college housing projects was very similar to that for schools; however, the average total cost and cost per square foot were much higher. This may be due to the fact that because they are in use 24 hours, college housing projects require more plumbing facilities and kitchen equipment than schools.

Appendix A. Comparison of all BLS construction studies, 1958-76

Employment and cost data for all of the BLS construction studies are given in tables A-1 through A-4. Table A-1 shows employee-hour requirements per 1,000 current dollars of contract cost by industry. The survey years in table A-1 refer to the time period when most construction took place. Those are the years used to develop offsite employee-hour data and to project labor requirements. In the remaining tables, years refer to the time when the survey projects were completed.

Table A-2 shows the percent distribution of onsite employee hours per 1,000 current dollars of contract cost by occupation. The percent distribution of construction cost is given in table A-3, and the distribution of materials, supplies, and equipment by product group is shown in table A-4.

Table A-1. Employee hours per 1,000 current dollars of contract cost by industry, all construction studies, 1958-76

Type of construction and year	Total, all industries	Construction		Manufacturing	Trade, transportation, and services	Mining and all other
		Onsite	Offsite 1/			
General hospitals:						
1959-60 2/	226.0	88.8	12.3	78.0	34.2	12.7
1965-66 2/	190.2	76.1	11.0	64.0	29.6	9.5
1975	87.7	34.7	4.5	29.3	15.1	4.1
Nursing homes:						
1965-66 4/	194.0	73.7	9.7	66.6	33.6	10.4
1975	87.1	31.3	3.1	32.2	15.5	5.0
Commercial office buildings:						
1972-73	97.5	37.2	4.8	33.0	16.6	5.9
Public housing:						
1960 2/	246.0	113.7	15.9	65.3	36.9	14.2
1968 2/	175.1	79.6	11.9	47.8	26.7	8.8
1975	3/	33.2	7.1	3/	3/	3/
Elementary and secondary schools:						
1959 2/	231.8	86.0	11.7	78.0	41.4	14.8
1965 2/	193.2	72.3	8.8	65.8	34.4	12.0
1971-72	114.1	41.6	6.0	40.8	18.8	6.8
Federally-aided highways:						
1958 2/	250.7	97.3	9.0	66.1	52.5	25.8
1976	80.5	32.2	3.3	22.8	15.4	6.9
Federal office buildings:						
1959 2/	235.8	97.1	10.9	79.2	35.7	12.9
1972	3/	42.8	4.7	3/	3/	3/
1976	81.5	29.8	4.7	26.0	16.5	4.5
College housing:						
1960-61 2/	236.3	93.6	14.1	77.5	37.2	13.8
1971-72	3/	48.3	8.1	3/	3/	3/
Civil works, total:						
1960	3/	3/	3/	3/	3/	3/
1971-72	3/	47.4	3.9	3/	3/	3/
Land projects:						
1960	213.4	84.7	4.5	53.2	46.9	24.1
1971-72	3/	43.2	2.5	3/	3/	3/
Dredging projects:						
1960 2/	251.4	133.9	15.6	56.8	31.6	13.5
1971-72	3/	57.0	7.0	3/	3/	3/
Sewer works:						
Lines:						
1963 2/	208.8	85.9	4.8	75.9	27.2	15.0
1971	128.3	48.0	3.0	48.8	18.8	9.7
Plants:						
1963 2/	208.1	82.7	5.7	80.0	27.1	12.6
1971	127.4	47.0	4.0	51.6	17.6	7.2
Private multifamily housing:						
1971 2/	137.5	50.0	6.5	46.9	26.1	8.1
Private single-family housing:						
1962 2/	215.7	72.1	11.0	68.6	48.7	16.1
1968-69 2/	145.6	51.9	8.2	47.2	29.6	8.7

[1] Revised due to adjustment to 1979 benchmarks of *Employment and Earnings* series. Some SIC groupings were not revised for earlier years; thus, data on offsite construction hours are not strictly comparable though differences would be slight. See text footnote 5.

[2] Indirect data revised from original study results due to reprocessing materials through improved input-output tables.

[3] Not available.

[4] Estimated except for onsite construction hours. Based on case study.

NOTE: Detail may not add to total due to rounding.

Table A-2. Percent distribution of onsite employee hours per 1,000 current dollars of contract cost by occupation, all construction studies, 1958-76

Type of construction and year	All occupations	Administrative and supervisory	Bricklayers	Carpenters	Electricians	Ironworkers	Operating engineers	Painters	Plasterers and lathers	Plumbers and pipefitters	Other skilled construction trades	Laborers, helpers, and tenders	Other occupations (including truckdrivers)
General hospitals:													
1960	100.0	3.9	5.4	13.2	8.8	3.5	1.6	2.8	6.2	14.2	12.0	26.7	1.7
1966	100.0	3.2	5.0	13.0	9.9	3.1	1.8	2.6	6.1	15.6	13.1	25.7	.7
1976	100.0	8.6	3.5	12.5	11.9	4.2	2.1	1.6	3.6	12.6	16.6	20.6	1.8
Nursing homes:													
1966 1/	100.0	4.4	6.4	15.2	7.8	2.2	1.8	4.7	5.6	13.7	11.2	26.7	.4
1976	100.0	11.1	7.3	13.7	11.1	2.0	1.3	3.5	2.1	13.4	12.2	21.7	.6
Commercial office buildings:													
1974	100.0	7.4	3.3	19.2	6.4	6.3	4.0	1.9	2.1	6.2	19.0	22.6	1.6
Elementary and secondary schools:													
1959	100.0	3.9	9.3	18.7	7.1	2.8	1.9	3.3	2.7	9.4	7.9	29.1	4.0
1965	100.0	3.6	9.2	16.5	7.3	3.1	2.7	3.5	2.0	9.6	10.1	30.9	1.5
1972	100.0	4.4	6.0	16.8	11.0	4.2	2.4	2.8	2.7	9.6	16.9	22.3	.9
Federally-aided highways:													
1958	100.0	10.4	2/	2/	2/	2/	2/	2/	2/	2/	38.2	2/	3/51.4
1976	100.0	6.3	--	5.7	1.2	2.6	24.3	.4	--	.2	5.9	33.2	4/20.3
Federal office buildings:													
1959	100.0	6.0	5.2	12.6	9.1	4.2	2.4	2.1	3.8	8.7	11.8	32.5	1.5
1973	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/
1976	100.0	8.1	2.7	13.9	11.5	7.9	3.6	1.6	2.2	7.9	17.0	21.4	2.2
College housing:													
1961	100.0	3.4	10.0	16.9	6.6	3.9	1.7	3.6	3.4	9.7	7.8	31.8	1.1
1972	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/
Civil works:													
Land projects:													
1960	100.0	10.1	--	6.4	--	3.1	24.1	--	--	--	6.9	23.0	26.4
1972	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/
Dredging projects:													
1960	100.0	4.7	--	--	--	--	1.1	--	--	--	1.7	1.7	5/90.8
1972	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/	2/
Sewer works, total:													
1963	100.0	11.2	1.7	7.7	1.5	1.9	17.4	.7	--	2.5	2.7	39.1	13.4
1971	100.0	12.9	1.0	6.9	2.9	1.9	20.4	.8	--	3.3	5.4	30.0	14.4
Lines:													
1963	100.0	11.6	1.3	2.4	.1	.4	19.6	--	--	.4	1.2	44.9	18.1
1971	100.0	13.5	.2	1.2	.4	.2	27.3	--	--	--	3.0	33.7	20.6
Plants:													
1963	100.0	11.0	2.0	14.3	3.3	3.9	14.6	1.5	--	5.1	4.6	31.8	7.9
1971	100.0	12.3	1.9	14.0	5.7	4.5	11.5	1.9	--	7.2	9.8	25.1	5.9
Private multifamily housing:													
1971	100.0	5.8	5.0	25.4	5.9	2.3	2.9	4.0	1.7	7.6	11.3	25.8	2.3
Private single-family housing:													
1962	100.0	3.0	5.5	34.6	2.8	--	1.4	9.5	2.0	5.2	12.2	23.3	.5
1969	100.0	2.8	5.7	34.9	3.0	--	1.8	7.3	1.7	4.3	20.0	27.9	.5
Public housing:													
1960	100.0	4.0	7.6	19.1	4.1	2.1	2.7	4.4	6.8	7.8	6.5	30.9	4.0
1968	100.0	3.6	7.8	20.3	5.8	3.5	3.1	4.9	3.0	9.3	6.6	30.2	1.9

[1] Based on case study.
[2] Not available.
[3] Includes apprentices and on-the-job trainees and laborers, helpers, and tenders.
[4] Includes blue-collar worker supervisors.
[5] Includes mostly ships' masters, captains, mates, crew, and support personnel.
NOTE: Detail may not add to totals due to rounding.

Table A-3. Percent distribution of construction contract costs, all construction studies, 1958-76

Type of construction and year	Total contract costs	Onsite wages and salaries	Materials, supplies, and built-in equipment	Construction equipment	Overhead and profit 1/
General hospitals:					
1976	100.0	27.7	42.2	2.4	27.7
1966	100.0	29.6	50.4	1.3	18.7
1960	100.0	28.2	53.2	1.2	17.4
Nursing homes:					
1976	100.0	24.5	48.3	2.2	25.0
1966 2/	100.0	28.7	53.7	1.2	16.4
Commercial office buildings:					
1974	100.0	26.7	42.2	2.7	28.5
Elementary and secondary schools:					
1972	100.0	28.2	44.4	2.1	25.3
1965	100.0	25.8	54.2	1.0	19.0
1959	100.0	26.7	54.1	1.4	17.8
Federally-aided highways:					
1976	100.0	23.8	46.7	3/	29.5
1958	100.0	23.9	50.6	3/	25.5
Federal office buildings:					
1973 4/	100.0	34.0	50.0	5/	16.0
1959	100.0	29.0	51.4	1.9	17.7
1976	100.0	25.8	42.5	2.9	28.8
College housing:					
1972 4/	100.0	36.0	51.1	5/	13.0
1961	100.0	29.3	52.6	1.6	16.5
Civil works, total:					
1972 4/	100.0	26.0	29.0	22.0	22.0
1960	100.0	29.1	26.2	22.1	22.6
Land projects:					
1972	100.0	25.0	32.0	20.0	24.0
1960	100.0	26.0	35.0	19.3	19.7
Dredging projects:					
1972	100.0	30.0	24.0	28.0	19.0
1960	100.0	32.3	17.3	24.9	25.5
Sewer works, total:					
1971	100.0	24.7	40.7	11.5	23.1
1963	100.0	25.3	46.6	9.9	18.2
Lines:					
1971	100.0	24.3	35.2	16.7	23.8
1963	100.0	24.3	44.5	11.2	20.0
Plants:					
1971	100.0	25.2	47.0	5.6	22.2
1963	100.0	26.6	49.2	8.2	16.0
Private multifamily housing:					
1971	100.0	27.9	44.2	3.0	24.8
Private single-family housing:					
1969 6/	100.0	20.4	43.4	.9	35.3
1962 6/	100.0	22.1	47.2	1.0	29.7
Public housing:					
1975 4/	100.0	32.7	48.7	4.4	14.2
1968	100.0	32.4	41.9	1.5	24.2
1960	100.0	35.5	45.0	2.5	17.0

[1] Includes offsite wages, fringe benefits, construction financing costs, inventory, and other overhead and administrative expenses as well as profit.

[2] Estimated. Based on case study.

[3] Equipment included with overhead and profit.

[4] Estimated.

[5] Equipment included in materials.

[6] Includes selling expenses.

Table A-4. Percent distribution of cost of materials, supplies, and equipment by product group, all construction studies, 1958-76

Type of construction and year	Total materials, supplies, and equipment	Mining and quarrying of nonmetallic minerals except fuel	Lumber and wood products except furniture	Furniture and fixtures	Chemical and allied products	Petroleum refining and related products	Stone, clay, glass, and concrete products	Primary metal products	Fabricated metal products 1/	Machinery except electrical	Electrical and electronic machinery, equipment, and supplies	Construction equipment (rental value and depreciation)	Material and supplies, n.e.c.
General hospitals:													
1960	100.00	.42	4.22	3.19	.81	.90	18.94	12.05	24.25	14.48	13.44	2.14	5.16
1966	100.00	.51	4.81	2.82	.77	.80	18.40	12.35	21.75	16.81	14.14	2.50	4.32
1976	100.00	.33	2.98	2.28	1.01	1.12	18.52	9.89	23.80	13.29	15.09	5.52	6.17
Nursing homes:													
1966 2/	100.00	.53	9.06	.27	1.24	1.82	20.16	6.23	33.32	11.03	10.78	2.15	3.41
1976	100.00	.84	6.76	1.97	1.65	2.13	19.38	11.00	23.22	12.40	12.21	4.40	4.04
Commercial office buildings:													
1974	100.00	.67	7.55	.42	.99	1.98	25.90	12.55	22.21	11.43	7.62	5.99	4.69
Federal office buildings:													
1959	100.00	.41	3.31	.34	1.03	.88	21.60	7.32	32.81	6.91	18.20	3.59	3.61
1973	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/
1976	100.00	.49	2.31	.41	1.10	1.11	22.61	20.82	19.33	10.65	10.11	6.52	4.56
Elementary and secondary schools:													
1959	100.00	.83	9.90	1.50	1.41	2.02	24.99	13.07	26.78	2.47	9.27	4.04	3.74
1965	100.00	1.62	9.13	2.90	.96	2.27	24.67	11.68	24.41	5.30	8.78	4.45	3.83
1972	100.00	.85	6.09	3.67	1.41	1.72	20.15	11.03	24.06	7.71	12.32	4.52	6.47
Private multifamily housing:													
1971	100.00	1.34	18.67	3.89	2.21	1.74	22.12	8.85	15.59	3.72	9.36	6.51	6.00
Private single-family housing:													
1962	100.00	.79	40.05	--	2.22	2.30	23.58	5.50	14.60	.46	6.49	2.03	1.99
1969	100.00	.89	37.40	3.28	1.82	1.80	21.33	5.05	12.90	1.90	6.77	2.00	4.87
Public housing:													
1960	100.00	.80	14.10	.30	1.80	1.70	27.10	8.00	28.50	2.30	8.40	5.30	1.80
1968	100.00	.80	14.40	.30	2.00	2.20	24.70	9.20	27.20	2.50	11.30	3.50	1.80
1975	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/
College housing:													
1961	100.00	.78	10.67	1.70	1.18	1.05	25.78	6.11	33.90	2.92	11.36	2.94	1.62
1972	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/
Federally-aided highways:													
1958	100.00	11.34	1.76	--	.80	17.09	16.77	--	19.48	--	--	4/	32.75
1976	100.00	12.42	.85	--	.97	17.58	14.04	--	21.22	--	--	4/	32.92
Civil works:													
Land projects:													
1960	100.00	17.46	4.15	--	3.87	12.65	9.09	1.33	13.20	.59	.24	35.39	2.05
1972	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/
Dredging projects:													
1960	100.00	--	--	--	3.93	28.07	--	--	1.49	1.40	--	58.98	6.13
1972	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/
Sewer works:													
Lines:													
1963	100.00	4.65	.79	--	.36	3.02	55.87	8.79	2.39	3.02	.74	20.19	.20
1971	100.00	3.43	1.53	--	1.14	4.82	40.77	7.38	2.20	4.48	1.03	32.22	1.00
Plants:													
1963	100.00	2.27	1.64	--	.98	1.85	16.78	14.48	13.16	22.34	9.51	14.25	2.75
1971	100.00	1.11	2.46	.22	.87	1.25	15.62	11.22	13.87	33.51	6.72	10.59	2.54

[1] Includes vitreous china plumbing fixtures for Federally-aided highways, commercial office buildings, elementary and secondary schools (1971), and single-family and multifamily housing.

[2] Based on case study.

[3] Not available.

[4] Construction equipment estimate included in materials and supplies, n.e.c.

NOTE: Detail may not add to total due to rounding.

Appendix B. Scope and Methods of Survey

Sampling techniques

The survey was designed to measure labor and material requirements for hospital and nursing homes funded under the Hill-Burton program and completed during 1976. The Office of Facilities Engineering within the Office of Federally Assisted Construction (under the former Department of Health, Education, and Welfare) provided the Bureau with a list of projects which met these specifications. A refined sampling frame of 137 projects was constructed from this list. All projects were stratified by cost class, and hospital projects were further stratified according to geographic location. (The four geographic locations are given in footnote 4.) Cost classes are as follows: Under $1,000,000; $1,000,000 to $1,999,999; $2,000,000 to $4,999,999; $5,000,000 to $9,999,999; $10,000,000 to $14,999,999; and $20,000,000 and over. A sample of 74 projects was randomly selected from the refined frame.

Several projects in the initial sample were found to be outside the scope of the study. These included projects which were designed to serve as living quarters for students and/or staff, those which consisted of rehabilitation work only, and projects not completed by December 31, 1976. A number of projects were not surveyed because the general contractor refused to cooperate or could not be located. The final sample consisted of 34 hospitals and 8 nursing homes—including a 17 project supplement to the original sample. The number of responding projects in each region was as follows: 8 in the Northeast, 11 in the North Central, 9 in the South, and 6 in the West. The average weighted response rate for the survey was 73 percent. Nonresponse factors, which represent the inverse of the weighted response rates, were calculated for each stratum. Final sample weights consisted of the inverse of the probability of selection and the nonresponse factor.

Data collection procedures

Field representatives received a list of projects containing the names and addresses of the projects' owners and/or developers. After contacting the owner to determine whether the project was within the scope of the study, field representatives visited the building construction site and met with the general contractor. The general contractor provided data on project characteristics; labor, material and equipment costs; and a list of their subcontractors. Field representatives then visited each subcontractor to obtain labor, material, and equipment cost data.

After collection, regional offices reviewed data for completeness and accuracy. Data were then sent to the national office in Washington, D.C. for final review, computer processing, and analysis.

Limitations of data

Subcontractors were asked to estimate if equipment, material, or payroll cost records were missing. When a subcontractor refused to cooperate or could not be located, the general contractor was asked to estimate missing data. Where an estimate could not be obtained, the missing data were imputed by matching the contract with one for a similar operation. (Imputation was not done for contracts whose total value was less than 0.3 percent of the total project amount.) Except for nonresponding sample projects and data estimated by contractors, there are no known sources of sampling error. No statistical evidence is available to prove that the nonresponding units had characteristics which were similar to those of the responding units. In addition, some projects which met survey requirements may have been inadvertently excluded from the sampling frame.

Detailed data have a wider margin of sampling error and may be subject to other limitations. Labor and material requirements may be affected by many factors, such as location and size of the project, the type of building, architectural design, the availability of certain materials or equipment, labor skills, and local building codes or customs. The effects of these separate factors cannot be isolated.

Sample variances

Variances for the hospital and nursing home construction survey were calculated by the balanced half-sample replication technique. Table B-1 shows the standard errors and coefficients of variation for material, equipment, and labor costs per $1,000 and cost per 100 square feet for hospitals and nursing homes, by region. Table B-2 shows the standard deviations and coefficients of variation for hospitals and nursing homes by selected contract operations. A complete description of the method used to calculate sample variances is available from BLS upon request.

Table B-1. Standard errors and coefficients of variation for hours, labor costs, materials costs, equipment costs, and cost per 100 square feet for hospitals and nursing homes, 1975

Measure	Hospitals					Nursing homes
	United States	Northeast	North Central	South	West	
Hours per $1,000:						
Standard error	0.57	2.47	0.26	0.99	1.65	3.15
Coefficient of variation (percent)	1.6	7.7	0.8	2.7	4.7	10.1
Labor costs per $1,000:						
Standard error (dollars)	4.35	21.68	6.40	4.32	10.52	4.81
Coefficient of variation (percent)	1.6	7.9	2.2	1.7	3.6	2.0
Materials costs per $1,000:						
Standard error (dollars)	4.60	10.36	10.88	3.23	11.65	13.90
Coefficient of variation (percent)	1.1	2.9	2.5	0.7	2.9	2.9
Equipment costs per $1,000:						
Standard error (dollars)	0.99	2.17	1.16	2.05	1.89	1.92
Coefficient of variation (percent)	4.1	12.2	4.6	7.9	7.3	8.9
Cost per 100 square feet:						
Standard error (dollars)	133.81	107.62	191.83	221.73	111.70	250.76
Coefficient of variation (percent)	2.7	1.4	4.3	4.6	2.0	6.1

Table B-2. Standard errors and coefficients of variation for hours, labor costs, materials costs, equipment costs, and cost per $1,000 by selected contract operations, 1975

Measure	General contractor	Heating, ventilating, and air-conditioning	Electrical	Plastering and lathing	Masonry	Plumbing	Concrete
Hours per $1,000:							
Standard error	0.60	0.25	0.15	0.24	0.36	0.21	0.10
Coefficient of variation (percent)	6.5	3.8	3.3	10.7	18.7	12.1	6.6
Labor costs per $1,000:							
Standard error (dollars)	3.73	1.92	1.32	1.82	1.62	2.00	0.74
Coefficient of variation (percent)	5.7	3.4	3.3	10.4	11.5	13.7	6.1
Materials costs per $1,000:							
Standard error (dollars)	7.64	5.15	2.28	0.98	2.76	3.01	2.50
Coefficient of variation (percent)	7.3	7.0	3.9	8.8	27.7	15.0	8.7
Equipment costs per $1,000:							
Standard error (dollars)	0.95	0.19	0.05	0.07	0.14	0.08	0.10
Coefficient of variation (percent)	9.7	8.3	6.3	11.5	12.9	16.2	4.8

NOTE: The high coefficients of variation for plastering and lathing, masonry and plumbing may be due to the fact that general contractors provided the materials or performed these operations for some of the projects surveyed.

Appendix C. Forms used for data collection

Bureau of Labor Statistics
Survey of Labor and Material Requirements
for Building Construction

U.S. Department of Labor

The information collected on this form by the Bureau of Labor Statistics will be held in confidence and will be used for statistical purposes only.

This report is authorized by law 29 U.S.C. 2. Your voluntary cooperation is needed to make the results of this survey comprehensive, accurate, and timely.

Form Approved
O.M.B. No. 44R-1381

Name of Building(s)	Survey

Building(s) Location *(street address)*

(city, county, state)

A Form

Survey Identification *(Enter 2 digit code)*	Schedule Number *(Enter 3 digit code)*	SMSA *(Enter 3 digit code)*	State *(Enter 2 digit code)*	Census Region *(Enter 1 digit code)*
		83	84	85

BLS 2652.05A (Revised March 1978)

Section 1: Type of Construction *(See the survey Technical Memorandum for type of construction codes.)*

1a.		001
1b.		002
1c.		003
1d.		004
1e.		005

Section 2: Total Value of Construction Contract

Enter the total value of all general and prime contracts on this project, adjusted for any change orders. Include the value of equipment and materials supplied by the project's sponsor. ***Exclude***, when possible, the value of out-of-scope activities described in the survey Technical Memorandum. ***(Round to whole dollars.)***

$ ____ 006

Section 3: Construction Dates

(Report for in-scope activities only. Enter dates to two digits; for example, July 4, 1976 would be reported 0 7 0 4 7 6.)

	Month	Day	Year	
3a. Beginning date of construction				007
3b. Ending date of construction				008

3c. Total number of weeks in construction ***(include down/time)*** ____ Wks. 009

Section 4: Square Footage

What is the total square footage of all in-scope floor space in the building(s)? ***(Enter to the nearest square foot.) (For a definition of square footage, see the survey Technical Memorandum.)***

____ Sq. ft. 010

Remarks

Section 5: Building Characteristics

5a. How many stories are there above ground level in the major building? (Ground level is the highest level at which the ground intersects the building, the point at which excavation begins. The major building is the one that cost the most.)

	011
Stories	

5b. Are elevators installed in the ***major*** building?

Code
1 - Yes
2 - No

	012

5c. Are escalators installed in the ***major*** building?

Code
1 - Yes
2 - No

	013

5d. Is there a below ground basement in the major building? (A basement is the area immediately below ground level.)

Code
1 - Yes
2 - No

	014

5e. Is automobile parking space provided?

Code
1 - Yes, in or under the building
2 - Yes, outdoors
3 - Yes, both in or under the building ***and*** outdoors
4 - No

	015

5f. What is the major type of heating provided?

Code
1 - Forced air (duct heating)
2 - Hot water (exclude steam)
3 - Radiant heating (electric)
4 - No heat
9 - Other type of heating (specify, e.g. steam, solar, etc.) _____

	016

5g. What is the major type of heating fuel used?

Code
1 - Electricity
2 - Gas
3 - Oil
4 - Coal
5 - No fuel
9 - Other (specify, e.g., solar, etc.) _____

	017

5h. Is air-conditioning provided in the ***major*** building?

Code
1 - Yes, central air conditioning
2 - Yes, other than central air conditioning
3 - No

	018

Remarks

Section 6: Building Materials

For each building feature listed below, select the predominant type of material (in terms of dollar costs for the entire project) which best describes that feature.

6a. Framing

Code

1 - Steel
2 - Concrete: pre-cast, poured, etc.
3 - Load bearing masonry: block or brick
4 - Wood
9 - Other (specify) _____

	019

6b. Exterior Walls

Code

1 - Steel
2 - Concrete: pre-cast, poured, etc.
3 - Load bearing masonry: block or brick
4 - Wood
5 - Stucco
6 - Curtain wall (any material)
9 - Other (specify) _____

	020

6c. Interior Walls

Code

1 - Drywall
2 - Plaster
3 - Masonry: block or brick
4 - Wood
5 - Metal
6 - Plastic
7 - Glass
8 - Movable partitions
9 - Other (specify) _____

	021

6d. Floor Base

Code

1 - Concrete
2 - Wood/Plywood
3 - Other (specify) _____

	022

Remarks

Section 6: Building Materials—Continued

6e. Floor Covering

Code

1 - Wood
2 - Terrazzo
3 - Carpet
4 - Vinyl/vinyl-asbestos tile
5 - Linoleum
8 - No floor covering
9 - Other (specify) _____

	023

6f. Ceiling

Code

1 - Drywall
2 - Plaster
3 - Acoustical tile (including suspension type)
9 - Other (specify) _____

	024

6g. Roof Base

Code

1 - Steel decking
2 - Concrete
3 - Wood/Plywood
9 - Other (specify) _____

	025

6h. Roof Cover

Code

1 - Asphalt/asbestos shingles
2 - Built-up
3 - Wood shingles
4 - Tile
9 - Other (specify) _____

	026

Remarks

Section 7: General Contractor Information

(Obtain data for this section solely from the general contractor, if possible.) If there is more than one general contractor to the project, report for the general contractor having the largest dollar portion of the project amount. ***(See the survey Technical Memorandum for the year and type of building construction.)***

Report all percentages and dollars to the nearest ***whole number***.

7a. What percentage of the general contractor's _____ (year) total dollar volume of business was for _____ (type of building) building construction? ***(Enter to three digits. For example 50% would be entered 050; one third would be entered 033.)***

%	027

7b. What does the general contractor estimate to be the percentage of total contract value "put in place" during each of the calendar years ***the project*** was under construction?

- Begin with the year the project was started (enter in box 028) and work down to the year the project was completed.
- Enter the four digit year in column A.
- Enter the percentage to three digits in column B. For example, 50% would be entered 050; one-third would be entered 033.
- The total percentage must equal 100.

	Column A (Year)	Column B (%)	
January 1 to December 31		%	028
January 1 to December 31		%	029
January 1 to December 31		%	030
January 1 to December 31		%	031
January 1 to December 31		%	032
January 1 to December 31		%	033
January 1 to December 31		%	034
	Total =	**100 %**	

Section 8: Number of Contracts

How many of the following types of contracts were let for this project? (The total must equal the number of B-forms submitted.)

General		035
Prime		036
Subcontract		037
Sub-subcontract		038
TOTAL		039

Remarks

Section 9: Prefabrication

Indicate the types of prefabricated components used in this project by answering questions 9a, 9b, and 9c.

More than one box may be checked (√) for each question.

9a. Which ***integrated assemblies*** (prefabricated components whose installation requires more than one trade) were used in this project? ***(Check as many boxes as necessary.)***

1 - Bathrooms		040
2 - Kitchens		041
3 - Pre-engineered buildings		042
4 - Solar heating units		043
5 - _____		044
6 - _____		045
7 - _____		046
8 - _____		047
9 - None		048
10 - Other (specify) _____		049

9b. Which ***special prefabricated components*** (single construction units—more than one trade may be employed) were used in the project? ***(Check as many boxes as necessary.)***

1 - Pre-cast concrete walls		050
2 - Pre-assembled brick panels		051
3 - Air handling ducts		052
4 - Air conditioning equipment		053
5 - Pre-cast concrete structural beams or columns		054
6 - Elevators and escalators		055
7 - Plumbing pipe "trees" or electrical conduit "trees"		056
8 - Communication and alarm systems		057
9 - None		058
10 - Other (specify) _____		059

(Note: Items 1-6 are fabricated offsite; items 7 and 8 are fabricated onsite from stock parts.)

Remarks

Section 9: Prefabrication—Continued

9c. Which ***stock prefabricated components*** were used in the project? ***(Check as many boxes as necessary.)***

1 - Toilet partitions		060
2 - Steel joists		061
3 - Windows		062
4 - Concrete forms		063
5 - Movable or remountable wall partitions		064
6 - Hung ceilings		065
7 - Concrete or metal roof and floor decks		066
8 - Underfloor duct		067
9 - None		068
10 - Other (specify) _____		069

(Note: Items 1-4 are fabricated offsite; items 5-8 are fabricated onsite from stock parts.)

Remarks

TURN TO PAGE 11 FOR SECTION 10

Remarks

Remarks

Section 10: Factors Affecting Productivity

Office Use Only	
Survey I.D.	Schedule Number

What factors can the general contractor identify as having contributed toward raising or lowering employee-hour requirements (productivity) during the construction of this building project, as contrasted to a similar project on which the contractor participated during the past two years?

List below each factor cited by the general contractor.

Explain ***why*** the factors identified raised or lowered requirements.

Examples of factors: strikes, weather, flooding, building codes, apprenticeship programs, union practices, supply of skilled workers, government specifications, prefabricated components, standardized components, unusual building conditions (such as adverse and unexpected ground conditions for foundation), ***other*** factors.

List of Factors:

Remarks—Continued

GPO 928 695

SURVEY: Hospital and Nursing Home Construction Labor and Material Requirements -- Fiscal 1979	Schedule No.
Name of Building(s):	

Section 11 - Additional Items

11a. Type of Ownership

This hospital, hospital addition, nursing home, or nursing home addition is -

Code

1. Public
(A public hospital or nursing home is one owned by a government or public agency)

2. Private
(A private hospital or nursing home is one owned by persons or corporations)

	070

11b. Number of Beds

NOTE: Enter the number of beds for the hospital, hospital addition, nursing home, or nursing home addition as designed, not the actual number of beds present. Include wards under semiprivate rooms.

a. In private rooms
(Designed for one patient)

	071

b. In semiprivate rooms
(Designed for 2-4 patients)

	072

11c. Is there a separate building or separate wing of the hospital, hospital addition, nursing home, or nursing home addition which is devoted primarily to living facilities for students, nurses, doctors, or staff?

Code

1. Yes
2. No

	073

If yes, (code 1), is entered above, what approximate percentage does the general contractor estimate that this type of construction comprises of total contract costs? (Enter to three digits. For example-twenty-five percent must be entered as 025; one-third must be entered as 033; etc.)

	074

11d. Special Purpose Areas

Indicate whether or not the following special purpose areas are included in the hospital, hospital addition, nursing home, or nursing home addition. Combination special purpose areas are to be coded by "majority of expected use."

Code

1. Included

2. Not included

Area		
a. Library (A facility that provides books for staff and/or patient use)		075
b. Auditorium		076
c. Cafeteria		077
d. Cafeteria-auditorium		078
e. Emergency room		079
f. Intensive care unit		080
g. Delivery room		081
h. Operating room		082
i. X-ray room		086
j. Laboratory (All types of laboratories included)		087
k. Diagnostic and therapy room		088
l. Other (specify in Remarks).....		089

REMARKS: _____

_____

_____

11e. Building Characteristics - Ground Conditions

See the technical memorandum for detailed instructions.

Code

1. Stable (normal)

2. Unstable

	090

11f. Building Characteristics - Pile Footings

Were driven pile footings of wood, steel, or concrete used in the foundation to support the hospital, hospital addition, nursing home, or nursing home addition?

Code

1. Yes

2. No

	091

11g. Building Materials - Foundation

Select the predominant type of material (in terms of dollar costs) which best describes this feature. The foundation is the substructure below first floor and includes the footings upon which the building rests.

Code

1 Masonry: block or brick
2 Concrete: pre-cast, poured, etc.
3 Metal
4 Treated wood
9 Other (specify) _____

	092

Bureau of Labor Statistics
Survey of Labor and Material Requirements
for Buildings Construction

U.S. Department of Labor

Contract Information

The information collected on this form by the Bureau of Labor Statistics will be held in confidence and will be used for statistical purposes only.

This report is authorized by law 29 U.S.C. 2 Your voluntary cooperation is needed to make the results of this survey comprehensive, accurate, and timely.

Form Approved
O.M.B. No. 44R-1381

Name of Contractor

Survey

Name of Project

Location of Project *(street address)*

(city, county, state)

B Form

Office Use Only

Schedule Number *(Enter 3 digit code)*	Contract Number *(Enter 3 digit code)*	Major Operations Code *(Enter 2 digit code)*	Superior Contract Number *(Enter 3 digit code)*	Status Code *(Enter 1 digit code)*
		093	094	

BLS 2652.05B (March 1978)

Part I Contract Information

Contract Amount

a. For the identified project, what was the final contract amount, including all change orders? *(Round to whole dollars.)*

$ | 095

b. How much interest expense, if any, did the contractor incur on monies borrowed for this contract? *(If none, enter "0.")*

$ | 096

c. Did this contractor have formal labor management agreement(s) covering a majority of the employees who performed work on the contract?

Code
1 - Yes
2 - No

| | 097

d. Scope of Operations

Briefly describe the work performed for the contract. Also, identify the **important** kinds of heavy equipment, materials, and occupations used or supplied under this contract.

e. List of Sub-subcontracts

Report any sub-subcontractors who worked on the identified project. For each sub-subcontractor, assign a contract number. For the contract number, refer to the SO-302 form.

Contract Number	Name of Contractor	Value of Sub-subcontract $

f. Record of Persons Supplying Data

Date of Visit	Name and Title of Person Contacted	Field Representative

Part II Construction Equipment

a. Enter the total on-site equipment costs (sum of all items reported in column C, lines 100-109 and 110-198 on the continuation sheets).
If none, enter "0."

$	199

b. Instructions
Complete columns A through D as follows:

Column A — List all equipment used on-site as a tool of construction. (Exclude equipment required solely for personal use.) Record each piece of equipment separately.

Column B — Enter the equipment code for each piece of equipment listed in column A. (Refer to the Coding Manual for Labor and Materials Requirements Surveys).

Column C — Enter, in whole dollars, the contractor's depreciation cost or the rental cost for each piece of equipment. If this data cannot be obtained, enter the rental cost equivalent; refer to the Technical Memorandum for the Rental Cost Equivalent procedure.

Column D — Code for the information reported in Column C as follows: Code
1 - contractor owned equipment
2 - contractor rented equipment

For additional entries, use continuation sheet(s) for Construction Equipment BLS 2652B.
In the column "Office Use," begin the continuation sheet with the appropriate line item number.

In the spaces provided at the bottom of the page, explain any unusual entries.

Column A Description of Construction Equipment	**Column B** Equipment Code	**Column C** Depreciation or Rental Cost *(express in whole dollars)*	**Column D** Enter Code 1 or 2	**Office Use** Line Item Number
		$		100
				101
				102
				103
				104
				105
				106
				107
				108
				109

Enter Line Item Number	Remarks or Work Area

Part III Materials, Supplies, and Built-In Equipment Costs

Instructions
Complete columns E through I as follows:

Column E – Enter the building materials, supplies, or built-in equipment used in or during construction. Report dissimilar items separately (i.e., rivets should be reported separately from structural steel bar beam).

Column F – Enter the materials code for the building material, supply, or built-in equipment listed in Column E. (Refer to the Coding Manual for Labor and Material Requirement Surveys).

Column G – Enter in whole dollars the cost of materials reported in Column E. (Include all taxes and delivery fees.)

Column H – If the data in Column G does *not* include sales tax, enter the sales tax rate (to one decimal) in column H.

Example: 5¼% – enter as | 5 | 3% |; 5% – enter as | 5 | 0% |.

Column I – Code for the material cost reported as follows: Code
3 - material cost is absolute (hard data)
4 - material cost is estimated

For additional entries, use continuation sheet(s) for Materials, Supplies, and Built-in Equipment BLS 2652B.
In the column "Office Use," begin the continuation sheet with the appropriate line item number.

a. In whole dollars, report the total cost of all materials and supplies used during construction (sum of all costs in Column G, lines 200-229 and 230-598 on the continuation sheet). Include all taxes and delivery fees.

If none, enter "0."

If "0" is reported for material cost, leave Column I blank.

$	Column I Enter Code 3 or 4	Office Use Line Item Number
		599

Column E Material Item	Column F Materials Code	Column G Total Cost Including All Taxes and Delivery Fees	Column H Sales Tax Rate if Taxes not Included in Column G *(report to one decimal)*		Column I Enter Code 3 or 4	Office Use Line Item Number
		$		%		200
						201
						202
						203
						204
						205
						206
						207
						208
						209
						210
						211
						212
						213
						214

Enter Line Item Number	Remarks or Work Area

Part III Materials and Supplies Costs—Continued

Column E Material Item	Column F Material Code	Column G Total Cost Including All Taxes and Delivery Fees	Column H Sales Tax Rate if Taxes not Included in Column G *(report to one decimal)*		Column I Enter Code 3 or 4	Office Use Line Item Number
		$		%		215
						216
						217
						218
						219
						220
						221
						222
						223
						224
						225
						226
						227
						228
						229

b. Referring to the list of materials and supplies reported in line item number 200-229 and 230-598 on the continuation sheets, record the sales tax rate for the greatest dollar amount of taxable materials purchased.

	%	098

Express a fractional percentage as follows: 3¼ percent as 3 3 %

Enter Line Item Number	Remarks or Work Area

Part IV Labor Requirements

Report, by occupation, monthly data for whole hours and gross earnings for each month that work was performed on the project's construction site.

a. Enter total gross earnings (sum of all earnings reported in Column M, lines 600-653 and lines 654 to 997 on the continuation sheet).

$	999

If none, enter "0."

b. **Instructions**

Complete the following for all on-site labor:

Column J— Enter the month and year as follows: January 1976— 01 | 76

Column K— Enter the three-digit occupational code for each type of worker. **(Refer to Contract Operations and Occupational Codes Lists). Code journey level workers and apprentices separately.**

Column L— Report the total number of hours (including overtime hours) worked on-site.
Do ***NOT*** boost overtime hours worked to obtain average hourly earnings.
Do ***NOT*** include travel time ***unless*** pay is received for this time.
Use the remarks or work area to identify the number of whole hours worked in overtime status.

Column M— Report total gross earnings paid to employees. Include in "total gross earnings" the following:

1. Overtime pay
2. Shift differential
3. Cost-of-living additives
4. Employer paid fringe benefits which are paid ***directly*** to the employee

Do **NOT** include in "total gross earnings," employer fringe benefits payments made directly to administered benefit funds.

For additional entries, use continuation sheet(s) for Labor Requirements by Month and Year. In the column "Office Use," begin the continuation sheet with the appropriate line item number.

c. Report the total number of overtime hours for all occupations listed in column K (lines 600-653 and 654-997 on the continuation sheets.)

	998

If none, enter "0."

Column J		**Column K**	**Column L**	**Column M**	**Office Use**	**Remarks or Work Area**
Month *(2-digit)*	Year *(2-digit)*	Occ. Code *(3-digit)*	Whole Hours	Gross Earnings Related to Hours *(express in whole dollars)*	Line Item Number	
				$	600	
					601	
					602	
					603	
					604	
					605	
					606	
					607	
					608	
					609	
					610	
					611	
					612	
					613	
					614	
					615	
					616	

Part IV Labor Requirements—Continued

Column J		Column K	Column L	Column M	Office Use	Remarks or Work Area
Month *(2-digit)*	Year *(2-digit)*	Occ. Code *(3-digit)*	Whole Hours	Gross Earnings Related to Hours *(express in whole dollars)*	Line Item Number	
				$	617	
					618	
					619	
					620	
					621	
					622	
					623	
					624	
					625	
					626	
					627	
					628	
					629	
					630	
					631	
					632	
					633	
					634	
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					650	
					651	
					652	
					653	

Part V Contract Reconciliation

Total value of subcontracts let by this contractor	$
Total equipment cost, (from line 199, page 3)	+
Total material cost, (from line 599, page 4)	+
Total labor cost from this "B" form (from line 999, page 6)	+
Total labor cost from attached payrolls (approx.)	+
TOTAL ON-SITE COSTS (APPROX.)	$
Total contract amount, (from line 095, page 2)	$
Total on-site costs (approx.), see above *(subtract)*	−
APPROXIMATE TOTAL PROFIT AND OVERHEAD	$
$\frac{\text{Approx. total profit and overhead}}{\text{Total contract amount}}$ = % profit and overhead	%

Explain any unusual profit and overhead percentages (over 35% or under 10%) or any unusual expense requirements.

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Appendix D. BLS Publications on Construction Labor Requirements

Recent Publications

Labor and Material Requirements for Federal Office Building Construction (BLS Bulletin 2146), 1982, pp.

Discusses the employment impact of the labor and material requirements for Federal building construction based on a 1976 survey; includes estimates for 1980. In addition to the direct and indirect employment impact, the summary also presents data on labor requirements by occupation and type of contractor, cost components, and material requirements. Comparisons are made with two previous similar surveys.

Dougherty, Dawn E. "Labor and Material Requirements for Hospital Construction," *Monthly Labor Review*, March 1982, pp. 34-37.

Summary of a survey of 90 hospitals constructed in 1976. The article provides data on labor requirements, material costs, and project characteristics. Data are compared with similar studies of hospital construction in 1960 and 1966.

Labor and Material Requirements for Commercial Office Building Construction (BLS Bulletin 2102), March 1982, 50 pp.

Presents the results of a survey of commercial office buildings completed in 1973-74. The projects surveyed represent $2.7 billion in construction value put-in-place. Data include onsite labor requirements per $1,000 of contract cost at regional and national levels, a detailed listing of the types and values of materials and equipment used, and the offsite labor hours required to manufacture and transport the materials. A discussion of the recent trends in design, technology and management of office building construction is included.

Ball, Robert. "Employment Created by Construction Expenditures," *Monthly Labor Review*, December 1981, pp. 38-44.

Discusses the direct and indirect employment impact of 13 different construction activities surveyed by BLS between 1959 and 1976. The article shows estimates of jobs generated by $1 billion of construction expenditures in 1980 as well as summary statistics on cost components, average annual rates of decline in onsite labor requirements, and related data.

Olsen, John G. "Labor and Material Requirements for Federal Building Construction," *Monthly Labor Review*, December 1981, pp. 47-51.

A summary of BLS Bulletin 2146.

Other Publications

Civil works construction

Bingham, Barbara J. "U.S. Civil Works Construction Shows Decrease in Required Labor," *Monthly Labor Review*, October 1978, pp. 24-30.

This study was based on a sample of 45 projects completed in 1971 and 1972 under the supervision of the Corps of Engineers. It provided data on labor hours, material and labor costs, and other project characteristics for both dredging and land projects. Also, data were compared with an earlier civil works survey published in 1964.

Labor and Material Requirements for Civil Works Construction by the Corps of Engineers (BLS Bulletin 1390), 1964, 28 pp.

A study of onsite and offsite employee-hour and wage requirements for dredging and land projects in the U.S. Corps of Engineers' civil works program from 1959 to 1960.

College housing construction

Bingham, Barbara J. "Labor Requirements for College Housing Construction," *Monthly Labor Review*, May 1979, pp. 28-34.

A 37-project sample was surveyed in this study of college housing projects constructed under the supervision of the Department of Housing and Urban Development and completed in 1973. The article summarized and compared the findings on employee-hour requirements, project costs, and other college housing characteristics to an earlier survey published in 1965.

Labor and Material Requirements for College Housing Construction (BLS Bulletin 1441), 1965, pp. 34.

A survey of 43 college housing projects administered by the Community Facilities Administration. The survey was designed primarily to determine the employee hours required per $1,000 of college housing construction.

Miller, Stanley F. "Labor and Material Required for College Housing," *Monthly Labor Review*, September 1965, pp. 1100-1104.

A summary of BLS Bulletin 1441.

Commercial office building construction

Bingham, Barbara J. "Labor and Material Requirements for Commercial Office Building Projects,"

Monthly Labor Review, May 1981, pp. 41-48.
A summary of BLS Bulletin 2102.

Federally-aided highways

Prier, Robert J. "Labor and Material Requirements for Federally-Aided Highways," *Monthly Labor Review*, December 1979, pp. 29-34.
A study of federally-aided highway projects completed in 1976. The article discusses trends in highway labor requirements since 1958, and provides data on minority employment, occupational distribution, and material usage. Estimates labor requirements for 1978.

Finger, Diane S. "Labor Requirements for Federal Highway Construction," *Monthly Labor Review*, December 1975, pp. 31-36.
A study of labor and material requirements for federally-aided highway projects completed during 1973. The study examines the trends between 1958 and 1973.

Ball, Robert. "Labor and Materials Required for Highway Construction," *Monthly Labor Review*, June 1973, pp. 40-45.
Discussion of labor and material trends in highway construction between 1958 and 1970.

Labor and Material Requirements for Construction of Federally-Aided Highways, 1958, 1961, and 1964 (BLS Report 299), 1966, 17 pp.
Study providing measures for 1958, 1961, and 1964 of the labor and material requirements for federally-aided highways, with separate measures of the requirements for onsite and offsite construction. For onsite construction, the study also compares annual labor requirements for 1947-64.

Wakefield, Joseph C. "Labor and Material Requirements: Highway Construction, 1958 and 1961," *Monthly Labor Review*, April 1963, pp. 34-98.
A summary comparison of the 1958 and 1961 highway surveys.

Kutscher, Ronald E. and Waite, Charles A. "Labor Requirements for Highway Construction," *Monthly Labor Review*, August 1961, pp. 858-61.
Summary of findings of the 1958 highway survey.

Federal office building construction

Olsen, John G. "Decline Noted in Hours Required to Erect Federal Office Buildings," *Monthly Labor Review*, October 1976, pp. 18-22.
A study of 26 new office building projects completed in 1973 under the jurisdiction of the General Services Administration. In addition to data on labor requirements, the study provides information on building characteristics and contract operation.

Labor Requirements for Federal Office Building Construction (BLS Bulletin 1331), 1962, 43 pp.
A study of onsite and offsite labor requirements for 22 Federal office building projects in various localities of the United States over a 3-year period from the fall of 1957 to 1960.

Murray, Roland V. "Labor Requirements for Federal Office Building Construction," *Monthly Labor Review*, August 1962, pp. 889-93.
A summary of BLS Bulletin 1331.

Hospital construction

Labor and Material Requirements for Hospital and Nursing Home Construction (BLS Bulletin 1691), 1971, 50 pp.
A study similar to one published in 1962 (see BLS Bulletin 1340 below) but with data shown per square foot as well as per $1,000 of construction contract cost. Covers hospitals and nursing homes constructed in 1965-66.

Riche, Martha Farnsworth. "Man-hour Requirements Decline in Hospital Construction," *Monthly Labor Review*, November 1970, p. 48.
Summary of BLS Bulletin 1691.

Labor Requirements for Hospital Construction (BLS Bulletin 1340), 1962, 46 pp.
A study of onsite and offsite labor requirements for construction of selected public and private, profit and nonprofit, general hospitals in various localities of the United States between mid-1958 and mid-1959.

Rothberg, Herman J. "Labor Requirements for Hospital Construction, 1959-60," *Monthly Labor Review*, October 1962, pp. 1120-24.
A summary of BLS Bulletin 1340.

Private multifamily housing construction

Labor and Material Requirements for Private Multifamily Housing Construction (BLS Bulletin 1892), 1976, 69 pp.
Discusses labor and material requirements for the construction of private multifamily housing projects. Data were obtained from a survey based on a probability sample representing all privately owned structures of five units or more located in metropolitan areas where building permits for 500 units or more of this type were issued during 1969. The survey covered 89 projects in 22 Standard Metropolitan Statistical Areas. Most of the construction took place in 1971.

Ball, Robert. "Labor and Material Requirements for Apartment Construction," *Monthly Labor Review*, January 1975, pp. 70-73.
Summarizes the first construction labor requirements study of private multifamily housing construction.

Private single-family housing construction

Labor and Material Requirements for Construction of Private Single-Family Houses (BLS Bulletin 1755), 1972, 30 pp.
A study of labor and material requirements for construction of single-family housing in 1969.

Ball, Robert and Ludwig, Larry. "Labor Requirements for Construction of Single-Family Houses," *Monthly Labor Review*, September 1971, pp. 12-14.

Summary of BLS Bulletin 1755, a study of labor and material requirements for single-family housing construction in 1969.

Labor and Material Requirements for Private One Family House Construction (BLS Bulletin 1404), 1964, 37 pp.

A study of onsite and offsite labor requirements for constructing single-family houses developed from a sample of one-family houses built in 1962 in various localities of the United States.

Rothberg, Herman J. "Labor and Material Requirements for One-Family Houses," *Monthly Labor Review*, July 1964, pp. 797-800.

A summary of BLS Bulletin 1404.

Public housing construction

Prier, Robert J. "Labor Requirements Decline for Public Housing Construction," *Monthly Labor Review*, December 1980, pp. 40-44.

A study of public housing projects completed in 1975. The article compares this study to others conducted in 1960 and 1968. It discusses trends in labor requirements and distribution of costs.

Labor and Material Requirements for Public Housing Construction, 1968 (BLS Bulletin 1821), 1974, 20 pp.

A study based on findings of a survey of 48 public housing projects sponsored by the Housing Assistance Administration of the Department of Housing and Urban Development.

Finn, Joseph T. "Labor Requirements for Public Housing," *Monthly Labor Review*, April 1972, pp. 40-42.

Summary of a study of labor requirements for public housing construction in 1968.

Labor and Material Requirements for Public Housing Construction (BLS Bulletin 1402), May 1964, 42 pp.

A report based on findings of a survey of 31 public housing projects which the Public Housing Administration administered. Projects were selected in various States to represent four broad geographic regions of the conterminous United States.

School construction

Labor and Material Requirements for Elementary and Secondary School Construction (Publication Number BLS/LAB Constr-72/81), 1981, 47 pp.

(Available from National Technical Information Service, U.S. Department of Commerce.)

This report presents the results of a survey of 68 elementary and secondary school construction projects completed in 1972. The report provides detailed data on employment requirements by occupation and type of contractor and information on contract costs and materials requirements. Survey results are compared with the findings of two similar studies of school construction in 1959 and 1965.

Olsen, John G. "Labor and Material Requirements for New School Construction," *Monthly Labor Review*, April 1979, pp. 38-41.

A summary of above publication.

Labor and Material Requirements for School Construction (BLS Bulletin 1586), June 1968, 23 pp.

A survey of selected elementary and secondary public schools constructed primarily during 1964-65. In addition to providing information on labor requirements, the study includes data on the types and values of materials used, wages paid, occupations, and use of apprentices.

Finn, Joseph T. "Labor Requirements for School Construction," *Monthly Labor Review*, August 1968, pp. 40-43.

A summary of BLS Bulletin 1586.

Labor Requirements for School Construction (BLS Bulletin 1299), 1961 50 pp.

A study of primary and secondary employee hours required per $1,000 of new school construction based on contracts awarded for 85 elementary and 43 junior and senior high schools throughout the United States.

Epstein, Joseph and Walker, James F. "Labor Requirements for School Construction," *Monthly Labor Review*, July 1961, pp. 724-30.

A summary of BLS Bulletin 1299.

Sewer works construction

Labor and Material Requirements for Sewer Works Construction (BLS Bulletin 2003), 1979, 55 pp.

This report gives the results of a study of new sewer works construction in the United States completed by August 31, 1973. Most of the construction was done in 1971. The sample consisted of 145 contracts for sewer works: 82 sewer lines and 63 wastewater treatment plants. Data include onsite labor requirements per $1,000 of contract cost by occupation at the national and regional levels, a detailed listing of the types and values of the materials and equipment used, and the offsite labor hours required to manufacture and transport the materials. Comparison is made with a 1962-63 study.

Ball, Robert and Finn, Joseph T. "Labor and Material Requirements for Sewer Works Construction," *Monthly Labor Review*, November 1976, pp. 38-41.

Summarizes the 1971 study of sewer works construction which updates a study done in 1962-63. Provides data on labor and material requirements for construction of sewer lines and plants for the United States.

Labor and Material Requirements for Sewer Works Construction (BLS Bulletin 1490), 1966, 31 pp.

Study designed to measure employee hours required for each $1,000 of new sewer facilities construction contract. The basis for this study was 138 contracts for new sewer works in the years 1962-63.

Other reports, articles, and summaries

Ball, Claiborne M. "Employment Effects of Construction Expenditures," *Monthly Labor Review*, February 1965, pp. 154-58.

A summary of labor requirements for eight types of construction broken down by offsite and onsite hours, occupation, and region.

Finn, Joseph T. "Material Requirements for Private Multifamily Housing," *Construction Review*, April 1976, pp. 4-10.

This article summarizes the results of the survey of labor and building materials requirements for private multifamily housing (BLS Bulletin 1892) with reference to the value of the materials, supplies, and equipment used in this type of construction. A detailed listing of the cost of these materials, supplies, and equipment per $1,000 of construction contract cost and per 100 square feet is included. In addition, comparisons are made between the results of this study and the public housing (BLS Bulletin 1821) and private one-family housing (BLS Bulletin 1755) studies.

Ball, Robert. "The Contract Construction Industry," *Technological Trends in Major American Industries* (BLS Bulletin 1474), 1966, pp. 32-38.

Discusses economic trends in the industry with emphasis on the impact of technological change on employment, occupations, job skill, and productivity.

"Construction Labor Requirements," reprint of Chapter 33 of *BLS Handbook of Methods* (BLS Bulletin 1910), 1976.

Description of techniques of construction labor requirements studies.

Mark, Jerome A. and Ziegler, Martin. "Measuring Labor Requirements for Different Types of Construction." Paper presented before the Conference on the Measurement of Productivity in the Construction Industry, sponsored by the National Commission on Productivity and the Construction Industry Collective Bargaining Commission, Washington, D.C., September 14, 1972.

Discussion of the BLS program of labor and materials requirements and analysis of the potential of using data from the program to measure productivity by type of construction.

Weinberg, Edgar. "Mechanization and Automation of Building Site Work." National Response Paper for the Economic Commission for Europe, Committee on Housing, Building, and Planning, Third Seminar on the Building Industry, Moscow, October 1970.

Discussion of current technology and labor requirements at the construction site.

Weinberg, Edgar. "Reducing Skill Shortages in Construction," *Monthly Labor Review*, February 1969, pp. 3-9.

Discussion of methods for reducing occupational shortages.

Ziegler, Martin. "BLS Construction Labor Requirements Program." Paper presented before the North American Conference on Labor Statistics, San Juan, Puerto Rico, June 1971.

Construction labor requirements program and objectives are discussed.

Finn, Joseph T. "Material Requirements for Sewer Works Construction," *Construction Review*, January 1979, pp. 4-13.

This article summarizes the results of the survey of labor and material requirements for sewer works construction during 1971 (BLS Bulletin 2003) with reference to the value of the materials, supplies, and equipment used in this type of construction. A detailed listing of the cost of these materials, supplies, and equipment per $1,000 of construction contract cost and per 100 square feet is included. In addition, comparisons are made with the results of an earlier study of sewer works construction during 1963.

Ball, Robert. "Material Requirements for Private Office Buildings and Other Selected Types of Construction Activities." Paper presented before the Construction Marketing Seminar, Chicago, Illinois, September 28, 1978.

Discusses material and equipment requirements for the construction of private office buildings and other types of building construction studied by BLS.

☆ U.S. GOVERNMENT PRINTING OFFICE :1982 O—381-608 (4212)

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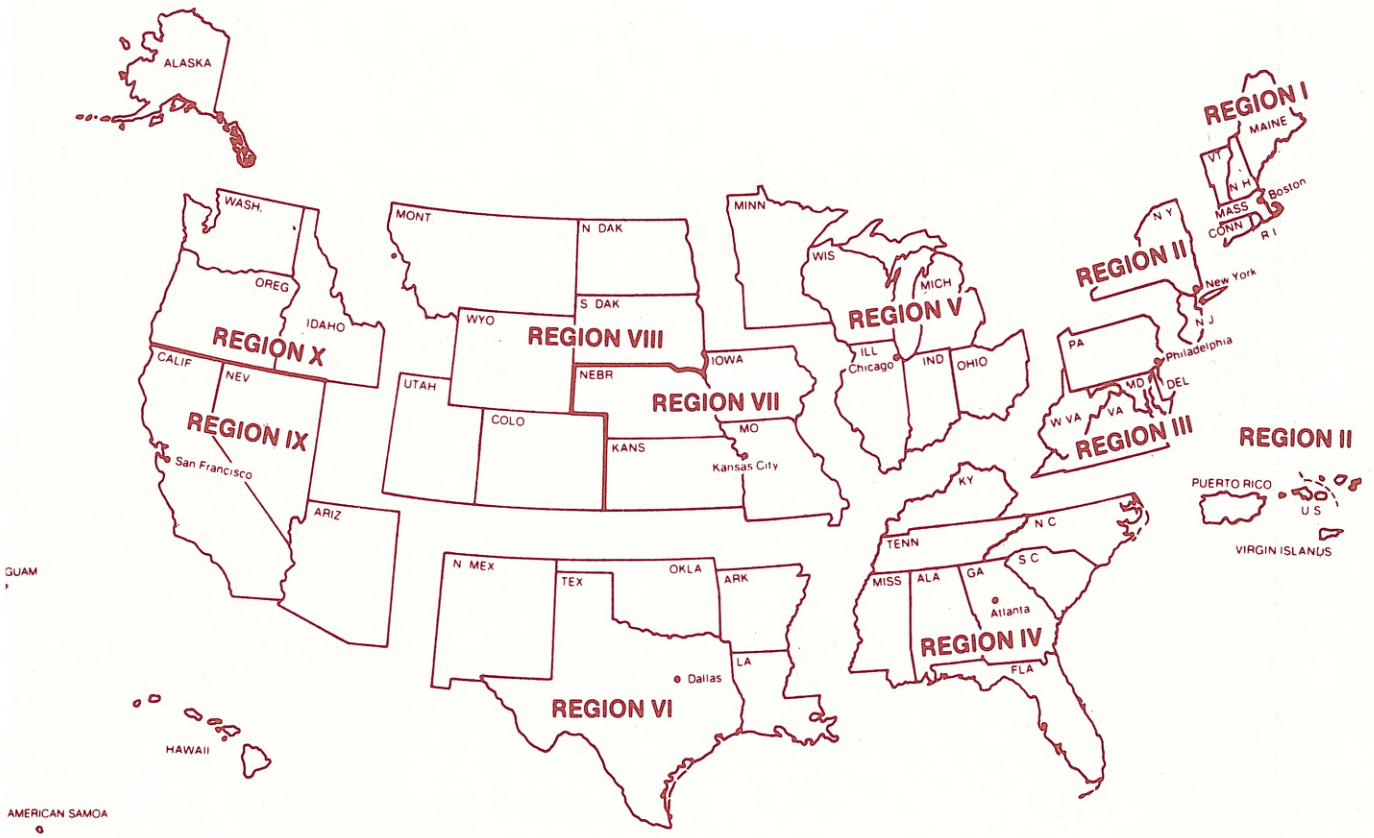

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Government Center
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Phone: (212) 944-3121

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