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Labor and Material Requirements for Federal Building Construction

U.S. Department of Labor
Bureau of Labor Statistics
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Bulletin 2146

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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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Preface

This bulletin presents the results of a survey of Federal building construction. It is one of a series of construction studies conducted by the Bureau of Labor Statistics which provide detailed data on employment requirements by occupation and type of contractor and information on contract costs and material requirements. A summary of this study was published in the December 1981 issue of the *Monthly Labor Review*.

Other published studies in the series include highways, public housing, commercial office buildings, elementary and secondary schools, college housing, civil works, sewer works, private multifamily housing, private single-family housing, and general hospitals.

The Bureau gratefully acknowledges the cooperation of the Office of Construction Management, Public

Buildings Service, General Services Administration in helping to develop the initial universe of projects. The Bureau also wishes to thank the almost 1,100 general and special trade contractors who provided information for the survey.

The study was prepared in the Bureau's Office of Productivity and Technology by John G. Olsen under the supervision of Robert Ball in the Office of Productivity and Technology, Jerome A. Mark, Assistant Commissioner. Karen J. Horowitz of the Office of Economic Growth assisted in the development of offsite employee hour estimates.

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Contents

	<i>Page</i>
Chapter 1. Introduction	1
Scope of survey	1
Survey methods	2
Nature of the industry	2
Chapter 2. Highlights of findings	4
General findings	4
Requirements by occupation and type of contractor	5
Distribution of costs	5
Regional differences	6
Chapter 3. Labor requirements	7
Onsite	7
Offsite	8
Chapter 4. Distribution of costs and wages and other characteristics	11
Construction costs by selected characteristics	11
Relative cost shares	11
Contractor costs	11
Wages and earnings by region	12
Wages by occupation	12
Materials, supplies, and equipment	12
Construction time	17
Contractors	17
Chapter 5. Comparison with other surveys	18
Text tables:	
1. Employee hours per \$1,000 of Federal building construction by industry, 1959, 1973, 1976, and estimated 1981	5
2. Federal building construction project characteristics, 1959, 1973, and 1976	5
3. Onsite employee hours required per \$1,000 of Federal building construction cost by occupation, 1959 and 1976	8
4. Percent distribution of apprentices employed on Federal building construction projects by occupation and region, 1976	8
5. Onsite employee hour requirements in Federal building construction by type of contractor, 1959, 1973, and 1976	9
6. Onsite employee hour requirements for Federal building construction by selected characteristics, 1959, 1973, and 1976	9
7. Indirect employee hour requirements per \$1,000 of contract construction cost for Federal building construction, 1959 and 1976	10
8. Construction costs of Federal buildings by selected characteristics, 1959, 1973, and 1976 ..	12
9. Percent distribution of contract costs for Federal building construction, 1959, 1973, and 1976	13
10. Percent distribution of contract cost on Federal building construction projects by type of contractor and region, 1973 and 1976	13

Contents—Continued

Page

11. Average onsite earnings and wages as a percent of contract cost on Federal building construction projects by region, 1959 and 1976	13
12. Average hourly earnings for selected onsite construction workers on Federal building projects by region, 1976	13
13. Materials, equipment, and supplies used in Federal building construction, 1959 and 1976. . .	14
14. Average number of weeks of construction time for Federal building projects by selected characteristics, 1959, 1973, and 1976	17
15. Percent distribution of onsite employee hours by decile of construction time, 1959 and 1976	17
16. Average number of contractors for Federal building projects by type of contractor and region, 1976	17
17. Employee hours per 1,000 current dollars of contract cost by industry, all construction studies, 1958-76	19
18. Percent distribution of onsite employee hours per 1,000 current dollars of contract cost by occupation, all construction studies, 1958-76	20
19. Percent distribution of construction contract costs, all construction studies, 1958-76	21
20. Percent distribution of cost of materials, supplies, and equipment by product group, all construction studies, 1958-76	22

Appendixes:

A. Detailed labor and cost data by region	23
Tables:	
A-1. Onsite employee hour requirements per \$1,000 of contract cost for Federal building construction by occupation and region, 1976	24
A-2. Percent distribution of onsite employee hour requirements per \$1,000 for Federal building construction by type of contractor and region, 1976	25
A-3. Onsite employee hour requirements in Federal building construction by selected characteristics and region, 1976.	26
A-4. Construction costs of Federal buildings by selected characteristics and region, 1976. . .	27
A-5. Average onsite earnings and wages as a percent of contract costs on Federal building construction projects by selected characteristics and region, 1976	28
B. Survey scope and methods	29
C. Forms used for data collection	31
D. Bibliography	51

Chapter I. Introduction

The construction industry is an important component of the U. S. economy. It is a major source of employment and a major consumer of the materials and services furnished by many manufacturing, trade, transportation, and service industries. Because of this extensive employment impact, the creation of new construction projects often is regarded as a means of counteracting cyclical unemployment.

Information on the number and composition of jobs generated by construction activity is necessary in order to determine training needs and to develop priorities for construction expenditures. To assist in evaluating the impact of construction expenditures on employment, Congress established a program of construction labor requirements studies in 1959. Since then, the Bureau of Labor Statistics has conducted periodic surveys of labor and material requirements for various segments of the construction industry.

These studies provide data which are important in determining skill shortages or bottlenecks for various types of construction. Resurveys of a given type of construction indicate cost changes and productivity trends for onsite construction labor. Of special interest

to market research analysts and companies manufacturing equipment and supplies are lists of material requirements per \$1,000 of construction contract.

Scope of survey

This study, the third BLS study of Federal office building construction,¹ is based on a survey of all Federal building construction completed in the continental United States in 1976 and 1977 under the auspices of the Public Buildings Service, General Services Administration.² The survey was designed primarily to determine the number of employee hours per \$1,000 of contract cost. Employee hours included both onsite and offsite construction and the indirect employment required to produce and deliver the materials used in the construction activity.³

The study originally comprised 33 projects, but was reduced to 24 due to lack of cooperation by contractors and because some projects were judged to be out of the scope of this survey. Lack of cooperation was particularly acute in the West. As a result, data from the West were not sufficiently reliable to permit publication of separate figures for that region.⁴ However,

requirements and are useful in analyzing changes in these factors over periods of time. The data also serve as benchmarks for developing current estimates of employment generating effects on construction expenditures.

³No attempt was made to measure the labor required for planning, design work, and public utilities installation. The employment generated from the spending and respending of wages and profits—the multiplier effect—also fell outside the scope of the survey.

⁴Data from the study were provided for the continental United States and four broad geographic regions. The 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.

No separate data are presented for the West, but those for the other regions and for the Nation as a whole are believed to be accurate. The detailed data, however, have a wider margin of sampling error and may be subject to other limitations. Except for the data estimated by the contractors, there are no known sources of probable nonsampling error. Sampling variances are being developed by the Bureau of Labor Statistics.

¹ John G. Olsen, "Decline Noted in Hours Required To Erect Federal Office Buildings," *Monthly Labor Review*, October 1976, pp. 18-22; Roland V. Murray, "Labor Requirements for Federal Office Building Construction," *Monthly Labor Review*, August 1962, pp. 889-93; and *Labor Requirements for Federal Office Building Construction*, Bulletin 1331 (Bureau of Labor Statistics, 1962).

The 1973 survey of Federal building construction was one of a group of abbreviated studies of construction labor requirements. To allow more frequent measurement of the labor requirements of different types of construction as well as to reduce survey costs, the abbreviated studies omitted the collection of onsite occupational and material data. Material and equipment cost information is used to generate indirect employment estimates for the industries which mine, manufacture, and transport construction materials. As a result, detailed data on occupational requirements, material usage, and indirect employment impact are not available for the 1973 survey.

² Although the study was based on project completions, most of the value put in place occurred between 1973 and 1977, with peak activity in 1976.

The length of time between the data year and the year of publication results from several factors. A considerable amount of time is needed to define and refine the universe and collect, compile, and verify the data. Actual data collection does not begin until at least a year after construction is completed, and surveyed projects require many personal visits to contractors and subcontractors. Additional time is required for preparation and publication of the results. Nevertheless, the data presented indicate trends in labor and material re-

data for the West were adjusted for nonresponse and included in national totals.

Projects in this study included regular and Social Security Administration office buildings, border stations, and other buildings included in the 1959 and 1973 BLS studies on Federal building construction. Federal and Social Security Administration office buildings accounted for about 80 percent of all Federal projects in 1973 and 1976. Although all three of these surveys are essentially studies of office buildings, several factors make comparisons among them difficult except in the broadest terms.

The average building size, for example, varies considerably among the studies. In 1959, the average size was about 94,000 square feet. In 1973, this dropped to 67,000 and then rose to 266,000 in 1976. A further complication resulted from the abolition of the Post Office Department, whose physical plant was formerly under the control of the General Services Administration. After the establishment of the U.S. Postal Service, control of the buildings reverted to the new agency. Thus, Postal Service buildings were excluded from the 1973 and 1976 studies. In addition, a larger proportion of small Social Security Administration office buildings, those with 10,000 square feet of floor space or less, were included in the 1973 study and made up about 40 percent of all projects. (See appendix B for further details on the scope of the survey.)

Survey methods

Onsite employee hour requirements in the construction industry were developed from payroll data supplied by contractors. Indirect labor requirements in other industries were derived from the materials and equipment cost information collected for the sample projects. Estimates of indirect employment were developed by classifying and aggregating individual material values, deflating them by an appropriate producer price index to match the base year of the input-output tables to generate estimates of final demand. Sector productivity factors then were applied to derive employee hours by industry group. (Further details on survey methods are presented in appendix B.)

Nature of the industry

According to the Bureau of the Census, expenditures for the category "other Federal building construction" amounted to about \$711 million in 1981.⁵ Federal building projects constructed under the auspices of the Public Buildings Service accounted for a substantial portion of this total. In 1981, other Federal building construction was about 26 percent lower in constant dollars than in 1976. This decline represents a continuation of a long-term trend that began in the late 1960's. The

declining level of Federal building construction activity is primarily a result of delayed replacement of old structures.

Technological changes in the construction industry during recent years have primarily consisted of modifications and improvements in existing methods, equipment, and materials. The technology of building construction continues to advance slowly through the adoption of new design concepts, stronger and more durable materials, laborsaving computer processes, and more efficient management techniques.

Advances in design concepts are allowing increasingly complex buildings to be erected economically. The development of new and better structural design techniques, such as plastic design, tubular design, the staggered truss frame method, and the shear friction principle, have helped reduce the weight and construction costs of high rise buildings. Tubular design, which uses exterior columns to carry wind loads, eliminating the need for any interior bracing, decreased the structural steel requirements for one multistory office building by 30 percent, significantly lowering framing costs.⁶

The growing interest in energy conservation is resulting in the development of energy saving designs for office buildings. The installation of a solar energy system in a new Federal building project, while increasing labor requirements and construction costs, significantly reduced water and space heating costs, suggesting the possibility of more efficient energy systems for future office building structures.

Continuing advances in computer technology are speeding production, improving output quality, and reducing unit labor costs on a variety of construction jobs. The development of smaller, less expensive, and easier to use computers has made it easier for construction contractors to use computers for many offsite functions. Most major design firms employ computer systems for design and cost analysis because of their greater sophistication, accuracy, and operating speed. Computer models have been devised to analyze an entire structure for stresses, enabling complex geometric designs to be built more efficiently. Electronic accounting systems are used by most large contractors for regular billing, payroll, and inventory functions, reducing the amount of clerical work required. Computer graphic systems, which provide visual representations of various design components, are used by surveyors because of their map-making ability to aid in the analysis of construction surveys. Architects are employing these programming methods to accelerate the production of detailed drafting plans.

Development of construction management methods in which the individual components of a project are

⁵ See table 2 of Construction Report C30-81-5, Bureau of the Census.

⁶ "Hexagonal Tube with Rigid Frames Reduces High Rise's Steel by 30 Percent," *Engineering News-Record*, October 4, 1973, p. 36.

examined according to their contribution to the whole building process is helping to control construction time-lags and costs. Techniques such as value engineering, fast-tracking or phased construction, design building, the Program Evaluation and Review Technique (PERT), and the Critical Path Method (CPM) are enhancing contractors' ability to coordinate the various aspects of large, complex construction projects. Value engineering, which is used in several Federal construction programs, is a systematic study of a design that

evaluates the functions of its various components. A cost reduction incentive in the Federal value engineering programs offers to share cost savings arising from contractor-initiated changes in plans, specifications, or other contract requirements. Fast-tracking, in which the design and construction schedules are overlapped, has the potential to shorten construction duration and to provide a defense against rising construction costs, material shortages, and early obsolescence in the design process.

Chapter II. Highlights of Findings

General findings

Federal building construction generated more than 34 employee hours directly in the construction sector for each \$1,000 expended on construction contracts in 1976 (table 1). This compares with estimates from similar studies of 48 employee hours in 1973 and 108 hours in 1959. In 1976, about 30 of the construction employee hour requirements were expended at the site, and almost 5 hours were created in offsite construction. In addition to the construction hours, almost 47 employee hours were generated in industries which produce, transport, and sell the materials, equipment, and supplies used in Federal building construction.

When adjusted for inflation, each \$1,000 (in 1959 dollars) spent on Federal building projects in 1976 generated about 79 construction employee hours, compared with 80 employee hours in 1973 and 108 hours in 1959. Assuming a continuation of this trend, an estimated 72 construction employee hours per \$1,000 (1959 dollars) would have been generated in 1981.⁷

In terms of employment, each \$1 billion spent on Federal building construction during 1981 would have generated the equivalent of about 24,100 year-long, full-time jobs throughout the economy.⁸ About 10,400 of these would have been in the construction industry, 9,100 onsite and 1,300 offsite.⁹ In addition, about 13,700

jobs would have been indirectly created in other industries. In comparison, during 1981, for each \$1 billion expended for commercial office building construction, about 21,100 jobs were generated; about 22,400 jobs were generated per \$1 billion spent on elementary and secondary school construction.¹⁰

Onsite employee hours per \$1,000 (constant dollars) decreased at an average annual rate of 22 percent between 1959 and 1976.¹¹ While this is not a measure of onsite labor productivity, the decline indicates some productivity improvement in this construction activity.

On average, a Federal building project finished in 1976 and 1977 required 130 weeks to complete, compared with 64 and 73 weeks, respectively, for projects completed in 1973 and 1959 (table 2). The increased length of time for completion reflects, in part, the larger average size of projects in the current survey. Actual construction of the sample projects took place in 1972 through 1978, but most projects were completed during 1976 and 1977. Construction time varied from 54 weeks for a small border station to 295 for one of the largest office buildings.

Federal building projects in 1976 required an average of 47 contractors, twice as many as in 1973 and 1959. Each project contained about 266,100 square feet and cost about \$12.7 million per project. The Federal

⁷ The 1981 employment estimates for Federal building construction were developed from 1973 and 1976 survey data adjusted for price and productivity changes. The deflator used to adjust survey data for price change is the Bureau of the Census' cost index for "non-residential building" construction. This consists of: An unweighted average of the Bureau of the Census single-family housing price index, excluding the value of the lot; the Turner Construction Company cost index; and the Federal Highway Administration structures price index. The nonresidential building construction price deflator, derived from an unweighted average of the three indexes on a 1972=100 base, equaled 224.8 in 1981, 136.8 at the midpoint of the 1976 survey, and 109.3 at the midpoint of the 1973 survey.

The estimate used to adjust the survey data for productivity change is the inverse of the change in onsite employee hours per \$1,000, after adjustment for price variations, between the 1973 and 1976 surveys. The annual rate of change averaged 1.6 percent during this period.

⁸ Estimates of the number of full-time jobs per \$1 billion spent in 1981 were derived using 1,800 hours per employee year for onsite construction; 2,000 hours for offsite construction; 2,068 for manufacturing; 1,780 for trade, transportation, and services; and 2,024 for mining and all other.

Because of part-time workers, transients, and the seasonal nature

of employment in the construction industry, more workers would be employed than indicated by the full-time jobs estimates.

⁹ Offsite construction labor requirements were estimated from the ratio of nonconstruction workers to total workers for the general building and the special trade contractors (SIC 15 and 17) segments of the contract construction industry as shown in *Employment and Earnings*, March issues of the years covered.

¹⁰ These 1981 employment estimates were developed from earlier BLS survey data adjusted for price and productivity changes. For reports on the earlier studies, see Barbara Bingham, "Labor and Material Requirements for Commercial Office Building Projects," *Monthly Labor Review*, May 1981, pp.41-48; and John G. Olsen, "Labor and Material Requirements for New School Construction," *Monthly Labor Review*, April 1979, pp. 38-41.

¹¹ Average annual rates of change in the article were calculated between the midpoints of the various surveys. The midpoint of a survey is based on estimates of the value of surveyed construction put in place by year of construction time. For the 1976 survey, most of the value put in place occurred between 1973 and 1977 with the midpoint falling in 1975. For the 1973 survey, most of the value put in place was erected between 1971 and 1973 with the midpoint occurring in 1972.

Table 1. Employee hours per \$1,000 of Federal building construction by industry, 1959, 1973, 1976, and estimated 1981

Industry	Current dollars				Constant 1959 dollars ¹		
	1959	1973	1976	1981 ²	1973	1976	1981 ²
All industries.....	235.7	n.a.	81.4	45.7	n.a.	187.2	172.6
Construction.....	107.9	47.7	34.4	19.0	80.2	79.1	71.8
Onsite.....	97.1	42.8	29.8	16.4	71.9	68.5	61.9
Offsite ³	10.8	4.9	4.6	2.6	8.2	10.6	9.8
Other industries ⁴	127.8	n.a.	47.0	26.7	n.a.	108.1	100.8
Manufacturing.....	79.2	n.a.	26.0	14.4	n.a.	59.8	54.4
Trade, transportation, and services.....	35.7	n.a.	16.5	9.7	n.a.	37.9	36.6
Mining and other.....	12.9	n.a.	4.5	2.6	n.a.	10.3	9.8

¹ The deflator used to adjust for price change is the Bureau of the Census' cost index for "nonresidential building" construction. (See text footnote 2.)

² The 1981 employment estimates were developed from 1976 survey data adjusted for price and productivity changes from the midpoint of the 1976 survey.

³ Offsite construction employee hours were estimated from the ratio of non-construction workers to total workers for the general building and special trade contractors (SIC 15 and 17) segment of the contract construction industry as

shown in *Employment and Earnings*, March issues of the years covered.

⁴ Indirect employment data were revised from the original 1959 survey results because of the reprocessing of materials data through improved input-output tables.

n.a. = Data not available.

NOTE: Detail may not add to totals because of rounding.

buildings consisted primarily of steel-framed, multistory office structures. Most projects had a built-in roof with a concrete roof base, an acoustical tile ceiling, drywall interiors, a concrete floor base with carpet covering, and a basement. A majority of the buildings had forced-air heating, central air-conditioning, and outdoor parking areas. All structures of more than two stories contained elevators.

Requirements by occupation and type of contractor

Onsite employee hour requirements contributed by skilled trades workers increased from about 60 percent of total onsite employee hours in 1959 to more than 68 percent in 1976. Employee hours attributable to semi-skilled and unskilled workers, more than one-third of onsite employee hours in 1959, declined to less than 24 percent in 1976. Hours of nonproduction employees, such as supervisors, engineers, and clerks, increased slightly to almost 3 percent in 1976.

General contractors accounted for 31 percent of onsite employee hour requirements in 1976. Compared

with the two earlier studies, this represents a continuing decline in the proportion of onsite hours worked by general contractors. The major subcontracting groups employed in Federal building construction are: Heating, ventilating, and air-conditioning; electrical; concrete; and structural steel. Along with the general contractors, these groups accounted for more than two-thirds of all onsite hours in 1976.

Distribution of costs

General contractors accounted for about 29 percent of all contract costs for Federal building projects in 1976. Among subcontractors, heating, ventilating, and air-conditioning made up the largest cost group, followed by structural steel and electrical work. These three major subcontractors accounted for almost one-third of total construction costs.

About 26 percent of the construction costs of Federal buildings completed in 1976 and 1977 represented expenditures for onsite wages and salaries. The largest share of the construction costs, around 42 percent, went for materials, built-in equipment, and supplies. Equip-

Table 2. Federal building construction project characteristics, 1959, 1973, and 1976

Characteristic	1959	1973	1976 ¹			
	United States	United States	United States	Northeast	North Central	South
Average square feet of space per project.....	93,700	67,300	266,100	281,800	248,500	338,100
Average cost per project.....	\$1,760,100	\$2,780,100	\$12,692,400	\$18,476,900	\$10,412,400	\$15,743,200
Average cost per square foot.....	\$18.80	\$41.28	\$47.70	\$65.60	\$41.90	\$46.55
Average hourly earnings of construction workers.....	\$2.98	(²)	\$8.66	\$9.54	\$9.93	\$7.64
Average wages as a percent of contract cost.....	29.0	34.0	25.8	24.7	28.1	24.3
Average number of weeks of construction per project.....	73	64	130	179	107	148
Average number of contractors per project.....	22	22	47	36	54	50

¹ In the 1976 study, data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Not available.

ment used to construct the projects accounted for another 3 percent of cost. The remaining almost 29 percent covered contractors' overhead costs and profits.

This cost distribution suggests that a significant change occurred between 1959 and 1976 in the relative cost shares for Federal building construction. The proportion of costs represented by materials fell from about 51 percent in 1959 to around 42 percent in 1976. The proportion contributed by onsite wages also declined slightly, while contractors' equipment showed a slight rise. Overhead and profit costs, which include salaries of offsite workers, supplemental benefits, performance bonds, contractors' profits, and expenses for interest, office, and miscellaneous items, increased from 18 percent in 1959 to almost 29 percent in 1976.

More than three-fifths of the costs of materials, equipment, and supplies used in Federal building construction during 1976 were expended for materials in three product groups—stone, clay, glass, and concrete products; primary metal products; and fabricated metal products, except ordnance, machinery, and transportation equipment. These three groups accounted for about 63 percent of material costs in 1976 compared with around 55 percent in 1959. Between 1959 and 1972, expendi-

tures for primary metal products as a percent of total materials almost doubled, reflecting, in part, an increase in the size of projects in the current study, requiring more structural steel products.

Regional differences

Data reflect differences in construction requirements due to differing regional conditions under which projects are built. For example, the leading roof base and exterior wall material used in projects in the South was concrete. In contrast, projects in the North Central States made extensive use of steel decking for roof bases and of load bearing masonry for exterior walls.

These different characteristics lead to differences in costs by region. The Northeast led all regions in average cost per project and per square foot, reflecting several factors; including a higher proportion of projects with more than two stories which required elevators.

Regional differences also were observed in earnings. Hourly earnings, for example, for all construction averaged \$8.66, ranging from \$7.64 in the South to \$9.93 in the North Central region. Wages as a percentage of costs varied from about 28 percent in the South to about 24 percent in the North Central.

Chapter III. Labor Requirements

Onsite

Onsite labor requirements for Federal building projects averaged about 30 onsite employee hours per \$1,000 of contract cost in 1976, about 37 percent of all employee hour requirements. Federal and Social Security Administration office building projects generated slightly lower onsite labor requirements than other Federal building projects, an average of about 29 hours, compared with 33.

In comparison, in 1959, Federal building projects averaged about 97 onsite employee hours per 1,000 current dollars and, in 1973, 43 onsite hours. The 1959 onsite figures constituted about 41 percent of all employee hour requirements in that study. Current estimates based on trends from the three Federal building studies indicate that about 17 onsite employee hours per \$1,000 of Federal building construction cost would have been generated in 1981.

On a constant (1959) dollar basis, onsite labor requirements declined from 97 employee hours per \$1,000 in 1959 to almost 72 hours in 1973, and more than 68 hours in 1976. The average annual rate of decline was 2.3 percent between 1959 and 1973 and 1.6 percent between 1973 and 1976.

	<i>Onsite employee hours per \$1,000 (1959 dollars)</i>
1959	97.1
1973	71.9
1976	68.5
	<i>Average annual percent change</i>
1959-76	-2.2
1959-73	-2.3
1973-76	-1.6

The change over time in onsite employee hour requirements per unit of output reflects the introduction of new methods, equipment, and materials, and shifts in the composition and location of construction. Although changes in onsite employee hour requirements reflect some differences in the type of structures built in the survey years, they provide a rough indication of productivity trends in this type of construction.

Employee hours by occupation. Carpenters, the major skilled trades workers, accounted for about 13.9 per-

cent of the onsite employee hours of all skilled workers in Federal building construction during 1976 (table 3). Other major skills, in descending order, included: Electricians, structural iron workers, plumbers, and sheet-metal workers. Together, these five occupations accounted for almost 60 percent of all skilled trades hours.

Bricklayers, and semiskilled and unskilled workers, who contributed 2.7 and 23.6 percent, respectively, of all onsite employee hour requirements in 1976, experienced a substantial decline from the 1959 Federal building study. These trends reflect the increasing use of prefabricated components and the mechanization of some material handling operations. The proportion of hours contributed by structural iron workers, elevator constructors, cement finishers, operating engineers, and electricians increased significantly over this period. These trends reflect greater use of structural steel and concrete as building materials as well as a larger mix of multistory office buildings with elevators in the 1976 study.

Apprentice onsite employee hours. Apprentices made up about 11 percent of all skilled workers in 1976 compared with approximately 6 percent in 1959. The occupations that had the largest relative number of apprentices were sprinkler fitters, plumbers, pipefitters, and electricians.

The distribution of total apprentice hours in 1976 indicates that about one-quarter of the apprentice hours were contributed by electricians (table 4). Other major occupations included plumbers, carpenters, structural iron workers, sheet-metal workers, and pipefitters. These six trades accounted for almost three-quarters of all apprentice hours in 1976.

Employee hours by type of contractor. The distribution of onsite employee hours per \$1,000 of Federal building construction cost by type of contractor in 1976 reflects a continuing trend toward more subcontracting (table 5). The proportion of onsite hours worked by general contractors has declined between each of the studies. While the proportion of hours worked by structural iron work, site preparation, excavation and grading, concrete work, electrical, acoustical, and wallboard

subcontractors increased substantially. This trend toward more subcontracting of onsite work reflects the need for general contractors to concentrate more of their efforts on coordinating, financing, and purchasing functions.

Compared with the two earlier studies, the proportion of hours worked by plastering and lathing and plumbing contractors declined substantially in 1976. These trends reflect, in part, the substitution of wall-board for plastering and lathing methods and the growing use of prefabricated materials that require less onsite finishing work.

Employee hours by selected characteristics. Federal building projects during 1976 required an average of 378,000 onsite employee hours or about 210 employee years of onsite labor, compared with 119,000 onsite hours in 1973 and 171,000 hours in 1959. On a square footage basis, Federal building projects in 1976 generated an average of almost 142 onsite employee hours per 100 square feet, a decline from the approximately 177 onsite employee hours generated in 1973, and the 183 hours in 1959 (table 6). Employee hour requirements per 100 square feet during 1976 ranged from about 102 hours in the North Central region to about

Table 3. Onsite employee hours required per \$1,000 of Federal building construction cost by occupation, 1959 and 1976

Occupation	Onsite employee hours		Percent distribution	
	1959	1976	1959	1976
All occupations.....	97.1	29.8	100.0	100.0
Skilled trades.....	58.2	20.4	59.9	68.3
Bricklayers.....	5.0	.8	5.2	2.7
Carpenters.....	12.2	4.1	12.6	13.9
Cement finishers.....	2.0	1.0	2.1	3.3
Electricians.....	8.8	3.4	9.1	11.5
Elevator constructors.....	.7	.4	.8	1.4
Glaziers.....	.4	.1	.4	.5
Insulation workers.....	2.1	.4	2.1	1.4
Iron workers, ornamental.....	.8	.3	.8	.9
Iron workers, reinforcing.....	2.1	.4	2.2	1.2
Iron workers, structural.....	1.2	1.7	1.2	5.8
Lathers.....	1.8	.3	1.8	1.1
Operating engineers.....	2.3	1.1	2.4	3.6
Painters.....	2.0	.5	2.1	1.6
Plasterers.....	2.0	.3	2.0	1.1
Plumbers and pipefitters.....	8.5	2.4	8.7	7.9
Plumbers.....	(¹)	1.3	(¹)	4.5
Pipefitters.....	(¹)	1.1	(¹)	3.4
Roofers.....	.7	.3	.7	1.0
Sheet metal workers.....	4.9	1.3	5.0	4.5
Soft floor layers.....	.2	(²)	.2	.1
Terrazzo workers and tile setters....	.5	.2	.5	.6
Other skilled workers.....	(¹)	1.2	(¹)	4.2
Laborers and other.....	33.0	7.0	34.0	23.6
Laborers, helpers, and tenders.....	31.5	6.4	32.5	21.4
Truckdrivers.....	.9	.2	.9	.8
Other.....	.6	.4	.6	1.4
Professional, technical, and clerical workers.....	2.2	.8	2.3	2.8
Superintendents and blue-collar supervisors.....	3.6	1.6	3.7	5.3

¹ Data not available.
² Less than 0.05 employee hours.

NOTE: Detail may not add to totals because of rounding.

Table 4. Percent distribution of apprentices employed on Federal building construction projects by occupation and region, 1976¹

Occupation	Percent distribution			
	United States	North-east	North Central	South
All skilled trades.....	100.0	100.0	100.0	100.0
Bricklayers.....	2.4	.2	5.1	1.8
Carpenters.....	13.6	13.9	10.3	14.9
Cement finishers.....	3.9	.9	4.0	4.5
Drywall finishers.....	.1	(²)	.3	-
Electricians.....	24.5	31.0	23.3	23.8
Elevator constructors.....	1.3	5.4	2.3	(²)
Glaziers.....	.6	(²)	.6	.7
Insulation workers.....	2.4	-	.6	3.8
Iron workers, ornamental.....	1.2	1.1	2.0	1.0
Iron workers, reinforcing.....	.9	.2	.6	1.1
Iron workers, structural.....	7.4	15.1	4.6	7.1
Lathers.....	1.0	1.4	.2	1.3
Machinists.....	.1	-	-	.2
Operating engineers.....	.5	1.1	1.0	.1
Painters.....	1.9	1.2	1.8	1.9
Pipefitters.....	6.9	6.7	9.8	5.8
Plasterers.....	1.2	.3	1.4	1.3
Plumbers.....	13.9	12.6	9.6	15.9
Roofers.....	1.4	(²)	.7	1.9
Sheet metal workers.....	7.2	7.5	7.0	7.2
Sprinkler fitters.....	5.0	.9	14.7	1.8
Soft floor layers.....	.2	-	.2	.2
Tile setters.....	.6	.2	-	1.0
Other skilled trades workers.....	1.6	.3	.1	2.6

¹ Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Less than 0.05 percent.

NOTE: Dash denotes that the survey had no sample projects in this cell. Detail may not add to totals because of rounding.

170 hours in the Northeast. Onsite employee hour requirements per \$1,000 frequently do not parallel requirements per 100 square feet. Differences in project type, design, materials, geographic location, and relative costs will affect the comparisons between these two measures of unit labor requirements.

In 1976, Federal and Social Security Administration office buildings generated slightly lower onsite labor requirements per \$1,000 than other Federal buildings—an average of about 29 hours compared with 33. Projects costing more than \$10 million experienced the lowest unit labor requirements of any cost class, suggesting that some labor saving may have resulted from economies of scale associated with large buildings.

The distribution of onsite employee hours per \$1,000 in 1976 also varied by geographic location. Federal building projects in the North Central region experienced the lowest unit labor requirements of any region. In contrast, projects in the South required the highest number of onsite employee hours per \$1,000, reflecting the more frequent use of semiskilled and unskilled workers.

Offsite

Offsite employee hours represent builders' administrative, estimating, and warehousing activities and the

Table 5. Onsite employee hour requirements in Federal building construction by type of contractor, 1959, 1973, and 1976

Type of contractor ¹	Employee hours required per \$1,000			Percent distribution		
	1959	1973	1976	1959	1973	1976
Total	97.1	42.8	29.8	100.0	100.0	100.0
General contractors.....	38.5	16.1	9.1	39.6	37.6	30.5
Plumbing, heating, ventilating, and air-conditioning	19.5	8.5	4.9	20.1	19.9	16.6
Heating, ventilating, and air-conditioning	(²)	5.9	4.0	(²)	13.7	13.6
Plumbing.....	(²)	2.6	.9	(²)	6.1	3.0
Electrical.....	9.5	4.2	3.3	9.8	9.8	11.2
Plastering and lathing	4.7	2.7	.5	4.8	6.4	1.6
Structural and ornamental iron work	3.4	1.7	1.8	3.5	3.9	6.0
Structural steel erection.....	(²)	1.4	1.7	(²)	3.3	5.8
Ornamental iron work.....	(²)	.2	.1	(²)	.6	.2
Elevator and other equipment installation	1.5	1.6	.8	1.5	3.8	2.8
Elevators.....	(²)	.4	(²)	(²)	1.0	(²)
Mechanical and equipment installation	(²)	1.2	(²)	(²)	2.8	(²)
Masonry and stonework.....	7.7	1.2	1.5	7.9	2.9	5.2
Site preparation, excavation, and grading.....	2.0	.9	1.4	2.1	2.2	4.7
Roofing and sheet metal work	1.2	1.0	.5	1.2	2.3	1.6
Roofing and gutter work.....	(²)	.9	.4	(²)	2.1	1.3
Sheet metal work (except heating)	(²)	.1	.1	(²)	.2	.3
Painting and paperhanging	2.0	.5	.5	2.1	1.2	1.5
Ceramic tile, terrazzo, and marble.....	1.4	.5	.3	1.4	1.2	1.0
Other	5.7	3.7	3.0	5.9	8.7	17.1
Concrete work	(²)	.8	1.8	(²)	1.8	6.0
Carpentry.....	(²)	.8	.3	(²)	1.8	1.2
Acoustical	(²)	.2	.5	(²)	.5	1.8
Wallboard.....	(²)	(³)	.9	(²)	.1	2.9

¹ Because many contractors perform more than one operation, contractors are classified according to the major cost component of their work.
² Data not available.

³ Less than 0.05 employee hours.

NOTE: Detail may not add to totals because of rounding.

Table 6. Onsite employee hour requirements for Federal building construction by selected characteristics, 1959, 1973, and 1976

Characteristic	Employee hours per \$1,000			Employee hours per 100 square feet		
	1959	1973	1976	1959	1973	1976
All projects.....	97.1	42.8	29.8	182.6	176.8	142.2
Federal office and social security buildings.....	(¹)	44.4	29.4	(¹)	178.2	138.5
All other buildings.....	(¹)	35.3	32.9	(¹)	168.6	177.0
Construction cost group:						
\$1,000,000 and under	(¹)	44.3	(²)	(¹)	181.0	(²)
\$1,000,001 - \$5,000,000	103.7	42.1	27.7	195.9	194.0	160.1
\$5,000,001 - \$10,000,000	(²)	47.8	(²)	(²)	182.3	(²)
\$10,000,001 and over	(²)	(²)	30.0	(²)	(²)	138.8
Region:						
Northeast	(²)	35.4	25.9	(²)	211.4	169.6
North Central	100.2	36.1	24.4	204.0	119.5	102.3
South	96.0	48.7	36.3	180.7	176.3	168.9
West.....	89.2	37.9	(²)	133.6	149.5	(²)

¹ Not available.

² Insufficient data.

labor to produce and distribute the materials, supplies, and equipment used in the construction process. Major categories involved are: (1) Offsite construction; (2) manufacturing; (3) trade, transportation, and services; and (4) mining and all other industries either directly or indirectly involved in the production and distribution process.

For every hour of work performed at the construction site, an additional 1.75 hours of offsite labor (in-

cluding offsite construction) were required to produce these materials, supplies, and services. Expenditures for Federal building construction during 1976 generated an estimated 52 offsite hours for each \$1,000 of construction.

Builders' offsite employee hours. Federal building construction during 1976 required an estimated 4.6 offsite employee hours in the construction industry per \$1,000

of contract cost. Offsite construction employee hours include builders' administrative, coordinating, estimating, scheduling, engineering (but not design work), maintenance, site protection, and warehousing activities. Estimates of builders' offsite employment requirements indicate that the proportion of total labor requirements contributed by offsite construction personnel has increased from 4.6 percent in 1959 to 5.8 percent in 1976. This trend reflects the increasing complexity of many construction projects, requiring more planning, coordination, and offsite work.

Current estimates based on trends from the surveys indicated that 2.6 hours per \$1,000 of contract cost would have been required for this segment of the industry in 1981.

Manufacturing employee hours. The manufacturing sector accounted for the second largest component of total labor requirements in both the 1959 and 1976 studies of Federal building construction. Labor requirements per \$1,000 of Federal building construction in 1976 totaled 26 hours in manufacturing industries. The manufacturing sector declined slightly from almost 34 percent of total labor requirements in 1959 to about 32 percent in 1976.

In 1981, an estimated 14 hours per \$1,000 would have been generated in the manufacturing sector.

Trade, transportation, and services employee hours. During 1976, more than 16 employee hours per \$1,000 of Federal building construction were generated in industries which distribute or provide other services for the materials, supplies, and equipment used in the construction process, either between processing stages or between the last stage of manufacturing and the construction site. The trade sector, including both wholesale trade and retail trade, accounted for almost two-thirds of this amount (table 7). Since 1959, the proportion of total labor requirements contributed by this sector has

Table 7. Indirect employee hour requirements per \$1,000 of contract construction cost for Federal building construction, 1959 and 1976

Sector	1959	1976
Manufacturing.....	79.2	26.0
Trade, transportation, and services	35.7	16.5
Trade	23.0	10.4
Wholesale trade	12.9	5.0
Retail trade	10.1	5.4
Transportation.....	9.0	3.7
Services	3.7	2.4
Mining and other	12.9	4.5
Agriculture.....	1.4	.4
Mining	4.3	1.3
Communications.....	1.1	.4
Public utilities.....	1.2	.5
Finance, insurance, and real estate.....	2.8	1.0
Government enterprises.....	1.1	.5
Construction.....	1.0	.4

NOTE: Detail may not add to totals because of rounding.

increased, rising from about 15 percent in 1959 to approximately 20 percent in 1976.

About 10 hours per \$1,000 of contract cost would have been required for these industries in 1981.

Mining and other industries employee hours. This group of industries includes agriculture, mining, communications, public utilities, finance, insurance, real estate, government enterprises, and maintenance construction. More than 4 employee hours per \$1,000 of Federal building construction cost were generated in these industries during 1976. This employee hour estimate represents the same proportion of total labor requirements, 5.5 percent, as was contributed by this sector in the 1959 study. Among individual industries, public utilities and government enterprises showed a slight increase between 1959 and 1976, while agriculture and mining declined over this period.

An estimated 3 hours per \$1,000 would have been generated in these industries in 1981.

Chapter IV. Distribution of Costs and Wages and Other Characteristics

Construction costs by selected characteristics

On average, Federal building construction in 1976 cost about \$12.7 million per project (table 8). Federal and Social Security Administration office buildings cost more per project than other Federal building projects in both 1973 and 1976, reflecting the larger size of office buildings in these studies. In contrast, Federal and Social Security Administration office building projects cost less per square foot of space than other Federal building projects during both 1973 and 1976. These findings indicate that some cost saving on office building construction may have resulted from economies of scale associated with large projects.

Relative cost shares

Materials, supplies, and built-in equipment constituted the largest share of total contract costs in all three studies of Federal building construction (between 42 and 51 percent) (table 9). Onsite wages and salaries made up the second largest cost group in the 1959 and 1973 studies (29 and 34 percent, respectively), followed by contractors' overhead and profit (18 and 16 percent).¹² In the 1976 study, however, overhead and profit costs accounted for the second largest cost group, rising from 18 percent in 1959 to almost 29 percent in 1976. Factors contributing to this large rise include increases in the proportion of total labor requirements contributed by offsite construction employees; a rise in interest rates for contractor loans; and increases in employer contributions for supplemental benefits such as paid holidays and vacations, health insurance, and retirement plans.

The distribution of construction contract costs within each of the four regions during 1976 was similar to the distribution for all projects, except for the South where onsite wages and salaries comprised the second largest cost group. There were greater differences, however, between the regions. The Northeast region showed the greatest proportion of contract dollars allotted to overhead and profit of any region in 1976. The South had the lowest percentage in that cost category. The reverse relationship for these two regions was observed for the materials, supplies, and built-in equipment cost

¹² For 1973, general contractors' costs were obtained directly, but some subcontractors' costs were estimated by general contractors.

component. The South generally had the highest percentage in this category, about 44 percent in 1976, while the Northeast showed the lowest proportion, almost 39 percent in 1976. The percentage of total costs contributed by onsite wages and salaries was highest in the South region and lowest in the North Central in 1976.

These trends may reflect, in part, variations in the level of financial costs and profits among the regions. For example, the cost of supplementary wage benefits received by employees is one of the items included in overhead. These benefits tend to be less costly in the South than in the Northeast. Variations in such factors may help to explain the wide differences in the percentage of total contract cost allotted to overhead and profit in the regions. A definitive explanation of these trends cannot be made without further research, particularly with respect to the composition of overhead costs.

Contractor costs

General contractors accounted for the major portion of total costs for materials, equipment, and supplies as well as onsite labor in all four regions in 1976 (table 10). Costs paid to heating, ventilating, and air-conditioning; structural steel; electrical; and concrete work contractors were among the largest categories of costs in all regions. Together with the general contractor, these four contractor groups accounted for about two-thirds of all contract costs in each region.

The distribution of construction contract value by contractor is substantially different for some groups from the employee hour distribution discussed earlier. Masonry, plastering and lathing, and painting contractors made up a significantly higher proportion of total onsite employee hours than of total contract value. On the other hand, structural steel, acoustical, and sheet-metal contractors showed a higher proportion of contract value than of employee hours. These discrepancies may reflect, in part, the higher cost of materials, supplies, and equipment for structural steel and sheet-metal work and the more labor-intensive nature of plastering, painting, and masonry work.

Differences in the mix of projects among the regions resulted in a wide range of contract values contributed

Table 8. Construction costs of Federal buildings by selected characteristics, 1959, 1973, and 1976

Characteristic	Cost per square feet			Cost per project		
	1959	1973	1976	1959	1973	1976
All projects.....	\$18.80	\$41.28	\$47.70	\$1,760,100	\$2,780,100	\$12,692,400
Federal office and social security buildings.....	(¹)	40.13	47.04	(¹)	2,840,800	14,136,200
All other buildings.....	(¹)	47.78	53.87	(¹)	2,525,000	6,915,700
Region:						
Northeast	(²)	59.63	65.56	(²)	2,929,700	18,476,900
North Central	20.35	33.08	41.90	1,402,600	230,300	10,412,400
South	18.83	36.17	46.56	2,008,600	4,188,800	15,743,200
West.....	14.98	39.42	(²)	1,466,000	4,154,300	(²)

¹ Not available.

² Insufficient data.

by some types of contractors. For example, masonry work, which averaged almost 4 percent of all contract costs, ranged from close to 7 percent in the Northeast to around 2 percent in the South. Structural steel erection varied from about 5 percent in the South to more than 15 percent in the North Central region. The proportion of value contributed by general contractors ranged from less than 17 percent in the North Central to more than 41 percent in the South.

Wages and earnings by region

During 1976, onsite wages and salaries paid to construction employees working on Federal building construction projects averaged \$8.66 per hour (table 11). This figure accounted for about 26 percent of all construction contract costs compared with 29 percent in 1959.

Average hourly earnings varied among the regions. Differences in average onsite hourly earnings were caused by a number of factors, including variations in the degree of unionization and the general level of wages in individual areas. (See the following tabulation.) Construction workers whose rates are set by labor-management agreement generally receive higher average hourly earnings than nonunion workers. Construction personnel working on Federal building projects completed in the South during 1976, for example, were paid substantially lower average hourly earnings than workers in other areas. The proportion of union contracts as a percent of all contracts was much lower in the South (less than 60 percent) than in the Northeast or North Central regions (more than 84 percent).

	<i>Union contracts as a percent of total contracts</i>	<i>Onsite average hourly earnings (all contracts)</i>
United States	75.4	\$8.66
Northeast	90.5	9.54
North Central	84.0	9.93
South	59.4	7.64

Wages by occupation

Straight-time average hourly rates in this study generally were lower than average union hourly wage rates

in the building trades as of July 1, 1975 (table 12).¹³ Exceptions are shown in the following tabulation:

<i>Occupation</i>	<i>Average hourly earnings from study</i>	<i>Union wage rate</i>
All occupations	\$8.66	\$8.88
Bricklayers	9.76	9.35
Cement finishers	8.94	8.81
Lathers	9.45	9.17
Marble setters	11.31	9.01
Plasterers	9.02	8.81
Tile setters	9.00	8.75

Factors that may account for some of the disparity between these two series are the inclusion of overtime in the study's data and the exclusion of Alaska from the area covered by the survey.

Materials, supplies, and equipment

Materials, supplies, and equipment costs for Federal building construction amounted to about \$454 per \$1,000 of construction costs in 1976 (table 13). This value represents a decline of \$79 per \$1,000 of costs or about 15 percent from the 1959 survey. Of the total materials, supplies, and equipment costs, more than 93 percent were spent for materials, supplies, and built-in equipment in both the 1959 and 1976 studies. The balance was allocated to contractor construction equipment required during construction.

Materials, supplies, and built-in equipment accounted for more than two-fifths of construction costs in 1976. Three major product groups made up more than three-fifths of all materials. Stone, clay, glass, and concrete products constituted the largest material grouping, representing almost \$103 per \$1,000 of total project costs. Most important within this group were ready-mix concrete and concrete products. Primary metal products were the next largest group of materials—about \$94 per \$1,000 of total cost. Structural steel products, which contributed \$65 per \$1,000, represented the largest cost category in the primary metal group. Fabricated metal products, except ordnance, machinery,

¹³ *Union Wages and Hours: Building Trades, July 1, 1975*, Bulletin 1907 (Bureau of Labor Statistics, 1976).

Table 9. Percent distribution of contract costs for Federal building construction, 1959, 1973, and 1976¹

Type of cost	United States			North-east	North Central	South
	1959	1973 ²	1976	1976	1976	1976
Total expenditures	100.0	100.0	100.0	100.0	100.0	100.0
Onsite wages and salaries.....	29.0	34.0	25.8	24.7	24.2	27.7
Materials, built-in equipment, and supplies	51.4	50.0	42.5	38.9	42.8	43.8
Contractors' equipment	1.9	(³)	2.9	3.0	2.9	2.9
Overhead and profit	17.7	16.0	28.8	33.5	30.1	25.6

¹ In the 1976 survey, data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Estimated.

³ Equipment included in materials.

NOTE: Detail may not add to totals because of rounding.

Table 10. Percent distribution of contract cost on Federal building construction projects by type of contractor and region, 1973 and 1976¹

Type of contractor ²	1973	1976			
	United States	United States	North-east	North Central	South
All contractors	100.0	100.0	100.0	100.0	100.0
General contractors.....	38.6	29.1	24.7	16.5	41.1
Subcontractors:					
Heating, ventilating, and air-conditioning	8.7	12.6	11.2	13.3	13.0
Structural steel.....	6.4	10.3	13.0	15.3	5.1
Electrical	7.4	9.8	12.0	8.1	10.0
Concrete work	2.2	5.9	5.5	11.5	1.7
Excavation, footing, foundations, and grading	3.2	4.2	5.5	5.9	2.4
Masonry	2.7	3.8	6.8	4.2	2.2
Elevators	2.1	3.3	3.8	3.5	2.9
Plumbing	6.3	2.7	3.2	2.3	2.4
Acoustical .....	.5	2.6	4.6	2.6	1.7
Wallboard.....	.1	2.2	.7	1.3	3.6
Carpentry	1.7	1.5	1.4	1.4	1.7
Roofing, gutter work, flashing, and siding.....	2.3	1.4	1.0	.9	1.9
Carpeting .....	.2	1.1	.8	1.5	.9
Glass and glazing.....	(³)	1.1	(⁴)	.9	1.8
Sheet metal work.....	.2	1.0	.5	2.6	(⁴)
Plastering and lathing.....	4.3	.9	(⁴)	1.2	.6
Painting and wallpapering .....	.7	.8	.5	.7	1.0
Insulating .....	.4	.6	(⁴)	1.6	.1
Ceramic tile.....	1.5	.5	.2	.8	.4
Mechanical equipment installation ..	4.1	(³)	(³)	(³)	(³)
Landscaping .....	.4	.4	.1	.4	.4
Ornamental iron work.....	1.4	.4	(⁴)	.7	(⁴)
Waterproofing .....	.8	.4	.3	.4	.6
Concrete reinforcement.....	(³)	.2	(⁴)	.1	.3
Linoleum, vinyl tile, and vinyl-asbestos tile .....	.3	.2	(⁴)	.1	.3
Terrazo	(³)	.2	(⁴)	(⁴)	.4
Asphalt paving.....	.2	.1	(⁴)	.1	.1
Other.....	3.2	2.7	4.2	2.2	3.3

¹ In the 1976 survey, data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Since many contractors perform more than one operation, contractors are classified according to the major cost component of their work.

³ Not available.

⁴ Insufficient data.

NOTE: Detail may not add to totals because of rounding.

Table 11. Average onsite earnings and wages as a percent of contract cost on Federal building construction projects by region, 1959 and 1976

Characteristic	Average hourly earnings		Wages as a percent of contract cost	
	1959	1976	1959	1976
All projects.....	\$2.98	\$8.66	29.0	25.8
Region:				
Northeast	(¹)	9.54	(¹)	24.7
North Central	3.15	9.93	31.5	24.2
South	2.90	7.64	27.9	27.7
West.....	3.22	(²)	(28.7)	(²)

¹ Insufficient data.

² In the 1976 study, data for the West are not sufficiently reliable to permit publication of detailed data for that region.

Table 12. Average hourly earnings for selected onsite construction workers on Federal building projects by region, 1976¹

Occupation	Average hourly earnings			
	United States	North-east	North Central	South
All occupations.....	\$8.66	\$9.54	\$9.93	\$7.64
Skilled trades workers:				
Bricklayers	9.76	9.18	10.04	9.65
Carpenters	8.60	9.29	9.33	8.04
Cement finishers.....	8.94	9.96	9.85	7.99
Drywall applicators	9.07	—	—	8.91
Drywall finishers	9.44	10.75	8.83	8.91
Electricians	9.72	10.71	10.73	8.33
Elevator constructors.....	9.61	9.88	9.97	9.07
Glaziers.....	8.63	9.69	9.42	8.12
Insulation workers.....	9.54	10.19	10.90	8.79
Iron workers, ornamental	9.48	9.64	10.54	8.70
Iron workers, reinforcing.....	8.87	8.98	10.95	7.88
Iron workers, structural.....	9.25	10.08	10.31	8.37
Lathers.....	9.45	10.11	10.34	8.63
Machinists.....	8.68	(²)	—	8.23
Marble setters.....	11.31	(²)	(²)	(²)
Millwrights	9.41	(²)	9.02	7.71
Operating engineers	9.27	10.41	10.18	8.30
Painters.....	8.22	8.80	9.37	7.63
Paperhangers	8.17	—	(²)	7.74
Pile driver operators	9.06	(²)	(²)	7.60
Pipefitters	9.54	9.28	10.64	8.40
Plasterers	9.02	9.47	10.02	8.22
Plumbers.....	8.80	9.42	10.20	7.98
Roofers	8.78	10.54	10.33	8.21
Sheet metal workers.....	9.28	11.16	9.92	8.06
Soft floor layers	10.15	(²)	12.17	8.59
Sprinkler fitters.....	9.69	10.03	10.00	8.90
Tile setters	9.00	8.27	10.29	8.53
Semiskilled and unskilled workers:				
Laborers, helpers, and tenders	6.54	7.72	7.38	5.83
Truckdrivers	6.74	7.59	7.52	5.94
Custodial workers	3.42	—	(²)	3.34
Onsite office and administrative workers:				
Clerical workers	4.25	4.71	6.03	3.83
Professional and technical workers.....	11.56	7.65	15.12	6.21
Superintendents and blue-collar supervisors.....	10.95	11.66	12.70	9.95

¹ Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Insufficient data.

NOTE: Dash denotes that the survey had no sample projects in this cell.

Table 13. Materials, equipment, and supplies used in Federal building construction, 1959 and 1976

Type of material	Value per \$1,000 of contract cost		Percent distribution	
	1959	1976	1959	1976
All materials, equipment, and supplies	532.50	453.96	100.00	100.00
Materials, built-in equipment, and supplies	513.40	424.88	96.41	93.59
Agricultural products	(²)	1.05	(²)	.23
All horticultural products	(²)	1.04	(²)	.23
Agricultural and forestry products, n.e.c. ³	(²)	.01	(²)	(⁴)
Mining and quarrying of nonmetallic minerals, except fuels	2.20	2.22	.41	.49
Sand and gravel	2.20	1.74	.41	.38
Mining and quarrying of nonmetallic minerals, n.e.c.	(²)	.47	(²)	.10
Textile mill products	(²)	7.49	(²)	1.65
Carpeting and pads	(²)	7.28	(²)	1.60
Textile mill products, n.e.c.	(²)	.21	(²)	.05
Apparel and other finished products made from fabrics and similar materials	(²)	.30	(²)	.07
Lumber and wood products, except furniture	17.60	10.51	3.31	2.32
Dressed boards and lumber products	6.70	2.40	1.26	.53
Millwork (wood)	8.20	3.56	1.54	.78
Wood kitchen cabinets and vanities-prebuilt	(²)	1.37	(²)	.30
Hardwood plywood	(²)	.89	(²)	.20
Softwood plywood	(²)	.39	(²)	.09
Treated lumber	(²)	.78	(²)	.17
Acoustical tile, cork	(²)	.18	(²)	.04
Wood products, n.e.c.	2.70	.94	.51	.21
Furniture and fixtures	1.80	1.88	.34	.41
Public buildings furniture and fixtures	(²)	.80	(²)	.18
Store furniture and fixtures	(²)	.64	(²)	.14
Window blinds and draperies	(²)	.32	(²)	.07
Furniture and fixtures, n.e.c.	(²)	.12	(²)	.03
Paper and allied products	(²)	2.03	(²)	.45
Construction paper and building board products	(²)	1.94	(²)	.43
Paper and allied products, n.e.c.	(²)	.09	(²)	.02
Chemicals and allied products	5.50	4.98	1.03	1.10
Paint and allied products	2.40	1.67	.45	.37
Miscellaneous industrial organic chemicals	(²)	.16	(²)	.04
Adhesives, sealants, and caulking compounds	(²)	1.40	(²)	.31
Chemicals and allied products, n.e.c.	3.10	1.75	.58	.39
Petroleum refining and related industries	4.70	5.03	.88	1.11
Fuels, diesel fuel, gas, oil, and grease	(²)	1.44	(²)	.32
Asphalt paving, asphaltic concrete, bituminous concrete, coal tar paving, and paving block	3.40	.68	.64	.15
Asphalt felts and coatings	1.30	2.91	.24	.64
Rubber and miscellaneous plastics products	(²)	3.05	(²)	.67
Fabricated rubber products	(²)	.29	(²)	.06
Plastic pipe, tubing, fittings, and conduit	(²)	.53	(²)	.12
Insulation—styrofoam and other cushioning and plastic foam insulation	(²)	.31	(²)	.07
Rubber and miscellaneous plastics products, n.e.c.	(²)	1.93	(²)	.43
Stone, clay, glass, and concrete products	115.00	102.75	21.60	22.63
Window glass (manufactured)	3.00	3.05	.56	.67
Pressed and blown glass and glassware	(²)	.78	(²)	.17
Glass products (made from purchased glass)	(²)	.47	(²)	.10
Hydraulic cement	3.00	1.19	.56	.26
Clay brick and structural clay tile	14.90	1.97	2.80	.43
Ceramic wall and floor tile	1.50	1.92	.28	.42
Clay sewer pipe, liner brick, and fittings	(²)	.12	(²)	.03
Plumbing fixtures and accessories — vitreous china	(²)	1.15	(²)	.25
Concrete block, brick, excluding cinder block	7.60	4.20	1.43	.92
Concrete pipe	(²)	.45	(²)	.10
Other precast concrete products	(²)	19.79	(²)	4.36
Precast terrazzo	(²)	.21	(²)	.05
Ready-mix concrete	43.00	33.90	8.08	7.47
Lime	(²)	.37	(²)	.08
Gypsum products	6.30	5.76	1.18	1.27
Marble, granite, slate, and other cut or natural stone	9.60	13.16	1.80	2.90

See footnotes at end of table.

Table 13. Continued — Materials, equipment, and supplies used in Federal building construction, 1959 and 1976

Type of material	Value per \$1,000 of contract cost		Percent distribution	
	1959	1976	1959	1976
Stone, clay, glass, and concrete products — Continued				
Asbestos cement products.....	2.70	1.22	0.51	0.27
Crushed rock, slag, and miscellaneous aggregate.....	(²)	1.74	(²)	.38
Insulation — magnesia, perlite, vermiculite, and related products.....	1.90	1.43	.36	.31
Insulation — fiberglass, mineral, or glass wool.....	14.80	5.40	2.78	1.19
Acoustical tile — fiberglass, mineral wool.....	(²)	4.04	(²)	.89
Stone, clay, glass, and concrete products, n.e.c.....	6.70	.43	1.26	.09
Primary metal industries.....				
Structural steel.....	57.60	94.38	10.82	20.79
Blast furnace, steel works, and related products.....	24.10	65.28	4.53	14.38
Steel or galvanized raw sheet metal.....	(²)	1.81	(²)	.40
Steel pipe — galvanized and ferrous noncast iron pipe.....	8.10	2.70	1.52	.59
Iron nails, spikes, cable, and wire—ferrous.....	(²)	10.67	(²)	2.35
Welded or seamless steel pipe and tubes—from purchased materials.....	(²)	(²)	(²)	.23
Cast iron products.....	(²)	.71	(²)	.16
Copper pipe and tubing.....	4.80	4.06	.90	.89
Aluminum sheet, plate, and foil.....	8.90	2.10	1.67	.46
Cable and wire — nonferrous (noniron).....	3.80	.24	.71	.05
Primary metal products, n.e.c.....	7.90	4.82	1.48	1.06
(²)	(²)	.99	(²)	.22
Fabricated metal products, except machinery and transportation equipment.....				
Builders' hardware.....	122.70	87.91	23.04	19.36
Plumbing fixtures, and accessories — metal or enameled iron.....	6.70	5.30	1.26	1.17
Plumbing accessories; fittings and trim — brass.....	7.80	1.43	1.46	.32
Domestic furnaces — steam or hot water.....	(²)	.99	(²)	.22
Fabricated structural steel.....	8.10	2.02	1.52	.45
Fabricated structural aluminum.....	(²)	9.36	(²)	2.06
Steel doors — all types.....	(²)	.62	(²)	.14
Aluminum doors — all types.....	(²)	3.04	(²)	.67
Metal windows — all metal types.....	19.80	.31	3.72	.07
Prefabricated store fronts — all metal types.....	(²)	5.91	(²)	1.30
(²)	(²)	.82	(²)	.18
Fabricated metal plate products.....				
Fabricated sheet metal products.....	1.80	3.21	.34	.71
Architectural and ornamental metal work.....	18.70	12.26	3.51	2.70
Prefabricated metal buildings and components.....	6.80	8.81	1.28	1.94
Metal reinforcing bars and expended metal lath.....	(²)	2.04	(²)	.45
Bolts, nuts, screws, rivets, and related products.....	43.30	16.18	8.13	3.57
Other metal stampings.....	(²)	1.32	(²)	.29
Plumbing accessories, fittings, and trim — metal.....	(²)	1.26	(²)	.28
Miscellaneous fabricated wire products — made from purchased wire.....	4.20	6.36	.79	1.40
Fabricated metal products, n.e.c.....	3.70	5.33	.69	1.18
1.80	1.34	.34	.30	
Machinery, except electrical.....				
Elevators and moving stairways.....	79.10	48.30	14.85	10.64
Pumps, and compressed air, oxygen, and nitrous oxide systems.....	26.40	18.24	4.96	4.02
Compressors.....	2.50	1.73	.47	.38
Blowers and exhaust and ventilation fans.....	(²)	.93	(²)	.21
Sprinkler systems — fire prevention.....	4.40	6.39	.83	1.41
Electric computing equipment.....	(²)	2.77	(²)	.61
Air-conditioning and warm-air heating equipment.....	(²)	2.45	(²)	.54
Commercial refrigeration equipment.....	3.50	12.57	.66	2.77
Commercial kitchen equipment other than refrigeration.....	34.70	.55	6.52	.12
Machinery, except electrical, n.e.c.....	(²)	1.25	(²)	.28
7.60	1.40	1.43	.31	
Electrical machinery, equipment, and supplies.....				
Transformers — power, distribution, and specialty.....	89.00	46.33	16.71	10.21
Switchgear and switchboards apparatus.....	2.80	1.64	.53	.36
Electrical motors and generators.....	17.30	6.57	3.25	1.45
Electronic timing systems and electric motor controls.....	2.30	4.34	.43	.96
Welding supplies.....	(²)	1.94	(²)	.43
Electric housewares and fans.....	(²)	.32	(²)	.07
Household appliances, n.e.c.....	(²)	.33	(²)	.07
Electric lamps and bulbs.....	(²)	.21	(²)	.05
Current-carrying wiring devices.....	(²)	.48	(²)	.11
Noncurrent-carrying wiring devices.....	4.20	1.74	.79	.38
Commercial, industrial, or institutional electric lighting fixtures.....	22.00	7.34	4.13	1.62
Emergency lighting systems and lighting equipment, n.e.c.....	30.80	13.49	5.78	2.97
Radio, television, and public address equipment, except communications and transmitting equipment.....	(²)	.46	(²)	.10
Radio and television communication and transmitting devices and parts, except tubes.....	3.50	.51	.66	.11
Electrical machinery, equipment, and supplies, n.e.c.....	3.30	4.34	.62	.96
2.80	2.61	.53	.57	

See footnotes at end of table.

Table 13. Continued — Materials, equipment, and supplies used in Federal building construction, 1959 and 1976

Type of material	Value per \$1,000 of contract cost		Percent distribution	
	¹ 1959	1976	1959	1976
Measuring, analyzing, and controlling instruments.....	15.40	4.61	2.89	1.01
Residential and commercial automatic environmental appliance controls	7.90	3.38	1.48	.74
Industrial instruments for measurement, display, and control of process variables.....	(²)	.24	(²)	.05
Measuring and controlling devices — nonelectrical.....	(²)	.81	(²)	.18
Miscellaneous measuring, analyzing, and controlling instruments.....	7.50	.18	1.41	.04
Miscellaneous manufacturing industries.....	2.80	2.04	.53	.45
Total contractors' construction equipment.....	19.10	29.08	3.59	6.41
Apparel and other finished products made from fabrics and similar materials.....	(²)	.01	(²)	(⁴)
Lumber and wood products, except furniture.....	(²)	.80	(²)	.18
Wood scaffolding — dressed board.....	(²)	.12	(²)	.03
Contractor's office — trailer.....	(²)	.58	(²)	.13
Wood products, n.e.c.....	(²)	.10	(²)	.02
Rubber and miscellaneous plastics products.....	(²)	.05	(²)	.01
Fabricated metal products, except machinery and transportation equipment.....	(²)	3.98	(²)	.88
Handtools (nonpowered).....	(²)	1.35	(²)	.30
Metal forms — any material.....	(²)	.82	(²)	.18
Metal scaffolding.....	(²)	1.72	(²)	.38
All other fabricated metal products.....	(²)	.10	(²)	.02
Machinery, except electrical.....	(²)	21.86	(²)	4.82
Power cranes.....	(²)	8.34	(²)	1.84
Tractors, bulldozers, and crawler tractors.....	(²)	1.45	(²)	.32
Backhoes and trenchers.....	(²)	1.48	(²)	.33
Motor scrapers and graders.....	(²)	.12	(²)	.03
Rollers and compactors.....	(²)	.25	(²)	.05
Mixers, pavers, and related equipment.....	(²)	.40	(²)	.09
Hoists, monorails, derricks, booms, and winches.....	(²)	2.64	(²)	.58
Off-highway trucks.....	(²)	.29	(²)	.06
Front-end loaders.....	(²)	.79	(²)	.17
Other light construction machinery and equipment.....	(²)	.33	(²)	.07
All other heavy construction equipment.....	(²)	.14	(²)	.03
Drill rigs.....	(²)	.25	(²)	.05
Industrial trucks, tractors, forklifts, and related equipment.....	(²)	.30	(²)	.07
Power driven handtools.....	(²)	1.59	(²)	.35
Welder and cutting apparatus.....	(²)	.31	(²)	.07
Pumps.....	(²)	.57	(²)	.13
Compressors.....	(²)	.35	(²)	.08
Power driven service machines.....	(²)	.13	(²)	.03
Machinery, except electrical, n.e.c.....	(²)	2.14	(²)	.47
Electrical machinery, equipment, and supplies.....	(²)	.69	(²)	.15
Electrical welding apparatus.....	(²)	.57	(²)	.13
Miscellaneous electrical machinery, equipment, and supplies.....	(²)	.12	(²)	.03
Transportation equipment.....	(²)	1.60	(²)	.35
Motor trucks (highway).....	(²)	1.53	(²)	.34
Miscellaneous transportation equipment.....	(²)	.07	(²)	.02
Measuring, analyzing, and controlling instruments.....	(²)	.03	(²)	.01
Miscellaneous manufacturing industries.....	(²)	.06	(²)	.01

¹ Detailed data have been regrouped for the year 1959 and group totals may vary slightly from those presented in earlier publications of the survey data.

² Not available.

³ The last items in each group labeled n.e.c. (not elsewhere classified) are those which have not appeared in the previous surveys in sufficient amounts to be recorded, but were included in this table to present the complete results

of the latest survey.

⁴ Less than 0.005.

NOTE: Detail may not add to totals because of rounding. Materials data for the 1959 Federal buildings study were reaggregated to match the 1972 Standard Industrial Classification manual to make comparisons with the 1976 materials data easier. Data include sales tax.

and transportation equipment, the third largest group, accounted for more than \$88 per \$1,000 of contract cost. Within this group, the important products were metal reinforcing bars and expanded metal lath, and fabricated sheet-metal products.

Three items, whose used increased appreciably in the current Federal building survey, were air-conditioning, structural steel, and concrete products. Air-conditioning is becoming widely used in most Federal buildings to help create a more productive working environment.

Concrete block and other concrete products have gained wide usage for floor and ceiling bases and exterior walls. Structural steel is more widely accepted as a replacement for load bearing masonry and other types of framing materials, particularly on high rise structures. Continuing development of new and better construction materials should help to control material costs on Federal building projects in the future.

For convenience, construction machinery and equipment were included in the materials table as a separate category. Costs for construction equipment were based on depreciated or rental costs or equivalent value of machinery or equipment at the construction site, exclusive of equipment operators. Expenditures amounted to about \$29 per \$1,000 during 1976 or more than 6 percent of all materials and equipment costs. The major cost item in this category is machinery, except electrical, which consists primarily of construction equipment such as cranes, hoists, power-driven handtools, backhoes, bulldozers, and similar items.

Construction time

Projects in the North Central region required the fewest number of weeks to complete of any region in the 1973 and 1976 Federal building surveys, reflecting the smaller average size of projects in this region (table 14). The South and Northeast regions experienced the highest average number of weeks of construction time, in 1973 and 1976, respectively. As expected, the length of time for completion increased as the size and cost of the projects grew.

In order to develop a typical employment pattern, the construction time for each project was divided into 10 equal parts or deciles. This distribution or phasing pattern of onsite work shows that the distribution of onsite hours during the construction period has not changed significantly between 1959 and 1976 (table 15). On average, the percentage of total hours required increased slowly over about two-thirds of the total time period and then declined gradually in both 1959 and 1976.

Contractors

Federal building projects in 1976 required an average of about 47 contractors per project, ranging from about 54 contractors per project in the North Central region to about 36 contractors in the Northeast (table 16). On average, each project had 1 general contractor, 5 prime contractors, 33 subcontractors, and 8 sub-subcontractors. The North Central region required the highest average number of prime contractors and subcontractors per project. The South region experienced the highest number of sub-subcontractors per project.

Table 14. Average number of weeks of construction time for Federal building projects by selected characteristics, 1959, 1973, and 1976

Characteristic	1959	1973	1976
All projects.....	73	63.8	129.9
Construction cost group:			
\$1,000,000 and less.....	(¹)	45.6	(²)
\$1,000,001—\$5,000,000.....	(¹)	70.3	104.0
\$5,000,001—\$10,000,000.....	(¹)	100.7	(²)
\$10,000,001—\$25,000,000.....	(¹)	(²)	121.9
\$25,000,001 and over.....	(¹)	—	211.5
Region:			
Northeast.....	(¹)	63.1	179.4
North Central.....	(¹)	40.7	107.3
South.....	(¹)	78.3	148.4
West.....	(¹)	75.7	(³)

¹ Not available.

² Insufficient data.

³ In the 1976 study, data for the West are not sufficiently reliable to permit publication of detailed data for that region.

NOTE: Dash denotes that the survey had no sample projects in this cell.

Table 15. Percent distribution of onsite employee hours by decile of construction time, 1959 and 1976

Construction time	Percent of onsite hours	
	1959	1976
Total.....	100.0	100.0
1st decile.....	2.7	3.7
2d decile.....	6.4	5.7
3d decile.....	9.7	10.5
4th decile.....	11.8	12.7
5th decile.....	13.0	13.5
6th decile.....	14.4	14.3
7th decile.....	13.3	15.8
8th decile.....	13.8	11.9
9th decile.....	10.5	8.4
10th decile.....	4.3	3.5

Table 16. Average number of contractors for Federal building projects by type of contractor and region, 1976¹

Type of contractor	United States	North-east	North Central	South
All contractors.....	47.3	35.8	53.9	50.2
General contractors.....	1.2	1.0	.9	1.8
Prime contractors.....	4.9	.6	8.3	3.6
Subcontractors.....	32.9	23.6	38.0	34.2
Sub-subcontractors.....	8.3	10.6	6.7	10.7

¹ Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

NOTE: Detail may not add to totals because of rounding.

Chapter V. Comparison With Other Surveys

Total employee hour requirements for Federal building construction were the lowest of any building construction activity in the BLS studies of construction labor requirements (table 17).¹⁴ However, it is possible that requirements for commercial office building and school construction might have been the same as for Federal building construction, or slightly lower, if the studies had been conducted in the same year.

The occupational requirements for Federal building construction were essentially the same as for commercial office buildings (table 18). Compared with all nonresidential building construction activity studied by BLS, the occupational requirements for Federal building construction were the highest for administrative and supervisory workers and the lowest for skilled trades workers. Among individual occupations, Federal building construction employed the highest proportion of electricians and iron workers and the lowest proportion of bricklayers, plasterers and lathers, and laborers, helpers, and tenders.

The distribution of contract costs for Federal building construction more closely resembled those for com-

mercial office buildings than schools or general hospitals (table 19). The ratio of onsite wages and salaries for Federal buildings, 25.8 percent, was the lowest among these four nonresidential building activities. The cost of overhead and profit, 28.8 percent, was the highest for Federal building construction, reflecting rising interest expenses and the increasing scope and size of most construction projects, necessitating more planning, coordination, and offsite work.

The material requirements for Federal building construction again most closely matched those for commercial office building construction than for the two other nonresidential building activities (table 20). Although Federal buildings required a larger proportion of primary metal products and a smaller proportion of stone, clay, glass, and concrete products and machinery, except electrical, than commercial office buildings, these three groups of materials accounted for almost 60 percent of the cost of materials in both types of construction. These three major groupings made up almost 63 percent of total materials, equipment, and supplies for Federal buildings and nearly 59 percent for commercial office buildings. Federal building construction required a larger proportion of primary metal products and construction equipment and a smaller proportion of mining, lumber, furniture, and fabricated metal products than the three other nonresidential building activities.

¹⁴In comparing the Federal building construction survey with other surveys of construction labor requirements, it must be kept in mind that the studies cover different time periods. Furthermore, comparisons cannot reasonably be made with heavy construction (i.e., highways, sewer works, and civil works) which is entirely different in nature from building construction.

Table 17. 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			
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
1972	114.1	41.6	6.0	40.8		
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
1973	(³)	42.8	4.7	(³)	(³)	(³)
1976	81.4	29.8	4.6	26.0	16.5	4.5
College housing:						
1961 ²	236.3	93.6	14.1	77.5	37.2	13.8
1972	(³)	48.3	8.1	(³)	(³)	(³)
Civil works, total:						
1960	(³)	(³)	(³)	(³)	(³)	(³)
1972	(³)	47.4	3.9	(³)	(³)	(³)
Land projects:						
1960	213.4	84.7	4.5	53.2	46.9	24.1
1972	(³)	43.2	2.5	(³)	(³)	(³)
Dredging projects:						
1960 ²	251.4	133.9	15.6	56.8	31.6	13.5
1972	(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
1969 ²	145.6	51.9	8.2	47.2	29.6	8.7
General hospitals:						
1959-60 ²	226.0	88.8	12.3	78.0	34.2	12.7
1966 ²	189.0	76.1	9.8	64.0	29.6	9.5
Nursing homes:						
1965-66 ⁴	192.7	73.7	8.4	66.6	33.6	10.4

¹ Revised. Revision based on 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. Differences, however, would be slight.

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 totals due to rounding.

Table 18. 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	Brick layers	Carpenters	Electricians	Iron workers	Operating engineers	Painters	Plasterers and lathers	Plumbers and pipe-fitters	Other skilled construction trades	Laborers, helpers, and tenders	Other occupations (including truck-drivers)
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	(¹)	(¹)	(¹)	(¹)	(^{1})	(^{1})	(^{1})	(^{1})	38.2	(¹)	² 51.4
1976	100.0	6.3	-	5.7	1.2	2.6	24.3	.4	-	.2	5.9	33.2	³ 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	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
1976	100.0	8.1	2.7	13.9	11.5	7.8	3.6	1.6	2.2	7.9	17.1	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	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Civil works:													
Land projects:													
1960	100.0	10.1	-	6.4	-	3.1	24.1	-	-	-	6.9	23.0	26.4
1972	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Dredging projects:													
1960	100.0	4.7	-	-	-	-	1.1	-	-	-	1.7	1.7	⁴ 90.8
1972	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
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
1975	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
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
Nursing homes:													
1966 ⁵	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

¹ Not available.

² Includes apprentices and on-the-job trainees and laborers, helpers, and tenders.

³ Includes blue-collar worker supervisors.

⁴ Includes mostly ships' masters, captains, mates, crew, and support personnel.

⁵ Based on case study.

NOTE: Dash denotes that the survey had no sample projects in this cell.

Table 19. 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
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	(²)	29.5
1958	100.0	23.9	50.6	(²)	25.5
Federal office buildings:					
1976	100.0	25.8	42.5	2.9	28.8
1973 ³	100.0	34.0	50.0	(⁴)	16.0
1959	100.0	29.0	51.3	1.9	17.7
College housing:					
1972 ³	100.0	36.0	51.1	(⁴)	13.0
1961	100.0	29.3	52.6	1.6	16.5
Civil works, total:					
1972 ³	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 ⁵	100.0	20.4	43.4	.9	35.3
1962 ⁶	100.0	22.1	47.2	1.0	29.7
Public housing:					
1975 ³	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
General hospitals:					
1966	100.0	29.6	50.4	1.3	18.7
1960	100.0	28.2	53.2	1.2	17.4
Nursing homes:					
1966 ⁶	100.0	28.7	53.7	1.2	16.4

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

⁵ Includes selling expenses.

⁶ Estimated. Based on case study.

² Equipment included with overhead and profit.

³ Estimated.

⁴ Equipment included in materials.

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

Table 20. 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 non-metallic 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.
Commercial office buildings: 1974	100.00	0.67	7.55	0.42	0.99	1.98	23.90	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	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
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	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
General hospitals: 1960	100.00	.42	4.16	.86	.81	.97	18.98	6.82	35.05	8.48	15.60	2.06	5.89
1966	100.00	.51	4.66	.44	.77	.80	18.40	8.61	31.11	12.11	15.62	2.50	4.47
Nursing homes: 1966 ⁴	100.00	.53	9.06	.27	1.24	1.82	20.16	6.23	33.32	11.03	10.78	2.15	3.41
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	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Federally aided highways: 1958	100.00	11.34	1.76	-	.80	17.09	16.77	-	19.48	-	-	(³)	32.75
1976	100.00	12.42	.85	-	.97	17.58	14.04	-	21.22	-	-	(³)	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	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Dredging projects: 1960	100.00	-	-	-	3.93	28.07	-	-	1.49	1.40	-	58.98	6.13
1972	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
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 except for Federally aided highways, private office buildings, elementary and secondary schools (1971), and single-family and multifamily housing.

² Not available.

³ Construction equipment estimate included in materials and supplies, n.e.c.

⁴ Based on case study.

NOTE: Detail may not add to totals due to rounding. Dash denotes that the survey had no sample projects in this cell.

Appendix A. Detailed Labor and Cost Data by Region

Tables A-1 through A-5 show detailed labor and cost data, by region, for Federal building construction during 1976. Detailed data on employment, wage, and cost requirements are presented for 3 of the 4 economic regions. (Data for the West are not sufficiently reliable to permit publication of detailed data for that region.)

Regional employment data

Tables A-1 and A-2 show regional detail during 1976 for the onsite employee hour data summarized in the text in tables 3 and 4. Regional onsite employment requirements by occupation are presented in table A-1. Table A-2 lists the employment share of the general

and special trades contractors engaged in Federal building construction, by region.

Regional data by selected building characteristics

Tables A-3, A-4, and A-5 show regional employment, cost, and wage data, by selected building characteristics during 1976. These data are summarized in text tables 5, 9, and 12. Variations in regional employment, cost, and wage requirements reflect differences in design and type of structure as well as the regional conditions under which the Federal building projects were built.

Table A-1. Onsite employee hour requirements per \$1,000 of contract cost for Federal building construction by occupation and region, 1976¹

Occupation	Employee hours per \$1,000				Percent distribution			
	United States	North-east	North Central	South	United States	North-east	North Central	South
All occupations.....	29.8	25.9	24.4	36.3	100.0	100.0	100.0	100.0
Skilled trades workers:								
Bricklayers.....	.8	.7	1.0	.7	2.7	2.8	4.3	1.8
Carpenters.....	4.1	3.8	2.8	5.4	13.9	14.6	11.4	14.9
Cement finishers.....	1.0	.5	1.1	1.1	3.3	2.0	4.4	3.1
Drywall applicators and finishers.....	.1	(²)	.1	.1	.2	.2	.2	.2
Electricians.....	3.4	3.5	3.4	3.4	11.5	13.6	14.0	9.4
Elevator constructors.....	.4	.7	.4	.4	1.4	2.6	1.5	1.0
Glaziers.....	.1	.1	.1	.2	.5	.3	.4	.6
Insulation workers.....	.4	.3	.3	.6	1.4	1.2	1.2	1.6
Iron workers, ornamental.....	.3	.4	.2	.3	.9	1.4	.8	.7
Iron workers, reinforcing.....	.4	.1	.3	.5	1.2	.5	1.1	1.4
Iron workers, structural.....	1.7	2.2	1.0	2.1	5.8	8.6	4.3	5.7
Lathers.....	.3	.5	.2	.4	1.1	1.9	.7	1.0
Marble setters.....	.2	(²)	(²)	(²)	.8	(²)	(²)	(²)
Operating engineers.....	1.1	.9	.9	1.2	3.6	3.6	3.6	3.4
Painters.....	.5	.2	.4	.7	1.7	.9	1.5	2.0
Pile-driver operators.....	.2	(²)	(²)	.2	.6	(²)	(²)	.6
Pipefitters.....	1.0	.7	1.3	1.0	3.4	2.7	5.3	2.7
Plasterers.....	.3	.2	.3	.4	1.1	.9	1.3	1.1
Plumbers.....	1.3	1.1	.8	1.8	4.5	4.4	3.4	5.1
Roofers.....	.3	.1	.2	.5	1.0	.5	.6	1.4
Sheet metal workers.....	1.3	1.2	1.2	1.5	4.5	4.7	5.1	4.1
Sprinkler fitters.....	.4	.2	.6	.2	1.2	.7	2.6	.7
Tile setters.....	.2	(²)	.1	.3	.6	.1	.6	.8
Other skilled trades workers.....	.4	1.5	.4	.7	1.4	5.8	1.5	2.0
Semiskilled and unskilled workers:								
Laborers, helpers, and tenders.....	6.4	5.2	4.4	8.6	21.4	20.2	18.0	23.7
Truckdrivers.....	.2	.1	.3	.3	.8	.3	1.2	.8
Custodial workers.....	.1	—	(²)	.1	.2	—	(²)	.4
Other.....	.4	.2	.3	.5	1.2	.9	1.1	1.4
Onsite office and administrative workers:								
Clerical workers.....	.2	.2	.1	.4	.8	.8	.3	1.0
Professional and technical workers.....	.6	.4	1.0	.4	2.0	1.7	4.1	1.1
Superintendents and blue-collar supervisors.....	1.6	.6	1.4	2.2	5.3	2.4	5.6	6.2

¹Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Less than 0.05.

³ Insufficient data.

NOTE: Dash denotes that the survey had no sample projects in this cell. Detail may not add to totals because of rounding.

Table A-2. Percent distribution of onsite employee hour requirements per \$1,000 for Federal building construction by type of contractor and region, 1976¹

Type of contractor ²	United States	North-east	North Central	South
Total	100.0	100.0	100.0	100.0
General contractor	30.5	24.6	15.4	40.4
Waterproofing .....	.6	.4	.6	.7
Concrete work	6.0	8.7	12.5	1.6
Structural steel	5.8	9.2	7.4	3.8
Carpentry	1.2	1.1	.7	1.5
Masonry	5.2	8.8	6.2	3.5
Heating, ventilating, and air-conditioning	13.6	9.9	12.5	15.6
Sheet metal work .....	.3	.3	.8	(³)
Plumbing	3.0	3.9	3.3	2.4
Electrical	11.2	12.0	13.7	9.6
Elevators	2.8	4.5	2.9	2.2
Insulating .....	.5	(³)	1.5	.1
Wallboard	2.9	.8	2.3	4.0
Plastering and lathing	1.7	(³)	2.5	1.1
Painting and wallpapering	1.5	.9	1.2	1.9
Linoleum, vinyl tile, and vinyl-asbestos tile .....	.1	(³)	.1	.2
Carpeting .....	.6	.5	.6	.7
Roofing, gutterwork, flashing, and siding	1.3	1.0	.8	1.7
Ornamental iron work .....	.2	(³)	.4	(³)
Asphalt paving .....	.1	(³)	.2	.1
Landscaping .....	.3	.1	.3	.4
Acoustical	1.8	3.2	2.4	.9
Excavation, footing, foundations, and grading	4.8	5.3	8.6	2.5
Ceramic tile .....	.6	.3	1.4	.4
Terrazzo .....	.4	(³)	(³)	.7
Glass and glazing .....	.6	(³)	.5	.9
Concrete reinforcement .....	.4	(³)	.2	.5
Other	1.9	4.6	1.1	2.7

¹ Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Since many contractors perform more than one operation, contractors are classified according to the major cost component of their work.

³ Insufficient data.

NOTE: Detail may not add to totals because of rounding.

Table A-3. Onsite employee hour requirements in Federal building construction by selected characteristics and region, 1976¹

Characteristic	Employee hours per \$1,000				Employee hours per 100 square feet			
	United States	North-east	North Central	South	United States	North-east	North Central	South
All projects.....	29.8	25.9	24.4	36.3	142.2	169.6	102.3	168.9
Number of stories:								
Less than 3.....	31.2	(²)	(²)	34.0	177.9	(²)	(²)	179.1
3 or 4.....	29.0	(²)	28.2	(²)	120.9	(²)	111.2	(²)
5 or more.....	29.7	26.0	(²)	36.9	140.7	174.4	(²)	163.8
Conveyor systems:								
Elevators.....	30.0	25.9	24.4	37.1	140.5	169.6	99.2	170.3
No elevators.....	27.8	-	(²)	(²)	164.7	-	(²)	(²)
Basement:								
Basement.....	29.4	26.0	24.2	36.6	139.8	173.3	101.7	166.9
No basement.....	32.3	(²)	(²)	35.2	158.9	(²)	(²)	177.2
Parking area:								
In or under the building.....	29.5	(²)	(²)	36.2	146.5	(²)	(²)	158.9
Outdoor.....	29.4	(²)	25.0	34.5	136.1	(²)	99.2	187.9
In or under the building and outdoor.....	31.7	(²)	(²)	(²)	135.3	(²)	(²)	(²)
Heat:								
Forced air.....	29.5	26.0	23.4	36.8	146.1	173.3	98.3	177.7
Hot water.....	32.2	-	(²)	(²)	118.6	-	(²)	(²)
Electric radiant.....	31.6	(²)	(²)	(²)	130.7	(²)	(²)	(²)
Fuel:								
Electricity.....	29.3	(²)	23.9	35.8	140.1	(²)	103.1	187.4
Gas.....	31.0	(²)	25.7	(²)	127.6	(²)	92.3	(²)
Framing:								
Steel.....	29.8	25.9	24.5	37.5	141.9	169.6	99.3	178.7
Concrete.....	31.1	-	(²)	(²)	150.6	-	(²)	(²)
Exterior wall:								
Concrete.....	32.0	(²)	(²)	37.4	150.2	(²)	(²)	165.6
Load bearing masonry.....	28.8	(²)	(²)	(²)	124.6	(²)	(²)	(²)
Curtain wall.....	31.7	(²)	(²)	(²)	159.1	(²)	(²)	(²)
Interior wall:								
Drywall.....	34.2	30.7	28.0	36.2	157.0	177.3	102.1	166.8
Floor base:								
Concrete.....	29.7	25.9	24.1	36.2	140.7	169.6	99.5	166.8
Floor covering:								
Carpet.....	29.0	26.0	23.7	37.3	141.6	173.3	103.1	170.7
Vinyl/vinyl-asbestos tile.....	33.6	(²)	-	34.7	162.9	(²)	-	165.9
Ceiling:								
Acoustical tile.....	29.8	25.9	24.4	37.1	141.5	169.6	102.3	170.3
Roof base:								
Steel decking.....	32.4	(²)	25.3	39.9	139.8	(²)	89.0	210.9
Concrete.....	31.0	26.0	27.1	35.3	153.8	173.3	112.5	158.7
Roof cover:								
Built up.....	29.7	25.5	24.4	36.4	140.5	169.3	102.3	167.2

¹ Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Insufficient data.

NOTE: Dash denotes that the survey had no sample projects in this cell.

Table A-4. Construction costs of Federal buildings by selected characteristics and region, 1976¹

Characteristic	Cost per square foot				Characteristic	Cost per square foot			
	United States	North-east	North Central	South		United States	North-east	North Central	South
All projects.....	\$47.70	\$65.60	\$41.90	\$46.55	Framing:				
Number of stories:					Steel.....	47.65	65.56	40.60	47.68
Less than 3.....	57.05	(²)	(²)	52.70	Concrete.....	48.44	-	(²)	(²)
3 or 4.....	41.73	(²)	39.43	(²)	Load bearing masonry.....	(²)	(²)	(²)	(²)
5 or more.....	47.37	67.09	(²)	44.42	Exterior wall:				
Conveyor systems:					Concrete.....	46.96	(²)	(²)	44.25
Elevators.....	46.84	65.56	40.60	45.85	Load bearing masonry.....	43.34	(²)	(²)	(²)
No elevators.....	59.25	-	(²)	(²)	Curtain wall.....	50.17	(²)	(²)	(²)
Basement:					Interior wall:				
Basement.....	47.49	66.78	42.01	45.6	Drywall.....	45.95	57.69	36.50	46.07
No basement.....	49.13	(²)	(²)	50.4	Plaster.....	(²)	(²)	(²)	(²)
Parking area:					Floor base:				
In or under the building.....	49.58	(²)	(²)	43.9	Concrete.....	47.34	65.56	41.23	46.07
Outdoor.....	46.26	(²)	39.67	54.4	Floor covering:				
In or under the building and outdoor.....	42.75	(²)	(²)	(²)	Carpet.....	48.80	66.78	43.46	45.82
Heat:					Vinyl/vinyl-asbestos tile.....	48.49	(²)	-	45.82
Forced air.....	49.45	66.78	32.04	48.35	Ceiling:				
Hot water.....	36.87	-	(²)	(²)	Acoustical tile.....	47.49	65.56	41.90	45.89
Electric radiant.....	41.40	(²)	(²)	(²)	Roof base:				
Fuel:					Steel decking.....	43.14	(²)	35.14	52.92
Electricity.....	47.87	(²)	43.16	52.39	Concrete.....	49.64	66.78	41.55	45.01
Gas.....	41.24	(²)	35.84	(²)	Roof cover:				
Oil.....	(²)	(²)	(²)	(²)	Built up.....	47.26	66.40	41.90	45.96

¹ Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Insufficient data.

NOTE: Dash denotes that the survey had no sample projects in this cell.

Table A-5. Average onsite earnings and wages as a percent of contract costs on Federal building construction projects by selected characteristics and region, 1976¹

Characteristic	Average hourly earnings				Wages as a percent of contract costs			
	United States	North-east	North Central	South	United States	North-east	North Central	South
All projects.....								
Number of stories:								
Less than 3.....	\$8.67	(²)	(²)	\$8.37	27.03	(²)	(²)	28.45
3 or 4.....	9.27	(²)	9.40	(²)	26.86	(²)	26.50	(²)
5 or more.....	8.57	9.56	(²)	7.40	25.46	24.85	(²)	27.29
Conveyor systems:								
Elevators.....	8.65	9.54	9.96	7.56	25.95	24.67	24.34	28.05
No elevators.....	8.87	-	(²)	(²)	24.65	-	(²)	(²)
Basement:								
Basement.....	8.80	9.55	10.05	7.68	25.90	24.80	24.31	28.10
No basement.....	7.86	(²)	(²)	7.47	25.41	(²)	(²)	26.27
Parking area:								
In or under the building.....	8.68	(²)	(²)	7.53	25.64	(²)	(²)	27.25
Outdoor.....	8.96	(²)	9.66	8.40	26.38	(²)	24.17	29.00
In or under the building and outdoor.....	8.15	(²)	(²)	(²)	25.80	(²)	(²)	(²)
Heat:								
Forced air.....	8.79	9.55	10.24	7.69	25.96	24.80	23.95	28.27
Hot water.....	8.11	-	(²)	(²)	26.08	-	(²)	(²)
Electric radiant.....	8.10	(²)	(²)	(²)	25.56	(²)	(²)	(²)
Fuel:								
Electricity.....	8.65	(²)	10.17	7.19	25.31	(²)	24.31	25.70
Gas.....	8.47	(²)	9.46	(²)	26.22	(²)	24.34	(²)
Framing:								
Steel.....	8.68	9.54	9.94	7.50	25.85	24.67	24.32	28.12
Concrete.....	8.63	-	(²)	(²)	26.84	-	(²)	(²)
Exterior wall:								
Concrete.....	8.53	(²)	(²)	7.80	27.26	(²)	(²)	29.18
Load bearing masonry.....	8.86	(²)	(²)	(²)	25.49	(²)	(²)	(²)
Curtain wall.....	6.15	(²)	(²)	(²)	19.51	(²)	(²)	(²)
Interior wall:								
Drywall.....	7.93	8.71	9.13	7.61	27.11	26.76	25.52	27.55
Floor base:								
Concrete.....	8.63	9.54	9.91	7.61	25.66	24.67	23.90	27.55
Floor covering:								
Carpet.....	8.72	9.55	10.04	7.33	25.28	24.80	23.81	27.30
Vinyl/vinyl-asbestos tile.....	8.30	(²)	-	8.16	27.87	(²)	-	28.37
Ceiling:								
Acoustical tile.....	8.68	9.54	9.93	7.56	25.87	24.67	24.23	28.05
Roof base:								
Steel decking.....	8.44	(²)	9.66	7.63	27.34	(²)	24.47	30.41
Concrete.....	8.38	9.55	9.26	7.64	25.96	24.80	25.07	26.95
Roof cover:								
Built up.....	8.68	9.71	9.93	7.60	25.80	24.76	24.23	27.63

¹ Data for the West are not sufficiently reliable to permit publication of detailed data for that region.

² Insufficient data.

NOTE: Dash denotes that the survey had no sample projects in this cell.

Appendix B. Survey Scope and Methods

The study was designed to develop estimates of the employee hour requirements for the construction of all Federal buildings completed between October 1975 and October 1977 in the 48 contiguous United States and the District of Columbia.

Universe characteristics

The survey included Federal office buildings, Social Security Administration office buildings, border stations, and other miscellaneous buildings constructed under the auspices of the Public Buildings Service of the General Services Administration. Out-of-scope activities and costs associated with an in-scope project included additions and renovations to existing structures, moveable equipment, customized construction, and repair work or materials replacement. Preconstruction activities such as land acquisition, demolition, architectural and engineering services, force account labor, utility company services, and any work beyond the property line also were excluded from the survey.

The initial universe was composed of 33 new Federal building projects. Of the original universe, a number were found to be out of the scope of the study or could not be studied because the contractors did not cooperate or could not be located. Therefore, the final sample for this survey consisted of 24 Federal building projects.

Accuracy of data

The aggregate U.S. data and regional data for this study, except for the West region, are believed to be accurate. Sample response for the West was not adequate to permit publishing data for that region. The detailed data, in general, have a wider margin of sampling error and may be subject to other limitations. Employee hour and material requirements are affected by a number of factors such as location, size of project, type of structure, architectural design, availability of certain materials or equipment, labor skills, and local building codes and customs. The effects of these separate factors cannot be isolated.

Except for the nonresponding sample units and the data estimated by the contractors, there are no known sources of nonsampling error. Sampling variances are being developed by the Bureau of Labor Statistics.

Data collection procedures

After receiving their lists of assigned projects, field representatives usually contacted the appropriate regional General Services Administration (GSA) office to secure their cooperation. They then verified that the work contractors performed was within the scope of the survey. At the GSA office, the field representatives also obtained some project information and summarized contractor payrolls filed with GSA.

Field representatives often visited the construction site to become as familiar as possible with the structural characteristics of the projects before visiting the general contractor. If a general contractor should refuse to cooperate, the project would have to be dropped which could bias the survey results. Therefore, every effort was made to enlist the cooperation of the general contractor by explaining the nature of the survey and the reasons for conducting it.

If the general contractors agreed, they were asked to verify the final contract value, including change orders, and the list of subcontractors and their current addresses. In addition to payroll data for onsite workers, the field representatives recorded the type of material item, the purchase cost, and the name and fair rental value or equivalent of any equipment used on the job. Each of the subcontractors also was contacted to obtain similar data.

After all the data for a sample project were collected, they were checked for completeness and internal consistency by the regional offices and forwarded to BLS in Washington for final review, editing, and coding for computer processing.

An imputation procedure was used to supply estimates for missing data within projects.

Development of employee hour estimates

Onsite and offsite employee hour estimates were combined to obtain estimates of total employee hour requirements for Federal building construction.

Onsite (direct) employee hours were obtained from individual contractor payrolls. Offsite (indirect) employee hour requirements, representing the hours to produce, transport, and sell the materials, supplies, and equipment used in construction were developed by the BLS Office of Economic Growth using the 1972 Inter-

industry Study of the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. Bureau of Labor Statistics field representatives collected the basic data on materials, supplies, and equipment from each prime contractor and his subcontractors (or estimated in a relatively small number of cases). The materials listings thus obtained were categorized according to the 4-digit industry classification of the *Standard Industrial Classification Manual* (1972 Edition, Office of Management and Budget). For each product group, the average amount required for \$1,000 of construction cost was calculated. This bill of materials was deflated to the 1972 price level by application of the appropriate producer price indexes. The resulting deflated value for each group was reduced by the ratio of producers' value to purchasers' value. (This ratio was based on data provided by BEA.) The differences between purchaser and producer valuation were allocated to trade and transportation sectors. The deflated values were matched to the sector coefficients in the 1972 interindustry study. For each group of materials, the interindustry study provided information on the amount of products required from each industry sector. The product data were converted to employee hours by use of output per employee hour ratios for each industry. While processing the data, the Economic Growth Division adjusted

for price and productivity changes from the base year of the tables (1972) to the study year. The results were the average total (indirect) employee hours per \$1,000 of contract cost required to produce, transport, and sell the materials used to construct the projects covered by this survey.

These employee hours, plus the builders' offsite employment, were combined with direct or onsite employee hours to determine total employee hours within the definition of the study. Offsite employment of each construction contractor was not obtained directly from the contractors since it would be difficult if not impossible to allocate a portion of total offsite employment to a particular project. Instead, an estimate for the offsite employee hours was developed by applying to the onsite employee hours collected for this study the ratio of construction workers to all employees in the general building and special trade contractors (SIC 15 and 17) segments of the contract construction industry for 1975 as reported in *Employment and Earnings, United States, 1909-78* (BLS Bulletin 1312-11, 1979).

An additional measure of employee hours expended in construction—employee hours per 100 square feet of construction—was developed by applying the cost per 100 square feet of construction to employee hours per \$1,000 of construction contract cost.

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 <i>(Enter 2 digit code)</i>	Schedule Number <i>(Enter 3 digit code)</i>	SMSA <i>(Enter 3 digit code)</i>	State <i>(Enter 2 digit code)</i>	Census Region <i>(Enter 1 digit code)</i>
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 **07 | 04 | 76**.)

	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. FramingCode

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

	019
--	-----

6b. Exterior WallsCode

- 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 WallsCode

- 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 BaseCode

- 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 _____ total dollar volume of business was for _____ 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—Continued9c. Which *stock prefabricated components* were used in the project? (Check as many boxes as necessary.)

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

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

Remarks

Remarks

Section 10: Factors Affecting Productivity

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?

Office Use Only

Survey I.D.	Schedule Number		

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:

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 (<i>street address</i>)	
<i>(city, county, state)</i>	

B Form

Office Use Only

Schedule Number <i>(Enter 3 digit code)</i>	Contract Number <i>(Enter 3 digit code)</i>	Major Operations Code <i>(Enter 2 digit code)</i>	Superior Contract Number <i>(Enter 3 digit code)</i>	Status Code <i>(Enter 1 digit code)</i>
		093		094

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		097
1 - Yes		
2 - No		

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).

\$	199
----	-----

If none, enter "0."

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 <i>(express in whole dollars)</i>	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% – enter as %.

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 <u>All</u> 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
	%	
3	3	%

Express a fractional percentage as follows: 3¼ percent as

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:

01	76
----	----

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

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 h 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 (<i>express in whole dollars</i>)	Line Item Number	
				\$	617	
					618	
					619	
					620	
					621	
					622	
					623	
					624	
					625	
					626	
					627	
					628	
					629	
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					652	
					653	

Part V Contract Reconciliation

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

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

Appendix D. Bibliography

Construction Labor Requirements Studies by BLS Office of Productivity and Technology

Civil works construction

Bingham, Barbara J. "U.S. Civil Works Construction Shows Decrease in Required Labor," *Monthly Labor Review*, October 1978, pp. 24-29.

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 characteristic data for both dredging and land projects. Also, a comparison was made with the data from 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 statistical 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 the findings on employee hour requirements, project costs, and other college housing characteristics and compared them 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 which were 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. 1100-04.

A summary of BLS Bulletin 1441 (1965).

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 (1981).

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 of labor requirements are shown 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 229), 1966, 17 pp.

A 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 provides a comparison of annual labor requirements for 1947-64.

Wakefield, Joseph C. "Labor and Material Requirements: Highway Construction, 1958 and 1961," *Monthly Labor Review*, April 1963, pp. 394-98.

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

Discusses the employment impact of the 1976 survey of Federal building construction, including 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.

Olsen, John G. "Decline Noted in Hours Required To Erect Federal Office Buildings," *Monthly Labor Review*, October 1976, pp. 18-22.

A statistical 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 statistical 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 (1962).

Hospital construction

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

A summary of a survey of 90 hospitals constructed in 1976. The article provides data on labor requirements, material costs, and project characteristics. A comparison is made with data from similar studies of hospital construction in 1960 and 1966.

Labor and Material Requirements for Hospital and Nursing Home Construction (BLS Bulletin 1691), 1971, 50 pp.

A study similar to the one done in 1962 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 (1971).

Labor Requirements for Hospital Construction (BLS Bulletin 1340), 1962, 46 pp.

A statistical 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 (1962).

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 were issued during 1969 for 500 units or more of this type. 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.

A summary of BLS Bulletin 1755 (1972).

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

A statistical 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 (1964).

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 the ones done 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.

A 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 Publication Number BLS/LAB Constr-72/81.

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 also 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 (1968).

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 (1961).

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 an earlier 1963 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.

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A 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, 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 dollars 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.

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, by occupation, and by 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 material requirements for private multifamily housing (BLS Bulletin 1892, 1976) 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, 1974) and private one-family housing (BLS Bulletin 1755, 1972) 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.

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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 Shortgages 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.

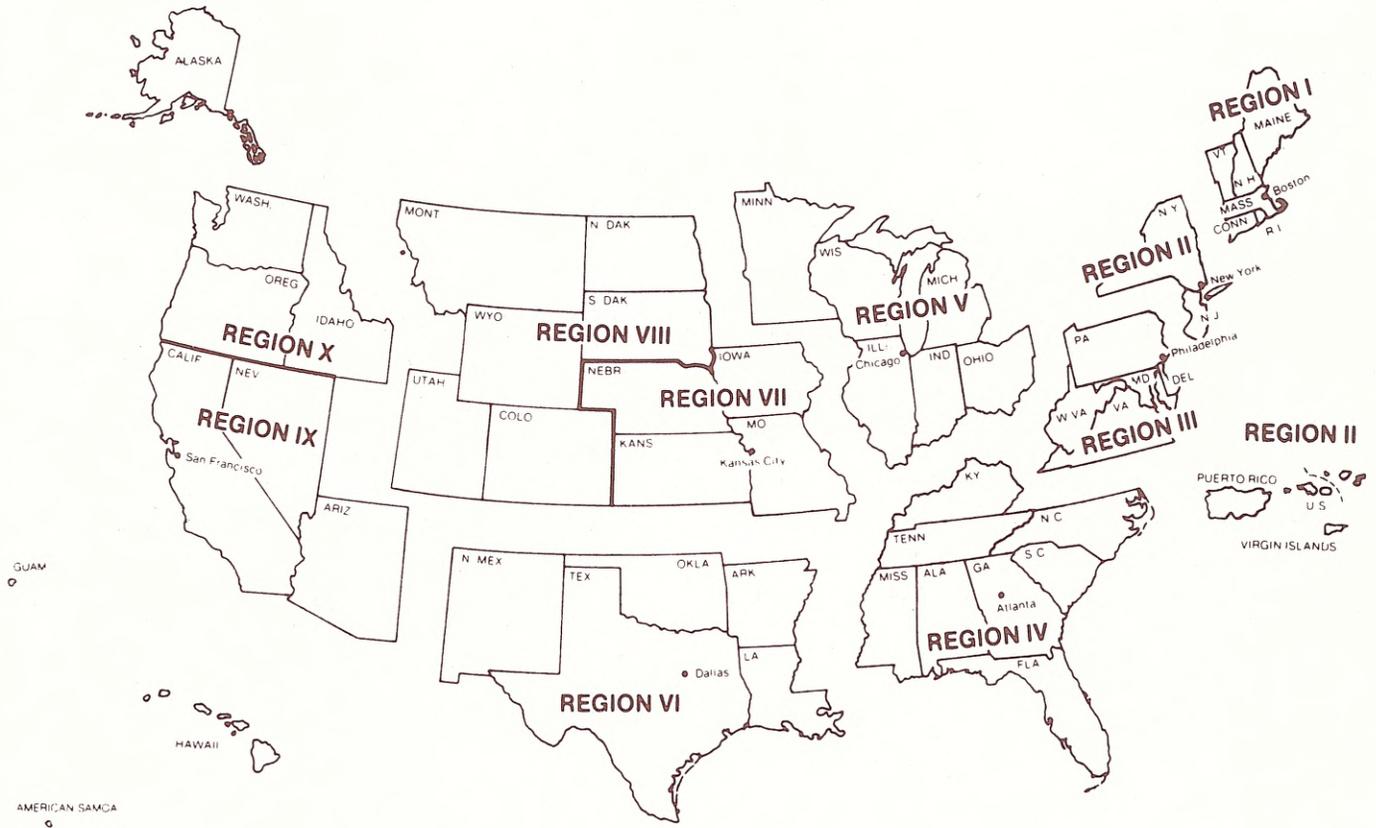
This article summarizes the results of the survey of labor and material requirements for sewer works construction during 1971 (BLS Bulletin 2003, 1979) with reference to the value of the materials, supplies, and equipment used in this type of construction. A detailed listing of the cost of these materials, 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.

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

Bureau of Labor Statistics

Regional Offices



Region I

1603 JFK Federal Building
 Government Center
 Boston, Mass. 02203
 Phone: (617) 223-6761

Region II

Suite 3400
 1515 Broadway
 New York, N.Y. 10036
 Phone: (212) 944-3121

Region III

3535 Market Street
 P.O. Box 13309
 Philadelphia, Pa. 19101
 Phone: (215) 596-1154

Region IV

1371 Peachtree Street, N.E.
 Atlanta, Ga. 30367
 Phone: (404) 881-4418

Region V

9th Floor
 Federal Office Building
 230 S. Dearborn Street
 Chicago, Ill. 60604
 Phone: (312) 353-1880

Region VI

Second Floor
 555 Griffin Square Building
 Dallas, Tex. 75202
 Phone: (214) 767-6971

Regions VII and VIII

911 Walnut Street
 Kansas City, Mo. 64106
 Phone: (816) 374-2481

Regions IX and X

450 Golden Gate Avenue
 Box 36017
 San Francisco, Calif. 94102
 Phone: (415) 556-4678