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ENERGY USE FOR BUILDING CONSTRUCTION
Supplement

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FINAL REPORT

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ABSTRACT

This Report Supplement amplifies the information contained in the basic report, Energy Use for Building Construction (December, 1976) and adds the following information:

With the addition of the information on energy per unit of component in major areas not covered by the original report, broad audits of energy embodied in buildings can now be made. Major areas added are Metal Doors and Windows, Plastics, Plumbing Fixtures, Plumbing Fittings, Heating Equipment, Electrical Equipment, Copper Pipe and Wire, Aluminun Pipe and Wire, and Asphalt.

An examination of energy distribution in typical 1-family residential construction shows that a greater percentage of the total energy required is in the General Construction (as opposed to Plumbing, Heating, Ventilating and Electrical) than in the dollar percentage divisions.

The largest single category of energy use in new building construction is Direct Energy (the energy brought to and expended on the job site). It is almost totally in the form of refined petroleum, which represents almost 15 percent of all energy required to build buildings. Of this, 59 percent is in asphalt, 14 percent in gasoline, 23 percent in diesel fuel, and the balance in fuel oil and liquid petroleum.

In broad categories, building construction is more labor intensive per dollar than non-building construction, and alterations and additions are more labor intensive per dollar than new building. This is in reverse order from energy intensivity in these categories. These relationships do not apply consistently in examining detailed examples. In two specific comparisons of assemblies meeting equal performance standards, the more energy intensive were also the more labor intensive.

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1 INTRODUCTION

INTRODUCTION

The first phase of the study on energy use in building construction, hereinafter referred to as the EBC Report, established the 1967 average national figures for energy use in construction, both building and non-building. This report is entitled Energy Use for Building Construction, by B. Hannon, R. G. Stein, B. Segal, D. Serber, C. Stein, University of Illinois, December 1976. Building and non-building construction are divided into 49 sub-categories according to major building types or major non-building construction usages (Figure 1, p. 7). In addition to the total energy use in each of these 49 sub-categories, a division was made between direct on-site energy and indirect or embodied energy in the products that were purchased by that construction sector for end use (Appendix IV A, Table 32). In each sub-category, the percentage divisions of energy use, both direct and indirect, were determined and graphed.* In the sub-categories relating to building construction, the average energy use per square foot was also established.**

*EBC Report, pp. 25 - 33.

**Ibid., p. 85.

The EBC Report determined the amount of energy necessary to produce most major building products, from the extraction of the raw materials through the complete manufacturing and fabrication of the product ready for shipment to the job site. The energy necessary to bring it to the job site was added. This total figure, the embodied energy, was expressed in Btu per unit characteristic of that building product. (e.g. Board Foot of Rough Lumber, Square Foot of ¼" Polished Plate Glass, Cubic Yard of Ready-mix concrete, etc.) These figures were compared against those derived in other studies that determined energy embodiment using different analytical methods. The Btu values derived were used as energy estimating components to estimate the embodied energy in different building assemblies. Energy cost/benefit analyses were made of interchangeable assemblies and life cycle comparisons were made based on varying performances.

This supplementary study, hereinafter referred to as the EBC Supplement, extends the information of the EBC Report in three major areas.

First, the investigation of embodied energy per unit of material has been supplemented with information on additional materials that were not covered in the EBC Report. Second, where alternative interchangeable assemblies were investigated for their energy contents, we have now added a comparison of the labor requirements of each, including the labor required to produce the components for these assemblies.

Third, since the largest single category of energy use in any of the building types referred to above was the direct energy, this study looks into the way direct energy is used in the new building categories to determine whether there are potential energy reductions.

The data base for these studies is the University of Illinois Center for Advanced Computation (CAC) Energy Input/Output (I/O) Model, based on Department of Commerce Bureau of Economic Analysis (BEA) figures for the economy in the year 1967.

The model was expanded to 399 sectors for the EBC Report by adding 32 new construction categories and 17 maintenance construction categories. The 399 sector numbers referred to are the numbers used in this 399 sector model.

II STUDIES

II ENERGY USE STUDIES

This section includes the following studies of energy use in the construction industry in 1967:

A. Embodied Energy per Unit of Building Material, which examines those materials making a major contribution to the energy embodied in new building construction (in addition to those examined in the EBC Report), and which translates the measure of embodiment from Btu/$ to Btu/physical unit. The physical units chosen are those used in standard building cost estimating.

B. Breakdown of Energy Use in One-Family Residences, which rearranges energy use information from the 399-Order Ranked Total Energy Requirements for this construction sector into construction industry categories and which compares the percent of the total energy cost in each category and the percent of the total dollar cost of each category.

C. Energy Use in New Building Construction vs. Total Production, which compares the total amount of energy used by industries which produce the materials examined under Section A with the amounts of energy used by those industries in new building construction.

D. Labor Intensities of Typical Assemblies, which compares the labor intensity and the energy intensity of some alternative structural and framing systems.

E. Direct Energy Consumption, which analyzes the way energy is used on the job site during the construction process according to building type and the amounts used by each building type.

IIA Embodied Energy per Unit of Building Material

EMBODIED ENERGY PER UNIT OF MATERIAL

The EBC Report showed that the entire new building sector accounted for 6.21 percent of the total 1967 national energy usage. This totaled 4155.10 trillion Btu. Of this, 3,421.6 were in New Building Construction, with the balance in Building Maintenance and Repair. (Figure 1.) Most of the major categories of building products which embody significant amounts of energy were investigated in detail. A printout of all of these products, arranged according to the percentage of total New Building energy use that they represented in 1967, appears in Appendix IV A, on Table 33.

The 3421.6 trillion Btu in New Building Construction can be broken down into three general categories; building materials and products (70 percent of total); direct energy (15 percent of total); and overhead, trade and transportation (15 percent of total). The categories covered in the EBC Report accounted for 40 percent of the 70 percent of embodied energy which is in New Building Construction building materials in addition to 15 percent in direct energy and 15 percent in embodied energy in overhead, trade and transportation margins. The additional categories investigated in this Supplement represent an additional 20 percent in the building materials component, raising the total to approximately 90 percent.

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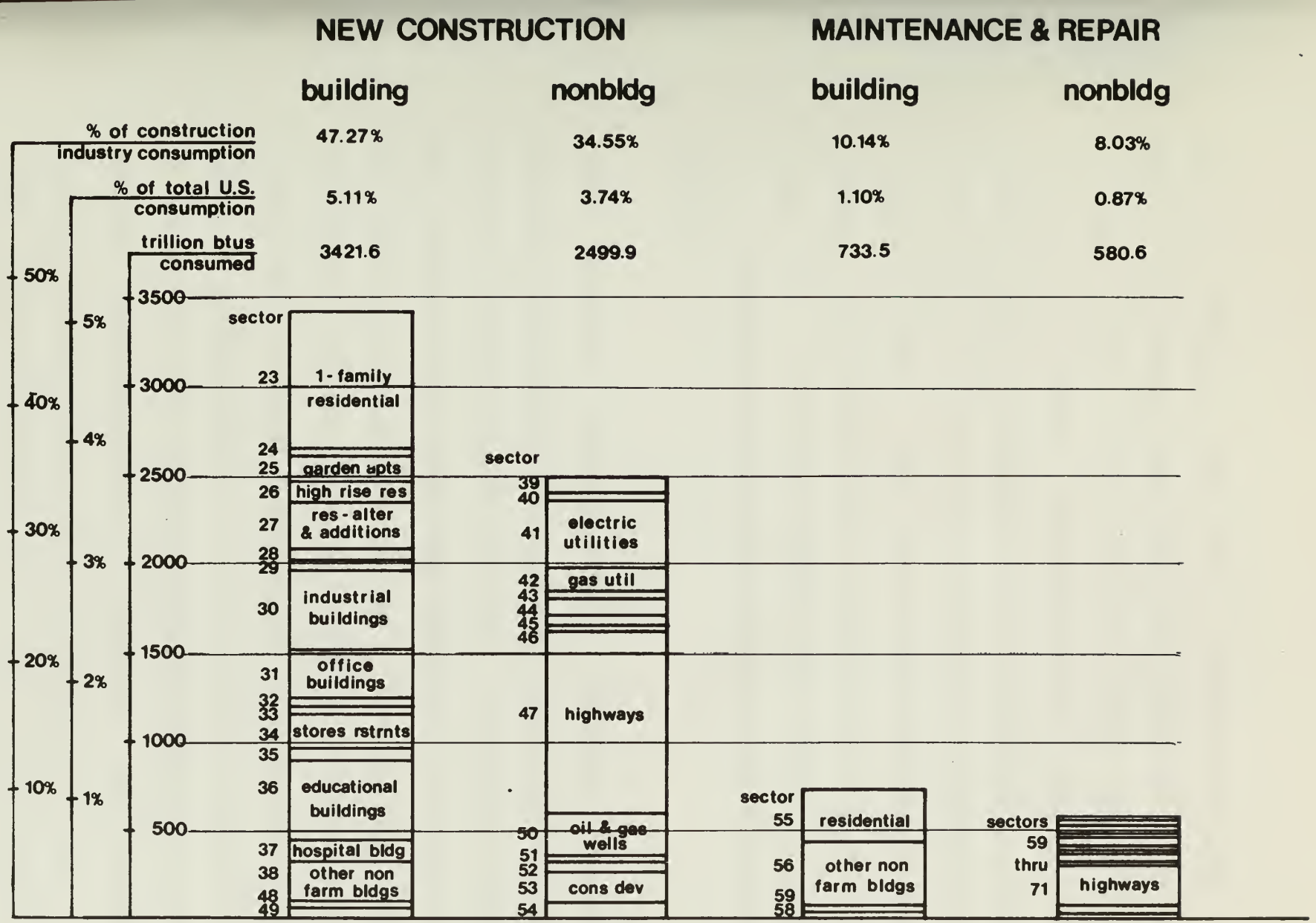
ENERGY IN BUILDING CONSTRUCTION
ERDA Contract No. E (11-1)-2791

Subject
Analysis of Energy Consumption by 49 Construction Sectors

by
CAC
RGS & A

date



49 CONSTRUCTION SECTORS - breakdown by major sector groupings - 1967

TOTAL % OF U.S. CONSUMPTION = 10.82%

TOTAL BTUS CONSUMED = 7235.6 TRILLION

Figure 1

The basic information is derived from CAC 399 sector model, which is based on the economic input/output matrix developed by the Department of Commerce Bureau of Economic Analysis (BEA) and translated from dollar transactions into energy transactions by CAC. These energy transactions include all indirect purchases of fuel, process energy consumed by sectors contributing to the sector under investigation, transportation between stages of the process chain, energy content of feedstocks for petrochemicals, direct energy value of products such as asphalt, administrative energy, etc. It is the only approach which includes all steps in the chain of industrial process and all inputs to a given sector from other sectors.

The CAC 399 model corresponds with the 1967 Census of Manufactures data, which uses the Department of Commerce Standard Industrial Classification (SIC), at a 4-digit classification level. The Census of Manufactures data, however, offers a much finer breakdown. It contains information at SIC 5 and 7 digit classification level. Therefore, we subdivided certain CAC 399 level industries that had significant inputs into New Building Construction into 5- and 7-digit classification, corresponding to the Census of Manufacturing data. At this level of breakdown, we were able to approach the type of product breakdown necessary for a precise energy estimate of building materials and components. From the Census, we obtained quantities of materials produced, such as pounds of copper, board feet of lumber, and the corresponding dollar value. To the unit price obtained from these figures, we applied the CAC figure for total energy intensity (Btu/dollar) of product (Table 34), arriving at an average figure for embodied Btu/Unit.

The additional energy necessary to transfer materials from the producer to the job site is accounted for by eight "margin" sectors. Six of these sectors account for transportation of materials, and two cover the operation of retail and wholesale trade. Tables 3 to 19 include the increments of Btu/Unit of product to New Building Construction which account for these margins. The derivation of this factor is described in detail in Appendix C of the EBC Report.

The additional energy embodiment per unit of materials charts follow the same methodology as described above with the exception of Asphalt Products and Miscellaneous Plastics Products.

The asphalt described in Table 5 is the energy content of asphalt sold directly for roofing, pavings, and similar building purposes. It is accounted for as one of the refined petroleum products in the direct energy sector and is described more fully in Section IID-Direct Energy Consumption.

Miscellaneous Plastics deviated from the procedure because the Census of Manufactures data does not include units of measure with dollar values for Miscellaneous Plastics. Since dollar values per unit are necessary to derive a Btu value per unit, we used the following method to determine those values. Process and feedstock energy values per pound of several different plastics were taken from the article by R. S. Berry, T. V. Long, and H. Makin, "An International Comparison

of Energy Polymers and Their Alternatives," Energy Policy, June 1975. To these we added overhead energy values which were derived from the CAC printout, "Partial Energy Intensities for Miscellaneous Plastics."

We feel that the resulting Btu per unit is comparable to the Btu per unit derived from our standard method.

In 1967, Miscellaneous Plastics consume 43.4 trillion Btu to produce building products for new building construction. It is a significant energy user. By 1975, a year with a sharply reduced national economy, plastic production had increased by about 60 percent overall.[1] The comparisons in Table 1 and Table 2 show how plastic products can be either more or less advantageous, from an energy use standpoint.

Comparing the two insulating materials on the basis of R value, polystyrene is approximately 10 times as energy intensive as mineral wool (Table 1). On the other hand, steel pipe is approximately three times as energy intensive as plastic pipe of the same diameter (Table 2).

The fact that plastics can in some cases reduce energy use should be borne in mind. However, the comparison between the polystyrene and mineral wool becomes particularly important in consideration of the enormous program for

TABLE 1
COMPARISON OF POLYSTYRENE INSULATION & MINERAL WOOL INSULATION
(UNIT: SQUARE FOOT)
POLYSTYRENE

Size	R Value	Total Btu/unit
1"	5	22,168
2"	10	44,337
3"	15	66,505
4"	20	88,674
5"	25	110,842

MINERAL WOOL

Size	R Value	Total Btu/unit
2½"	7	5,700
3½"	11	6,860
5½"	19	8,800
7½"	27	10,900
9½"	35	13,000

TABLE 2
COMPARISON OF STEEL PIPE & PLASTIC PIPE
(UNIT: LINEAL FOOT)
PLASTIC PIPE (PVC)

Diameter	lb/lf	Total Btu/unit
3"	1.53	71,344
4"	2.16	100,821
6"	3.76	175,329
8"	5.80	270,454

STEEL PIPE

Diameter	lb/lf	Total Btu/unit
3"	7.58	195,663
4"	10.79	278,522
6"	18.97	489,673
8"	28.55	736,961

the insulation of existing buildings and the increased insulation recommended for new buildings under ASHRAE 90-75 and other State building codes. While the greater increase is provided for with fibreglas insulation, it should be borne in mind that there is a difference of about 180,000,000 Btu in insulating a typical one-family residence between using fibreglas or another mineral wool insulation and using a polystyrene insulation. In other words, in a single house the difference is about 30 barrels of oil equivalent.[2]

The energy embodied in major plumbing and heating equipment has been accounted for.

In plumbing, both vitreous fixtures (solid porcelain, used in water closets and lavatories) and enamelled iron and steel fixtures (a glazed enamel fused to a cast iron or steel body for bath tubs, lavatories, and sinks) as well as urinals, shower stalls, stainless steel sinks, service sinks and other fixtures have all been detailed. The fittings - faucets, drains, shower heads and such, have also been examined and listed. It is interesting to note that an average bathtub requires 6,021,440 Btu, the equivalent of a barrel of oil. If the 1,001,083 Btu for the fittings are added, the total is over 7,000,000 and represents 1 percent of the energy required by an average small house.

This report provides further information on energy per unit of product as follows:

Additional detail has been added to the Wood Products Category, which accounted for 0.47 percent of total consumption in New Building Construction. Vitreous plumbing fixtures accounted for 0.31 percent; rolled copper represented 0.69 percent. Copper wire represented 2.22 percent of New Building Energy Consumption. Together, the various copper products represented about one eighth of the copper industry. It should be noted that the copper for power generation and transmission lines is not included in these figures. Aluminum wire, which is about twice as energy intensive per pound, represents a considerably smaller part of the electric transmission wire market, totalling in 1967 about 129 million pounds as compared with almost 1.2 billion pounds of copper wire.*

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*There have been recent examples of fires in aluminum-wired houses due to failures at the connection points. The necessity for substantial alterations to aluminum wired residential installations has caused a shift back to copper and a disapproval of aluminum wiring in some codes. National Bureau of Standards NBS IR 75-677, "Hazard Assessment of Aluminum Electrical Wiring in Residential Use," December 1974.

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

WOOD PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
142	2499	WOOD PRODUCTS[1]					71,339		16,005		
	24996	Fabricated hardboard products									
	24996 11	Prefinished paneling (including siding, and wall panels that are plastic coated, embossed, painted, grooved, printed, varnished, or shellacked)	SQ FT 1/8"	2,215.3	117.2	.0529	"	3,774	"	847	4,621
	41	Panel Stock (including interior & exterior panels and siding not face finished)	"	889.8	28.8	.0324	"	2,309	"	518	2,827
	24993 00	Particleboard (including woodboard made from wood residue, with resins added as a binder and pounded together under heat and pressure	SQ FT 3/4"	1,018.2	89.1	.0875	"	6,243	"	1,401	7,644

NOTE: 1. WOOD PRODUCTS CONTRIBUTED 16.04 TRILLION BTU TO NEW BUILDING CONSTRUCTION, .47% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 47th (SEE TABLE 32).

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL — PAPER PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA: No. of Units (Millions)	Total $ (Millions)	Average $/Unit	BEFORE DELIVERY TO JOBSITE: CAC Btu/$	Embodied Energy (Btu/Unit)	DELIVERY & TRADE ENERGY INPUT: CAC Btu/$	Embodied Energy (Btu/Unit)	TOTAL AT JOBSITE: Embodied Energy (Btu/Unit)
160	2661	BUILDING PAPER & BOARD[1]					189,900		35,151		
	26611	Insulating board (less than 31 lbs. per cu. ft.)	LB	2,604.8	177.3	.0681	"	12,926	"	2,393	15,319

PRODUCT EXAMPLE - INSULATING BOARD
(wood fiber with cement @ 22 lb/cu ft)

THICKNESS	LB/SF[2]	TOTAL BTU/UNIT
1"	1.83	28,034
2"	3.67	56,221
2½"	4.58	70,161
3"	5.50	84,254

NOTE: 1. BUILDING PAPER & BOARD CONTRIBUTED 30.99 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 0.91% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 33rd (SEE TABLE 32). APPROXIMATELY 51% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

2. AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIRCONDITIONING ENGINEERS, ASHRAE HANDBOOK OF FUNDAMENTALS, NEW YORK CITY, 1972, PG 361.

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

REFINED PETROLEUM PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	BTU CONTENT[2]	BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
					CAC Btu/Btu	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
3	2911	REFINED PETROLEUM[1]							
		Asphalt	GAL	158,095	1.198	189,380	.018	2,846	192,235

NOTE: 1. REFINED PETROLEUM CONTRIBUTED 497.31 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 14.54% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 1st (SEE TABLE 32). APPROXIMATELY 65% OF REFINED PETROLEUM PRODUCTS IS ASPHALT WHICH IS A BUILDING PRODUCT, AND THE REMAINDER IS DIRECT FUEL. ASPHALT CONTRIBUTED 323.84 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 9.47% OF TOTAL NEW BUILDING CONSUMPTION (SEE PG 8).

2. D. SIMPSON, D. SMITH, "DIRECT ENERGY USE IN U.S. ECONOMY, 1967," CAC TECHNICAL MEMO NO. 39, CENTER FOR ADVANCED COMPUTATION, UNIVERSITY OF ILLINOIS AT URBANA, JANUARY 1975, PG 5.

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

PLASTIC PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	ENERGY USE IN PRODUCTION BEFORE DELIVERY TO JOBSITE[2] Energy Content of Feedstock (Btu/unit)	Process Energy (Btu/unit)	Overhead Input	Total (Btu/unit)	DELIVERY & TRADE ENERGY INPUT CAC % increase	Embodied Energy (Btu/Unit)	TOTAL AT JOBSITE Embodied Energy (Btu/Unit)
188	3079	MISCELLANEOUS PLASTICS[1] PRODUCTS								
	30792	Foamed plastics products: Polystyrene insulation	LB	19,884	45,744	2,625	68,253	.12	8,190	76,443

PRODUCT EXAMPLE - POLYSTYRENE INSULATION (Weight 3.5 lb/cu ft)

THICKNESS	LB/SF[3]	TOTAL BTU/UNIT
1"	.29	22,168
2"	.58	44,337
3"	.88	67,270
4"	1.16	88,674
5"	1.46	111,607

188	3079	MISCELLANEOUS PLASTICS[1] PRODUCTS								
	30796 53	Plastic pipe: PVC	LB	9,509	30,524	1,601	41,634	.12	4,996	46,630

PRODUCT EXAMPLE - PVC PIPE

OIA	LB/LF[4]	TOTAL BTU/UNIT
3"	1.53	71,344
4"	2.16	100,821
6"	3.76	175,329
8"	5.80	270,454

NOTE: 1. MISCELLANEOUS PLASTICS PRODUCTS CONTRIBUTED 43.40 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 1.27% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 22nd (SEE TABLE 32). APPROXIMATELY 8% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

2. FOR DESCRIPTION OF PROCEDURE USED SEE PG 7.

3. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIRCONDITIONING ENGINEERS, ASHRAE HANDBOOK OF FUNDAMENTALS, NEW YORK CITY, PG 361.

4. PLASTIC PIPE INSTITUTE, "RECOMMENDED METHOD FOR CALCULATION OF NOMINAL WEIGHT OF PLASTIC PIPE," TECHNICAL REPORT 7, NEW YORK CITY.

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

STONE & CLAY PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
205	3272	CONCRETE PRODUCTS[1]					108,490		6,260		
	32721	Concrete Pipe									
	32721 13	Reinf. Concrete Pipe									
	15	Non-reinf. culvert Pipe									
	22	Reinf. Sewer Pipe 24" or more									
	23	Reinf. Sewer Pipe less than 24"	LB	1,3885.0	215.6	.0155	"	1,685	"	97	1,782
	26	Non-reinf sewer pipe 15" or more									
	27	Non-reinf sewer pipe 15" or less									
	32722	Precast products									
	32722 71	Dry-mixed concrete materials (including prepackaged sand, gravel, & cement, mortar & cement premixes)	LB	2,905.4	27.1	.0093	"	1,012	"	58	1,070
	32723	Prestressed conc products									
	32723 11	Single tees, double tees, & channels	SQ FT	50.2	55.7	1.1095	"	120,376	"	6,946	127,322
	23	Piling, bearing piles, & sheet piles	LIN FT	5.2	20.1	3.8654	"	419,356	"	24,197	443,553

PRODUCT EXAMPLE - CONCRETE PIPE

INSIDE DIA	LB/LF[2]	TOTAL BTU/UNIT
4"	16	28,512
6"	23	40,986
8"	37	65,934
10"	51	90,882
12"	67	119,394

NOTE: 1. CONCRETE PRODUCTS CONTRIBUTED 48.72 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 1.42% OF TOTAL NEW BUILDING CONSTRUCTION. ITS RANKED ORDER IS 20th (SEE TABLE 32). APPROXIMATELY 39% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 21).

2. McGRAW-HILL INFORMATION SYSTEMS CO., SWEET'S ARCHITECTURAL CATALOG FILE, NEW YORK CITY, 1976, SECTION 2.20 Wa.

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

STONE & CLAY PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
199	3259	STRUCTURAL CLAY PRODUCTS[1]					259,790		17,253		
	32591 11	Vitrified clay sewer pipe and fittings	LB	2,980.8	93.0	.0312	"	8,105	"	538	8,643
	32592	Other structural clay products									
	32592 11	Drain tile	LB	1,557.0	20.5	.0132	"	3,420	"	227	3,647
200	3261	VITREOUS PLUMBING FIXTURES[3]					91,042		18,052		
	32610 17	Lavatories	1 EA	2.3039	25.6	11.11	"	1,011,622	"	200,586	1,212,208
		Water closet bowels:									
	18	Syphon jet	"	5.2049	61.10	11.74	"	1,068,736	"	211,911	1,280,647
	20	Washdown									
	22	Reverse trap									
	24	Flush tanks	"	4.4308	42.7	9.64	"	877,380	"	173,969	1,051,349

PRODUCT EXAMPLE - CLAY PIPE
(standard strength ASTM Spec C13-14)

DIA	LB/LF [2]	TOTAL BTU/UNIT
4"	9	77,787
6"	16	138,288
8"	23	198,789
10"	36	311,148
12"	48	414,864
15"	72	622,296

NOTE: 1. STRUCTURAL CLAY PRODUCTS CONTRIBUTED 12.94 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 0.38% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 51st (SEE TABLE 32). APPROXIMATELY 36% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

2. ELWYN E. SEEYLE, DATA BOOK FOR CIVIL ENGINEERS, DESIGN, NEW YORK CITY, 1966, PG 18 - 45.

3. VITREOUS PLUMBING FIXTURES CONTRIBUTED 10.44 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 0.31% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 59th (SEE TABLE 32). APPROXIMATELY 77% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

PRIMARY NONFERROUS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
227	3351	ROLLED & DRAWN COPPER[1, 3]					101,700		2,643		
	33512	Rolled, drawn & extruded copper & copper-base alloy mill products									
		Copper, unalloyed mill shapes:									
	33512 11	Rod, bar & shapes	LB	888.4	398.4	.4484	"	45,607	"	1,185	46,792
	13	Flat Products (sheet, strip plates)	"	215.2	143.6	.6673	"	67,863	"	1,764	69,627
	16	Pipe & tube, plumbing	"	383.4	268.7	.7008	"	71,275	"	1,852	73,127
		Copper-base alloy mill shapes:									
	32	Rod, bar & shapes	"	778.2	361.3	.4643	"	47,217	"	1,227	48,444
	35	Flat products (sheet, strip, plates)	"	839.8	507.2	.6040	"	61,422	"	1,596	63,018
	36	Pipe & tube, plumbing	"	120.4	81.7	.6786	"	69,011	"	1,793	70,804

PROOUCT EXAMPLE - COPPER ALLOY PIPE
(Brass - 85% copper, 15% zinc)

NOM PIPE SIZE	LB/LF[2]	TOTAL BTU/UNIT
½"	.980	69,389
3/4"	1.308	92,613
1"	1.944	137,645
1¼"	2.630	186,217
1½"	3.130	221,620

NOTE: 1. ROLLED & DRAWN COPPER CONTRIBUTEO 23.46 TRILLION BTU TO NEW BUILOING CONSTRUCTION, 0.69% OF TOTAL NEW BUILOING CONSUMPTION. ITS RANKED OROER IS 37% (SEE TABLE 32). APPROXIMATELY 10% OF THIS INDUSTRY'S TOTAL PROOUCTION WENT INTO NEW BUILOING CONSTRUCTION (SEE TABLE 22).

2. McGRAW-HILL INFORMATION SYSTEMS CO., SWEET'S ARCHITECTURAL CATALOG FILE, NEW YORK CITY, 1976, SECTION 5.1 Br.

3. THE LOWER ENERGY VALUE OF UNALLOYEO COPPER IS OUE TO THE LARGE AMOUNT OF RECYCLEO COPPER USEO IN THIS INOUSTRY.

CENTER FOR ADVANCED COMPUTATION
University of Illinois Urbana IL 61801

and

RICHARD G. STEIN AND ASSOCIATES, ARCHITECTS
588 Fifth Avenue New York NY 10036

ENERGY IN BUILDING CONSTRUCTION
ERDA Contract No. E (11-1)-2791

date

Subject
Energy Embodiment per Unit of Material

by
CAC
RGS & A

Table 9

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

PRIMARY NONFERROUS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA: No. of Units (Millions)	Total $ (Millions)	Average $/Unit	BEFORE DELIVERY TO JOBSITE: CAC Btu/$	Embodied Energy (Btu/Unit)	DELIVERY & TRADE ENERGY INPUT: CAC Btu/$	Embodied Energy (Btu/Unit)	TOTAL AT JOBSITE: Embodied Energy (Btu/Unit)
228	3352	ROLLED & DRAWN ALUMINUM					244,200		3,479		
	33521	Aluminum and alum-base alloy wire and cable (including ACSR)									
	33521 11	Bare wire for electrical transmission	LB	129.0	50.2	.3891	"	95,029	"	1,354	96,383
	62	Aluminum cable steel reinforced	"	64.4	21.3	.3307	"	80,768	"	1,151	81,919

PRODUCT EXAMPLE - ALUMINUM WIRE (made from primary alum @ 165 lb/cu ft)

SIZE	DIA	LB/LF^2	TOTAL BTU/UNIT
#14	.0641	.00116	111
#12	.0808	.00182	175
#10	.1019	.00297	286
#6	.1620	.00759	732
#2	.2576	.01896	1,828
#1	.2893	.02393	2,306
1/0	.3249	.03020	2,910

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA: No. of Units (Millions)	Total $ (Millions)	Average $/Unit	BEFORE DELIVERY TO JOBSITE: CAC Btu/$	Embodied Energy (Btu/Unit)	DELIVERY & TRADE ENERGY INPUT: CAC Btu/$	Embodied Energy (Btu/Unit)	TOTAL AT JOBSITE: Embodied Energy (Btu/Unit)
230	3357	NONFERROUS WIREDRAWING & INSULATING[1]					91,433		3,290		
	33572	Copper & copper-base alloy wire (including strand and cable) bare and tinned for electrical transmission	LB	670.0	372.8	.5564	"	50,874	"	1,831	52,705
	33572 11 51	Wire, alloyed & unalloyed for electrical transmission	"	521.6	262.7	.5036	"	46,050	"	1,657	47,707
	33472 71	Strand & cable	"	165.2	103.5	.6265	"	57,284	"	2,061	59,345

PRODUCT EXAMPLE - COPPER WIRE (made from primary copper @ 556 lb/cu ft)

SIZE	DIA	LB/LF^2	TOTAL BTU/UNIT
#14	.0641	.00396	210
#12	.0808	.00630	333
#10	.1019	.00100	503
#6	.1620	.02533	1,340
#2	.2576	.06405	3,389
#1	.2893	.08079	4,274
1/0	.3249	.10189	5,391

NOTE: 1. NONFERROUS WIRE CONTRIBUTED 75.85 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 2.22% OF NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 13th (SEE TABLE 32). APPROXIMATELY 23% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO BUILDING CONSTRUCTION (SEE TABLE 22).

2. AMERICAN INSTITUTE OF STEEL CONSTRUCTION INC., MANUAL OF STEEL CONSTRUCTION, NEW YORK CITY, 1973, PG 6 - 3.

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
237	3431	METAL PLUMBING FIXTURES[1, 2]					98,392		16,316		
	34310 12 13 14	Drinking foutains: Cast iron steel, aluminum and other metals	1 EA	.0437	1.5	34.32	"	3,377,300	"	560,046	3,937,346
	34310 17	Lavatories: Cast iron	"	1.8761	22.1	11.78	"	1,159,034	"	192,198	1,351,232
	18 19	Steel, aluminum and other metals	"	.8035	4.7	5.85	"	575,535	"	95,439	670,974
	34310 36 39	Urinals: Cast iron, aluminum and other metals	"	.0087	.3	34.48	"	3,392,827	"	562,621	3,955,448
	34310 42	Kitchen sinks: Steel porcelain enameled	"	1.1841	12.3	10.39	"	1,022,060	"	169,485	1,191,545
	46	Stainless Steel	"	1.0245	20.4	19.91	"	1,959,196	"	324,887	2,284,083
	34310 41 48 32610 45 46	Cast iron, aluminum and and other metals, vitreous china and glazed earthenware	"	.6078	11.2	18.43	"	1,813,081	"	300,657	2,113,738
	34310 52 53 55 32610 52 53 55	Wash sinks: Cast iron, steel, concrete and other materials	"	.082	4.7	57.32	"	5,639,541	"	935,185	6,574,726
	34310 56 59 32610 52 53 55	Service sinks: Cast iron, steel, vitreous china and glazed earthenware	1 EA	.1239	5.5	44.39	"	4,367,684	"	724,278	5,091,962
	34310 61 63	Sink and laundry tray combinations: Steel and cast iron	"	.0284	.8	28.17	"	2,771,606	"	459,606	3,231,212
	34310 71	Bathtubs: Cast iron	"	1.3354	70.1	52.49	"	5,164,954	"	856,486	6,021,440
	32610 72 34310 72	Steel and glazed earthenware	"	.7578	20.0	26.39	"	2,596,780	"	430,615	3,027,395
	34310 81 83 85	Showerstalls, including receptors: Steel, aluminum, monel, and other metal concrete, and composition	"	.1991	9.6	48.22	"	4,744,165	"	786,708	5,530,873

TE: 1. METAL PLUMBING FIXTURES CONTRIBUTEO 15.81 TRILLION BTU TO NEW BUILOING CONSTRUCTION, 0.46% OF NEW BUILDING CONSUMPTION. ITS RANKEO ORDER IS 48th (SEE TABLE 32). APPROXIMATELY 75% OF THE INOUSTRY'S TOTAL PROOUCTION WENT INTO NEW BUILOING CONSTRUCTION (SEE TABLE 22).

2. AGGREGATIONS IN THIS SECTOR CORRESPONO WITH THE CENSUS OF MANUFACTURES AGGREGATIONS.

CENTER FOR ADVANCED COMPUTATION
University of Illinois Urbana IL 61801

and

RICHARD G. STEIN AND ASSOCIATES, ARCHITECTS
588 Fifth Avenue New York NY 10036

ENERGY IN BUILDING CONSTRUCTION
ERDA Contract No. E (11-1)-2791

date

Subject: Energy Embodiment per Unit of Material

by: **CAC** **RGS & A**

Table 11

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
238	3432	PLUMBING FITTINGS AND BRASS GOODS[1]					74,662		12,862		
	34320 01, 05	Bath and shower fittings: Single control, and other than single control bath & shower fittings	1 EA	3.2	36.6	11.44	"	853,947	"	147,109	1,001,056
	34320 03	Bathtub fillers	"	.4	3.1	7.75	"	578,631	"	99,681	678,312
	07	Shower fittings (with shower head)	"	.6	5.1	8.50	"	634,627	"	109,327	743,954
	18	Bath drains and overflows	"	3.1	18.3	5.90	"	440,747	"	75,927	516,674
	19	Other bath and shower fittings, including single bath faucets, shower heads and popup drains sold separately	"	3.0	8.5	2.83	"	211,542	"	36,442	247,984
		Lavatory fittings: (combination 4" center-set fittings with without popup drains)									
	34320 21, 22, 23	Single control type, and other type combination fittings (with without popup drains)	"	5.5	49.7	9.04	"	674,673	"	116,226	790,899
	29	Other lavatory fittings, including popup drains sold separately, and single lavatory faucets	"	2.6	9.6	3.69	"	275,675	"	47,490	323,165
		Sink fittings: (deck-type combination sink faucets)									
	34320 31, 32, 33	Single control type and other combination sink faucets	"	6.8	61.1	8.99	"	670,860	"	115,569	786,429
	39	Other sink fittings including sink strainers sold separately and single sink faucets	"	10.4	15.8	1.52	"	113,429	"	19,540	132,969

NOTE: 1. PLUMBING FITTINGS & BRASS GOODS CONTRIBUTED 20.49 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 0.60% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 40th (SEE TABLE 32). APPROXIMATELY 68% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
239	3433	HEATING EQUIPMENT EXCEPT ELECTRIC					71,217		13,985		
	34331	Oil burners, residential, commercial, and industrial (sold separately), except parts									
		Residential:									
	34331 13	High pressure atomizing	1 EA	.3725	18.5	49.66	"	3,536,952	"	694,557	4,231,509
	11 15 17	Low-pressure atomizing pot natural draft vaporizing, pot mechanical									
	19	draft vaporizing, & rotary	"	.0106	.6	56.60	"	4,031,151	"	791,604	4,822,755
		Commercial and industrial:									
	25	Low-pressure atomizing	"	.0065	4.2	646.15	"	46,017,138	"	9,036,462	55,053,600
	27	High-pressure atomizing	"	.0164	6.6	402.44	"	28,660,500	"	5,628,110	34,288,610
	29	Rotary atomizing	"	.0013	1.7	1,307.69	"	93,129,923	"	18,288,077	111,418,000
	34332	Warm air furnaces (except floor and wall and parts)	"								
		Forced air type (cast iron and steel):									
		Solid fuel (coal, coke & wood):									
	34332 11	150,000 Btu bonnet output & under	"	.0022	.6	272.73	"	19,422,818	"	3,814,091	23,236,909
	12	Over 150,000 output	"	.0001	.1	1,000.00	"	71,217,000	"	13,985,000	85,202,000
		Oil:									
	14	150,000 Btu bonnet output & under	"	.285	54.3	190.53	"	13,568,713	"	2,664,511	16,233,224
	15 16	Over 150,000 output	"	.0137	5.5	401.46	"	28,590,766	"	5,614,416	34,205,182
		Gas:									
	17	150,000 Btu bonnet output & under	"	1.1186	140.7	125.78	"	8,957,833	"	1,759,064	10,716,897
	18 19	Over 150,000 output	"	.0233	13.9	596.57	"	42,485,678	"	8,342,983	50,828,661
		Gravity air-flow type (cast iron and steel):									
	31	Solid fuel	"	.0019	.3	157.89	"	11,244,789	"	2,208,158	13,452,947
	35 37	Gas	"	.0038	.4	105.26	"	7,496,522	"	1,472,104	8,968,626
	34333	Cast iron heating boilers, radiators, and convectory except parts									
		Cast iron boilers:									
	34333 11 13	Oil and solid fuel	"	.0926	33.5	361.77	"	25,764,249	"	5,059,368	30,823,617
	15	Gas	"	.097	42.8	441.24	"	31,423,584	"	6,170,701	37,594,285
		Radiators and convectors									
	30 50	Cast iron	SQ. FT	9.8	7.8	.80	"	56,683	"	11,131	67,814
		Aluminum, including baseboard and finned tube type:									
	72	Residential	SQ FT	59.2	25.8	.4358	"	31,037	"	6,095	37,132
	74	Industrial and special	"	25.4	13.6	.5354	"	38,132	"	7,488	45,620

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
239	3433	HEATING EQUIPMENT, EXCEPT ELECTRIC (CONTINUED)					71,217		13,986		
	34334	Domestic heating stoves (except electric) except parts:									
		Gas:									
	34334 11	Vented circulators	1 EA	.3116	20.5	65.79	"	4,685,329	"	920,132	5,605,461
	13	Unvented circulators	"	.491	7.9	16.09	"	1,145,854	"	225,029	1,370,883
	15	Radiants	"	.0803	1.6	19.93	"	1,419,019	"	278,675	1,697,694
	17	All other (including laundry stoves)	"	.037	1.2	32.43	"	2,309,738	"	453,600	2,763,338
	27	Wood (sheet-metal air-tight types)	"	.1711	.7	4.09	"	291,356	"	57,218	348,574
		Coal and wood (other than sheetmetal airtight types):									
	31	Circulators (standard and magazine types	"	.0316	2.5	79.11	"	5,634,255	"	1,106,487	6,740,742
	33	Magazine radiants	"	.0326	1.1	33.74	"	2,403,028	"	471,920	2,874,948
	39	All other (including kitchen, heaters, cabose, schoolroom, etc.)	"	.0911	3.1	34.03	"	2,423,411	"	475,923	2,899,334
		Kerosene, gasoline, and fuel oil:									
	41	Flue-connected circulators and radiant circulators with vaporizing pot-type burners	"	.1152	9.6	83.33	"	5,934,750	"	1,165,500	7,100,250
	43	Flue-connected radiant heaters (without casing) and trailer heaters, equipped with vaporizing pot-type burners	"	.0511	3.0	58.71	"	4,181,037	"	821,096	5,002,133
	45, 47	Flue-connected heater equipped with sleeve burner, and unvented portable kerosene heaters[1]	"	.1053	1.2	11.40	"	811,590	"	159,385	970,975
	34335	Steel heating boilers (15 psi and under, steam working pressure and under and all hot water boilers):									
	34335 12	294 sq. ft. of heating surface or less	"	.093	40.3	433.33	"	30,860,700	"	6,060,553	36,921,253
		Over 294 sq. ft. of heating surfaces:									
	21	horizontal firebox	"	.0022	8.5	3,863.64	"	275,156,586	"	54,036,817	329,193,403
	31	Scotch type	"	.005	10.1	2,020.00	"	143,858,340	"	28,251,720	172,110,060

NOTE: 1. AGGREGATIONS SHOWN IN THIS SECTOR CORRESPOND WITH THE CENSUS OF MANUFACTURES AGGREGATIONS.

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

HEATING & PLUMBING

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
239	3433	HEATING EQUIPMENT, EXCEPT ELECTRIC (CONTINUED)[1]									
							71,217		13,985		
	34336	Other heating equipment except electric, including parts for non-electric heating equipment									
		Gas burners:									
	34336 14	Gas conversion burners, residential, commercial, and industrial	"	.1018	10.1	99.21	"	7,065,734	"	1,387,510	8,453,244
		Floor and wall furnaces: Gas Fired:									
	21	Floor furnaces, including dual register	1 EA	.0471	3.8	80.68	"	5,745,745	"	1,128,301	6,874,046
	23	Wall furnaces, panel type	"	.3825	27.9	72.94	"	5,194,652	"	1,020,082	6,214,734
		Oil fired:									
	25	Floor furnaces, including dual register	"	.0103	1.5	145.63	"	10,371,408	"	2,036,650	12,408,058
	27	Wall furnaces, panel type	"	.0061	.8	131.15	"	9,339,934	"	1,834,098	11,174,032
		Unit Heaters: Gas fired:									
	32	Centrifugal fan type	"	.012	3.1	258.33	"	18,397,725	"	3,612,792	22,010,517
	37	Propeller fan type	"	.1795	24.5	136.49	"	9,720,426	"	1,908,816	11,629,242
		Range boilers, expansion tanks and hot water storage tanks:									
	51	Range boilers	"	.0307	.8	26.06	"	1,855,818	"	364,430	2,220,248
	53	Expansion tanks (including basement tanks)	"	.2208	2.9	13.13	"	935,368	"	183,680	1,119,048
	55	Hot water storage tanks	"	.0297	5.6	188.55	"	13,428,121	"	2,636,902	16,065,023

NOTE: 1. HEATING EQUIPMENT, EXCEPT ELECTRIC CONTRIBUTED 34.66 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 1.01% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 30th (SEE TABLE 32). APPROXIMATELY 51% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

FABRICATED METAL PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
241	3442	METAL DOORS, SASH, AND TRIM [1]					116,790		9,304		
	34421	Metal doors & frames (except storm doors)									
		Aluminum doors:									
		Residential:									
	34421 15	Garage	1 EA	.0276	2.5	90.58	"	10,578,804	"	842,754	11,421,558
	16	Sliding (glass, patio-type)	"	.6886	41.4	60.12	"	7,021,647	"	559,375	7,581,022
		Iron and steel doors, including stainless steel doors:									
		Residential:									
	23	Garage	"	.1607	11.9	74.05	"	8,648,419	"	668,971	9,317,390
		Metal doors frames, including trim sold as integral part of door frame:									
	42	Aluminum	"	.2488	12.7	51.05	"	5,961,547	"	474,923	6,436,470
	44	Steel	"	1.3829	28.5	20.61	"	2,406,909	"	191,745	2,598,654
	34422	Metal window sash and frames (except storm sash)									
		Residential:									
		Steel:									
	34422 19	Other than casement	"	.5025	3.9	7.76	"	906,430	"	72,210	978,640
		Aluminum:									
	21	Single and double-hung	"	4.1631	48.8	11.72	"	1,369,016	"	109,062	1,478,078
	25	Horizontal sliding	"	2.6702	40.0	14.98	"	1,749,532	"	139,375	1,888,907
	34424	Metal combination screen & storm sash and doors									
		Sash:									
	34424 25	Aluminum	1 EA	12.9443	116.8	9.02	"	1,053,828	"	83,953	1,137,781
		Doors:									
	65	Aluminum	"	2.1840	42.6	19.51	"	2,278,047	"	181,479	2,459,526
	34425	Metal window & door screens & metal sash									
	34425 11	Screen doors, metal	"	.7132	7.9	11.08	"	1,293,664	"	103,059	1,396,723
		Window screens with metal frames									
	25	Aluminum	"	14.5517	30.6	2.10	"	245,592	"	19,565	265,157
	51	Weatherstrip	LIN FT	481.8	5.0	.0311	"	3,636	"	290	3,926

NOTE: 1. METAL DOORS, SASH & TRIM CONTRIBUTED 101.88 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 5.71% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 5th (SEE TABLE 32). APPROXIMATELY 67% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION. (SEE TABLE 22.)

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL — FABRICATED METAL PRODUCTS

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
242	3443	FABRICATED PLATEWORK[1] (BOILER SHOP PRODUCTS)					104,910		2,852		
	34437	Metal tanks (standard line, nonpressure)									
	34437 21	Basement oil tanks	1 EA	.16430	5.2	31.65	"	3,320,341	"	90,264	3,410,605
	71	Septic tanks	"	.0765	3.7	48.37	"	5,074,077	"	137,940	5,212,017
243	3444	SHEET METALWORK[2]					114,110		6,410		
	34441	Sheet metal roofing and siding and roof drainage equipment									
	34441 05	Fabricated metal flooring	LB	243.2	33.1	.1361	"	15,530	"	872	16,402
		Metal Roofing:									
	11	Steel, all types	"	1,451.4	179.5	.1237	"	14,112	"	793	14,905
	13	Aluminum, all types	"	100.8	38.1	.3780	"	43,131	"	2,423	45,554
		Metal Siding:									
	18	Aluminum, commercial industrial	"	22.6	14.6	.6460	"	73,717	"	4,141	77,858
245	3449	MISC. METALWORK[3]					139,810		5,541		
	34493	Misc. metal building materials									
		Metal plaster bases:									
	34493 11	Expanded metal lath	SQ YD	81.2	29.1	.3584	"	50,104	"	1,986	52,090
	42	Fabricated bar joists	LB	1,394.8	151.8	.10883	"	15,216	"	603	15,819

NOTE: 1. FABRICATED PLATEWORK CONTRIBUTED 41.30 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 1.21% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 26th (SEE TABLE 32). APPROXIMATELY 15% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

2. SHEET METALWORK CONTRIBUTED 95.39 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 2.79% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 6th (SEE TABLE 32). APPROXIMATELY 50% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

3. MISC. METALWORK CONTRIBUTED 94.30 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 2.76% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 7th (SEE TABLE 32). APPROXIMATELY 60% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL — HOUSEHOLD APPLIANCES

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA: No. of Units (Millions)	Total $ (Millions)	Average $/Unit	BEFORE DELIVERY TO JOBSITE: CAC Btu/$	Embodied Energy (Btu/Unit)	DELIVERY & TRADE ENERGY INPUT: CAC Btu/$	Embodied Energy (Btu/Unit)	TOTAL AT JOBSITE: Embodied Energy (Btu/Unit)
310	3639	HOUSEHOLD APPLIANCES[1]					82,264		5,915		
	36391	Household water heaters, electric									
		Electric water heaters (for permanent installation)									
	36391 11, 12, 14, 15	Storage type	1 ea	1.4516	60.6	41.75	"	3,434,278	"	246,934	3,681,212
	36392	Household water heaters, except electric									
		Water heaters: Direct-fired water heaters: Gas:									
	36392 11, 13	Underfired storage & sidearm	"	2.8718	118.7	41.33	"	3,400,215	"	244,484	3,644,699
		Oil									
	23, 25	Underfired storage & sidearm	"	.0135	2.0	148.15	"	12,187,259	"	876,296	13,063,555
		Indirect water heaters:									
	41, 43	Storage, cast or coil-type (less tank)	"	.0061	0.6	98.36	"	8,091,541	"	581,803	8,673,344

NOTE: 1. HOUSEHOLD APPLIANCES CONTRIBUTED 6.14 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 0.18% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 69th (SEE TABLE 32). APPROXIMATELY 15% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

ELECTRIC LIGHTING EQPT

CAC NO.	SIC NO.	SIC TITLE	UNIT	CENSUS OF MANUFACTURES DATA			BEFORE DELIVERY TO JOBSITE		DELIVERY & TRADE ENERGY INPUT		TOTAL AT JOBSITE
				No. of Units (Millions)	Total $ (Millions)	Average $/Unit	CAC Btu/$	Embodied Energy (Btu/Unit)	CAC Btu/$	Embodied Energy (Btu/Unit)	Embodied Energy (Btu/Unit)
313	3643	CURRENT CARRYING WIRING[1] DEVICES					72,488		8,009		
		Lampholders:									
		Incandescent (threaded and luminative only):									
	36430 01	Metal outer shell lampholders, key, keyless, push through and pull types - medium size only	1 EA	68.7	10.5	.1528	"	11,079	"	1,224	12,303
	02	Outlet box lampholders, pull and keyless types - medium size only	"	5.0	1.8	.360	"	26,096	"	2,883	28,979
	03	All other lampholders (including luminine, weatherproof, temporary, socket interiors, etc.)									
		All sizes	"	252.3	24.0	.0951	"	6,895	"	762	7,657
	05	Fluorescent (all types)	"	188.9	14.4	.0762	"	5,526	"	611	6,137
		Convenience and power outlets:									
		Flush (all types, designed for mounting in switch or outlet boxes:									
	11	15 amperes and under (nonlocking type)	"	108.9	23.5	.2158	"	15,642	"	1,728	17,370

NOTE: 1. CURRENT CARRYING WIRING DEVICES CONTRIBUTED 12.08 TRILLION BTU TO NEW BUILDING CONSTRUCTION, 0.35% OF TOTAL NEW BUILDING CONSUMPTION. ITS RANKED ORDER IS 54th (SEE TABLE 32). APPROXIMATELY 21% OF THIS INDUSTRY'S TOTAL PRODUCTION WENT INTO NEW BUILDING CONSTRUCTION (SEE TABLE 22).

IIB Breakdown of Energy Use in One-Family Residences

BREAKDOWN OF ENERGY USE IN 1-FAMILY RESIDENCES

The information in the EBC Report and the Supplement permits an energy estimate of an entire building. The information retrieved from the matrix describes the average divisions of energy use in an entire building category, as follows:

Within the New Building Construction sectors, the largest single category is 1-family residences, accounting for 1.17 percent of the U.S. total energy use. The Ranked Total Energy Requirements of this sector lists all the contributing industries to this sector but does not reflect typical construction categories. By rearranging the information from the Ranked Total Energy order, we can see how the energy of this sector is used in relation to the major trade divisions generally used in building construction. Therefore, an analysis was made by putting each of the contributing sectors into one or more of six categories (General Construction, Mechanical, Electrical, Overhead, Trade and Transport, Direct Energy). The resulting totals give us a rough idea of how much energy is embodied in each construction category

A comparison can then be made between the percent of the total amount of energy use in each category and the percent of total cost of each category.

TABLE 20 - BREAKDOWN INTO CONSTRUCTION CATEGORIES: 1-FAMILY RESIDENTIAL

SECTOR 23 - NEW CONSTRUCTION RESIDENTIAL 1-FAMILY
RANKED TOTAL ENERGY REQUIREMENTS OF CONSTRUCTION SECTORS
(399 - ORDER, 1967)

BREAKDOWN OF TOTAL INPUTS INTO 1 FAM RES INTO BUILDING CONSTRUCTION CATEGORIES IN BTU x 10^{12}

399 - ORDER INDEX	TOTAL ENERGY (BTU)	CUMULATIVE FRACTION		GENERAL CONSTR.	MECH	ELEC	OVERHEAD	TRADE & TRANSPORT	DIRECT
3	0.88665E 14	0.11353E 00	PETRO REFIN PROD	64.46	-	-	-	-	24.20
206	0.67460E 14	0.19991E 00	READY-MIX CONCRETE	67.46	-	-	-	-	-
135	0.53456E 14	0.26836E 00	SAWMILLS	53.46	-	-	-	-	-
373	0.35303E 14	0.31357E 00	RETAIL TRADE	-	-	-	-	35.30	-
198	0.34029E 14	0.35714E 00	BRICKS	34.03	-	-	-	-	-
184	0.24218E 14	0.38815E 00	ASPHALT	24.22	-	-	-	-	-
140	0.23596E 14	0.41836E 00	PREFAB WD STRUC	23.60	-	-	-	-	-
372	0.23578E 14	0.44855E 00	WOLESALE TRADE	-	-	-	-	23.58	-
243	0.21545E 14	0.47614E 00	SHEET METAL WORK	10.77	-	-	-	-	-
139	0.20956E 14	0.50297E 00	VENEER, PLYWD	20.96	-	-	-	-	-
138	0.19494E 14	0.52794E 00	MILLWORK	19.49	-	-	-	-	-
186	0.18683E 14	0.55186E 00	MISC PROF SERVICE	-	-	-	-	18.68	-
195	0.18464E 14	0.57550E 00	CEMENT	18.46	-	-	-	-	-
208	0.17028E 14	0.59730E 00	GYPSUM PRODUCTS	17.03	-	-	-	-	-
362	0.15328E 14	0.61693E 00	RAILROAD	-	-	-	-	15.33	-
241	0.14073E 14	0.63495E 00	METAL DOORS	14.07	-	-	-	-	-
204	0.13214E 14	0.65187E 00	CONCRETE BLOCKS	13.21	-	-	-	-	-
188	0.11106E 14	0.66609E 00	MISC PLASTICS	5.55	5.55	-	-	-	-
217	0.11080E 14	0.68028E 00	STEEL PRODUCTS	10.09	.99	-	-	-	-
160	0.10577E 14	0.69382E 00	BUILDING PAPER	10.58	-	-	-	-	-
182	0.98404E 13	0.70642E 00	PAINT PRODUCTS	9.84	-	-	-	-	-
244	0.97039E 13	0.71885E 00	ARCH METAL WORK	9.70	-	-	-	-	-
117	0.95643E 13	0.73110E 00	FLOOR COVERINGS	9.56	-	-	-	-	-
238	0.82800E 13	0.74170E 00	PLUMBING FITTINGS	-	8.28	-	-	-	-
230	0.82564E 13	0.75227E 00	NONFER WIRE	-	-	8.26	-	-	-
144	0.8166CE 13	0.76273E 00	WOOD H'HOLD FURN	8.17	-	-	-	-	
398	0.81441E 13	0.77315E 00	BUSINESS TRAVEL	-	-	-	8.14	-	-
227	0.74445E 13	0.78269E 00	COPPER ROLLING	-	7.44	-	-	-	-
239	0.73781E 13	0.79213E 00	HEATING EQUIP	-	7.38	-	-	-	-
364	0.70194E 13	0.80112E 00	MOTOR PGT TRANSP	-	-	-	-	7.02	-
245	0.68506E 13	0.80989E 00	MISC METAL WORK	6.85	-	-	-	-	-
293	0.66495E 13	0.81841E 00	REFRIG MACH	-	6.65	-	-	-	-
237	0.63758E 13	0.82657E 00	METAL SANIT WARE	-	6.38	-	-	-	-
384	0.59847E 13	0.83424E 00	MISC BUS SERVIC	-	-	-	-	5.98	-
199	0.58192E 13	0.84169E 00	CLAY PRODUCTS	-	5.82	-	-	-	-
240	0.55942E 13	0.84885E 00	FAB STRUCT STEEL	5.59	-	-	-	-	-
197	0.54642E 13	0.85585E 00	CERAMIC TILE	5.46	-	-	-	-	-
250	0.51563E 13	0.86245E 00	HARDWARE	5.16	-	-	-	-	-
214	0.50190E 13	0.86888E 00	MINERAL WOOL	5.02	-	-	-	-	-
312	0.48547E 13	0.87509E 00	LIGHT FIXTURES	4.85	-	-	-	-	-
310	0.47795E 13	0.88121E 00	H'HOLD APPLIANCES	-	4.78	-	-	-	-
142	0.46727E 13	0.88720E 00	WOOD PRODUCTS	4.67	-	-	-	-	-
255	0.45667E 13	0.89304E 00	VALVES & PIPE	-	4.57	-	-	-	-
136	0.42803E 13	0.89852E 00	HARDWOOD FLOORING	4.28	-	-	-	-	-
200	0.41971E 13	0.90390E 00	PLUMBING FIXTURES	-	4.20	-	-	-	-
252	0.39242E 13	0.90892E 00	FAB WIRE PRODUCTS	3.92	-	-	-	-	-
4	0.38793E 13	0.91389E 00	ELECTRIC UTILITIES	-	-	-	-	-	3.88
203	0.38078E 13	0.91877E 00	CONCRETE PRODUCTS	2.54	1.27	-	-	-	-
146	0.34569E 13	0.92319E 00	METAL H'HOLD FURN	3.46	-	-	-	-	-
211	0.32701E 13	0.92738E 00	ASBESTOS PRODUCTS	3.27	-	-	-	-	-
21	0.32484E 13	0.93154E 00	STONE CLAY MINING	3.24	-	-	-	-	-
303	0.29524E 13	0.93532E 00	WATER TRANSPORT	-	-	-	-	2.95	-
5	0.28964E 13	0.93903E 00	GAS UTILITIES	-	-	-	-	-	2.40
279	0.28419E 13	0.94267E 00	PUMPS COMPRESSORS	-	2.84	-	-	-	-
387	0.26888E 13	0.94611E 00	AUTO REPAIR	-	-	-	2.69	-	-
242	0.26227E 13	0.94947E 00	FAB PLATE WORK	-	2.62	-	-	-	-
313	0.25516E 13	0.95274E 00	WIRING DEVICES	-	-	2.55	-	-	-
218	0.22643E 13	0.95563E 00	IR, STL FOUNDRIES	-	2.26	-	-	-	-
380	0.21733E 13	0.95842E 00	REAL ESTATE	-	-	2.17	-	-	-
342	0.21042E 13	0.96111E 00	TEMP CONTROLS	-	2.10	-	-	-	-
167	0.19792E 13	0.96365E 00	CONV PAPER PRODUCT	1.98	-	-	-	-	-
183	0.17812E 13	0.96586E 00	PAVING	1.73	-	-	-	-	-
207	0.16731E 13	0.96801E 00	LIME	1.67	-	-	-	-	-
137	0.13604E 13	0.96975E 00	SPECIAL PRODUCT MILWK	1.36	-	-	-	-	-
17	0.12450E 13	0.97134E 00	AGR, FOR FISH SERVICE	-	-	-	1.25	-	-

(cont'd)

(cont'd)

TABLE 20- BREAKDOWN INTO CONSTRUCTION CATEGORIES: 1-FAMILY RESIDENTIAL

SECTOR 23 - NEW CONSTRUCTION RESIDENTIAL 1-FAMILY
RANKED TOTAL ENERGY REQUIREMENTS OF CONSTRUCTION SECTORS
(399 - ORDER, 1967)

BREAKDOWN OF TOTAL INPUTS INTO 1 FAM RES INTO BUILDING CONSTRUCTION CATEGORIES IN BTU x 10^{12}

399 - ORDER INDEX	TOTAL ENERGY (BTU)	CUMULATIVE FRACTION		GENERAL CONSTR.	MECH	ELEC	OVERHEAD	TRADE & TRANSPORT	DIRECT
130	0.11974E 13	0.97287E 00	APPARL, PURCH MAT	-	-	-	1.20	-	-
377	0.11818E 13	0.97439E 00	INSUR CARRIERS	-	-	-	1.18	-	-
151	0.11448E 13	0.97585E 00	WOOD FIXTURES	-	-	-	1.14	-	-
209	0.11049E 13	0.97727E 00	STONE PRODUCTS	1.10	-	-	-	-	-
15	0.99438E 12	0.97854E 00	FORS, GRHOUSE, NURS	.99	-	-	-	-	-
298	0.94877E 12	0.97976E 00	SWITCHGEAR	-	-	.95	-	-	-
174	0.89668E 12	0.98090E 00	MISC CHEM PROD	.89	-	-	-	-	-
215	0.88704E 12	0.98204E 00	NONCLAY REFRACT	.88	-	-	-	-	-
385	0.85425E 12	0.98313E 00	ADVERTISING	-	-	-	.85	-	-
366	0.82056E 12	0.98419E 00	AIR TRANSPORT	-	-	-	-	.82	-
369	0.79470E 12	0.98520E 00	COMMUNICATIONS	-	-	-	.79	-	-
394	0.79200E 12	0.98622E 00	NONPROFIT ORGAN	-	-	-	.79	-	-
358	0.74882E 12	0.98718E 00	HARD FLOOR COV	.75	-	-	-	-	-
182	0.63127E 12	0.98798E 00	MET FIXTURES	-	-	-	.63	-	-
213	0.62155E 12	0.98878E 00	TREATED MINERALS	.62	-	-	-	-	-
374	0.60947E 12	0.98956E 00	RANKING	-	-	-	.61	-	-
187	0.57955E 12	0.99030E 00	MISC RUBBER PRODUCTS	.58	-	-	-	-	-
185	0.48394E 12	0.99092E 00	TIRES	-	-	-	.48	-	-
397	0.43463E 12	0.99148E 00	ST, LOCAL GOVT ENTR	-	-	-	.48	-	-
325	0.40067E 12	0.99199E 00	ELECTRICAL EQUIPT	-	-	.40	-	-	-
286	0.36440E 12	0.99246E 00	MACH SHOP PROD	.36	-	-	-	-	-
220	0.35733E 12	0.99292E 00	PRIMARY METAL PROD	.36	-	-	-	-	-
360	0.34722E 12	0.99336E 00	SIGNS, ADS	-	-	-	.35	-	-
357	0.34604E 12	0.99380E 00	BRUSHES	-	-	-	.35	-	-
246	0.31750E 12	0.99421E 00	SCREW MACH PRODUCTS	.32	-	-	-	-	-
171	0.30982E 12	0.99461E 00	INORGAN-ORGAN CHEM	.31	-	-	-	-	-
371	0.29323E 12	0.99498E 00	WATER-SANIT SER	-	-	-	.29	-	-
10	0.28881E 12	0.99535E 00	FEEDS GRAINS	-	-	-	.29	-	-
113	0.27723E 12	0.99571E 00	BROAD FAB MILLS	-	-	-	.28	-	-
399	0.27067E 12	0.99605E 00	OFFICE SUPPLIES	-	-	-	.27	-	-
141	0.24151E 12	0.99636E 00	WOOD PRESERV	.24	-	-	-	-	-
210	0.24103E 12	0.99667E 00	ABRASIVE PROD	.29	-	-	-	-	-
307	0.22925E 12	0.99696E 00	ELECTRIC HARDWARES	-	-	-	.23	-	-
86	0.21380E 12	0.99724E 00	MAINT CONST. OTH NON FAR	-	-	-	.21	-	-
249	0.20768E 12	0.99750E 00	HANDTOOLS	-	-	-	.21	-	-
228	0.19586E 12	0.99775E 00	ALUM ROLLING	-	-	.20	-	-	-
395	0.17788E 12	0.99798E 00	POST OFFICE	-	-	-	.18	-	-
301	0.17401E 12	0.99820E 00	WELDING APPARATUS	-	-	-	.17	-	-
193	0.14394E 12	0.99839E 00	GLASS PRODUCTS	.14	-	-	-	-	-
212	0.12648E 12	0.99855E 00	GASKETS	.13	-	-	-	-	-
317	0.11809E 12	0.99870E 00	R-TV COMMUN EQUIPT	-	-	-	.12	-	-
321	0.10422E 12	0.99884E 00	STORAGE BATTERY	-	-	-	.10	-	-
266	0.10266E 12	0.99897E 00	CONVEYORS	-	-	-	.10	-	-
267	0.79372E 11	0.99907E 00	HOIST-CRANES	-	-	-	.08	-	-
308	0.79352E 11	0.99917E 00	H'HOLD VACUUM	-	-	-	.08	-	-
281	0.68369E 11	0.99926E 00	BLOWERS	-	.07	-	-	-	-
247	0.66922E 11	0.99934E 00	METAL STAMPINGS	.06	-	-	-	-	-
324	0.60133E 11	0.99942E 00	ENGINE ELECTRIC EQUIPT	-	-	.06	-	-	-
367	0.57424E 11	0.99949E 00	PIPE LINE TRANSPORT	-	-	-	-	.06	-
271	0.54868E 11	0.99956E 00	SPECIAL DIE TOOL	.03	-	-	-	-	-
158	0.52442E 11	0.99963E 00	ENVELOPES	-	-	-	.05	-	-
339	0.48028E 11	0.99969E 00	TRANSPORT EQUIPT	-	-	-	.05	-	-
302	0.44596E 11	0.99975E 00	CARBON PRODUCTS	.04	-	-	-	-	-
376	0.30120E 11	0.99979E 00	SEC, COMM BROKER	-	-	-	.03	-	-
297	0.29328E 11	0.99983E 00	TRANSFORMERS	-	-	.03	-	-	-
216	0.28088E 11	0.99986E 00	NONMETAL MIN PROD	.03	-	-	-	-	-
299	0.18761E 11	0.99989E 00	MOTORS, GENERATORS	-	-	.02	-	-	-
322	0.18429E 11	0.99991E 00	PRIMARY BATTERY	-	-	-	.02	-	-
311	0.17861E 11	0.99993E 00	ELECTRIC LAMPS	-	-	-	.02	-	-
361	0.17021E 11	0.99995E 00	MISC MANUF	-	-	-	.02	-	-
165	0.13710E 11	0.99997E 00	BOOK PUBLISHING	-	-	-	.01	-	-
125	0.13482E 11	0.99999E 00	CORDAGE, TWINE	-	-	-	.01	-	-
300	0.11531E 11	0.10000E 01	IND CONTROLS	-	-	.01	-	-	-
170	0.76688E 10	0.10000E 01	MISC PRINTING	-	-	-	.008	-	-
			TOTAL INPUTS (BTU x 10^{12})	517.87	84.03	14.65	23.71	109.72	30.98 = 780.96
			PERCENTAGE BREAKDOWN	66.32%	10.76%	1.85%	3.05%	14.05%	3.97%= 100%
				GENERAL CONSTR.	MECH	ELEC	OVERHEAD	TRADE & TRANSPORT	DIRECT

Average building costs do not have a separate category for Trade and Transport, so to make cost and energy categories consistent, we proportioned the Trade and Transport energy and added the results to General Construction, Mechanical and Electrical categories. Also, the average building cost of Overhead is a combination of overhead expense and the expense of direct fuel. Therefore, we added Overhead Energy and Direct Energy to make it consistent with costs.

When the margins (Trade and Transport) and the Direct Energy used on site are prorated among General Construction, Mechanical (Heating, Ventilating, Air Conditioning and Plumbing), Electrical and Overhead, the percentages are, respectively, 78.12; 12.67; 2.19; and 7.02. (Table 21)

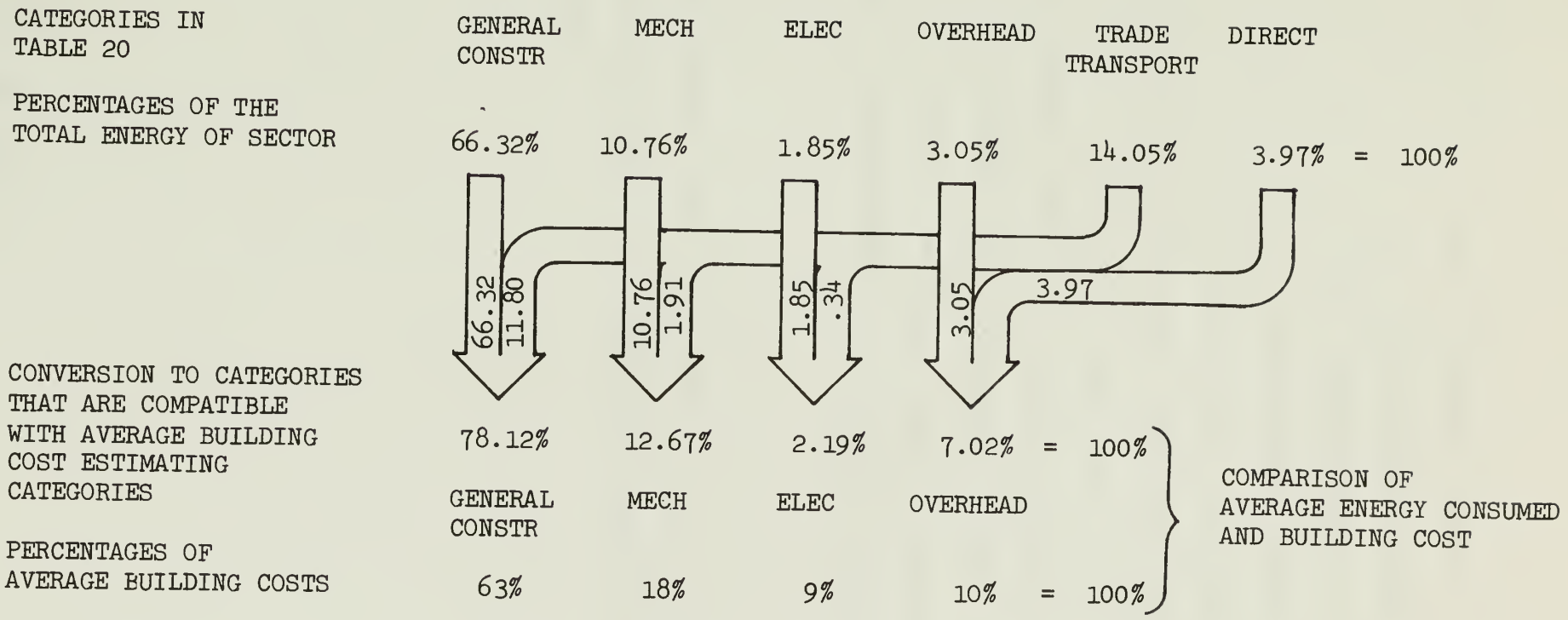
In contrast, the percentage divisions for average building costs in these categories are 63, 18, 9 and 10.*

The comparison shows the energy requirement for General Construction to be approximately 78 percent of the total. The average construction costs are approximately 63 percent of the total cost. The energy requirement for Mechanical and Electrical for 1-family residences add up to approximately 15 percent of the total, while the costs add up to approximately 27 percent.

These discrepancies can be explained by looking at the CAC figures for total energy intensity (Btu/$) of product (Appendix IV A, Table 34).

*"Average Building Costs," 1976 Dodge Construction Systems Costs,[2] pp 177 - 217.

TABLE 21 COMPARISON OF ENERGY CONSUMED AND BUILDING COSTS IN TYPICAL CONSTRUCTION CATEGORIES (1-FAMILY RESIDENCES)



General Construction consists of products with high Btu/$ figures (such as concrete, CAC # 206 - 180,130 Btu/$; asphalt, CAC # 184 - 478,610 Btu/$; cement, CAC #195 - 479,598 Btu/$), resulting in a higher Btu percentage than cost percentage. Moreover, these products are the larger primary building materials that provide the basic building structures and enclosures. Mechanical and Electrical, though, consist of products with relatively low Btu/$ figures (such as plumbing fittings, CAC #238 - 74,662 Btu/$; heating equipment, CAC #239 - 71,217 Btu/$; metal sanitware, CAC #237 - 98,392 Btu/$), resulting in a lower Btu percentage than cost percentage. Even where there is a high Btu/unit as in bathtubs, there are few units per job.

This level of detail can be developed for all new building categories, amplifying the bar graphs of energy input fractions* developed for the EBC Report.

*EBC Report pp. 26 - 33.

II C New Building Construction Versus Total Production

NEW BUILDING CONSTRUCTION ENERGY USE AS A PERCENT OF AN INDUSTRY'S TOTAL PRODUCTION ENERGY USE

Since one method of reducing energy in New Building Construction is to improve the energy efficiency of the industries producing the products, it is useful to know how much of the energy which goes into an industry's total production goes to the New Building Construction sector. Those with the largest percentages of products going into buildings are most affected by the economics of the building industry and will be most sensitive to cost pressures emanating from this sector.

The CAC categories that are included in these additional studies of energy embodiment in materials have been examined to determine this information (Table 22). The Input/Output Model records transactions to final demand, in this case, the contractor. Where a final sale may be to a homeowner or a plumber, as in the case of a bathtub, that product would not appear as either a dollar cost or energy cost to the new 1-family residence category. If concrete goes to road building or power plants, it will not appear in new building construction. Thus, of the categories studied, the one with the largest part of its output to new building construction is vitreous plumbing fixtures (77 percent) and the lowest is miscellaneous plastics - (8 percent). The dollar value of the miscellaneous plastics in the new building field, however, was $463 million compared to $115 million in vitreous plumbing fixtures. (All figures relate to 1967).

TABLE 22 NEW BUILDING CONSTRUCTION ENERGY USE AS PERCENT OF INDUSTRY'S TOTAL PRODUCTION ENERGY USE - 1967

CAC NO	SIC TITLE	CENSUS OF MANUFACTURES TOTAL $ (MILLIONS)	CAC BTU/$	TOTAL CONSUMPTION TOTAL $ x BTU/$ (BTU x 10^{12})	INPUT INTO NEW BLDG CONSTR (BTU x 10^{12})	% OF TOTAL PRODUCTION OF INDUSTRY (INPUT ÷ TOTAL CONSUMPTION)
160	BUILDING PAPER	317.9	189,900	60.37	30.99	51%
188	MISC PLASTICS	5,789.0	99,782	577.60	43.40	8%
199	STRUC CLAY PROD	137.1	259,790	35.62	12.94	36%
200	VITREOUS PLUMB FIXT	148.9	91.042	13.56	10.44	77%
205	CONCRETE PRODUCTS	1,147.5	108,490	124.49	48.74	39%
227	ROLLED COPPER	2,216.8	101,700	225.45	23.46	10%
230	NONFERROUS WIRE	3,650.9	91,433	333.81	75.85	23%
237	METAL PLUMB FIXT	213.1	98,392	30.71	15.81	75%
238	PLUMBING FITTINGS	404.6	74,662	30.21	20.49	68%
239	HEATING EQUIPMENT	954.6	71,217	67.98	34.66	51%
241	METAL DOORS & SASH	1,301.5	116.790	152.00	101.88	67%
242	FABRICATED PLATEWORK	2,589.4	104,910	271.65	41.31	15%
243	SHEET METALWORK	1,687.1	114,110	192.51	95.39	50%
245	MISC METALWORK	1,116.6	139,981	152.30	94.30	60%
310	H'HOLD APPLIANCES	510.2	82,264	41.97	6.14	15%
313	WIRING DEVICES	789.8	72,488	57.25	12.08	21%

IID Labor Intensities of Typical Assemblies

LABOR INTENSITY IN COMPARISON WITH ENERGY INTENSITY FOR COMPARABLE INTERCHANGEABLE ASSEMBLIES

There are two scales at which labor intensity for different materials, products and assemblies can be investigated. One of them is the macro-scale in which whole industries can be examined for the labor intensity per dollar of product. This has been done by CAC and has demonstrated that such activities as highway construction require considerably less labor per dollar of end product than does new building construction (in 1967, 0.8724×10^{-4} FTE per dollar of highway construction, 0.9477×10^{-4} FTE per dollar of new building construction, single family residences).* Maintenance and repair construction requires more labor per dollar than does new construction (0.3739×10^{-4} FTE per dollar of new construction average, 0.5501×10^{-4} FTE for maintenance and repair construction).** These figures are not surprising when one examines the activities that take place in each. For example, highway construction uses a large amount of heavy equipment such as bulldozers, scrapers, road graders, asphalt laying machines, cranes and various fleets of trucks, all very expensive construction equipment that is amortized against the construction costs. In addition, there is a large amount of material brought in and placed by very few men. These materials include concrete, reinforcing road mesh, asphalt, gravel, and steel. In contrast, the amount of labor

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*CAC Technical Memo 77,[3] Table 13, p. 66.

**Derived from Table 11 from CAC TM 77,[3] p. 62 for FTE values; EBC Table B1-5, p. 135 for dollar values.

time necessary both to manufacture the specialized components that are required in building construction, to deliver them to the site, to bring them to the proper part of the building assembly at the right time, and to fit and assemble them are all considerably more labor-intensive both off-site and on-site. In the case of maintenance and repair work, there is even more on-site labor per dollar of expenditure because of the careful and limited way in which material is either introduced into an existing building or selectively replaced.

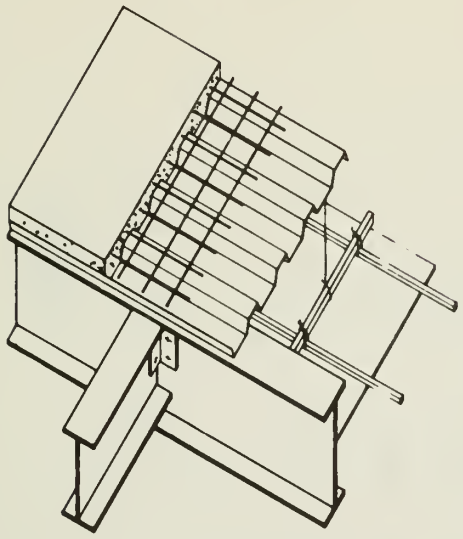
At the micro-scale, however, there are variations in energy use which may run counter to either preconceptions or the generalities of the larger scale energy use. The detailed examination of three inter-changeable structural methods of providing for 30 x 30 typical office bays indicates this. (Figure 2 and Table 23.) The energy intensivity of steel was the critical factor that made the steel assembly more energy intensive in toto than either a composite construction or the concrete waffle system.*

In comparing these alternatives, part of the process in which labor is introduced is quite different in each case. The steel system has 68 percent of its labor embodied in the material brought to the jobsite. This drops to 65 percent in the composite system and to 37 percent in the concrete system. Direct on-site labor, however, is less than a quarter of total labor in each of the steel systems, but over half, 56 percent, in the reinforced concrete system. The balance in each case is margin labor which amounts to about 10 percent.**

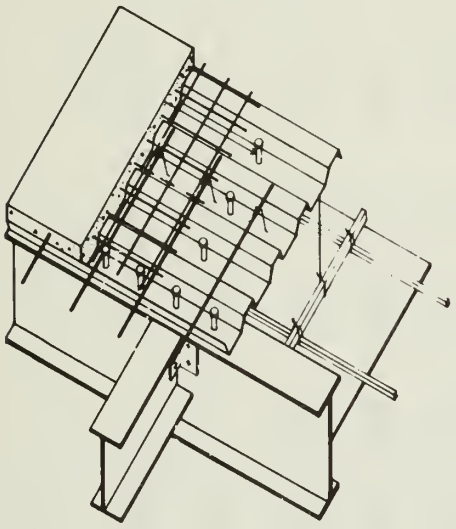
*EBC Report, pp. 89 - 91.

**For calculations, see Appendix IV B.

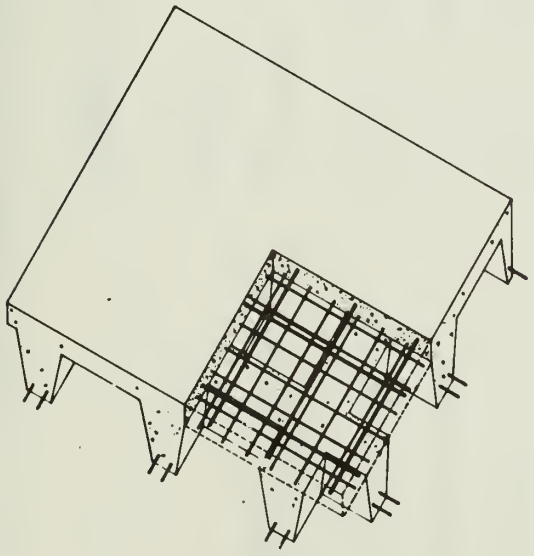
TYPICAL CONSTRUCTION



STANDARD STEEL SYSTEM

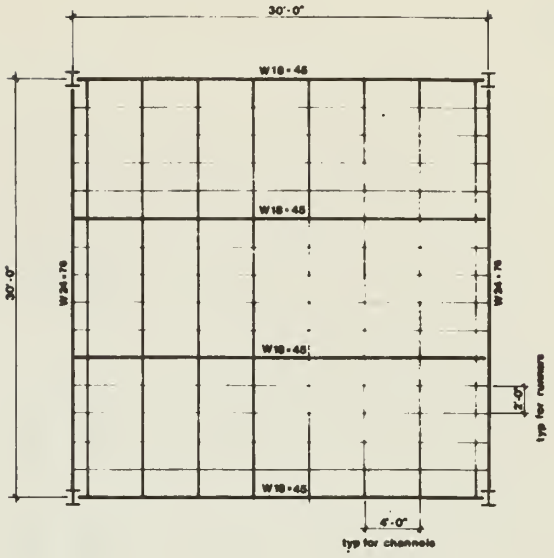


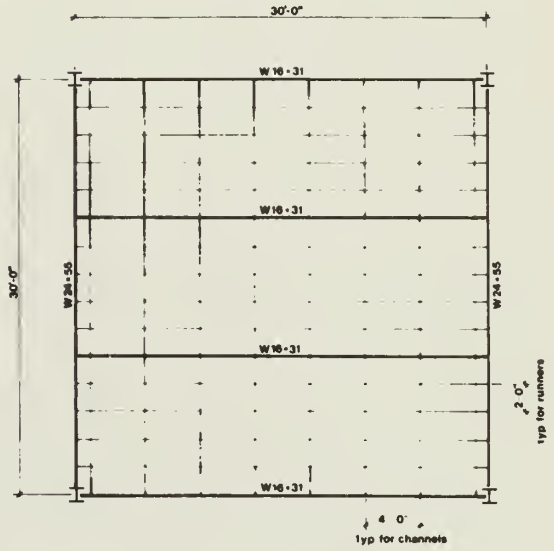
COMPOSITE STEEL SYSTEM

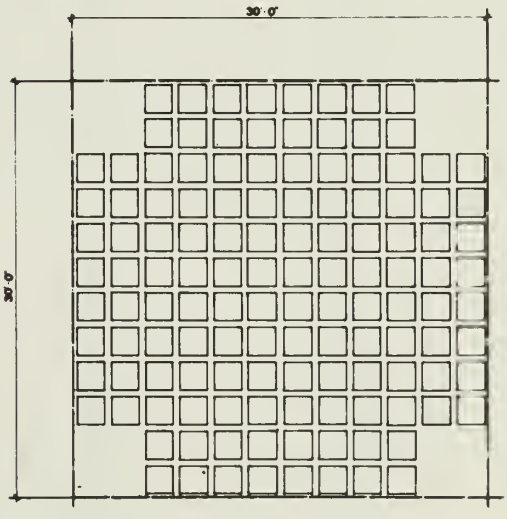


REINFORCED CONCRETE SYSTEM

FRAMING PLAN







CENTER FOR ADVANCED COMPUTATION University of Illinois Urbana IL 61801 and **RICHARD G. STEIN AND ASSOCIATES, ARCHITECTS** 588 Fifth Avenue New York NY 10036	**ENERGY IN BUILDING CONSTRUCTION** ERDA Contract No. E (11-1)-2791		date
	Subject Comparative Framing Methods 30 x 30 Bay	by **CAC** **RGS & A**	file Figure 2

TABLE 23 LABOR AND ENERGY IN COMPARATIVE ASSEMBLIES

	LABOR (man hours)*								Man hrs/ SF	ENERGY** Btu x 10^3/ SF
	Direct		Embodied		Margin		Total (900 SF)			
COMMERCIAL BUILDING BAYS (900 SF)	hrs	%	hrs	%	hrs	%	hrs	%		
Standard Steel	100.7	23%	303.0	68%	40.3	9%	444.0	100%	0.49	293
Composite Steel	95.5	17%	254.8	65%	42.6	11%	392.9	100%	0.44	250
Concrete	181.7	56%	118.9	37%	21.3	7%	321.9	100%	0.36	172
STUD WALLS (80 SF)							Total (80 SF)			
Wood Frame	8.2	47%	5.9	34%	3.4	19%	17.5	100%	0.22	32
Brick Veneer on Wood Frame	20.0	66%	8.0	26%	3.4	11%	30.5	100%	0.38	126

Note:

*For calculations, see Tables 35, 36, 73.
**See Fig. 6, 7, 8.

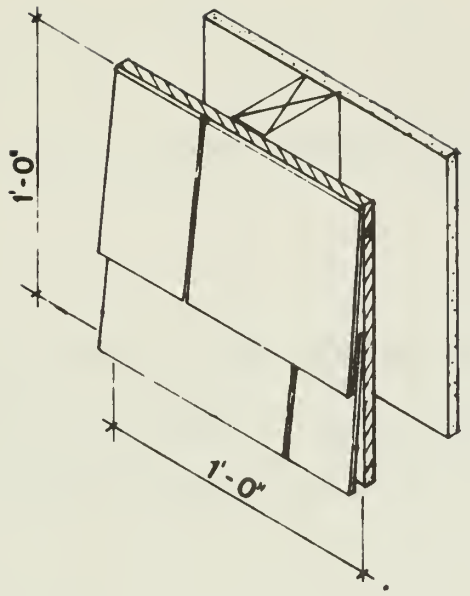
In comparing the brick veneer and the wood shingles on stud construction (Figure 3), brick veneer is the more energy intensive assembly, and is also more labor intensive. (Table 23.) In this case, it is because brick, which has a high energy component in its manufacture as a fired clay product, also has a high on-site labor cost since it is assembled in small units requiring a large component of labor. In this case, the total amount of labor required for the brick work is slightly higher in embodied labor than the shingles but more than twice as great for on-site labor which represents almost two-thirds of the total. In the case of the wood shingles, less than half is on-site labor and the margin labor represents 20 percent of the total.*

There are some generalities that can be derived from the data cited.

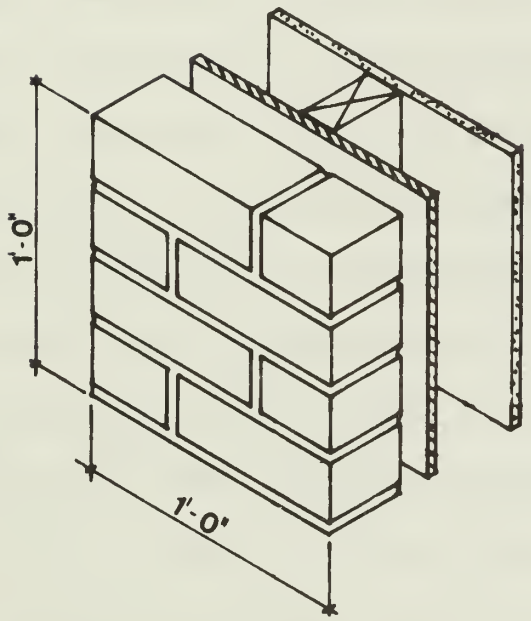
Visible on-site labor intensiveness should not be extrapolated to represent overall labor intensiveness. In one case (e.g. concrete construction), it may represent the bulk of labor required for the overall process. In another case, where components come to the jobsite ready for final assembly (e.g. steel construction), the low on-site labor is more than offset by labor-intensive multi-stage manufacturing.

The figures for embodied labor are national averages and do not account for differences from one manufacturer to another, or from one region to another. A brickyard using some individual kilns will require more labor than one completely equipped with tunnel kilns.

*See Appendix IV B for calculations.



WOOD FRAME WALLS



BRICK ON WOOD FRAME WALLS

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ENERGY IN BUILDING CONSTRUCTION
ERDA Contract No. E (11-1)-2791

date

Subject

Comparative Stud Wall Assemblies

by

CAC

RGS & A

Figure 3

The tendency in manufacturing is to substitute energy and mechanization for labor. This means, in general, manufacturers with new equipment and plants will use less labor per unit than older firms in the same industry.

The labor for the margins varies sharply from one example to the next. A factory close to its source of supply and its market will use much less labor for transportation than will a factory that is remote from both.

Within an industry, the more precisely a material is used to respond to a specific program requirement, the less energy will be used and the more labor. Less energy will be used because a smaller quantity of material will be required with savings going back through the entire production chain. There will often be an increase in labor but this is not always the case. If a material is highly labor intensive in its manufacturing process (as in the production of some metals that require mining, smelting, refining, alloying, shaping and fabrication with handling and shipment between each two steps) where for example 90 percent of the total labor required is embodied in the product, the on site labor could be trebled in order to reduce material by one-third and the result would be a 10 percent reduction in overall labor. In practice, these decisions are made in the marketplace. Economics

determines when it is more costly to put in a rolled steel beam section with no modifications than to use a lighter section and reinforce it with plates or stiffeners, using labor to cut down on weight (amount) of material, which cuts down the embodied labor.

With the cost of energy rising rapidly, a reduction in the amount of material used now represents the saving of the cost of the embodied labor plus the cost of the embodied energy in the material eliminated.

IIE Direct Energy Consumption

DIRECT ENERGY CONSUMPTION

For a more complete understanding of the way new building construction uses energy, it is necessary to examine the sector responsible for the largest single usage in 1967, Direct Energy.

By definition, the Direct Energy consumption of the construction industry is the energy consumed on the job site during the construction process. It is made up of sales from the energy-producing industries directly to the end user, the building contractor. In the CAC model the energy sectors are classified as:

Coal

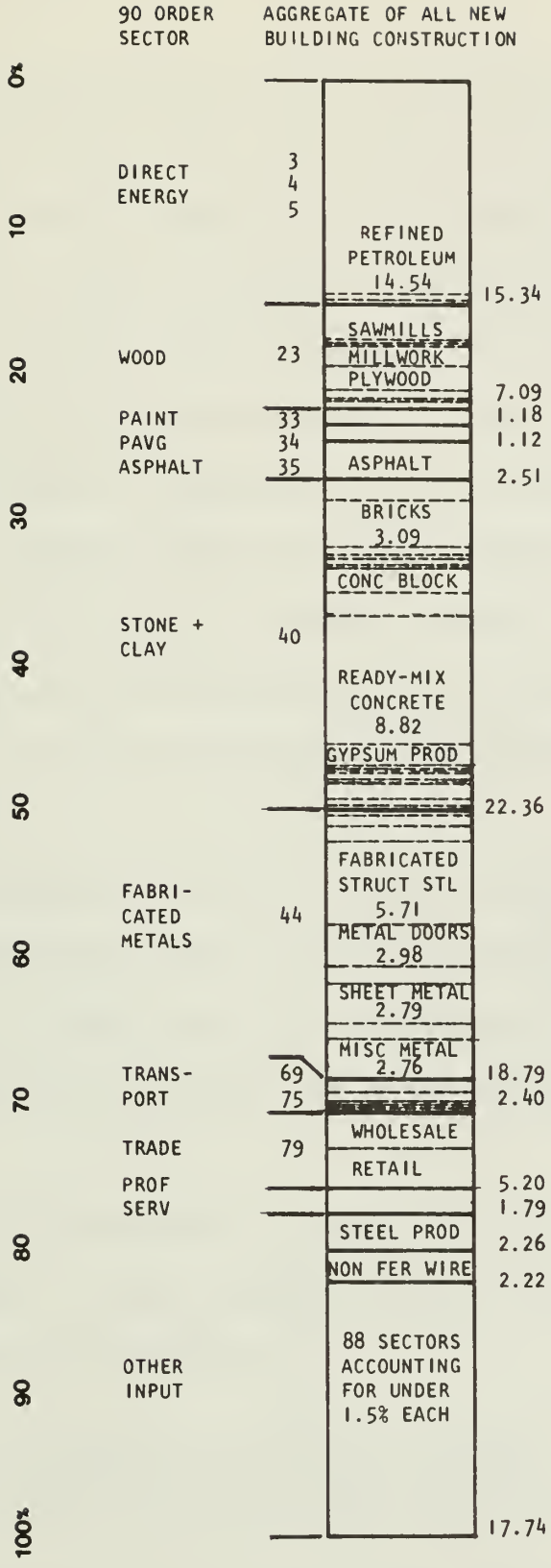
Crude Petroleum

Refined Petroleum

Electricity

Natural Gas

Of those sectors, neither Coal nor Crude Petroleum sells directly to New Building Construction. Most of the energy consumed in 1967 for New Building Construction was purchased from Refined Petroleum products (14.54 percent) while Electricity and Natural Gas together provided only a small amount (0.80 percent). Thus, Direct Energy consumption accounted for 15.34 percent of all the energy consumed for New Building Construction (Figure 4).



AGGREGATE OF ALL NEW BUILDING CONSTRUCTION

Source: EBC Report, p. 25

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ENERGY IN BUILDING CONSTRUCTION
ERDA Contract No. E (11-1)-2791

date 30 Dec 76

Subject: Energy Input Fractions By Construction Sector

by: CAC, RGS & A

Figure 4

Refined Petroleum includes all the products from petroleum refineries, including gasoline, diesel fuel, No. 6 oil, asphalt, road oil, propane (liquefied petroleum gases), etc. Of these, in 1967, Asphalt and Road Oil products,* which are used as construction materials, represented the largest portion (58.90 percent) of the energy (Btu) purchased from Refined Petroleum by New Building Construction (Figure 5). If these paving materials are separated from other direct energy, they become the second largest category of energy embodied in New Building Construction (8.57 percent), and Direct Energy (excluding asphalt) then drops to the third ranking position (6.77 percent). (Ready-mix Concrete is first and accounts for 8.82 percent.)

Table 24 summarizes the use of refined petroleum according to petroleum product and building type, listing the amount of each product used in 1967 by each type, in Btu. The method used for developing this tabulation is explained in Section IV C, the Disaggregation of Refined Petroleum.

In all, the direct energy for asphalt and road oil constitutes 57 percent of the total, an amount representing the latent energy content** of these refined petroleum products.

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*Asphalt incorporated in building materials such as asphalt shingle roofing or asphalt tile flooring is reported as embodied energy under Asphalt Products, EBC Report, Table B7, p. 47.

**It must be remembered that the energy content of the asphalt (158,000 Btu/gallon equivalent - Table 4) is still latent in the material after it has been placed, just as road oil may be No. 6 oil that is spread on gravel as a binder rather than being burned to release its energy content as heat.

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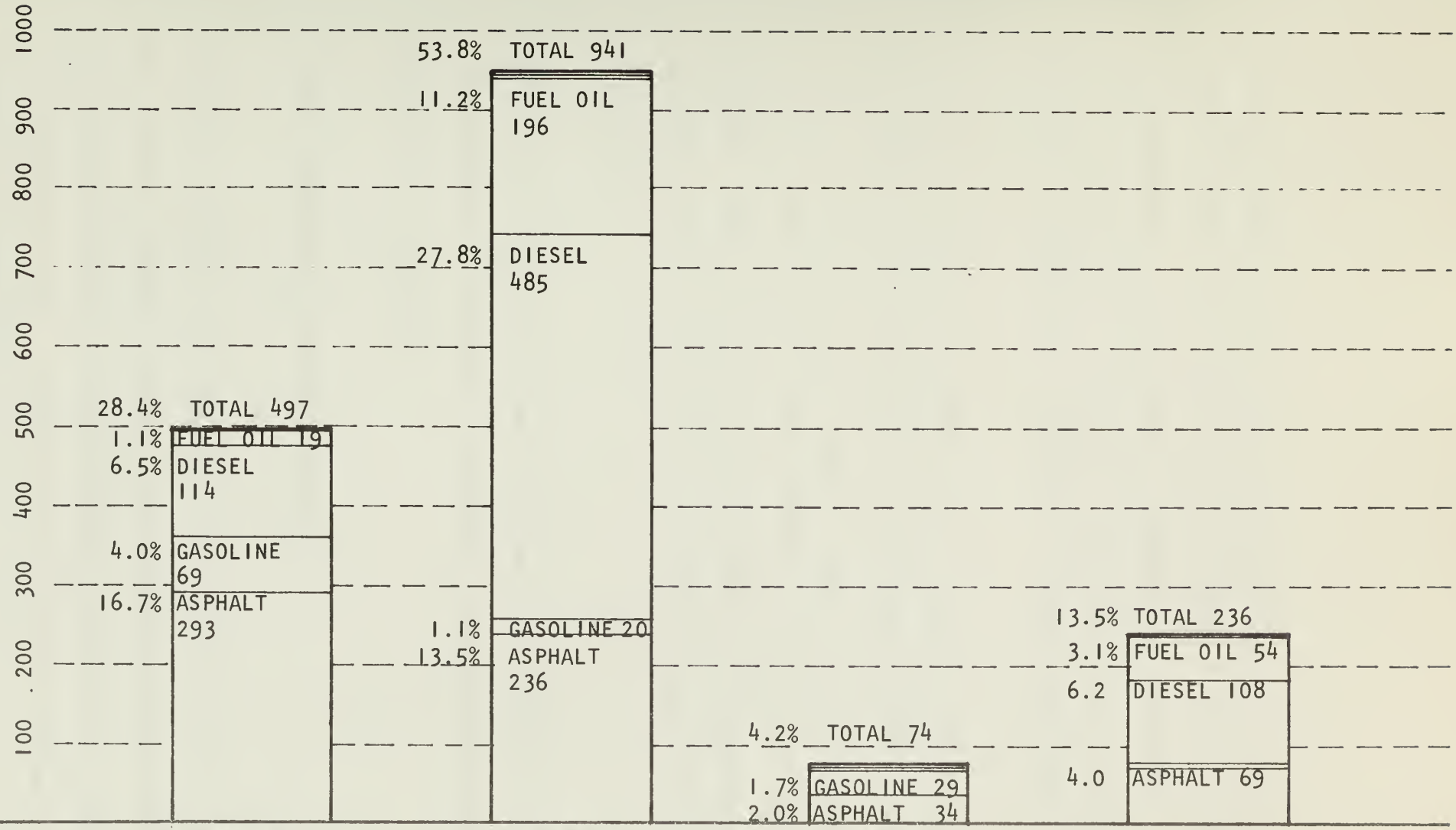
ERDA Contract No. E (11-1)-2791

Subject
Analysis of Refined Petroleum Consumption

by
CAC
RGS & A

date



Percentages are of Total Construction Industry Consumption of Refined Petroleum Products (1748×10^{12} BTU)

Figure 5

REFINED PETROLEUM CONSUMPTION - 1967

The next largest refined petroleum product used is diesel fuel, the fuel for large trucks, earth-moving equipment and other heavy construction equipment. It accounts for an additional 20 percent, almost entirely in New Construction. The sectors reporting the greatest use of diesel fuel are the Educational, Industrial and Office Buildings.

Gasoline accounts for an additional 17½ percent, about two-thirds in New Construction and one-third in Maintenance and Repair categories. Almost a third of the total gasoline usage is for the Residential 1-Family sector, a total usage of almost 250 million gallons, or 160 gallons per building. This is for the pick-up trucks, the contractor's business vehicles, and does not include the personal transportation of those working on the job.

Fuel Oil and Liquid Petroleum Gases used for temporary heat during construction and for heat in construction shanties and field offices accounts for 5 percent.

A minor amount is used for lubricants.

Tables 25 through 31 tabulate the use of direct energy (both including and excluding asphalt), asphalt, and refined petroleum (both including and excluding asphalt) in New Building Construction in 1967, according to construction types. Figures are derived from information shown on Table 43 in Appendix IV C.

TABLE 24 SUMMARY BREAKDOWN OF REFINED PETROLEUM USAGE PER BUILDING SECTOR IN TRILLION BTU (Btu x 10^{12}) (IN 1967)

399 ORDER SECTOR	BUILDING TYPE	ASPHALT & ROAD OIL	GASOLINES GAS	GASOLINES DIESEL	FUEL OIL	LIQ PETROL GASES	LUB OILS	TOTAL
23	Residential 1-Family	55.38	31.41	-	1.82	-	0.05	88.66
24	Residential 2- to 4-Family	3.52	0.54	1.27	-	-	-	5.33
25	Residential Garden Apts	17.28	2.01	5.19	0.53	-	0.02	25.03
26	Residential Highrise Apts	13.92	2.29	6.12	0.28	-	0.02	22.63
27	Residential Add'n & Alt	5.09	2.17	-	1.42	-	0.02	8.70
28	Hotel/Motel	8.72	1.46	3.78	-	-	0.02	13.98
29	Dormitories	7.50	1.28	3.45	0.27	-	0.02	12.52
30	Industrial Buildings	20.44	3.17	14.47	5.68	0.93	0.13	44.82
31	Office Buildings	31.68	5.38	14.41	0.85	0.97	0.08	53.37
32	Warehouses	4.09	0.50	2.22	0.75	-	0.02	7.58
33	Garage/Service Stations	3.48	0.65	1.54	0.27	-	-	5.94
34	Stores/Restaurants	25.04	4.88	11.58	1.66	-	0.08	43.24
35	Religious Buildings	7.31	0.70	4.52	0.57	-	0.02	13.12
36	Educational Buildings	46.59	4.10	26.46	1.13	-	0.08	78.36
37	Hospitals	14.03	0.74	7.63	-	-	-	22.40
38	Other Non-Farm	26.93	4.90	13.04	1.98	-	0.08	46.93
48	Farm Residential	0.84	0.49	-	0.25	-	-	1.58
49	Farm Service	1.14	1.17	-	0.83	-	0.02	3.16
	Sub-Total New Building	292.98	67.84	115.68	18.29	1.90	0.66	497.35
	Percentages New Building	58.9%	13.6%	23.3%	3.7%	0.4%	0.1%	100.00%
55	M + R Residential	15.78	9.42	-	-	0.72	-	25.92
56	M + R Non-Residential	15.94	19.08	1.29	7.26		0.17	43.74
57	M + R Farm Residential	1.37	0.85	-	-	-	-	2.22
58	M + R Farm Service	1.38	0.24	-	0.60	-	-	2.22
	Sub-Total M + R	34.47	29.59	1.29	7.86	0.72	0.17	74.10
	Percentages M + R	46.6%	39.9%	1.7%	10.6%	1.0%	0.2%	100.00%
	TOTAL	327.45	97.43	116.97	26.15	2.62	0.83	571.45
	PERCENTAGES	57.3%	17.0%	20.5%	4.6%	0.5%	0.5%	100.00%

Table 25 describes the use of direct energy in New Building Construction (including asphalt) and indicates the percent, the total amount in Btu, and the amount per square foot used by each building type. It also shows the total direct energy used by New Building Construction.

Table 26 tabulates the percentage of each building type's total energy use expended in the form of direct energy.

Table 27 looks at the direct energy use in the New Building sectors, excluding asphalt, and lists the total amount in each building type in Btu, and the total Btu for the entire New Building sector, and then notes the percentage of this total represented by each building type as well as the Btu per square foot. More than half the total use (54.47 percent) is through the first four categories: Residential 1-Family (17.24 percent), Educational (15.59 percent), Industrial (11.09 percent), and Office Buildings (10.55 percent).

Table 28 lists and ranks the Asphalt and Road Oil; and Table 29, the Direct Refined Petroleum use, by building type, as well as recording Btu per square foot for these uses. The figures for direct energy per square foot (excluding asphalt) in Table 27 includes the amounts of direct refined petroleum (which is the major component of the direct energy) use per square foot (excluding asphalt) in Table 29.

Table 30 lists the Asphalt and Road Oil used by each building sector as a percentage of that sector's total energy use. Dormitories has the highest percentage (13.32 percent) and Industrial Buildings the lowest (4.41 percent) of the Non-Farm New Building types.

TABLE 25 TOTAL DIRECT ENERGY CONSUMPTION IN NEW BUILDING CONSTRUCTION
(Ranked Order of New Building Construction Types)

RANKED ORDER	399 ORDER SECTOR	BUILDING TYPE	DIRECT ENERGY CONSUMPTION % of Total Direct Energy	Btu x 10^{12}	Btu/SF
1	23	Residential 1-Family	18.15	95.42	85,778
2	36	Educational Buildings	15.75	82.75	262,282
3	31	Office Buildings	10.69	56.20	356,599
4	38	Other Non-Farm	9.36	49.20	308,657
5	30	Industrial Buildings	8.79	46.20	96.957
6	34	Stores/Restaurants	8.65	45.49	219,637
7	25	Residential-Garden Apts	4.95	26.02	114,173
8	26	Residential-Highrise Apts	4.56	23.97	149,532
9	37	Hospitals	4.52	23.78	349,192
10	28	Hotel/Motel	2.95	15.51	253,431
11	35	Religious Buildings	2.61	13.74	251,648
12	29	Dormitories	2.49	13.10	324,257
13	27	Residential-Add'n & Alt	1.75	9.20	-
14	32	Warehouses	1.54	8.08	78,068
15	33	Garages/Service Stations	1.21	6.34	151,675
16	24	Residential 2- to 4-Family	1.09	5.72	102,693
17	49	Farm Service	0.62	3.25	8,370
18	48	Farm Residential	0.32	1.66	30,459
		TOTAL DIRECT ENERGY IN NEW BUILDING CONST	100.0	525.63	

TABLE 26 ENERGY INPUT FRACTIONS IN TOTAL DIRECT ENERGY WITHIN NEW BUILDING CONSTRUCTION TYPES
(In Ranked Order)

RANKED ORDER	399 ORDER SECTOR	BUILDING TYPE	% of Total Sector Energy In Direct Energy
1	34	Stores & Restaurants	23.09
2	29	Dormitories	22.66
3	28	Hotels/Motels	22.46
4	31	Office Buildings	21.73
5	38	Other Non-Farm	21.29
6	26	Highrise Apartments	20.32
7	37	Hospital Buildings	20.29
8	35	Religious Buildings	20.03
9	33	Garages & Service Stations	19.67
10	36	Educational Buildings	18.92
11	25	Residences-Garden Apartments	17.61
12	24	Residences 2- to 4-Family	16.42
13	32	Warehouses	13.98
14	23	Residences 1-Family	12.22
15	30	Industrial Buildings	9.97
16	49	Farm Service Buildings	5.62
17	48	Farm Residences	5.49
18	27	Residences-Alts & Add'n	4.24

TABLE 27 DIRECT ENERGY CONSUMPTION IN NEW BUILDING CONSTRUCTION (Excluding Asphalt)
(Ranked Order of New Building Construction Types)

RANKED ORDER	399 ORDER SECTOR	BUILDING TYPE	DIRECT ENERGY CONSUMPTION (excl. asphalt) % of Total Direct Energy (excl. asphalt)	Btu x 10^{12}	Btu/SF
1	23	Residential 1-Family	17.24	40.04	35,994
2	36	Educational	15.59	36.20	114,739
3	30	Industrial	11.09	25.76	54,061
4	31	Office	10.55	24.50	155,457
5	38	Other Non-Farm	9.60	22.29	139,837
6	34	Store/Restaurant	8.81	20.47	97,802
7	37	Hospital	4.20	9.75	143,172
8	26	Residential-Highrise Apts	3.76	8.74	54,523
9	25	Residential-Garden Apts	3.76	8.74	38,350
10	28	Hotel/Motel	2.92	6.79	110,948
11	35	Religious	2.77	6.43	117,766
12	29	Dormitories	2.33	5.40	133,663
13	27	Residential-Add'n & Alt	1.77	4.11	-
14	32	Warehouse	1.65	3.84	37,101
15	33	Garage/Service Stations	1.23	2.85	68,182
16	24	Residential 2- to 4-Family	0.95	2.20	39,497
17	49	Farm Service	0.86	2.00	5,151
18	48	Farm Residential	0.35	0.82	15,046
		TOTAL DIRECT ENERGY (Excluding Asphalt) IN NEW BUILDING CONSTRUCTION	100.0	232.24	

TABLE 28 ASPHALT CONSUMPTION IN NEW BUILDING CONSTRUCTION
(Ranked Order of New Building Construction Types)

RANKED ORDER	399 ORDER SECTOR	BUILDING TYPE	ASPHALT CONSUMPTION % of Total Asphalt	Btu x 10^{12}	Btu/SF
1	23	Residential 1-Family	18.88	55.38	49,784
2	36	Educational Buildings	15.87	46.55	147,544
3	31	Office Buildings	10.80	31.70	201,142
4	38	Other Non-Farm Buildings	9.17	26.91	168,821
5	34	Stores/Restaurants	8.53	25.02	119,541
6	30	Industrial Buildings	6.97	20.44	42,896
7	25	Residential-Garden Apts	5.89	17.28	75,823
8	37	Hospitals	4.78	14.03	206,021
9	26	Residential-Highrise Apts	4.74	13.92	86,837
10	28	Hotel/Motel	2.92	8.72	142,484
11	29	Dormitories	2.62	7.70	190,594
12	35	Religious Buildings	2.49	7.31	133,883
13	27	Residential-Add'n & Alt	1.73	5.09	-
14	32	Warehouse	1.45	4.24	40,966
15	24	Residential 2- to 4-Family	1.20	3.52	63,196
16	33	Garage/Service Stations	1.19	3.49	83,493
17	49	Farm Service	0.43	1.25	3,219
18	48	Farm Residential	0.29	0.84	15,413
		TOTAL ENERGY IN ASPHALT CONSUMPTION	100.0	293.39	

TABLE 29 DIRECT REFINED PETROLEUM CONSUMPTION IN NEW BUILDING CONSTRUCTION (Excl Asphalt
(Ranked Order of New Building Construction Types)

RANKED ORDER	399 ORDER SECTOR	BUILDING TYPE	REFINED PETROLEUM CONSUMPTION (Excluding Asphalt) % of Total Refined Petroleum (Excl Asphalt)	Btu x 10^{12}	Btu/SF
1	23	Residential 1-Family	16.26	33.28	29,917
2	36	Educational Buildings	15.54	31.81	100,824
3	30	Industrial Buildings	11.91	24.38	51,165
4	31	Office Buildings	10.59	21.67	137,500
5	38	Other Non-Farm Buildings	9.78	20.02	125,596
6	34	Store/Restaurant	8.90	18.21	87,004
7	26	Residential-Highrise Apts	4.25	8.71	54,336
8	37	Hospital	4.09	8.37	122,907
9	25	Residential-Garden Apts	3.78	7.74	33,962
10	28	Hotel/Motel	2.89	5.91	96,569
11	35	Religious Buildings	2.84	5.81	106,410
12	29	Dormitories	2.35	4.82	119,307
13	27	Residential-Add'n & Alt	1.76	3.61	-
14	32	Warehouse	1.69	3.45	33,333
15	33	Garage/Service Stations	1.76	3.61	-
16	49	Farm/Service	0.94	1.92	4,945
17	24	Residential 2- to 4-Family	0.88	1.81	32,496
18	48	Farm Residential	0.36	0.74	13,578
		TOTAL ENERGY IN DIRECT REFINED PETROLEUM CONSUMPTION	100.0	204.72	

TABLE 30 ENERGY INPUT FRACTIONS IN ASPHALT
(Ranked Order of New Building Construction Types)

RANKED ORDER	399 ORDER SECTOR	BUILDING TYPE	% of Total Sector Energy in Asphalt
1	29	Dormitories	13.32
2	34	Stores/Restaurants	12.70
3	28	Hotel/Motel	12.63
4	31	Office Buildings	12.26
5	37	Hospital Buildings	11.97
6	26	Residential-Highrise Apts	11.80
7	25	Residential-Garden Apts	11.69
8	38	Other Non-Farm Buildings	11.65
9	33	Garage/Service Stations	10.83
10	35	Religious Buildings	10.65
11	36	Educational Buildings	10.64
12	24	Residential 2- to 4-Family	10.11
13	32	Warehouses	7.34
14	23	Residential 1-Family	7.09
15	30	Industrial Buildings	4.41
16	48	Farm Residence	2.78
17	27	Residential-Add'n & Alt	2.35
18	49	Farm Service Buildings	2.16

Table 31 lists the Non-Asphalt Direct Energy use in the same manner as Table 30 lists the Asphalt. In this listing, Stores and Restaurants leads with 10.39 percent with Residential 1-Family being at the low end with 5.17 percent.

An analysis of the use of direct energy in the construction industry indicates that the Non-Building sectors used about two-thirds the total direct energy and the Building sectors only one-third.

Asphalt, however, was used more in the Building sectors than in the Non-Building sectors (327.76 trillion Btu versus 305.73 trillion Btu*). In the Building sectors, the greatest amount of asphalt was used in New Buildings (293.39 trillion Btu*) and in the New Building category the greatest amount was used in Residential 1-Family construction (55.38 trillion Btu or 18.88 percent**) followed by Educational construction (46.55 trillion Btu or 15.87 percent**).

The high use of asphalt in all direct energy categories is explainable as a by-product of our enormously expanded automobile usage. Stores and Restaurants are now largely synonymous with the suburban shopping center, an island of building in a sea of asphalt. The Residential 1-Family category, representing 30 percent of the total square footage

*Figures are compiled from data included in Table 43.

**Table 28.

TABLE 31 ENERGY INPUT FRACTIONS IN DIRECT ENERGY (Excluding Asphalt)
(Ranked Order of New Building Construction Types)

RANKED ORDER	399 ORDER SECTOR	BUILDING TYPE	% of Total Sector Energy in Direct Energy (Excluding Asphalt)
1	34	Stores/Restaurants	10.39
2	28	Hotels/Motels	9.83
3	38	Other Non-Farm	9.65
4	31	Office Buildings	9.47
5	35	Religious Buildings	9.37
6	29	Dormitories	9.34
7	33	Garage/Service Stations	8.84
8	37	Hospitals	8.32
9	36	Educational Buildings	7.65
10	26	Highrise Apartments	7.41
11	32	Warehouses	6.65
12	24	Residential 2- to 4-Family	6.32
13	25	Residential Garden Apts	5.91
14	30	Industrial Buildings	5.56
15	23	Residential 1-Family	5.17
16	49	Farm Service	3.46
17	48	Farm Residential	2.71
18	27	Residential-Add'n & Alt	1.90

of new building has its ubiquitous asphalt driveway.

In considering the shopping center, most zoning ordinances require between 2 and 3 square feet of parking for every square foot of mercantile space.* Asphalt paving used in Residential 1-Family construction, the largest single quantity of energy in all new building construction, accounted for 10.54 percent of all direct energy consumption in new building construction and 1.62 percent of its total energy consumption.

Acknowledging that asphaltic concrete paving is an excellent paving material because of its resiliency, it is nevertheless appropriate to consider alternative pavings for the Residential 1-Family sector, where other solutions may be equally acceptable. Since we are faced with a growing scarcity of oil, it may be especially desirable to divert petroleum into more essential uses, employing asphaltic concrete only where it is clearly necessary.

Table 32 compares four alternatives for a typical Residential 1-Family driveway considering energy, labor, and costs, all of which must be examined to select an alternative. The base condition, asphalt, requires 24.3 million Btu, 34 man hours and $420. In comparing this with concrete, concrete strips and brick, two strips of concrete would requaire 6.1 million Btu, 8 man hours and $280. For 1½ million one-family houses,

*The recommended standard of 5.5 spaces per 1,000 square feet of GLA (gross leasable area) is equivalent to a parking ratio of 2.2 square feet of parking area for one square foot of gross leasable area, p. 341, The Community Builders Handbook, Urban Land Institute, Washington, DC, 1968.

TABLE 32 ALTERNATIVES FOR TYPICAL RESIDENTIAL DRIVEWAY
(10' wide x 45' long)

Material	Energy ($Btu \times 10^6$)	Labor (man hours)	Cost (1977 $)
Asphalt (1)	24.3	34	$ 420
Concrete (2)	20.3	27	930
Concrete strips (2)	6.1	8	280
Brick (3)	69.1	60	1,280

Notes:

(1) Asphalt

Material - Mix by weight: 6% asphalt, 94% aggregate (Civil Engineering Handbook); 1 ton of asphalt = 235 gallons (Asphalt Institute); 1 CF of asphaltic concrete = 145 lbs (Asphalt Institute); 1 gallon of asphalt = 158,100 Btu (EBC Supplement, Table 5).
Therefore, 1 lb of asphalt = 18,577 Btu and 1 CY of asphalt concrete = 4,363,740 Btu.
4" thick driveway = 5.56 CY.

Labor and cost - Applied in two layers (1977 Dodge Manual)
top course, 1½" = 0.27 man hours/SY & $5.00/SY
base course, 2½" = 0.40 man hours/SY & $3.37/SY
Total, 4" = 0.67 man hours/SY & $8.37/SY

(2) Concrete

Material - 1 CY ready mix concrete = 2,594,338 Btu/CY (EBC p. 50); 1 lb welded wire mesh = 24,187 Btu (EBC p. 55); 6 x 6 x 10/10 mesh = 21 lb/CSF (conc. Reinf. Stl. Institute Design Handbook); 5" thick conc. driveway = 6.94 CY of conc. and 94.5 lb of mesh; 2 - 18" strips 5" thick = 2.08 CY of conc. and 28.35 lb of mesh.

Labor and cost - 5" thick reinf. conc. paving = 0.54 man hours/SY and $18.63/SY (1977 Dodge Manual).

(3) Brick

Material - Brick on edge = 6 bricks/SF; ea brick = 25,582 Btu (EBC p. 49).

Labor and cost - Brick set in sand = 1.20 man hours/SY and 25.65/SY (1977 Dodge Manual).

this would represent a saving of about 4.5 million barrels of oil per year.

In the non-asphalt uses of refined petroleum as direct energy, the greatest expectation for reductions must be directed toward a conservationist attitude on the part of the building industry workers - partially stimulated by increasing costs of fuel - and toward the introduction of automotive equipment that produces more mileage per gallon. The target area is significant from a national perspective. Gasoline used as direct fuel represents about 14 percent of the 15.34 percent of Direct Energy in New Building Construction which, in turn was 5.11 percent of all national energy use in 1967, or over 0.1 percent of all energy used.

III CONCLUSIONS

CONCLUSIONS

This report is a supplement to the report, Energy Use for Building Construction, December 1976 prepared by Richard G. Stein and Associates, Architects and the Energy Research Group at the Center for Advanced Computation at the University of Illinois, December 1976. The purpose of this supplementary study has been to fill in additional detail in some areas of the EBC Report and to examine how the labor component in building construction relates to the energy requirements. The conclusions can be summarized as follows:

1. The studies on energy embodiment per unit of material were extended. The unit energy required for a number of additional materials, components and assemblies was added to the units contained in the EBC Report. These additional materials included insulating board, asphalt, plastic products, plumbing fixtures, plumbing fittings, copper piping and wiring, aluminum piping and wiring, heating components, hot water heaters, metal doors and windows, metal roofing and siding, fabricated metals and structural materials other than steel sections, and electrical equipment. With these additions it is now possible to develop energy estimates of complete buildings.

   In examining one building type, one-family residences, we found that 78 percent of the total energy expenditure is in those

trades listed as general construction with 15 percent in the mechanical and electrical trades. The remainder is in direct energy, expended on the job site. In dollar costs, the general construction averages about 63 percent of the total cost and the mechanical and electrical require 27 percent. The balance represents the contractors' on-site costs and overhead. The information on energy per unit of product is presented in enough detail to permit extrapolations for most building energy estimating purposes. It is now suitable for use as the basic framework of a computer-based energy estimating data bank. The units used are those used for dollar estimating in the construction fields and the format would permit the immediate utilization of a quantity survey of the proposed building for either dollar estimating or energy estimating with no change in format. As with dollar estimating, when such an energy estimating program is set up, it can be constantly expanded and supplemented with more detail and can follow changed conditions in the industry; however, it would not require the constant up-dating of a dollar estimating format since it is not subject to inflation, but only to changes in manufacturing technology, shipping patterns and methods.

2. The EBC Report of December 1976 compared the energy requirement of three interchangable assemblies for structural bays in a typical high-rise office building. Also, two wood frame wall

assemblies were compared, one with wood shingle finish and one with brick finish, with similar thermal performance characteristics. The present study includes a labor comparison of each of these and relates the labor requirements to the energy requirements. In both cases, the assembly with the higher energy content was also the one with the higher labor content. Steel with a high energy content also has a high labor content per unit, resulting from the many steps in the process of mining, refining, and fabrication. More than three-quarters of the labor in steel is embodied in the material and in the margins by the time it is delivered to the job site. The pattern in concrete is quite different with more than half the labor expended on the job site, in the process of placing the concrete. In comparing brick veneer, and wood shingles in frame construction the high energy requirement for the firing of the bricks made this an extremely energy intensive assembly. The handling of the bricks both in the manufacturing process and in their incorporation in the building are both done with a good deal of hand labor. The result is that brick masonry is high both in energy and labor.

These studies indicate the importance of making detailed studies rather than accepting generalities. According to the overall statistics of the construction industry, such building activities as repair and modernization are more labor intensive but less energy intensive per dollar than new construction. Further,

when the construction industry reduces the amount of material by using it more precisely in building, the labor requirement increases but the embodied energy is decreased.

It becomes necessary to separate two aspects of labor use in building. The first is in comparing different construction practices in the use of the same construction material, in one case used non-specifically with a minimum of labor, in the other case, used more precisely but with more labor. The second deals with the substitution of one material and technique for another. This requires a detailed and specific study of different components and assemblies, all meeting the same performance criteria to determine which are least energy-intensive. The marketplace determination of the costs will reflect both the energy and the labor. As energy costs escalate, those components that are energy intensive will have a steeper rise in their price per unit. Where a process is labor intensive, the cost of labor will probably be decisive. The interplay between labor costs and energy costs will determine the changing market position of each assembly.

3. The direct energy used in new building construction has been examined in greater detail. The category, Direct Energy, represents the energy content of those energy materials consumed directly on the job site. The five components, coal, crude petroleum, refined petroleum natural gas, and electricity

together are the single largest energy-using category among the energy input fractions recorded. In examining Direct Energy it was noted in the EBC Report that the great preponderance - almost 97 percent - is in the refined petroleum category. This category includes asphalt and road oil delivered to the job for driveways, parking areas, pavings and similar uses. Asphalt use in itself represents 56 percent of all direct energy use. Of this total asphalt use, Single Family Residences, representing 30 percent of the square footage built, are responsible for about 19 percent of the asphalt used. Educational Buildings, representing only 8.6 percent of the total square footage are responsible for about 16 percent of the asphalt use. Office Buildings, representing 4.3 percent of the square footage use about 11 percent; and Other Non-Farm buildings representing 4.3 percent of construction require over 9 percent of the asphalt usage. Stores and Restaurants, representing less than 6 percent of the total square footage, require more than 8 percent of the total asphalt.

All of the asphalt road uses can be reexamined from several different angles. First, is the question of necessity for the amount of paved area called for. In many cases there has been an excessive amount of blacktop area and parking provided based on once a year peak load requirements. The same holds true for parking provisions for institutional and commercial buildings.

In single family residential buildings there are a number of satisfactory alternatives to the ubiquitous blacktop driveway. If a permanent all-weather solution is sought, two strips of concrete can be provided with a major energy saving. In addition, in most residences, screened, washed gravel provides a satisfactory wearing surface (and in most cases, a much more sympathetic visual surface) at only the energy cost of quarrying stone, operating the rock crusher, delivering the gravel stock to the job site and spreading it.

In the balance of the refined petroleum category, that is petroleum that is burned as a fuel on the job, the building construction industry uses a total of 25 million barrels of petroleum. Of this, 92 percent of the dollar cost is in gasoline and motor fuels. That means the greatest part is in the equipment and trucks used to support the construction activities. A general improvement in the gasoline mileage of motor equipment would have its impact on this total which includes pick-up trucks, panel trucks, contractors' cars and other smaller vehicles in addition to the large pieces of heavy diesel equipment that work efficiently on large scale construction tasks. 4.8 percent of the dollar total representing a somewhat higher gallon total is in distillate fuel oils. These are used for the temporary heating of construction projects to permit construction through the winter. This figure is also capable of being substantially reduced through a more select pattern of where and when temporary heating is required.

FUTURE WORK

While additional detail has been added to the information presented in the EBC Report, much of the future work outlined in that report still remains to be done, as follows:

1. Additional studies of comparative constructions and components and the development of techniques for life cycle energy comparisons.

2. Analysis of the energy demands of a solar collector industry, both to determine the net energy gains for the individual systems, and also to assess the impact on some of the major materials suppliers to the solar collector industry, such as aluminum, copper and glass.

3. The development of an energy estimating computer program, stated in the units used by the building industry for cost estimating.

4. A further analysis of the plastics industry to identify the products which can best be provided by the plastics industry and those which can be provided equally well or better by natural materials that plastics may have supplanted.

5. Development of the dynamic model of the entire energy flow through the construction industry for use as a planning tool, both for the energy sector and for the industrial sector.

6. An upgrading of the data on the basis of the experience of individual industries that are now beginning to reduce energy expenditure per unit of product.

7. The determination of the spread between highest and lowest energy embodiment per unit of product, component or individual building. Since the input-output model has as its base annual average figures, there is no indication of what reductions can be expected even within the present state of the art. This information can be ascertained through more detailed energy values than in the EBC Report and in the supplement, based on individual audits.

8. A study of greater regionalism in the use of materials to determine whether this will cut down on the transportation margins.

9. In these figures there is no accounting for auto use to job sites by construction workers, although this is a characteristic of construction procedure. Its quantitative evaluation and investigation of possible alternates should be undertaken.

10. The 1972 Bureau of Economic Analysis figures should be available in 1978. An updating of the data in the report will provide

important information. Have there been changes in the overall use of energy in the building process? How does this correlate with changes in labor requirements? Are there shifts away from some materials and toward others? Are there process changes that affect the energy required for units of different materials? Are there changes in the way different types of buildings are designed and built that change the percentages graphed in the energy profiles? These facts concerning changes are important in understanding the dynamics that operate in the building design field and permit policy decisions that can accelerate some tendencies and retard others.

IV APPENDICES

IVA Embodied Energy Requirements of New Building Construction

TABLE 33

RANKED TOTAL ENERGY REQUIREMENTS FOR NEW BUILDING CONSTRUCTION -- 1967

399-ORDER INDEX	NAME	TOTAL ENERGY (TRILLION BTU)	INPUT FRACTION	CUMULATIVE FRACTION
3	PETRO REFIN PROD	497.37	0.1454	0.1454
206	READY-MIX CONCR	301.92	0.0882	0.2336
240	FAB STRUC STEEL	195.31	0.0571	0.2907
196	BRICKS	105.66	0.0309	0.3216
241	METAL DOORS	101.88	0.0298	0.3513
243	SHEET METAL WORK	95.39	0.0279	0.3792
245	MISC METAL WORK	94.30	0.0276	0.4068
373	RETAIL TRADE	93.95	0.0275	0.4342
135	SAWMILLS	85.88	0.0251	0.4593
184	ASPHALT	85.82	0.0251	0.4844
372	WHOLSALE TRADE	83.93	0.0245	0.5089
217	STEEL PROD	77.18	0.0226	0.5315
230	NONFER WIRE	75.85	0.0222	0.5537
386	MISC PROF SER	61.24	0.0179	0.5716
204	CONCRETE BLOCKS	60.45	0.0177	0.5892
195	CEMENT	55.25	0.0161	0.6054
138	MILLWORK	54.13	0.0158	0.6212
312	LIGHT FIXTURES	50.69	0.0148	0.6360
139	VENEER, PLYWOOD	50.26	0.0147	0.6507
205	CONCRETE PRODUCT	48.74	0.0142	0.6649
208	GYPSUM PRODUCTS	45.83	0.0134	0.6783
188	MISC PLASTICS	43.40	0.0127	0.6910
244	ARCH METAL WORK	43.33	0.0127	0.7037
255	PIPE	43.07	0.0126	0.7163
362	RAILROAD	41.87	0.0122	0.7285
242	FAB PLATE WORK	41.30	0.0121	0.7406
182	PAINT PRODUCTS	40.49	0.0118	0.7524
293	REFRIG MACH	38.79	0.0113	0.7638
183	PAVING	38.25	0.0112	0.7749
239	HEATING EQUIP	34.66	0.0101	0.7851
214	MINERAL WOOL	34.56	0.0101	0.7952
398	BUSINESS TRAVEL	33.64	0.0098	0.8050
160	BUILDING PAPER	30.99	0.0091	0.8141
364	MOTOR FGT TRANSP	30.10	0.0088	0.8229
252	FAB WIRE PRODUCT	28.07	0.0082	0.8311
140	PREFAB WD STRUC	23.60	0.0069	0.8380
227	COPPER ROLLING	23.46	0.0069	0.8448
250	HARDWARE	23.07	0.0067	0.8516
211	ASBESTOS PRODUCT	21.72	0.0063	0.8579
238	PLUMB FITTINGS	20.49	0.0060	0.8639
215	NONCLAY REFRACT	20.04	0.0059	0.8697
384	MISC BUS SERVICE	18.01	0.0053	0.8750
298	SWITCHGEAR	17.24	0.0050	0.8800
117	FLOOR COVERINGS	16.81	0.0049	0.8850
197	CERAMIC TILE	16.56	0.0048	0.8898
4	ELECTRIC UTIL	16.19	0.0047	0.8945
142	WOOD PRODUCTS	16.04	0.0047	0.8992
237	METAL SANIT WARE	15.81	0.0046	0.9038
193	GLASS PRODUCTS	15.66	0.0046	0.9084
21	STONE CLAY MIN	14.89	0.0044	0.9128
199	CLAY PRODUCTS	12.94	0.0038	0.9165
144	WOOD H'HOLD FURN	12.63	0.0037	0.9202
198	CLAY REFRACT	12.34	0.0036	0.9238
313	WIRING DEVICES	12.08	0.0035	0.9274
342	TEMP CONTROLS	11.66	0.0034	0.9308
267	HOISTS, CRANES	11.53	0.0034	0.9342
5	GAS UTILITIES	11.39	0.0033	0.9375
387	AUTO REPAIR	11.10	0.0032	0.9407
200	PLUMBING FIXTURE	10.44	0.0031	0.9438
174	MISC CHEM PROD	10.21	0.0030	0.9468
218	IR,STL FOUNDRIES	10.14	0.0030	0.9497
265	ELEVATORS	9.65	0.0028	0.9525
380	REAL ESTATE	8.89	0.0026	0.9551
161	CONV PAPER PROD	6.84	0.0020	0.9571
365	WATER TRANSPORT	6.81	0.0020	0.9591
207	LIME	6.74	0.0020	0.9611
136	HARDWD FLOORING	6.36	0.0019	0.9630
152	MET FIXTURES	6.24	0.0018	0.9648
310	H'HOLD APPLIANCE	6.14	0.0018	0.9666
146	MET H'HOLD FURN	6.13	0.0018	0.9684
151	WOOD FIXTURES	5.91	0.0017	0.9701
279	PUMPS,COMPRESORS	5.91	0.0017	0.9718
209	STONE PRODUCTS	5.15	0.0015	0.9733
377	INSUR CARRIERS	4.82	0.0014	0.9747
307	ELECTRIC H'WARES	4.49	0.0013	0.9761
141	WOOD PRESERVING	4.19	0.0012	0.9773
259	HARD FLOOR COV	3.80	0.0011	0.9784
385	ADVERTISING	3.51	0.0010	0.9794
15	FOR,GRHOUSE,NURS	3.40	0.0010	0.9804

TABLE 33 (continued)

369	COMMUNICATIONS	3.26	0.0010	0.9814
394	NONPROFIT ORG	3.24	0.0009	0.9823
228	ALUM ROLLING	3.20	0.0009	0.9832
213	TREATED MINERALS	3.07	0.0009	0.9841
366	AIR TRANSPORT	3.02	0.0009	0.9850
185	TIRES	2.69	0.0008	0.9858
229	NONFER ROLLING	2.59	0.0008	0.9866
17	AG FOR,FISH SVR	2.56	0.0007	0.9873
171	INORG-ORG CHEM	2.56	0.0007	0.9881
374	BANKING	2.48	0.0007	0.9888
187	MISC RUBBER PROD	2.29	0.0007	0.9894
281	BLOWERS	2.29	0.0007	0.9901
137	SPEC PROD SAWMIL	2.19	0.0006	0.9908
210	ABRASIVE PRODUCT	2.04	0.0006	0.9914
246	SCREW MACH PROD	2.02	0.0006	0.9919
266	CONVEYORS	1.97	0.0006	0.9925
397	ST,LOC GOVT ENTR	1.81	0.0005	0.9930
360	SIGNS, ADS	1.58	0.0005	0.9935
130	APPARL, PURCH MAT	1.57	0.0005	0.9940
286	MACH SHOP PROD	1.56	0.0005	0.9944
212	GASKETS	1.49	0.0004	0.9949
325	ELECTRICAL EQUIP	1.39	0.0004	0.9953
399	OFFICE SUPPLIES	1.22	0.0004	0.9956
371	WATER,SANIT SER	1.17	0.0003	0.9960
113	BROAD FAB MILLS	1.17	0.0003	0.9963
150	PUBLIC BLDG FURN	1.13	0.0003	0.9966
122	COATED FABRICS	1.05	0.0003	0.9969
357	BRUSHES	1.05	0.0003	0.9973
317	R-TV COMMUN EQ	1.05	0.0003	0.9976
247	METAL STAMPINGS	0.96	0.0003	0.9978
56	MAINT CONST OTH. NON-FRM	0.85	0.0002	0.9981
301	WELDING APPARAT	0.82	0.0002	0.9983
220	PRIMARY MET PROD	0.76	0.0002	0.9986
395	POST OFFICE	0.68	0.0002	0.9988
10	FEED GRAINS	0.50	0.0001	0.9989
321	STORAGE BATTERY	0.47	0.0001	0.9990
297	TRANSFORMERS	0.43	0.0001	0.9992
367	PIPE LINE TRANSP	0.29	0.0001	0.9992
324	ENGINE ELEC EQ	0.28	0.0001	0.9993
249	HANDTOOLS	0.27	0.0001	0.9994
158	ENVELOPES	0.26	0.0001	0.9995
216	NONMET MIN PROD	0.23	0.0001	0.9996
262	CONST MACHINERY	0.22	0.0001	0.9996
302	CARBON PRODUCTS	0.18	0.0001	0.9997
308	H'HOLD VACUUMS	0.16	0.0000	0.9997
125	CORDAGE, TWINE	0.13	0.0000	0.9998
346	WATCHES, CLOCKS	0.13	0.0000	0.9998
376	SEC, COMMOD BROK	0.12	0.0000	0.9998
361	MISC SRG	0.09	0.0000	0.9999
322	PRIMARY BATTERY	0.08	0.0000	0.9999
271	SPECIAL DIE TOOL	0.07	0.0000	0.9999
165	BOOK PUBLISHING	0.06	0.0000	0.9999
339	TRANSPORT EQUIP	0.06	0.0000	0.9999
299	MOTORS,GENERATOR	0.05	0.0000	0.9999
311	ELECTRIC LAMPS	0.05	0.0000	1.0000
259	FAB METAL PROD	0.03	0.0000	1.0000
300	IND CONTROLS	0.03	0.0000	1.0000
232	BRASS,OTHR CAST	0.03	0.0000	1.0000
133	FAB TEXTILE PROD	0.02	0.0000	1.0000
178	MISC PRINTING	0.02	0.0000	1.0000
328	MOTOR VEH & PART	0.01	0.0000	1.0000
	TOTAL	3421.63	1.0000	1.0000

Source: EBC Report, Table B1 - 10, p. 140.

TABLE 34 ENERGY INTENSITIES OF 399-ORDER SECTORS TO JOB SITE - 1967 - BTU PER DOLLAR

TOTAL PRIMARY ENERGY INTENSITIES
OF 399 - ORDER SECTORS, 1967
(FIRST FIVE SECTORS IN BTU/BTU; REST IN BTU/$)

90-ORDER INDEX	399-ORDER INDEX	I/O CODE	NAME	ENERGY INTENSITY
1	1	700	COAL MINING	0.10068E 01
2	2	800	CRUDE PETRO, GAS	0.10573E 01
3	3	3101	PETRO REFIN PROD	0.11980E 01
4	4	6801	ELECTRIC UTIL	0.37888E 01
5	5	6802	GAS UTILITIES	0.11014E 01
6	6	101	DAIRY	0.62152E 05
6	7	102	POULTRY, EGGS	0.77819E 05
6	8	103	MEAT,ANIMAL PROD	0.65241E 05
7	9	201	COTTON	0.10057E 06
7	10	202	FEED GRAINS	0.68763E 05
7	11	203	TOBACCO	0.63245E 05
7	12	204	FRUITS	0.43579E 05
7	13	205	VEGT,MISC CROPS	0.42836E 05
7	14	206	OIL BEARING CROP	0.51008E 05
7	15	207	FOR,GRHOUSE,NURS	0.55864E 05
8	16	300	FOREST FISH PROD	0.65169E 05
9	17	400	AG FOR,FISH SER	0.33739E 05
10	18	500	IRON ORE MINING	0.12723E 06
11	19	601	COPPER MINING	0.13019E 06
11	20	602	NONFERR MINING	0.12790E 06
12	21	900	STONE CLAY MIN	0.10411E 06
13	22	1000	CHEM MINERAL MIN	0.19829E 06
14	23	110101	NEW CONST RES--1 FAM.	0.55511E 05
14	24	110102	NEW CONST RES--2-4 FAM.	0.52139E 05
14	25	110103	NEW CONST RES--GRDN APT.	0.52864E 05
14	26	110104	NEW CONST HIGH-RISE APT.	0.60000E 05
14	27	110105	NEW CONST RES--ALT.,ADD.	0.51646E 05
14	28	110106	NEW CONST HOTELS,MOTELS	0.69184E 05
14	29	110107	NEW CONST DORMITORIES	0.70604E 05
14	30	110201	NEW CONST INDUST. BLDG.	0.70864E 05
14	31	110202	NEW CONST OFFICE BLDG.	0.68737E 05
14	32	110203	NEW CONST WAREHOUSES	0.77556E 05
14	33	110204	NEW CONST GAR.,SRV. STA.	0.76217E 05
14	34	110205	NEW CONST STORES,RSTRNTS	0.73183E 05
14	35	110206	NEW CONST RELIG. BLDG.	0.65597E 05
14	36	110207	NEW CONST EDUC. BLDG.	0.67924E 05
14	37	110208	NEW CONST HOSPITAL BLDG.	0.60572E 05
14	38	110209	NEW CONST OTH. NON-FARM	0.69894E 05
14	39	110301	NEW CONST TELEPH.,TELEG.	0.66636E 05
14	40	110302	NEW CONST RAILROADS	0.77585E 05
14	41	110303	NEW CONST ELECT. UTIL.	0.66639E 05
14	42	110304	NEW CONST GAS UTIL.	0.14004E 06
14	43	110305	NEW CONST PETROL. PIPE.	0.14720E 06
14	44	110306	NEW CONST WATER SUPPLY	0.73738E 05
14	45	110307	NEW CONST SEWER	0.76828E 05
14	46	110308	NEW CONST LOC. TRANSIT	0.62447E 05
14	47	110400	NEW CONST HIGHWAYS	0.12375E 06
14	48	110501	NEW CONST FARM RESID.	0.53773E 05
14	49	110502	NEW CONST FARM SERVICE	0.75956E 05
14	50	110503	NEW CONST OIL/GAS WELLS	0.11690E 06
14	51	110504	NEW CONST OIL/GAS EXPL.	0.92941E 05
14	52	110505	NEW CONST MILITARY	0.77815E 05
14	53	110506	NEW CONST CONS.,DEV.	0.84788E 05
14	54	110507	NEW CONST OTH. NON-BLDG.	0.89466E 05
15	55	120100	MAINT CONST RESID.	0.50072E 05
15	56	120201	MAINT CONST OTH. NON-FRM	0.49720E 05
15	57	120202	MAINT CONST FARM RESID.	0.71292E 05
15	58	120203	MAINT CONST FARM SERVICE	0.96288E 05
15	59	120204	MAINT CONST TEL.,TEL.	0.35530E 05
15	60	120205	MAINT CONST RAILROADS	0.42796E 05
15	61	120206	MAINT CONST ELECT. UTIL.	0.26418E 05
15	62	120207	MAINT CONST GAS UTIL.	0.83078E 05
15	63	120208	MAINT CONST PETR. PIPE.	0.11716E 06
15	64	120209	MAINT CONST WATER SUPPLY	0.61927E 05
15	65	120210	MAINT CONST SEWER	0.45044E 05
15	66	120211	MAINT CONST LOC. TRANSIT	0.48542E 05
15	67	120212	MAINT CONST MILITARY	0.62352E 05
15	68	120213	MAINT CONST CONSER.,DEV.	0.92963E 05
15	69	120214	MAINT CONST HIGHWAYS	0.76044E 05
15	70	120215	MAINT CONST OIL/GS WELLS	0.10910E 06
15	71	120216	MAINT CONST OTH. N-BLDG.	0.62045E 05
16	72	1301	GUIDED MISSILES	0.29792E 05
16	73	1302	AMMUNITION	0.95159E 05
16	74	1303	TANKS	0.99255E 05
16	75	1304	FIRE CONTROL EQ	0.41142E 05
16	76	1305	SMALL ARMS	0.50147E 05
16	77	1306	SMALL ARMS AMMUN	0.89420E 05
16	78	1307	OTHER ORDNANCE	0.67824E 05
17	79	1401	MEAT PRODUCTS	0.68232E 05
17	80	1402	BUTTER	0.78297E 05
17	81	1403	CHEESE	0.72401E 05
17	82	1404	CONDENSED MILK	0.76113E 05
17	83	1405	ICE CREAM	0.61046E 05
17	84	1406	FLUID MILK	0.60287E 05
17	85	1407	CANNED SEA FOODS	0.59178E 05
17	86	1408	CANNED SPECIALTY	0.72617E 05
17	87	1409	CANNED FRUIT,VEG	0.74309E 05
17	88	1410	DEHYDRATED PROD	0.65565E 05
17	89	1411	PICKLES,DRESSING	0.71455E 05
17	90	1412	FISH	0.59990E 05
17	91	1413	FROZEN FRUIT,VEG	0.73024E 05
17	92	1414	FLOUR,CEREALS	0.68949E 05
17	93	1415	PREP ANIMAL FEED	0.81815E 05
17	94	1416	RICE MILLING	0.64760E 05
17	95	1417	WET CORN MILLING	0.12564E 06
17	96	1418	BAKERY PRODUCTS	0.46977E 05
17	97	1419	SUGAR	0.11690E 06
17	98	1420	CONFECTIONERY	0.56246E 05
17	99	1421	ALCOHOLIC BEV	0.44040E 05
17	100	1422	SOFT DRINKS	0.59078E 05
17	101	1423	FLAVORINGS	0.48971E 05
17	102	1424	COTTONSEED MILLS	0.11673E 06
17	103	1425	SOYBEAN MILLS	0.74133E 05
17	104	1426	VEG OIL MILLS	0.61423E 05
17	105	1427	ANIMAL FATS	0.10777E 06
17	106	1428	COFFEE	0.31485E 05

TABLE 34 (continued)

17	107	1429	COOKING OILS	0.86856E 05
17	108	1430	MANUFACTURED ICE	0.13654E 06
17	109	1431	MACARONI	0.58222E 05
17	110	1432	FOOD PREPARATION	0.58718E 05
18	111	1501	CIGARETTES	0.28423E 05
18	112	1502	TOBACCO STEMMING	0.55136E 05
19	113	1601	BROAD FAB MILLS	0.99011E 05
19	114	1602	NAR FABRIC MILLS	0.79479E 05
19	115	1603	YARN MILLS	0.10162E 06
19	116	1604	THREAD MILLS	0.91365E 05
20	117	1701	FLOOR COVERINGS	0.89975E 05
20	118	1702	FELT GOODS	0.62349E 05
20	119	1703	LACE GOODS	0.74351E 05
20	120	1704	UPHOLSTERY FILL	0.64590E 05
20	121	1705	PROC TEX WASTE	0.66797E 05
20	122	1706	COATED FABRICS	0.93972E 05
20	123	1707	TIRE CORD	0.14277E 06
20	124	1708	SCOURING PLANTS	0.59011E 05
20	125	1709	CORDAGE, TWINE	0.67411E 05
20	126	1710	TEXTILE GOODS	0.78293E 05
21	127	1801	HOSIERY	0.67613E 05
21	128	1802	KNIT APPRL MILLS	0.63129E 05
21	129	1803	KNIT FAB MILLS	0.10491E 06
21	130	1804	APPARL,PURCH MAT	0.50309E 05
22	131	1901	CURTAINS	0.65329E 05
22	132	1902	HOUSEFURNISHINGS	0.82830E 05
22	133	1903	FAB TEXTILE PROD	0.61969E 05
23	134	2001	LOGGING	0.54418E 05
23	135	2002	SAWMILLS	0.65285E 05
23	136	2003	HARDWD FLOORING	0.55516E 05
23	137	2004	SPEC PROD SAWMIL	0.39319E 05
23	138	2005	MILLWORK	0.47350E 05
23	139	2006	VENEER,PLYWOOD	0.67686E 05
23	140	2007	PREFAB WD STRUC	0.55182E 05
23	141	2008	WOOD PRESERVING	0.10063E 06
23	142	2009	WOOD PRODUCTS	0.71339E 05
24	143	2100	WOOD CONTAINERS	0.48730E 05
25	144	2201	WOOD H'HOLD FURN	0.46058E 05
25	145	2202	UPH H'HOLD FURN	0.47598E 05
25	146	2203	MET H'HOLD FURN	0.89324E 05
25	147	2204	MATTRESSES	0.60136E 05
26	148	2301	WOOD OFC FURN	0.49728E 05
26	149	2302	METAL OFC FURN	0.69042E 05
26	150	2303	PUBLIC BLDG FURN	0.63660E 05
26	151	2304	WOOD FIXTURES	0.47901E 05
26	152	2305	MET FIXTURES	0.84170E 05
26	153	2306	BLINDS, SHADES	0.76509E 05
26	154	2307	FURN, FIXTURES	0.61331E 05
27	155	2401	PULP MILLS	0.19981E 06
27	156	2402	PAPER MILLS	0.20063E 06
27	157	2403	PAPERBOARD MILLS	0.21856E 06
27	158	2404	ENVELOPES	0.87404E 05
27	159	2405	SANIT PAPER PROD	0.10241E 06
27	160	2406	BUILDING PAPER	0.18990E 06
27	161	2407	CONV PAPER PROD	0.10417E 06
28	162	2500	PAPERBOARD CONT	0.11821E 06
29	163	2601	NEWSPAPERS	0.54556E 05
29	164	2602	PERIODICALS	0.52461E 05
29	165	2603	BOOK PUBLISHING	0.45698E 05
29	166	2604	MISC PUBLISHING	0.35052E 05
29	167	2605	COMM PRINTING	0.70971E 05
29	168	2606	BUSINESS FORMS	0.67489E 05
29	169	2607	GREETING CARDS	0.42243E 05
29	170	2608	MISC PRINTING	0.37794E 05
30	171	2701	INORG-ORG CHEM	0.28166E 06
30	172	2702	FERTILIZERS	0.17357E 06
30	173	2703	AG CHEMICALS	0.16728E 06
30	174	2704	MISC CHEM PROD	0.18300E 06
31	175	2801	PLASTICS	0.21614E 06
31	176	2802	SYN RUBBER	0.29215E 06
31	177	2803	MAN-MADE FIBERS	0.20779E 06
31	178	2804	ORGANIC FIBERS	0.14135E 06
32	179	2901	DRUGS	0.55497E 05
32	180	2902	CLEANING PREP	0.99259E 05
32	181	2903	TOILET PREP	0.66367E 05
33	182	3000	PAINT PRODUCTS	0.12239E 06
34	183	3102	PAVING	0.55847E 06
35	184	3103	ASPHALT	0.47861E 06
36	185	3201	TIRES	0.98764E 05
36	186	3202	RUBBER FOOTWARE	0.64366E 05
36	187	3203	MISC RUBBER PROD	0.95008E 05
36	188	3204	MISC PLASTICS	0.99782E 05
37	189	3300	INDUST LEATHER	0.55761E 05
38	190	3401	FOOTWARE CUT STK	0.65151E 05
38	191	3402	FOOTWARE EXC RUB	0.40556E 05
38	192	3403	MISC LEATHER	0.47262E 05
39	193	3501	GLASS PRODUCTS	0.10281E 06
39	194	3502	GLASS CONTAINERS	0.15284E 06
40	195	3601	CEMENT	0.47959E 06
40	196	3602	BRICKS	0.34029E 06
40	197	3603	CERAMIC TILE	0.11061E 06
40	198	3604	CLAY REFRACT	0.17959E 06
40	199	3605	CLAY PRODUCTS	0.25979E 06
40	200	3606	PLUMBING FIXTURE	0.91042E 05
40	201	3607	FOOD UTENSILS	0.95178E 05
40	202	3608	PORCEL ELEC SUPP	0.74510E 05
40	203	3609	POTTERY PRODUCTS	0.89590E 05
40	204	3610	CONCRETE BLOCKS	0.14163E 06
40	205	3611	CONCRETE PRODUCT	0.10849E 06
40	206	3612	READY-MIX CONCR	0.18013E 06
40	207	3613	LIME	0.50701E 06
40	208	3614	GYPSUM PRODUCTS	0.15854E 06
40	209	3615	STONE PRODUCTS	0.52613E 05
40	210	3616	ABRASIVE PRODUCT	0.70891E 05
40	211	3617	ASBESTOS PRODUCT	0.11010E 06
40	212	3618	GASKETS	0.84318E 05
40	213	3619	TREATED MINERALS	0.14126E 06
40	214	3620	MINERAL WOOL	0.15587E 06
40	215	3621	NONCLAY REFRACT	0.15035E 06
40	216	3622	NONMET MIN PROD	0.93625E 05
41	217	3701	STEEL PROD	0.26698E 06
41	218	3702	IR,STL FOUNDRIES	0.98021E 05

TABLE 34 (continued)

41	219	3703	IN,STL FORGING	0.17053E 06
41	220	3704	PRIMARY MET PROD	0.14889E 06
42	221	3801	PRIMARY COPPER	0.13926E 06
42	222	3802	PRIMARY LEAD	0.10985E 06
42	223	3803	PRIMARY ZINC	0.27411E 06
42	224	3804	PRIM ALUMINUM	0.38696E 06
42	225	3805	PRIM NONFER MET	0.15673E 06
42	226	3806	SEC NONFERR MET	0.74679E 05
42	227	3807	COPPER ROLLING	0.10170E 06
42	228	3808	ALUM ROLLING	0.24420E 06
42	229	3809	NONFER ROLLING	0.11560E 06
42	230	3810	NONFER WIRE	0.91433E 05
42	231	3811	ALUM CASTINGS	0.13829E 06
42	232	3812	BRASS,OTHR CAST	0.86923E 05
42	233	3813	NONFER CASTING	0.10846E 06
42	234	3814	NONFER FORGING	0.14828E 06
43	235	3901	METAL CANS	0.14082E 06
43	236	3902	METAL BARRELS	0.14086E 06
44	237	4001	METAL SANIT WARE	0.98392E 05
44	238	4002	PLUMB FITTINGS	0.74662E 05
44	239	4003	HEATING EQUIP	0.71217E 05
44	240	4004	FAB STRUC STEEL	0.12432E 06
44	241	4005	METAL DOORS	0.11679E 06
44	242	4006	FAB PLATE WORK	0.10491E 06
44	243	4007	SHEET METAL WORK	0.11411E 06
44	244	4008	ARCH METAL WORK	0.11848E 06
44	245	4009	MISC METAL WORK	0.13981E 06
45	246	4101	SCREW MACH PROD	0.85812E 05
45	247	4102	METAL STAMPINGS	0.11154E 06
46	248	4201	CUTLERY	0.50131E 05
46	249	4202	HANDTOOLS	0.66994E 05
46	250	4203	HARDWARE	0.74406E 05
46	251	4204	COAT, ENGRAV SER	0.78749E 05
46	252	4205	FAB WIRE PRODUCT	0.15389E 06
46	253	4206	SAFES, VAULTS	0.66488E 05
46	254	4207	STEEL SPRINGS	0.12703E 06
46	255	4208	PIPE	0.74014E 05
46	256	4209	COLLAPSIBLE TUBE	0.10450E 06
46	257	4210	METAL FOIL, LEAF	0.12986E 06
46	258	4211	FAB METAL PROD	0.10390E 06
47	259	4301	STEAM ENGINES	0.69807E 05
47	260	4302	INT COMBUST ENG	0.61554E 05
48	261	4400	FARM MACHINERY	0.71648E 05
49	262	4501	CONST MACHINERY	0.67847E 05
49	263	4502	MINING MACHINERY	0.71175E 05
49	264	4503	OIL FIELD MACH	0.72091E 05
50	265	4601	ELEVATORS	0.58218E 05
50	266	4602	CONVEYORS	0.64161E 05
50	267	4603	HOISTS, CRANES	0.66144E 05
50	268	4604	INDUSTRIAL TRUCK	0.59013E 05
51	269	4701	MET CUTTING TOOL	0.41290E 05
51	270	4702	MET FORMING TOOL	0.57533E 05
51	271	4703	SPECIAL DIE TOOL	0.54868E 05
51	272	4704	MET'WORKING MACH	0.55974E 05
52	273	4801	FOOD PROD MACH	0.50716E 05
52	274	4802	TEXTILE MACH	0.58664E 05
52	275	4803	WOODWORKING MACH	0.48948E 05
52	276	4804	PAPER IND MACH	0.60785E 05
52	277	4805	PRINTING MACH	0.42241E 05
52	278	4806	SPECIAL IND MACH	0.58423E 05
53	279	4901	PUMPS,COMPRESORS	0.55076E 05
53	280	4902	BEARINGS	0.80229E 05
53	281	4903	BLOWERS	0.62154E 05
53	282	4904	INDUST PATTERNS	0.43664E 05
53	283	4905	POWER TRANS EQ	0.59442E 05
53	284	4906	INDUS FURNACES	0.71344E 05
53	285	4907	GENERAL IND MACH	0.64176E 05
54	286	5000	MACH SHOP PROD	0.55213E 05
55	287	5101	COMPUTING MACH	0.36193E 05
55	288	5102	TYPEWRITERS	0.33065E 05
55	289	5103	SCALES	0.55259E 05
55	290	5104	OFC MACHINES	0.43702E 05
56	291	5201	MERCH'DISE MACH	0.60441E 05
56	292	5202	LAUNDRY EQUIP	0.67249E 05
56	293	5203	REFRIG MACH	0.66829E 05
56	294	5204	MEASURING PUMPS	0.52717E 05
56	295	5205	SERVICE IND MACH	0.64420E 05
57	296	5301	ELEC MEAS INSTR	0.34744E 05
57	297	5302	TRANSFORMERS	0.73319E 05
57	298	5303	SWITCHGEAR	0.46281E 05
57	299	5304	MOTORS,GENERATOR	0.62536E 05
57	300	5305	IND CONTROLS	0.38437E 05
57	301	5306	WELDING APPARAT	0.83148E 05
57	302	5307	CARBON PRODUCTS	0.14865E 06
57	303	5308	ELEC IND APPARAT	0.58789E 05
58	304	5401	H'HOLD COOK EQ	0.78960E 05
58	305	5402	H'HOLD REFRIG EQ	0.75531E 05
58	306	5403	H'HOLD LAUNDRY	0.82620E 05
58	307	5404	ELECTRIC H'WARES	0.69469E 05
58	308	5405	H'HOLD VACUUMS	0.56680E 05
58	309	5406	SEWING MACHINES	0.53683E 05
58	310	5407	H'HOLD APPLIANCE	0.82264E 05
59	311	5501	ELECTRIC LAMPS	0.44653E 05
59	312	5502	LIGHT FIXTURES	0.70562E 05
59	313	5503	WIRING DEVICES	0.72488E 05
60	314	5601	RADIO,TV SETS	0.42607E 05
60	315	5602	PHONO RECORDS	0.56843E 05
60	316	5603	PHONE,TELEGR EQ	0.36266E 05
60	317	5604	R-TV COMMUN EQ	0.31916E 05
61	318	5701	ELECTRON TUBES	0.52228E 05
61	319	5702	SEMICONDUCTORS	0.50481E 05
61	320	5703	ELECTRONIC COMP	0.50925E 05
62	321	5801	STORAGE BATTERY	0.94745E 05
62	322	5802	PRIMARY BATTERY	0.61431E 05
62	323	5803	X-RAY EQUIPMENT	0.35382E 05
62	324	5804	ENGINE ELEC EQ	0.60133E 05
62	325	5805	ELECTRICAL EQUIP	0.63599E 05
63	326	5901	TRUCK,BUS BODIES	0.76921E 05
63	327	5902	TRUCK TRAILERS	0.83050E 05
63	328	5903	MOTOR VEH & PART	0.66556E 05
64	329	6001	AIRCRAFT	0.38517E 05
64	330	6002	AIRCRAFT ENGINES	0.48205E 05
64	331	6003	AIRCRAFT PROPELL	0.62632E 05
64	332	6004	AIRCRAFT EQUIP	0.45047E 05
65	333	6101	SHIPBUILDING	0.63474E 05
65	334	6102	BOATBUILDING	0.63505E 05

TABLE 34 (continued)

65	335	6103	LOCOMOTIVES	0.54240E 05
65	336	6104	RR, STREET CARS	0.10945E 06
65	337	6105	MOTOR, BICYCLES	0.72461E 05
65	338	6106	TRAILER COACHES	0.69933E 05
65	339	6107	TRANSPORT EQUIP	0.96056E 05
66	340	6201	SCIEN INSTR	0.44748E 05
66	341	6202	MECH MEAS DEVICE	0.44422E 05
66	342	6203	TEMP CONTROLS	0.43475E 05
66	343	6204	MEDICAL INSTR	0.62257E 05
66	344	6205	SURGICAL SUPPLY	0.49763E 05
66	345	6206	DENTAL EQUIPMENT	0.50109E 05
66	346	6207	WATCHES, CLOCKS	0.43423E 05
67	347	6301	OPTICAL INSTR	0.39922E 05
67	348	6302	OPHTHALMIC GOODS	0.46419E 05
67	349	6303	PHOTOGRAPHIC EQ	0.46724E 05
68	350	6401	JEWELRY	0.46378E 05
68	351	6402	MUSICAL INSTR	0.54594E 05
68	352	6403	GAMES	0.65273E 05
68	353	6404	ATHLETIC EQUIP	0.60127E 05
68	354	6405	PENS AND PENCILS	0.55575E 05
68	355	6406	ARTIFICAL FLOWER	0.79372E 05
68	356	6407	CLOTH FASTENERS	0.64920E 05
68	357	6408	BRUSHES	0.65290E 05
68	358	6409	HARD FLOOR COV	0.73414E 05
68	359	6410	MORTICIAN GOODS	0.69092E 05
68	360	6411	SIGNS, ADS	0.60915E 05
68	361	6412	MISC MFG	0.56736E 05
69	362	6501	RAILROAD	0.75769E 05
70	363	6502	LOCAL TRANSPORT	0.66427E 05
71	364	6503	MOTOR FGT TRANSP	0.45819E 05
72	365	6504	WATER TRANSPORT	0.22198E 06
73	366	6505	AIR TRANSPORT	0.19083E 06
74	367	6506	PIPE LINE TRANSP	0.95706E 05
75	368	6507	TRANSP SERVICES	0.68871E 04
76	369	6600	COMMUNICATIONS	0.16731E 05
77	370	6700	R-TV BROADCAST	0.29137E 05
78	371	6803	WATER,SANIT SER	0.10860E 06
79	372	6901	WHOLSALE TRADE	0.35429E 05
79	373	6902	RETAIL TRADE	0.35250E 05
80	374	7001	BANKING	0.18248E 05
80	375	7002	CREDIT AGENCIES	0.72326E 05
80	376	7003	SEC, COMMOD BROK	0.11585E 05
80	377	7004	INSUR CARRIERS	0.20698E 05
80	378	7005	INSURANCE AGENTS	0.24160E 05
81	379	7101	OWNER-OCC DWLNG	0.68930E 04
81	380	7102	REAL ESTATE	0.22406E 05
82	381	7201	HOTELS	0.76593E 05
82	382	7202	PERSONAL SERVICE	0.52075E 05
82	383	7203	BARB,BEAUT SHOPS	0.16858E 05
83	384	7301	MISC BUS SERVICE	0.26813E 05
83	385	7302	ADVERTISING	0.44725E 05
83	386	7303	MISC PROF SER	0.24871E 05
84	387	7500	AUTO REPAIR	0.48887E 05
85	388	7601	MOTION PICTURE	0.32598E 05
85	389	7602	AMUSMNT,REC SER	0.24215E 05
86	390	7701	DOCTORS,DENTISTS	0.14730E 05
86	391	7702	HOSPITALS	0.51126E 05
86	392	7703	MED, HEALTH SER	0.47320E 05
86	393	7704	EDUCATIONAL SER	0.56653E 05
86	394	7705	NONPROFIT ORG	0.58235E 05
87	395	7801	POST OFFICE	0.36944E 05
87	396	7804	FED GOVT ENTERP	0.36063E 05
88	397	7903	ST,LOC GOVT ENTR	0.10348E 06
89	398	8100	BUSINESS TRAVEL	0.96380E 05
90	399	8200	OFFICE SUPPLIES	0.71229E 05

Source: CAC.

IV B Labor Intensities of Typical Assemblies: Calculations

LABOR INTENSITIES OF TYPICAL ASSEMBLIES: CALCULATIONS

The typical assemblies compared in the EBC Report for energy intensities have been compared in this Supplement for labor intensities. The Direct Labor was determined using 1976 Means Construction Cost Data.[4] The materials were arranged into appropriate task groups (e.g. all structural steel items were aggregated into a group called Bolted Structural Steel), and the output/day and man-hours/day of the required crew was established. For each particular task the quantity of material to be placed was established from which the percent of the crew's daily output and therefore the actual man-hours required were determined and totaled for each assembly.

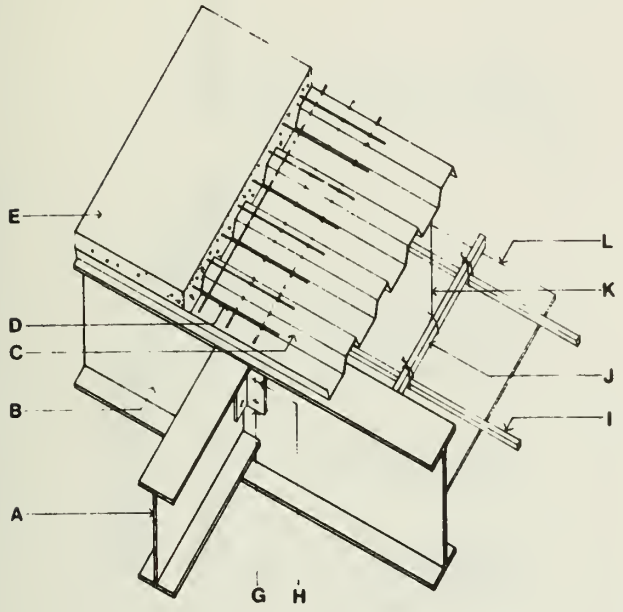
Values for embodied and margin labor were determined using Census of Manufactures data and CAC FTE/$ data (see Table 37). The dollar value of the materials in the assembly was determined by applying the Census of Manufactures $/unit values recorded in the EBC Report.* These values were then aggregated into groups that correspond with the CAC 399 order sectors to which the CAC FTE/$ values were applied. FTE values were then totaled and multiplied by the 1967 average man hours/FTE recorded for manufacturing industries to determine the required man-hours.

*EBC Report, pp. 41-59.

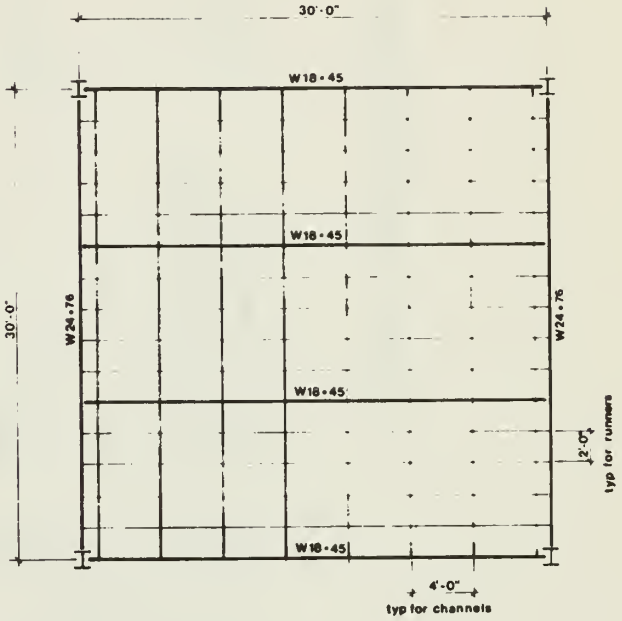
The unit value for the labor to produce the typical assembly is determined by totaling the direct, embodied, and margin labor and dividing by the size of the assembly in question.

STANDARD STEEL SYSTEM
TYPICAL FLOOR BAY

TYPICAL CONSTRUCTION



FRAMING PLAN



	Material	Size	Quantity	Weight/ Unit	Total Weight (30 x 30 Bay)	Embodied Energy (Btu/Unit)	Total Embodied Energy
A.	Filler Beams	W 18 x 45	90 ft	45 lb/ft	4,050 lb	22,707 Btu/lb	91,963,350 Btu
B.	Girder	W 24 x 76	30 ft	76 lb/ft	2,280 lb	22,707 Btu/lb	51,771,960 Btu
C.	Steel Deck	20 gauge	900 ft^2	2.15 lb/ft^2	1,935 lb	27,836 Btu/lb	53,8[illegible] Btu
D.	Temp Reinf	6 x 6 #8/#8	900 ft^2	.30 lb/ft^2	270 lb	24,187 Btu/lb	6,530,490 Btu
E.	Conc Deck	4" thick	900 ft^2	.33 ft^3/ft^2	300 cu ft	96,087 Btu/cu ft	28,826,100 Btu
F.	Girder Angles	3½" x 5/16" x 10"	4	6.0 lb ea	24 lb	22,707 Btu/lb	544,968 Btu
G.	Filler Angles	3½" x 5/16" x 7"	12	4.2 lb ea	50.4 lb	22,707 Btu/lb	1,144,432 Btu
H.	Bolts	3/4" H.S. Bolts	36	.55 lb ea	19.8 lb	26,625 Btu/lb	527,175 Btu
I.	Channels	1½" x 3/4" x 1/8"	210 ft	1.20 lb/ft	252 lb	22,707 Btu/lb	5,722,164 Btu
J.	Runners	3/4" x 3/4" x 3/32"	480 ft	.72 lb/ft	346 lb	22,707 Btu/lb	7,856,622 Btu
K.	Wirehangers	¼" diam	98 ft	.17 lb/ft	16.6 lb	34,385 Btu/lb	570,791 Btu
L.	Gyp Board	½" thick	900 ft^2	2.0 lb/ft	1,800 lb	3,485 Btu/lb	6,273,000 Btu
							263,450,344 Btu

÷ 900 = 292,723 Btu/SF

Source: EBC Report, p. 89.

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ENERGY IN BUILDING CONSTRUCTION
ERDA Contract No. E (11-1)-2791

date

Subject
Embodied Energy in Typ. Building Assemblies
Standard Steel System

by
CAC
RGS & A

Figure 6

TABLE 35 LABOR IN TYPICAL ASSEMBLIES: COMMERCIAL BUILDING BAYS: (STANDARD STEEL SYSTEM)

DIRECT LABOR

Item	Reference (1)	DAILY OUTPUT (2) Crew	Man Hours	Quantity	WORK REQUIRED Quantity(3)		% of daily Crew Output	Man Hours
bolted structural steel-office	ABFGH	E2	64	6.5 T	3.2	T	0.49	31.4
steel deck	C	E5	72	8600 SF	900	SF	0.10	7.2
concrete reinforcing	D	2Rodm	16	34 CSF	9	CSF	0.26	4.2
4" concrete deck	E	C8	56	1850 SF	900	SF	0.49	27.4
ceiling suspension system	IJK	1Carp	8	470 SF	900	SF	1.91	15.3
½" gypsum board	L	2Carp	16	1800 SF	900	SF	0.50	8.0
taping and finishing	-	2Carp	16	2000 SF	900	SF	0.45	7.2
								100.7

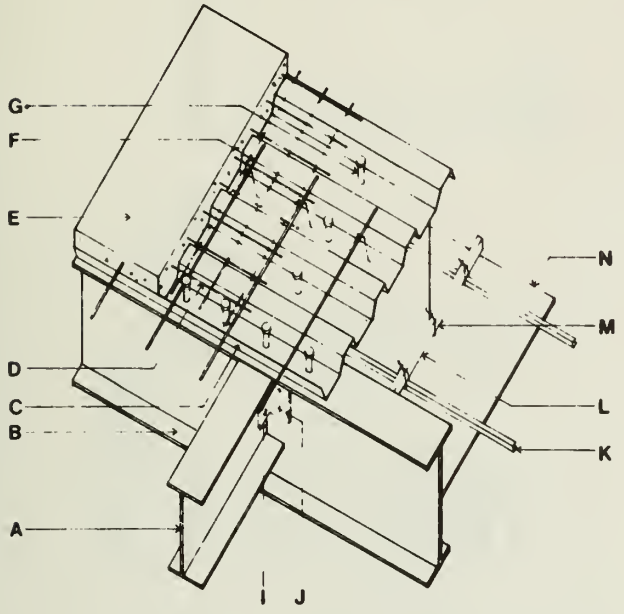
EMBODIED LABOR

Item	Reference (1)	VALUE Quantity	$/unit (4)	$	MAN YEARS (FTE) (5) CAC Sectors(399 order) No.	Name	$	Producer	Margin
structural steel	ABFGIJ	7002 lb	0.1746	1222.55	240	fab.str.st	1222.55	0.1105	0.0108
wire hangers	K	17 lb	0.1224	2.08					
steel deck	C	1935 lb	0.0991	191.76	217	steel products	236.74	0.0175	0.0063
reinforcing mesh	D	270 lb	0.0861	42.90					
bolts	H	20 lb	0.2619	5.24	246	screw machine prod.	5.24	0.0004	0.0003
concrete	E	11.11 CY	14.3509	159.45	206	ready mix concrete	159.45	0.0127	0.0003
gypsum board	L	0.90 T	38.0398	35.14	208	gypsum products	35.14	0.0024	0.0014
								0.1435	0.0191
						x 2111.2 man hours/FTE(6)=		303.0 man hours	40.3 man hours

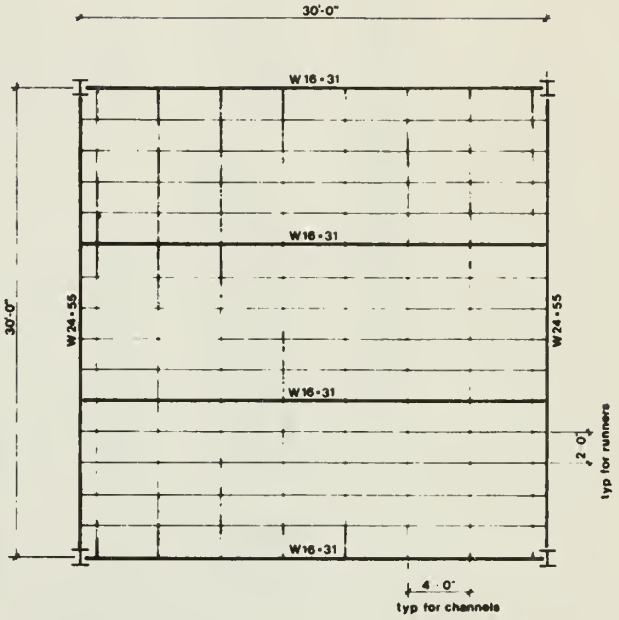
Notes
(1) see Fig. 6
(2) from 1976 Means Construction Cost Data[4]
(3) quantity from Fig. 6
(4) from EBC Report, pp. 41 - 59
(5) from CAC FTE/$
(6) from Bureau of Labor Statistics

COMPOSITE STEEL SYSTEM
TYPICAL FLOOR BAY

TYPICAL CONSTRUCTION



FRAMING PLAN



	Material	Size	Quantity	Weight/ Unit	Total Weight (30 x 30 Bay)	Embodied Energy (Btu/Unit)	Total Embodied Energy
A.	Filler Beam	W 16 x 31	90 ft	31 lb/ft	2,790 lb	22,707 Btu/lb	63,352,530 Btu
B.	Girder	W 24 x 55	30 ft	55 lb/ft	1,650 lb	22,707 Btu/lb	37,466,550 Btu
C.	Steel Deck	20 gauge	900 ft^2	2.15 lb/ft^2	1,935 lb	27,836 Btu/lb	53,863,660 Btu
D.	Temp Reinf	6 x 6 - #8/#8	900 ft^2	.30 lb/ft^2	270 lb	24,187 Btu/lb	6,530,490 Btu
E.	Conc Deck	4" thick	900 ft^2	.33 ft^3/ft^2	300 cu ft	96,087 Btu/cu ft	28,826,100 Btu
F.	Neg Reinf	#4 @ 12"	600 ft	.668 lb/ft	401 lb	15,664 Btu/lb	6,281,264 Btu
G.	Studs	3/4" x 3"	168	1.5 lb ea	252 lb	26,625 Btu/lb	6,709,500 Btu
H.	Girder Angles	3½" x 5/16" x 10"	4	6.0 lb ea	24 lb	22,707 Btu/lb	544,968 Btu
I.	Filler Angles	3½" x 5/16" x 7"	12	4.2 lb ea	50.4 lb	22,707 Btu/lb	1,144,432 Btu
J.	Bolts	3/4" H.S.	36	.55 lb ea	19.8 lb	26,625 Btu/lb	527,175 Btu
K.	Runners	3/4" x 3/4" x 3/32"	480 ft	.72 lb/ft	346 lb	22,707 Btu/lb	7,856,622 Btu
L.	Channels	1½" x 3/4" x 1/8"	210 ft	1.20 lb/ft	252 lb	22,707 Btu/lb	5,722,164 Btu
M.	Wirehangers	½" diam	98 ft	.17 lb/ft	16.6 lb	34,385 Btu/lb	570,791 Btu
N.	Gyp Board	½" thick	900 ft^2	2.0 lb/ft^2	1,800 lb	3,485 Btu/lb	6,273,000 Btu
							225,668,246 Btu

÷ 900 = 250,095 Btu/SF

Source: EBC Report, p. 90.

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ERDA Contract No. E (11-1)-2791

date

Subject
Embodied Energy in Typ. Building Assemblies
Composite Steel System

by
CAC
RGS & A

Figure 7

TABLE 36 LABOR IN TYPICAL ASSEMBLIES: COMMERCIAL BUILDING BAYS: (COMPOSITE STEEL SYSTEM)

DIRECT LABOR

Item	Reference (1)	DAILY OUTPUT (2) Crew	Man Hours	Quantity	WORK REQUIRED Quantity (3)	% of daily Crew Output	Man Hours
structural steel,bolted, office	ABGHIJ	E2	64	6.5 T	2.4 T	0.37	23.6
steel deck	C	E5	72	8600 SF	900 SF	0.10	7.2
reinforcing mesh	D	2Rodm	16	34 CSF	9 CSF	0.26	4.2
reinforcing bars #4	F	4Rodm	32	2.5 T	0.2 T	0.08	2.6
4" concrete deck	E	C8	56	1850 SF	900 SF	0.49	27.4
ceiling suspension system	KLM	1Carp	8	470 SF	900 SF	1.91	15.3
½" gypsum board	N	2Carp	16	1800 SF	900 SF	0.50	8.0
taping and finishing	-	2Carp	16	2000 SF	900 SF	0.45	7.2
							95.5

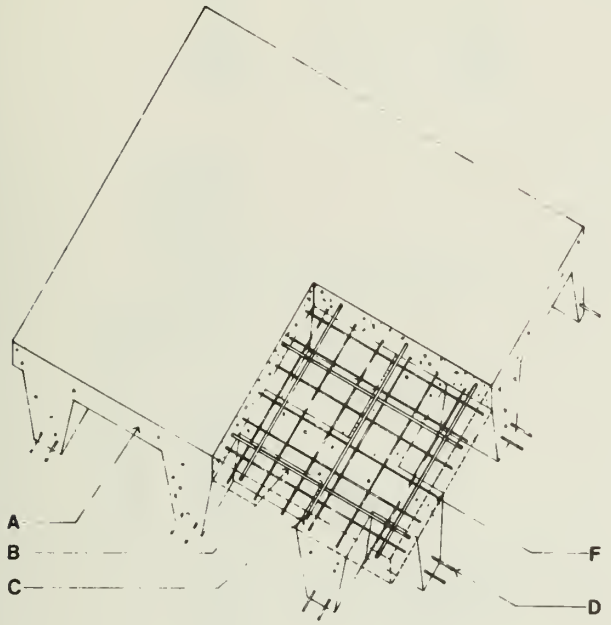
EMBODIED LABOR

Item	Reference (1)	VALUE Quantity	$/unit (4)	$	MAN YEARS (FTE) (5) CAC Sectors(399 order) No.	Name	$	Producer	Margin
structural steel	ABHIKL	5112.4 lb	0.1746	892.63	240	fab.str.steel	892.63	0.0807	0.0079
wire hangers	M	17 lb	0.1224	2.08					
steel deck	C	1935 lb	0.0991	191.76	217	steel products	259.12	0.0192	0.0069
reinforced mesh	D	270 lb	0.0861	42.90					
reinforced bars	F	401 lb	0.0558	22.38					
bolts, studs	G,J	272 lb	0.2619	71.24	246	screw machine prod.	71.24	0.0057	0.0037
concrete	E	11.11 cy	14.3509	159.45	206	ready mix concrete	159.45	0.0127	0.0003
gypsum board	N	0.90 T	38.0398	35.14	208	gypsum products	35.14	0.0024	0.0014
								0.1207	0.0206
						x 2111.2 man hours/FTE(6) =		254.8 man hours	42.6 man hours

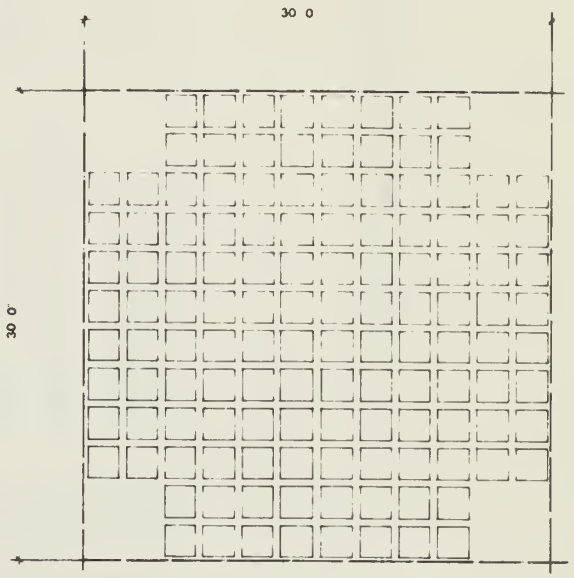
Notes
(1) see Fig. 7
(2) from 1976 Means Construction Cost Data[4]
(3) quantity from Fig. 7
(4) from EBC Report, pp. 41 - 59
(5) from CAC FTE/$
(6) from Bureau of Labor Statistics

REINFORCED CONCRETE SYSTEM
TYPICAL FLOOR BAY

TYPICAL CONSTRUCTION



FRAMING PLAN



	Material	Size	Quantity	Weight/ Unit	Total Weight (30 x 30 bay)	Embodied Energy (Btu/Unit)	Total Embodied Energy
A.	Concrete	16" waffle	900 ft^2	.796 ft^3/ft^2	717 cu ft	96,087 Btu/cu ft	68,894,379 Btu
B.	Top col. strip Reinforcing	#6 bars	784	1.502 lb/ft	1,177 lb	15,664 Btu/lb	18,436,528 Btu
C.	Top mid strip Reinforcing	#4 bars	420 ft	.668 lb/ft	280.5 lb	15,664 Btu/lb	4,393,752 Btu
D.	Bottom rib col. strip reinf	#6 bars	960 ft	1.502 lb/ft	1,442 lb	15,664 Btu/lb	22,587,488 Btu
E.	Bottom rib mid strip reinf	#5 bars	1,440 ft	1.043 lb/ft	1,502 lb	15,664 Btu/lb	23,527,328 Btu
F.	Wire mesh Reinforcing	6" x 6" - 2/2	900 ft^2	.78 lb/ft^2	702 lb	24,187 Btu/lb	16,979,274 Btu
							154,818,749 Btu

÷ 900 = 172,021 Btu/SF

Source: EBC Report, p. 91.

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ERDA Contract No. E (11-1)-2791

date

Subject
Embodied Energy in Typ. Building Assemblies
Reinforced Concrete System

by
CAC
RGS & A

file
Figure 8

TABLE 37 LABOR IN TYPICAL ASSEMBLIES: COMMERCIAL BUILDING BAYS: (REINFORCED CONCRETE SYSTEM)

DIRECT LABOR

Item	Reference (1)	DAILY OUTPUT (2) Crew	Man Hours	Quantity		WORK REQUIRED Quantity (3)		% of daily Crew Output	Man Hours
concrete: 24" waffle slab (incl.form & reinforc)	A-F	C14	240	435	CY	26.56	CY	0.61	146.5
screen	-	1Cefi	8	900	SF	900	SF	1.00	8.0
wood float	-	C9	8	725	SF	900	SF	1.24	9.9
steel trowel	-	C9	8	625	SF	900	SF	1.44	11.5
dust proof	-	1Cefi	8	1900	SF	900	SF	0.47	3.8
curing	-	2Clab	16	75	CSF	9	CSF	0.12	1.9
									181.7

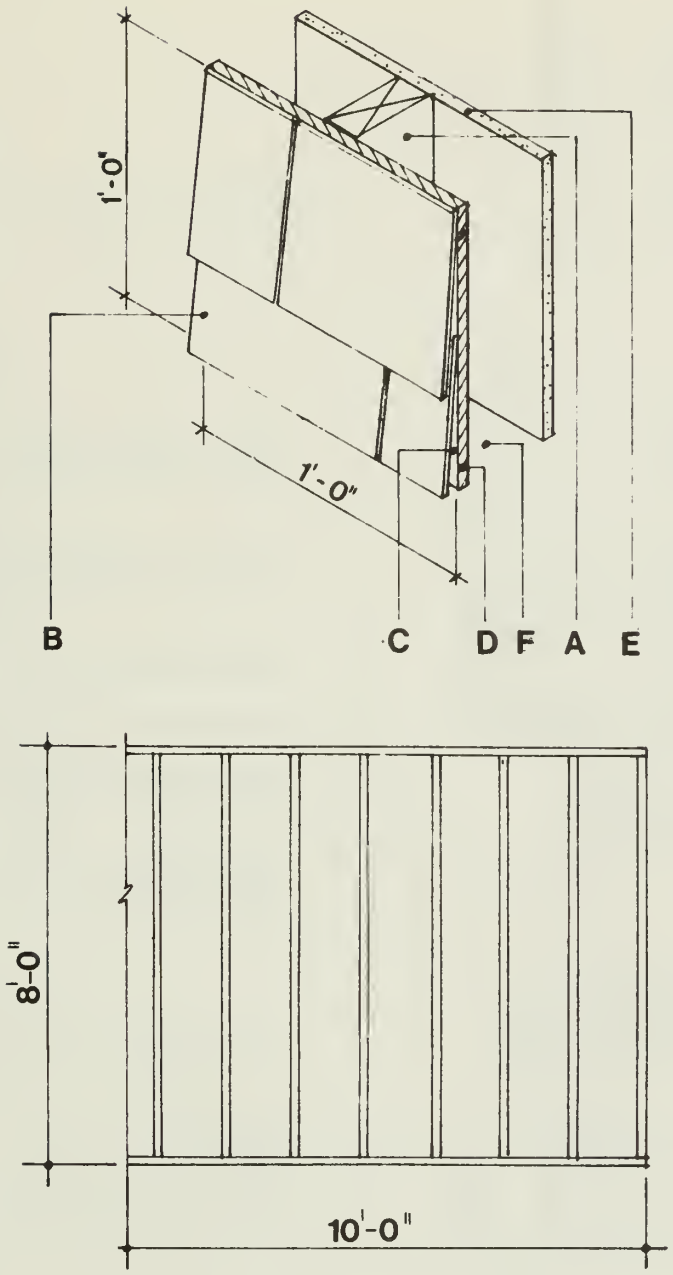
EMBODIED LABOR

Item	Reference (1)	VALUE Quantity		$/unit (4)	$	MAN YEARS (FTE) (5) CAC Sectors (399 order) No.	Name	$	Producer	Margin
concrete	A	26.56	CY	14.3509	381.16	206	ready mix concrete	381.16	0.0304	0.0006
reinforcing bars	B-E	4402	lb	0.0558	245.63					
wire mesh	F	711	lb	0.0861	61.22	217	steel products	306.85	0.0227	0.0081
3/4" plywood forms (4 uses)	-	900	SF	0.1299	29.21	139	veneer/plywood	29.21	0.0032	0.0015
									0.0563	0.0101

x 2111.2 man hours/FTE (6) = 118.9 man hours | 21.3 man hours

Notes
(1) see Fig. 8
(2) from 1976 Means Construction Cost Data[4]
(3) quantity from Fig. 8
(4) from EBC Report, pp. 41 - 59
(5) from CAC FTE/$
(6) from Bureau of Labor Statistics

WOOD FRAME WALLS



	Material	Size	Quantity	Embodied Energy (Btu/SF)
A.	Wood Framing	2" x 4"-16" o.c.	56 bd ft	3,486
B.	Wood Shingles	18"	80 sq ft	7,315
C.	Building Paper	15#	80 sq ft (12#)	--
D.	Plywood Sheathing	½"	80 sq ft	7,705
E.	Gypsum Wall Board	½"	80 sq ft (160#)	6,920
F.	Batt Insulation	3½"	80 sq ft	6,860
				32,286

Source: EBC Report, p. 96.

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ERDA Contract No. E (11-1)-2791

date

Subject
Embodied Energy in Typical Building Assemblies - Wood Frame Walls

by
CAC
RGS & A

Figure 9

TABLE 38 LABOR IN TYPICAL ASSEMBLIES: STUD WALLS: (WOOD SHINGLES)

DIRECT LABOR

Item	Reference (1)	DAILY OUTPUT (2) Crew	Man Hours	Quantity		WORK REQUIRED Quantity (3)		% of daily Crew Output	Man Hours
wood framing	A	F2	16	0.7	MFBM	0.06	MFBM	0.09	1.4
wood shingles	B	1Carp	8	2.25	SQ	0.8	SQ	0.36	2.8
asphalt bldg. paper	C	1Carp	8	37.	CSF	0.8	CSF	0.02	0.2
½" plywood sheathing	D	F2	16	1125	SF	80	SF	0.07	1.1
gyspum wall board	E	2Carp	16	1800	SF	80	SF	0.04	0.7
tape and spackle	-	2Carp	16	2000	SF	80	SF	0.04	0.6
paint (2 coats)	-	1Pord	8	715	SF	80	SF	0.11	0.9
batt insulation	F	1Carp	8	1400	SF	80	SF	0.06	0.5
									8.2

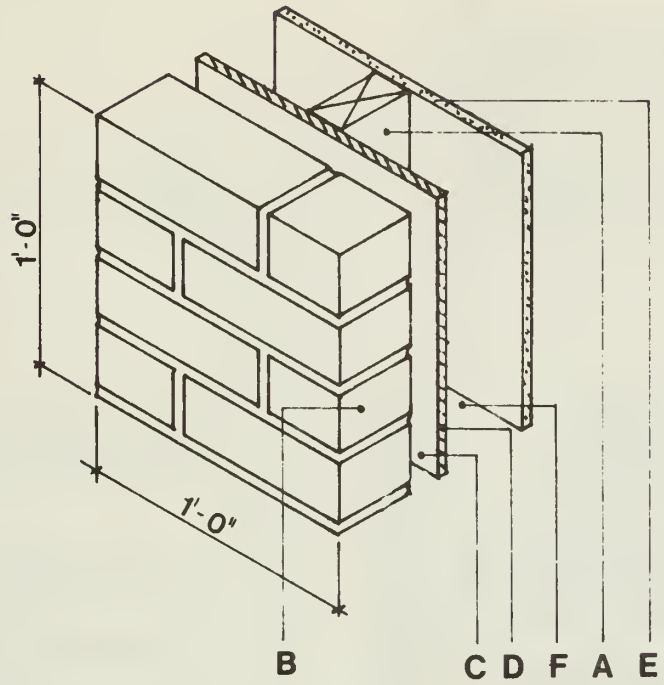
EMBODIED LABOR

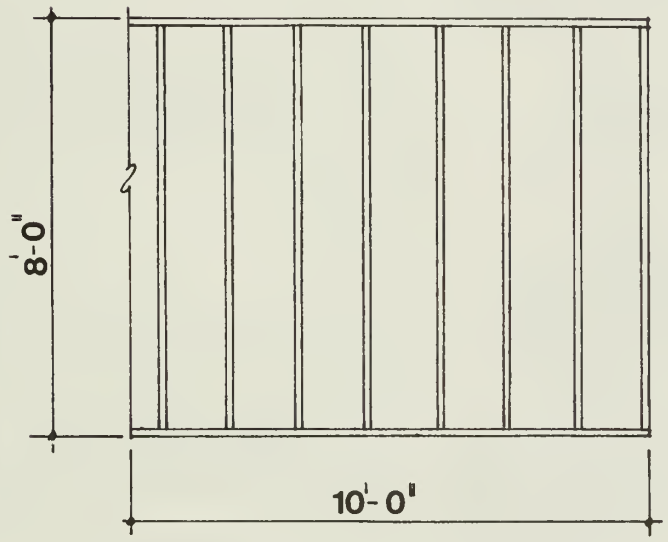
Item	Reference (1)	VALUE Quantity		$/unit (4)	$	MAN YEARS (FTE) (5) CAC Sectors (399 order) No.	Name	$	Producer	Margin
wood frame	A	56	bdft	0.0801	4.49	135	sawmill	14.02	0.0017	0.0011
wood shingles	B	80	SF	0.1191	9.53					
asphalt paper	C	12	lb	0.0140	0.17	184	asphalt felts	0.17	0.0000	0.0000
½" plywood	D	80	SF	0.0745	5.96	139	veneer/plywood	5.96	0.0007	0.0003
gypsum board	E	160	lb	0.0195	3.12	208	gypsum product	3.12	0.0002	0.0001
batt insulation	F	80	SF	0.0392	3.14	214	mineral wool	3.14	0.0002	0.0001
									0.0028	0.0016

x 2111.2 man hours/FTE(6)= 5.9 man hours 3.4 man hours

Notes
(1) see Fig. 9
(2) from 1976 Means Construction Cost Data
(3) quantity from Fig. 9
(4) from EBC Report, pp. 41 - 59
(5) from CAC FTE/$
(6) from Bureau of Labor Statistics

BRICK ON WOOD FRAME WALLS





	Material	Size	Quantity	Embodied Energy (Btu/SF)
A.	Wood Framing	2" x 4"-16" o.c.	56 bd ft	3,486
B.	Brick	common	480	105,004
C.	Building Paper	15#	80 sq ft (12#)	--
D.	Plywood Sheathing	½"	80 sq ft	5,779
E.	Gypsum Wall Board	½"	80 sq ft (160#)	5,297
F.	Batt Insulation	3½"	80 sq ft	6,860
				126,426

Source: EBC Report, p. 97.

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ENERGY IN BUILDING CONSTRUCTION
ERDA Contract No. E (11-1)-2791

date

Subject
Embodied Energy in Typical Building Assemblies - Brick on Wood Frame

by
CAC
RGS & A

Figure 10

TABLE 39 LABOR IN TYPICAL ASSEMBLIES: STUD WALLS: (BRICK VENEER)

DIRECT LABOR

Item	Reference (1)	DAILY OUTPUT (2) Crew	Man Hours	Quantity	WORK REQUIRED Quantity (3)	% of daily Crew Output	Man Hours
wood framing	A	F2	16	0.7 MFBM	0.06 MFBM	0.09	1.4
bricks	B	D2	44	1.45 M	0.48 M	0.33	14.6
asphalt building paper	C	1Carp	8	37 CSF	0.8 CSF	0.02	0.2
plywood sheathing	D	F2	16	1125 SF	80 SF	0.007	1.1
gypsum wall board	E	2Carp	16	1800 SF	80 SF	0.04	0.7
tape and spackle	-	2Carp	16	2000 SF	80 SF	0.04	0.6
paint (2 coats)	-	1Pord	8	715 SF	80 SF	0.11	0.9
batt insulation	F	1Carp	8	1400 SF	80 SF	0.06	0.5
							20.0

EMBODIED LABOR

Item	Reference (1)	VALUE Quantity	$/unit (4)	$	MAN YEARS (FTE) (5) CAC Sectors (399 order) No.	Name	$	Producer	Margin
wood frame	A	56 bdft	0.0801	4.49	135	sawmill	4.49	0.0005	0.0004
brick	B	0.48 M	39.9000	19.15	196	brick & sct	19.15	0.0022	0.0007
asphalt paper	C	12 lb	0.0140	0.17	184	asphalt felts	0.17	0.0000	0.0000
½" plywood	D	80 SF	0.0745	5.96	139	veneer/plywood	5.96	0.0007	0.0003
gypsum board	E	160 lb	0.0195	3.12	208	gypsum product	3.12	0.0002	0.0001
batt insulation	F	80 SF	0.0392	3.14	214	mineral wood	3.14	0.0002	0.0001
								0.0038	0.0016

x 2111.2 man hours/FTE(6)= 8.0 man hours 3.4 man hours

Notes
(1) see Fig. 10
(2) from 1976 Means Construction Cost Data [4]
(3) quantity from Fig. 10
(4) from EBC Report, pp. 41 - 59
(5) from CAC FTE/$
(6) from Bureau of Labor Statistics

TABLE 40 TOTAL LABOR COSTS FTE PER UNIT OF 399-ORDER PRODUCTS TO JOB SITE

INFORMATION FOR COMPUTING TOTAL LABOR COST
PER PHYSICAL UNIT FOR 399-ORDER PRODUCTS
INCLUDING DELIVERY TO NEW BUILDING CONSTRUCTION JOB SITE
(1967; FTE/$ TO FIRST 5 POSITIONS, FTE/$ ELSEWHERE)

399-ORDER INDEX	NAME	TOTAL PRIMARY LABOR INTENSITY (PRODUCER $ BEFORE DELIVERY TO JOB SITE)	LABOR MARGIN FACTOR	TOTAL PRIMARY LABOR INTENSITY (PRODUCER $ AFTER DELIVERY TO JOB SITE)
1	COAL MINING	0.15005E-10	0.0	0.15005E-10
2	CRUDE PETRO. GAS	0.12469E-10	0.0	0.12469E-10
3	PETRO. REFIN. PROD	0.37372E-10	0.36749E-10	0.74321E-10
4	ELECTRIC UTIL	0.26119E-09	0.0	0.26119E-09
5	GAS UTILITIES	0.27680E-10	0.0	0.27680E-10
6	DAIRY	0.14106E-03	0.0	0.14106E-03
7	POULTRY, EGGS	0.14454E-03	0.0	0.14454E-03
8	MEAT, ANIMAL PROD	0.10533E-03	0.0	0.10533E-03
9	COTTON	0.16414E-03	0.0	0.16414E-03
10	FEED GRAINS	0.37760E-04	0.17055E-03	0.25831E-03
11	TOBACCO	0.22103E-03	0.0	0.22103E-03
12	FRUITS	0.16573E-03	0.0	0.16573E-03
13	VEGS, MISC CROPS	0.13801E-03	0.0	0.13801E-03
14	OIL BEARING CROP	0.74479E-04	0.0	0.74479E-04
15	FOR, GRH, OTH, NURS	0.14352E-03	0.15637E-04	0.15916E-03
16	FOREST PROD	0.90538E-04	0.0	0.90538E-04
17	AG FOR, FISH SRS	0.13096E-03	0.0	0.13096E-03
18	IRON ORE MINING	0.66684E-04	0.0	0.66684E-04
19	COPPER MINING	0.78446E-04	0.0	0.78446E-04
20	NONFERR MINING	0.86037E-04	0.0	0.86037E-04
21	STONE, CLAY MIN	0.75954E-04	0.40807E-04	0.11676E-03
22	CHEM MINERAL MIN	0.52341E-04	0.0	0.52341E-04
23	NEW CONST RES--1 FAM.	-0.10000E 01	0.0	-0.10000E 01
24	NEW CONST RES--2-4 FAM.	-0.10000E 01	0.0	-0.10000E 01
25	NEW CONST RES--GRDN APT.	-0.10000E 01	0.0	-0.10000E 01
26	NEW CONST HIGH-RISE APT.	-0.10000E 01	0.0	-0.10000E 01
27	NEW CONST RES--ALT., ADD.	-0.10000E 01	0.0	-0.10000E 01
28	NEW CONST HOTELS, MOTELS	-0.10000E 01	0.0	-0.10000E 01
29	NEW CONST DORMITORIES	-0.10000E 01	0.0	-0.10000E 01
30	NEW CONST INDUST. BLDG.	-0.10000E 01	0.0	-0.10000E 01
31	NEW CONST OFFICE BLDG.	-0.10000E 01	0.0	-0.10000E 01
32	NEW CONST WAREHOUSES	-0.10000E 01	0.0	-0.10000E 01
33	NEW CONST GAR., SERV. STA.	-0.10000E 01	0.0	-0.10000E 01
34	NEW CONST STORES, RESTRNTS	-0.10000E 01	0.0	-0.10000E 01
35	NEW CONST RELIG. BLDG.	-0.10000E 01	0.0	-0.10000E 01
36	NEW CONST EDUC. BLDG.	-0.10000E 01	0.0	-0.10000E 01
37	NEW CONST HOSPITAL BLDG.	-0.10000E 01	0.0	-0.10000E 01
38	NEW CONST OTH. NON-FARM	-0.10000E 01	0.0	-0.10000E 01
39	NEW CONST TELEPH., TELEG.	-0.10000E 01	0.0	-0.10000E 01
40	NEW CONST PIPELINES	-0.10000E 01	0.0	-0.10000E 01
41	NEW CONST ELECT. UTIL.	-0.10000E 01	0.0	-0.10000E 01
42	NEW CONST GAS UTIL.	-0.10000E 01	0.0	-0.10000E 01
43	NEW CONST PETROL. PIPE.	-0.10000E 01	0.0	-0.10000E 01
44	NEW CONST WATER SUPPLY	-0.10000E 01	0.0	-0.10000E 01
45	NEW CONST SEWER	-0.10000E 01	0.0	-0.10000E 01
46	NEW CONST LOC. TRANSIT	-0.10000E 01	0.0	-0.10000E 01
47	NEW CONST HIGHWAYS	-0.10000E 01	0.0	-0.10000E 01
48	NEW CONST FARM RESID.	-0.10000E 01	0.0	-0.10000E 01
49	NEW CONST FARM SERVICE	-0.10000E 01	0.0	-0.10000E 01
50	NEW CONST OIL/GAS WELLS	-0.10000E 01	0.0	-0.10000E 01
51	NEW CONST OIL/GAS EXPL.	-0.10000E 01	0.0	-0.10000E 01
52	NEW CONST MILITARY	-0.10000E 01	0.0	-0.10000E 01
53	NEW CONST CONS., DEV.	-0.10000E 01	0.0	-0.10000E 01
54	NEW CONST OTH. NON-PLDG.	-0.10000E 01	0.0	-0.10000E 01
55	MAINT CONST RESID.	-0.10000E 01	0.0	-0.10000E 01
56	MAINT CONST OTH. NON-FRM	-0.10000E 01	0.0	-0.10000E 01
57	MAINT CONST FARM RESID.	-0.10000E 01	0.0	-0.10000E 01
58	MAINT CONST FARM SERVICE	-0.10000E 01	0.0	-0.10000E 01
59	MAINT CONST TEL., TEL.	-0.10000E 01	0.0	-0.10000E 01
60	MAINT CONST RAILROADS	-0.10000E 01	0.0	-0.10000E 01
61	MAINT CONST ELECT. UTIL.	-0.10000E 01	0.0	-0.10000E 01
62	MAINT CONST GAS UTIL.	-0.10000E 01	0.0	-0.10000E 01
63	MAINT CONST PETRO. PROD.	-0.10000E 01	0.0	-0.10000E 01
64	MAINT CONST WATER SUPPLY	-0.10000E 01	0.0	-0.10000E 01
65	MAINT CONST SEWER	-0.10000E 01	0.0	-0.10000E 01
66	MAINT CONST LOC. TRANSIT	-0.10000E 01	0.0	-0.10000E 01
67	MAINT CONST MILITARY	-0.10000E 01	0.0	-0.10000E 01
68	MAINT CONST CONSRV., DEV.	-0.10000E 01	0.0	-0.10000E 01
69	MAINT CONST HIGHWAYS	-0.10000E 01	0.0	-0.10000E 01
70	MAINT CONST OIL/GS WELLS	-0.10000E 01	0.0	-0.10000E 01
71	MAINT CONST OTH. N-BLDG.	-0.10000E 01	0.0	-0.10000E 01
72	GUIDED MISSILES	0.75526E-04	0.0	0.75526E-04
73	AMMUNITION	0.75739E-04	0.0	0.75739E-04
74	TANKS	0.78808E-04	0.0	0.78808E-04
75	PERS CONTROL EQ	0.83637E-04	0.0	0.83637E-04
76	SMALL ARMS	0.75525E-04	0.0	0.75525E-04
77	SMALL ARMS AMMUN	0.73612E-04	0.0	0.73612E-04
78	OTHER ORDNANCE	0.75813E-04	0.0	0.75813E-04
79	MEAT PRODUCTS	0.10989E-03	0.0	0.10989E-03
80	BUTTER	0.13035E-03	0.0	0.13035E-03
81	CHEESE	0.12318E-03	0.0	0.12318E-03
82	CONDENSED MILK	0.10151E-03	0.0	0.10151E-03
83	ICE CREAM	0.10399E-03	0.0	0.10399E-03
84	FLUID MILK	0.12078E-03	0.0	0.12078E-03
85	CANNED SEA FOODS	0.99909E-04	0.0	0.99909E-04
86	CANNED SPECIALTY	0.93259E-04	0.0	0.93259E-04
87	CANNED FRUITS, VEG	0.10395E-03	0.0	0.10395E-03
88	DEHYDRATED FOOD	0.11043E-03	0.0	0.11043E-03
89	PICKLES, DRESSING	0.97993E-04	0.0	0.97993E-04
90	FISH	0.11316E-03	0.0	0.11316E-03
91	FROZEN FRUIT, VEG	0.99692E-04	0.0	0.99692E-04
92	FLOUR, CEREALS	0.76086E-04	0.0	0.76086E-04
93	PREP ANIMAL FEED	0.87449E-04	0.0	0.87449E-04
94	RICE MILLING	0.84294E-04	0.0	0.84294E-04
95	WET CORN MILLING	0.74169E-04	0.0	0.74169E-04
96	BAKERY PRODUCTS	0.81786E-04	0.0	0.81786E-04
97	SUGAR	0.90397E-04	0.0	0.90397E-04
98	CONFECTIONERY	0.80422E-04	0.0	0.80422E-04
99	ALCOHOLIC BEV	0.44266E-04	0.0	0.44266E-04
100	SOFT DRINKS	0.88160E-04	0.0	0.88160E-04
101	FLAVORINGS	0.56089E-04	0.0	0.56089E-04
102	COTTONSEED MILLS	0.15134E-03	0.0	0.15134E-03
103	SOYBEAN MILLS	0.77369E-04	0.0	0.77369E-04
104	VEG OIL MILLS	0.71673E-04	0.0	0.71673E-04
105	ANIMAL FATS	0.92717E-04	0.0	0.92717E-04

TABLE 40 (cont'd) TOTAL LABOR COSTS FTE PER UNIT OF 399-ORDER PRODUCTS TO JOB SITE

126	COPPER	0.29827E-04	0.0		0.29827E-04
127	COOKING OILS	0.81334E-04	0.0		0.81334E-04
128	VARIETY/SUNDRY IDF	0.14176E-03	0.0		0.14176E-03
129	MACARONI	0.86110E-04	0.0		0.86110E-04
130	FOOD PREPARATION	0.81455E-04	0.0		0.81455E-04
131	SUGAR BEETS	0.67838E-04	0.0		0.67838E-04
132	TOBACCO STEMMING	0.18563E-03	0.0		0.18563E-03
133	BROAD WVN MILLS	0.11347E-03	0.67691E-05		0.12024E-03
134	NAR FABRIC MILLS	0.11523E-03	0.0		0.11523E-03
135	YARN MILLS	0.10653E-03	0.0		0.10853E-03
136	THREAD MILLS	0.10961E-03	0.0		0.10961E-03
137	FLOOR COVERINGS	0.94337E-04	0.12691E-04		0.10703E-03
138	FELT GOODS	0.92546E-04	0.0		0.92546E-04
139	LACE GOODS	0.13928E-03	0.0		0.13928E-03
140	UPHOLSTERY MILL	0.95145E-04	0.0		0.95145E-04
141	PROC FROM WASTE	0.98898E-04	0.0		0.98898E-04
142	COATED FABRICS	0.83081E-04	0.87820E-05		0.91863E-04
143	TIRE CORD	0.89849E-04	0.0		0.89849E-04
144	SCOURING PLANTS	0.87438E-04	0.0		0.87438E-04
145	CORDAGE, TWINE	0.10360E-03	0.22042E-04		0.12564E-03
146	TEXTILE GOODS	0.82898E-04	0.0		0.82898E-04
147	HOSIERY	0.13803E-03	0.0		0.13803E-03
148	KNIT APPRL MILLS	0.12595E-03	0.0		0.12595E-03
149	KNIT FAB MILLS	0.93398E-04	0.0		0.93398E-04
150	APPARL, PURCH MAT	0.14023E-03	0.13834E-04		0.15423E-03
151	CURTAINS	0.12470E-03	0.0		0.12470E-03
152	HOUSEFURNISHINGS	0.11382E-03	0.0		0.11382E-03
153	FAB TEXTILE PROD	0.11286E-03	0.0		0.11286E-03
154	LOGGING	0.86944E-04	0.0		0.86944E-04
155	SAWMILLS	0.11980E-03	0.75951E-04		0.19575E-03
156	HARDWD PICKING	0.14755E-03	0.78387E-04		0.22593E-03
157	SPEC PROD SAWMIL	0.12754E-03	0.51557E-04		0.17909E-03
158	MILLWORK	0.11477E-03	0.45587E-04		0.16036E-03
159	VENEER, PLYWOOD	0.11055E-03	0.52925E-04		0.16347E-03
160	PREFAB WD STRUC	0.11037E-03	0.22611E-04		0.13298E-03
161	WOOD PRESERVING	0.99755E-04	0.13359E-04		0.11311E-03
162	WOOD PRODUCTS	0.11622E-03	0.42833E-04		0.15915E-03
163	WOOD CONTAINERS	0.14442E-03	0.0		0.14442E-03
164	WOOD HOUSEHLD FURN	0.12475E-03	0.59902E-05		0.13174E-03
165	UPH HOUSEHOLD FURN	0.12461E-03	0.0		0.12481E-03
166	MET HOUSEHOLD FURN	0.10455E-03	0.10606E-04		0.11515E-03
167	MATTRESSES	0.11189E-03	0.0		0.11189E-03
168	WOOD OFC FURN	0.10304E-03	0.0		0.10304E-03
169	METAL OFC FURN	0.87873E-04	0.0		0.87873E-04
170	PUBLIC BLDG FURN	0.11562E-03	0.14436E-04		0.13006E-03
171	WOOD FIXTURES	0.10499E-03	0.99133E-05		0.11490E-03
172	MET FIXTURES	0.99502E-04	0.12490E-04		0.10269E-03
173	BLINDS, SHADES	0.11011E-03	0.0		0.11011E-03
174	FURN, FIXTURES	0.10687E-03	0.0		0.10687E-03
175	PULP MILLS	0.79994E-04	0.0		0.79994E-04
176	PAPER MILLS	0.82983E-04	0.0		0.82983E-04
177	PAPERBOARD MILLS	0.70050E-04	0.0		0.70050E-04
178	ENVELOPES	0.95903E-04	0.23740E-04		0.11964E-03
179	SANIT PAPER PROD	0.65356E-04	0.0		0.65356E-04
180	BUILDING PAPER	0.94970E-04	0.91135E-04		0.18608E-03
181	CONV PAPER PROD	0.79724E-04	0.17099E-04		0.96822E-04
182	PAPERBOARD CONT	0.83018E-04	0.0		0.83018E-04
183	NEWSPAPERS	0.10445E-03	0.0		0.10445E-03
184	PERIODICALS	0.82106E-04	0.0		0.82106E-04
185	BOOK PUBLISHING	0.84956E-04	0.13916E-04		0.98873E-04
186	MISC PUBLISHING	0.86646E-04	0.0		0.86646E-04
187	COMM PRINTING	0.95910E-04	0.0		0.95910E-04
188	BUSINESS FORMS	0.83081E-04	0.0		0.83081E-04
189	GREETING CARDS	0.89395E-04	0.0		0.89395E-04
190	MISC PRINTING	0.10624E-03	0.0		0.10624E-03
191	INORG-ORG CHEM	0.58119E-04	0.57955E-05		0.63915E-04
192	FERTILIZERS	0.71420E-04	0.0		0.71420E-04
193	AG CHEMICALS	0.62003E-04	0.0		0.62003E-04
194	MISC CHEM PROD	0.76234E-04	0.14913E-04		0.91147E-04
195	PLASTICS	0.70513E-04	0.0		0.70513E-04
196	SYN RUBBER	0.60424E-04	0.0		0.60424E-04
197	MAN-MADE FIBERS	0.78212E-04	0.0		0.78212E-04
198	ORGANIC FIBERS	0.69603E-04	0.0		0.69603E-04
199	DRUGS	0.63598E-04	0.0		0.63598E-04
200	CLEANING PREP	0.65859E-04	0.0		0.65859E-04
201	TOILET PREP	0.79500E-04	0.0		0.79500E-04
202	PAINT PRODUCTS	0.70020E-04	0.69533E-04		0.13955E-03
203	PAVING	0.63967E-04	0.78470E-05		0.71814E-04
204	ASPHALT	0.79454E-04	0.37233E-04		0.11669E-03
205	TIRES	0.64041E-04	0.38561E-04		0.10260E-03
206	RUBBER FOOTWEAR	0.10814E-03	0.0		0.10814E-03
207	MISC RUBBER PROD	0.88385E-04	0.40087E-04		0.12907E-03
208	MISC PLASTICS	0.84598E-04	0.31626E-04		0.11622E-03
209	INDUST LEATHER	0.64539E-04	0.0		0.64539E-04
210	FOOTWEAR CUT STK	0.10003E-03	0.0		0.10003E-03
211	FOOTWEAR EXC RUB	0.12214E-03	0.0		0.12214E-03
212	MISC LEATHER	0.11198E-03	0.0		0.12198E-03
213	GLASS PRODUCTS	0.81485E-04	0.42557E-04		0.12404E-03
214	GLASS CONTAINERS	0.84872E-04	0.0		0.84872E-04
215	CEMENT	0.69821E-04	0.31400E-04		0.10122E-03
216	BRICKS	0.11417E-03	0.35584E-04		0.14976E-03
217	CERAMIC TILE	0.11517E-03	0.25883E-04		0.14106E-03
218	CLAY REFRACT	0.10154E-03	0.14012E-04		0.11555E-03
219	CLAY PRODUCTS	0.10159E-03	0.37464E-04		0.13905E-03
220	PLUMBING FIXTURE	0.74977E-04	0.44225E-04		0.11920E-03
221	FOOD UTENSILS	0.13454E-03	0.0		0.13454E-03
222	PORCEL ELEC SUPP	0.86684E-04	0.0		0.86684E-04
223	POTTERY PRODUCTS	0.12813E-03	0.0		0.12813E-03
224	CONCRETE BLOCKS	0.98653E-04	0.33680E-04		0.12233E-03
225	CONCRETE PRODUCT	0.86934E-04	0.17488E-04		0.10442E-03
226	READY-MIX CONCR	0.79871E-04	0.16730E-05		0.81544E-04
227	LIME	0.78872E-04	0.83481E-04		0.16235E-03
228	GYPSUM PRODUCTS	0.68416E-04	0.38917E-04		0.10733E-03
229	STONE PRODUCTS	0.10896E-03	0.20266E-04		0.12923E-03
230	ABRASIVE PRODUCT	0.82346E-04	0.49974E-04		0.13232E-03
231	ASBESTOS PRODUCT	0.84725E-04	0.49921E-04		0.13465E-03
232	GASKETS	0.98740E-04	0.20143E-04		0.11888E-03
233	TREATED MINERALS	0.89057E-04	0.60744E-04		0.14980E-03
234	MINERAL WOOL	0.76986E-04	0.37470E-04		0.11446E-03
235	NONCLAY REFRACT	0.79304E-04	0.12575E-04		0.91879E-04
236	NONMET MIN PROD	0.97145E-04	0.28476E-04		0.12562E-03
237	STEEL PROD	0.74103E-04	0.26551E-04		0.10065E-03
238	IR,STL FOUNDRIES	0.85422E-04	0.46492E-05		0.90051E-04
239	IR,STL FORGING	0.82557E-04	0.0		0.82557E-04

TABLE 40 (cont'd) TOTAL LABOR COSTS FTE PER UNIT OF 399-ORDER PRODUCTS TO JOB SITE

220	PRIMARY MET PROD	0.65527E-04	0.64993E-04	0.13052E-03
221	PRIMARY COPPER	0.71304E-04	0.0	0.71304E-04
222	PRIMARY LEAD	0.67114E-04	0.0	0.67114E-04
223	PRIMARY ZINC	0.82339E-04	0.0	0.82339E-04
224	PRIM ALUMINUM	0.65902E-04	0.0	0.65902E-04
225	PRIM NONFER MET	0.65035E-04	0.0	0.65035E-04
226	SEC NONFERR MET	0.52566E-04	0.0	0.52566E-04
227	COPPER ROLLING	0.67580E-04	0.49577E-05	0.72538E-04
228	ALUM ROLLING	0.75220E-04	0.66707E-05	0.81891E-04
229	NONFER ROLLING	0.70930E-04	0.43050E-05	0.75235E-04
230	NONFER WIRE	0.68860E-04	0.73549E-05	0.76215E-04
231	ALUM CASTINGS	0.88768E-04	0.0	0.88768E-04
232	BRASS,BRZ CAST	0.82308E-04	0.0	0.82308E-04
233	NONFER CASTING	0.85078E-04	0.0	0.85078E-04
234	NONFER FORGING	0.77474E-04	0.0	0.77474E-04
235	METAL CANS	0.74747E-04	0.0	0.74747E-04
236	METAL BARRELS	0.86552E-04	0.0	0.86552E-04
237	METAL SANIT WARE	0.10517E-03	0.39384E-04	0.14456E-03
238	PLUMB FITTINGS	0.10723E-03	0.35952E-04	0.14319E-03
239	HEATING EQUIP	0.94208E-04	0.38183E-04	0.13239E-03
240	FAB STRUC STEEL	0.90388E-04	0.88039E-05	0.99191E-04
241	METAL DOORS	0.98532E-04	0.27040E-04	0.12557E-03
242	FAB PLATE WORK	0.89585E-04	0.54654E-05	0.95050E-04
243	SHEET METAL WORK	0.90705E-04	0.17006E-04	0.10771E-03
244	ARCH METAL WORK	0.90364E-04	0.10455E-04	0.10082E-03
245	MISC METAL WORK	0.76083E-04	0.15435E-04	0.91518E-04
246	SCREW MACH PROD	0.79737E-04	0.51859E-04	0.13160E-03
247	METAL STAMPINGS	0.83758E-04	0.39414E-05	0.87699E-04
248	CUTLERY	0.77814E-04	0.0	0.77814E-04
249	HANDTOOLS	0.90136E-04	0.24304E-04	0.11444E-03
250	HARDWARE	0.80280E-04	0.55099E-04	0.13538E-03
251	COAT, ENGRAV SER	0.10043E-03	0.0	0.10043E-03
252	FAB WIRE PRODUCT	0.88403E-04	0.28378E-04	0.11678E-03
253	SAFES, VAULTS	0.66082E-04	0.0	0.66082E-04
254	STEEL SPRINGS	0.72047E-04	0.0	0.72047E-04
255	PIPE	0.74273E-04	0.19367E-04	0.93640E-04
256	COLLAPSIBLE TUBE	0.95358E-04	0.0	0.95358E-04
257	METAL FOIL, LEAF	0.70921E-04	0.0	0.70921E-04
258	FAB METAL PROD	0.76140E-04	0.0	0.76140E-04
259	STEAM ENGINES	0.78926E-04	0.0	0.78926E-04
260	INT COMBUST ENG	0.82526E-04	0.0	0.82526E-04
261	FARM MACHINERY	0.85802E-04	0.0	0.85802E-04
262	CONST MACHINERY	0.76540E-04	0.28757E-04	0.10530E-03
263	MINING MACHINERY	0.87229E-04	0.0	0.87229E-04
264	OIL FIELD MACH	0.87467E-04	0.0	0.87467E-04
265	ELEVATORS	0.92265E-04	0.81522E-05	0.10042E-03
266	CONVEYORS	0.84775E-04	0.68480E-05	0.91623E-04
267	HOISTS, CRANES	0.76017E-04	0.51916E-05	0.81208E-04
268	INDUSTRIAL TRUCK	0.88728E-04	0.0	0.88728E-04
269	MET CUTTING TOOL	0.78117E-04	0.0	0.78117E-04
270	MET FORMING TOOL	0.83839E-04	0.0	0.83839E-04
271	SPECIAL DIE TOOL	0.85694E-04	0.13916E-04	0.99610E-04
272	METWORKING MACH	0.87124E-04	0.0	0.87124E-04
273	FOOD PROD MACH	0.91384E-04	0.0	0.91384E-04
274	TEXTILE MACH	0.10728E-03	0.0	0.10728E-03
275	WOODWORKING MACH	0.80639E-04	0.0	0.80639E-04
276	PAPER IND MACH	0.90847E-04	0.0	0.90847E-04
277	PRINTING MACH	0.79300E-04	0.0	0.79300E-04
278	SPECIAL IND MACH	0.73900E-04	0.0	0.73900E-04
279	PUMPS,COMPRESORS	0.84060E-04	0.43135E-04	0.12719E-03
280	BEARINGS	0.86515E-04	0.0	0.86515E-04
281	BLOWERS	0.10186E-03	0.87247E-05	0.11058E-03
282	INDUST PATTERNS	0.84816E-04	0.0	0.84816E-04
283	POWER TRANS EQ	0.80588E-04	0.0	0.80588E-04
284	INDUS FURNACES	0.84443E-04	0.0	0.84443E-04
285	GENERAL IND MACH	0.82021E-04	0.0	0.82021E-04
286	MACH SHOP PROD	0.99876E-04	0.87622E-05	0.10864E-03
287	COMPUTING MACH	0.91861E-04	0.0	0.91861E-04
288	TYPEWRITERS	0.70118E-04	0.0	0.70118E-04
289	SCALES	0.86686E-04	0.0	0.86686E-04
290	OFC MACHINES	0.76504E-04	0.0	0.76504E-04
291	MERCHNDISE MACH	0.10229E-03	0.0	0.10229E-03
292	LAUNDRY EQUIP	0.91954E-04	0.0	0.91954E-04
293	REFRIG MACH	0.79622E-04	0.11075E-04	0.90697E-04
294	MEASURING PUMPS	0.90877E-04	0.0	0.90877E-04
295	SERVICE IND MACH	0.84011E-04	0.0	0.84011E-04
296	ELEC MEAS INSTR	0.92534E-04	0.0	0.92534E-04
297	TRANSFORMERS	0.85125E-04	0.10212E-04	0.95337E-04
298	SWITCHGEAR	0.86338E-04	0.66657E-05	0.93003E-04
299	MOTORS,GENERATOR	0.88461E-04	0.0	0.88461E-04
300	IND CONTROLS	0.92915E-04	0.0	0.92915E-04
301	WELDING APPARAT	0.63084E-04	0.22727E-04	0.85811E-04
302	CARBON PRODUCTS	0.80556E-04	0.0	0.80556E-04
303	ELEC IND APPARAT	0.88214E-04	0.0	0.88214E-04
304	H'HOLD COOK EQ	0.91510E-04	0.0	0.91510E-04
305	H'HOLD REFRIG EQ	0.85804E-04	0.0	0.85804E-04
306	H'HOLD LAUNDRY	0.82437E-04	0.0	0.82437E-04
307	ELECTRIC H'WARES	0.93948E-04	0.12670E-04	0.10662E-03
308	H'HOLD VACUUMS	0.68359E-04	0.44301E-04	0.11266E-03
309	SEWING MACHINES	0.10787E-03	0.0	0.10787E-03
310	H'HOLD APPLIANCE	0.81619E-04	0.13591E-04	0.95409E-04
311	ELECTRIC LAMPS	0.79352E-04	0.82233E-05	0.88075E-04
312	LIGHT FIXTURES	0.87380E-04	0.20047E-04	0.10743E-03
313	WIRING DEVICES	0.10821E-03	0.21352E-04	0.12956E-03
314	RADIO,TV SETS	0.99864E-04	0.0	0.99864E-04
315	PHONO RECORDS	0.12044E-03	0.0	0.12044E-03
316	PHONE,TELEGR EQ	0.87385E-04	0.0	0.87385E-04
317	R-TV COMMUN EQ	0.82420E-04	0.16847E-05	0.84079E-04
318	ELECTRON TUBES	0.90119E-04	0.0	0.90119E-04
319	SEMICONDUCTORS	0.98395E-04	0.0	0.98395E-04
320	ELECTRONIC COMP	0.95874E-04	0.0	0.95874E-04
321	STORAGE BATTERY	0.85537E-04	0.17405E-04	0.10294E-03
322	PRIMARY BATTERY	0.73419E-04	0.13916E-04	0.87336E-04
323	X-RAY EQUIPMENT	0.72298E-04	0.0	0.72298E-04
324	ENGINE ELEC EQ	0.84555E-04	0.30210E-04	0.11476E-03
325	ELECTRICAL EQUIP	0.90051E-04	0.48637E-04	0.13869E-03
326	TRUCK,BUS BODIES	0.10537E-03	0.0	0.10537E-03
327	TRUCK TRAILERS	0.92754E-04	0.0	0.92754E-04
328	MOTOR VEH & PART	0.73435E-04	0.0	0.73435E-04
329	AIRCRAFT	0.92248E-04	0.0	0.92248E-04
330	AIRCRAFT ENGINES	0.88608E-04	0.0	0.88608E-04
331	AIRCRAFT PROPELL	0.10968E-03	0.0	0.10968E-03
332	AIRCRAFT EQUIP	0.74050E-04	0.0	0.74050E-04
333	SHIPBUILDING	0.97864E-04	0.0	0.97864E-04

TABLE 40 (cont'd) TOTAL LABOR COSTS FTE PER UNIT OF 399-ORDER PRODUCTS TO JOB SITE

334	BOATBUILDING	0.11546E-03	0.0	0.11546E-03
335	LOCOMOTIVES	0.74546E-04	0.0	0.74546E-04
336	RR, STREET CARS	0.80600E-04	0.0	0.80600E-04
337	MOTOR, BICYCLES	0.89875E-04	0.0	0.89875E-04
338	TRAILER COACHES	0.97531E-04	0.0	0.97531E-04
339	TRANSPORT EQUIP	0.91661E-04	0.45228E-04	0.13689E-03
340	SCIEN INSTR	0.12450E-03	0.0	0.12450E-03
341	MECH MEAS DEVICE	0.90433E-04	0.0	0.90433E-04
342	TEMP CONTROLS	0.10416E-03	0.72368E-05	0.11140E-03
343	MEDICAL INSTR	0.83463E-04	0.0	0.83463E-04
344	SURGICAL SUPPLY	0.90401E-04	0.0	0.90401E-04
345	DENTAL EQUIPMENT	0.89473E-04	0.0	0.89473E-04
346	WATCHES, CLOCKS	0.99918E-04	0.12061E-04	0.11198E-03
347	OPTICAL INSTR	0.87599E-04	0.0	0.87599E-04
348	OPHTHALMIC GOODS	0.11493E-03	0.0	0.11493E-03
349	PHOTOGRAPHIC EQ	0.57842E-04	0.0	0.57842E-04
350	JEWELRY	0.82829E-04	0.0	0.82829E-04
351	MUSICAL INSTR	0.12507E-03	0.0	0.12507E-03
352	GAMES	0.10489E-03	0.0	0.10489E-03
353	ATHLETIC EQUIP	0.10459E-03	0.0	0.10459E-03
354	PENS AND PENCILS	0.96627E-04	0.0	0.96627E-04
355	ARTIFICAL FLOWER	0.11237E-03	0.0	0.11237E-03
356	CLOTH PASTIERES	0.11718E-03	0.0	0.11718E-03
357	BRUSHES	0.10094E-03	0.21693E-04	0.12264E-03
358	HARD FLOOR COV	0.73789E-04	0.32448E-04	0.10624E-03
359	MORTICIAN GOODS	0.11854E-03	0.0	0.11854E-03
360	SIGNS, ADS	0.10143E-03	0.24790E-04	0.12622E-03
361	MISC MFG	0.10885E-03	0.60304E-05	0.11488E-03
362	RAILROAD	0.86542E-04	0.0	0.86542E-04
363	LOCAL TRANSPORT	0.97602E-04	0.0	0.97602E-04
364	MOTOR FGT TRANSP	0.79023E-04	0.0	0.79023E-04
365	WATER TRANSPORT	0.10330E-03	0.0	0.10330E-03
366	AIR TRANSPORT	0.72006E-04	0.0	0.72006E-04
367	PIPE LINE TRANSP	0.37862E-04	0.0	0.37862E-04
368	TRANSP SERVICES	0.11018E-03	0.0	0.11018E-03
369	COMMUNICATIONS	0.57837E-04	0.0	0.57837E-04
370	R-TV BROADCAST	0.85090E-04	0.0	0.85090E-04
371	WATER,SANIT SER	0.77823E-04	0.0	0.77823E-04
372	WHOLSALE TRADE	0.90456E-04	0.0	0.90456E-04
373	RETAIL TRADE	0.12127E-03	0.0	0.12127E-03
374	BANKING	0.78195E-04	0.0	0.78195E-04
375	CREDIT AGENCIES	0.19241E-03	0.0	0.19241E-03
376	SEC, COMMOD BROK	0.45711E-04	0.0	0.45711E-04
377	INSUR CARRIERS	0.87860E-04	0.0	0.87860E-04
378	INSURANCE AGENTS	0.70779E-04	0.0	0.70779E-04
379	OWNER-OCC DWLNG	0.12728E-03	0.0	0.12728E-03
380	REAL ESTATE	0.41886E-04	0.0	0.41886E-04
381	HOTELS	0.22044E-03	0.0	0.22044E-03
382	PERSONAL SERVICE	0.12859E-03	0.0	0.12859E-03
383	BARB,BEAUT SHOPS	0.13417E-03	0.0	0.13417E-03
384	MISC BUS SERVICE	0.92811E-04	0.0	0.92811E-04
385	ADVERTISING	0.92513E-04	0.0	0.92513E-04
386	MISC PROF SER	0.69666E-04	0.0	0.69666E-04
387	AUTO REPAIR	0.70771E-04	0.0	0.70771E-04
388	MOTION PICTURE	0.11534E-03	0.0	0.11534E-03
389	AMUSMNT,REC SER	0.11472E-03	0.0	0.11472E-03
390	DOCTORS,DENTISTS	0.52731E-04	0.0	0.52731E-04
391	HOSPITALS	0.18173E-03	0.0	0.18173E-03
392	MED, HEALTH SER	0.12233E-03	0.0	0.12233E-03
393	EDUCATIONAL SER	0.16170E-03	0.0	0.16170E-03
394	NONPROFIT ORG	0.15105E-03	0.0	0.15105E-03
395	POST OFFICE	0.16014E-03	0.0	0.16014E-03
396	FED GOVT ENTERP	0.38027E-04	0.0	0.38027E-04
397	ST,LOC GOVT ENTR	0.86056E-04	0.0	0.86056E-04
398	BUSINESS TRAVEL	0.10252E-03	0.53034E-04	0.15555E-03
399	OFFICE SUPPLIES	0.84786E-04	0.21433E-04	0.10622E-03

***** FRAN3000 *** 299 ***** BIN 97 ***** BARR SEGAL ***** BIN 97 ***** 1.45.37 PM * 10 JUN 77 ****** END

Source: CAC.

IVC Disaggregation of Refined Petroleum

DISAGGREGATION OF REFINED PETROLEUM

The disaggregation of Asphalt and Road Oil from the Refined Petroleum sector transactions to Construction sectors was determined by applying data supplied by BEA and CAC. BEA records provided the 1967 dollar value of each refined petroleum product for each building type (Table 41). Table 42 explains the derivation of the quantities for each product as follows. An assumed 1967 unit cost ($/Million Btu) was established for each petroleum product, based on overall 1967 records. These unit costs were divided into the BEA dollar values to establish the proportional divisions among the different petroleum products in each building type category. The total Btu of direct petroleum products was obtained from the CAC model.* This was divided among the various products in accordance with the proportioning noted above. This established the end use Btu expenditure in each of the petroleum product categories, and by multiplying these by 1.198, the average ratio between source energy and end use energy for petroleum products, the source energy value of each product was established. The results are summarized on Table 43.

*EBC Report, p. 132.

TABLE 41 REFINED PETROLEUM PRODUCT TRANSFERS TO CONSTRUCTION SECTORS IN 1967

Source: Bureau of Economic Analysis, Figures in Millions of Dollars
Producers Value
(1) Excise tax to manufacturer in parentheses ( )

399 ORDER SECTOR	TYPE OF CONSTRUCTION	ASPHALT	ROAD OIL	MOTOR & OTHER GASOLINE (1)	DISTILLATE FUEL OIL	LIQUIFIED PETROLEUM GASES	LUBRICATING OILS (1)	LUBRICATING GREASES	TOTAL
23	Residential-1 Family	24.6	0.2	25.5 (4.8)	0.7	0.0	0.3	0.0	56.1
24	Residential-2 to 4 Family	1.4	0.1	1.2 (0.2)	0.0	0.0	0.0	0.0	2.9
25	Residential-Garden Apt	7.2	0.4	4.8 (0.9)	0.2	0.0	0.1	0.0	13.6
26	Residential-Highrise Apt	5.7	0.1	5.3 (1.0)	0.1	0.0	0.1	0.0	12.3
27	Residential-Alt & Addn's	2.5	0.0	1.9 (0.4)	0.6	0.0	0.1	0.0	5.5
28	Hotel/Motel	3.5	0.1	3.3 (0.6)	0.0	0.0	0.1	0.0	7.6
29	Dormitories	3.2	0.1	2.8 (0.5)	0.1	0.0	0.1	0.0	6.8
30	Industrial	8.2	0.6	11.2 (2.1)	2.1	0.5	0.6 (0.1)	0.0	25.4
31	Office Buildings	12.9	0.2	12.4 (2.3)	0.3	0.5	0.4	0.0	29.0
32	Warehouses	1.6	0.2	1.8 (0.3)	0.3	0.0	0.1	0.0	4.3
33	Garage/Service Station	1.4	0.1	1.5 (0.2)	0.1	0.0	0.0	0.0	3.3
34	Store/Restaurant	10.0	0.5	10.5 (2.0)	0.6	0.0	0.4	0.0	24.0
35	Religious Buildings	3.0	0.0	3.1 (0.6)	0.2	0.0	0.1	0.0	7.0
36	Educational Buildings	18.6	0.6	18.3 (3.5)	0.4	0.0	0.4	0.0	41.8
37	Hospital Buildings	5.6	0.1	4.9 (0.9)	0.0	0.0	0.0	0.0	11.5
38	Other Non-Farm Buildings	11.0	0.1	11.2 (2.1)	0.7	0.0	0.4	0.0	25.5
39	Telephone/Telegraph	3.5	0.5	3.5 (0.6)	0.4	0.0	0.2	0.0	8.7
40	Railroad	0.6	0.1	0.8 (0.2)	0.2	0.0	0.1	0.0	2.0
41	Electric Utilities	7.9	0.4	13.7 (2.6)	1.8	0.0	0.4 (0.1)	0.0	26.9
42	Gas Utilities	4.3	0.5	26.0 (4.9)	6.4	0.0	1.6 (0.5)	0.1	44.3

(cont'd)

TABLE 41 REFINED PETROLEUM PRODUCT TRANSFERS TO CONSTRUCTION SECTORS IN 1967

Source: Bureau of Economic Analysis, Figures in Millions of Dollars
Producers Value
(1) Excise tax to manufacturer in parentheses ( )

399 ORDER SECTOR	TYPE OF CONSTRUCTION	ASPHALT	ROAD OIL	MOTOR & OTHER GASOLINE (1)	DISTILLATE FUEL OIL	LIQUIFIED PETROLEUM GASES	LUBRICATING OILS	LUBRICATING GREASES	TOTAL
43	Petroleum Pipeline	0.6	0.1	6.8 (1.3)	1.9	0.0	0.5 (0.1)	0.0	11.3
44	Water Supply	2.5	0.2	6.0 (1.1)	1.2	0.0	0.2 (0.1)	0.0	11.3
45	Sewers	2.9	0.2	5.9 (1.1)	0.7	0.0	0.3	0.0	11.1
45	Local Transport	0.5	0.0	0.9 (0.1)	0.1	0.0	0.0	0.0	1.6
47	Highways	53.1	10.2	151.3 (28.4)	40.2	0.0	8.1 (1.9)	0.2	293.4
48	Farm Residential	0.4	0.0	0.4 (0.1)	0.1	0.0	0.0	0.0	1.0
49	Farm Service	0.4	0.1	0.9 (0.2)	0.3	0.0	0.1	0.0	2.0
50	Oil/Gas Wells	2.4	0.1	33.3 (6.3)	7.6	0.0	1.4 (0.4)	0.0	51.5
51	Oil/Gas Exploration	0.6	0.0	8.4 (1.6)	0.6	0.0	0.2	0.0	11.4
52	Military	2.2	0.2	3.4 (0.6)	0.7	0.0	0.2	0.0	7.3
53	Conservation & Dev	4.1	0.2	41.3 (7.8)	9.2	0.0	1.9 (0.6)	0.1	65.2
54	Other Non-Building	4.4	0.5	9.8 (1.8)	2.2	0.0	0.6 (0.1)	0.0	19.4
55	M + R/Residential	6.9	0.1	7.6 (1.4)	0.0	0.4	0.0	0.0	16.4
56	M + R/Other Non-Farm Bldg	7.1	0.3	16.9 (3.2)	2.9	0.0	0.7 (0.3)	0.0	31.4
57	M + R/Farm Residence	0.6	0.0	0.7 (0.1)	0.0	0.0	0.0	0.0	1.4
58	M + R/Farm Service	0.6	0.2	0.3	0.3	0.0	0.0	0.0	1.4
59	M + R/Telephone & Telegraph	0.6	0.1	0.8 (0.2)	0.3	0.0	0.1	0.0	2.1
60	M + R/Railroad	0.6	0.1	2.3 (0.4)	0.6	0.0	0.2	0.0	4.2
61	M + R/Electric Utilities	0.5	0.0	0.8 (0.1)	0.2	0.0	0.1	0.0	1.7
62	M + R/Gas Utilities	0.7	0.2	1.9 (0.4)	0.7	0.0	0.3	0.0	4.2

(cont'd)

TABLE 41 REFINED PETROLEUM PRODUCT TRANSFERS TO CONSTRUCTION SECTORS IN 1967

Source: Bureau of Economic Analysis, Figures in Millions of Dollars
Producers Value
(1) Excise tax to manufacturer in parentheses ( )

399 ORDER SECTOR	TYPE OF CONSTRUCTION	ASPHALT	ROAD OIL	MOTOR & OTHER GASOLINE (1)	DISTILLATE FUEL OIL	LIQUIFIED PETROLEUM GASES	LUBRICATING OILS	LUBRICATING GREASES	TOTAL
63	M + R/Petro Pipeline	0.1	0.0	1.2 (0.2)	0.4	0.0	0.1	0.0	2.0
64	M + R/Water Supply	4.1	1.2	2.9 (0.5)	1.3	0.0	0.3	0.0	10.3
65	M + R/Sewers	0.6	0.2	1.1 (0.2)	0.7	0.0	0.1	0.0	2.9
66	M + R/Local Transport	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.3
67	M + R/Military	2.2	0.5	5.2 (0.9)	1.3	0.0	0.3 (0.1)	0.0	10.5
68	M + R/Conservation	0.2	0.0	6.0 (1.1)	1.7	0.0	0.4 (0.1)	0.0	9.5
69	M + R/Highways	13.0	3.7	35.1 (6.7)	9.5	0.0	2.2 (0.7)	0.2	71.1
70	M + R/Oil & Gas Wells	0.2	0.0	5.2 (0.9)	1.8	0.0	0.4	0.0	8.5
71	M + R/Other Non-Building	1.8	0.2	8.3 (1.6)	2.0	0.0	0.6 (0.1)	0.0	14.6
SUBTOTALS									
	New Building	121.2	3.5	121.0 (22.7)	6.8	1.0	3.3 (0.1)	0.0	279.6
	New Non-Building	89.6	13.2	311.1 (58.4)	73.2	0.0	15.7 (3.8)	0.4	565.4
	M + R Building	15.2	0.6	25.5 (4.7)	3.2	0.4	0.7 (0.3)	0.0	50.6
	M + R Building	24.7	6.2	71.0 (13.2)	20.5	0.0	5.1 (1.0)	0.2	141.9
TOTAL CONSTRUCTION		250.7	23.5	528.6 (99.0)	103.7	1.4	24.8 (5.2)	0.6	1,037.5

TABLE 42 REFINED PETROLEUM BREAKDOWN FOR NEW BUILDING CONSTRUCTION 1967

399 ORDER SECTOR	BUILDING TYPE	REFINED PETROLEUM PRODUCT	% DIVISION OF GASOLINE $ BETWEEN GAS & DIESEL[1]	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETR PROD[3] ($/Btu x 10^6)	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})
23	Res 1-Family	Asphalt & R.O.		24.8	0.461	53.796		46.23	55.38
		Gasolines		(30.3)	-	-		-	-
		Gas	100%	30.3	0.993	30.514		26.22	31.41
		Diesel	0%	0.0	-	0.0		-	-
		Fuel Oil		0.7	0.396	1.768		1.52	1.82
		Lube Oil		0.3	5.776	0.052		0.04	0.05
		TOTAL		56.1	0.063 *	86.130	0.859	74.01	88.66
24	Res 2 - 4 Family	Asphalt & R.O.		1.5	0.461	3.254		2.941	3.52
		Gasolines		(1.4)	-	-		-	-
		Gas	32.7	0.5	0.993	0.504		0.45	0.54
		Diesel	67.3	0.9	0.767	1.173		1.06	1.27
		TOTAL		2.9	0.588 *	4.931	0.902	4.45	5.33
25	Res Garden Apt	Asphalt & R.O.		7.6	0.461	16.486		14.42	17.28
		Gasolines		(5.7)	-	-		-	-
		Gas	32.7	1.9	0.993	1.913		1.67	2.01
		Diesel	67.3	3.8	0.767	4.954		4.33	5.19
		Fuel Oil		0.2	0.396	0.505		0.44	0.53
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		13.6	0.570 *	23.876	0.875	20.89	25.03

1,2,3,4,5,6 - For notes, see page 107

399 ORDER SECTOR	BUILDING TYPE	REFINED PETROLEUM PRODUCT	% DIVISION OF GASOLINE $ BETWEEN GAS & DIESEL[1]	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETRO PROD[3] ($/Btu x 10^{6})	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})
26	Res Highrise Apts	Asphalt & R.O.		5.8	0.461	12.581		11.62	13.92
		Gasolines		(6.3	-	-		-	-
		Gas	32.7	2.1	0.993	2.068		1.91	2.29
		Diesel	67.3	4.2	0.767	5.536		5.11	6.12
		Fuel Oil		0.1	0.396	0.253		0.23	0.28
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		12.3	0.615*	20.455	0.923	18.89	22.63
27	Res Alt & Add'n	Asphalt & R.O.		2.5	0.461	5.423		4.25	5.09
		Gasolines		(2.3)	-	-		-	-
		Gas	100%	2.3	0.993	2.316		1.81	2.17
		Diesel	0%	0.0	-	0.0		-	-
		Fuel Oil		0.6	0.396	1.515		1.19	1.42
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		5.5	0.593*	9.271	0.783	7.26	8.70
28	Hotel/Motel	Asphalt & R.O.		3.6	0.461	7.809		7.28	8.72
		Gasolines		(3.9)	-	-		-	-
		Gas	32.7	1.3	0.993	1.309		1.22	1.46
		Diesel	67.3	2.6	0.767	3.390		3.16	3.78
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		7.6	0.607*	12.525	0.932	11.67	13.98
29	Dormitories	Asphalt & R.O.		3.3	0.461	7.158		6.43	7.50
		Gasolines		(3.7)	-	-		-	-
		Gas	32.7	1.2	0.993	1.215		1.09	1.28
		Diesel	67.3	2.5	0.767	3.251		2.92	3.45
		Fuel Oil		0.1	0.396	0.253		0.23	0.27
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		6.8	0.584*	11.641	0.898	10.45	12.52

1,2,3,4,5,6 - For notes, see page 107

399 ORDER SECTOR	BUILDING TYPE	REFINED PETROLEUM PRODUCT	% DIVISION OF GASOLINE $ BETWEEN GAS & DIESEL[1]	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETRO PROD[3] ($/Btu x 10^6)	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})
30	Industrial	Asphalt & R.O.		8.8	0.461	19.089		17.06	20.44
		Gasolines		(13.3)	-	-		-	-
		Gas	22.1	2.9	0.993	2.960		2.65	3.17
		Diesel	77.9	10.4	0.767	13.508		12.08	14.47
		Fuel Oil		2.1	0.396	5.303		4.74	5.68
		LPG		0.5	0.576	0.868		0.78	0.93
		Lube Oil		0.7	5.776	0.121		0.11	0.13
		TOTAL		25.4	0.607*	41.849	0.894	37.41	44.82
31	Office	Asphalt & R.O.		13.1	0.461	28.416		26.46	31.69
		Gasolines		(14.7)	-	-		-	-
		Gas	32.7	4.8	0.993	4.826		4.49	5.38
		Diesel	67.3	9.9	0.767	12.918		12.03	14.41
		Fuel Oil		0.3	0.396	0.765		0.71	0.85
		LPG		0.5	0.576	0.868		0.81	0.97
		Lube Oil		0.4	5.776	0.069		0.06	0.08
		TOTAL		29.0	0.606*	47.862	0.931	44.55	53.37
32	Warehouses	Asphalt & R.O.		1.8	0.461	3.905		3.54	4.09
		Gasolines		(2.1)	-	-		-	-
		Gas	22.1	0.5	0.993	0.467		0.42	0.50
		Diesel	77.9	1.6	0.767	2.133		1.93	2.22
		Fuel Oil		0.3	0.396	0.758		0.69	0.75
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		4.3	0.616*	6.985	0.906	6.33	7.58
33	Garage/Serv Sta	Asphalt & R.O.		1.5	0.461	3.254		2.91	3.48
		Gasolines		(1.7)	-	-		-	-
		Gas	35.3	0.6	0.993	0.604		0.54	0.65
		Diesel	64.7	1.1	0.767	1.434		1.28	1.54
		Fuel Oil		0.1	0.396	0.253		0.23	0.27
		TOTAL		3.3	0.596*	5.545	0.894	4.96	5.94

1,2,3,4,5,6 - For notes, see page 107

399 ORDER SECTOR	BUILDING TYPE	REFINED PETROLEUM PRODUCT	% DIVISION OF GASOLINE $ BETWEEN GAS & DIESEL[1]	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETRO PROD[3] ($/Btu x 10^6)	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})
34	Stores/Restaurants	Asphalt & R.O.		10.5	0.461	22.777		20.89	25.04
		Gasolines		(12.5)	-	-		-	-
		Gas	35.3	4.4	0.993	4.444		4.08	4.88
		Diesel	64.7	8.1	0.767	10.544		9.67	11.58
		Fuel Oil		0.6	0.396	1.515		1.39	1.66
		Lube Oil		0.4	5.776	0.069		0.06	0.08
		TOTAL		24.0	0.610*	39.349	0.917	36.09	43.24
35	Religious	Asphalt & R.O.		3.0	0.461	6.508		6.10	7.31
		Gasolines		(3.7)	-	-		-	-
		Gas	16.7	0.6	0.993	0.622		0.58	0.70
		Diesel	83.3	3.1	0.767	4.018		3.77	4.52
		Fuel Oil		0.2	0.396	0.509		0.48	0.57
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		7.0	0.600*	11.675	0.938	10.95	13.12
36	Educational	Asphalt & R.O.		19.2	0.461	41.649		38.86	46.55
		Gasolines		(21.8)	-	-		-	-
		Gas	16.7	3.6	0.993	3.666		3.42	4.10
		Diesel	83.3	18.2	0.767	23.676		22.09	26.46
		Fuel Oil		0.4	0.396	1.010		0.94	1.13
		Lube Oil		0.4	5.776	0.069		0.06	0.08
		TOTAL		41.8	0.597*	70.070	0.933	65.41	78.36
37	Hospital	Asphalt & R.O.		5.7	0.461	12.364		11.71	14.03
		Gasolines		(5.8)	-	-		-	-
		Gas	11.2	0.6	0.993	0.654		0.62	0.74
		Diesel	88.9	5.2	0.767	6.723		6.37	7.63
		TOTAL		11.5	0.583*	19.741	0.947	18.70	22.40

1,2,3,4,5,6 - For notes, see page 107

399 ORDER SECTOR	BUILDING TYPE	REFINED PETROLEUM PRODUCT	% DIVISION OF GASOLINE $ BETWEEN GAS & DIESEL[1]	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETRO PROD[3] ($/Btu x 10^6)	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})
38	Other Non-Farm	Asphalt & R.O.		11.1	0.461	24.078		22.46	26.93
		Gasolines		(13.3)	-	-		-	-
		Gas	32.7	4.3	0.993	4.380		4.09	4.90
		Diesel	67.3	9.0	0.767	11.670		10.89	13.04
		Fuel Oil		0.7	0.396	1.768		1.65	1.98
		Lube Oil		0.4	5.776	0.069		0.06	0.08
		TOTAL		25.5	0.608*	41.965	0.933	39.17	46.93
48	Farm Residential	Asphalt & R.O.		0.4	0.461	0.868		0.70	0.84
		Gasolines		(0.5)	-	-		-	-
		Gas	100%	0.5	0.993	0.504		0.41	0.49
		Diesel	0%	0.0	0.767	0.0		-	-
		Fuel Oil		0.1	0.396	0.253		0.21	0.25
		TOTAL		1.0	0.615*	1.625	.812	1.32	1.58
49	Farm Service	Asphalt & R.O.		0.5	0.461	1.085		1.04	1.14
		Gasolines		(1.1)	-	-		-	-
		Gas	100%	1.1	0.993	1.108		1.06	1.17
		Diesel	0%	0.0	0.767	0.0		-	-
		Fuel Oil		0.3	0.396	0.758		0.72	0.83
		Lube Oil		0.1	5.776	0.017		0.01	0.02
		TOTAL		2.0	0.723*	2.768	0.954	2.64	3.16

1,2,3,4,5,6 - For notes, see page 107

399 ORDER SECTOR	BUILDING TYPE	REFINED PETROLEUM PRODUCT	% DIVISION OF GASOLINE $ BETWEEN GAS & DIESEL[1]	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETRO PROD[3] ($/Btu x 10^6)	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})
55	M + R Residential	Asphalt & R.O.		7.0	0.461	15.184		13.18	15.78
		Gasoline		9.0	0.993	9.063		7.87	9.42
		LPG		0.4	0.576	0.694		0.60	0.72
		TOTAL		16.4	0.658*	24.942	0.868	21.64	25.92
56	M + R Non-Res	Asphalt & R.O.		7.4	0.461	16.052		13.29	15.94
		Gasolines		(20.1)	-	-		-	-
		Gas	94.9	19.1	0.993	19.235		15.93	19.08
		Diesel	5.1	1.0	0.767	1.304		1.08	1.29
		Fuel Oil		2.9	0.396	7.323		6.06	7.26
		Lube Oil		1.0	5.976	0.173		0.14	0.17
		TOTAL		31.4	0.712*	44.087	0.828	36.51	43.74
57	M + R Farm Res	Asphalt & R.O.		0.6	0.461	1.302		1.14	1.37
		Gasoline		0.8	0.993	0.806		0.71	0.85
		TOTAL		1.4	0.664*	2.107	0.878	1.85	2.22
58	M + R Farm Service	Asphalt & R.O.		0.8	0.461	1.735		1.15	1.38
		Gasoline		0.3	0.993	0.302		0.20	0.24
		Fuel Oil		0.3	0.396	0.758		0.50	0.60
		TOTAL		1.4	0.501*	2.795	0.662	1.85	2.22

1,2,3,4,5,6 - For notes, see page 107

CONSTRUCTION DIVISION	REFINED PETROLEUM PRODUCT	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETRO PROD[3] ($/Btu x 10^6)	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})	BTU OF REF PETR PROD AS % OF TOTAL BTU
New Building Construction	Asphalt & R.O.	124.7	0.461	270.499		244.80	293.27	16.7
	Gasoline	63.4	0.993	63.847		57.78	69.22	4.0
	Diesel	80.3	0.767	104.694		94.75	113.51	6.5
	Fuel Oil	6.8	0.396	17.172		15.54	18.62	1.1
	LPG	1.0	0.576	1.736		1.57	1.88	0.1
	Lube Oil	3.4	5.776	0.589		0.53	0.64	0.0
	TOTAL	279.6	0.610*	458.537	.905	415.15	497.35	28.4
New Non-Building Construction	Asphalt & R.O.	102.8	0.461	222.993		197.35	236.43	13.5
	Gasoline	18.5	0.993	18.630		16.49	19.75	1.1
	Diesel	351.0	0.767	457.627		405.00	485.19	27.8
	Fuel Oil	73.2	0.396	184.848		163.59	195.98	11.2
	Lube Oil	19.5	5.776	3.376		2.99	3.58	0.2
	Lube Grease	0.4	-	-		-	-	0.0
	TOTAL	565.4	0.637*	887.474	.885	785.27	940.76	53.8
M + R Building Construction	Asphalt & R.O.	15.8	0.461	34.273		28.69	34.37	2.0
	Gasoline	29.2	0.993	29.406		24.61	29.49	1.7
	Diesel	1.0	0.767	1.304		1.09	1.31	0.1
	Fuel Oil	3.2	0.393	8.081		6.76	8.10	0.5
	LPG	0.4	0.576	0.694		0.58	0.70	0.0
	Lube Oil	1.0	5.776	0.173		0.14	0.17	0.0
	TOTAL	50.6	0.683*	73.931	.837	61.85	74.10	4.2

1,2,3,4,5,6 - For notes, see page 107

CONSTRUCTION DIVISION	REFINED PETROLEUM PRODUCT	COST OF REF PETR PRODUCTS[2] (IN MILLION $)	ASSUMED UNIT COSTS FOR EACH REF PETRO PROD[3] ($/Btu x 10^6)	PRELIM ESTIMATE OF ENERGY VALUE OF REF PETR PROD (Btu x 10^{12})	ADJUSTMENT FACTOR TO RECONCILE ESTIMATE WITH SECTOR TOTALS[5]	ADJUSTED ENERGY VALUE OF REF PETR PROD ON SITE[5] (Btu x 10^{12})	ADJUSTED ENERGY VALUE OF REF PETR PROD AT SOURCE[6] (Btu x 10^{12})	BTU OF REF PETR PROD AS % OF TOTAL BTU
M + R Non-Building Construction	Asphalt & R.O.	30.9	0.461	67.028		57.85	69.30	4.0
	Gasoline	4.2	0.993	4.230		3.65	4.37	0.2
	Diesel	80.0	0.767	104.302		90.01	107.84	6.2
	Fuel Oil	20.5	0.393	51.768		44.68	53.52	3.1
	Lube Oil	6.1	5.776	1.056		0.91	1.09	0.1
	Lube Grease	0.2	-	-		-	-	0.0
	TOTAL	141.7	0.621*	228.384	.863	197.09	236.11	13.5
TOTAL CONSTRUCTION		1037.5	0.629*	1618.326	0.885	1459.36	1748.32	100.00

NOTES:

1. Source: EBC Report, pp. 153 - 163.

2. Source: Table 41.

3. Source: EBC Report, p. 152. Lube Oil figures derived from the following data:
   1976 gasoline cost - $0.595/gal (Carmen Diaz, National Petroleum News)
   1976 lube oil cost estimate $1.00/qt.
   1967 gasoline cost - $3.063/barrel (EBC Report, p. 152)
   1967 lube oil energy - 6.060 Btu/barrel (CAC TM 39).

4. Cost of refined petroleum products divided by assumed unit costs for each product.

5. Totals correlated with EBC Report, Table B1-2, p. 132 and breakdowns apportioned according to adjustment factor.

6. Adjusted Btu consumed x 1.1980 (energy cost of refined petroleum - Table 34).

*Average unit cost derived from total preliminary estimated energy value and total cost of refined petroleum product.

TABLE 43 1967 DIRECT ENERGY CONSUMPTION DATA - ADJUSTED-NEW BUILDING CONSTRUCTION SECTORS

399 ORDER SECTOR	BUILDING TYPE	AMOUNT BUILT[1] ($SF \times 10^6$)	DIRECT ENERGY AT JOB SITE ($Btu \times 10^{12}$)					DIRECT ENERGY AT SOURCE ($Btu \times 10^{12}$)					TOTAL ENERGY DIRECT & INDIRECT[7] ($Btu \times 10^{12}$)
			REFINED ASP+RO[2]	PETROL OTHER[2]	ELEC[3]	GAS[3]	TOTAL[3]	REFINED ASP+RO[4]	PETROL OTHER[4]	ELEC[5]	GAS[6]	TOTAL	
23	Res 1-Family	1112.4	46.23	27.78	1.02	2.63	77.65	55.38	33.78	3.86	2.90	95.42	780.98
24	Res 2 - 4 Family	55.7	2.94	1.51	0.05	0.18	4.68	3.52	1.81	0.19	0.20	5.72	34.83
25	Res Garden Apt	227.9	14.42	6.47	0.16	0.35	21.40	17.28	7.74	0.61	0.39	26.02	147.76
26	Res Highrise Apt	160.3	11.62	7.27	0.20	0.53	19.61	13.92	8.71	0.76	0.58	23.97	117.96
27	Res Add'n & Alt	--	4.25	3.01	0.08	0.18	7.51	5.09	3.61	0.30	0.20	9.20	216.85
28	Hotel/Motel	61.2	7.28	4.39	0.13	0.35	12.15	8.72	5.91	0.49	0.39	15.51	69.05
29	Dormitories	40.4	6.43	4.02	0.10	0.18	10.72	7.70	4.82	0.38	0.20	13.10	57.82
30	Industrial Bldgs	476.5	17.06	20.35	0.21	0.53	38.15	20.44	24.38	0.80	0.58	46.20	463.38
31	Office Bldgs	157.6	26.46	18.09	0.44	1.05	46.04	31.70	21.67	1.67	1.16	56.20	258.66
32	Warehouses	103.5	3.54	2.88	0.05	0.18	6.56	4.24	3.45	0.19	0.20	8.08	57.78
33	Garage/Serv Sta	41.8	2.91	2.05	0.05	0.18	5.19	3.49	2.46	0.19	0.20	6.34	32.24
34	Stores/Restaurants	209.3	20.89	15.20	0.34	0.88	37.31	25.02	18.21	1.29	0.97	45.49	197.01
35	Religious Bldgs	54.6	6.10	4.85	0.11	0.18	11.24	7.31	5.81	0.42	0.20	13.74	68.61
36	Educational Bldgs	315.5	38.86	26.55	0.70	1.58	67.69	46.55	31.81	2.65	1.74	82.75	437.36
37	Hospitals	68.1	11.71	6.99	0.21	0.53	19.44	14.03	8.37	0.80	0.58	23.78	117.21
38	Other Non-Farm	159.4	22.46	16.71	0.39	0.88	40.44	26.91	20.02	1.48	0.79	49.20	231.07
48	Farm Residential	54.5	0.70	0.62	0.02	0.0	1.34	0.84	0.74	0.08	0.0	1.66	30.22
49	Farm Service	388.3	1.04	1.60	0.02	0.0	2.65	1.25	1.92	0.08	0.0	3.25	57.88
	New Building	3686.8	244.90	170.35	4.28	10.39	429.92	293.39	204.72	16.24	11.28	525.63	3421.67
	New Non-Building	--	197.35	587.92	2.18	5.28	792.73	236.43	704.33	8.26	5.82	954.84	2499.90
	M + R Building	--	28.69	33.16	0.63	1.58	64.06	34.37	39.73	2.39	1.74	78.23	79.60
	M + R Non-Building	--	57.85	139.24	0.54	0.54	198.17	69.30	166.81	2.05	0.59	238.75	300.82
	TOTAL CONSTRUCTION	--	528.79	930.67	7.64	17.79	1484.89	633.49	1115.59	28.94	19.43	1797.45	6301.99

NOTE:
1. Source: EBC Report, Table C1, p. 84
2. Source: Table 42
3. Source: EBC Report, Table B1-2, p. 132
4. Btu consumed x 1.1980 (energy cost of refined petroleum - Table 34).
5. Btu consumed x 3.7888 (energy cost of electricity - Table 34).
6. Btu consumed x 1.1014 (energy cost of gas - Table 34)
7. Source: EBC Report, Table B1-7, p. 137.

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