ENERGY

DOE/CS/20220-1

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HANDBOOK OF ENERGY USE FOR BUILDING
CONSTRUCTION

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March 1980

Work Performed Under Contract No. AC02-79CS20220

The Stein Partnership
New York, New York

U. S. DEPARTMENT OF ENERGY

Division of Industrial Energy Conservation

CONSTRUCTION

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Available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Price: Paper Copy ^{13.00}~~\$12.00~~
Microfiche \$3.50

Handbook of Energy Use for Building Construction

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The preparation of this handbook has relied heavily on the efforts of many individuals. Their participation is gratefully acknowledged. While it is not possible to name every person who played a role, the particular contributions of several individuals must be mentioned.

This handbook could not have been written without the support of the United States Department of Energy through the Office of Buildings and Community Systems, Conservation and Solar Energy. In particular, Maxine Savitz, Deputy Assistant Secretary and John Cable, Director, Buildings Division, have encouraged the Energy Use for Building Construction project from its initial research through the development of this manual. Jean Boulin, Program Manager, has contributed materially to the work through his advice and editorial assistance.

Dr. Bruce Hannon, Director of the Energy Research Group at the University of Illinois in Urbana, was our collaborator in developing the data which are the basis for this manual. His help in reformulating the information for use here was invaluable. The handbook is a reorganization and extension of previous research reports which were developed with the important participation of Diane Serber of our office and Barr Segal of the Energy Research Group.

Hermann Strohbach, in the areas of format, type style and size and other such questions, has helped greatly in organizing and presenting this mountain of information.

Finally, in our office, Rita Gayhart, Tasos Kokoris and Tore Knudsen have labored heroically to produce this handbook. Each page is evidence of their contribution.

Preface

The construction industry accounts for over 11.14 percent of the total energy consumed in the United States annually.¹ This represents approximately 7,500 trillion Btu which has the equivalent energy value of 1¼ billion barrels of oil. Within the construction industry, new building construction accounts for 5.19 percent of national annual energy consumption. The remaining 5.95 percent is distributed among new nonbuilding construction (highways, railroads, dams, bridges, etc.), building maintenance construction and nonbuilding maintenance construction. The focus of this handbook is new building construction; however, some information for the other parts of the construction industry is also included.

Of the 3,472.8 trillion Btu used by new building construction, 15.79 percent or 548.5 trillion Btu are used directly at the construction site. The remaining 84.21 percent or 2,925.3 trillion Btu are referred to as embodied energy, the energy required for the production of materials which are incorporated into buildings. This handbook deals with both forms of energy input, direct and embodied.

This handbook provides building designers with information to determine the energy required for buildings construction and to evaluate the energy required for alternative materials, assemblies, and methods. The handbook is also applicable to large-scale planning and policy determination in that it provides the means to estimate the energy required to carry out major building programs.

The data in this handbook results from work performed by The Stein Partnership (formerly Richard G. Stein and Partners) and the Energy Research Group (formerly The Center for Advanced Computation) at the University of Illinois at Urbana under contract to the U.S. Department of Energy. This work was in turn based on data gathered and reported by the Bureau of Economic Analysis (BEA) of the United States Department of Commerce.

BEA developed an input/output (I/O model) which records the dollar transactions between all sectors of the economy.² The Energy Research Group built on the data in the BEA dollar model and developed an energy input/output model. In its original form, this model contained two construction sectors, new construction and maintenance construction. The Stein Partnership, in conjunction with the Energy Research Group, subdivided these generalized groupings and developed representative energy use patterns for each, resulting in a new energy input/output model with 49 construction categories.

The Stein Partnership and the Energy Research Group also identified the energy required for the raw materials manufacture and delivery to construction jobsite of over 400 different building materials and products. The material in this handbook is an elaboration and reorganization of these data.

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Chapter 1

Introduction

The energy required for the construction of buildings represents 5.19 percent of the total energy consumed in the United States annually based on 1967 data (1967 is the most recent year for which complete data are available). More important, the energy required for building construction may equal the energy required for as many as 15 years of building operation, particularly as buildings are designed to operate with lower energy input. Through the entire new building construction industry, 15.79 percent of the energy required for building construction is used directly on the jobsite (direct energy),³ the remaining 84.21 percent is required for the production of materials and products which are eventually incorporated into buildings (embodied energy).⁴ This includes the extraction of raw materials, the processing and manufacturing of finished materials and components, transportation, the prorated share of processing plants and equipment, and other overhead items required for the industries which produce building materials and their components.

The Center for Advanced Computation (CAC), now called the Energy Research Group of the University of Illinois and The Stein Partnership (TSP), Architects, under contract to the U.S. Department of Energy, calculated and organized an extensive body of data, quantifying the energy required for construction activities. These were reported in two volumes under the titles, *ENERGY USE FOR BUILDING CONSTRUCTION, FINAL REPORT*, dated December 1976, and *ENERGY USE FOR BUILDING CONSTRUCTION, SUPPLEMENT*, dated October 1977. This handbook consolidates that information and places it into a format useful to architects, building designers, and planners. The energy values for building materials, components, and assemblies are reorganized into the Construction Specification Institute (CSI) format in order to facilitate the handbook's use by persons familiar with building design or construction.

The energy values given in this handbook vary considerably in detail. They are based primarily on data assembled by

the Bureau of Economic Analysis of the Department of Commerce and were produced by prorating the total energy used by an industry among the number of units produced. The figures are national average figures and are not adjusted for regional differences. Most materials are described in their most commonly used form—board feet of lumber, pounds of cement, cubic yards of transit mixed concrete, etc. Some more complicated assembled materials, such as heating equipment and plumbing fixtures, are listed with average energy embodiment for different sized components. In spite of the approximation, these data are valuable in that they complete the overall picture of energy requirements for New Building Construction.

The handbook contains the following chapters:

Chapter 1: Introduction

Chapter 2: Construction Sectors and the U.S. Economy
This chapter describes the 18 New Building Construction sectors, the 14 New Nonbuilding Construction sectors, and the 17 Maintenance Construction sectors as a part of a 399 sector breakdown of the entire U.S. economy. It indicates which of these 399 sectors contribute to New Building Construction.

Chapter 3: Overall Energy Use by Construction Sectors
The total annual direct and indirect energy requirement of each of the 49 construction sectors is presented in three ways: absolute energy (trillion Btu), percentage of total national energy use, and percentage of energy use for all construction. The 18 New Building Construction sectors are described in further detail, breaking down for each sector the direct energy versus the embodied energy. These data are presented in graphic and tabular form.

Chapter 4: Breakdown of Energy Use by Each Construction Sector
Each construction is broken down to show the energy contributed by each of the 399 industrial

sectors. This information is displayed graphically comparing the energy input requirements for each construction sector. The energy inputs into the 18 new building categories are also described in units of absolute energy. These data are arranged both according to category and in ranked order.

Chapter 5: Energy Use Per Square Foot for New Building Construction The average energy use per square foot of construction of each new building type is presented in tabular and graphic form.

Chapter 6: Energy Per Unit of Building Material The total embodied energy in more than 1,000 building materials is presented, including the energy embodied for delivery to the jobsite.

Chapter 7: Energy in Typical Building Assemblies Sample analyses are presented which compare the energy required by alternative construction methods to achieve similar building functions.

Chapter 8: Energy Cost/Benefit Studies A methodology is presented which compares the total energy requirements for construction with the annual energy requirement for operation. For example, in some cases, the energy required to fabricate and install certain energy conserving materials may be greater than the savings in operating energy during the life of that installation. Examples of the use of this methodology are presented.

Chapter 9: Percentage of Industry Output Going to Building Construction The 140 industries which input energy to New Building Construction are presented in tabular form to indicate the percentage of the total output of each of these industries going to New Building Construction.

Chapter 10: Energy Flow Model A methodology is presented for determining the flow of energy from its first entry into the economy as raw material extracted from the ground through its embodiment into building materials and finally its incorporation into New Building Construction.

Chapter 11: Labor Per Unit of Building Material The total embodied labor required by building materials is presented in the same format as Chapter 6. Also included are comparisons between embodied labor and direct labor in typical building assemblies.

Appendices: The methodology used for the development of the data in the body of the handbook is presented.

How to Use this Handbook

The data in this handbook may be used to perform a number of different tasks. These may be broken down into two basic groups. The first group relates to the analysis of a specific building. The handbook includes formats for energy cost estimates and for comparing differences in energy requirements for alternative building methods. This group also includes tables which permit estimating of embodied labor in construction products and systems. The second group of tasks relates to the energy required by the construction industry or specific sectors of the construction industry as a whole.

Analysis of Specific Buildings

The data related to the analysis of specific buildings are contained in Chapters 6, 7, 8, and 11.

The embodied energy per unit of building material delivered to the jobsite is included in Chapter 6. These figures may be applied in the form required for a detailed cost estimate to the quantities in a materials take-off of a building. Just as a dollar cost estimate is the result of multiplying quantities of materials by dollar costs per unit, an energy cost estimate is the result of multiplying quantities of materials by energy costs per unit.

In addition to permitting whole building energy estimates, the data in Chapter 6 can be used to compare the embodied energy in alternative building materials or systems. For example, it is possible to evaluate the energy requirements for a non-loadbearing brick wall assembly as compared with an aluminum curtain wall.

Examples of how the data in Chapter 6 are used to measure the embodied energy in building assemblies and entire buildings is given in Chapter 7. Calculations are shown for four different residential exterior wall systems, three fire-proof slab systems, four curtain wall assemblies, and one small building.

How the data from Chapter 6 and the analyses from Chapter 7 can be used to perform energy cost-benefit studies for alternative building materials or systems is described in Chapter 8. In this case, the energy embodied during construction (first energy cost) is compared to the energy required for operation. This is referred to as energy life-cycle analysis. Examples are given for evaluating the benefits of adding insulation to several different residential wall systems and for two entire building shells.

The embodied labor intensities for the building products

described in Chapter 6 is presented in Chapter 11. This information permits an evaluation of the possible trade-offs between labor and energy for various alternative building materials and assemblies.

Energy Use by Construction Sectors

Chapters 2, 3, 4, 5, 9, and 10 describe various aspects of the relationship between energy use in the building construction sectors and energy use in the total economy. They also describe overall energy use patterns within those construction sectors.

The construction industry as a part of the U.S. economy is described in Chapter 2. This chapter establishes four major construction groupings that are referred to in this handbook.

A quick reference for determining the annual energy requirements for all construction in the United States, or for various specific types of construction (i.e. Residential, One Family, Educational Buildings, etc.) is presented in Chapter 3. This chapter presents an overall picture of the energy requirements of the construction industry and the 49 sectors which make it up. The information is presented as absolute energy (trillion Btu), percent of total construction industry energy consumption, and percent of total U.S. energy consumption.

A more detailed understanding of the individual construction sectors both as they relate to each other and in themselves is provided in Chapter 4. Each construction industry sector has been broken down to show which industries contribute embodied energy. For example, the energy embodied in the stone and clay products used for the construction of all hospitals in the U.S. in the sample here can be determined. The material is presented in comparative form for 49 construction sectors and in absolute form for the 18 New Building Construction sectors. For each new building construction sector, data are presented in two ways—according to category and in ranked order. The ranked order permits a rapid determination of the most important energy contributors to each sector.

The average energy input required per square foot of construction for each of the new building sectors is described in Chapter 5. This information may be used in two ways. It may be used to estimate the energy requirements for construction of a known amount of a specific building type. For example, it can be estimated that a program to build 10,000 one-family housing units at 1,500 square feet (i.e. 15,000,000 square feet of construction) will require 6.188 trillion Btu. The information may also be used as a baseline against which specific building energy estimates may

be compared. If, for example, using the data from Chapters 6 and 7, a 2,730 square foot residence is calculated to have a total embodied energy of 1,270 million Btu (i.e. 465,500 Btu per square foot), this can be seen as representing approximately three-quarters of the average energy use for this building type.

The percentage for each industrial sector of that sector's output which goes to New Building Construction is described in Chapter 9. This allows the evaluation of the impact on specific industries which will be caused by changes in New Building Construction sectors.

Some industries do not contribute directly to the New Building Construction sector, but contribute indirectly by supplying the direct contributors. A methodology for determining their role is described in Chapter 10. It permits one to trace the total quantity of embodied energy back to the quantity of energy embodied in new building construction back to a starting point of resources in the ground.

Data Used in this Handbook

To a greater or lesser degree, all of the data used in this handbook are averages. A steel beam produced in an integrated plant where the entire process from refining ore to the final rolling is carried out in one location may require less energy than will a similar beam for which the iron is produced in one place, remelted at another where alloys are added, and rolled to the final form at a third location. Figures for transportation are averages. Concrete block used for a building 10 miles from the factory will require less energy for transportation than will the same block used 100 miles from the plant.

The base year for this handbook is 1967. When the information in this handbook was first compiled in 1976 and 1977, 1967 was the most recent year for which a complete set of energy data was available. Because the energy requirements are presented as Btu per unit of building material rather than Btu per dollar, the effect of inflation has been eliminated. There have, however, been some changes in manufacturing processes which have altered the energy requirements per unit of building material since 1967. In spite of this, in most cases, the figures remain accurate. For reference, in 1978, the energy input per constant dollar of total industry output was 2.70 times that in 1967.

Within this context, however, the data are consistent and are a method by which representative analyses can be performed to outline energy use characteristics in New Building Construction.

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Chapter 2

Construction Sectors and the U.S. Economy

This chapter describes the basic relationships between the total U.S. economy, construction industries, and New Building Construction in particular.

The importance of the construction sectors to the understanding of energy consumption by the U.S. economy as a whole results from three basic factors. First, construction is material intensive and therefore energy intensive. Second, construction purchases large amounts of materials from other industrial sectors, either directly or indirectly, so that changes in consumption patterns in construction have impacts which reach far into the economy as a whole. Third, construction offers many areas in which energy consumption can be reduced through reductions in quantities of materials required and through material substitutions.

The heavy use of material per dollar of construction may be seen by comparing several products. Five thousand dollars invested in a building project might purchase five tons of steel or 20 tons of concrete. A \$5,000 car will contain less than 1½ tons of material. Five thousand dollars worth of electronic office equipment may weigh less than 200 pounds, and \$5,000 will purchase 50 good wrist watches which may weigh a total of 6½ pounds.

Table 2.1 lists the 399 industrial sectors which make up the entire U.S. economy. The categories correspond to the Standard Industrial Classifications (SIC) of the U.S. Department of Commerce. Because of the particular importance of construction as an energy consumer, this area of the economy has been expanded from two sectors (New Construction and Maintenance Construction) in the original University of Illinois Matrix, to 49 sectors.⁵ These are Sectors 23 through 71 and are identified with asterisks on Table 2.1.

Table 2.1 also identifies each industrial sector whose products are transferred directly to any of the New Building Construction sectors and which represent more than 0.1 percent of all energy consumed by New Building Construc-

tion. These sectors are identified by daggers, representing 98 percent of all energy required by New Building Construction. The remaining 2 percent results from the product of miscellaneous industries, each of which represents only a small part of the energy embodied in New Building Construction.

Some industries which make little or no contribution directly to New Building Construction do, however, make important contributions to other industries, which, in turn contribute directly to New Building Construction. An example of this would be Iron Ore Mining (Sector 18). While iron ore is not used directly as a building material, it is an essential raw material for many of the products which are ultimately integrated into New Building Construction. The energy required to extract and process the iron ore is carried as embodied energy in the materials that eventually are transferred directly to the building site, such as structural steel, boilers, elevators, etc. Changes in the construction industry's use of products which involve iron will work back through the economy and have an impact on iron ore mining. Conversely, changes within the iron ore mining process, which affect the amount of energy required by that industry will work their way up through the economy and have an effect on the total energy used for New Building Construction.

In totalling the energy requirements for New Building Construction, only the direct and embodied energy contained in the product actually purchased by New Building Construction are considered. These products have already taken into account all energy required for raw materials and manufacture up to the point at which the products enter the New Building Construction sectors. Therefore, even though a ton of steel going to New Building Construction may have required the commitment of a substantial amount of energy in the Iron Ore Mining sector, to list that energy separately would be double counting. Because the impact of decisions in New Building Construction on the entire economy, even those parts with no direct links to the

Table 2.1 Division of U.S. Economy into 399 Industrial Sectors

1 Coal mining	64 Water supply facilities	130 Apparel, purchased material
2 Crude petroleum	65 Sewer facilities	131 Curtains
† 3 Refined petroleum products	66 Local transit facilities	132 House furnishings
† 4 Electric utilities	67 Military facilities	133 Fabricated textile products
† 5 Gas utilities	68 Conservation and development facilities	134 Logging
6 Dairy farms	69 Highways	†135 Sawmills
7 Poultry, egg production	70 Oil and gas wells	†136 Hardwood flooring
8 Meat, animal production	71 Other non-building facilities	†137 Special sawmill products
9 Cotton crops		†138 Millwork
10 Grain crops	72 Guided missiles	†139 Veneer, plywood
11 Tobacco crops	73 Ammunition	†140 Prefabricated wood structures
12 Fruits crops	74 Tanks	†141 Wood preserving
13 Vegetables, miscellaneous crops	75 Fire control equipment	†142 Wood products
14 Oil bearing crops	76 Small arms	143 Wood containers
15 Forestry, greenhouses, nurseries	77 Small arms ammunition	†144 Wood household furniture
16 Forest, fish products	78 Other ordnance	145 Upholstered household furniture
17 Agricultural forestry, fish service	79 Meat products	†146 Metal household furniture
18 Iron ore mining	80 Butter	147 Mattresses
19 Copper mining	81 Cheese	148 Wood office furniture
20 Nonferrous mining	82 Condensed milk	149 Metal office furniture
† 21 Stone, clay mining	83 Ice cream	150 Public building furniture
22 Chemical, mineral mining	84 Fluid milk	†151 Wood furniture and fixtures
	85 Canned sea foods	†152 Metal furniture and fixtures
	86 Canned specialty	153 Blinds, shades
NEW CONSTRUCTION	87 Canned fruit, vegetables	154 Miscellaneous furniture and fixtures
• 23 Residential, one family	88 Dehydrated products	155 Pulp mills
• 24 Residential, two-four family	89 Pickles, dressing	156 Paper mills
• 25 Residential, garden apartment	90 Fish	157 Paperboard mills
• 26 Residential, high-rise apartments	91 Frozen fruit, vegetatables	158 Envelopes
• 27 Residential, alterations and additions	92 Flour, cereals	159 Sanitary paper products
• 28 Hotels and motels	93 Prepared animal feed	†160 Building paper
• 29 Dormitories	94 Rice milling	†161 Converted paper products
• 30 Industrial buildings	95 Pet corn milling	162 Paperboard
• 31 Office buildings	96 Bakery products	163 Newspapers
• 32 Warehouses	97 Sugar	164 Periodicals
• 33 Garages, service stations	98 Confectionery	165 Book publishing
• 34 Stores, restaurants	99 Alcoholic beverages	166 Miscellaneous publishing
• 35 Religious Buildings	100 Soft drinks	167 Commercial printing
• 36 Educational buildings	101 Flavorings	168 Business forms
• 37 Hospital buildings	102 Cottonseed mills	169 Greeting cards
• 38 Other non-farm buildings	103 Soybean mills	170 Miscellaneous printing
39 Telephone and telegraph facilities	104 Vegetable oil mills	171 Inorganic, organic chemicals
40 Railroads	105 Animal fats	172 Fertilizers
41 Electric utility facilities	106 Coffee	173 Agricultural chemicals
42 Gas utility facilities	107 Cooking oils	†174 Miscellaneous chemical products
43 Petroleum pipelines	108 Manufactured ice	175 Plastics
44 Water supply facilities	109 Macaroni	176 Synthetic rubber
45 Sewer facilities	110 Food Preparations	177 Man-made fibers
46 Local transit facilities	111 Cigarettes	178 Organic fibers
47 Highways	112 Tobacco stemming	179 Drugs
• 48 Farm residences	113 Broad woven fabric mills	180 Cleaning preparations
• 49 Farm service buildings	114 Narrow fabric mills	181 Toilet preparations
50 Oil and-gas wells	115 Yarn mills	†182 Paint products
51 Oil and gas exploration	116 Thread mills	†183 Paving
52 Military facilities	†117 Floor coverings	†184 Asphalt
53 Conservation and devel facilities	118 Felt goods	185 Tires
54 Other non-building facilities	119 Lace goods	186 Rubber footwear
	120 Upholstery fill	187 Misc rubber products
MAINTENANCE CONSTRUCTION	121 Processed textile waste	†188 Miscellaneous plastics products
55 Residential	122 Coated fabrics	189 Industrial leather
56 Other non-farm buildings	123 Tire cord	190 Footware cut stock
57 Farm residential	124 Scouring plants	191 Footware except rubber
58 Farm service facilities	125 Cordage, twine	192 Miscellaneous leather products
59 Telephone and telegraph facilities	126 Textile goods	†193 Glass products
60 Railroads	127 Hosiery	194 Glass products
61 Electric utility facilities	128 Knit apparel mills	†195 Cement
62 Gas utility facilities	129 Knit fabric mills	†196 Bricks
63 Petroleum pipelines		

†197	Ceramic tile	†265	Elevators	333	Shipbuilding
†198	Clay refractories	266	Conveyors	334	Boatbuilding
†199	Clay products	†267	Hoists, cranes	335	Locomotives
†200	Plumbing fixtures	268	Industrial trucks	336	Railroad equipment, street cars
201	Food utensils	269	Metal cutting tools	337	Motorcycles, bicycles
202	Porelain electrical supplies	270	Metal forming tools	338	Trailer coaches, campers
203	Pottery products	271	Special die tools	339	Misc transportation equipment
†204	Concrete blocks	272	Metalworking machinery	340	Scientific and research instruments
†205	Concrete products	273	Food products machinery	341	Mechanical measuring devices
†206	Ready-mix concrete	274	Textile machinery	342	Temperature controls
†207	Lime	275	Woodworking machinery	343	Medical instruments
†208	Gypsum products	276	Paper industries machinery	344	Surgical supply
†209	Stone products	277	Printing machinery	345	Dental equipment
210	Abrasive products	278	Special industry machinery	346	Watches, clocks
†211	Asbestos products	†279	Pumps, compressors	347	Optical instruments
212	Gaskets	280	Bearings	348	Ophthalmic goods
213	Treated minerals	281	Blowers and exhaust fans	349	Photographic equipment
†214	Mineral wool	282	Industrial patterns	350	Jewelry
†215	Nonclay refractories	283	Power transmission	351	Musical instruments
216	Nonmetal mineral products	284	Industrial furnaces	352	Games and toys
†217	Steel products	285	General industrial machinery	353	Athletic equipment
†218	Iron, steel foundries	286	Machine shop products	354	Pens and pencils
219	Iron, steel forgings	287	Computing machinery	355	Artificial flowers
220	Primary metal products	288	Typewriters	356	Cloth fasteners
221	Primary copper refining	289	Scales	357	Brushes
222	Primary lead refining	290	Office machines	†358	Hard floor coverings
223	Primary zinc refining	291	Merchandising machinery	359	Mortician goods
224	Primary aluminum production	292	Laundry equipment	360	Signs, ads
225	Primary nonferrous metal	†293	Refrigeration machinery	361	Miscellaneous manufacturing
226	Secondary nonferrous metal	294	Measuring pumps	†362	Railroad transportation
†227	Copper rolling	295	Service industry machinery	363	Local transportation
228	Aluminum rolling	296	Electrical measuring instruments	†364	Motor freight transportation
229	Nonferrous rolling	297	Transformers	†365	Water transportation
†230	Nonferrous wire products	†298	Switchgear	366	Air transportation
231	Aluminum castings	299	Motors, generators	367	Pipe line transportation
232	Brass, other castings	300	Industrial controls	368	Transportation services
233	Nonferrous castings	301	Welding apparatus	369	Communications
234	Nonferrous forgings	302	Carbon products	370	Radio and tv broadcasting
235	Metal cans	303	Electrical industrial apparatus	371	Water, sanitary services
236	Metal barrels	304	Household cooking equipment	†372	Wholesale trade
†237	Metal sanitary ware	305	Household refrigeration equipment	†373	Retail trade
†238	Plumbing fittings	306	Household laundry equipment	374	Banking
†239	Heating equipment	†307	Electric housewares and fans	375	Credit agencies
†240	Fabricated structural steel	308	Household vacuum cleaners	376	Security and commodity brokers
†241	Metal doors	309	Sewing machines	†377	Insurance carriers
†242	Fabricated plate work	†310	Household appliances	378	Insurance agents
†243	Sheet metal work	311	Electric lamps	379	Owner-operator dwellings
†244	Architectural metal work	†312	Light fixtures	†380	Real estate
†245	Miscellaneous metal work	†313	Wiring devices	381	Hotels and other lodgings
246	Screw machine products	314	Radio, TV sets	382	Personal services
247	Metal stampings	315	Phonograph records and magnetic tape	383	Barber shops, beauty shops
248	Cutlery	316	Telephone and telegraph equipment	†384	Miscellaneous business services
249	Handtools	317	Radio and tv communication equip.	†385	Advertising
†250	Hardware	318	Electronic tube	†386	Miscellaneous professional services
251	Coatings, engraving services	319	Semiconductors	†387	Automotive repair services
†252	Fabricated wire products	320	Electronic components and accessories	388	Motion pictures
253	Safes, vaults	321	Storage battery	389	Amusements and recreation services
254	Steel springs	322	Primary battery	390	Doctors and dentists offices
†255	Pipe	323	X-ray equipment	391	Hospitals
256	Collapsible tube	324	Internal combustion eng elec equip	392	Medical, health-services
257	Metal foil, leaf	325	Miscellaneous electrical equipment	393	Educational services
258	Fabricated metal products	326	Truck, bus bodies	394	Nonprofit organizations
259	Steam engines	327	Truck, trailers	395	Postal services
260	Internal combustion engines	328	Motor vehicle bodies and parts	396	Federal government enterprises
261	Farm machinery	329	Aircraft	397	State and local government enterprises
262	Construction machinery	330	Aircraft engine and parts	†398	Business travel
263	Mining machinery	331	Aircraft propellers	399	Office supplies
264	Oil field machinery	332	Aircraft equipment		

* Indicates New Building Construction sectors

† Indicates 399 order inputs into New Building Construction over 0.1 percent

Table 2.2 49 Construction Sectors of 399 Model Divided into Major Construction Groupings

Sector No	Name
New Construction—Building	
23	Residential, one family
24	Residential, two-four family
25	Residential, garden apartments
26	Residential, high-rise apartments
27	Residential, alterations and additions
28	Hotels and motels
29	Dormitories
30	Industrial buildings
31	Office buildings
32	Warehouses
33	Garages and service stations
34	Stores and restaurants
35	Religious buildings
36	Education buildings
37	Hospital buildings
38	Other non-farm buildings
48	Farm residences
49	Farm service buildings
New Construction—Nonbuilding	
39	Telephone and telegraph facilities
40	Railroads
41	Electric utility facilities
42	Gas utility facilities
43	Petroleum pipelines
44	Water supply facilities
45	Sewer facilities
46	Local transit facilities
47	Highways
50	Oil and gas wells
51	Oil and gas exploration
52	Military facilities
53	Conservation and development facilities
54	Other new non-building facilities
Maintenance Construction—Building	
55	Residential
56	Other non-farm buildings
57	Farm residences
58	Farm service buildings
Maintenance Construction—Nonbuilding	
59	Telephone and telegraph facilities
60	Railroads
61	Electric utility facilities
62	Gas utility facilities
63	Petroleum pipelines
64	Water supply facilities
65	Sewer facilities
66	Local transit facilities
67	Military facilities
68	Conservation and development facilities
69	Highways
70	Oil and gas wells
71	Other nonbuilding facilities

building industry may be of interest to economists and planners. A methodology for examining all such interactions is contained in Chapter 10.

In Table 2.1, the first five sectors—Coal Mining, Crude Petroleum, Refined Petroleum Products, Electric Utilities, and Gas Utilities—are the energy sectors. That is, the products of these sectors are energy either in the form of fuel or as electricity. In later chapters of this handbook where the products of these sectors are quantified, the energy content of the product includes both the direct energy value plus the embodied energy, that energy which was required to convert the energy raw material into its final useful form. The energy value of a ton of coal, for example, includes the total heat released by the complete combustion of that coal, plus the energy which was required to mine and process the coal and to deliver it to its point of use. In the case of electricity, the losses inherent in the generation process are accounted for. As in the example of iron ore mining above, neither coal mining nor crude petroleum contribute energy directly to New Building Construction, although as can be seen in Chapter 4, Refined Petroleum Products is the largest single contributor of energy directly to New Building Construction. Refined Petroleum Products in turn is almost entirely dependent on Crude Petroleum as its energy source.

Sectors 23 through 54 are the New Construction sectors, and Sectors 55 through 71 are the Maintenance Construction sectors. Together, this group of sectors makes up the Construction Industry. Within each of these new major groupings are Building and Nonbuilding Construction. These sub-groupings are not strictly sequential according to the sector index numbers.

Table 2.2 reorganizes the 49 Construction Industry sectors into four sub-groupings, New Building Construction, New Nonbuilding Construction, Building Maintenance Construction, and Nonbuilding Maintenance Construction. Several of the sectors which are included as nonbuilding include a certain amount of building construction. For example, Electric Utility Facilities, Sector 41, includes the buildings which enclose generating stations. It may also include certain office facilities used by the utilities. In Military Facility construction, listed as Nonbuilding, 2.41 percent of energy input results from purchases of metal doors. This compares with 3.98 percent input from metal doors into office buildings and suggests that a large percentage of Military facility construction is actually Building Construction. Similar patterns may be found to some degree in each of the nonbuilding sectors.

This chapter provides a general overview of the construction industry which will be expanded upon in Chapters 3 and 4.

Chapter 3

Overall Energy Use by Construction Sectors

This chapter provides detailed and specific information regarding the energy requirements of the construction industry and of the individual sectors which make up the construction industry. The data are presented in terms of absolute energy (trillion Btu), as percentages of overall U.S. annual energy use and, for individual sectors, as percentages of the construction industry as a whole. In addition, the New Building Construction sectors are further broken down into their direct energy requirements, embodied energy requirements, and total energy requirements.

Table 3.1 lists the 49 construction sectors and identifies

the total annual energy consumption of each, the percent of all construction required energy, and the percent of total U.S. energy requirements which each sector's consumption represents. The subtotals for each of the four major groupings described in Chapter 2 and the total for all construction are shown. Figure 3.1 presents the data from Table 3.1 in graphic form. As in Table 3.1, the sectors have been assembled into the four major groupings, and the columns representing each of these groupings have been subdivided into the 49 sectors. A review of Figure 3.1 reveals the comparison of the relative impacts of the energy requirements of the major groupings and sectors.

Table 3.1 Energy Use of the 49 Construction Sectors

Sector Number	Name	Trillion Btu consumed	Percent of construction industry consumption	Percent of total U.S. consumption
New Construction—Building				
23	Residential, one family	795.88	10.66	1.19
24	Residential, two-four family	35.41	0.47	0.05
25	Residential, garden apartments	151.36	2.03	0.23
26	Residential, high-rise apartments	119.32	1.60	0.18
27	Residential, alterations and additions	264.38	3.54	0.39
28	Hotels and motels	70.08	0.94	0.10
29	Dormitories	59.28	0.79	0.09
30	Industrial buildings	468.84	6.28	0.70
31	Office buildings	262.70	3.52	0.39
32	Warehouses	58.57	0.78	0.09
33	Garages and service stations	32.94	0.44	0.05
34	Stores and restaurants	200.97	2.69	0.30
35	Religious buildings	69.49	0.93	0.10
36	Educational buildings	443.02	5.94	0.66
37	Hospital buildings	118.48	1.59	0.18
38	Other non-farm buildings	234.47	3.14	0.35
48	Farm residences	30.60	0.42	0.05
49	Farm service buildings	58.05	0.78	0.09
Subtotals		3473.80	46.54	5.19

Table 3.1 Energy Use of the 49 Construction Sectors (continued)

Sector Number	Name	Trillion Btu consumed	Percent of construction industry consumption	Percent of total U.S. consumption
New Construction—Nonbuilding				
39	Telephone and telegraph facilities	111.07	1.49	0.17
40	Railroads	25.81	0.35	0.04
41	Electric utility facilities	309.87	4.15	0.46
42	Gas utility facilities	226.57	3.04	0.34
43	Petroleum pipelines	48.38	0.65	0.07
44	Water supply facilities	96.13	1.28	0.14
45	Sewer facilities	83.71	1.12	0.13
46	Local transit facilities	13.09	0.18	0.02
47	Highways	1099.72	14.74	1.64
50	Oil and gas wells	246.76	3.30	0.37
51	Oil and gas exploration	25.06	0.34	0.04
52	Military facilities	55.68	0.75	0.08
53	Conservation and development facilities	194.27	2.60	0.29
54	Other new nonbuilding facilities	86.98	1.16	0.13
Subtotals		2623.10	35.15	3.92
Maintenance Construction—Building				
55	Residential	317.75	4.26	0.47
56	Other non-farm buildings	365.54	4.90	0.55
57	Farm residences	25.57	0.34	0.04
58	Farm service buildings	39.35	0.52	0.06
Subtotals		748.20	10.02	1.12
Maintenance Construction—Nonbuilding				
59	Telephone and telegraph facilities	18.93	0.25	0.03
60	Railroads	47.95	0.64	0.07
61	Electric utility facilities	19.40	0.26	0.03
62	Gas utility facilities	22.64	0.30	0.03
63	Petroleum pipelines	8.15	0.12	0.01
64	Water supply facilities	64.24	0.86	0.09
65	Sewer facilities	18.84	0.25	0.03
66	Local transit facilities	2.17	0.03	0.01
67	Military facilities	55.74	0.75	0.08
68	Conservation and development facilities	20.56	0.28	0.03
69	Highways	246.13	0.30	0.36
70	Oil and gas wells	48.74	0.65	0.07
71	Other nonbuilding facilities	44.96	0.60	0.07
Subtotals		618.40	8.29	0.91
Totals		7463.50	100.00	11.14

Table 3.2 further refines the information for New Building Construction. The 18 sectors are arranged in ranked order according to their total energy requirements. This permits a rapid determination of the relative importance of each of the 18 sectors as energy consumers. In Table 3.3, the energy consumed by each of the 18 New Building Construction sectors is broken down into direct energy consumption (purchases by the construction sectors made directly from the five energy sectors) and energy already embodied

in the products when they are delivered to the jobsite.

Figure 3.2 represents the data from Table 3.3 in graphic form. It also represents an expansion of the New Building Construction column from Figure 3.1. Each of the New Building Construction sectors is represented by a separate column in Figure 3.2. In order that the relative magnitude of each sector within the New Building Construction group can be rapidly determined.

Figure 3.1 49 Construction Sectors Arranged by Major Groupings

Table 3.2 Ranked Order Direct and Embodied Energy in New Building Construction

Number	Name	Percent of new building construction	Total (Trillion Btu)
23	Residential, one family	22.91	795.88
30	Industrial buildings	13.50	468.84
36	Educational buildings	12.75	443.02
27	Residential alterations and additions	7.61	264.38
31	Office buildings	7.56	262.70
38	Other non-farm buildings	6.75	234.47
34	Stores and restaurants	5.79	200.97
25	Residential, garden apartments	4.36	151.36
26	Residential, high-rise apartments	3.43	119.32
37	Hospital buildings	3.41	118.48
28	Hotels and motels	2.02	70.08
35	Religious buildings	2.00	69.49
29	Dormitories	1.71	59.28
32	Warehouses	1.69	58.57
49	Farm service buildings	1.67	58.05
24	Residential, two-four family	1.02	35.41
33	Garages and service stations	0.95	32.94
48	Farm residences	0.88	30.60
Total		100.00	3473.80

Table 3.3 Numerical Order Direct and Embodied Energy in New Building Construction

Construction sector		Trillion Btu		
Number	Name	Direct energy	Embodied energy	Total energy
23	Residential, one family	110.03	685.85	795.88
24	Residential, two-four 4 family	6.29	29.12	35.41
25	Residential, garden apartments	29.59	121.77	151.36
26	Residential, high-rise apartments	25.28	94.04	119.32
27	Residential, alterations and additions	11.61	252.77	264.38
28	Hotels and motels	15.88	54.20	70.08
29	Dormitories	14.51	44.77	59.28
30	Industrial buildings	51.52	417.32	468.84
31	Office buildings	60.16	202.54	262.70
32	Warehouses	8.74	49.83	58.57
33	Garages and service stations	7.01	25.93	32.94
34	Stores and restaurants	48.23	152.74	200.97
35	Religious buildings	14.60	54.89	69.49
36	Educational buildings	88.28	354.74	443.02
37	Hospital buildings	25.01	93.84	118.85
38	Other non-farm buildings	52.69	181.78	234.47
48	Farm residences	2.01	28.59	30.60
49	Farm service buildings	3.38	54.67	58.05
Total		594.70	2,899.10	3,473.80

Figure 3.2 Energy Use of the 18 Sectors in New Building Construction

Table 3.4 lists the energy inputs from the 399 industrial sectors into New Building Construction as a whole. Sectors with no contribution are not listed. The information is presented in absolute units (trillion Btu) and as percentages of total New Building Construction energy requirements. Seventy-eight industry sectors are listed. These 78 sectors represent 98 percent of all energy requirements of New

Building Construction. The remaining 2 percent comes from inputs by industries each of which represent less than 0.1 percent of all New Building Construction requirements.

Detailed information regarding the energy inputs from each industrial sector into each construction sector is contained in Chapter 4.

Table 3.4 Inputs to New Building Construction from the 399 Industrial Sectors

Sector Number	Name	Percent of new building construction	Trillion Btu consumed
3	Refined petroleum products	15.79	548.51
4	Electric utilities	.47	16.33
5	Gas utilities	.33	11.46
21	Stone and clay mining	.43	14.94
117	Floor coverings	.48	16.67
135	Sawmills	2.47	85.80
136	Hardwood flooring	.18	6.25
138	Millwork	1.56	54.19
139	Veneer, plywood	1.45	50.37
140	Prefabricated wood structures	.68	23.62
141	Wood preserving	.12	4.17
142	Wood products	.46	15.98
144	Wood household furniture	.36	12.51
146	Metal household furniture	.18	6.25
151	Wood fixtures	.17	5.51
152	Metal fixtures	.18	6.25
160	Building paper	.89	30.92
161	Converted paper products	.20	6.95
174	Miscellaneous chemical products	.25	10.07
182	Paint products	1.17	40.64
183	Paving	1.10	38.21
184	Asphalt	2.47	85.80
188	Miscellaneous plastics	1.25	43.42
193	Glass products	.45	15.63
195	Cement	1.59	55.23
196	Bricks	3.04	105.60
197	Ceramic tile	.48	16.67
198	Clay refractories	.36	12.51
199	Clay products	.37	12.85
200	Plumbing fixtures	.30	10.42
204	Concrete blocks	1.74	60.44
205	Concrete products	1.40	48.63
206	Ready-mix concrete	8.69	301.87
207	Lime	.19	6.60
208	Gypsum products	1.32	45.85
209	Stone products	.15	5.21
211	Asbestos products	.63	21.88
214	Mineral wool	.99	34.39
215	Nonclay refractories	.58	20.16
217	Steel products	2.22	76.42
218	Iron, steel foundries	.29	10.07
227	Copper rolling	.68	23.62
230	Nonferrous wire	2.18	75.73
237	Metal sanitary ware	.46	15.98
238	Plumbing fittings	.59	20.50
239	Heating equipment	1.00	34.74

Table 3.4 Inputs to New Building Construction from the 399 Industrial Sectors (continued)

Sector Number	Name	Percent of new building construction	Trillion Btu consumed
240	Fabricated structural steel	5.62	195.23
241	Metal doors	2.98	101.78
242	Fabricated plate work	1.19	41.34
243	Sheet metal work	2.75	95.53
244	Architectural metal work	1.25	43.42
245	Miscellaneous metal work	2.72	94.49
250	Hardware	.66	20.93
252	Fabricated wire products	.81	28.14
255	Pipe	1.24	43.08
265	Elevators	.28	9.73
267	Hoists, cranes	.33	11.46
279	Pumps, compressors	.17	5.91
293	Refrigeration equipment	1.12	38.91
298	Switchgear	.50	17.37
307	Electric housewares and fans	.13	4.52
310	Household appliances	.18	6.25
312	Light fixtures	1.46	50.72
313	Wiring devices	.35	12.16
342	Temperature controls	.34	11.81
358	Hard floor coverings	.11	3.82
362	Railroad transport	1.21	42.03
364	Motor freight transport	.87	30.22
365	Water transport	.20	6.95
372	Wholesale trade	2.42	84.07
373	Retail trade	2.71	94.14
377	Insurance carriers	.14	4.86
380	Real estate	.26	9.03
384	Miscellaneous business services	.52	18.06
285	Advertising	.10	3.47
386	Miscellaneous professional services	1.76	61.14
387	Automobile repair	.32	11.12
398	Business travel	.97	33.70
Other input under 0.1 percent		2.00	69.48
Total		100.00	3473.80

Chapter 4

Breakdown of Energy Use by Construction Sectors

Chapter 3 described the total energy requirements of each of the 49 construction sectors and the breakdown between direct and embodied energy in the 18 new building construction sectors. Chapter 4 further breaks down the direct and embodied energy in these 18 sectors according to the energy contributions by the other industrial sectors, both in absolute energy terms (trillion Btu) and as percentage of that construction sector's total energy requirement. Using this information it is possible to determine how much energy goes into the construction sectors as a result of their use of different products. For example, it can be determined that the use of bricks in one family residential buildings requires 34.04 trillion Btu per year and that this was 4.28% of all energy required in this building category (see Table 4.2).

The material in Chapter 4 is divided into three parts. The first part represents the major energy inputs to each of the 49 construction sectors on a comparative basis. Figure 4.1 graphically represents the 49 construction sectors with energy inputs arranged into 9 major categories, (Direct Energy; Wood Products; Paint, Paving and Asphalt Products; Stone and Clay Products; Metal Products; Transportation; Trade; Miscellaneous Services; and Miscellaneous.)

Wall chart 1, an enlargement of Figure 4.1, is located in the pocket of the back cover. The chart further breaks down the 9 major energy input categories into approximately 20. Input sectors with an average contribution of less than 0.1 percent each are grouped together in a single category at the bottom of each graph. This information is presented graphically in order to permit a rapid comparison between the various construction sectors in terms of the percentages of energy input to each resulting from the use of different combinations of materials.

The second part, Table 4.1, describes in greater detail the characteristic energy inputs into New Building Construction as a whole. This section identifies the 78 input

categories which contribute more than one-tenth of one percent each of all energy input to New Building Construction. As noted in Chapter 3, these 78 sectors account for 98 percent of all energy input, the remaining 2 percent resulting from miscellaneous inputs of less than 0.1 percent each. The information in this section is presented in several different ways. The sectors have been arranged both according to the standard indexing number for each sector as described in Chapter 2 and in ranked order. The arrangement according to location permits the rapid location of any contributing sector. The arrangement according to ranked order permits identification of the most significant energy input sectors.

The listing of energy input sectors according to index order describes each input as a percentage of the total energy requirements of new building construction. This is the same information which has been provided in the preceding sectors of this chapter describing 49 separate construction sectors except that the information is in greater detail. The information is presented in both tabular and graphic form. The largest energy input to New Building Construction comes from Refined Petroleum Products, one of the direct energy inputs. Asphalt sold directly to the construction industry at the building site and used for such purposes as paths and driveways is included in the Refined Petroleum Products sector. (Other asphalt products where the asphalt is incorporated in the product as in asphalt roofing shingles is included in the Asphalt sector.) It should be noted that the asphalt is listed at its potential energy content value, even though it is not converted to energy by burning at the jobsite, and is not an energy product in the same sense as are gasoline, diesel fuel, natural gas, electricity, etc. In the case of New Building Construction, asphalt represents 59 percent of all refined petroleum consumption. Because of the importance of this product and in order to avoid misunderstandings regarding the nature of the commitment of energy products to New Building Construction, the Refined Petroleum Products sector has been subdivided into asphalt and other products. This subdivision represents a degree of

refinement which is one level higher than that used for any other sector.

The ranked order arrangement of the input sectors gives three pieces of information. The first is the total energy embodied in the transactions between each sector and New Building Construction (given in trillion Btu per year). The second is the fraction which each sector's embodied energy represents of the total energy requirements of new building construction. This is a reiteration of the information contained in the arrangement according to index number. Because the fractions are arranged sequentially from largest to smallest, this column may be used to go from the index order listing to the ranked order listing. It also permits the rapid determination of certain general information. For example, there are only three input categories representing 5 percent or more and 31 categories representing 1 percent or more. The third column lists the cumulative fraction of

total energy input, allowing the identification of such facts as four input sectors (petroleum refined products, ready-mix concrete, fabricated structural steel, and bricks) of the 350 non-construction sectors require almost one-third of the total energy used in New Building Construction and that 11 sectors require over half of the total. It further indicates that 47 sectors require over 90 percent of the total energy used in new building construction and that the smallest 31 sectors listed use less than 8 percent.

The third part of this chapter, Tables 4.2 to 4.19, takes the same information that was presented for all New Building Construction and breaks it down according to each of the 18 sectors that makes up New Building Construction. Using this section, it is possible to understand with considerable subtlety the energy input patterns characteristic of each New Building Construction sector.

Figure 4.1 Energy Input Fractions of All 49 Construction Sectors

Table 4.1 Energy Input Fractions of Composite of the 18 New Building Construction Sectors

Rank	399 Order	Name	Trillion Btu	Fraction	Cumulative Fraction	399 Order	Name	Fraction
1	3	Refined petroleum	548.51	15.79	15.79	3	Refined petroleum	15.79
2	206	Ready-mix concrete	301.87	8.69	24.28	4	Electric utilities	.47
3	240	Fab structural steel	195.23	5.62	30.10	5	Gas utilities	.33
4	196	Bricks	105.60	3.04	33.14	135	Sawmills	2.47
5	241	Metal doors	101.78	2.93	36.07	136	Hardwood flooring	.18
6	243	Sheet metal work	95.53	2.75	38.82	138	Millwork	1.56
7	245	Misc metal work	94.49	2.72	41.54	139	Veneer, plywood	1.45
8	373	Retail trade	94.14	2.71	44.25	140	Prefab wood struc	.68
9	135	Sawmills	85.80	2.47	46.72	141	Wood preserving	.12
10	184	Asphalt	85.80	2.47	49.19	142	Wood products	.46
11	372	Wholesale trade	84.07	2.24	51.62	Other inputs under .1 percent each .06		
12	217	Steel products	76.42	2.22	53.83	182	Paint products	1.17
13	230	Nonferrous wire	75.73	2.18	56.01	183	Paving	1.10
14	386	Misc prof services	61.14	1.76	57.77	184	Asphalt	2.47
15	204	Concrete blocks	60.44	1.74	59.51	195	Cement	1.59
16	195	Cement	55.23	1.59	61.10	196	Bricks	3.04
17	138	Millwork	54.19	1.56	62.66	197	Ceramic tile	.48
18	312	Light fixtures	50.72	1.46	64.12	198	Clay refractories	.36
19	139	Veneer, plywood	50.37	1.45	65.57	199	Clay products	.37
20	205	Concrete products	48.63	1.40	66.97	200	Plumbing fixtures	.30
21	208	Gypsum products	45.85	1.32	68.29	204	Concrete blocks	1.74
22	188	Misc plastics	43.42	1.25	69.54	205	Concrete products	1.40
23	244	Arch metal work	43.42	1.25	70.79	206	Ready-mix concrete	8.69
24	522	Pipe	43.08	1.24	72.03	207	Lime	.19
25	362	Railroad	42.03	1.21	73.24	208	Gypsum products	1.32
26	242	Fab plate work	41.34	1.19	74.43	209	Stone products	.15
27	182	Paint products	40.64	1.17	75.60	211	Asbestos products	.63
28	293	Refrigeration mach	38.91	1.12	76.72	214	Mineral wool	1.00
29	183	Paving	38.21	1.10	77.82	215	Nonclay refractories	.58
30	239	Heating equipment	34.74	1.00	78.82	Other inputs under .1 percent each .20		
31	214	Mineral wool	34.39	1.00	79.82	217	Steel Products	2.22
32	398	Business travel	33.70	.97	80.79	218	Iron, steel foundries	.29
33	160	Building paper	30.92	.89	81.68	227	Copper rolling	.68
34	364	Motor freight trans	30.22	.87	82.55	230	Nonferrous wire	2.18
35	252	Fab wire products	28.14	.81	83.36	237	Metal sanitary ware	.46
36	140	Prefab wood struc	23.62	.68	84.04	238	Plumbing fittings	.59
37	277	Copper rolling	23.62	.68	84.72	239	Heating equipment	1.00
38	250	Hardware	22.93	.66	85.38	240	Fab structural steel	5.62
39	211	Asbestos products	21.88	.63	86.01	241	Metal doors	2.93
40	238	Plumbing fittings	20.50	.59	86.60	242	Fab plate work	1.19
41	215	Nonclay refractories	20.16	.58	87.18	243	Sheet metal work	2.75
42	384	Misc business serv	18.06	.52	87.70	244	Arch metal work	1.25
43	298	Switchgear	17.37	.50	88.20	245	Misc metal work	2.72
44	117	Floor covering	16.67	.48	88.68	250	Hardware	.66
45	197	Ceramic tile	16.67	.48	89.16	252	Fab wire products	.81
46	4	Electric utilities	16.33	.47	89.63	255	Pipe	1.24
47	142	Wood products	15.98	.46	90.09	Other inputs under .1 percent each .28		
48	237	Metal sanitary ware	15.98	.46	90.55	362	Railroad	1.21
49	193	Glass products	15.63	.45	91.00	364	Motor freight trans	.87
50	21	Stone clay mining	14.94	.43	91.43	365	Water transport	.20
51	199	Clay products	12.85	.37	91.80	Other inputs under .1 percent each .10		
52	144	Wood h'hold furn	12.51	.36	92.16	372	Wholesale trade	2.42
53	198	Clay refractories	12.51	.36	92.52	373	Retail trade	2.71
54	313	Wiring devices	12.16	.35	92.87	384	Misc business serv	.52
55	342	Temp controls	11.81	.34	93.21	385	Advertising	.10
56	5	Gas utilities	11.46	.33	93.54	386	Misc prof services	1.76
57	267	Hoists, cranes	11.46	.33	93.87	21	Stone clay mining	.43
58	387	Automobile repair	11.12	.32	94.19	117	Floor covering	.48
59	200	Plumbing fixtures	10.42	.30	94.49	144	Wood h'hold furn	.36
60	174	Misc chemical prod	10.07	.29	94.78	146	Metal h'hold furn	.18
61	218	Iron, steel foundries	10.07	.29	95.07	151	Wood fixtures	.17
62	265	Elevators	9.73	.28	95.35	152	Metal fixtures	.18
63	380	Real estate	9.03	.26	95.61	160	Building paper	.89
64	161	Conv paper prod	6.95	.20	95.81	161	Conv paper products	.20
65	365	Water transport	6.95	.20	96.01	174	Misc chemical prod	.29
66	207	Lime	6.60	.19	96.20	188	Misc plastics	1.25
67	146	Metal h'hold furn	6.25	.18	96.38	193	Glass products	.45
68	152	Metal fixtures	6.25	.18	96.56	265	Elevators	.28
69	136	Hardwood flooring	6.25	.18	96.74	267	Hoists, cranes	.33
70	310	H'hold appliances	6.25	.18	96.92	279	Pumps, compressors	.17
71	279	Pumps, compressors	5.91	.17	97.09	293	Refrigeration mach	1.12
72	151	Wood fixtures	5.91	.17	97.26	298	Switchgear	.50
73	209	Stone products	5.21	.15	97.41	307	Electric h'wares	.13
74	377	Insurance carriers	4.86	.14	97.55	310	H'hold appliances	.18
75	307	Electric h'wares	4.52	.13	97.68	312	Light fixtures	1.46
76	141	Wood preserving	4.17	.12	97.80	313	Wiring devices	.35
77	358	Hard floor covering	3.82	.10	97.90	342	Temp controls	.34
78	385	Advertising	3.47	.10	98.00	358	Hard floor covering	.10
Other inputs under .1 percent each			69.48	2.00	100.00	377	Insurance carriers	.14
Total			3473.80	100.00		380	Real estate	.26
						387	Automobile repair	.32
						398	Business travel	.97
						Other inputs under .1 percent each 1.36		

Table 4.2 Energy Input Fractions of Sector 23 - Residential, One Family

Rank	399		Trillion	Cumulative		399		
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction
1	3	Refined petroleum	103.25	12.97	12.97	3	Refined petroleum	12.97
2	206	Ready-mix concrete	67.48	8.48	21.45	4	Electric utilities	.49
3	135	Sawmills	53.49	6.72	28.17	5	Gas utilities	.36
4	373	Retail trade	35.33	4.44	32.61	135	Sawmills	6.72
5	196	Bricks	34.04	4.28	36.89	136	Hardwood flooring	.54
6	184	Asphalt	24.22	3.04	39.93	137	Special sawmill prod	.17
7	140	Prefab wood	23.61	2.97	42.90	138	Millwork	2.45
8	372	Wholesale trade	23.59	2.97	45.87	139	Veneer, plywood	2.64
9	243	Sheet metal work	21.55	2.71	48.58	140	Prefab wood	2.97
10	139	Veneer, plywood	20.98	2.64	51.22	142	Wood products	.59
11	138	Millwork	19.51	2.45	53.67	Other inputs under .1 percent each .02		
12	386	Misc prof services	18.59	2.35	56.02	182	Paint products	1.24
13	195	Cement	18.47	2.32	58.34	183	Paving	.22
14	208	Gypsum products	17.03	2.14	60.48	184	Asphalt	3.04
15	362	Railroad	15.35	1.93	62.41	195	Cement	2.32
16	241	Metal doors	14.08	1.77	64.18	196	Bricks	4.28
17	204	Concrete blocks	13.22	1.66	65.84	197	Ceramic tile	.69
18	188	Misc plastics	11.11	1.40	67.24	199	Clay products	.73
19	217	Steel products	11.08	1.39	68.63	200	Plumbing fixtures	.53
20	160	Building paper	10.58	1.33	69.96	204	Concrete blocks	1.66
21	182	Paint products	9.84	1.24	71.20	205	Concrete products	.48
22	244	Arch metal work	9.71	1.22	72.42	206	Ready-mix concrete	8.48
23	117	Floor covering	9.57	1.20	73.62	207	Lime	.21
24	238	Plumbing fittings	8.28	1.04	74.66	208	Gypsum products	2.14
25	230	Nonferrous wire	8.26	1.04	75.70	209	Stone products	.14
26	144	Wood h'hold furn	8.17	1.03	76.73	211	Asbestos products	.41
27	398	Business travel	8.15	1.02	77.76	214	Mineral wool	.63
28	227	Copper rolling	7.45	.94	78.69	215	Nonclay refractories	.11
29	239	Heating equipment	7.38	.93	79.52	Other inputs under .1 percent each .13		
30	364	Motor freight trans	7.02	.88	80.50	217	Steel products	1.39
31	245	Misc metal work	6.85	.86	81.36	218	Iron, steel foundries	.28
32	293	Refrigeration mach	6.65	.84	82.20	227	Copper rolling	.94
33	237	Metal sanitary ware	6.38	.80	83.00	230	Nonferrous wire	1.04
34	384	Misc business serv	5.99	.75	83.75	237	Metal sanitary ware	.80
35	199	Clay products	5.82	.73	84.48	238	Plumbing fittings	1.04
36	240	Fab structural steel	5.60	.70	85.18	239	Heating equipment	.93
37	197	Ceramic tile	5.47	.69	85.87	240	Fab structural steel	.70
38	250	Hardware	5.16	.65	86.52	241	Metal doors	1.77
39	214	Mineral wool	5.00	.63	87.15	242	Fab plate work	.33
40	312	Light fixtures	4.80	.61	87.76	243	Sheet metal work	2.71
41	310	H'hold appliances	4.78	.60	88.36	244	Arch metal work	1.22
42	142	Wood products	4.67	.59	88.95	245	Misc metal work	.86
43	255	Pipe	4.57	.57	89.52	250	Hardware	.65
44	136	Hardwood flooring	4.28	.54	90.06	252	Fab wire products	.49
45	200	Plumbing fixtures	4.20	.53	90.59	255	Pipe	.57
46	252	Fab wire products	3.93	.49	91.08	Other inputs under .1 percent each .16		
47	4	Electric utilities	3.88	.49	91.57	362	Railroad	1.93
48	205	Concrete products	3.81	.48	92.05	364	Motor freight trans	.88
49	146	Metal h'hold furn	3.46	.43	92.48	365	Water transport	.37
50	211	Asbestos products	3.27	.41	92.89	366	Air transport	.10
51	21	Stone clay mining	3.25	.41	93.30	373	Wholesale trade	2.97
52	365	Water transport	2.95	.37	93.67	374	Retail trade	4.44
53	5	Gas utilities	2.90	.36	94.03	384	Misc business serv	.75
54	279	Pumps, compressors	2.84	.36	94.39	385	Advertising	.11
55	387	Automobile repair	2.69	.34	94.73	386	Misc prof services	2.35
56	242	Fab plate work	2.62	.33	95.06	15	Forestry, greenhouse	.13
57	313	Wiring devices	2.55	.32	95.38	17	Agric, fish service	.16
58	218	Iron, steel foundries	2.27	.28	95.66	21	Stone clay mining	.41
59	380	Real estate	2.18	.27	95.93	117	Floor covering	1.20
60	342	Temp controls	2.11	.26	96.19	130	Appl, purch mat	.15
61	161	Conv paper prod	1.98	.25	96.44	144	Wood h'hold furn	1.03
62	183	Paving	1.73	.22	96.66	146	Metal h'hold furn	.43
63	207	Lime	1.67	.21	96.87	152	Wood fixtures	.14
64	137	Special sawmill prod	1.36	.17	97.04	160	Building paper	1.32
65	17	Agric, fish service	1.25	.16	97.20	161	Conv paper prod	.25
66	130	Appl, purch mat	1.20	.15	97.35	174	Misc chemical prod.	.11
67	377	Insurance carriers	1.18	.15	97.50	188	Misc plastics	1.40
68	151	Wood fixtures	1.15	.14	97.64	279	Pumps, compressors	.36
69	209	Stone products	1.11	.14	97.78	293	Refrigeration mach	.84
70	15	Forestry, greenhouse	.99	.13	97.91	298	Switchgear	.12
71	298	Switchgear	.95	.12	98.03	310	H'hold appliances	.60
72	174	Misc chemical prod	.90	.11	98.14	312	Light fixtures	.61
73	215	Nonclay refractory	.89	.11	98.25	313	Wiring devices	.32
74	384	Advertising	.85	.11	98.36	342	Temp controls	.26
75	366	Air transport	.82	.10	98.46	377	Insurance carriers	.15
Other inputs under .1 percent each			12.26	1.54	100.00	380	Real estate	.27
Total			795.88	100.00		387	Automobile repair	.34
						398	Business travel	1.02
						Other inputs under .1 percent each 1.23

Table 4.3 Energy Input Fractions of Sector 24 - Residential, Two-Four Family

Rank	399		Trillion	Cumulative		399			
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction	
1	3	Refined petroleum	5.91	16.69	16.69	3	Refined petroleum	16.69	
2	206	Ready-mix concrete	2.29	6.46	23.15	4	Electric utilities	.52	
3	243	Sheet metal work	1.53	4.32	27.47	5	Gas utilities	.54	
4	196	Bricks	1.40	3.94	31.41	135	Sawmills	3.65	
5	135	Sawmills	1.29	3.65	35.06	136	Hardwood flooring	.31	
6	373	Retail trade	1.15	3.26	36.32	138	Millwork	3.10	
7	138	Millwork	1.10	3.10	41.42	139	Veneer, plywood	1.65	
8	184	Asphalt	1.01	2.84	44.26	142	Wood products	.57	
9	241	Metal doors	1.00	2.84	47.10	Other inputs under .1 percent each			.11
10	377	Wholesale trade	.90	2.55	49.65	182	Paint products	1.24	
11	217	Steel products	.80	2.26	51.91	183	Paving	1.74	
12	208	Gypsum products	.78	2.19	54.10	184	Asphalt	2.84	
13	204	Concrete blocks	.72	2.04	56.14	195	Cement	1.63	
14	239	Heating equipment	.68	1.91	58.05	196	Bricks	3.94	
15	386	Misc prof services	.63	1.79	59.84	197	Ceramic tile	.53	
16	183	Paving	.61	1.73	61.57	199	Clay products	.88	
17	117	Floor covering	.59	1.68	63.25	200	Plumbing fixtures	.33	
18	139	Veneer, plywood	.58	1.65	64.90	104	Concrete blocks	2.04	
19	195	Cement	.58	1.63	66.53	205	Concrete products	1.16	
20	188	Misc plastics	.47	1.32	67.85	206	Ready-mix concrete	6.46	
21	230	Nonferrous wire	.46	1.29	69.14	207	Lime	.29	
22	182	Paint products	.44	1.24	70.38	208	Gypsum products	2.19	
23	398	Business travel	.43	1.23	71.61	209	Stone products	.18	
24	204	Concrete products	.41	1.16	72.77	211	Asbestos products	.75	
25	362	Railroad	.39	1.11	73.88	213	Treated minerals	.12	
26	244	Arch metal work	.39	1.10	74.98	214	Mineral wool	.62	
27	279	Pumps, compressors	.39	1.09	76.07	Other inputs under .1 percent each			.19
28	245	Misc metal work	.36	1.03	77.10	217	Steel products	2.26	
29	255	Pipe	.35	.98	78.08	218	Iron, steel foundries	.53	
30	144	Wood h'hold furn	.35	.98	79.06	227	Copper rolling	.75	
31	312	Light fixtures	.32	.92	79.98	230	Nonferrous wire	1.29	
32	160	Building paper	.32	.91	80.89	237	Metal sanitary ware	.53	
33	199	Clay products	.31	.88	81.77	238	Plumbing fittings	.70	
34	293	Refrigeration mach	.28	.79	82.56	239	Heating equipment	1.91	
35	146	Metal h'hold furn	.28	.78	83.34	240	Fab structural steel	.67	
36	227	Copper rolling	.26	.75	84.09	241	Metal doors	2.84	
37	211	Asbestos product	.26	.75	84.84	242	Fab plate work	.50	
38	238	Plumbing fittings	.25	.70	85.54	243	Sheet metal work	4.32	
39	250	Hardware	.25	.69	86.23	244	Arch metal work	1.10	
40	240	Fab structural steel	.24	.67	86.90	245	Misc metal work	1.03	
41	384	Misc business serv	.23	.66	87.56	250	Hardware	.69	
42	364	Motor freight trans	.23	.65	88.21	252	Fab wire products	.61	
43	214	Mineral wool	.22	.62	88.83	255	Pipe	.98	
44	252	Fab wire products	.22	.61	89.44	Other inputs under .1 percent each			.15
45	142	Wood products	.20	.56	90.00	362	Railroad	1.11	
46	21	Stone clay mining	.20	.56	90.56	364	Motor freight trans	.65	
47	5	Gas utilities	.19	.55	91.11	Other inputs under .1 percent each			.06
48	197	Ceramic tile	.19	.53	91.64	372	Wholesale trade	2.55	
49	237	Metal Sanitary ware	.19	.53	92.17	373	Retail trade	3.26	
50	218	Iron, steel foundries	.19	.53	92.70	384	Misc business serv	.66	
51	4	Electric utilities	.18	.52	93.22	385	Advertising	.10	
52	242	Fab plate work	.18	.50	93.72	386	Misc prof services	1.79	
53	200	Plumbing fixtures	.12	.33	94.05	17	Agric, fish service	.10	
54	387	Automobile repair	.12	.33	94.38	21	Stone clay mining	.56	
55	298	Switchgear	.11	.31	94.69	117	Floor covering	1.68	
56	136	Hardwood flooring	.11	.31	95.00	144	Wood h'hold furn	.98	
57	310	H'hold appliances	.10	.30	95.30	146	Metal h'hold furn	.78	
58	207	Lime	.10	.29	95.59	151	Wood fixtures	.28	
59	151	Wood fixtures	.10	.28	95.87	160	Building paper	.91	
60	380	Real estate	.09	.27	96.14	161	Conv paper products	.11	
61	161	Conv paper products	.09	.26	96.40	174	Misc chemical prod	.10	
62	313	Wiring devices	.09	.25	96.65	187	Misc rubber products	.11	
63	342	Temp controls	.08	.22	96.87	188	Misc plastics	1.32	
64	358	Hard floor covering	.07	.19	97.06	193	Glass products	.12	
65	209	Stone products	.06	.18	97.24	267	Hoists, cranes	.13	
66	377	Insurance carriers	.05	.14	97.38	279	Pumps, compressors	1.09	
67	267	Hoists, cranes	.05	.13	97.51	293	Refrigeration mach	.79	
68	213	Treated minerals	.04	.12	97.63	298	Switchgear	.31	
69	193	Glass products	.04	.12	97.75	310	H'hold appliances	.30	
70	187	Misc rubber products	.04	.11	97.86	312	Light fixtures	.92	
71	17	Agric, fish service	.04	.10	97.96	313	Wiring devices	.25	
72	174	Misc chemical prod	.04	.10	98.05	342	Temp controls	.22	
73	355	Advertising	.04	.10	98.16	377	Insurance carriers	.14	
Other inputs under .1 percent each			.65	1.84	100.00	380	Real estate	.27	
Total			35.41	100.00		387	Automobile repair	.33	
						398	Business travel	1.23	
						Other inputs under .1 percent each			1.32
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Table 4.4 Energy Input Fractions of Sector 25 - Residential, Garden Apartments

Rank	399		Trillion	Cumulative		399		
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction
1	3	Refined petroleum	28.59	18.89	18.89	3	Refined petroleum	18.89
2	206	Ready-mix concrete	7.44	4.92	23.81	4	Electric utilities	.41
3	243	Sheet metal work	6.56	4.34	28.15	5	Gas utilities	.25
4	241	Metal doors	6.11	4.04	32.19	135	Sawmills	.93
5	136	Millwork	5.95	3.93	36.12	136	Millwork	3.93
6	196	Bricks	5.07	3.35	39.47	139	Veneer, plywood	.79
7	217	Steel products	4.67	3.09	42.56	142	Wood products	.53
8	183	Paving	4.64	3.06	45.62	Other inputs under .1 percent each .13		
9	373	Retail trade	4.22	2.79	48.41	182	Paint products	1.29
10	372	Wholesale trade	3.99	2.64	51.05	183	Paving	3.06
11	204	Concrete blocks	3.71	2.45	53.50	184	Asphalt	2.40
12	184	Asphalt	3.64	2.40	55.90	195	Cement	1.17
13	208	Gypsum products	3.62	2.39	58.29	196	Bricks	3.35
14	117	Floor covering	3.43	2.27	60.56	197	Ceramic tile	.29
15	239	Heating equipment	2.70	1.79	62.35	199	Clay products	.98
16	366	Misc prof services	2.63	1.74	64.09	200	Plumbing fixtures	.20
17	230	Nonferrous wire	2.39	1.58	65.67	204	Concrete blocks	2.45
18	205	Concrete products	2.27	1.50	67.17	205	Concrete products	1.50
19	255	Pipe	2.11	1.39	68.56	206	Ready-mix concrete	4.92
20	182	Paint products	1.95	1.29	69.85	207	Lime	.17
21	245	Misc metal work	1.92	1.27	71.12	208	Gypsum products	2.39
22	128	Misc plastics	1.84	1.21	72.33	209	Stone products	.21
23	312	Light fixtures	1.79	1.18	73.51	210	Abrasive products	.13
24	195	Cement	1.77	1.17	74.68	211	Asbestos products	1.05
25	398	Business travel	1.76	1.17	75.85	214	Mineral wool	.55
26	244	Arch metal work	1.69	1.12	76.97	Other inputs under .1 percent each .20		
27	211	Asbestos products	1.59	1.05	78.02	217	Steel products	3.09
28	144	Wood h'hold furn	1.53	1.01	79.03	218	Iron, steel foundries	.74
29	279	Pumps, compressors	1.51	1.00	80.03	227	Copper Rolling	.60
30	199	Clay products	1.48	.98	81.01	230	Nonferrous wire	1.58
31	135	Sawmills	1.41	.93	81.94	237	Metal sanitary ware	.29
32	354	Motor freight trans	1.38	.91	82.85	238	Plumbing fittings	.38
33	362	Railroad	1.37	.91	83.76	239	Heating equipment	1.79
34	293	Refrigeration mach	1.22	.80	84.56	240	Fab structural steel	.66
35	139	Veneer, plywood	1.20	.79	85.25	241	Metal doors	4.04
36	146	Metal h'hold furn	1.13	.75	86.10	242	Fab plate work	.66
37	250	Hardware	1.12	.74	86.84	243	Sheet metal work	4.34
38	218	Iron, steel foundries	1.12	.74	87.58	244	Arch metal work	1.12
39	21	Stone clay mining	1.05	.69	88.27	245	Misc metal work	1.27
40	242	Fab plate work	1.00	.66	89.93	250	Hardware	.74
41	240	Fab structural steel	.99	.66	89.59	252	Fab wire products	.53
42	227	Copper rolling	.92	.60	90.19	255	Pipe	1.39
43	214	Mineral wool	.83	.55	90.74	Other inputs under .1 percent each .20		
44	252	Fab wire products	.80	.53	91.27	362	Railroad	.91
45	142	Wood products	.80	.53	91.80	364	Motor freight trans	.91
46	298	Switchgear	.77	.51	92.31	365	Water transport	.16
47	364	Misc bus service	.71	.47	92.78	Other inputs under .1 percent each .02		
48	4	Electric utilities	.62	.41	93.19	372	Wholesale trade	2.63
49	160	Building paper	.61	.40	93.59	373	Retail trade	2.79
50	238	Plumbing fittings	.58	.38	93.97	384	Misc business serv	.47
51	367	Automobile repair	.45	.29	94.26	386	Misc prof services	1.74
52	237	Metal sanitary ware	.44	.29	94.55	Other inputs under .1 percent each .09		
53	197	Ceramic tile	.44	.29	94.84	21	Stone clay mining	.69
54	151	Wood fixtures	.43	.28	95.12	117	Floor coverings	2.27
55	161	Conv paper prod	.42	.28	95.40	144	Wood h'hold furn	1.01
56	267	Hoists, cranes	.39	.26	95.66	146	Metal h'hold furn	.75
57	5	Gas utilities	.39	.26	95.92	151	Wood fixtures	.28
58	320	Real estate	.37	.24	96.16	160	Building paper	.40
59	353	Hard floor covering	.35	.23	96.39	161	Conv paper prod	.28
60	209	Stone products	.32	.21	96.60	171	Inorg-org chemicals	.11
61	193	Glass products	.32	.21	96.81	174	Misc chemical prod	.11
62	200	Plumbing fixtures	.30	.20	97.01	188	Misc plastics	1.21
63	342	Temp controls	.27	.18	97.19	193	Glass products	.21
64	207	Lime	.25	.17	97.36	267	Hoists, cranes	.26
65	365	Water transport	.24	.16	97.52	279	Pumps, compressors	1.00
66	313	Wiring devices	.23	.15	97.67	293	Refrigeration mach	.80
67	377	Insurance carriers	.20	.13	97.80	298	Switchgear	.51
68	210	Abrasive products	.19	.13	97.93	307	Electric h'wares	.10
69	171	Inorg-org chemicals	.17	.11	98.04	312	Light fixtures	1.18
70	174	Misc chemical prod	.16	.11	98.15	313	Wiring devices	.15
71	307	Electric h'wares	.15	.10	98.25	342	Temp controls	.18
Other inputs under .1 percent each			2.85	1.75	100.00	358	Hard floor covering	.23
Total			151.36	100.00		377	Insurance carriers	.13
						380	Real estate	.24
						387	Automobile repair	.29
						398	Business travel	1.17
						Other inputs under .1 percent each 1.13		

Table 4.5 Energy Input Fractions of Sector 26 - Residential High Rise

Rank	399		Trillion	Cumulative		399		
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction
1	3	Refined petroleum	23.96	20.08	20.08	3	Refined petroleum	20.08
2	206	Ready-mix concrete	21.17	17.74	37.82	4	Electric utilities	.62
3	245	Misc metal work	4.94	4.14	41.96	5	Gas utilities	.49
4	241	Metal doors	4.84	4.05	46.01	135	Sawmills	.44
5	243	Sheet metal work	3.05	2.55	48.56	138	Millwork	1.08
6	240	Fab structural steel	3.00	2.51	51.07	139	Veneer, plywood	1.26
7	217	Steel products	2.91	2.44	53.51	141	Wood preserving	.13
8	196	Bricks	2.76	2.31	55.82	142	Wood products	.54
9	208	Gypsum products	2.39	2.01	57.83	Other inputs under .1 percent each .08		
10	372	Wholesale trade	2.27	1.90	59.73	182	Paint products	.82
11	373	Retail trade	2.08	1.74	61.47	183	Paving	.98
12	204	Concrete blocks	2.05	1.72	63.19	184	Asphalt	.73
13	230	Nonferrous wire	2.00	1.67	64.86	195	Cement	1.57
14	386	Misc prof services	1.99	1.66	66.52	196	Bricks	2.31
15	195	Cement	1.87	1.57	68.09	197	Ceramic tile	.62
16	255	Pipe	1.63	1.37	69.46	199	Clay products	.17
17	398	Business travel	1.53	1.23	70.69	200	Plumbing fixtures	.19
18	139	Veneer, plywood	1.50	1.26	71.95	204	Concrete blocks	1.72
19	321	Light fixtures	1.48	1.24	73.19	205	Concrete products	1.20
20	205	Concrete products	1.43	1.20	74.39	206	Ready-mix concrete	17.74
21	245	Arch metal work	1.41	1.18	75.57	207	Lime	.17
22	138	Millwork	1.28	1.08	76.65	208	Gypsum products	2.01
23	364	Motor freight trans	1.25	1.04	77.69	209	Stone products	.15
24	211	Asbestos products	1.19	1.00	78.69	211	Asbestos products	1.00
25	183	Paving	1.17	.98	79.67	213	Treated minerals	.11
26	265	Elevators	1.14	.95	80.62	214	Mineral wool	.31
27	252	Fab wire products	1.05	.88	81.50	215	Nonclay refractories	.34
28	182	Paint products	.98	.82	82.32	Other inputs under .1 percent each .15		
29	293	Refrigeration mach	.96	.80	83.12	217	Steel product	2.44
30	184	Asphalt	.86	.73	83.85	218	Iron, steel foundries	.36
31	188	Misc plastics	.84	.70	84.55	227	Copper rolling	.49
32	117	Floor covering	.84	.70	85.25	228	Aluminum rolling	.10
33	362	Railroad	.82	.69	85.94	230	Nonferrous wire	1.67
34	197	Ceramic tile	.74	.62	86.56	237	Metal sanitary ware	.28
35	4	Electric utilities	.74	.62	87.18	238	Plumbing fittings	.36
36	242	Fab plate work	.75	.60	87.78	239	Heating equipment	.53
37	384	Misc business serv	.70	.58	88.36	240	Fab structural steel	2.51
38	298	Switchgear	.65	.55	88.91	241	Metal doors	4.05
39	142	Wood products	.64	.54	89.45	242	Fab plate work	.60
40	239	Heating equipment	.63	.53	89.93	243	Sheet metal work	2.55
41	227	Copper rolling	.59	.49	90.47	244	Arch metal work	1.18
42	5	Gas utilities	.58	.49	90.96	245	Misc metal work	4.14
43	250	Hardware	.57	.48	91.44	250	Hardware	.48
44	135	Sawmills	.52	.44	91.88	252	Fab wire product	.88
45	387	Automobile repair	.50	.43	92.31	255	Pipe	1.37
46	238	Plumbing fittings	.43	.36	92.67	Other inputs under .1 percent each .13		
47	218	Iron, steel foundries	.43	.36	93.03	362	Railroad	.69
48	380	Real estate	.41	.35	93.38	364	Motor freight trans	1.04
49	215	Nonclay refractories	.41	.34	93.72	365	Water transport	.11
50	214	Mineral wool	.37	.31	94.03	Other inputs under .1 percent each .03		
51	21	Stone clay mining	.34	.29	94.32	372	Wholesale trade	1.90
52	237	Metal sanitary ware	.33	.28	94.60	373	Retail trade	1.74
53	174	Misc chemical prod	.31	.26	94.86	384	Misc business serv	.58
54	193	Glass products	.31	.26	95.12	385	Advertising	.14
55	160	Building paper	.30	.25	95.37	386	Misc prof services	1.66
56	144	Wood h'hold furn	.29	.24	95.61	21	Stone clay mining	.29
57	161	Conv paper products	.25	.21	95.82	117	Floor covering	.70
58	200	Plumbing fixtures	.23	.19	96.01	144	Wood h'hold furn	.24
59	377	Insurance carriers	.22	.19	96.20	160	Building paper	.25
60	342	Temp controls	.21	.18	96.38	161	Conv paper products	.21
61	199	Clay products	.21	.17	96.55	174	Misc chemical prod	.26
62	207	Lime	.20	.17	96.72	188	Misc plastics	.70
63	358	Hard floor covering	.19	.16	96.88	193	Glass products	.26
64	267	Hoists, cranes	.19	.16	97.04	265	Elevators	.95
65	313	Wiring devices	.18	.15	97.19	267	Hoists, cranes	.16
66	209	Stone products	.18	.15	97.34	293	Refrigeration mach	.80
67	385	Advertising	.17	.14	97.48	298	Switchgear	.55
68	141	Wood preserving	.16	.13	97.61	307	Electric h'wares	.10
69	369	Communications	.15	.13	97.74	312	Light fixtures	1.24
70	394	Nonprofit org	.15	.13	97.87	313	Wiring devices	.15
71	365	Water transport	.13	.11	97.98	342	Temp controls	.18
72	213	Treated minerals	.13	.11	98.09	358	Hard floor covering	.16
73	307	Electric h'wares	.12	.10	98.19	369	Communications	.13
74	223	Aluminum rolling	.12	.10	98.29	377	Insurance carriers	.19
Other inputs under .1 percent each			2.04	1.71	100.00	380	Real estate	.35
Total			119.32	100.00		387	Automobile repair	.43
						394	Nonprofit org	.13
						398	Business travel	1.28
						Other inputs under .1 percent each 1.45		

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Table 4.6 Energy Input Fractions of Sector 27 - Residential Additions and Alterations

Rank	399 Order	Name	Trillion Btu	Fraction	Cumulative Fraction	399 Order	Name	Fraction
1	206	Ready-mix concrete	19.19	7.26	7.26	3	Refined petroleum	4.20
2	135	Sawmills	17.42	6.59	13.85	4	Electric utilities	.12
3	230	Nonferrous wire	14.26	5.39	19.24	Other inputs under .1 percent each .07		
4	373	Retail trade	13.68	5.17	24.41	135	Sawmills	5.59
5	138	Millwork	11.37	4.30	28.71	136	Hardwood flooring	.25
6	3	Refined petroleum	11.11	4.20	32.91	138	Millwork	4.30
7	241	Metal doors	10.19	3.85	36.76	139	Veneer, plywood	3.56
8	208	Gypsum products	9.99	3.78	40.54	142	Wood products	1.03
9	139	Veneer, plywood	9.41	3.56	44.10	Other inputs under .1 percent each .11		
10	372	Wholesale trade	9.38	3.55	47.65	182	Paint products	2.52
11	312	Light fixtures	7.50	2.84	50.49	183	Paving	.13
12	182	Paint products	6.93	2.62	53.11	184	Asphalt	1.59
13	252	Fab wire products	6.14	2.32	55.43	195	Cement	1.74
14	196	Bricks	5.92	2.24	57.67	196	Bricks	2.24
15	363	Railroad	5.43	2.05	59.72	197	Ceramic tile	1.22
16	188	Misc plastics	5.20	1.97	61.69	199	Clay products	.41
17	243	Sheet metal work	5.15	1.95	63.64	200	Plumbing fixtures	.97
18	238	Plumbing fittings	5.11	1.93	65.57	204	Concrete blocks	.89
19	195	Cement	4.51	1.74	67.31	205	Concrete products	.50
20	313	Wiring devices	4.22	1.60	68.91	206	Ready-mix concrete	7.26
21	184	Asphalt	4.21	1.59	70.59	207	Lime	.15
22	227	Copper rolling	4.13	1.56	72.16	208	Gypsum products	1.78
23	160	Building paper	3.99	1.51	73.57	211	Asbestos products	.57
24	237	Metal sanitary ware	3.93	1.49	75.06	214	Mineral wool	1.06
25	217	Steel products	3.66	1.38	76.44	Other inputs under .1 percent each .21		
26	293	Refrigeration mach	3.64	1.38	77.82	217	Steel products	1.38
27	197	Ceramic tile	3.22	1.22	79.04	218	Iron, steel foundries	.30
28	239	Heating equipment	3.16	1.20	80.24	227	Copper rolling	1.56
29	245	Misc metal work	2.81	1.06	81.30	230	Nonferrous wire	5.39
30	214	Mineral wool	2.81	1.06	82.36	237	Metal sanitary ware	1.49
31	142	Wood products	2.73	1.03	83.39	238	Plumbing fittings	1.93
32	244	Arch metal work	2.58	.98	84.37	239	Heating equipment	1.20
33	200	Plumbing fixtures	2.57	.97	85.34	240	Fab structural steel	.61
34	364	Motor freight trans	2.52	.95	86.29	241	Metal doors	3.85
35	204	Concrete blocks	2.37	.89	87.18	242	Fab plate work	.46
36	255	Pipe	2.31	.87	88.05	243	Sheet metal work	1.95
37	144	Wood h'hold furn	2.01	.76	88.81	244	Arch metal work	.98
38	398	Business travel	1.96	.74	89.55	245	Misc metal work	1.06
39	240	Fab structural steel	1.62	.61	90.16	250	Hardware	.53
40	298	Switchgear	1.56	.59	90.75	252	Fab wire products	2.32
41	211	Asbestos products	1.50	.57	91.32	255	Pipe	.87
42	250	Hardware	1.41	.53	91.85	Other inputs under .1 percent each .14		
43	342	Temp controls	1.34	.51	92.36	363	Railroad	2.05
44	205	Concrete product	1.32	.50	92.86	364	Motor freight trans	.95
45	242	Fab plate work	1.22	.46	93.32	365	Water transport	.29
46	384	Misc business serv	1.15	.44	93.76	366	Air transport	.13
47	161	Conv paper products	1.15	.43	94.19	372	Wholesale trade	1.55
48	199	Clay products	1.09	.41	94.60	373	Retail trade	5.17
49	310	H'hold appliances	1.07	.40	95.00	384	Misc business serv	.44
50	21	Stone clay mining	1.03	.39	95.39	Other inputs under .1 percent each .07		
51	117	Floor covering	.98	.37	95.76	15	Forestry, greenhouse	.15
52	146	Metal h'hold furn	.87	.33	95.09	21	Stone clay mining	.39
53	218	Iron, steel foundries	.78	.30	95.39	117	Floor coverings	.37
54	279	Pumps, compressors	.78	.30	96.69	144	Wood h'hold furn	.76
55	365	Water transport	.76	.29	96.98	146	Metal h'hold furn	.33
56	136	Hardwood flooring	.65	.25	97.24	151	Wood fixtures	.16
57	151	Wood fixtures	.43	.16	97.40	152	Metal fixtures	.15
58	15	Forestry, greenhouse	.41	.15	97.55	160	Building paper	1.51
59	207	Lime	.41	.15	97.70	161	Conv paper products	.43
60	152	Metal fixtures	.40	.15	97.85	187	Misc rubber products	.11
61	399	Air transport	.34	.13	97.93	188	Misc plastics	1.97
62	183	Paving	.34	.13	98.11	279	Pumps, compressors	.30
63	4	Electric utilities	.31	.12	98.23	293	Refrigeration mach	1.38
64	187	Misc rubber products	.29	.11	98.34	298	Switchgear	.59
65	357	Brushes	.29	.11	98.45	310	H'hold appliances	.40
Other inputs under .1 percent each			4.10	1.55	100.00	312	Light fixtures	2.84
Total			264.38	100.00		313	Wiring devices	1.60
						342	Temp controls	.51
						357	Brushes	.11
						398	Business travel	.74
						Other inputs under .1 percent each .96		

Table 4.7 Energy Input Fractions of Sector 28 - Hotel and Motels

Rank	399 Order	Name	Trillion Btu	Fraction	Cumulative Fraction		399 Order	Name	Fraction	
1	3	Refined petroleum	15.00	21.41	21.41		3	Refined petroleum	21.41	
2	206	Ready-mix concrete	9.86	14.06	35.47		4	Electric utilities	.70	
3	241	Metal Doors	3.26	4.65	40.12		5	Gas utilities	.55	
4	245	Misc metal work	2.75	3.93	44.05		135	Sawmills	.44	
5	243	Sheet metal work	1.88	2.69	46.74		138	Millwork	1.28	
6	217	Steel products	1.74	2.48	49.22		139	Veneer, plywood	1.06	
7	240	Fab structural steel	1.53	2.18	51.40		141	Wood preserving	.10	
8	196	Bricks	1.50	2.14	53.54		142	Wood products	.50	
9	183	Paving	1.45	2.07	55.61		Other inputs under .1 percent each			.07
10	372	Wholesale trade	1.38	1.90	57.51		182	Paint products	.97	
11	373	Retail trade	1.31	1.86	59.37		183	Paving	2.07	
12	230	Nonferrous wire	1.29	1.84	61.21		184	Asphalt	1.16	
13	386	Misc prof services	1.17	1.68	62.89		195	Cement	1.51	
14	255	Pipe	1.14	1.63	64.52		196	Bricks	2.14	
15	195	Cement	1.06	1.51	66.03		197	Ceramic tile	.92	
16	204	Concrete blocks	1.02	1.46	67.49		199	Clay products	.11	
17	312	Light fixtures	.97	1.38	68.87		200	Plumbing fixtures	.25	
18	208	Gypsum products	.90	1.29	70.16		204	Concrete blocks	1.46	
19	135	Millwork	.90	1.28	71.44		205	Concrete products	1.04	
20	184	Asphalt	.81	1.16	72.60		206	Ready-mix concrete	14.06	
21	398	Business travel	.80	1.14	73.74		207	Lime	.22	
22	139	Veneer, plywood	.75	1.06	74.80		208	Gypsum products	1.29	
23	205	Concrete products	.73	1.04	75.84		209	Stone products	.14	
24	250	Hardware	.71	1.02	76.86		211	Asbestos products	.57	
25	182	Paint products	.69	.98	77.84		213	Treated minerals	.10	
26	188	Misc plastics	.69	.94	78.78		214	Mineral wool	.82	
27	244	Arch metal work	.65	.93	79.71		215	Nonclay refractories	.24	
28	364	Motor freight trans	.65	.92	80.68		Other inputs under .1 percent each			.10
29	197	Ceramic tile	.64	.92	81.55		217	Steel products	2.48	
30	293	Refrigeration mach	.61	.87	82.42		218	Iron, steel foundries	.43	
31	252	Fab wire products	.60	.86	83.28		227	Copper rolling	.61	
32	242	Fab plate work	.59	.84	84.12		228	Aluminum rolling	.10	
33	214	Mineral wool	.58	.82	84.94		230	Nonferrous wire	1.84	
34	193	Glass products	.58	.82	85.76		237	Metal sanitary ware	.38	
35	4	Electric utilities	.49	.70	86.46		238	Plumbing fittings	.47	
36	227	Copper rolling	.43	.61	87.07		239	Heating equipment	.59	
37	298	Switchgear	.43	.61	87.68		240	Fab structural steel	2.18	
38	239	Heating equipment	.41	.59	88.27		241	Metal doors	4.65	
39	211	Asbestos products	.40	.57	88.84		242	Fab plate work	.84	
40	362	Railroad	.39	.55	89.39		243	Sheet metal work	2.69	
41	5	Gas utilities	.35	.55	89.94		244	Arch metal work	.93	
42	265	Elevators	.38	.55	90.49		245	Misc metal work	3.93	
43	384	Misc business serv	.37	.53	91.02		250	Hardware	1.02	
44	142	Wood products	.35	.50	91.52		252	Fab wire product	.86	
45	387	Automobile repair	.33	.47	91.99		255	Pipe	1.63	
46	238	Plumbing fittings	.33	.47	92.46		Other inputs under .1 percent each			.13
47	21	Stone clay mining	.32	.46	92.92		362	Railroad	.55	
48	135	Sawmills	.31	.44	93.36		364	Motor freight trans	.92	
49	218	Iron, steel foundries	.30	.43	93.79		365	Water transport	.13	
50	174	Misc chemical prod	.27	.39	94.18		Other inputs under .1 percent each			.01
51	160	Building paper	.27	.38	94.56		372	Wholesale trade	1.90	
52	237	Metal sanitary ware	.27	.38	94.94		373	Retail trade	1.86	
53	380	Real estate	.26	.37	95.31		384	Misc business serv	.53	
54	267	Hoists, cranes	.20	.28	95.59		385	Advertising	.15	
55	200	Plumbing fixtures	.17	.25	95.84		386	Misc prof services	1.68	
56	215	Nonclay refractories	.17	.24	96.08		21	Stone clay mining	.46	
57	207	Lime	.15	.22	96.30		160	Building paper	.38	
58	377	Insurance carriers	.14	.20	96.50		161	Conv paper product	.19	
59	161	Conv paper products	.14	.19	96.69		174	Misc chemical prod	.39	
60	342	Temp controls	.13	.19	96.88		188	Misc plastics	.94	
61	358	Hard floor covering	.12	.18	97.06		193	Glass products	.82	
62	313	Wiring devices	.11	.16	97.22		265	Elevators	.55	
63	385	Advertising	.10	.15	97.37		267	Hoists, cranes	.28	
64	394	Nonprofit org	.10	.14	97.51		293	Refrigeration mach	.87	
65	369	Communications	.10	.14	97.65		298	Switchgear	.61	
66	209	Stone products	.10	.14	97.79		312	Light fixtures	1.38	
67	365	Water transport	.09	.13	97.92		313	Wiring devices	.16	
68	199	Clay products	.08	.11	98.03		342	Temp controls	.19	
69	228	Aluminum rolling	.07	.10	98.13		358	Hard floor covering	.18	
70	374	Banking	.07	.10	98.23		369	Communications	.14	
71	213	Treated minerals	.07	.10	98.33		374	Banking	.10	
72	141	Wood preserving	.07	.10	98.43		377	Insurance carriers	.20	
Other inputs under .1 percent each			1.10	1.57	100.00	380	Real estate	.37		
Total			70.08	100.00		387	Automobile repair	.47		
						394	Nonprofit org	.14		
						398	Business travel	1.14		
						Other inputs under .1 percent each			1.27	

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Table 4.8 Energy Input Fractions of Sector 29 - Dormitories

Rank	399 Order	Name	Trillion Btu	Fraction	Cumulative Fraction	399 Order	Name	Fraction
1	3	Refined petroleum	13.95	23.54	23.54	3	Refined petroleum	23.54
2	206	Ready-mix concrete	4.77	8.06	31.60	4	Electric utilities	.62
3	196	Bricks	2.69	4.54	36.14	5	Gas utilities	.32
4	241	Metal doors	2.59	4.38	40.52	135	Sawmills	.31
5	204	Concrete blocks	2.01	3.39	43.91	138	Millwork	1.11
6	240	Fab structural steel	2.00	3.38	47.29	139	Veneer, plywood	.69
7	205	Concrete products	1.98	3.33	50.62	141	Wood preserving	.24
8	243	Sheet metal work	1.72	2.91	53.53	142	Wood products	.34
9	245	Misc metal work	1.68	2.83	56.36	Other inputs under .1 percent each .04		
10	217	Steel products	1.63	2.75	59.11	182	Paint products	1.03
11	244	Arch metal work	1.22	2.06	61.17	183	Paving	1.13
12	372	Wholesale trade	1.22	2.06	63.23	184	Asphalt	1.21
13	230	Nonferrous wire	1.10	1.85	65.08	195	Cement	1.78
14	195	Cement	1.06	1.78	66.86	196	Bricks	4.54
15	373	Retail trade	1.04	1.76	68.62	197	Ceramic tile	.52
16	386	Misc prof services	.97	1.63	70.25	199	Clay products	.22
17	255	Pipe	.81	1.37	71.62	200	Plumbing fixtures	.14
18	312	Light fixtures	.81	1.37	72.99	204	Concrete blocks	3.39
19	293	Refrigeration mach	.74	1.24	74.23	205	Concrete products	3.33
20	184	Asphalt	.72	1.21	75.44	206	Ready-mix concrete	8.06
21	183	Paving	.67	1.13	76.57	207	Lime	.26
22	298	Business travel	.67	1.12	77.69	208	Gypsum products	.54
23	250	Hardware	.66	1.12	78.81	209	Stone products	.28
24	138	Millwork	.66	1.11	79.92	210	Abrasive products	.13
25	182	Paint products	.61	1.03	80.95	211	Asbestos products	.61
26	239	Heating equipment	.45	.76	81.71	214	Mineral wool	.53
27	193	Glass products	.44	.75	82.46	215	Nonclay refractories	.20
28	188	Misc plastics	.44	.74	83.20	Other inputs under .1 percent each .17		
29	242	Fab plate work	.43	.73	83.93	217	Steel products	2.75
30	364	Motor freight trans	.42	.70	84.63	218	Iron, steel foundries	.28
31	139	Veneer, plywood	.41	.69	85.32	228	Aluminum rolling	.12
32	4	Electric utilities	.37	.62	85.94	230	Nonferrous wire	1.85
33	211	Asbestos products	.36	.61	86.55	237	Metal sanitary ware	.23
34	298	Switchgear	.36	.60	87.15	238	Plumbing fittings	.29
35	252	Fab wire product	.35	.60	87.75	239	Heating equipment	.76
36	384	Misc business serv	.32	.55	88.30	240	Fab structural steel	3.38
37	208	Gypsum products	.32	.54	88.84	241	Metal doors	4.38
38	214	Mineral wool	.31	.53	89.37	242	Fab plate work	.73
39	197	Ceramic tile	.31	.52	89.89	243	Sheet metal work	2.91
40	227	Copper rolling	.31	.51	90.40	244	Arch metal work	2.06
41	362	Railroad	.28	.47	90.87	245	Misc metal work	2.83
42	387	Automobile repair	.28	.47	91.34	250	Hardware	1.12
43	265	Elevators	.27	.45	91.79	252	Fab wire products	.60
44	160	Building paper	.25	.42	92.21	255	Pipe	1.37
45	174	Misc chemical prod	.24	.40	92.61	Other inputs under .1 percent each .10		
46	380	Real estate	.21	.36	92.97	362	Railroad	.47
47	142	Wood products	.20	.34	93.31	364	Motor freight trans	.70
48	5	Gas utilities	.19	.33	93.64	Other inputs under .1 percent each .10		
49	21	Stone clay mining	.19	.32	93.96	372	Wholesale trade	2.06
50	135	Sawmills	.18	.31	94.27	373	Retail trade	1.75
51	238	Plumbing fittings	.17	.29	94.56	384	Misc business service	.55
52	218	Iron, steel foundries	.17	.28	94.84	385	Advertising	.14
53	209	Stone products	.16	.28	95.12	386	Misc prof services	1.63
54	242	Temp controls	.16	.27	95.39	21	Stone clay mining	.32
55	207	Lime	.15	.26	95.65	160	Building paper	.42
56	141	Wood preserving	.14	.24	95.89	161	Conv paper products	.12
57	267	Hoists, cranes	.14	.23	96.12	174	Misc chemical prod	.12
58	237	Metal sanitary ware	.14	.23	96.35	188	Misc plastics	.74
59	199	Clay products	.13	.22	96.57	193	Glass products	.75
60	215	Nonclay refractories	.12	.20	96.77	265	Elevators	.45
61	377	Insurance carriers	.12	.20	96.97	267	Hoists, cranes	.23
62	307	Electric h'wares	.97	.16	97.13	281	Blowers	.10
63	313	Wiring devices	.94	.16	97.29	293	Refrigeration mach	1.24
64	325	Advertising	.85	.14	97.43	298	Switchgear	.60
65	200	Plumbing fixtures	.82	.14	97.57	307	Electric h'wares	.16
66	394	Non profit org	.82	.14	97.71	318	Light fixtures	1.37
67	358	Hard floor covering	.81	.14	97.85	313	Wiring devices	.16
68	369	Communications	.80	.14	97.99	342	Temp controls	.27
69	210	Abrasive products	.78	.13	98.12	358	Hard floor covering	.14
70	228	Aluminum rolling	.73	.12	98.24	369	Communications	.14
71	161	Conv paper products	.73	.12	98.36	374	Banking	.10
72	281	Blowers	.62	.10	98.46	377	Insurance carriers	.20
73	374	Banking	.60	.10	98.56	380	Real estate	.36
Other inputs under .1 percent each			.95	1.44	100.00	387	Automobile repair	.47
Total!			59.28	100.00		394	Nonprofit org	.14
						398	Business travel	1.12
						Other inputs under .1 percent each 1.05		

DIRECT ENERGY

WOOD PROD

PAINT PAVING

STONE CLAY PROD

METAL PROD TRADE

TRANSPORT

SERVICE

MISC

Table 4.9 Energy Input Fractions of Sector 30 - Industrial Buildings

Rank	399		Trillion	Cumulative		399		
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction
1	240	Fab structural steel	69.28	14.78	14.78	3	Refined petroleum	10.70
2	3	Refined petroleum	50.14	10.69	25.47	4	Electric utilities	.17
3	206	Ready-mix concrete	41.64	8.88	34.35	5	Gas utilities	.12
4	242	Fab plate work	21.26	4.53	38.88	135	Sawmills	.12
5	184	Asphalt	17.95	3.83	42.71	138	Millwork	.32
6	215	Nonclay refractories	15.97	3.41	46.12	139	Veneer, plywood	.54
7	217	Steel products	13.51	2.88	49.00	141	Wood preserving	.26
8	245	Misc metal work	13.40	2.86	51.86	142	Wood products	.14
9	198	Clay refractories	12.34	2.63	54.49	Other inputs under .1 percent each .04		
10	196	Bricks	11.98	2.56	57.04	182	Paint products	.68
11	230	Nonferrous wire	10.83	2.31	59.36	183	Paving	1.31
12	241	Metal doors	10.81	2.31	61.67	184	Asphalt	3.83
13	255	Pipe	10.67	2.28	63.95	195	Cement	.91
14	243	Sheet metal work	10.54	2.27	66.22	196	Bricks	2.56
15	205	Concrete products	10.57	2.25	68.47	198	Clay refractories	2.63
16	372	Wholesale trade	9.34	1.99	70.46	199	Clay products	.12
17	204	Concrete blocks	8.81	1.88	72.34	200	Plumbing fixtures	.11
18	312	Light fixtures	7.81	1.67	74.01	204	Concrete blocks	1.88
19	244	Arch metal work	6.95	1.48	75.49	205	Concrete products	2.25
20	386	Misc prof services	6.61	1.41	76.90	206	Ready-mix concrete	8.88
21	188	Misc plastics	6.61	1.41	78.31	208	Gypsum products	.49
22	373	Retail trade	6.31	1.35	79.66	209	Stone products	.17
23	183	Paving	6.14	1.31	80.97	211	Asbestos products	.57
24	293	Refrigeration mach	5.69	1.21	82.18	214	Mineral wool	1.12
25	214	Mineral wool	5.27	1.12	83.30	215	Non clay refractories	3.41
26	362	Railroad	5.26	1.12	84.42	Other inputs under .1 percent each .30		
27	364	Motor freight trans	4.35	.93	85.35	217	Steel product	2.88
28	195	Cement	4.28	.91	86.26	218	Iron, steel foundries	.20
29	239	Heating equipment	3.75	.80	87.06	227	Copper rolling	.59
30	252	Fab wire product	3.39	.72	87.78	230	Nonferrous wire	2.31
31	298	Switchgear	3.20	.68	88.46	237	Metal sanitary ware	.16
32	182	Paint products	3.18	.68	89.14	238	Plumbing fittings	.21
33	398	Business travel	2.95	.63	89.77	239	Heating equipment	.80
34	267	Hoists, cranes	2.75	.59	90.36	240	Fab structural steel	14.78
35	227	Copper rolling	2.75	.59	90.95	241	Metal doors	2.31
36	160	Building paper	2.74	.58	91.53	242	Fab plate work	4.53
37	211	Asbestos products	2.65	.57	91.30	243	Sheet metal work	2.27
38	193	Glass products	2.53	.54	92.64	244	Arch metal work	1.48
39	139	Veneer, plywood	2.52	.54	93.18	245	Misc metal work	2.86
40	208	Gypsum products	2.28	.49	93.67	250	Hardware	.23
41	21	Stone clay mining	1.65	.35	94.12	252	Fab wire products	.72
42	138	Millwork	1.48	.32	94.34	255	Pipe	2.28
43	141	Wood preserving	1.23	.26	94.60	Other inputs under .1 percent each .22		
44	342	Temp controls	1.22	.26	94.86	362	Railroad	1.12
45	384	Misc business serv	1.16	.25	95.11	364	Motor freight trans	.93
46	250	Hardware	1.10	.23	95.34	365	Water transport	.12
47	238	Plumbing fittings	.98	.21	95.55	366	Air transport	.18
48	313	Wiring devices	.94	.20	95.75	Other inputs under .1 percent each .01		
49	218	Iron, steel foundries	.92	.20	95.95	372	Wholesale trade	1.99
50	174	Misc chemical prod	.84	.18	96.13	373	Retail trade	1.35
51	366	Air transport	.84	.18	96.31	384	Misc business serv	.25
52	4	Electric utilities	.80	.17	96.48	386	Misc prof services	1.41
53	209	Stone products	.78	.17	96.65	Other inputs under .1 percent each .04		
54	237	Metal sanitary ware	.76	.16	96.81	21	Stone clay mining	.35
55	171	Inorg-org chemicals	.73	.16	96.97	160	Building paper	.58
56	307	Electric h'wares	.70	.15	97.12	161	Conv paper products	.11
57	142	Wood products	.67	.14	97.26	171	Inorg-org chemicals	.16
58	5	Gas utilities	.58	.12	97.38	174	Misc chemical prod	.18
59	365	Water transport	.58	.12	97.50	188	Misc plastics	1.41
60	387	Automobile repair	.58	.12	97.62	193	Glass products	.54
61	266	Conveyors	.57	.12	97.74	265	Elevators	.11
62	135	Sawmills	.56	.12	97.86	266	Conveyors	.12
63	199	Clay products	.55	.12	97.98	267	Hoists, cranes	.59
64	161	Conv paper products	.52	.11	98.09	293	Refrigeration mach	1.21
65	200	Plumbing fixtures	.51	.11	98.20	298	Switchgear	.68
66	265	Elevators	.50	.11	98.31	307	Electric h'wares	.15
67	358	Hard floor covering	.49	.10	98.41	312	Light fixtures	1.67
68	380	Real estate	.48	.10	98.51	313	Wiring devices	.20
Other inputs under .1 percent each			6.99	1.49	100.00	342	Temp controls	.26
Total			468.83	100.00		358	Hard floor covering	.10
						380	Real estate	.10
						387	Automobile repair	.12
						398	Business travel	.63
						Other inputs under .1 percent each .87		

Table 4.10 Energy Input Fractions of Sector 31 - Office Buildings

Rank	399 Order	Name	Trillion Btu	Fraction	Cumulative Fraction	399 Order	Name	Fraction
1	3	Refined petroleum	57.34	21.83	21.83	3	Refined petroleum	21.83
2	240	Fab structural steel	24.97	9.50	31.33	4	Electric utilities	.63
3	206	Ready-mix concrete	19.51	7.43	38.76	5	Gas utilities	.44
4	241	Metal doors	10.47	3.98	42.74	135	Sawmills	.19
5	245	Misc metal work	7.37	2.81	44.55	138	Millwork	.58
6	243	Sheet metal work	7.13	2.72	48.27	139	Veneer, plywood	.61
7	217	Steel products	6.97	2.65	50.92	141	Wood preserving	.18
8	196	Bricks	6.50	2.47	53.39	142	Wood products	.23
9	230	Nonferrous wire	6.49	2.47	55.86	Other inputs under .1 percent each .05		
10	372	Wholesale trade	5.61	2.13	57.99	182	Paint products	.98
11	204	Concrete blocks	4.86	1.85	59.84	183	Paving	1.26
12	312	Light fixtures	4.81	1.83	61.67	184	Asphalt	1.11
13	373	Retail trade	4.56	1.73	63.40	195	Cement	1.09
14	255	Pipe	4.22	1.61	65.05	196	Bricks	2.47
15	205	Concrete products	4.13	1.57	66.58	197	Ceramic tile	.25
16	386	Misc prof services	4.09	1.56	68.14	199	Clay products	.17
17	244	Arch metal work	3.85	1.47	69.61	200	Plumbing fixtures	.12
18	193	Glass products	3.81	1.45	71.06	204	Concrete blocks	1.85
19	293	Refrigeration mach	3.66	1.39	72.45	205	Concrete products	1.57
20	183	Paving	3.30	1.25	73.70	206	Ready-mix concrete	7.43
21	214	Mineral wool	3.09	1.18	74.88	207	Lime	.17
22	184	Asphalt	2.92	1.11	75.99	208	Gypsum products	.43
23	195	Cement	2.88	1.10	77.09	209	Stone products	.16
24	398	Business travel	2.85	1.09	78.18	211	Asbestos products	.78
25	182	Paint products	2.58	.98	79.16	214	Mineral wool	1.18
26	242	Fab plate work	2.57	.98	80.14	215	Nonclay refractories	.34
27	265	Elevators	2.48	.92	81.06	Other inputs under .1 percent each .26		
28	374	Motor freight trans	2.15	.82	81.88	217	Steel products	2.65
29	239	Heating equipment	2.14	.81	82.69	218	Iron, steel foundries	.23
30	362	Railroad	2.09	.79	83.48	227	Copper rolling	.49
31	298	Switchgear	2.08	.79	84.27	228	Aluminum rolling	.13
32	188	Misc plastics	2.07	.79	85.06	230	Nonferrous wire	2.47
33	211	Asbestos product	2.05	.78	85.84	237	Metal sanitary ware	.17
34	250	Hardware	1.88	.71	86.55	238	Plumbing fittings	.22
35	4	Electric utilities	1.66	.63	87.18	239	Heating equipment	.81
36	139	Veneer, plywood	1.61	.61	87.79	240	Fab structural steel	9.50
37	138	Millwork	1.54	.58	88.37	241	Metal doors	3.98
38	252	Fab wire products	1.40	.57	88.94	242	Fab plate work	.98
39	152	Metal fixtures	1.41	.54	89.40	243	Sheet metal work	2.72
40	384	Misc business service	1.30	.50	89.98	244	Arch metal work	1.47
41	227	Copper rolling	1.28	.49	90.47	245	Misc metal work	2.81
42	160	Building paper	1.23	.47	90.94	250	Hardware	.71
43	267	Hoists, cranes	1.21	.46	91.40	252	Fab wire products	.57
44	5	Gas utilities	1.16	.44	91.84	255	Pipe	1.61
45	208	Gypsum products	1.14	.43	92.27	Other inputs under .1 percent each .10		
46	387	Automobile repair	1.14	.43	92.70	362	Railroad	.79
47	174	Misc chemical prod	1.08	.41	93.11	364	Motor freight trans	.82
48	215	Nonclay refractories	.90	.34	93.45	365	Water transport	.13
49	380	Real estate	.90	.34	93.79	Other inputs under .1 percent each .11		
50	342	Temp controls	.81	.31	94.10	372	Wholesale trade	2.14
51	21	Stone clay mining	.81	.31	94.41	373	Retail trade	1.73
52	197	Ceramic tile	.66	.25	94.66	384	Misc business serv	.50
53	218	Iron, steel foundries	.61	.23	94.89	385	Advertising	.14
54	142	Wood products	.59	.23	95.12	386	Misc prof services	1.56
55	238	Plumbing fittings	.59	.22	95.34	21	Stone, clay mining	.31
56	313	Wiring devices	.56	.21	95.55	117	Floor covering	.17
57	135	Sawmills	.50	.19	95.74	151	Wood fixtures	.17
58	377	Insurance carriers	.50	.19	95.93	152	Metal fixtures	.54
59	141	Wood preserving	.48	.18	96.11	160	Building paper	.47
60	307	Electric h'wares	.48	.18	96.29	161	Conv paper products	.13
61	207	Lime	.46	.17	96.46	174	Misc chemical prod	.41
62	237	Metal sanitary ware	.45	.17	96.63	185	Tires	.11
63	199	Clay products	.44	.17	96.80	188	Misc plastics	.79
64	177	Floor coverings	.44	.17	96.97	193	Glass products	1.45
65	151	Wood fixtures	.44	.17	97.14	265	Elevators	.92
66	209	Stone products	.42	.16	97.30	267	Hoists, cranes	.46
67	385	Advertising	.36	.14	97.44	281	Blowers	.11
68	228	Aluminum rolling	.34	.13	97.57	293	Refrigeration mach	1.39
69	369	Communications	.34	.13	97.70	298	Switchgear	.79
70	161	Conv paper products	.33	.13	97.83	307	Electric h'wares	.18
71	365	Water transport	.33	.13	97.96	312	Light fixtures	1.83
72	394	Nonprofit org	.33	.13	98.09	313	Wiring devices	.21
73	358	Hard floor covering	.32	.12	98.12	342	Temp controls	.31
74	200	Plumbing fixtures	.31	.12	98.33	358	Hard floor covering	.12
75	185	Tires	.29	.11	98.11	369	Communications	.13
76	281	Blowers	.29	.11	98.55	377	Insurance carriers	.19
Other inputs under .1 percent each		3.71	1.45	100.00	380	Real estate	.34	
Total		262.70	100.00		387	Automobile repair	.43	
					394	Nonprofit org	.13	
					398	Business travel	1.09	
					Other inputs under .1 percent each .94			

MISC

Table 4.11 Energy Input Fractions of Sector 32 - Warehouses

Rank	399	Name	Trillion	Cumulative		399	Name	Fraction	
Order	Order		Btu	Fraction		Order			
1	240	Fab structural steel	9.35	15.97	15.97	3	Refined petroleum	14.28	
2	3	Refined petroleum	8.36	14.28	30.25	4	Electric utilities	.32	
3	245	Misc metal work	5.41	9.24	39.49	5	Gas utilities	.32	
4	206	Ready-mix concrete	4.79	8.18	47.67	135	Sawmills	.19	
5	184	Asphalt	3.45	5.88	53.55	138	Millwork	.59	
6	183	Paving	1.79	3.05	56.60	139	Veneer, plywood	.58	
7	205	Concrete products	1.57	2.69	59.29	141	Wood preserving	.19	
8	241	Metal doors	1.54	2.63	61.92	142	Wood products	.12	
9	196	Bricks	1.46	2.50	64.42	Other inputs under .1 percent each			.03
10	217	Steel products	1.20	2.05	66.47	182	Paint products	.65	
11	243	Sheet metal work	1.15	1.97	68.44	183	Paving	3.05	
12	372	Wholesale trade	1.00	1.71	70.15	184	Asphalt	5.88	
13	204	Concrete blocks	.99	1.69	71.84	195	Cement	.82	
14	255	Pipe	.92	1.57	73.41	196	Bricks	2.50	
15	230	Nonferrous wire	.90	1.53	74.94	199	Clay products	.13	
16	214	Mineral wool	.75	1.28	76.22	204	Concrete blocks	1.69	
17	386	Misc prof services	.74	1.26	77.48	205	Concrete products	2.69	
18	373	Retail trade	.73	1.25	78.73	206	Ready-mix concrete	8.18	
19	312	Light fixtures	.69	1.18	79.91	207	Lime	.17	
20	293	Refrigeration mach	.67	1.14	81.05	208	Gypsum products	.22	
21	244	Arch metal work	.65	1.11	82.16	209	Stone products	.16	
22	188	Misc plastics	.63	1.07	83.23	211	Asbestos products	.36	
23	160	Building paper	.49	.84	84.07	214	Mineral wool	1.28	
24	195	Cement	.48	.82	84.89	Other inputs under .1 percent each			.39
25	364	Motor freight trans	.46	.79	85.68	217	Steel products	2.05	
26	398	Business travel	.40	.69	86.37	218	Iron, steel foundries	.15	
27	193	Glass products	.39	.67	87.04	227	Copper rolling	.50	
28	182	Paint products	.38	.65	87.69	228	Aluminum rolling	.13	
29	362	Railroad	.38	.65	88.34	230	Nonferrous wire	1.53	
30	21	Stone clay mining	.36	.62	88.96	237	Metal sanitary ware	.12	
31	267	Hoists, cranes	.36	.62	89.58	238	Plumbing fittings	.14	
32	138	Millwork	.35	.59	90.17	239	Heating equipment	.57	
33	139	Veneer, plywood	.34	.58	90.75	240	Fab structural steel	15.97	
34	239	Heating equipment	.33	.57	91.32	241	Metal doors	2.63	
35	242	Fab plate work	.31	.54	91.86	242	Fab plate work	.54	
36	252	Fab wire products	.31	.53	92.39	243	Sheet metal work	1.97	
37	227	Copper rolling	.30	.50	92.89	244	Arch metal work	1.11	
38	298	Switchgear	.28	.49	93.37	245	Misc metal work	9.24	
39	211	Asbestos products	.27	.36	93.73	250	Hardware	.27	
40	5	Gas utilities	.19	.33	94.06	252	Fab wire products	.53	
41	384	Misc business services	.19	.32	94.38	255	Pipe	1.57	
42	3	Electric utilities	.18	.32	94.70	Other inputs under .1 percent each			.08
43	171	Inorg-org chemicals	.17	.29	94.99	363	Railroad	.65	
44	174	Misc chemical prod	.16	.28	95.27	364	Motor freight trans	.79	
45	250	Hardware	.16	.27	95.54	Other input under .1 percent each			.14
46	211	Gypsum products	.13	.22	95.76	372	Wholesale trade	1.71	
47	287	Automobile repair	.12	.20	95.96	373	Retail trade	1.24	
48	342	Temp controls	.11	.19	96.15	384	Misc business serv	.32	
49	135	Sawmills	.11	.19	96.34	386	Misc prof services	1.26	
50	141	Wood preserving	.11	.19	96.53	21	Stone clay mining	.62	
51	207	Lime	.10	.17	96.70	160	Building paper	.84	
52	209	Stone products	.09	.16	96.86	171	Inorg-org chemicals	.29	
53	380	Real estate	.09	.16	97.02	174	Misc chemical prod	.28	
54	313	Wiring devices	.09	.16	97.18	185	Tires	.10	
55	218	Iron, steel foundries	.09	.15	97.33	188	Misc plastics	1.07	
56	233	Plumbing fittings	.08	.14	97.47	193	Glass products	.67	
57	199	Clay products	.08	.13	97.60	267	Hoists, cranes	.62	
58	228	Aluminum rolling	.07	.13	97.73	293	Refrigeration mach	1.14	
59	142	Wood products	.07	.12	97.85	298	Switchgear	.48	
60	237	Metal sanitary ware	.07	.12	97.97	307	Electric h'wares	.11	
61	307	Electric h'wares	.06	.11	98.08	312	Light fixtures	1.18	
62	185	Tires	.06	.10	98.18	313	Wiring devices	.16	
63	358	Hard floor covering	.06	.10	98.28	342	Temp controls	.19	
Other inputs under .1 percent each			1.01	1.72	100.00	358	Hard floor covering	.10	
Total			58.57	100.00		380	Real estate	.16	
						387	Automobile repair	.20	
						398	Business travel	.69	
						Other inputs under .1 percent each			1.10

DIRECT ENERGY

WOOD

PAINT PAVING ASPHALT

STONE CLAY PROD

METAL PROD

TRADE

TRANSPORT SERVICE

MISC

Table 4.12 Energy Input Fractions of Sector 33 - Garages and Service Stations

Rank	399		Trillion	Cumulative		399		
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction
1	3	Refined petroleum	6.63	24.14	20.24	3	Refined petroleum	20.14
2	206	Ready-mix concrete	3.78	11.49	31.63	4	Electric utilities	.56
3	240	Fab structural steel	2.56	7.78	39.41	5	Gas utilities	.58
4	245	Misc metal work	1.20	3.63	44.63	135	Sawmills	.73
5	241	Metal doors	1.59	4.82	49.45	138	Millwork	.66
6	242	Fab plate work	1.20	3.63	53.08	139	Veneer, plywood	.78
7	183	Paving	1.17	3.56	56.64	141	Wood preserving	.18
8	243	Sheet metal work	.91	2.77	59.41	142	Wood products	.24
9	184	Asphalt	.91	2.76	62.17	Other inputs under .1 percent each .05		
10	205	Concrete products	.78	2.37	64.54	182	Paint products	.86
11	312	Light fixtures	.71	2.16	66.70	183	Paving	3.56
12	217	Steel products	.67	2.03	68.73	184	Asphalt	2.76
13	230	Nonferrous wire	.57	1.72	70.45	195	Cement	1.31
14	372	Wholesale trade	.52	1.58	72.03	196	Bricks	1.24
15	386	Misc prof services	.45	1.37	73.40	197	Ceramic tile	.30
16	373	Retail trade	.44	1.34	74.74	199	Clay products	.16
17	195	Cement	.43	1.31	76.05	200	Plumbing fixtures	.11
18	265	Elevators	.43	1.29	77.34	204	Concrete blocks	1.29
19	204	Concrete blocks	.43	1.29	78.63	205	Concrete products	2.37
20	196	Bricks	.41	1.24	79.87	206	Ready-mix concrete	11.49
21	255	Pipe	.33	.99	80.86	207	Lime	.31
22	244	Arch metal work	.31	.94	81.80	208	Gypsum products	.24
23	398	Business travel	.29	.88	82.68	211	Asbestos products	.33
24	182	Paint products	.28	.85	83.53	214	Mineral wool	.62
25	139	Veneer, plywood	.26	.78	84.31	215	Nonclay refractories	.14
26	135	Sawmills	.24	.73	85.04	Other inputs under .1 percent each .27		
27	138	Millwork	.22	.66	86.70	217	Steel products	2.03
28	364	Motor freight trans	.21	.63	86.33	218	Iron, steel foundries	.18
29	214	Mineral wool	.20	.62	86.95	227	Copper rolling	.37
30	252	Fab wire products	.20	.61	87.36	298	Aluminum rolling	.15
31	188	Misc plastics	.20	.61	88.17	230	Nonferrous wire	1.72
32	5	Gas utilities	.19	.59	88.76	237	Metal sanitary ware	.15
33	46	Electric utilities	.18	.56	89.32	238	Plumbing fittings	.18
34	239	Heating equipment	.17	.52	89.84	239	Heating equipment	.52
35	362	Railroad	.17	.51	90.35	240	Fab structural steel	7.78
36	293	Refrigeration mach	.15	.47	90.82	241	Metal doors	4.82
37	384	Misc business serv	.14	.42	91.24	242	Fab plate work	3.63
38	298	Switchgear	.13	.41	91.65	243	Sheet metal work	2.77
39	21	Stone clay mining	.12	.38	92.03	244	Arch metal work	.94
40	193	Glass products	.12	.37	92.40	245	Misc metal work	5.22
41	227	Copper rolling	.12	.37	92.77	250	Hardware	.29
42	160	Building paper	.11	.35	93.12	252	Fab wire products	.61
43	387	Automobile repair	.11	.34	93.46	255	Pipe	.99
44	211	Asbestos products	.11	.33	93.79	Other inputs under .1 percent each .05		
45	267	Hoists, cranes	.11	.32	94.11	362	Railroad	.51
46	207	Lime	.10	.31	94.42	364	Motor freight trans	.63
47	197	Ceramic tile	.10	.30	94.72	372	Wholesale trade	1.58
48	250	Hardware	.10	.29	95.01	373	Retail trade	1.34
49	380	Real estate	.09	.27	95.28	384	Misc business serv	.42
50	315	Wiring devices	.09	.26	95.54	385	Advertising	.11
51	208	Gypsum products	.08	.24	95.78	386	Misc prof services	1.37
52	142	Wood products	.08	.24	96.02	21	Stone clay mining	.38
53	174	Misc chemical prod	.07	.22	96.24	152	Metal fixtures	.18
54	141	Wood preserving	.06	.18	96.42	160	Building paper	.35
55	238	Plumbing fittings	.06	.18	96.60	174	Misc chemical prod	.22
56	152	Metal fixtures	.06	.18	96.18	185	Tires	.12
57	218	Iron, steel foundries	.06	.18	96.95	188	Misc plastics	.61
58	342	Temp controls	.06	.17	97.13	193	Glass products	.37
59	199	Clay products	.05	.16	97.29	265	Elevators	1.29
60	281	Blowers	.05	.15	97.44	267	Hoists, cranes	.32
61	377	Insurance carriers	.05	.15	97.59	281	Blowers	.15
62	237	Metal sanitary ware	.05	.15	97.74	293	Refrigeration mach	.47
63	228	Aluminum rolling	.05	.15	97.89	298	Switchgear	.41
64	215	Nonclay refractories	.05	.14	98.03	312	Light fixtures	2.16
65	185	Tires	.04	.12	98.15	313	Wiring devices	.26
66	200	Plumbing fixtures	.04	.11	98.26	342	Temp controls	.17
67	385	Advertising	.04	.11	98.37	369	Communications	.10
68	394	Nonprofit org	.03	.11	98.48	377	Insurance carriers	.15
69	369	Communications	.03	.10	98.58	380	Real estate	.27
Other inputs under .1 percent each			.47	1.42	100.00	387	Automobile repair	.34
Total			32.94	100.00		394	Nonprofit org	.11
						398	Business travel	.88
						Other input under .1 percent each 1.07		

Table 4.13 Energy Input Fractions of Sector 34 - Stores and Restaurants

Rank	399		Trillion	Cumulative		399		Fraction
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction
1	3	Refined petroleum	47.14	23.46	23.46	3	Refined petroleum	23.46
2	240	Fab structural steel	21.48	10.69	34.15	4	Electric utilities	.64
3	205	Ready-mix concrete	16.34	8.13	42.28	5	Gas utilities	.48
4	184	Asphalt	6.08	3.03	45.31	135	Sawmills	.19
5	230	Nonferrous wire	5.57	2.77	48.08	138	Millwork	.41
6	243	Sheet metal work	5.55	2.76	50.84	139	Veneer, plywood	.60
7	183	Paving	5.36	2.67	53.51	141	Wood preserving	.23
8	196	Bricks	4.32	2.15	55.66	142	Wood products	.32
9	217	Steel products	4.22	2.10	57.76	Other inputs under .1 percent each .03		
10	214	Mineral wool	4.20	2.09	59.85	182	Paint products	.93
11	312	Light fixtures	4.18	2.08	61.93	183	Paving	2.67
12	245	Misc metal work	3.85	1.91	63.84	184	Asphalt	3.03
13	205	Concrete products	3.72	1.85	65.69	195	Cement	1.03
14	372	Wholesale trade	3.71	1.85	67.54	196	Bricks	2.15
15	241	Metal doors	3.47	1.73	69.27	197	Ceramic tile	.25
16	204	Concrete blocks	3.23	1.61	70.88	204	Concrete blocks	1.61
17	386	Misc prof services	2.98	1.48	72.36	205	Concrete products	1.85
18	373	Retail trade	2.74	1.36	73.72	206	Ready-mix concrete	8.13
19	244	Arch metal work	2.67	1.33	75.05	207	Lime	.18
20	255	Pipe	2.62	1.31	76.36	208	Gypsum products	.66
21	293	Refrigeration mach	2.23	1.12	77.48	209	Stone products	.14
22	242	Fab plate work	2.22	1.11	78.59	211	Asbestos products	.71
23	398	Business travel	2.18	1.08	79.67	213	Treated minerals	.11
24	195	Cement	2.06	1.03	80.70	214	Mineral wool	2.09
25	182	Paint products	1.87	.93	81.63	215	Nonclay refractories	.13
26	188	Misc plastics	1.82	.90	82.53	Other inputs under .1 percent each .29		
27	298	Switchgear	1.78	.89	83.42	217	Steel products	2.10
28	364	Motor freight trans	1.63	.81	84.23	218	Iron, steel foundries	.14
29	362	Railroad	1.59	.79	85.02	227	Copper rolling	.44
30	267	Hoists, cranes	1.52	.75	85.77	230	Nonferrous wire	2.77
31	211	Asbestos products	1.42	.71	86.48	237	Metal sanitary ware	.12
32	208	Gypsum products	1.33	.66	87.14	238	Plumbing fittings	.14
33	239	Heating equipment	1.32	.66	87.80	239	Heating equipment	.66
34	4	Electric utilities	1.29	.64	88.44	240	Fab structural steel	10.69
35	139	Veneer, plywood	1.21	.60	89.04	241	Metal doors	1.73
36	21	Stone clay mining	1.19	.59	89.63	242	Fab plate work	1.11
37	160	Building paper	1.14	.57	90.20	243	Sheet metal work	2.76
38	252	Fab wire products	1.11	.55	90.75	244	Arch metal work	1.33
39	193	Glass products	1.04	.52	91.27	245	Misc metal work	1.91
40	5	Gas utilities	.97	.48	91.75	250	Hardware	.27
41	384	Misc business serv	.92	.46	92.21	252	Fab wire products	.55
42	387	Automobile repair	.91	.45	92.66	255	Pipe	1.31
43	227	Copper rolling	.87	.44	93.10	Other inputs under .1 percent each .15		
44	138	Millwork	.81	.41	93.51	362	Railroad	.79
45	380	Real estate	.71	.35	93.86	364	Motor freight trans	.81
46	142	Wood products	.65	.32	94.18	365	Water transport	.11
47	265	Elevators	.54	.27	94.45	Other inputs under .1 percent each .08		
48	250	Hardware	.54	.27	94.72	372	Wholesale trade	1.85
49	342	Temp controls	.50	.25	94.97	373	Retail trade	1.36
50	197	Ceramic tile	.50	.25	95.22	384	Misc business serv	.46
51	313	Wiring devices	.49	.24	95.46	385	Advertising	.14
52	141	Wood preserving	.45	.23	95.69	386	Misc prof services	1.48
53	377	Insurance carriers	.39	.19	95.88	21	Stone clay mining	.59
54	135	Sawmills	.37	.19	96.07	160	Building paper	.57
55	207	Lime	.35	.18	96.25	171	Inorg-org chemicals	.57
56	174	Misc chemical prod	.33	.16	96.41	174	Misc chemical prod	.16
57	307	Electric h'wares	.30	.15	96.56	185	Tires	.12
58	358	Hard floor covering	.29	.15	96.71	188	Misc plastics	.90
59	238	Plumbing fittings	.29	.14	96.85	193	Glass products	.52
60	209	Stone products	.29	.14	96.99	265	Elevators	.27
61	385	Advertising	.29	.14	97.13	267	Hoists, cranes	.75
62	218	Iron, steel foundries	.27	.14	97.27	293	Refrigeration mach	1.12
63	369	Communications	.26	.13	97.40	298	Switchgear	.89
64	394	Nonprofit org	.26	.13	97.53	307	Electric h'wares	.15
65	215	Nonclay refractories	.26	.13	97.65	312	Light fixtures	2.08
66	171	Inorg-org chemicals	.25	.13	97.79	313	Wiring devices	.24
67	185	Tires	.25	.12	97.91	342	Temp controls	.25
68	237	Metal sanitary ware	.24	.12	98.03	358	Hard floor covering	.15
69	213	Treated minerals	.23	.11	98.14	369	Communications	.13
70	365	Water transport	.22	.11	98.25	374	Banking	.10
71	374	Banking	.20	.10	98.35	377	Insurance carriers	.19
Other inputs under 1 percent each			3.32	1.65	100.00	380	Real estate	.35
Total			200.97	100.00		387	Automobile repair	.45
						394	Nonprofit org	.13
						398	Business travel	1.08
						Other inputs under .1 percent each 1.10		

Table 4.14 Energy Input Fractions of Sector 35 - Religious Buildings

Rank	399	Name	Trillion	Cumulative	
Order	Order		Btu	Fraction	Fraction
1	3	Refined petroleum	13.98	20.12	20.12
2	206	Ready-mix concrete	5.91	8.50	28.62
3	240	Fab structural steel	3.83	5.51	34.13
4	196	Bricks	3.54	5.09	39.22
5	204	Concrete blocks	2.59	3.73	42.95
6	184	Asphalt	2.20	3.17	46.12
7	243	Sheet metal work	1.09	2.86	48.98
8	245	Misc metal work	1.94	2.80	51.78
9	241	Metal doors	1.71	2.45	54.23
10	386	Misc prof services	1.56	2.26	56.48
11	142	Wood products	1.52	2.19	58.67
12	372	Wholesale trade	1.45	2.09	60.76
13	217	Steel products	1.44	2.08	62.84
14	230	Nonferrous wire	1.43	2.05	64.89
15	373	Retail trade	1.37	1.97	66.86
16	244	Arch metal work	1.24	1.79	68.65
17	195	Cement	1.15	1.66	70.31
18	138	Millwork	1.13	1.62	71.93
19	312	Light fixtures	1.05	1.52	73.45
20	293	Refrigeration mach	.85	1.22	74.67
21	122	Coated fabrics	.80	1.15	75.82
22	398	Business travel	.76	1.10	76.92
23	255	Pipe	.74	1.07	77.99
24	182	Paint products	.72	1.04	79.03
25	214	Mineral wool	.62	.90	79.93
26	205	Concrete products	.60	.86	80.79
27	208	Gypsum products	.59	.84	81.63
28	188	Misc plastics	.58	.83	82.46
29	250	Hardware	.56	.80	83.26
30	139	Veneer, plywood	.56	.80	84.06
31	364	Motor freight trans	.53	.76	84.82
32	239	Heating equipment	.51	.73	85.55
33	362	Railroad	.49	.70	86.25
34	211	Asbestos products	.47	.68	86.93
35	298	Switchgear	.46	.67	87.60
36	242	Fab plate work	.46	.66	88.26
37	160	Building paper	.46	.66	88.92
38	183	Paving	.45	.64	89.56
39	4	Electric utilities	.43	.62	90.18
40	193	Glass products	.41	.59	90.77
41	252	Fab wire products	.37	.53	91.30
42	135	Sawmills	.34	.49	91.79
43	384	Misc business serv	.34	.48	92.27
44	227	Copper rolling	.33	.47	92.74
45	174	Misc chemical prod	.31	.45	93.19
46	267	Hoists, cranes	.28	.41	93.60
47	387	Automobile repair	.28	.40	94.00
48	209	Stone products	.24	.34	94.34
49	380	Real estate	.22	.32	94.66
50	21	Stone clay mining	.22	.31	94.97
51	5	Gas utilities	.19	.28	95.25
52	342	Temp controls	.19	.27	95.52
53	199	Clay products	.16	.22	95.74
54	207	Lime	.15	.22	95.96
55	358	Hard floor covering	.13	.19	96.35
56	313	Wiring devices	.13	.19	96.34
57	238	Plumbing fittings	.13	.18	96.52
58	141	Wood preserving	.12	.17	96.69
59	377	Insurance carriers	.12	.17	96.86
60	218	Iron, steel foundries	.12	.17	97.03
61	171	Inorg-org chemicals	.11	.16	97.19
62	307	Electric h'wares	.11	.16	97.35
63	237	Metal sanitary ware	.11	.16	97.51
64	385	Advertising	.09	.13	97.64
65	213	Treated minerals	.08	.12	97.76
66	161	Conv paper products	.08	.12	97.88
67	369	Communications	.08	.12	98.00
68	394	Nonprofit org	.08	.12	98.12
69	281	Blowers	.08	.12	98.24
70	197	Ceramic tile	.03	.11	98.35
71	228	Aluminum rolling	.07	.11	98.46
Other inputs under .1 percent each			1.07	1.54	100.00
Total			69.49	100.00

Table 4.15 Energy Input Fractions of Sector 36 - Educational Buildings

Rank	399		Trillion		Cumulative		399		
Order	Order	Name	Btu	Fraction	Fraction		Order	Name	Fraction
1	3	Refined petroleum	83.89	18.94	18.94		3	Refined petroleum	18.94
2	206	Ready-mix concrete	41.75	9.42	28.36		4	Electric utilities	.60
3	240	Fab structural steel	23.50	5.31	33.67		5	Gas utilities	.39
4	245	Misc metal work	16.42	3.71	37.38		135	Sawmills	.44
5	241	Metal doors	15.52	3.50	40.88		136	Hardwood flooring	.10
6	196	Bricks	13.24	2.99	43.87		138	Millwork	.80
7	386	Misc prof services	10.65	2.40	47.27		139	Veneer, plywood	.74
8	243	Sheet metal work	10.22	2.31	48.58		142	Wood products	.30
9	217	Steel products	10.01	2.26	50.84		Other inputs under .1 percent each		.10
10	230	Nonferrous wire	9.91	2.24	53.08		182	Paint products	1.11
11	372	Wholesale trade	9.89	2.23	55.31		183	Paving	1.53
12	373	Retail trade	9.08	2.05	57.36		184	Asphalt	2.01
13	184	Asphalt	8.90	2.01	59.37		195	Cement	1.66
14	205	Concrete products	8.18	1.85	61.22		196	Bricks	2.99
15	204	Concrete blocks	7.88	1.78	63.00		197	Ceramic tile	.29
16	312	Light fixtures	7.56	1.71	64.71		199	Clay products	.30
17	195	Cement	7.34	1.66	66.37		200	Plumbing fixtures	.17
18	239	Heating equipment	7.15	1.61	67.98		204	Concrete blocks	1.78
19	183	Paving	6.76	1.53	69.51		205	Concrete products	1.85
20	188	Misc plastics	5.82	1.31	70.82		206	Ready-mix concrete	9.42
21	160	Building paper	5.70	1.29	72.11		207	Lime	.26
22	214	Mineral wool	5.66	1.28	73.39		208	Gypsum products	.48
23	293	Refrigeration mach	5.24	1.18	74.57		209	Stone products	.12
24	250	Hardware	5.16	1.16	75.73		211	Asbestos products	.74
25	182	Paint products	4.86	1.10	76.83		214	Mineral wool	1.28
26	244	Arch metal work	4.69	1.06	77.89		Other inputs under .1 percent each		.25
27	398	Business travel	4.56	1.03	78.92		217	Steel products	2.26
28	255	Pipe	4.35	.98	79.90		218	Iron, steel foundries	.32
29	364	Motor freight trans	4.01	.91	80.81		227	Copper rolling	.34
30	362	Railroad	3.89	.88	81.69		228	Aluminum rolling	.12
31	174	Misc chemical prod	3.88	.88	82.57		229	Nonferrous rolling	.34
32	193	Glass products	3.60	.81	83.38		230	Nonferrous wire	2.24
33	138	Millwork	3.54	.80	84.18		237	Metal sanitary ware	.25
34	139	Veneer, plywood	3.28	.74	84.92		238	Plumbing fittings	.32
35	211	Asbestos products	3.27	.74	85.66		239	Heating equipment	1.61
36	242	Fab plate work	3.04	.69	86.35		240	Fab structural steel	5.31
37	21	Stone clay mining	2.78	.63	86.98		241	Metal doors	3.50
38	4	Electric utilities	2.65	.60	87.58		242	Fab plate work	.69
39	342	Temp controls	2.60	.59	88.17		243	Sheet metal work	2.31
40	252	Fab wire products	2.48	.56	88.73		244	Arch metal work	1.06
41	384	Misc business serv	2.36	.53	89.26		245	Misc metal work	3.71
42	298	Switchgear	2.21	.50	89.76		250	Hardware	1.16
43	267	Hoists, cranes	2.15	.49	90.25		252	Fab wire products	.56
44	208	Gypsum products	2.11	.48	90.73		255	Pipe	.98
45	135	Sawmills	1.97	.44	91.17		Other inputs under .1 percent each		.09
46	387	Automobile repair	1.80	.41	91.58		362	Railroad	.88
47	5	Gas utilities	1.74	.39	91.97		364	Motor freight trans	.91
48	229	Nonferrous rolling	1.53	.34	92.31		365	Water transport	.17
49	227	Copper rolling	1.51	.34	92.65		Other input under .1 percent each		.10
50	152	Wood fixtures	1.44	.32	92.97		372	Wholesale trade	2.23
51	238	Plumbing fittings	1.43	.32	93.29		373	Retail trade	2.05
52	380	Real estate	1.43	.32	93.61		384	Misc business serv	.53
53	218	Iron, steel foundries	1.40	.32	93.93		385	Advertising	.13
54	152	Metal fixtures	1.38	.31	94.24		386	Misc prof services	2.40
55	142	Wood products	1.35	.30	94.54		15	Forestry, greenhouse	.10
56	199	Clay products	1.33	.30	94.84		21	Stone clay mining	.63
57	197	Ceramic tile	1.29	.29	95.13		117	Floor covering	.12
58	207	Lime	1.17	.26	95.35		150	Public bldg furn	.25
59	307	Electric h'wares	1.13	.26	95.65		151	Wood fixtures	.32
60	150	Public bldg furn	1.12	.25	95.90		152	Metal fixtures	.31
61	237	Metal sanitary ware	1.10	.25	95.15		160	Building paper	1.29
62	313	Wiring devices	1.01	.23	96.28		161	Conv paper products	.19
63	161	Conv paper prod	.83	.19	95.57		174	Misc chemical prod	.99
64	377	Insurance carriers	.79	.18	96.75		188	Misc plastics	1.31
65	365	Water transport	.75	.17	96.92		193	Glass products	.81
66	200	Plumbing fixtures	.74	.17	97.09		265	Elevators	.14
67	265	Elevators	.62	.14	97.23		267	Hoists, cranes	.49
68	385	Advertising	.57	.13	97.36		281	Blowers	.10
69	209	Stone products	.54	.12	97.48		293	Refrigeration mach	1.18
70	369	Communications	.53	.12	97.60		298	Switchgear	.50
71	117	Floor covering	.53	.12	97.82		307	Electric h'wares	.26
72	394	Nonprofit org	.52	.12	97.84		312	Light fixtures	1.71
73	228	Aluminum rolling	.51	.12	97.96		313	Wiring devices	.23
74	15	Forestry, greenhouse	.46	.10	98.06		342	Temp controls	.59
75	281	Blowers	.45	.10	98.16		369	Communications	.12
76	136	Hardwood flooring	.45	.10	98.26		377	Insurance carriers	.18
Other inputs under .1 percent each			7.71	1.74	100.00		380	Real estate	.32
Total			443.02	100.00			387	Automobile repair	.41
							394	Nonprofit org	.12
							398	Business travel	1.03
							Other inputs under .1 percent each		1.19

DIRECT
ENERGYWOOD
PRODPAINT
PAVING
ASPHALTSTONE
CLAY
PRODMETAL
PROD

TRADE

TRANSPORT

SERVICE

MISC

Table 4.16 Energy Input Fractions of Sector 37 - Hospital Buildings

Rank	399		Trillion		Cumulative		399			
Order	Order	Name	Btu	Fraction	Fraction		Order	Name	Fraction	
1	3	Refined petroleum	23.63	19.95	19.95	DIRECT ENERGY WOOD PROD PAINT PAVING	3	Refined petroleum	19.95	
2	205	Ready-mix concrete	8.27	6.93	26.93		4	Electric utilities	.67	
3	241	Metal doors	5.04	4.25	31.18		5	Gas utilities	.49	
4	240	Fab structural steel	4.44	3.75	34.93		135	Sawmills	.46	
5	230	Nonferrous wire	4.16	3.51	38.44		138	Millwork	.80	
6	245	Misc metal work	3.71	3.13	41.57		139	Veneer, plywood	.65	
7	217	Steel products	3.63	3.07	44.64		142	Wood products	.38	
8	386	Misc prof services	3.04	2.57	47.21		Other input under .1 percent each			.09
9	196	Bricks	3.03	2.56	49.77		182	Paint products	1.22	
10	243	Sheet metal work	2.72	2.29	52.06		183	Paving	.75	
11	372	Wholesale trade	2.66	2.24	54.30	184	Asphalt	.85		
12	373	Retail trade	2.29	1.94	56.24	195	Cement	1.50		
13	293	Refrigeration mach	2.21	1.86	58.10	196	Bricks	2.56		
14	265	Elevators	2.10	1.77	59.87	197	Ceramic tile	.67		
15	188	Misc plastics	1.91	1.61	61.48	199	Clay products	.44		
16	312	Light fixtures	1.84	1.55	63.06	200	Plumbing fixtures	.25		
17	195	Cement	1.77	1.50	64.53	204	Concrete blocks	1.24		
18	205	Concrete products	1.73	1.46	65.99	205	Concrete products	1.46		
19	250	Hardware	1.61	1.36	67.35	206	Ready-mix concrete	6.98		
20	214	Mineral wool	1.57	1.33	68.68	207	Lime	.75		
21	255	Pipe	1.53	1.29	69.97	208	Gypsum products	.75		
22	204	Concrete blocks	1.47	1.24	71.21	209	Stone products	.27		
23	239	Heating equipment	1.46	1.23	72.44	211	Asbestos products	.64		
24	182	Paint products	1.44	1.22	73.66	213	Treated minerals	.13		
25	398	Business travel	1.41	1.19	74.85	214	Mineral wool	1.33		
26	160	Building paper	1.29	1.09	75.94	Other inputs under .1 percent each			.14	
27	151	Wood fixtures	1.12	.94	76.88	217	Steel products	3.07		
28	229	Nonferrous rolling	1.06	.90	77.78	218	Iron, steel foundries	.51		
29	184	Asphalt	1.01	.85	77.63	227	Copper rolling	.15		
30	244	Arch metal work	1.00	.84	79.47	228	Aluminum rolling	.41		
31	138	Millwork	.95	.80	80.27	229	Nonferrous rolling	.90		
32	342	Temp controls	.94	.79	81.06	230	Nonferrous wire	3.51		
33	364	Motor freight trans	.91	.77	81.83	237	Metal sanitary ware	.37		
34	183	Paving	.89	.75	82.58	238	Plumbing fittings	.50		
35	208	Gypsum products	.89	.75	83.33	239	Heating equipment	1.23		
36	4	Electric utilities	.80	.65	84.01	240	Fab structural steel	3.75		
37	197	Ceramic tile	.80	.67	84.68	241	Metal doors	4.25		
38	362	Railroad	.77	.65	85.38	242	Fab plate work	.40		
39	139	Veneer, plywood	.77	.65	85.98	243	Sheet metal work	2.29		
40	252	Fab wire products	.77	.65	86.63	244	Arch metal work	.84		
41	211	Asbestos products	.76	.64	87.25	245	Misc metal work	3.13		
42	174	Misc chemical prod	.73	.62	87.89	250	Hardware	1.36		
43	218	Iron, steel foundries	.61	.51	88.40	252	Fab wire products	.65		
44	238	Plumbing fittings	.53	.50	88.90	255	Pipe	1.29		
45	5	Gas utilities	.58	.49	89.39	Other inputs under .1 percent each			.12	
46	384	Misc business serv	.57	.43	89.87	362	Railroad	.65		
47	21	Stone clay mining	.57	.43	90.35	364	Motor freight trans	.77		
48	135	Sawmills	.55	.46	90.81	365	Water transport	.11		
49	313	Wiring devices	.53	.45	91.26	Other input under .1 percent each			.03	
50	387	Automobile repair	.53	.45	91.71	372	Wholesale trade	2.24		
51	199	Clay products	.52	.44	92.15	373	Retail trade	1.94		
52	298	Switchgear	.50	.42	92.57	384	Misc business serv	.48		
53	228	Aluminum rolling	.49	.41	92.28	385	Advertising	.14		
54	267	Hoists, cranes	.48	.41	93.39	386	Misc prof services	2.57		
55	242	Fab plate work	.47	.40	93.79	15	Forestry, greenhouse	.12		
56	266	Conveyors	.47	.40	94.19	21	Stone clay mining	.48		
57	142	Wood products	.45	.38	94.57	151	Wood fixtures	.94		
58	237	Metal sanitary ware	.44	.37	94.94	160	Building paper	1.09		
59	380	Real estate	.42	.36	95.30	161	Conv paper products	.23		
60	317	R-TV commun eq	.38	.32	95.62	174	Misc chemical prod	.62		
61	307	Electric h'wares	.36	.31	95.93	188	Misc plastics	1.61		
62	207	Lime	.35	.30	96.23	193	Glass products	.26		
63	209	Stone clay products	.32	.27	96.50	265	Elevators	1.77		
64	193	Glass products	.31	.26	96.76	266	Conveyors	.40		
65	200	Plumbing fixtures	.30	.25	97.01	267	Hoists, cranes	.41		
66	161	Conv paper products	.27	.23	97.24	281	Blowers	.10		
67	377	Insurance carriers	.23	.19	97.43	293	Refrigeration equip	1.89		
68	227	Copper rolling	.17	.15	97.58	298	Switchgear	.42		
69	385	Advertising	.17	.14	97.72	307	Electric h'wares	.31		
70	394	Nonprofit org	.16	.13	97.85	312	Light fixtures	1.55		
71	369	Communications	.16	.13	97.98	313	Wiring devices	.45		
72	213	Treated minerals	.16	.13	98.11	317	R-TV commun eq	.32		
73	15	Forestry, greenhouse	.15	.12	98.23	325	Electrical equip	.10		
74	365	Water transport	.13	.11	98.34	242	Temp controls	.79		
75	281	Blowers	.12	.10	98.44	369	Communications	.13		
76	325	Electrical equipment	.12	.10	98.54	374	Banking	.10		
77	374	Banking	.12	.10	98.64	377	Insurance carriers	.19		
Other inputs under .1 percent each			1.61	1.36	100.00	380	Real estate	.36		
Total			118.46	100.00		387	Automobile repair	.45		
						394	Nonprofit org	.13		
						398	Business travel	1.19		
						Other inputs under .1 percent each			.99	
						MISC				

Table 4.17 Energy Input Fractions of Sector 38 - Other Non-Farm Buildings

Rank	399	Name	Trillion	Fraction	Cumulative	399	Name	Fraction
Order	Order		Btu		Fraction	Order		
1	3	Refined petroleum	50.25	21.43	21.43	3	Refined petroleum	21.43
2	240	Fab structural steel	20.34	8.68	30.11	4	Electric utilities	.63
3	206	Ready-mix concrete	20.31	8.66	38.77	5	Gas utilities	.41
4	241	Metal doors	8.05	3.43	42.20	135	Sawmills	.26
5	243	Sheet metal work	6.85	2.92	45.12	138	Millwork	.78
6	217	Steel products	6.84	2.92	48.04	139	Veneer, plywood	.72
7	245	Misc metal work	6.17	2.63	50.67	141	Wood preserving	.24
8	196	Bricks	5.17	2.21	52.88	142	Wood products	.29
9	230	Nonferrous wire	5.03	2.15	55.03	Other inputs under .1 percent each .05		
10	372	Wholesale trade	4.85	2.07	57.10	182	Paint products	.96
11	386	Misc prof services	4.68	2.00	59.10	183	Paving	.48
12	255	Pipe	4.31	1.84	60.94	184	Asphalt	1.61
13	205	Concrete products	4.13	1.76	62.70	195	Cement	1.74
14	195	Cement	4.08	1.74	64.44	197	Ceramic tile	.59
15	373	Retail trade	3.98	1.70	66.14	196	Bricks	2.21
16	204	Concrete blocks	3.90	1.66	67.80	199	Clay products	.12
17	184	Asphalt	3.78	1.61	69.41	200	Plumbing fixtures	.16
18	312	Light fixtures	3.71	1.58	70.99	204	Concrete blocks	1.66
20	244	Arch metal work	3.54	1.51	74.05	205	Concrete products	1.76
21	214	Mineral wool	2.73	1.16	75.21	206	Ready-mix concrete	8.66
22	398	Business travel	2.46	1.05	76.26	207	Lime	.19
23	242	Fab plate work	2.46	1.05	77.31	208	Gypsum products	.57
24	182	Paint products	2.25	.96	78.27	209	Stone products	.14
25	188	Misc plastics	2.19	.93	79.20	211	Asbestos products	.59
26	239	Heating equipment	2.14	.91	80.11	213	Treated minerals	.10
27	364	Motor freight trans	1.83	.78	80.89	214	Mineral wool	1.16
28	138	Millwork	1.82	.78	81.67	215	Nonclay refractories	.22
29	362	Railroad	1.76	.75	82.42	Other inputs under .1 percent each .19		
30	250	Hardware	1.70	.72	83.34	217	Steel products	2.92
31	139	Veneer, plywood	1.69	.72	83.86	218	Iron, steel foundries	.28
32	152	Metal fixtures	1.65	.70	84.56	227	Copper rolling	.69
33	298	Switchgear	1.62	.69	85.25	228	Aluminum rolling	.14
34	227	Copper rolling	1.61	.69	85.74	230	Nonferrous wire	2.15
35	267	Hoists, cranes	1.59	.68	86.62	237	Metal sanitary ware	.24
36	193	Glass products	1.55	.68	87.28	238	Plumbing fittings	.30
37	252	Fab wire products	1.51	.64	87.92	239	Heating equipment	.91
38	4	Electric utilities	1.48	.63	88.55	240	Fab structural steel	8.68
39	211	Asbestos products	1.35	.59	89.14	241	Metal doors	3.43
40	197	Ceramic tile	1.38	.59	89.73	242	Fab plate work	1.05
41	208	Gypsum products	1.35	.57	90.30	243	Sheet metal work	2.92
42	384	Misc business serv	1.17	.50	90.80	244	Arch metal work	1.51
43	265	Elevators	1.12	.48	91.28	245	Misc metal work	2.63
44	183	Paving	1.12	.48	91.76	250	Hardware	.72
45	387	Automobile repair	1.00	.43	92.19	252	Fab wire products	.64
46	160	Building paper	.97	.41	92.60	255	Pipe	1.84
47	5	Gas utilities	.97	.41	93.01	Other inputs under .1 percent each .11		
48	342	Temp controls	.81	.35	93.36	362	Railroad	.75
49	380	Real estate	.79	.34	93.70	364	Motor freight trans	.78
50	238	Plumbing fittings	.70	.30	94.00	365	Water transport	.13
51	142	Wood products	.68	.29	94.29	Other input under .1 percent each .07		
52	218	Iron, steel foundries	.66	.28	94.57	372	Wholesale trade	2.07
53	135	Sawmills	.60	.26	94.83	373	Retail trade	1.70
54	141	Wood preserving	.56	.24	95.07	384	Misc business serv	.50
55	237	Metal sanitary ware	.55	.24	95.31	385	Advertising	.14
56	174	Misc chemical prod	.53	.23	95.54	386	Misc prof services	2.00
57	215	Nonclay refractories	.51	.22	95.76	21	Stone clay mining	.19
58	151	Wood fixtures	.50	.21	95.07	151	Wood fixtures	.21
59	307	Electric h'wares	.48	.20	96.17	152	Metal fixtures	.10
60	207	Lime	.46	.19	96.36	160	Building paper	.41
61	21	Stone clay mining	.44	.19	96.55	161	Conv paper products	.13
62	377	Insurance carriers	.44	.19	96.74	174	Misc chemical prod	.23
63	313	Wiring devices	.43	.18	96.92	185	Tires	.11
64	200	Plumbing fixtures	.36	.16	97.08	188	Misc plastics	.93
65	209	Stone products	.34	.14	97.22	193	Glass products	.66
66	385	Advertising	.32	.14	97.36	265	Elevators	.48
67	228	Aluminum rolling	.32	.14	97.50	267	Hoists, cranes	.68
68	161	Conv paper products	.31	.13	97.63	281	Blowers	.10
69	365	Water transport	.31	.13	97.76	293	Refrigeration mach	1.55
70	369	Communications	.30	.13	97.89	298	Switchgear	.69
71	353	Hard floor covering	.29	.13	98.02	307	Electric h'wares	.20
72	394	Nonprofit org	.29	.12	98.14	312	Light fixtures	1.58
73	199	Clay products	.29	.12	98.26	313	Wiring devices	.18
74	185	Tires	.26	.11	98.37	342	Temp controls	.35
75	281	Blowers	.24	.10	98.47	358	Hard floor covering	.13
76	213	Treated minerals	.24	.10	98.57	369	Communications	.13
Other input under .1 percent			3.35	1.43	100.00	377	Insurance carriers	.19
Total			234.47	100.00		380	Real estate	.34
						387	Automobile repair	.43
						394	Nonprofit org	.12
						398	Business travel	1.05
						Other inputs under .1 percent each 1.01		
						MISC		

MISC

Table 4.18 Energy Input Fractions of Sector 48 - Farm Residences

Rank	399 Order	Name	Trillion Btu	Fraction	Cumulative Fraction	399 Order	Name	Fraction
1	206	Ready-mix concrete	2.49	8.13	8.13	3	Refined petroleum	6.37
2	135	Sawmills	2.09	6.83	14.96	4	Electric utilities	.20
3	3	Refined petroleum	1.95	6.37	21.33	135	Sawmills	6.83
4	373	Retail trade	1.32	4.32	25.65	136	Hardwood flooring	.44
5	196	Bricks	1.16	3.78	29.43	137	Spec prod sawmill	.16
6	245	Misc metal work	1.12	3.66	33.09	138	Millwork	3.42
7	138	Millwork	1.05	3.42	36.51	139	Veneer plywood	3.14
8	230	Nonferrous wire	.98	3.20	39.71	142	Wood products	.86
9	139	Veneer, plywood	.96	3.14	42.85	182	Paint products	2.16
10	208	Gypsum products	.92	3.01	45.86	183	Paving	.18
11	372	Wholesale trade	.88	2.88	48.74	184	Asphalt	2.51
12	241	Metal doors	.86	2.83	51.57	195	Cement	2.19
13	184	Asphalt	.77	2.50	54.07	196	Bricks	3.78
14	195	Cement	.67	2.50	56.26	197	Ceramic tile	1.05
15	182	Paint products	.66	2.16	58.42	199	Clay products	.59
16	312	Light fixtures	.54	1.78	60.20	200	Plumbing fixtures	.80
17	188	Misc plastics	.54	1.76	61.96	204	Concrete blocks	1.39
18	217	Steel products	.53	1.75	63.71	205	Concrete products	1.35
19	243	Sheet metal work	.53	1.72	65.43	206	Ready-mix concrete	8.13
20	362	Railroad	.52	1.69	67.12	207	Lime	.33
21	160	Building paper	.47	1.55	68.67	208	Gypsum products	3.01
22	238	Plumbing fittings	.46	1.51	70.18	209	Stone products	.10
23	252	Fab wire products	.46	1.51	71.69	211	Asbestos products	.58
24	204	Concrete blocks	.42	1.39	73.08	214	Mineral wool	.87
25	205	Concrete products	.41	1.35	74.45	Other inputs under .1 percent each		
26	227	Copper rolling	.39	1.26	75.69	217	Steel products	1.75
27	244	Arch metal work	.37	1.20	76.89	218	Iron, steel foundries	.32
28	237	Metal sanitary ware	.36	1.19	78.08	227	Copper rolling	1.26
29	293	Refrigeration mach	.36	1.18	79.26	230	Nonferrous wire	3.20
30	197	Ceramic tile	.32	1.05	80.31	237	Metal sanitary ware	1.19
31	313	Wiring devices	.31	1.02	81.33	238	Plumbing fittings	1.51
32	242	Fab plate work	.29	.96	82.23	239	Heating equipment	.75
33	144	Wood h'hold furn	.28	.92	83.21	240	Fab structural steel	.69
34	214	Mineral wool	.27	.87	84.08	241	Metal doors	2.83
35	142	Wood products	.26	.86	84.94	242	Fab plate work	.96
36	117	Floor covering	.26	.85	85.79	243	Sheet metal work	1.72
37	398	Business travel	.25	.82	86.61	244	Arch metal work	1.20
38	200	Plumbing fixtures	.24	.80	87.41	245	Misc metal work	3.66
39	255	Pipe	.24	.77	88.18	250	Hardware	.61
40	239	Heating equipment	.23	.75	88.93	252	Fab wire products	1.51
41	386	Misc prof services	.23	.74	89.67	255	Pipe	.77
42	240	Fab structural steel	.21	.69	90.36	Other inputs under .1 percent each		
43	364	Motor freight trans	.21	.67	91.03	362	Railroad	1.69
44	250	Hardware	.19	.61	91.64	364	Motor freight trans	.67
45	384	Misc business serv	.19	.61	92.25	365	Water transport	.15
46	199	Clay products	.18	.59	92.84	372	Wholesale trade	2.89
47	211	Asbestos products	.18	.58	93.42	373	Retail trade	4.32
48	310	H'hold appliances	.16	.51	93.93	384	Misc business serv	.61
49	21	Stone clay mining	.14	.44	94.37	386	Misc prof services	.74
50	136	Hardwood flooring	.13	.44	94.81	Other inputs under .1 percent each		
51	342	Temp controls	.12	.38	95.19	15	Forestry, greenhouse	.13
52	161	Conv paper products	.11	.37	95.56	17	Agric, forestry	.11
53	298	Switchgear	.11	.36	95.92	21	Stone clay mining	.44
54	207	Lime	.10	.33	96.25	117	Floor coverings	.85
55	218	Iron, steel foundries	.10	.32	96.57	130	Appl, purch mat	.13
56	146	Metal h'hold furn	.08	.26	96.83	144	Wood h'hold furn	.92
57	4	Electric utilities	.06	.20	97.03	146	Metal h'hold furn	.26
58	183	Paving	.06	.18	97.21	151	Wood fixtures	.11
59	137	Special sawmill prod	.05	.15	97.36	152	Metal fixtures	.14
60	365	Water transport	.04	.15	97.51	160	Building paper	1.55
61	152	Metal fixtures	.04	.14	97.65	161	Conv paper products	.37
62	130	Appl, purch mat	.04	.13	97.78	174	Misc chemical products	.12
63	15	Forestry, greenhouse	.04	.13	97.91	187	Misc rubber products	.12
64	187	Misc rubber products	.04	.12	98.03	188	Misc plastics	1.76
65	174	Misc chemical prod	.04	.12	98.15	293	Refrigeration mach	1.18
66	387	Automobile repair	.03	.11	98.26	298	Switchgear	.36
67	17	Agric, forestry	.03	.11	98.37	310	H'hold appliances	.51
68	151	Wood fixtures	.03	.11	98.48	312	Light fixtures	1.78
69	209	Stone products	.03	.10	98.58	313	Wiring devices	1.02
70	320	Real estate	.03	.10	98.68	342	Temp controls	.38
Other inputs under .1 percent each			.40	1.32	100.00	380	Real estate	.10
Total			30.60	100.00		387	Automobile repair	.11
						398	Business travel	.82
						Other inputs under .1 percent each		

Table 4.19 Energy Input Fractions of Sector 49 - Farm Service Buildings

Rank	399		Trillion	Cumulative		399		
Order	Order	Name	Btu	Fraction	Fraction	Order	Name	Fraction
1	245	Misc metal work	11.92	20.52	20.52	3	Refined petroleum	5.71
2	243	Sheet metal work	6.29	10.83	31.35	4	Electric utilities	.16
3	206	Ready-mix concrete	5.01	8.63	39.98	135	Sawmills	6.88
4	135	Sawmills	3.99	6.88	46.86	137	Spec prod sawmill	.49
5	3	Refined petroleum	3.31	5.71	52.57	138	Millwork	.90
6	252	Fab wire products	2.91	5.01	57.58	139	Veneer, plywood	3.97
7	184	Asphalt	2.39	4.12	61.70	142	Wood products	.21
8	373	Retail trade	2.38	4.10	65.80	Other inputs under .1 percent each .01		
9	139	Veneer, plywood	2.30	3.97	69.77	182	Paint products	1.41
10	217	Steel products	1.68	2.90	72.67	183	Paving	1.06
11	196	Bricks	1.50	2.58	75.25	184	Asphalt	4.12
12	372	Wholesale trade	1.38	2.38	77.63	195	Cement	1.24
13	362	Railroad	.98	1.70	79.33	196	Bricks	2.58
14	205	Concrete products	.98	1.68	81.01	197	Ceramic tiles	.34
15	182	Paint products	.82	1.41	82.42	199	Clay products	.13
16	241	Metal doors	.79	1.37	83.79	204	Concrete blocks	1.34
17	204	Concrete blocks	.78	1.34	85.13	205	Concrete products	1.68
18	195	Cement	.72	1.24	86.37	206	Ready-mix concrete	8.63
19	211	Asbestos products	.65	1.12	87.49	207	Lime	.26
20	183	Paving	.61	1.06	88.55	211	Asbestos products	1.12
21	138	Millwork	.52	.90	89.45	214	Mineral wool	.11
22	188	Misc plastics	.52	.89	90.34	Other inputs under .1 percent each .11		
23	240	Fab structural steel	.44	.75	90.90	217	Steel products	2.90
24	244	Arch metal work	.41	.71	91.80	227	Copper rolling	.12
25	364	Motor freight trans	.38	.65	92.45	230	Nonferrous wire	.47
26	279	Pumps, compressors	.37	.64	93.09	239	Heating equipment	.11
27	137	Spec prod sawmill	.28	.49	93.58	240	Fab structural steel	.75
28	230	Nonferrous wire	.27	.47	94.05	241	Metal doors	1.37
29	242	Fab plate work	.27	.47	94.52	242	Fab plate work	.47
30	255	Pipe	.24	.42	94.94	243	Sheet metal work	10.83
31	398	Business travel	.23	.40	95.34	244	Arch metal work	.72
32	21	Stone clay mining	.22	.39	95.73	245	Misc metal work	20.53
33	250	Hardware	.22	.39	96.10	246	Screw machine prod	.35
34	384	Misc business serv	.21	.37	96.47	250	Hardware	.37
35	246	Screw mach prod	.20	.35	96.82	252	Fab wire products	5.01
36	197	Ceramic tile	.20	.34	97.16	255	Pipe	.42
37	207	Lime	.15	.26	97.42	Other inputs under .1 percent each .21		
38	142	Wood products	.12	.21	97.63	362	Railroad	1.70
39	365	Water transport	.11	.19	97.82	364	Motor freight trans	.65
40	312	Light fixtures	.08	.15	97.97	365	Water transport	.19
41	199	Clay products	.08	.13	98.10	372	Wholesale trade	2.38
42	160	Building paper	.08	.13	98.13	372	Retail trade	4.10
43	174	Misc chemical prod	.07	.13	98.36	384	Misc business serv	.37
44	227	Copper rolling	.07	.12	98.48	Other inputs under .1 percent each .12		
45	239	Heating equipment	.06	.11	98.59	21	Stone clay mining	.39
46	214	Mineral wool	.06	.11	98.70	160	Building paper	.13
47	4	Electric utilities	.06	.16	98.81	174	Misc chemical prod	.13
Other inputs under .1-percent each			.69	1.19	100.00	188	Misc plastics	.89
						279	Pumps, compressors	.64
						312	Light fixtures	.15
						398	Business travel	.40
						Other inputs under .1 percent each .73		

Chapter 5

Energy Use per Square Foot for New Building Construction

Chapter 5 describes the typical energy use per square foot of construction for each of the 18 New Building Construction sectors. It also describes the total volume of construction in each of the sectors,⁶ both in absolute terms (million square feet) and as percentages of total New Building Construction. This material is presented in tabular form in Table 5.1 and in graphic form in Figure 5.1.

In addition to the total energy use per square foot of each of the 18 New Building Construction sectors, the direct energy use per square foot is listed. The direct energy use is in turn broken down into actual energy products (e.g. diesel fuel, natural gas, electricity) and asphalt.

By correlating the energy use per square foot for any sector and the total volume of that sector, the impact of energy requirements can be readily determined. For example, although one family residential requires only 715,611 Btu per square foot and is the sixth lowest sector in energy use per square foot, it represents 30 percent of the total volume of construction in the United States and, therefore, the sector as a whole requires more than 50 percent more energy for construction than does the next highest sector—Industrial Buildings.

In using these data, it is important to remember that these are average figures for the entire U.S.A. Just as Chapter

Table 5.1 Energy Embodiment per Square Foot by Building Type

Sector number	Building type	Total embodied and direct energy	Direct energy		Total new building (1967) SF	Total embodied and direct energy per sector Trillion Btu
			Total direct energy Btu/SF	Direct fuels only		
23	Residential, one family	715,611	98,807	37,140	1,122,169,260	795.88
24	Residential, two-four family	635,638	112,825	38,329	55,707,821	35.41
25	Residential, garden apartments	664,482	129,906	40,201	227,786,508	151.36
26	Residential, high-rise apartments	744,703	157,802	60,768	160,224,925	119.32
27	Residential, alterations and additions	NA	NA	NA	NA	264.38
28	Hotel and motel	1,145,337	259,533	97,697	61,187,224	70.08
29	Dormitories	1,466,399	358,974	144,000	40,425,572	59.28
30	Industrial buildings	983,697	108,108	58,825	476,468,069	468.70
31	Office buildings	1,667,111	381,768	155,041	157,578,031	262.70
32	Warehouses	566,071	84,457	38,889	103,467,550	58.57
33	Garages and service stations	788,024	167,691	69,425	41,800,749	32.94
34	Stores and restaurants	960,050	235,980	99,365	209,332,751	200.97
35	Religious buildings	1,273,540	267,570	118,439	54,564,452	69.49
36	Educational buildings	1,404,249	279,866	113,604	315,485,400	443.02
37	Hospital buildings	1,742,549	367,852	137,487	67,978,644	118.45
38	Other non-farm buildings	1,470,192	330,352	140,844	159,482,535	234.47
48	Farm residences	561,914	36,917	17,304	54,456,763	30.60
49	Farm service buildings	147,799	8,587	5,483	392,763,410	58.05
Total					3,690,879,664	7473.80

Figure 5.1 Total Embodied Energy per Square Foot by Building Type

7 demonstrates that there are large energy differences for different assemblies performing the same work, so there are regional requirements that will result in average differences in the various regions. For example, an area with a 4'-0" deep frost line will have an average need for more foundation per square foot than one with no frost line. (And within each region, individual examples will vary markedly above or below the average.)

Direct Energy requirements are listed as Total Direct Energy. A portion of this is identified as Direct Fuel. This is done because a portion of the asphalt used in construction is purchased directly from petroleum companies and is therefore reported as Direct Energy. Total Direct Energy includes asphalt and road oils as well as the Total Fuel category which includes liquid and gaseous fuels, electricity, and lubricating oils.

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Chapter 6

Energy per Unit of Building Material

Chapter 6 contains a comprehensive list of the energy per unit of building material. The units describing each material and the order of listing the materials are presented in the Construction Specification Institute (CSI) format, a format which is generally used in building design and construction. This chapter provides the tools for preparing energy "estimates" for buildings and alternative building systems.

The energy content for building materials is presented in several forms. Each basic material is described in bulk terms. For example, the energy content of cast-in-place concrete is first given in Btu per cubic yard and Btu per pound. From this information, the energy content of any cast-in-place concrete element can be determined by calculating its volume or its weight.

In order to facilitate estimating of building materials, this chapter includes the energy content of a number of specific configurations of materials frequently found in construction. For example, the energy content of a 12 inch deep, cast-in-place concrete waffle slab with 8 inch x 19 inch voids, 24 inches on center is given in Btu per square foot of slab area.

Certain building materials are typically used in combination with other materials. In such cases energy content figures are given for complete assemblies. For example, a brick wall is a combination of brick and mortar. The energy content per square foot of wall area includes both brick and mortar and is given for a number of configurations and thicknesses.

In both of the examples given above, reinforcing may be used in widely differing quantities. Because of this variation in a highly energy intensive material, reinforcing has been omitted from the typical assemblies and its energy content must be added to complete the picture.

Certain building materials and systems do not lend them-

selves to quantity take off in forms which would correlate to embodied energy. For these categories, allowances have been developed which list the typical energy content per square foot of total building. These allowances have been developed for each of the New Building Construction types. Alterations and Additions have been treated differently since a square foot measurement may be misleading. For this sector a series of multipliers have been developed which represent percentage additions to the energy subtotals obtained from the detailed material take off. In order to use these multipliers, first prepare a detailed embodied energy take off for the entire project except for those categories which are to be estimated by an allowance. This subtotal is then multiplied by each of the multipliers in order to get the appropriate allowances. These allowances are then added to the subtotal to yield the total embodied energy for the project. Several categories for which allowances have been developed also list the energy content of specific components. This will permit a detailed take off of that category if such is desired. For example, there are general allowance figures for plumbing systems, but there are also energy content figures for specific fixtures, fittings and piping.

As is the case for any figure representing typical conditions, the general allowances must be used with discretion and judgement. A building in southern Florida will probably have a smaller heating system than would be typical for the United States as a whole. A building in northern New Hampshire would be apt to have a heating system somewhat larger than average. In addition, a building which has been designed to be inherently energy efficient in its performance, would have a smaller heating system than one built to inferior standards.

In addition to the variations resulting from climatological differences, two buildings within the same new building construction category may have widely and obviously differing requirements for the systems for which allowances have been developed. For example, the allowances for con-

veying systems (in this case, basically elevators) reflect the average range for this very generalized building type including everything from small single story motels to large high-rise urban hotels. Obviously, a small single story motel may have no conveying system while a large high-rise hotel may have elevator and escalator systems equal or exceeding those in a high-rise office tower. Each building must be assessed to determine whether there are factors involved which set it far apart from the national norm in addition where allowances are used, judgement must be applied to determine whether the conclusions resulting from their use may appear reasonable.

Also, there are two general allowances which do not relate to specific building materials. The first of these is Direct Fuel Energy. This is the total of petroleum, gas, and electric products used directly in the construction process, excluding asphalt and road oils. In other words, all asphalt or road oil used on a specific job must be recorded and counted separately from the Direct Energy allowance.

The second non-material allowance is for Overhead. This represents the energy associated with all of the goods and services required by the contractor in the performance of his business which are not eventually incorporated into the building itself.

SECTION 0 - DIRECT ENERGY*

0.1 GENERAL ALLOWANCE (excluding asphalt and road oil) - Btu/sq ft by Building Type

Sector no.	Building type	Btu/sq ft allowance
23	Residential, one family	37,000
24	Residential, two-four family	38,000
25	Residential, garden apartments	40,000
26	Residential, high-rise apartments	61,000
27	Residential, alterations and additions	.0290**
28	Hotels and motels	98,000
29	Dormitories	140,000
30	Industrial buildings	59,000
31	Office buildings	160,000
32	Warehouses	39,000
33	Garages and service stations	69,000
34	Stores and restaurants	99,000
35	Religious buildings	120,000
36	Educational buildings	110,000
37	Hospital buildings	140,000
38	Other non-farm buildings	140,000
48	Farm residences	17,000
49	Farm service buildings	5,500

*Direct energy is used throughout the construction process. It is summarized here and therefore, the direct energy requirements in each of the following sections is accounted for in this table and should be added to estimates.

**Use this factor to determine allowances for entire project - multiply energy estimate subtotal by factor and add result to subtotal.

SECTION 1 - OVERHEAD

1.1 GENERAL ALLOWANCE - Btu/sq ft by Building Type

Sector no.	Building type	Btu/sq ft of allowance
23	Residential, one family	23,000
24	Residential, two-four family	20,000
25	Residential, garden apartments	15,000
26	Residential, high-rise apartments	21,000
27	Residential, alterations and additions	.0210*
28	Hotels and motels	37,000
29	Dormitories	47,000
30	Industrial buildings	12,000
31	Office buildings	51,000
32	Warehouses	8,800
33	Garages and service stations	10,000
34	Stores and restaurants	29,000
35	Religious buildings	37,000
36	Educational buildings	41,000
37	Hospital buildings	55,000
38	Other non-farm buildings	44,000
48	Farm residences	10,000
49	Farm service buildings	1,300

*Use this factor to determine allowance for entire project - multiply energy estimate subtotal by factor and add result to subtotal.

SECTION 2 - SITE WORK

2.1	SITE DRAINAGE	Unit	Btu/Unit at Jobsite
2.1.1	Non-Reinforced Concrete Drainage Pipe	lb	1,780
	4" diameter (16 lb/lin ft)	lin ft	28,500
	6" diameter (23 lb/lin ft)	lin ft	40,900
	8" diameter (37 lb/lin ft)	lin ft	65,900
	10" diameter (51 lb/lin ft)	lin ft	90,800
	12" diameter (67 lb/lin ft)	lin ft	119,000
	15" diameter (97 lb/lin ft)	lin ft	172,000
	18" diameter (144 lb/lin ft)	lin ft	256,000
	21" diameter (162 lb/lin ft)	lin ft	288,000
	24" diameter (224 lb/lin ft)	lin ft	399,000
2.1.2	Vitrified Clay Sewer Pipe	lb	8,650
	4" diameter (9 lb/lin ft)	lin ft	77,900
	6" diameter (16 lb/lin ft)	lin ft	138,000
	8" diameter (23 lb/lin ft)	lin ft	199,000
	10" diameter (36 lb/lin ft)	lin ft	311,000
	12" diameter (48 lb/lin ft)	lin ft	415,000
	15" diameter (72 lb/lin ft)	lin ft	623,000
2.1.3	Perforated Plastic Pipe (PVC) (200 psi)	lb	46,600
	1½" diameter (.36 lb/lin ft)	lin ft	15,900
	2" diameter (.53 lb/lin ft)	lin ft	24,700
	2½" diameter (.78 lb/lin ft)	lin ft	36,400
	3" diameter (1.16 lb/lin ft)	lin ft	54,100
	4" diameter (1.91 lb/lin ft)	lin ft	89,100
	5" diameter (2.93 lb/lin ft)	lin ft	137,000
	6" diameter (4.61 lb/lin ft)	lin ft	215,000
	8" diameter (7.05 lb/lin ft)	lin ft	329,000
	10" diameter (10.02 lb/lin ft)	lin ft	467,000
	12" diameter (15.55 lb/lin ft)	lin ft	725,000
2.1.4	Cement Asbestos Pipe		
	Non-pressure sewer pipe	lb	9,370
	4" diameter (6.5 lb/lin ft)	lin ft	60,900
	5" diameter (8.9 lb/lin ft)	lin ft	83,400
	6" diameter (10.3 lb/lin ft)	lin ft	96,500
	8" diameter (14.5 lb/lin ft)	lin ft	136,000
	10" diameter (20.5 lb/lin ft)	lin ft	192,000
	12" diameter (27.0 lb/lin ft)	lin ft	253,000
	16" diameter (41.1 lb/lin ft)	lin ft	385,000
	18" diameter (48.9 lb/lin ft)	lin ft	458,000
	20" diameter (57.1 lb/lin ft)	lin ft	535,000
	24" diameter (74.5 lb/lin ft)	lin ft	698,000

2.1	SITE DRAINAGE (continued)	Unit	Btu/Unit at Jobsite
2.1.4	Cement Asbestos Pipe (continued)		
	Pressure Pipe (200 psi)	lb	9,370
	4" diameter (8.8 lb/lin ft)	lin ft	82,500
	6" diameter (14.5 lb/lin ft)	lin ft	136,000
	8" diameter (22.2 lb/lin ft)	lin ft	208,000
	10" diameter (34.5 lb/lin ft)	lin ft	323,000
	12" diameter (48.2 lb/lin ft)	lin ft	452,000
	14" diameter (64.7 lb/lin ft)	lin ft	606,000
	16" diameter (83.7 lb/lin ft)	lin ft	784,000
2.2	CAISSONS AND PILINGS		
2.2.1	Concrete Caissons and Piles	See Section 3	
2.2.2	Steel Piles	See Section 5	
2.3	EARTHWORK	Included in Section O - Direct Energy	
2.4	PAVEMENT		
2.4.1	Concrete Paving		
	4" thick with 6 x 6 No. 5/5 wire mesh reinforcing	sq ft	44,000
	6" thick with 6 x 6 No. 5/5 wire mesh reinforcing	sq ft	60,000
2.4.2	Bituminuous Paving		
	1½" thick wearing surface (base course not included)	sq ft	54,600
2.4.3	Paving Brick		
	Clay Paving Brick (2½ x 3 5/8 x 7 5/8)	l brk	25,600
	Clay Paving Brick (5.2 bricks/sq ft)	sq ft	133,000

SECTION 3 - CONCRETE

3.2	CONCRETE REINFORCING	Unit	Btu/Unit at Jobsite
3.2.1	Carbon Steel Reinforcing (ASTM Standard)		
		lb	15,700
	No. 2 bar (0.167 lb/ft)	lin ft	2,620

3.2	CONCRETE REINFORCING (continued)	Unit	Btu/Unit at Jobsite
3.2.1	Carbon Steel Reinforcing (continued) (ASTM Standard)	lb	15,700
	No. 3 bar (0.376 lb/ft)	lin ft	5,900
	No. 4 bar (0.668 lb/ft)	lin ft	10,500
	No. 5 bar (1.043 lb/ft)	lin ft	16,400
	No. 6 bar (1.502 lb/ft)	lin ft	23,600
	No. 7 bar (2.044 lb/ft)	lin ft	32,100
	No. 8 bar (2.670 lb/ft)	lin ft	41,900
	No. 9 bar (3.400 lb/ft)	lin ft	53,400
	No. 10 bar (4.303 lb/ft)	lin ft	67,600
	No. 11 bar (5.313 lb/ft)	lin ft	83,400
	No. 14 bar (7.650 lb/ft)	lin ft	120,000
	No. 18 bar (13.600 lb/ft)	lin ft	214,000
3.2.2	Wire Strand for Prestressed Concrete	lb	44,600
	1/4" diameter (0.122 lb/ft)	lin ft	5,440
	3/8" diameter (0.274 lb/ft)	lin ft	12,200
	7/16" diameter (0.373 lb/ft)	lin ft	16,600
	1/2" diameter (0.494 lb/ft)	lin ft	22,000
	5/8" diameter (0.820 lb/ft)	lin ft	36,600
	3/4" diameter (1.160 lb/ft)	lin ft	51,700
	7/8" diameter (1.610 lb/ft)	lin ft	71,800
	1" diameter (2.060 lb/ft)	lin ft	91,900
	1 1/8" diameter (2.700 lb/ft)	lin ft	120,000
	1 1/4" diameter (3.350 lb/ft)	lin ft	140,000
	1 3/8" diameter (4.050 lb/ft)	lin ft	181,000
	1 1/2" diameter (4.840 lb/ft)	lin ft	216,000
	1 9/16" diameter (5.110 lb/ft)	lin ft	228,000
	1 5/8" diameter (5.520 lb/ft)	lin ft	246,000
	1 11/16" diameter (5.970 lb/ft)	lin ft	266,000
	1 3/4" diameter (6.450 lb/ft)	lin ft	288,000
	1 13/16" diameter (6.890 lb/ft)	lin ft	307,000
	1 7/8" diameter (7.370 lb/ft)	lin ft	329,000
	1 15/16" diameter (7.750 lb/ft)	lin ft	346,000
	2" diameter (8.260 lb/ft)	lin ft	368,000
3.2.3	Welded Wire Fabric	lb	24,200
	2 x 4 No. 14/14 (0.16 lb/sq ft)	sq ft	3,870
	2 x 12 No. 3/8 (1.05 lb/sq ft)	sq ft	25,400
	2 x 16 No. 5/10 (0.75 lb/sq ft)	sq ft	18,200
	3 x 16 No. 8/12 (0.32 lb/sq ft)	sq ft	7,740
	4 x 8 No. 13/13 (0.11 lb/sq ft)	sq ft	2,660
	4 x 12 No. 12/12 (0.13 lb/sq ft)	sq ft	3,150
	4 x 12 No. 9/12 (0.22 lb/sq ft)	sq ft	5,320
	4 x 16 No. 8/12 (0.25 lb/sq ft)	sq ft	6,050
	2 x 2 No. 12/12 (0.37 lb/sq ft)	sq ft	8,950
	2 x 2 No. 10/10 (0.60 lb/sq ft)	sq ft	14,500
	4 x 4 No. 12/12 (0.19 lb/sq ft)	sq ft	4,600
	4 x 4 No. 10/10 (0.31 lb/sq ft)	sq ft	7,500
	6 x 6 No. 10/10 (0.21 lb/sq ft)	sq ft	5,080
	6 x 6 No. 8/8 (0.30 lb/sq ft)	sq ft	7,260

3.2	CONCRETE REINFORCING (continued)	Unit	Btu/l Unit at Jobsite
3.2.3	Welded Wire Fabric (continued)	lb	24,200
	6 x 6 No. 5/5 (0.49 lb/sq ft)	sq ft	11,900
	6 x 6 No. 3/3 (0.68 lb/sq ft)	sq ft	16,500
3.3	CAST-IN-PLACE CONCRETE		
3.3.1	Ready-Mix Concrete	lb	641
	(See Section 3.2 for reinforcing)	cu ft	96,100
		cu yd	2,590,000
	Flat Slab Construction		
	4" Slab (50 lbs/sq ft)	sq ft	32,100
	6" Slab (75 lb/sq ft)	sq ft	48,100
	8" Slab (100 lb/sq ft)	sq ft	64,100
	10" Slab (125 lb/sq ft)	sq ft	80,100
	12" Slab (150 lb/sq ft)	sq ft	96,200
	One-Way Joist Construction		
	30" o.c., 6" wide joist, slab 2½" thick		
	8" deep (50 lb/sq ft)	sq ft	32,100
	10" deep (55 lb/sq ft)	sq ft	35,300
	12" deep (60.5 lb/sq ft)	sq ft	38,800
	14" deep (66 lb/sq ft)	sq ft	42,300
	16" deep (72 lb/sq ft)	sq ft	46,200
	20" deep (84 lb/sq ft)	sq ft	53,800
	30" o.c., 6" wide joist, slab 3" thick		
	8" deep (56 lb/sq ft)	sq ft	35,900
	10" deep (61 lb/sq ft)	sq ft	39,100
	12" deep (67 lb/sq ft)	sq ft	42,900
	14" deep (72 lb/sq ft)	sq ft	46,200
	16" deep (78 lb/sq ft)	sq ft	50,000
	20" deep (90 lb/sq ft)	sq ft	57,700
	30" o.c., 6" wide joist, slab 4½" thick		
	8" deep (75 lb/sq ft)	sq ft	48,100
	10" deep (80 lb/sq ft)	sq ft	51,300
	12" deep (86 lb/sq ft)	sq ft	55,100
	14" deep (92 lb/sq ft)	sq ft	59,000
	16" deep (97 lb/sq ft)	sq ft	62,200
	20" deep (110 lb/sq ft)	sq ft	70,500
	20" o.c., 5" wide joist, slab 2½" thick		
	8" deep (54 lb/sq ft)	sq ft	34,600
	10" deep (61 lb/sq ft)	sq ft	39,100
	12" deep (67 lb/sq ft)	sq ft	42,900
	14" deep (74 lb/sq ft)	sq ft	47,400
	16" deep (82 lb/sq ft)	sq ft	52,600
	20" deep (97 lb/sq ft)	sq ft	62,200
	20" o.c., 5" wide joist, slab 3" thick		
	8" deep (60 lb/sq ft)	sq ft	38,500
	10" deep (67 lb/sq ft)	sq ft	42,900

3.3	CAST-IN-PLACE CONCRETE (continued)	Unit	Btu/Unit at Jobsite
3.3.1	Ready-Mix Concrete (continued)		
	20" o.c., 5" wide joist, slab 3" thick (continued)		
	12" deep (74 lb/sq ft)	sq ft	47,400
	14" deep (81 lb/sq ft)	sq ft	51,900
	16" deep (88 lb/sq ft)	sq ft	56,400
	20" deep (104 lb/sq ft)	sq ft	66,700
	20" o.c., 5" wide joist, slab 4½" thick		
	8" deep (79 lb/sq ft)	sq ft	50,600
	10" deep (86 lb/sq ft)	sq ft	55,100
	12" deep (92 lb/sq ft)	sq ft	59,000
	14" deep (99 lb/sq ft)	sq ft	63,500
	16" deep (107 lb/sq ft)	sq ft	68,600
	20" deep (122 lb/sq ft)	sq ft	78,200
	Waffle Slab Construction		
	12" x 2'-0" x 2'-0" overall, void 8" x 19" x 19" (97 lb/sq ft)	sq ft	62,200
	void 10" x 19" x 19" (80 lb/sq ft)	sq ft	51,300
	16" x 2'-0" x 2'-0" overall, void 12" x 19" x 19" (117 lb/sq ft)	sq ft	75,000
	void 14" x 19" x 19" (107 lb/sq ft)	sq ft	68,600
	12" x 3'-0" x 3'-0" overall, void 8" x 30" x 30" (85 lb/sq ft)	sq ft	54,500
	14" x 3'-0" x 3'-0" overall, void 10" x 30" x 30" (96 lb/sq ft)	sq ft	61,500
	16" x 3'-0" x 3'-0" overall, void 12" x 30" x 30" (107 lb/sq ft)	sq ft	68,600
	18" x 3'-0" x 3'-0" overall, void 14" x 30" x 30" (114 lb/sq ft)	sq ft	73,100
	20" x 3'-0" x 3'-0" overall, void 16" x 30" x 30" (137 lb/sq ft)	sq ft	87,800
	24" x 3'-0" x 3'-0" overall, void 20" x 30" x 30" (148 lb/sq ft)	sq ft	94,900
	18" x 4'-0" x 4'-0" overall, void 14" x 41" x 41" (108 lb/sq ft)	sq ft	69,200
	20" x 4'-0" x 4'-0" overall, void 16" x 41" x 41" (131 lb/sq ft)	sq ft	84,000
	24" x 4'-0" x 4'-0" overall, void 20" x 41" x 41" (139 lb/sq ft)	sq ft	89,100
	28" x 4'-0" x 4'-0" overall, void 24" x 41" x 41" (159 lb/sq ft)	sq ft	102,000

3.3	CAST-IN-PLACE CONCRETE (continued)	Unit	Btu/Unit at Jobsite
	Columns		
	6" x 6" (38 lb/lin ft)	lin ft	24,400
	8" x 8" (67 lb/lin ft)	lin ft	42,900
	10" x 10" (104 lb/lin ft)	lin ft	66,700
	12" x 12" (150 lb/lin ft)	lin ft	96,200
	4" round (13 lb/lin ft)	lin ft	8,330
	6" round (29 lb/lin ft)	lin ft	18,600
	8" round (50 lb/lin ft)	lin ft	32,100
	10" round (82 lb/lin ft)	lin ft	52,600
	12" round (118 lb/lin ft)	lin ft	75,600
	16" round (209 lb/lin ft)	lin ft	134,000
3.4	PRECAST CONCRETE		
3.4.1	Slabs - Prestressed roof and floor members (hollow core)	lb cu ft	2,120 318,000
	6" deep (45 lb/sq ft)	sq ft	95,400
	6" deep with 2" topping (70 lb/sq ft)	sq ft	148,000
	8" deep (57 lb/sq ft)	sq ft	121,000
	8" deep with 2" topping (82 lb/sq ft)	sq ft	174,000
3.4.2	Single Tees - Prestressed	lb	2,120
	6 T 12 (47.5 lb/sq ft)	sq ft	101,000
	6 T 16 (53.1 lb/sq ft)	sq ft	113,000
	6 T 20 (58.6 lb/sq ft)	sq ft	124,000
	6 T 24 (64.1 lb/sq ft)	sq ft	136,000
	6 T 28 (69.7 lb/sq ft)	sq ft	148,000
	6 T 32 (75.2 lb/sq ft)	sq ft	159,000
	6 T 36 (80.7 lb/sq ft)	sq ft	171,000
	6 T 40 (86.3 lb/sq ft)	sq ft	183,000
	6 T 44 (91.8 lb/sq ft)	sq ft	195,000
	6 T 48 (97.4 lb/sq ft)	sq ft	206,000
	8 T 12 (48.7 lb/sq ft)	sq ft	103,000
	8 T 16 (52.9 lb/sq ft)	sq ft	112,000
	8 T 20 (57.1 lb/sq ft)	sq ft	121,000
	8 T 24 (61.2 lb/sq ft)	sq ft	130,000
	8 T 28 (65.4 lb/sq ft)	sq ft	139,000
	8 T 32 (69.6 lb/sq ft)	sq ft	148,000
	8 T 36 (73.8 lb/sq ft)	sq ft	156,000
	8 T 40 (77.9 lb/sq ft)	sq ft	165,000
	8 T 44 (82.1 lb/sq ft)	sq ft	174,000
	8 T 48 (86.3 lb/sq ft)	sq ft	183,000
	10 T 12 (51.8 lb/sq ft)	sq ft	110,000
	10 T 16 (55.1 lb/sq ft)	sq ft	117,000
	10 T 20 (58.5 lb/sq ft)	sq ft	124,000
	10 T 24 (61.8 lb/sq ft)	sq ft	131,000

3.4	PRECAST CONCRETE (continued)	Unit	Btu/Unit at Jobsite
3.4.2	Single Tees - Prestressed (continued)	lb	2,120
	10 T 28 (65.1 lb/sq ft)	sq ft	138,000
	10 T 32 (68.4 lb/sq ft)	sq ft	145,000
	10 T 36 (71.8 lb/sq ft)	sq ft	152,000
	10 T 40 (75.1 lb/sq ft)	sq ft	159,000
	10 T 44 (78.4 lb/sq ft)	sq ft	166,000
	10 T 48 (81.8 lb/sq ft)	sq ft	173,000
3.4.3	Double Tees - Prestressed	lb	2,120
	16½" x 4'-0" (60 lb/sq ft)	sq ft	127,000
	16½" x 4'-0" with 2" topping (85 lb/sq ft)	sq ft	180,000
	18" x 5'-0" (58 lb/sq ft)	sq ft	123,000
	18" x 5'-0" with 2" topping (83 lb/sq ft)	sq ft	176,000
	18" x 5'-0" with 3" topping (96 lb/sq ft)	sq ft	204,000
3.4.4	Topping for Precast Decks	lb	641
	2" (25 lb/sq ft)	sq ft	16,000
	3" (38 lb/sq ft)	sq ft	24,200
	4" (50 lb/sq ft)	sq ft	32,100
	6" (63 lb/sq ft)	sq ft	40,400

SECTION 4 - MASONRY

4.1	MORTAR	Unit	Btu/Unit at Jobsite
4.1.1	Prepared Hydraulic and Masonry Cements	lb	5,670
4.2	BRICK MASONRY		
	(Does not include energy for brick ties or reinforcement- see Section 4.4)		
4.2.1	Building or Common Brick		
	Common Brick (2¼" x 3 5/8" x 7 5/8")	1 brk	14,300
	Common brick wall including mortar (6.75 brk/sq ft)	sq ft	131,000
	Solid common brick wall including mortar, 8" thick (13.5 brk/sq ft)	sq ft	281,000
	Cavity wall with 4" thick common brick (6.75 brk/sq ft) and 4" thick concrete block backup, 4" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	160,000

4.2	BRICK MASONRY (continued)	Unit	Btu/Unit at Jobsite
4.2.1	Building or Common Brick (continued)		
	Cavity wall with 4" thick common brick (6.75 brk/sq ft) and 6" thick concrete block backup, 6" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	170,000
	Cavity wall with 4" thick common brick (6.75 brk/sq ft) and 8" thick concrete block backup, 8" x 8" x 16" units (1.13 blocks/sq ft) including mortar	sq ft	176,000
	Jumbo Brick (7 5/8" x 3 5/8" x 7 5/8")	1 brk	48,400
	4" Thick jumbo brick wall including mortar, (2.25 brk/sq ft)	sq ft	126,000
	8" Thick solid jumbo brick wall including mortar, (4.50 brk/sq ft)	sq ft	271,000
	Cavity wall with 4" thick jumbo brick (2.25 brk/sq ft) and 4" thick concrete block backup, 4" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	155,000
	Cavity wall with 4" thick jumbo brick (2.25 brk/sq ft) and 6" thick concrete block backup, 6" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	165,000
	Cavity wall with 4" thick jumbo brick (2.25 brk/sq ft) and 8" thick concrete block backup, 8" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	171,000
4.2.2	Paving and Flooring Brick		
	Clay Flooring Brick (2.25 x 3 5/8" x 7 5/8")	1 brk	25,600
	Clay Flooring Brick (5.2 brk/sq ft)	sq ft	133,000
4.3	BLOCK AND TILE MASONRY		
4.3.1	Structural Facing Tile, 4" thick (5 1/3" x 12" x 4")	1 brk	117,000
	4" Thick Structural Facing Tile wall, including mortar (2.1 tiles/sq ft)	sq ft	287,000
	6" Thick Structural Facing Tile, (5 1/3" x 12" x 6")	1 brk	162,000

4.3	BLOCK AND TILE MASONRY (continued)	Unit	Btu/Unit at Jobsite
4.3.1	Structural Facing Tile (continued)		
	6" Thick Structural Facing Tile wall, including mortar (2.1 tiles/sq ft)	sq ft	405,000
	Structural Facing Tile, 8" thick (5 1/3" x 12" x 8")	1 brk	208,000
	8" Thick Structural Facing Tile wall including mortar (2.1 tiles/sq ft)	sq ft	522,000
4.3.2	Concrete Block (4" x 4" x 16")	1 blk	9,330
	4" Thick Concrete Block wall, 4" x 4" x 16" units, including mortar (2.25 blocks/sq ft)	sq ft	30,600
	Concrete Block (6" x 4" x 16")	1 blk	13,700
	6" Thick Concrete Block wall, 6" x 4" x 16" units, including mortar (2.25 blocks/sq ft)	sq ft	41,600
	Concrete Block (8" x 4" x 16")	1 blk	15,900
	8" Thick Concrete Block wall, 8" x 4" x 16" units, including mortar (2.25 blocks/sq ft)	sq ft	47,700
	Concrete Block (4" x 8" x 16")	1 blk	18,700
	4" Thick Concrete Block wall, 4" x 8" x 16" units, including mortar (1.13 blocks/sq ft)	sq ft	28,300
	Concrete Block (6" x 8" x 16")	1 blk	27,400
	6" Thick Concrete Block wall, 6" x 8" x 16" units, including mortar (1.13 blocks/sq ft)	sq ft	39,100
	Concrete Block (8" x 8" x 16")	1 blk	31,800
	8" Thick Concrete Block wall, 8" x 8" x 16" units, including mortar (1.13 blocks/sq ft)	sq ft	44,900
	Concrete Block (12" x 8" x 16")	1 blk	49,400
	12" Thick Concrete Block wall, 12" x 8" x 16" units, including mortar (1.13 blocks/sq ft)	sq ft	66,400

4.4	MASONRY REINFORCING	Unit	Btu/Unit at Jobsite
	(For standard reinforcing bars, see Section 3.2)		
4.4.1	Truss Horizontal Reinforcing	lb	24,200
	4" Standard (.178 lb/lin ft)	lin ft	4,310
	4" Extra heavy (.247 lb/lin ft)	lin ft	5,980
	6" Standard (.180 lb/lin ft)	lin ft	4,360
	6" Extra heavy (.250 lb/lin ft)	lin ft	6,050
	8" Standard (.187 lb/lin ft)	lin ft	4,530
	8" Extra heavy (.257 lb/lin ft)	lin ft	6,220
	12" Standard (.207 lb/lin ft)	lin ft	5,010
	12" Extra heavy (.276 lb/lin ft)	lin ft	6,680
	16" Standard (.236 lb/lin ft)	lin ft	5,710
	16" Extra heavy (.306 lb/lin ft)	lin ft	7,410
4.4.2	Ladder-Type Masonry Reinforcing	lb	24,200
	4" Standard (.125 lb/lin ft)	lin ft	3,030
	4" Extra heavy (.195 lb/lin ft)	lin ft	4,720
	6" Standard (.132 lb/lin ft)	lin ft	3,190
	6" Extra heavy (.202 lb/lin ft)	lin ft	4,890
	8" Standard (.139 lb/lin ft)	lin ft	3,360
	8" Extra heavy (.210 lb/lin ft)	lin ft	5,080
	12" Standard (.155 lb/lin ft)	lin ft	3,750
	12" Extra heavy (.225 lb/lin ft)	lin ft	5,450
	16" Standard (.171 lb/lin ft)	lin ft	4,140
	16" Extra heavy (.241 lb/lin ft)	lin ft	5,830

SECTION 5 - METALS

5.1	METALS AND ALLOYS	Unit	Btu/Unit at Jobsite
5.1.1	Steel		
	Carbon Steel:		
	sheets (plain)	lb	16,800
	sheets (galvanized)	lb	27,800
	structural shapes	lb	22,700
	pipe	lb	25,800
	Alloy Steel:		
	Structural shapes	lb	26,900
	Stainless Steel:		
	sheets (cold-rolled)	lb	138,000
	sheets (hot rolled)	lb	89,800
	plates	lb	159,000
	bars (cold rolled)	lb	193,000
	bars (hot rolled)	lb	157,000
5.1.2	Aluminum		
	Structural shapes	lb	92,200
	plate & sheet	lb	116,000

5.1	METALS AND ALLOYS (continued)	Unit	Btu/Unit at Jobsite
5.1.3	Copper		
	Unalloyed Copper:		
	structural shapes	lb	46,800
	sheets, strips	lb	69,700
	pipe	lb	73,100
	Copper Alloy:		
	structural shapes	lb	48,500
	sheets, strips	lb	63,000
	pipe	lb	70,800
5.2	STRUCTURAL METALS		
5.2.1	Structural Aluminum Shapes	lb	92,200
	I Beams		
	3 I 1.67 (1.96 lb/lin ft)	lin ft	181,000
	4 I 2.25 (2.64 lb/lin ft)	lin ft	243,000
	5 I 2.92 (3.43 lb/lin ft)	lin ft	316,000
	6 I 3.66 (4.30 lb/lin ft)	lin ft	396,000
	7 I 4.48 (5.27 lb/lin ft)	lin ft	486,000
	8 I 5.40 (6.35 lb/lin ft)	lin ft	585,000
	9 I 6.38 (7.51 lb/lin ft)	lin ft	692,000
	10 I 7.45 (8.76 lb/lin ft)	lin ft	808,000
	12 I 9.35 (10.99 lb/lin ft)	lin ft	1,010,000
	Wide Flange		
	2½ WF 1.80 (1.80 lb/lin ft)	lin ft	166,000
	4 WF 4.76 (4.76 lb/lin ft)	lin ft	439,000
	5 WF 6.49 (6.49 lb/lin ft)	lin ft	598,000
	6 WF 7.85 (7.85 lb/lin ft)	lin ft	724,000
	8 WF 10.72 (10.72 lb/lin ft)	lin ft	988,000
	10 WF 7.30 (7.30 lb/lin ft)	lin ft	673,000
	Channels		
	3 C 1.42 (1.42 lb/lin ft)	lin ft	131,000
	4 C 1.85 (1.85 lb/lin ft)	lin ft	171,000
	6 C 2.83 (2.83 lb/lin ft)	lin ft	261,000
	8 C 6.48 (6.48 lb/lin ft)	lin ft	597,000
	10 C 8.84 (8.84 lb/lin ft)	lin ft	797,000
	12 C 10.37 (10.37 lb/lin ft)	lin ft	956,000
	Angles		
	1 1/2 x 1 1/2 x 1/8 (.43 lb/lin ft)	lin ft	39,600
	2 x 2 x 1/8 (.49 lb/lin ft)	lin ft	45,200
	2 x 2 x 1/4 (.94 lb/lin ft)	lin ft	86,700
	3 x 3 x 3/8 (2.47 lb/lin ft)	lin ft	228,000
	4 x 4 x 3/8 (2.86 lb/lin ft)	lin ft	264,000
	5 x 5 x 1/2 (5.58 lb/lin ft)	lin ft	514,000
	6 x 6 x 1/2 (6.75 lb/lin ft)	lin ft	622,000

5.2	STRUCTURAL METALS (continued)	Unit	Btu/Unit at Jobsite
5.2.2	Structural Steel Shapes	lb	22,700
	Wide Flange Shapes		
	W 4 x 13 (13 lb/lin ft)	lin ft	295,000
	W 5 x 16 (16 lb/lin ft)	lin ft	363,000
	W 6 x 20 (20 lb/lin ft)	lin ft	454,000
	W 8 x 24 (24 lb/lin ft)	lin ft	545,000
	W 10 x 29 (29 lb/lin ft)	lin ft	658,000
	W 12 x 36 (36 lb/lin ft)	lin ft	817,000
	W 14 x 38 (38 lb/lin ft)	lin ft	863,000
	W 16 x 50 (50 lb/lin ft)	lin ft	1,140,000
	W 18 x 60 (60 lb/lin ft)	lin ft	1,360,000
	W 21 x 73 (73 lb/lin ft)	lin ft	1,660,000
	W 24 x 94 (94 lb/lin ft)	lin ft	2,130,000
	W 27 x 102 (102 lb/lin ft)	lin ft	2,320,000
	W 30 x 116 (116 lb/lin ft)	lin ft	2,620,000
	W 36 x 135 (135 lb/lin ft)	lin ft	3,060,000
	Channels		
	C 3 x 6 (6 lb/lin ft)	lin ft	136,000
	C 4 x 7 (7.25 lb/lin ft)	lin ft	165,000
	C 5 x 9 (9 lb/lin ft)	lin ft	204,000
	C 6 x 13 (13 lb/lin ft)	lin ft	295,000
	C 7 x 14.75 (14.75 lb/lin ft)	lin ft	335,000
	C 8 x 18.75 (18.75 lb/lin ft)	lin ft	426,000
	C 9 x 20 (20 lb/lin ft)	lin ft	454,000
	C 10 x 30 (30 lb/lin ft)	lin ft	681,000
	C 12 x 30 (30 lb/lin ft)	lin ft	681,000
	C 15 x 50 (50 lb/lin ft)	lin ft	1,140,000
	Angles		
	L 1 x 1 x 1/4 (1.49 lb/lin ft)	lin ft	33,800
	L 1½ x 1½ x ¼ (2.34 lb/lin ft)	lin ft	53,000
	L 2 x 2 x 3/8 (4.7 lb/lin ft)	lin ft	107,000
	L 3 x 3 x 1/2 (9.4 lb/lin ft)	lin ft	213,000
	L 4 x 4 x 3/4 (18.5 lb/lin ft)	lin ft	420,000
	L 5 x 5 x 7/8 (27.2 lb/lin ft)	lin ft	617,000
	L 6 x 6 x 1 (37.4 lb/lin ft)	lin ft	849,000
	L 8 x 8 x 1 (51 lb/lin ft)	lin ft	1,160,000
	Structural Tees		
	WT 2 x 6.5 (6.5 lb/lin ft)	lin ft	148,000
	WT 3 x 8 (8 lb/lin ft)	lin ft	182,000
	WT 4 x 10 (10 lb/lin ft)	lin ft	277,000
	WT 5 x 12.5 (12.5 lb/lin ft)	lin ft	284,000
	WT 6 x 15.5 (15.5 lb/lin ft)	lin ft	352,000
	WT 8 x 20 (20 lb/lin ft)	lin ft	454,000
	WT 10 x 22 (22 lb/lin ft)	lin ft	499,000

5.2	STRUCTURAL METALS (continued)	Unit	Btu/Unit at Jobsite
5.2.3	Stainless Steel Shapes		
	Angles (Hot Rolled)	lb	157,000
	1" x 1" x 1/4" (1.49 lb/lin ft)	lin ft	234,000
	2" x 2" x 1/4" (3.19 lb/lin ft)	lin ft	501,000
	3" x 3" x 1/4" (4.90 lb/lin ft)	lin ft	769,000
	3" x 3" x 5/16" (6.10 lb/lin ft)	lin ft	958,000
	3" x 3" x 3/8" (7.20 lb/lin ft)	lin ft	1,130,000
	3" x 3" x 1/2" (11.10 lb/lin ft)	lin ft	1,740,000
	Angles (Cold Rolled)	lb	193,000
	1/2" x 1/2" x 1/8" (.38 lb/lin ft)	lin ft	73,300
	3/4" x 3/4" x 1/8" (.59 lb/lin ft)	lin ft	114,000
	1" x 1" x 1/8" (.80 lb/lin ft)	lin ft	154,000
	1" x 1" x 3/16" (1.16 lb/lin ft)	lin ft	224,000
	2" x 2" x 1/8" (1.65 lb/lin ft)	lin ft	318,000
	2" x 2" x 3/16" (2.44 lb/lin ft)	lin ft	471,000
	Channels (Hot Rolled)	lb	157,000
	1" x 1/2" x 1/8" (.75 lb/lin ft)	lin ft	118,000
	1 1/2" x 1/2" x 1/8" (.96 lb/lin ft)	lin ft	151,000
	2" x 3/4" x 3/16" (2.02 lb/lin ft)	lin ft	317,000
	3" x 1 3/8" x 3/16" (4.10 lb/lin ft)	lin ft	644,000
	Channels (Cold Rolled)	lb	193,000
	1/2" x 1/2" x .093" (.40 lb/lin ft)	lin ft	77,200
	3/4" x 3/4" x .093" (.57 lb/lin ft)	lin ft	110,000
	1" x 1" x .109" (1.03 lb/lin ft)	lin ft	199,000
	1 1/4" x 1 1/4" x .109" (1.32 lb/lin ft)	lin ft	255,000
	2" x 2" x .125" (2.41 lb/lin ft)	lin ft	465,000
5.3	METAL JOISTS AND DECKS		
5.3.1	Longspan Steel Joists	lb	15,900
	18 LH 02 (13 lb/lin ft)	lin ft	207,000
	20 LH 05 (17 lb/lin ft)	lin ft	270,000
	24 LH 06 (19 lb/lin ft)	lin ft	302,000
	28 LH 09 (24 lb/lin ft)	lin ft	382,000
	32 LH 13 (36 lb/lin ft)	lin ft	572,000
	36 LH 15 (41 lb/lin ft)	lin ft	652,000
5.3.2	Metal Decking		
	Corrugated Steel Decking (Galvanized)		
	2 1/2 x 1/2 inch	lb	27,800
	12 gauge .1084" thick (494 lb/sq ft)	sq ft	137,000
	14 gauge .0785" thick (3.58 lb/sq ft)	sq ft	99,500

5.3	METAL JOISTS AND DECKS (continued)	Unit	Btu/Unit at Jobsite
5.3.2	Metal Decking (continued)		
	Corrugated Steel Decking (Galvanized)		
	2½ x ½ inch	lb	27,800
	16 gauge .0635" thick (2.90 lb/sq ft)	sq ft	80,600
	18 gauge .0516" thick (2.35 lb/sq ft)	sq ft	65,300
	20 gauge .0396" thick (1.81 lb/sq ft)	sq ft	50,300
	22 gauge .0336" thick (1.53 lb/sq ft)	sq ft	42,500
	24 gauge .0276" thick (1.26 lb/sq ft)	sq ft	35,000
	26 gauge .0217" thick (0.99 lb/sq ft)	sq ft	27,500
	28 gauge .0187" thick (0.85 lb/sq ft)	sq ft	23,600
	29 gauge .0172" thick (0.78 lb/sq ft)	sq ft	21,700
5.4	MISCELLANEOUS AND ORNAMENTAL METALS		
5.4.1	Aluminum Railings (anodized)	lb	92,200
	1" outside diameter, .065" wall thickness (.225 lb/lin ft)	lin ft	20,700
	1" outside diameter, .083" wall thickness (.281 lb/lin ft)	lin ft	25,900
	1" outside diameter, .095" wall thickness (.318 lb/lin ft)	lin ft	29,300
	1½" outside diameter, .078" wall thickness (.338 lb/lin ft)	lin ft	31,200
	1½" outside diameter, .094" wall thickness (.402 lb/lin ft)	lin ft	37,100
	1½" outside diameter, .125" wall thickness (.520 lb/lin ft)	lin ft	47,900
	1½" outside diameter, .094" wall thickness (.488 lb/lin ft)	lin ft	45,000
	1½" outside diameter, .125" wall thickness (.635 lb/lin ft)	lin ft	58,500
	1½" outside diameter, .156" wall thickness (.775 lb/lin ft)	lin ft	71,500
	1½" outside diameter, .188" wall thickness (.911 lb/lin ft)	lin ft	84,000
	1½" outside diameter, .250" wall thickness (1.15 lb/lin ft)	lin ft	106,000
	2" outside diameter, .125" wall thickness (.866 lb/lin ft)	lin ft	79,800

5.4	MISCELLANEOUS AND ORNAMENTAL METALS (continued)	Unit	Btu/Unit at Jobsite
5.4.1	Aluminum Railings (continued)	lb	92,200
	2" outside diameter, .156" wall thickness (1.06 lb/lin ft)	lin ft	97,700
	2" outside diameter, .188" wall thickness (1.26 lb/lin ft)	lin ft	116,000
	2" outside diameter, .250" wall thickness (1.62 lb/lin ft)	lin ft	149,000
	2" outside diameter, .313" wall thickness (1.95 lb/lin ft)	lin ft	180,000
	2" outside diameter, .375" wall thickness (2.25 lb/lin ft)	lin ft	207,000
5.4.2	Steel Railings	lb	25,800
	1.05" outside diameter, .113" wall thickness (1.13 lb/lin ft)	lin ft	29,200
	1.05" outside diameter, .154" wall thickness (1.54 lb/lin ft)	lin ft	39,700
	1.32" outside diameter, .133" wall thickness (1.68 lb/lin ft)	lin ft	43,300
	1.32" outside diameter, .179" wall thickness (2.17 lb/lin ft)	lin ft	56,000
	1.66" outside diameter, .140" wall thickness (2.27 lb/lin ft)	lin ft	58,600
	1.66" outside diameter, .191" wall thickness (3.00 lb/lin ft)	lin ft	77,400
	1.90" outside diameter, .145" wall thickness (2.72 lb/lin ft)	lin ft	70,200
	1.90" outside diameter, .200" wall thickness (3.63 lb/lin ft)	lin ft	93,700
	2.38" outside diameter, .154" wall thickness (3.65 lb/lin ft)	lin ft	94,200
	2.38" outside diameter, .218" wall thickness (5.18 lb/lin ft)	lin ft	134,000
5.4.3	Stainless Steel Railings (Cold Rolled)	lb	138,000
	1" outside diameter, .120" wall thickness (1.128 lb/lin ft)	lin ft	156,000

5.4	MISCELLANEOUS AND ORNAMENTAL METALS (continued)	Unit	Btu/Unit at Jobsite
5.4.3	Stainless Steel Railings (Cold Rolled) (continued)	lb	138,000
	1" outside diameter, .187" wall thickness (1.630 lb/lin ft)	lin ft	225,000
	1" outside diameter, .250" wall thickness (2.003 lb/lin ft)	lin ft	276,000
	1½" outside diameter, .083" wall thickness (1.256 lb/lin ft)	lin ft	173,000
	1½" outside diameter, .120" wall thickness (1.769 lb/lin ft)	lin ft	244,000
	1½" outside diameter, .187" wall thickness (2.634 lb/lin ft)	lin ft	363,000
	1½" outside diameter, .250" wall thickness (3.338 lb/lin ft)	lin ft	461,000
	1¾" outside diameter, .065" wall thickness (1.170 lb/lin ft)	lin ft	161,000
	1¾" outside diameter, .083" wall thickness (1.478 lb/lin ft)	lin ft	204,000
	1¾" outside diameter, .120" wall thickness (2.089 lb/lin ft)	lin ft	288,000
	1¾" outside diameter, .187" wall thickness (3.136 lb/lin ft)	lin ft	433,000
	2" outside diameter, .083" wall thickness (1.699 lb/lin ft)	lin ft	234,000
	2" outside diameter, .120" wall thickness (2.409 lb/lin ft)	lin ft	332,000
	2" outside diameter, .187" wall thickness (3.638 lb/lin ft)	lin ft	502,000
	2" outside diameter, .250" wall thickness (4.673 lb/lin ft)	lin ft	645,000
5.8	METAL FASTENERS		
5.8.1	Steel High Strength Bolts	lb	26,600
	½" diameter, 1" length (.17 lb ea)	ea	4,520
	½" diameter, 1½" length (.18 lb ea)	ea	4,790
	½" diameter, 1½" length (.19 lb ea)	ea	5,050
	½" diameter, 2" length (.22 lb ea)	ea	5,850

5.8	METAL FASTENERS (continued)	Unit	Btu/Unit at Jobsite
5.8.1	Steel High Strength Bolts (continued)	lb	26,600
	½" diameter, 3" length (.27 lb ea)	ea	7,180
	½" diameter, 4" length (.33 lb ea)	ea	8,780
	½" diameter, 5" length (.39 lb ea)	ea	10,400
	½" diameter, 6" length (.44 lb ea)	ea	11,700
	5/8" diameter, 1" length (.29 lb ea)	ea	7,710
	5/8" diameter, 1½" length (.33 lb ea)	ea	8,780
	5/8" diameter, 2" length (.37 lb ea)	ea	9,840
	5/8" diameter, 3" length (.46 lb ea)	ea	12,200
	5/8" diameter, 4" length (.55 lb ea)	ea	14,600
	5/8" diameter, 5" length (.63 lb ea)	ea	16,800
	5/8" diameter, 6" length (.72 lb ea)	ea	19,200
	5/8" diameter, 7" length (.81 lb ea)	ea	21,500
	1" diameter, 1½" length (1.09 lb ea)	ea	29,000
	1" diameter, 2" length (1.19 lb ea)	ea	31,700
	1" diameter, 3" length (1.41 lb ea)	ea	37,500
	1" diameter, 4" length (1.62 lb ea)	ea	43,092
	1" diameter, 5" length (1.84 lb ea)	ea	48,900
	1" diameter, 6" length (2.07 lb ea)	ea	55,100
	1" diameter, 7" length (2.29 lb ea)	ea	60,900
	1" diameter, 8" length (2.51 lb ea)	ea	66,800
	1½" diameter, 2" length (3.44 lb ea)	ea	91,500
	1½" diameter, 3" length (3.91 lb ea)	ea	104,000
	1½" diameter, 4" length (4.41 lb ea)	ea	117,000
	1½" diameter, 5" length (4.90 lb ea)	ea	130,000
	1½" diameter, 6" length (5.40 lb ea)	ea	144,000
	1½" diameter, 7" length (5.89 lb ea)	ea	157,000
	1½" diameter, 8" length (6.39 lb ea)	ea	170,000
5.8.2	Structural Rivets (High Button or Acorn Heads)	lb	17,400
	½" diameter, 1½" length (.12 lb ea)	ea	2,090
	½" diameter, 2" length (.15 lb ea)	ea	2,160
	½" diameter, 3" length (.21 lb ea)	ea	3,650
	½" diameter, 4" length (.26 lb ea)	ea	4,520
	5/8" diameter, 2" length (.24 lb ea)	ea	4,180
	5/8" diameter, 3" length (.33 lb ea)	ea	5,740
	5/8" diameter, 4" length (.41 lb ea)	ea	7,130
	5/8" diameter, 5" length (.50 lb ea)	ea	8,700
	¾" diameter, 2" length (.37 lb ea)	ea	6,440
	¾" diameter, 3" length (.50 lb ea)	ea	8,700
	¾" diameter, 4" length (.62 lb ea)	ea	10,800
	¾" diameter, 5" length (.74 lb ea)	ea	12,900
	¾" diameter, 6" length (.87 lb ea)	ea	15,100
	¾" diameter, 7" length (1.00 lb ea)	ea	17,400
	1" diameter, 2" length (.72 ea)	ea	12,500
	1" diameter, 3" length (.94 lb ea)	ea	16,400
	1" diameter, 4" length (1.16 lb ea)	ea	20,000
	1" diameter, 5" length (1.38 lb ea)	ea	24,000
	1" diameter, 6" length (1.61 lb ea)	ea	28,000
	1" diameter, 7" length (1.83 lb ea)	ea	31,800
	1" diameter, 8" length (2.05 lb ea)	ea	35,700

5.8	METAL FASTENERS (continued)	Unit	Btu/Unit at Jobsite
5.8.2	Structural Rivets (continued)	lb	17,400
	1½" diameter, 2" length (1.22 lb ea)	ea	21,200
	1½" diameter, 3" length (1.56 lb ea)	ea	27,000
	1½" diameter, 4" length (1.91 lb ea)	ea	33,200
	1½" diameter, 5" length (2.26 lb ea)	ea	39,300
	1½" diameter, 6" length (2.61 lb ea)	ea	45,400
	1½" diameter, 7" length (2.95 lb ea)	ea	51,300
	1½" diameter, 8" length (3.30 lb ea)	ea	57,400
5.8.3	Common Nails	lb	34,000

SECTION 6 - CARPENTRY

6.1	ROUGH CARPENTRY	Unit	Btu/Unit at Jobsite
6.1.1	Softwood Framing	bd ft	7,620
	1 x 2 (1/6 bd ft)	lin ft	1,270
	1 x 3 (1/4 bd ft)	lin ft	1,910
	1 x 4 (1/3 bd ft)	lin ft	2,510
	1 x 6 (1/2 bd ft)	lin ft	3,810
	1 x 8 (2/3 bd ft)	lin ft	5,080
	2 x 2 (1/3 bd ft)	lin ft	1,910
	2 x 3 (1/2 bd ft)	lin ft	3,810
	2 x 4 (2/3 bd ft)	lin ft	5,080
	2 x 6 (1 bd ft)	lin ft	7,620
	2 x 8 (1 1/3 bd ft)	lin ft	10,100
	2 x 10 (1 2/3 bd ft)	lin ft	12,700
	2 x 12 (2 bd ft)	lin ft	15,200
	3 x 4 (1 bd ft)	lin ft	7,620
	3 x 6 (1 1/2 bd ft)	lin ft	11,400
	3 x 8 (2 bd ft)	lin ft	15,200
	3 x 10 (2 1/2 bd ft)	lin ft	19,000
	3 x 12 (3 bd ft)	lin ft	22,900
	4 x 4 (1 1/3 bd ft)	lin ft	10,100
	4 x 6 (2 bd ft)	lin ft	15,200
	4 x 8 (2 2/3 bd ft)	lin ft	17,800
	4 x 10 (3 1/2 bd ft)	lin ft	25,400
	4 x 12 (4 bd ft)	lin ft	30,500
	6 x 6 (3 bd ft)	lin ft	22,900
	6 x 8 (4 bd ft)	lin ft	30,500
	6 x 10 (5 bd ft)	lin ft	38,100
	8 x 8 (5 1/3 bd ft)	lin ft	40,600
	10 x 10 (8 1/3 bd ft)	lin ft	63,500
	12 x 12 (12 bd ft)	lin ft	91,400
6.1.2	Exterior Grade Plywood		
	1/4" thick	sq ft	3,860
	5/16" thick	sq ft	4,820
	3/8" thick	sq ft	5,790

6.1	ROUGH CARPENTRY (continued)	Unit	Btu/Unit at Jobsite
6.1.2	Exterior Grade Plywood (continued)		
	1/2" thick	sq ft	7,710
	5/8" thick	sq ft	9,640
	3/4" thick	sq ft	11,600
6.2	FINISH CARPENTRY		
6.2.1	Molding	bd ft	17,900
	Base Molding		
	1/2" x 3" (1/8 bd ft)	lin ft	2,240
	1/2" x 4" (1/6 bd ft)	lin ft	2,980
6.2.2	Miscellaneous Hardwood	bd ft	9,820
	1" x 1" (1/12 bd ft)	lin ft	818
	1" x 2" (1/6 bd ft)	lin ft	1,640
	1" x 3" (1/4 bd ft)	lin ft	2,460
	1" x 4" (1/3 bd ft)	lin ft	3,270
6.2.3	Prefinished Paneling (1/8" thick)	sq ft	4,620
6.2.4	Exterior Siding		
	Red Cedar Shingles	sq ft	7,320
	Particleboard, 3/4" thick	sq ft	7,650
	Plywood, 3/8" thick	sq ft	5,790
6.3	LAMINATED CONSTRUCTION		
6.3.1	Laminated Framing	bd ft	16,700
	Net Finished Sizes		
	2 1/4" x 9 3/4" (3 bd ft)	lin ft	50,100
	5" x 6 1/2" (4 bd ft)	lin ft	66,800
	5" x 8 1/8" (5 bd ft)	lin ft	83,500
	5 1/2" x 9 3/4" (6 bd ft)	lin ft	100,000
	7" x 9 3/4" (8 bd ft)	lin ft	134,000
	9" x 9 3/4" (10 bd ft)	lin ft	167,000
	7" x 14 5/8" (12 bd ft)	lin ft	200,000
	9" x 14 5/8" (15 bd ft)	lin ft	251,000
	5" x 26" (16 bd ft)	lin ft	267,000
	7" x 24 3/8" (20 bd ft)	lin ft	334,000

SECTION 7 - MOISTURE PROTECTION

7.1	WATER PROOFING	Unit	Btu/Unit at Jobsite
7.1.1	Asphalt Coating	Gal	10,500

7.1	WATERPROOFING (continued)	Unit	Btu/Unit at Jobsite
7.1.2	Building Paper	lb	10,500
	1 ply (.05 lb/sq ft)	sq ft	525
	2 ply (.10 lb/sq ft)	sq ft	1,050
	3 ply (.15 lb/sq ft)	sq ft	1,080
	4 ply (.20 lb/sq ft)	sq ft	2,100
7.2	BUILDING INSULATION		
7.2.1	Insulating Board (wood fiber with cement, 22 lb/cu ft)	lb	15,300
	1" thick (1.83 lb/sq ft)	sq ft	28,000
	2" thick (3.67 lb/sq ft)	sq ft	55,200
	2½" thick (4.58 lb/sq ft)	sq ft	70,100
	3" thick (5.50 lb/sq ft)	sq ft	84,200
	3½" thick (6.42 lb/sq ft)	sq ft	95,500
	4" thick (7.34 lb/sq ft)	sq ft	112,000
7.2.2	Rigid Insulation (Polystyrene, 2.4 lb/cu ft)	lb	76,400
	1" thick (.20 lb/sq ft)	sq ft	15,300
	1½" thick (.30 lb/sq ft)	sq ft	22,900
	2" thick (.40 lb/sq ft)	sq ft	30,600
	2½" thick (.50 lb/sq ft)	sq ft	76,400
	3" thick (.60 lb/sq ft)	sq ft	45,800
	3½" thick (.70 lb/sq ft)	sq ft	53,500
	4" thick (.80 lb/sq ft)	sq ft	61,100
	4½" thick (.90 lb/sq ft)	sq ft	68,800
	5" thick (1.00 lb/sq ft)	sq ft	76,400
7.2.3	Batt Insulation (Mineral Wool)		
	2½" thick	sq ft	5,700
	3½" thick	sq ft	6,860
	4½" thick	sq ft	7,850
	5½" thick	sq ft	8,800
	6½" thick	sq ft	9,250
	7½" thick	sq ft	10,900
	9½" thick	sq ft	12,000
7.2.4	Loose Fiber Insulation (3 lb/cu ft)	lb	6,420
7.3	SHINGLES AND SIDING		
7.3.1	Asphalt Strip Shingles (Self Sealing)	sq ft	29,700
7.3.2	Regular Asphalt Strip Shingles	sq ft	25,300

7.3	SHINGLES AND SIDING (continued)	Unit	Btu/Unit at Jobsite
7.3.3	Red Cedar Shingles	sq ft	7,320
7.3.4	Aluminum Siding	lb	116,000
	8" wide horizontal siding .024" thick (.45 lb/sq ft)	sq ft	53,400
	4" wide horizontal siding .019" thick (.40 lb/sq ft)	sq ft	46,400
7.3.5	Asbestos Siding and Shingles	sq ft	16,700
7.4	ROOFING		
7.4.1	Rolled Asphalt Roofing	sq ft	7,760
7.4.2	Asphalt Saturated Felts (.05 lb/sq ft)	sq ft	13,600
7.4.3	Tar Saturated Felts (.15 lb/sq ft)	sq ft	16,900
7.4.4	Aluminum Roofing	lb	116,000
	Ribbed 4":		
	.027" thick (.55 lb/sq ft)	sq ft	63,800
	.032" thick (.73 lb/sq ft)	sq ft	84,700
	.040" thick (.90 lb/sq ft)	sq ft	104,000
	Corrugated		
	.024" thick (.42 lb/sq ft)	sq ft	48,700
	.032" thick (.55 lb/sq ft)	sq ft	63,800
	.040" thick (.69 lb/sq ft)	sq ft	80,000
	Standing Seam:		
	.032" thick (.58 lb/sq ft)	sq ft	67,300
	.040" thick (.73 lb/sq ft)	sq ft	84,700
	12" Vertical Panel		
	.032" thick (.64 lb/sq ft)	sq ft	74,200
	.040" thick (.80 lb/sq ft)	sq ft	92,800
7.4.5	Steel Roofing	lb	27,800
	2½" x ½" Corrugated		
	18 guage (2.35 lb/sq ft)	sq ft	65,300
	20 guage (1.81 lb/sq ft)	sq ft	50,300
	22 guage (1.53 lb/sq ft)	sq ft	42,500

7.4	ROOFING (continued)	Unit	Btu/Unit at Jobsite
7.4.5	Steel Roofing (continued)	lb	27,800
	2½" x ½" Corrugated (continued)		
	24 gauge (1.26 lb/sq ft)	sq ft	35,000
	6" Ribbed:		
	18 gauge (2.84 lb/sq ft)	sq ft	79,500
	20 gauge (2.13 lb/sq ft)	sq ft	59,200
	22 gauge (1.73 lb/sq ft)	sq ft	48,100
	24 gauge (1.43 lb/sq ft)	sq ft	39,800
7.4.6	Copper Roofing	lb	63,000
	16 oz Standing Seam (1.25 lb/sq ft)	sq ft	78,800
	20 oz Batten Seam (1.55 lb/sq ft)	sq ft	97,700
7.4.7	Stainless Steel Roofing	lb	80,800
	28 gauge Continuous Weld (.72 lb/sq ft)	sq ft	58,200
	32 gauge Standing Seam (.58 lb/sq ft)	sq ft	46,900
7.4.8	Corrugated Plastic Roofing	lb	50,000
	2.67" Corrugations, 9/16" deep (.40 lb/sq ft)	sq ft	20,000
7.6	FLASHING		
7.6.1	Aluminum Flashing	lb	96,000
	.016" thick (.224 lb/sq ft)	sq ft	21,500
	.019" thick (.280 lb/sq ft)	sq ft	26,900
	.032" thick (.451 lb/sq ft)	sq ft	43,300
	.040" thick (.563 lb/sq ft)	sq ft	54,000
	.050" thick (.718 lb/sq ft)	sq ft	68,900
	Copper Flashing	lb	63,000
	10 oz (.625 lb/sq ft)	sq ft	39,400
	16 oz (1.00 lb/sq ft)	sq ft	63,000
	20 oz (1.25 lb/sq ft)	sq ft	78,800
	24 oz (1.50 lb/sq ft)	sq ft	94,500
	32 oz (2.00 lb/sq ft)	sq ft	126,000
	Stainless Steel Flashing	lb	80,800
	30 gauge, .0125" thick (.526 lb/sq ft)	sq ft	42,500
	28 gauge, .0156" thick (.656 lb/sq ft)	sq ft	53,000
	26 gauge, .0188" thick (.788 lb/sq ft)	sq ft	63,700
	24 gauge, .0250" thick (1.05 lb/sq ft)	sq ft	84,800
	22 gauge, .0313" thick (1.31 lb/sq ft)	sq ft	106,000

7.6 FLASHING (continued)	Unit	Btu/Unit at Jobsite
Stainless Steel Flashing (continued)	lb	80,800
20 gauge, .0375" thick (1.58 lb/sq ft)	sq ft	128,000
18 gauge, .0500" thick (2.10 lb/sq ft)	sq ft	170,000
16 gauge, .0625" thick (2.63 lb/sq ft)	sq ft	213,000
14 gauge, .0781" thick (3.28 lb/sq ft)	sq ft	265,000
Galvanized Steel Flashing	lb	27,800
30 gauge, .016" thick (.656 lb/sq ft)	sq ft	18,200
28 gauge, .019" thick (.781 lb/sq ft)	sq ft	21,700
26 gauge, .022" thick (.906 lb/sq ft)	sq ft	25,000
24 gauge, .028" thick (1.16 lb/sq ft)	sq ft	32,200
22 gauge, .034" thick (1.41 lb/sq ft)	sq ft	39,200
20 gauge, .040" thick (1.66 lb/sq ft)	sq ft	46,100
18 gauge, .052" thick (2.16 lb/sq ft)	sq ft	60,000
16 gauge, .064" thick (2.66 lb/sq ft)	sq ft	73,900
14 gauge, .080" thick (3.28 lb/sq ft)	sq ft	91,200

SECTION 8 - DOORS AND WINDOWS

8.1 METAL DOORS	Unit	Btu/Unit at Jobsite
8.1.1 Flush Hollow Metal Doors (20 gauge with 22 gauge stiffeners)		
2'-0" x 6'-8"	ea	1,750,000
2'-6" x 6'-8"	ea	2,190,000
2'-8" x 6'-8"	ea	2,290,000
3'-0" x 6'-8"	ea	2,630,000
3'-4" x 6'-8"	ea	2,960,000
3'-6" x 6'-8"	ea	3,070,000
8.1.2 Flush Hollow Metal Doors (18 gauge with 22 gauge stiffeners)		
2'-0" x 6'-8"	ea	2,120,000
2'-6" x 6'-8"	ea	2,650,000
2'-8" x 6'-8"	ea	2,790,000
3'-0" x 6'-8"	ea	3,190,000
3'-4" x 6'-8"	ea	3,580,000
3'-6" x 6'-8"	ea	3,720,000
8.1.3 Flush Hollow Metal Doors (16 gauge with 22 gauge stiffeners)		
2'-0" x 6'-8"	ea	2,490,000
2'-6" x 6'-8"	ea	3,120,000
2'-8" x 6'-8"	ea	3,280,000
3'-0" x 6'-8"	ea	3,740,000
3'-4" x 6'-8"	ea	4,200,000

8.1	METAL DOORS (continued)	Unit	Btu/Unit at Jobsite
8.1.3	Flush Hollow Metal Doors (continued) (16 gauge with 22 gauge stiffeners)		
	3'-6" x 6'-8"	ea	4,370,000
8.2	WOOD DOORS		
8.2.1	Wood Panel Doors		
	2'-4" x 6'-8"	ea	678,000
	2'-6" x 6'-8"	ea	727,000
	2'-8" x 6'-8"	ea	800,000
	3'-0" x 6'-8"	ea	873,000
	3'-4" x 6'-8"	ea	1,230,000
8.2.2	Wood Hollow Core Doors		
	2'-4" x 6'-8"	ea	266,000
	2'-6" x 6'-8"	ea	285,000
	2'-8" x 6'-8"	ea	305,000
	3'-0" x 6'-8"	ea	347,000
	3'-4" x 6'-8"	ea	380,000
8.2.3	Wood Solid Core Doors		
	2'-4" x 6'-8"	ea	914,000
	2'-6" x 6'-8"	ea	981,000
	2'-8" x 6'-8"	ea	1,050,000
	3'-0" x 6'-8"	ea	1,190,000
	3'-4" x 6'-8"	ea	1,310,000
8.3	METAL WINDOWS		
8.3.1	Aluminum Residential Casement, Sliders, and Double Hung		
	(single glazed)		
	2'-0" x 3'-0"	ea	907,000
	3'-0" x 4'-0"	ea	1,260,000
	4'-0" x 4'-0"	ea	1,430,000
	4'-0" x 6'-0"	ea	1,910,000
	(double glazed)		
	2'-0" x 3'-0"	ea	961,000
	3'-0" x 4'-0"	ea	1,380,000
	4'-0" x 4'-0"	ea	1,610,000
	4'-6" x 4'-0"	ea	1,810,000
	4'-0" x 6'-0"	ea	2,170,000
8.3.2	Aluminum Commercial Casement, Sliders, Double Hung, and Pivot		
	(single glazed)		
	2'-0" x 3'-0"	ea	1,610,000

8.3 METAL WINDOWS (continued)	Unit	Btu/Unit at Jobsite
8.3.2 Aluminum Commercial Casement, Sliders, Double Hung, and Pivot (continued)		
(single glazed)		
3'-0" x 4'-0"	ea	2,230,000
4'-0" x 4'-0"	ea	2,570,000
4'-0" x 6'-0"	ea	3,380,000
(double glazed)		
2'-0" x 3'-0"	ea	1,660,000
3'-0" x 4'-0"	ea	2,400,000
4'-0" x 4'-0"	ea	2,740,000
4'-0" x 6'-0"	ea	3,650,000
8.3.3 Fixed Commercial Windows		
(single glazed)		
2'-0" x 3'-0"	ea	666,000
3'-0" x 4'-0"	ea	980,000
4'-0" x 4'-0"	ea	1,150,000
4'-0" x 6'-0"	ea	1,149,000
(double glazed)		
2'-0" x 3'-0"	ea	733,000
3'-0" x 4'-0"	ea	1,120,000
4'-0" x 4'-0"	ea	1,340,000
4'-0" x 6'-0"	ea	1,790,000
8.4 WOOD WINDOWS		
8.4.1 Wood Casement, Double Hung or Sliders		
(single glazed)		
2'-0" x 3'-0"	ea	866,000
3'-0" x 4'-0"	ea	1,030,000
4'-0" x 4'-0"	ea	1,120,000
4'-0" x 6'-0"	ea	1,340,000
(double glazed)		
2'-0" x 3'-0"	ea	925,000
3'-0" x 4'-0"	ea	1,170,000
4'-0" x 4'-0"	ea	1,350,000
4'-0" x 6'-0"	ea	1,630,000
8.5 GLAZING		
8.5.1 Sheet Glass		
Single Strength - 3/32" thick	sq ft	13,700
Double Strength - 1/8" thick	sq ft	15,400

8.5	GLAZING (continued)	Unit	Btu/Unit at Jobsite
8.5.2	Plate and Float Glass		
	1/8" thick	sq ft	37,500
	1/4" thick	sq ft	48,000
8.5.3	Tempered Glass	sq ft	72,600
8.5.4	Laminated Glass		
	Laminated Sheet Glass	sq ft	113,000
	Laminated Plate Glass	sq ft	213,000
8.6	HARDWARE (General Allowance - Btu/sq ft by Building Type)		

Sector no.	Building type	Low	Average	High
23	Residential, one family	1,500	4,600	5,800
24	Residential, two-four family	1,400	4,400	5,600
25	Residential, garden apartments	3,200	4,900	6,400
26	Residential, high-rise Apartments	3,300	3,600	3,700
27	Residential, alterations and additions	.0070*	.0090*	.0100*
28	Hotels and motels	11,000	12,000	13,000
29	Dormitories	15,000	16,000	17,000
30	Industrial buildings	1,700	2,200	10,000
31	Office buildings	9,400	12,000	17,000
32	Warehouses	1,300	1,600	1,700
33	Garages and service stations	1,800	2,300	2,600
34	Stores and restaurants	1,500	2,600	3,500
35	Religious buildings	7,400	10,000	11,500
36	Educational buildings	9,600	16,000	23,000
37	Hospital buildings	23,000	24,000	26,000
38	Other non-farm buildings	8,000	11,000	12,000
48	Farm residences	1,200	3,800	5,400
49	Farm service buildings	300	600	12,000

*Use this factor to determine allowance for entire project - multiply energy estimate subtotal by factor and add result to subtotal.

SECTION 9 - FINISHES

9.1	LATH, PLASTER AND DRYWALL	Unit	Btu/Unit at Jobsite
9.1.1	Expanded Metal Lath	sq yd	52,100
9.1.2	Steel Studs	lb	18,700
	25 Gauge:		
	1 5/8" stud (.28 lb/lin ft)	lin ft	5,240
	2 1/2" stud (.32 lb/lin ft)	lin ft	5,980
	3 5/8" stud (.39 lb/lin ft)	lin ft	7,290
	4" stud (.42 lb/lin ft)	lin ft	7,850
	6" stud (.55 lb/lin ft)	lin ft	10,300

9.1	LATH, PLASTER AND DRYWALL (continued)	Unit	Btu/Unit at Jobsite
9.1.2	Steel Studs (continued)		
	20 Gauge:		
	2 1/2" stud (.53 lb/lin ft)	lin ft	9,910
	3 5/8" stud (.67 lb/lin ft)	lin ft	12,500
	4" stud (.71 lb/lin ft)	lin ft	13,300
	6" stud (.94 lb/lin ft)	lin ft	17,600
9.1.3	Wood Studs	bd ft	7,600
	2 x 3 (1/2 bd ft/lin ft)	lin ft	3,810
	2 x 4 (2/3 bd ft/lin ft)	lin ft	5,070
	2 x 6 (1 bd ft/lin ft)	lin ft	7,610
9.1.4	Gypsum Plasterboard	lb	3,490
	1/2" thick (2 lb/sq ft)	sq ft	6,980
	3/8" thick (1.52 lb/sq ft)	sq ft	5,300
	5/8" thick (2.5 lb/sq ft)	sq ft	8,730
9.1.5	Partition Walls		
	2 x 3 wood studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	17,000
	2 x 4 wood studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	18,200
	2 x 6 wood studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	20,300
	2 1/2" 25 ga metal studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	18,900
	3 5/8" 25 ga metal studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	20,000
	4" 25 ga metal studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	20,300
	2 1/2" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	25,700
	3 5/8" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	27,800
	4" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	28,500
	6" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	32,100

9.2	TILE WORK	Unit	Btu/ Unit at Jobsite
9.2.1	Glazed Ceramic Tile	sq ft	68,700
9.2.2	Unglazed Ceramic Tile	sq ft	63,600
9.2.3	Quarry Tile	sq ft	51,100
9.3	FLOORING		
9.3.1	Vinyl Resilient Tile	lb	50,000
	.050" thick (.40 lb/sq ft)	sq ft	20,000
	.093" thick (.75 lb/sq ft)	sq ft	37,500
	.125" thick (1.00 lb/sq ft)	sq ft	50,000
9.3.2	Hardwood Flooring	bd ft	14,300
	25/32" thick (2/3 bd ft/sq ft)	sq ft	9,530
9.3.3	Softwood Flooring	bd ft	10,300
	3/4" thick (3/4 bd ft/sq ft)	sq ft	7,730
9.3.4	Asphalt Floor Tile	sq ft	13,000
9.3.5	Vinyl Asbestos Floor Tile	sq ft	15,700
9.4	PAINTING		
9.4.1	Exterior Oil-Base Paint	gal	488,000
	Exterior oil-base paint on wood walls or masonry (350 sq ft/gal per coat)	sq ft	1,390
	Exterior oil-base paint on exterior trim (525 sq ft/gal per coat)	sq ft	929
9.4.2	Exterior Water-Base Paint	gal	489,000
	Exterior water-base paint on exterior wood walls or masonry (350 sq ft/gal per coat)	sq ft	1,400
	Exterior water-base paint on exterior trim (525 sq ft/gal per coat)	sq ft	931
9.4.3	Interior Oil-Base Paint	gal	509,000
	Interior oil-base paint on interior walls masonry, trim (475 sq ft/gal per coat)	sq ft	1,070
9.4.4	Interior Water-Base Paint	gal	437,000
	Interior water-base paint on interior walls masonry, trim (475 sq ft/gal per coat)	sq ft	920

SECTION 10 - SPECIALTIES
SECTION 11 - EQUIPMENT, CABINETS AND BUILT-IN FURNISHINGS

11.1 GENERAL ALLOWANCE - Btu/sq ft by Building Type

Sector no.	Building type	Low	Average	High
23	Residential, one family	9,000	27,000	34,000
24	Residential, two-four family	8,000	25,000	32,000
25	Residential, garden apartments	18,000	28,000	34,000
26	Residential, high-rise apartments	22,000	24,000	25,000
27	Residential, alterations and additions	.0750*	.0920*	.1000*
28	Hotels and motels	14,000	15,000	16,000
29	Dormitories	15,000	16,000	17,000
30	Industrial buildings	2,600	3,200	15,000
31	Office buildings	7,700	9,700	14,000
32	Warehouses	2,000	2,400	2,500
33	Garages and service stations	2,100	2,700	3,000
34	Stores and restaurants	6,500	11,000	15,000
35	Religious buildings	16,000	18,000	21,000
36	Educational buildings	12,000	20,000	28,000
37	Hospital buildings	31,000	32,000	38,000
38	Other non-farm buildings	22,000	24,000	34,000
48	Farm residences	9,000	27,000	34,000
49	Farm service buildings	900	1,300	1,500

*Use this factor to determine allowance for entire project - multiply energy estimate subtotal by factor and add result to subtotal.

11.2 KITCHEN APPLIANCES

11.2.1 Electric Ranges

Free Standing:		
23" to 32" wide	ea	10,600,000
33" wide and over	ea	11,800,000
Built-in:		
Single oven	ea	8,140,000
Twin oven	ea	18,200,000
Surface cooking tops	ea	4,120,000
Drop-in ranges	ea	10,100,000

11.2.2 Gas Ranges

Free Standing:		
24" to 32" wide	ea	8,210,000
33" wide and over	ea	8,730,000
Built-in (all types)	ea	8,680,000
Surface cooking tops	ea	3,260,000

11.2.3 Refrigerators/Freezers

6.5 to 9.4 cubic feet	ea	7,930,000
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11.2	KITCHEN APPLIANCES (continued)	Unit	Btu/Unit at Jobsite
11.2.3	Refrigerators/Freezers (continued)		
	9.4 to 13.4 cubic feet	ea	9,440,000
	13.5 to 17.4 cubice feet	ea	13,600,000
	17.5 to 19.4 cubic feet	ea	18,900,000
11.2.4	Laundry Equipment		
	Washing Machines (all types)	ea	10,700,000
	Dryers:		
	Electric	ea	8,810,000
	Gas	ea	7,650,000

SECTION 14 - CONVEYING SYSTEMS

14.1 GENERAL ALLOWANCE - Btu/sq ft by Building Type

Sector no.	Building type	Low	Average	High
23	Residential, one family	-----	-----	-----
24	Residential, two-four family	-----	-----	-----
25	Residential, garden apartments	-----	-----	-----
26	Residential, high-rise apartments	6,400	7,000	7,400
27	Residential, alterations and additions	-----	-----	-----
28	Hotels and motels	3,500	6,300	6,700
29	Dormitories	5,400	6,600	7,100
30	Industrial buildings	500	1,100	4,000
31	Office buildings	21,000	23,000	32,000
32	Warehouses	450	900	3,100
33	Garages and service stations	1,000	1,200	1,500
34	Stores and restaurants	2,100	2,500	3,200
35	Religious buildings	-----	-----	-----
36	Educational buildings	1,700	2,000	2,600
37	Hospital buildings	29,000	31,000	34,000
38	Other non-farm buildings	6,500	7,000	7,900
48	Farm residences	-----	-----	-----
49	Farm service buildings	-----	-----	-----

SECTION 15 - MECHANICAL EQUIPMENT

15.1 PLUMBING (General Allowance - Btu/sq ft by Building Type)

Sector no.	Building type	Low	Average	High
23	Residential, one family	26,000	29,000	45,000
24	Residential, two-four family	26,000	29,000	45,000
25	Residential, garden apartments	18,000	27,000	39,000
26	Residential, high-rise apartments	23,000	26,000	28,000
27	Residential, alterations and additions	.1000*	.1230*	.1300*
28	Hotels and motels	37,000	38,000	42,000
29	Dormitories	36,000	38,000	43,000
30	Industrial buildings	23,000	26,000	34,000

15.1 MECHANICAL EQUIPMENT (General Allowance -Btu/sq ft by Building Type continued)

Sector no.	Building type	Low	Average	High
31	Office buildings	21,000	24,000	25,000
32	Warehouses	12,000	14,000	16,000
33	Garages and service stations	13,000	16,000	19,000
34	Stores and restaurants	13,000	19,000	21,000
35	Religious buildings	17,000	21,000	24,000
36	Educational buildings	28,000	37,000	43,000
37	Hospital buildings	61,000	69,000	75,000
38	Other non-farm buildings	38,000	44,000	47,000
48	Farm residences	26,000	29,000	45,000
49	Farm service buildings	1,500	1,900	2,400

*Use this factor to determine allowance for entire project - multiply energy estimate subtotal by factor and add result to subtotal.

15.2 PIPE AND FITTINGS

	Unit	Btu/Unit at Jobsite
15.2.1 Cast Iron Pipe (50 psi)	lb	7,450
4" diameter (19 lb/lin ft)	lin ft	142,000
6" diameter (30 lb/lin ft)	lin ft	234,000
8" diameter (42 lb/lin ft)	lin ft	313,000
10" diameter (52 lb/lin ft)	lin ft	387,000
12" diameter (73 lb/lin ft)	lin ft	544,000
14" diameter (85 lb/lin ft)	lin ft	633,000
16" diameter (105 lb/lin ft)	lin ft	782,000
18" diameter (128 lb/lin ft)	lin ft	954,000
20" diameter (140 lb/lin ft)	lin ft	1,100,000
24" diameter (198 lb/lin ft)	lin ft	1,480,000
15.2.2 Copper Pipe	lb	73,100
1/4" diameter (.500 lb/lin ft)	lin ft	36,600
3/8" diameter (.750 lb/lin ft)	lin ft	54,800
1/2" diameter (.980 lb/lin ft)	lin ft	71,600
5/8" diameter (1.220 lb/lin ft)	lin ft	89,200
3/4" diameter (1.308 lb/lin ft)	lin ft	95,600
1" diameter (1.944 lb/lin ft)	lin ft	142,000
1 1/4" diameter (2.630 lb/lin ft)	lin ft	192,000
1 1/2" diameter (3.130 lb/lin ft)	lin ft	229,000
2" diameter (3.930 lb/lin ft)	lin ft	287,000
2 1/2" diameter (4.900 lb/lin ft)	lin ft	358,000
3" diameter (7.900 lb/lin ft)	lin ft	577,000
15.2.3 Plastic Pipe (200 psi)	lb	46,600
1 1/2" diameter (.340 lb/lin ft)	lin ft	15,800
2" diameter (.530 lb/lin ft)	lin ft	24,700
2 1/2" diameter (.780 lb/lin ft)	lin ft	36,300
3" diameter (1.16 lb/lin ft)	lin ft	54,100
4" diameter (1.91 lb/lin ft)	lin ft	89,000
5" diameter (2.93 lb/lin ft)	lin ft	137,000
6" diameter (4.61 lb/lin ft)	lin ft	215,000
8" diameter (7.05 lb/lin ft)	lin ft	329,000

15.2	PIPE AND FITTINGS (continued)	Unit	Btu/Unit at Jobsite
15.2.3	Plastic Pipe (200 psi) (continued)	lb	46,600
	10" diameter (10.02 lb/lin ft)	lin ft	467,000
	12" diameter (15.55 lb/lin ft)	lin ft	725,000
15.2.4	Steel Pipe (Standard Weight)	lb	25,800
	1/2" diameter (.85 lb/lin ft)	lin ft	21,300
	3/4" diameter (1.13 lb/lin ft)	lin ft	29,200
	1" diameter (1.68 lb/lin ft)	lin ft	43,300
	1 1/4" diameter (2.27 lb/lin ft)	lin ft	58,600
	1 1/2" diameter (2.72 lb/lin ft)	lin ft	70,200
	2" diameter (3.65 lb/lin ft)	lin ft	94,200
	3" diameter (7.58 lb/lin ft)	lin ft	196,000
	4" diameter (10.79 lb/lin ft)	lin ft	278,000
	5" diameter (14.62 lb/lin ft)	lin ft	377,000
	6" diameter (18.79 lb/lin ft)	lin ft	485,000
	8" diameter (28.55 lb/lin ft)	lin ft	737,000
	10" diameter (40.48 lb/lin ft)	lin ft	1,040,000
	12" diameter (49.56 lb/lin ft)	lin ft	1,280,000
15.2.5	Bath and Shower Fittings		
	Combination bath and shower fittings (including single control faucets)	ea	1,000,000
	Shower fittings (with shower head)	ea	679,000
	Bath drains and overflows	ea	517,000
15.2.6	Lavatory Fittings (including single control faucets)	ea	792,000
15.2.7	Sink Fittings (including single control faucets)	ea	787,000
15.3	PLUMBING FIXTURES ⁷		
15.3.1	Bathtubs		
	Cast iron (3'-0" x 5'-0")	ea	6,020,000
	Steel (3'-0" x 5'-0")	ea	3,030,000
15.3.2	Drinking Fountains (all types)	ea	3,940,000
15.3.3	Lavatories		
	Cast Iron	ea	1,350,000
	Steel	ea	671,000
	Vitreous	ea	1,210,000
15.3.4	Sink and Laundry Tray Combinations (all types)	ea	3,230,000
15.3.5	Showerstalls (all types, including fittings)	ea	5,530,000

15.3	PLUMBING FIXTURES (continued)	Unit	Btu/Unit at Jobsite	
15.3.6	Kitchen Sinks			
	Steel porcelain enameled	ea	1,190,000	
	Stainless steel	ea	2,280,000	
15.3.7	Urinals (all types)	ea	3,960,000	
15.3.8	Water Closets			
	Wall hung one-piece	ea	1,280,000	
	Two-piece (with flush tank)	ea	2,330,000	
15.4	PLUMBING APPLIANCES			
15.4.1	Residential Electric Water Heaters			
	Storage type for permanent installation (average)	ea	3,680,000	
15.4.2	Residential Gas-Fired Water Heaters			
	Underfired Storage and sidearm types (average)	ea	3,650,000	
15.4.3	Residential Oil-Fired Water Heaters			
	Underfired storage and sidearm (average)	ea	13,100,000	
	Indirect water heaters (average)	ea	8,680,000	
15.5	HVAC (General Allowance - Btu/sq ft by Building Type)			
Sector no.	Building type	Low	Average	High
23	Residential, one family	49,000	50,000	54,000
24	Residential, two-four family	49,000	50,000	54,000
25	Residential, garden apartments	49,000	56,000	54,000
26	Residential, high-rise apartments	39,000	43,000	71,000
27	Residential, alterations and additions	.1000*	.1110*	.1200*
28	Hotels and motels	64,000	73,000	82,000
29	Dormitories	73,000	88,000	98,000
30	Industrial buildings	46,000	68,000	86,000
31	Office buildings	102,000	126,000	137,000
32	Warehouses	24,000	29,000	32,000
33	Garages and service stations	48,000	56,000	63,000
34	Stores and restaurants	84,000	84,000	101,000
35	Religious buildings	80,000	82,000	82,000
36	Educational buildings	108,000	132,000	148,000
37	Hospital buildings	138,000	173,000	190,000
38	Other non-farm buildings	77,000	90,000	99,000
48	Farm residences	49,000	50,000	54,000
49	Farm service buildings	3,100	3,700	4,200

* Use this factor to determine allowance for entire project - multiply energy estimate subtotal by factor and add result to subtotal.

15.6 HEATING	Unit	Btu/Unit at Jobsite
15.6.1 Oil Burners		
Residential Atomizing (average)	ea	4,350,000
Residential draft vaporizing and rotary (average)	ea	4,960,000
Industrial low-pressure atomizing (average)	ea	56,600,000
Industrial high-pressure atomizing (average)	ea	35,200,000
Industrial rotary atomizing (average)	ea	114,000,000
15.6.2 Gas Burners		
Gas conversion burners (average)	ea	8,690,000
15.6.3 Boilers		
Residential cast iron	ea	36,100,000
Steel - 294 sq ft of heating surface or less	ea	37,900,000
Steel - 294 sq ft of heating surface, horizontal firebox type	ea	338,000,000
Steel - over 294 sq ft of heating surface, scotch type	ea	177,000,000
15.6.3 Warm Air Furnaces - Forced Air Type		
Solid Fuel:		
150,000 Btu Bonnet and under	ea	23,900,000
Over 150,000 Btu Bonnet output	ea	85,200,000
Oil:		
150,000 Btu Bonnet output and under	ea	16,700,000
Over 150,000 Btu Bonnet output	ea	35,200,000
Gas:		
150,000 Btu Bonnet output and under	ea	11,000,000
Over 150,000 Btu Bonnet output	ea	52,200,000
15.6.4 Warm Air Furnaces - Gravity Flow Type		
Solid Fuel (average)	ea	13,800,000
Gas (average)	ea	38,600,000
15.6.5 Radiators and Convectors		
Cast iron - all types	sq ft	70,000
Residential aluminum, including baseboard and finned tube types	sq ft	38,200
Industrial and special types of aluminum	sq ft	46,900

15.6 HEATING (continued) Unit Btu/Unit at Jobsite

15.6.6 Domestic Heating Stoves

Gas:		
Vented Circulators	ea	5,760,000
Unvented Circulators	ea	1,910,000
Radiants	ea	1,750,000
Wood (sheet-metal air-tight types)		
	ea	358,000
Coal and Wood:		
Circulators (standard and magazine types)	ea	6,930,000
Magazine radiants	ea	2,950,000
Kerosene, Gasoline and Fuel Oil:		
Flue connected circulators and radiant circulators	ea	5,140,000

SECTION 16 - ELECTRICAL

16.1 ELECTRICAL (General Allowance - Btu/Unit by Building Type)

Sector no.	Building type	Low	Average	High
23	Residential, one family	17,000	20,000	26,000
24	Residential, two-four family	21,000	24,000	32,000
25	Residential, garden apartments	22,000	27,000	36,000
26	Residential, high-rise apartments	25,000	26,000	27,000
27	Residential, alterations and additions	.2500*	.2660*	.2750*
28	Hotels and motels	38,000	48,000	54,000
29	Dormitories	52,000	56,000	63,000
30	Industrial buildings	48,000	62,000	69,000
31	Office buildings	100,000	110,000	134,000
32	Warehouses	27,000	33,000	38,000
33	Garages and service stations	21,000	22,000	25,000
34	Stores and restaurants	36,000	41,000	46,000
35	Religious buildings	33,000	35,000	41,000
36	Educational buildings	102,000	120,000	131,000
37	Hospital buildings	120,000	144,000	156,000
38	Other non-farm buildings	75,000	88,000	92,000
48	Farm residences	17,000	20,000	26,000
49	Farm service buildings	8,500	9,100	9,600

*Use this factor to determine allowance for entire project - multiply energy estimate subtotal by factor and add result to subtotal.

16.2 CONDUCTORS

16.2.2 Copper Stranded Wire (bare wire weight does not include insulation)

	lb	55,500
No. 18 (.0050 lb/lin ft)	lin ft	278
No. 16 (.0077 lb/lin ft)	lin ft	427
No. 14 (.0124 lb/lin ft)	lin ft	688
No. 12 (.0197 lb/lin ft)	lin ft	1,090

16.2	CONDUCTORS (continued)	Unit	Btu/Unit at Jobsite
16.2.2	Copper Stranded Wire (continued)		
	No. 10 (.0313 lb/lin ft)	lin ft	1,740
	No. 8 (.0502 lb/lin ft)	lin ft	2,790
	No. 6 (.1034 lb/lin ft)	lin ft	5,790
	No. 4 (.1622 lb/lin ft)	lin ft	9,000
	No. 2 (.2586 lb/lin ft)	lin ft	14,400
	No. 1 (.3360 lb/lin ft)	lin ft	18,600
16.2.3	Aluminum Stranded Wire (bare wire weight/lin ft, does not include insulation)	lb	96,400
	No. 18 (.0014 lb/lin ft)	lin ft	135
	No. 16 (.0023 lb/lin ft)	lin ft	222
	No. 14 (.0036 lb/lin ft)	lin ft	350
	No. 12 (.0058 lb/lin ft)	lin ft	560
	No. 10 (.0093 lb/lin ft)	lin ft	895
	No. 8 (.0149 lb/lin ft)	lin ft	1,440
	No. 6 (.0209 lb/lin ft)	lin ft	2,980
	No. 4 (.0481 lb/lin ft)	lin ft	4,630
	No. 2 (.0767 lb/lin ft)	lin ft	7,400
	No. 1 (.0997 lb/lin ft)	lin ft	9,610

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Chapter 7

Energy in Typical Building Assemblies

Chapter 7 provides a series of examples describing how the data in Chapter 6 may be used for making comparative analyses of alternative building systems. Chapter 7 also contains a sample energy cost estimate of a 2,730 square foot, two-family house.

In the comparative examples, the assemblies examined are similar in performance. The analysis indicates that different approaches which achieve similar results may have markedly different energy requirements.

The first example compares three exterior wall systems typically used in small scale residential construction (Figures 7.1, 7.2, and 7.3). All use wood frame construction. One has brick veneer, one has wood shingle siding, and the

third has aluminum siding. The thermal properties of the three walls are similar ($U=.24$ for the brick, $U=.25$ for the wood shingle and $U=.31$ for the aluminum siding) but the energy required for construction varies by a factor of almost 6. When insulation is added to the three wall systems, the impact of the different siding systems on the thermal performance becomes negligible but the energy required for construction still varies by a factor of almost 5. This is primarily a reflection of the fact that difference in embodied energy between the wood shingles and the brick veneer is approximately 120,000 Btu per square foot. A 20 x 40 two story frame house will have about 2,300 square feet of exterior wall surface. The added energy cost for brick veneer on that surface is approximately 284 million Btu or the equivalent of about 2,000 gallons of oil.

Figure 7.1 Brick on Wood Frame Walls

Construction	R Value	R Value at frame	Embodied energy in bldg section (Btu/sq ft)
1. Outside surface (15 mph wind)	.17	.17	—
2. Brick and masonry (4")	.44	.44	131,000
3. 1" Airspace	.97	.97	—
4. Building paper (2 ply)	.15	.15	1,050
5. Plywood (3/8")	.47	.47	5,790
6. 4" airspace	.97	.97	—
7. 2 x 4 at 16 o.c.	—	4.35	2,080
8. Gypsum wallboard (5/8")	.32	.32	5,300
9. Inside surface (still air)	.68	.68	—
Total	3.98	7.55	145,220

$U=1/R=.24$ $U=.13$ at framing
Adjusted U (to account for framing)=.24

Addition of Insulation	R Value	Embodied energy in bldg section (Btu/sq ft)
Add 3 1/2" batt insulation	11.00	Add 6,860
Deduct R value of airspace	.97	
	10.03	
Add to above R value	3.98	
Total	14.01	152,080

$U=1/R=.07$ $U=.13$ at framing
Adjusted U (to account for framing)=.076

Figure 7.2 Wood Frame Walls

Construction	R Value	R Value at frame	Embodied energy in bldg section (Btu/sq ft)
1. Outside surface (15 mph wind)	.17	.17	----
2. Wood shingles (1/2" x 8" lapped)	.87	.87	7,320
3. Building paper (2 ply)	.15	.15	1,050
4. Plywood (1/2")	.62	.62	7,710
5. 4" airspace	.97	----	----
6. 2 x 4" at 16" o.c.	----	4.35	2,080
7. Gypsum wall board (1/2")	.45	.45	6,980
8. Inside surface (still air)	.68	.68	----
Total	3.91	7.29	25,140

$U=1/R=.26$ $U=.14$ at framing
Adjusted U (to account for framing)=.25

Addition of Insulation	R Value	Embodied energy in bldg section (Btu/sq ft)
Add 3 1/2" batt insulation	11.00	Add 6,860
Deduct R value of airspace	.97	
	10.03	
Add to above R value	3.91	
Total	13.79	32,000

$U=1/R=.07$ $U=.14$ at framing
Adjusted U (to account for framing)=.077

Figure 7.3 Aluminum Siding on Wood Frame Walls

Construction	R Value	R Value at frame	Embodied energy in bldg section (Btu/sq ft)
1. Outside surface (15 mph wind)	.17	.17	----
2. Aluminum siding	*	*	53,400
3. Building paper (2 ply)	.15	.15	1,050
4. Plywood (1/2")	.62	.62	7,710
5. 4" Airspace	.97	----	----
6. 2 x 4 at 16" o.c.	----	4.35	2,080
7. Gypsum wallboard (1/2")	.45	.45	6,980
8. Inside surface (still air)	.68	.68	----
Total	3.04	6.42	71,220

$U=1/R=.33$ $U=.16$ at framing
Adjusted U (to account for framing)=.31

Addition of Insulation	R Value	Embodied energy in bldg section (Btu/sq ft)
Add 3 1/2" batt insulation	11.00	Add 6,860
Deduct R value of airspace	.97	
	10.03	
Add to above R value	3.09	
Total	13.08	78,080

$U=1/R=.08$ $U=.16$ at framing
Adjusted U (to account for framing)=.087

* R value negligible

Thus, the decision regarding the exterior facing of a small residential building may have an impact equal to several years of the total heating requirement of that building.

The energy required for maintaining the wood siding will

be greater than that for brick. However, even when capital energy is added to the wood system in the form of periodic paint and replacement shingling, the total energy embodied in the wood facing system will still be less than in the brick after 30 years. (See Chapter 8)

A second comparative study looks at three structural floor framing systems typical of fireproof commercial construction. (Figures 7.4, 7.5, and 7.6). These are: a reinforced concrete waffle slab, a composite steel frame and concrete deck systems, and a steel frame construction with corrugated steel decking and concrete fill. The steel framing, the most energy intensive system requires 65 percent more energy than does the least energy intensive system. The difference is 111,000 Btu per square foot of floor construction. Energy efficient office buildings are designed

to keep an on-site energy use to about 50,000 Btu per square foot per year which translates to a source energy use of approximately 100,000 Btu per square foot per year. It can be seen that the choice of floor systems alone can have an energy impact greater than one year's total building operating cost. It should be noted that the dollar costs of the three systems are competitive. The decision to use one system rather than another is generally based on scheduling advantages, availability of materials, labor conditions, special skills of the builder, or other concerns that may be un-

Figure 7.4 Reinforced Concrete System - Typical Floor Bay

Figure 7.6 Standard Steel System - Typical Floor Bay

Material	Size	Quantity	Weight/unit	Total weight (30 x 30 bay)	Embodied energy Btu/unit	Total embodied energy (Btu)
A. Filler beam	W 18 x L5	90 ft	45 lb/ft	4,050 lb	27,000 Btu/lb	91,900,000
B. Girder	W 24 x 76	30 ft	76 lb/ft	2,280 lb	22,700 Btu/lb	51,800,000
C. Steel deck	20 guage	900 sq ft	2.51 lb/sq ft	1,935 lb	27,800 Btu/lb	53,800,000
D. Temp reinforcing	6 x 6-8/8	900 sq ft	.30 lf/sq ft	270 lb	24,200 Btu/lb	6,530,000
E. Concrete deck	4" thick	900 sq ft	.33 ft ² /ft ³	300 cu ft	96,100 Btu/lb	28,800,000
F. Girder angles	3½"x5/16"x10"	4	6.0 lb ea	24 lb	22,700 Btu/lb	545,000
G. Filler angles	3½"x5/16"x7"	12	4.2 lb ea	50.4 lb	22,700 Btu/lb	1,140,000
H. Bolts	¾" H.S.	36	.55 lb ea	19.8 lb	26,600 Btu/lb	527,000
I. Channels	1½"x3/4"x1/8"	210 ft	1.20 lb/ft	252 lb	22,700 Btu/lb	5,720,000
J. Runners	3/4"x3/4"x3/32"	480 ft	.72 lb/ft	346 lb	22,700 Btu/lb	7,850,000
K. Wirehangers	1/4" diameter	98 ft	.17 lb/ft	16.6 lb	34,400 Btu/lb	571,000
L. Gypsum board	½" thick	900 sq ft	2.0 lb/ft	1,800 lb	3,490 Btu/lb	6,280,000
Total						255,000,000
divided by 900=						283,000 Btu/sq ft

a 2,730 square foot, two family wood frame detached house. The construction is typical of similar such buildings with two exceptions. The entire building has been laid out on a 4 x 8 foot module, permitting the use of sheet materials (plywood and gypsum board) with a minimum of waste. Also, the exterior framing uses 2 inch x 6 inch members 24 inches on center rather than the more typical 2 inch x 4

inch members, 16 inches on center. This construction provides a 5½ inch space in the exterior wall which permits the use of heavier than normal insulation. The building shows an energy requirement of 465,000 Btu per square foot for construction. This may be compared with the national average of 636,000 Btu per square foot for two-four family residential construction.

Figure 7.7 Brick Veneer Building Skin

	Unit	Quantity	Btu/unit	Total Btu
A. Exterior panel consisting of:				
1. Common brick with mortar	sq ft	25.0	131,000	3,280,000
2. Rigid insulation 2" thick	sq ft	25.0	30,600	765,000
B. Exterior panel support consisting of:				
1. Shelf angle 5" x 5" 5/16" (10.3 lb/lin. ft)	lin ft	4.0	234,000	936,000
2. Masonry wall ties 16" c. to c. vertically, 24" o.c. (.20 lb ea)	ea	12.0	4,540	54,500
C. Window				
Double glazed aluminum pivot window 4'-0" x 4'-6"	ea	1.0	1,810,000	1,810,000
D. Interior back-up wall consisting of:				
Concrete block (6" x 8" x 16" units) with mortar	sq ft	13.3	39,100	520,000
Total				7,370,000
		divided by 44 sq ft=		168,000 Btu/sq ft

Figure 7.8 Aluminum Panel Building Skir

	Unit	Quantity	Btu/unit	Total Btu
A. Exterior panel consisting of:				
1. .040" Aluminum (.563 lb/sq ft)	sq ft	25.0	65,300	1,630,000
2. Rigid insulation 2" thick	sq ft	25.0	30,600	765,000
3. 1/4" Plywood backing	sq ft	25.0	3,860	96,500
B. Exterior panel support consisting of:				
1. Steel tee 4'-0" o.c. (WT2 x 6.5)	lin ft	6.5	148,000	962,000
2. (2) 2" x 2" Steel angles, top and bottom of panel, (2.44 lb/ lin ft)	lin ft	16.0	55,400	886,000
C. Window				
Double glazed aluminum pivot window 4'-0" x 4'-6"	ea	1.0	1,810,000	1,810,000
D. Interior back-up wall consisting of:				
Concrete block (6" x 8" x 16" units) with mortar	sq ft	13.3	39,100	520,000
Total			divided by 44 sq ft=	6,670,000 152,000 Btu/sq ft

Figure 7.9 Concrete Panel Building Skin

	Unit	Quantity	Btu/unit	Total Btu
A. Exterior panel consisting of:				
1. 4" thick overall precast concrete panel	cu ft	5.5	318,000	1,750,000
2. 2" thick rigid insulation set in panel	sq ft	20.0	30,600	612,000
B. Exterior panel support consisting of:				
1. Steel clip angle 6" x 6" x 1/2" 6" long, 4'-0" o.c. (10 lb ea)	ea	1.0	227,000	227,000
2. 1/2" x 4" anchor bolt (.5 lb ea)	ea	1.0	13,200	13,200
3. 2" x 2" steel angles, 6" long, 4'-0" o.c. (2.4 lb ea)	ea	2.0	55,500	111,000
C. Window				
Double glazed aluminum pivot window 4'-0" x 4'-6"	ea	1.0	1,810,000	1,810,000
D. Interior back-up wall consisting of:				
Concrete block (6" x 8" x 16" units) with mortar	sq ft	13.3	39,100	520,000
Total				5,040,000
		divided by 44 sq ft =		115,000 Btu/sq ft

Figure 7.10 Glass Curtain Wall

	Unit	Quantity	Btu/unit	Total Btu
A. Exterior panel consisting of:				
1. 1/4" Tempered glass	sq ft	25.0	72,600	1,820,000
2. Rigid insulation 2" thick	sq ft	25.0	30,600	765,000
B. Exterior panel support consisting of:				
1. Aluminum mullions and rails (1.0 lb/lin ft)	lin ft	18.0	92,100	1,660,000
2. 2" x 2" Steel angles, 6" long, 4'-0" o.c., top and bottom of panel (2.4 lb ea)	ea	4.0	55,500	220,000
C. Window				
Double glazed aluminum pivot window 4'-0" x 4'-6"	ea	1.0	1,810,000	1,810,000
D. Interior back-up wall consisting of:				
Concrete block (6" x 8" x 16" units) with mortar	sq ft	13.3	39,100	520,000
Total				6,800,000
divided by 44 sq ft =				155,000
				Btu/sq ft

Figure 7.11 Floor Plans of Two Family House

Unit 2- Main Level

Unit 2-Upper Level

Unit 1-Lower Level

Unit 1-Main Level

0 5 10 15 20
feet

Figure 7.12 Elevations of Two Family House

Table 7.1 Energy Estimate for Two Family House

	Unit	Quantity	Energy per unit	Embodied energy
			Btu	
0. Direct energy	Allowance/sq ft of bldg	2,730	38,300	105,000,000
1. Overhead	Allowance/sq ft of bldg	2,730	19,600	53,500,000
2. Sitework				
Concrete sidewalk	cu yd	2	2,590,000	5,180,000
Concrete stairs	cu yd	2.5	2,390,000	6,480,000
Bituminous paving	cu yd	205	437,000	89,600,000
Reinforcing				
6 x 6 No. 10/10 wire mesh	sq ft	106	5,080	538,000
6 x 6 No. 5/5 wire mesh	sq ft	156	11,900	1,860,000
No. 4 rebar	lin ft	162	10,500	1,700,000
Clay drainage pipe	lin ft	120	77,900	9,350,000
3. Concrete				
Footings	cu yd	4	2,590,000	10,400,000
Slab	cu yd	11	2,590,000	28,500,000
Reinforcing				
10 x 10 No. 6/6 wire mesh	sq ft	864	4,370	3,780,000
4. Masonry				
4" Concrete block (including mortar)	sq ft	752	30,600	23,000,000
Reinforcing				
Truss-type, standard 8"	lin ft	376	4,530	1,700,000
3/8" diameter bars	lin ft	365	12,200	4,450,000
5. Metals - none				
6. Wood				
2 x 4 Framing	lin ft	1,500	5,080	7,620,000
2 x 6 Framing	lin ft	2,379	7,610	18,100,000
2 x 8 Framing	lin ft	2,279	10,100	28,200,000
3/4" Interior plywood	sq ft	1,944	11,600	22,600,000
5/8" Exterior plywood	sq ft	2,772	9,640	26,700,000
3/8" Exterior plywood	sq ft	1,350	5,790	7,820,000
Trim, stairs, etc.	bd ft	750	17,900	13,400,000
7. Thermal and moisture Protection				
Building paper - 2 ply	sq ft	2,772	1,050	2,910,000
Asphalt roofing felts	sq ft	1,350	13,600	18,400,000
Asphalt shingles	sq ft	1,350	29,700	40,100,000
Insulation				
3½" batt	sq ft	250	6,860	1,720,000
5½" batt	sq ft	2,424	8,800	21,800,000
7½" batt	sq ft	1,440	10,900	157,000,000
2" Rigid styrofoam	sq ft	240	30,600	7,340,000
Flashing				
.019" Aluminum	sq ft	165	26,900	4,440,000

		Unit	Quantity	Energy per unit	Embodied energy
				Btu	
8.	Doors and windows				
	Exterior wood doors (Solid core)	ea	2	1,190,000	2,380,000
	Interior wood doors (Hollow core)	ea	26	305,000	7,930,000
	Aluminum windows (Double glazed)				
	2'-0" x 3'-0"	ea	7	1,660,000	11,600,000
	3'-0" x 3'-0"	ea	2	2,030,000	4,060,000
	3'-0" x 4'-0"	ea	2	2,400,000	4,800,000
	4'-0" x 4'-0"	ea	4	2,740,000	11,000,000
	4'-0" x 6'-0"	ea	6	3,650,000	21,900,000
	Aluminum sliding door (Double glazed)				
	6'-0" x 6'-8"	ea	1	5,620,000	5,620,000
	Hardware	Allowance/sq ft of bldg	2,730	4,400	12,000,000
9.	Finishes				
	Gypsum board				
	1/2" thick	sq ft	10,300	6,980	71,900,000
	5/8" thick	sq ft	960	8,730	8,380,000
	Paint				
	Exterior oil-base	sq ft	11,260	1,390	15,700,000
	Exterior stain	sq ft	2,800	929	2,600,000
	Ceramic tile	sq ft	100	68,700	6,870,000
	3/32" Vinyl tile	sq ft	240	50,000	12,000,000
10.	Specialties - none				
11.	Equipment	Allowance/sq ft of bldg	2,730	23,400	63,900,000
12.	Furnishings - none				
13.	Special construction - none				
14.	Conveying systems - none				
15.	Mechanical equipment				
	HVAC	Allowance/sq ft of bldg	2,730	50,000	137,000,000
	Plumbing	Allowance/sq ft of bldg	2,730	29,000	79,200,000
16.	Electrical	Allowance/sq ft of bldg	2,730	24,000	65,500,000
	Total				1,270,000,000
	Gross building area				2,730 sq ft
Total (per square foot)					465,000 Btu

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Chapter 8

Energy Cost/Benefit Studies

Chapter 8 provides a basis for determining the impact on total energy requirements as a result of comparing various approaches to construction. For example, increasing the amounts of insulation in a building requires the expenditure of some energy for the installation itself in return for future savings in energy required for operation. It is desirable to know whether over the life of the building the savings in operation will exceed the added cost for installation and, if they do, how many years of operation will be required. Two examples are given. The first compares the two wood frame wall systems described in Chapter 7 but also adds to it a series of alternatives utilizing deeper wall sections and added insulation up to a total of 15½ inches thick. The second analysis compares single with double glazing.

Energy requirements for operation are highly climate dependent. This is in contrast with energy requirements for construction which, although varying according to regional availability of materials, are not fundamentally functions of temperature, solar availability, etc. Because of this, an accurate energy life cycle analysis, particularly one relating to thermal properties of a construction system, will have to be site specific.

The average annual temperature variation, which will differ with the location of the building, is expressed by "degree days." The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) estimates that when outside temperatures fall below 65 degrees F, heating system operation will be required in order to maintain 68 degrees F inside. The number of degrees below 65 degrees F of a given day's average temperature is equal to the number of heating degree days for that day. The U.S. Department of Commerce, National Oceanic and Atmospheric Administration has established annual heating and cooling degree day data for locations throughout the United States, based on a 30-year average.⁸ Since the degree day data refer to an average temperature for an entire day, heating degree days must be multiplied by 24 to arrive at "degree hours" which are compatible with the

U-factor (an hourly measure) in order to estimate the total Btu flow through a given wall or assembly in a year. This Btu flow is the energy demand on the heating system produced by the given wall or assembly.

Energy required for space heating as function of heat loss through the exterior envelope can thus be computed by the following formula:

$$\text{Annual Heat Loss (Btu)} = \text{Heating Degree Days} \times 24 \text{ (hours/day)} \times \text{U-factor (Btu/hour)}.$$

Location	Heating Degree Days	Annual Demand
Atlanta, GA (Atl)	3,095	$\times 24 = 74,280 \times U =$ Btu/sq ft
New York, NY (NYC)	4,848	$\times 24 = 116,352 \times U =$ Btu/sq ft
Champaign-Urbana, IL (Ch-Urb)	5,641	$\times 24 = 135,144 \times U =$ Btu/sq ft

The U-values for the uninsulated walls shown in Figures 7.1 and 7.2 are .25 (wood shingle) and .24 (brick veneer). The U-values for walls with 3½ inches of insulation are .077 and .076. The following table shows the annual Btu heat loss per square foot of these four wall types for the three locations cited above:

Wall Type	U-Value	Atl	NYC	Ch-Urb
A. No insulation, wood shingle	.25	18,600	29,100	33,800
B. No insulation, brick veneer	.24	17,800	27,900	32,400
C. 3½" insulation, brick	.076	5,645	8,843	10,289
D. 3½" insulation, wood	.077	5,720	8,959	10,125

In order to determine the demand for energy resulting from building heat loss, the efficiency of the system supplying the heat must be considered. Throughout this chapter an efficiency of 65 percent is used.

Using the same method shown for exterior walls in Figure 7.1 and 7.2 calculation of the thermal characteristics for a typical flat roof with either 3½ inch or 5½ inch of mineral wool insulation is possible. Assuming in both cases 2 x 12 wood rafters at 16 inches on center with built-up roofing on a plywood deck over the rafters and a ½ inch gypsum board ceiling below, we arrive at the following figures:

Per Square Foot of Roof

Roof Insulation	U-Factor	Embodied Energy (Btu)
a) 3½ inch thick	.075	68,063
b) 5½ inch thick	.036	70,003

Adding 2 inches of insulation between the rafters would save 6,980 Btu annually per square foot of roof at an additional embodiment of 1,940 Btu. Energy payback would be in less than one third of a heating season.

Similarly, the thermal characteristics and embodied energy for glass are compared in Table 8.2. This table does not deal with transmission of light which may have positive or

negative energy use consequences but only with conducted heat transfer.

To put these figures into perspective, assume a simple rectangular one-story wood frame residence 30 feet wide by 50 feet long with walls 10 feet high and a flat roof. Eighty percent of the wall is solid with a wood shingled exterior. Twenty percent of the wall is window or door. The roof is covered with built-up roofing as in the example above.

The addition of insulation to a typical 2 x 4 frame wall is now generally acknowledged to be cost effective. It is also highly energy effective. In New York City, addition of 3½ inches of insulation will save an average 16,300 Btu per square foot of wall annually at an additional embodiment (from Figure 7.2) of 6,860 Btu. Energy payback (Btu saved versus extra Btu embodied) will be in approximately 1/3 heating season.

Figure 8.1 plots the total energy embodied in and demanded by one square foot of a series of frame walls located in New York City over a period of 20 years. The walls are similar to those shown in Figures 7.2 and 7.1; however, five more alternative shingle walls with depth of wall and insulation increasing in 2 inch increments have been added. Table 8.1 outlines the characteristics of the walls selected for investigation.

Several conclusions may be drawn from the diagram. First, compared with no insulation at all, the energy em-

Table 8.1 Energy Embodiment and U-Factors of Typical Exterior Walls

Note: Energy requirements are given for one square foot of exterior wall.

Nominal wall thickness	Type of framing	Insulation	U-factor	Embodied energy - Btu
Brick veneer walls				
10"	2 x 4 at 16" o.c.	0	.240	145,000
10"	2 x 4 at 16" o.c.	3½"	.076	152,000
Shingled walls				
4"	2 x 4 at 16" o.c.	0	.250	25,140
4"	2 x 4 at 16" o.c.	2½"	.100	30,840
4"	2 x 4 at 16" o.c.	3½"	.077	32,000
6"	2 x 6 at 24" o.c.	5½"	.051	33,940
8"	2 x 8 at 24" o.c.	7½"	.039	36,040
10"	(2) 2 x 4 at 24" o.c.	9½"	.031	37,140
12"	(2) 2 x 4 at 24" o.c.	11½"	.026	40,240
14"	(2) 2 x 4 at 24" o.c.	13½"	.022	42,340

Additional embodiment for maintenance (shingled walls)

Paint - one coat every 5 years: 1,390 Btu/sq ft
 Reshingle 50 percent every 20 years: 3,660 Btu/sq ft
 (Brick veneer walls are assumed to be maintenance free)

Figure 8.1 Embodied Energy and Operating Energy Requirements of Typical Wood Frame Walls

- Notes:
1. The embodied energy at year 0 is the energy required for construction. (see table 8.1)
 2. Operating characteristics assume 4,848 heating degree days.
 3. Heating system efficiency assumed at 65 percent.

bodied in insulation of any thickness will be paid back by operational energy saved within one heating season. Second, the additional embodied energy required to install 5½ inches versus 3½ inches of insulation will be paid off by operating savings in less than one heating season. Third, the additional embodied energy required to install any thickness of insulation greater than 3½ inches will be paid off by operating savings within 3 heating seasons.

Three and one half inches of insulation is now used routinely in 2 x 4 exterior walls in residential construction and 5½ inches in a 2 x 6 stud wall is becoming more and more common. Thicknesses greater than that provide progressively smaller increments of operational savings.

This comparison deals only with the conducted thermal transfer characteristics of opaque walls. In addition, heat is transferred, beneficially or detrimentally, as a result of infiltration and opening of windows, doors and louvers. Furthermore, by admitting light, which makes artificial light unnecessary and by admitting air for natural, non-mechanical ventilation, the wall influences all of the energy

requirements of the space, not only the thermal.

This energy accounting includes only the outer shell of the building. It does not include foundations, floors, interior partitions, paint and other finishes, plumbing and electrical systems, and other components which do not affect thermal transfer nor floor and foundations which permit thermal transfer but at different temperature differences.

In Table 8.3, House A, the less well insulated building shell, requires about 11,200,000 Btu less to build than House B, or about 75 gallons of oil. Over the first twenty years of use, House A will require 754,000,000 Btu more than House B in order to offset the added heat loss. This represents about 5,200 gallons of oil. The net energy savings for adding insulation at the time of construction will be greater than 5,000 gallons of oil. It should be noted that House A has an annual operating energy requirement which is 57,690,000 Btu or about 400 gallons of oil greater than House B. In other words, the added energy for construction of House B (75 gallons of oil) will be repaid by operating savings in just over two months.

Table 8.2 Embodied Energy and Energy Required for Heating - Single or Double Glazing

	Embodied energy Btu per square foot	U-factor	Annual requirement per square foot NYC (4,848 degree day)
Glass: a) Single glass	15,400	1.13	202,000 Btu
b) Double with ¼" space	30,000	.65	116,000 Btu
c) Double with ½" space	30,800	.58	67,484 Btu
Compared with a) single glazing:			
b) Double with ¼" space		uses 15,400 Btu more to produce; requires 86,000 less annually; pays back in ¼+ heating season	
c) Double with ½" space		uses 15,400 Btu more to produce; requires 98,000 less annually; pays back under ¼ heating season.	
Compared with b) double glazing with ¼" space:			
c) Double with ½" space		uses the same Btu to produce; requires 12,000 less annually.	
Over a 20-year period, 1 square foot of glass will require (embodied and operational energy):			
			No. 6 Oil Equivalent (gal)
a) Single glass:	4.06 million Btu		28.0
b) Double with ¼" space	2.35 million Btu		16.2
c) Double with ½" space	2.11 million Btu		14.6

Table 8.3 20-Year Energy Requirements for Two Similar Building Skins

Basic information for both houses

Floor area	1,500 sq ft
Roof area (flat)	1,500 sq ft
Exterior wall perimeter	1,600 lin ft
Exterior wall area	
Windows (23 - 3'-0" x 4'-0" wood casements)	276 sq ft
Doors (2 - 3'-0" x 6'-8", solid core)	40 sq ft
Solid area	1,284 sq ft

House A—Single glazed, 3½" insulation in walls, 3½" insulation in roof

Construction energy embodiment:

Solid walls:	1,284 sq ft	x	32,000 Btu/sq ft	=	41,100,000 Btu
Openings:	2 doors	x	1,050,000 Btu/ea	=	2,100,000 Btu
	23 windows	x	1,030,000 Btu/ea	=	23,700,000 Btu
Roof:	1,500 sq ft	x	68,100 Btu/sq ft	=	102,200,000 Btu
Total:					169,100,000 Btu

Annual operating Energy (exclusive of maintenance factors):

Solid walls:	1,284 sq ft	x	.077 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	11,180,000 Btu/yr
Windows:	276 sq ft	x	1.1 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	35,324,467 Btu/yr
Doors:	40 sq ft	x	.35 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	1,628,928 Btu/yr
Roofs:	1,500 sq ft	x	.075 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	13,089,600 Btu/yr
Total conducted loss:							61,223,956

Infiltration (½ air change per hour):

6,040 cu ft/hr	x	.018 Btu/cu ft/deg F	x	116,352 deg hr	=	12,649,789 Btu/yr
Total loss:						73,873,745 Btu/yr

Assume system efficiency of 65 percent

Energy requirements to offset total loss:	113,652,000 Btu/yr
20 year operating requirements:	2,273,000,000 Btu
Construction embodiment:	169,100,000 Btu
Total 20 year energy requirements:	2,442,100,000 Btu

House B—Double glazed, 5½" insulation in walls, 5½" insulation in roof

Construction energy embodiment:

Solid walls:	1,284 sq ft	x	36,000 Btu/sq ft	=	46,300,000 Btu
Openings:	2 doors	x	1,050,000 Btu/ea	=	2,100,000 Btu
	23 windows	x	1,170,000 Btu/ea	=	26,900,000 Btu
Roof:	1,500 sq ft	x	70,000 Btu/sq ft	=	105,000,000 Btu
Total:					180,300,000 Btu

Annual operating Energy (exclusive of maintenance factors):

Solid walls:	1,284 sq ft	x	.051 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	7,619,194 Btu/yr
Windows:	276 sq ft	x	.66 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	21,194,680 Btu/yr
Doors:	40 sq ft	x	.35 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	1,628,928 Btu/yr
Roofs:	1,500 sq ft	x	.036 Btu/hr/sq ft/deg F	x	116,352 deg hr	=	6,283,008 Btu/yr
Total conducted loss:							36,725,810 Btu/yr

Infiltration (½ air change per hour):

6,040 cu ft/hr	x	.018 Btu/cu ft/deg F	x	116,352 deg hr	=	12,649,789 Btu/yr
Total loss:						49,375,599 Btu/yr

Assume system efficiency of 65 percent

Energy requirements to offset total loss:	75,962,000 Btu/yr
20 year operating requirements:	1,519,000,000 Btu
Construction embodiment:	180,300,000 Btu
Total 20 year energy requirements:	1,699,300,000 Btu

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Chapter 9

Percentage of Industry Output Going to Building Construction

Chapter 9 looks at the industrial sectors which contribute embodied energy to New Building Construction and identifies the percentage of each sector's total output which is committed to New Building Construction. It indicates, for example, that 76.26 percent of the total output of Gypsum Products industry goes to New Building Construction, and 21.11 percent of Nonferrous Wire Products go to New Building Construction. Table 9.1 lists each sector in ranked percentage order, plus each sector's energy intensity (Btu/\$). Table 9.2 lists each sector in 399 order.

This information is necessary in order to understand the adjustments which will be required throughout the economy due to changes in techniques used for New Building Construction. If, for example, a particular building material—Product A, which is highly energy-intensive, could be replaced by another building material—Product B, which is energy-efficient, the demand for Product A might be sharply reduced, while the demand for Product B, greatly

increased. If both of these products represented small fractions of their respective industries' total output, the impact of this substitution would be relatively small. If, on the other hand, the quantity of Product A used in New Building Construction represented a sizeable portion of that industry's total output, a sharp curtailment in its use for construction would have a substantial impact—probably negative—on that industry. Also, if the quantity of Product B used for New Building Construction represented a substantial portion of that industry's total output prior to any consideration of exchange of Product B for Product A, the projected exchange could cause a demand for Product B which would exceed the capacity of Product B's industry for expansion.

The data in this chapter will be of use to those concerned with the impact of energy conservation measures in New Building Construction on the economy as a whole.

Table 9.1 Percent of Industry Output into New Building Construction in Ranked Order

Ranked order	Output fraction percent	Energy intensity Btu/dollar	Ranked order	Output fraction percent	Energy intensity Btu/dollar
197 Ceramic tile	99.46	121,200	266 Conveyors	3.76	67,157
140 Prefab wd struc	90.50	62,965	372 Wholesale trade	3.73	55,996
196 Bricks	86.15	358,240	364 Motor frt transp	3.58	72,115
138 Millwork	78.44	63,156	210 Abrasive prod	3.54	87,599
204 Concrete blocks	76.26	155,536	398 Business travel	3.22	112,810
208 Gypsum prod	76.26	178,610	360 Signs, ads	2.87	73,630
200 Plumbing fixture	69.98	109,130	17 Ag, for, fish serv	2.85	33,760
206 Ready-mix concrete	64.08	180,840	384 Misc Bus serv	2.84	26,845
325 Electrical eq	63.30	79,280	373 Retail trade	2.70	35,274
238 Plumbing fittings	62.95	85,236	216 Normet min prod	2.33	109,850
237 Metal sanit ware	62.65	114,750	218 Ir, stl foundries	2.23	100,570
244 Arch metal work	62.04	122,350	229 Nonfer rolling	2.05	117,830
241 Metal doors	60.15	126,140	3 Petro refin prod	1.96	121,450
245 Misc metal work	53.39	145,390	301 Welding apparat	1.94	92,229
240 Fab struc steel	53.29	130,060	122 Coated fabrics	1.63	97,577
265 Elevators	49.76	61,695	387 Auto repair	1.54	48,917
214 Mineral wool	47.91	175,020	174 Misc chem prod	1.47	189,910
137 Spec prod sawmill	46.19	61,166	161 Conv paper prod	1.40	111,440
312 Light fixtures	43.26	78,097	217 Steel prod	1.24	280,950
243 Sheet metal work	42.65	120,560	377 Insur carriers	1.24	20,719
139 Veneer, plywood	42.56	89,132	369 Communications	1.01	16,769
209 Stone products	42.27	61,569	113 Broad fab mills	.98	102,180
160 Building paper	41.60	225,110	125 Cordage, twine	.96	76,819
342 Temp controls	41.10	46,417	374 Banking	.91	18,264
239 Heating equip	39.42	85,236	321 Storage battery	.86	102,490
135 Sawmills	36.62	95,091	308 H'hold vacuums	.84	70,578
215 Nonclay refrac	36.20	159,350	246 Screw mach prod	.83	101,700
205 Concrete prod	35.94	114,780	262 Const machinery	.75	84,307
267 Hoists, cranes	34.73	68,695	286 Mach shp prod	.72	59,791
199 Clay products	32.81	277,100	187 Misc rubber prod	.71	108,040
211 Asbestos prod	32.34	131,920	185 Tires	.70	111,440
184 Asphalt	30.83	493,910	399 Office supplies	.66	79,603
136 Hardwd flooring	27.45	86,032	365 Water transport	.65	222,150
198 Clay refrac	26.14	188,270	153 Envelopes	.63	97,235
151 Wood fixtures	23.03	52,701	380 Real estate	.62	22,485
358 Hard floor cov	22.73	88,026	300 Ind controls	.61	38,456
230 Nonfer wire	21.11	94,756	232 Brass, other cast	.58	86,950
298 Switchgear	20.05	49,614	5 Gas utilities	.58	11,055
255 Pipe	19.36	81,441	171 Inorg-org chem	.55	248,610
142 Wood prod	17.56	87,385	394 Nonprofit org	.48	58,293
293 Refrig mach	14.74	71,858	10 Feed grains	.47	137,430
386 Misc prof serv	14.52	24,883	297 Transformers	.47	79,274
242. Fab plate work	13.47	107,790	385 Advertising	.47	44,752
310 H'hold appliances	12.80	88,211	228 Alum rolling	.43	33,083
250 Hardware	12.64	91,927	170 Misc printing	.41	37,810
152 Met fixtures	12.53	91,346	249 Handtools	.38	77,284
141 Wood preserving	11.95	108,770	322 Primary battery	.38	66,907
183 Paving	11.53	561,490	302 Carbon prod	.37	148,700
182 Paint prod	11.35	144,800	165 Book publishing	.37	51,180
144 Wood h'hold furn	10.78	49,736	346 Watches, clocks	.35	48,167
146 Met h'hold furn	10.54	94,154	395 Post office	.35	36,964
313 Wiring devices	10.30	80,526	317 R-TV commun eq	.34	32,580
227 Copper rolling	9.38	104,380	271 Special die tool	.30	60,341
252 Fab wire prod	9.41	163,710	324 Engine elec equip	.30	70,927
195 Cement	9.21	497,180	371 Water, sanit serv	.30	109,190
220 Primary metal prod	7.67	170,070	299 Motors, generator	.28	62,599
207 Lime	7.08	544,580	397 St, loc govt entr	.28	104,210
188 Misc plastics	7.03	111,300	367 Pipe line transp	.25	96,166
193 Glass prod	6.47	118,110	328 Motor veh and part	.24	66,580
21 Stone clay min	6.40	135,200	56 Main-const other nonfrm	.24	51,004
281 Blowers	6.22	65,757	258 Fab metal prod	.23	103,930
213 Treated minerals	6.01	169,810	366 Air transp	.20	190,880
307 Electric h'ware	5.35	74,529	376 Sec, commod bank	.20	11,593
15 For, grhouse, nurs	4.63	64,722	133 Fab textile prod	.18	61,992
279 Pumps, compressors	4.55	70,710	130 Apparl, purch mat	.16	56,736
357 Brushes	4.55	74,097	339 Transp equip	.16	113,810
212 Gaskets	4.35	96,552	361 Misc mfg	.15	59,123
362 Railroad	4.34	75,880	247 Metal stampings	.14	113,460
150 Public building furn	3.77	70,147	311 Electric lamps	.13	47,894
			4 Elec util	.10	37,893

Table 9.2 Percent of Industry Output into New Building Construction in 399 Order

399 Order	Output fraction percent	399 Order	Output fraction percent
3 Petro refin prod	1.96	239 Heating equip	39.42
4 Electric util	.10	240 Fab struc steel	53.29
5 Gas util	.58	241 Metal doors	60.15
10 Feed grains	.47	242 Fab plate work	13.47
15 For, grhouse, nurs	4.63	243 Sheet metal work	42.65
17 Ag for, fish serv	2.85	244 Arch metal work	62.04
21 Stone clay min	6.40	245 Misc metal work	53.39
56 Mainconst oth nonfrm	.24	246 Screw mach prod	.83
113 Broad fab mills	.93	247 Metal stampings	.14
117 Floor coverings	10.58	249 Handtools	.38
122 Coated fabrics	1.63	250 Hardware	12.64
125 Cordage, twine	.96	252 Fab wire prod	9.41
130 Apparel, puch mat	.16	255 Pipe	19.36
133 Fab textile prod	.18	258 Fab metal prod	.23
135 Sawmills	36.82	262 Const machinery	.75
136 Hardwd flooring	27.45	265 Elevators	49.76
137 Spec prod sawmill	46.19	266 Conveyors	3.76
138 Millwork	78.44	267 Hoists, cranes	34.73
139 Veneer, plywood	42.56	271 Special die tool	.30
140 Prefab wd struc	90.50	279 Pumps, compressors	4.55
141 Wood preserving	11.95	281 Blowers	6.22
142 Wood products	17.56	286 Mach shp prod	.72
144 Wood h'hold	10.78	293 Refrig mach	14.74
146 Met h'hold	10.54	297 Transformers	.47
150 Public bld fum	3.77	298 Switchgear	20.05
151 Wood fixtures	23.03	299 Motors, generators	.28
152 Met fixtures	12.53	300 Ind controls	.61
158 Envelopes	.63	301 Welding apparat	1.94
160 Building paper	41.60	302 Carbon prod	.37
161 Conv paper prod	1.40	307 Electric h'ware	5.35
165 Book publishing	.37	308 H'hold vacuums	.84
170 Misc printing	.41	310 H'hold appliance	12.80
171 Inorg-org chem	.55	311 Electric lamps	.13
174 Misc chem prod	1.47	312 Light fixtures	43.26
182 Paint prod	11.35	313 Wiring devices	10.30
183 Paving	11.53	317 R-TV commun eq	.34
184 Asphalt	30.83	321 Storage battery	.86
185 Tires	.70	322 Primary battery	.38
187 Misc Rubber prod	.71	324 Engine elec eq	.30
188 Misc plastics	7.03	325 Electrical eq	63.30
193 Glass prod	6.47	328 Motor veh and part	.24
195 Cement	9.21	339 Transport equip	.16
196 Bricks	86.15	342 Temp controls	41.10
197 Ceramic tile	99.46	346 Watches, clocks	.35
198 Clay refract	26.14	357 Brushes	4.55
199 Clay prod	32.81	358 Hard floor cov	22.73
200 Plumbing fixture	69.98	360 Signs, ads	2.87
204 Concrete blocks	76.26	361 Misc mfg	.15
205 Concrete prod	35.94	362 Railroad	4.34
206 Ready-mix concrete	64.03	364 Motor fgt transport	3.58
207 Lime	7.08	365 Water transport	.65
208 Gypsum prod	76.26	366 Air transport	.20
209 Stone products	42.27	367 Pipe line transp	.25
210 Abrasive prod	3.54	369 Communications	1.01
211 Asbestos prod	32.34	371 Water, sanit serv	.30
212 Gaskets	4.35	372 Wholesale trade	3.73
213 Treated minerals	6.01	373 Retail trade	2.70
214 Mineral wool	47.91	374 Banking	.91
215 Nonclay refract	36.20	376 Sec, commod brok	.20
216 Nonmet min prod	2.33	377 Insur carriers	1.24
217 Steel prod	1.24	380 Real estate	.62
218 Ir, stl foundries	2.23	384 Misc bus service	2.84
220 Primary metal prod	7.67	385 Advertising	.47
227 Copper rolling	9.38	386 Misc prof serv	14.52
228 Alum rolling	.43	387 Auto repair	1.54
229 Nonfer rolling	2.05	394 Nonprofit org	.48
230 Nonfer wire	21.11	395 Post office	.35
232 Brass, other cast	.58	397 St, loc govt entr	.28
237 Metal sanit ware	62.65	398 Business travel	3.22
238 Plumb fittings	62.95	399 Office supplies	.66

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Chapter 10

Energy Flow Model

Chapter 10 describes a technique which permits the tracing of the energy eventually embodied in New Building Construction from its initial state as a basic resource through the economy and into the Construction sectors. All of the material previously presented in this handbook has been concerned with only the energy embodied in materials transferred directly into New Building Construction. In order, however, to have a complete understanding of the impact of New Building Construction on the energy economy as a whole, it is necessary to know not only which industries transfer products directly to New Building Construction, but also which industries sell products to other industries which in turn sell products to New Building Construction.

For example, the Chemical Products sector makes very little direct contribution of embodied energy to New Building Construction, but sells its output to a large number of other industries which sell products to New Building Construction. When all of these small transactions are combined, it turns out that the Chemical Products industry controls a sizable portion of the flow of energy into New Building Construction.

The material contained in this chapter is not an energy flow model, but rather a description of how an energy flow model works and how it might be used.

The terminology contained in the description of the flow model relates to the input/output model of the structure of the U.S. economy. The consideration of imported products as the primary energy source is based on the fact that if these same imports were produced domestically, a certain quantity of energy resource would be required for their production.

Uses for a Flow Model

An Energy Flow Model makes the following information relating to New Building Construction immediately ap-

parent for research or policy development.

The total amounts of each primary energy resource (coal, crude petroleum, non-fossil electricity, and imports) required due to the direct or indirect demand from New Building Construction.

The transactions between primary energy resources and those sectors which consume primary energy resources directly. These will include the five energy industries, the non-energy industries which purchase energy resources directly, such as the steel industry's purchase of coal, and the industries which purchase imports.

Transactions between the energy industries which use energy resources directly and the energy industries which finally sell the energy product to some non-energy industry. For example, a portion of the Crude Petroleum resource will be transferred to Refined Petroleum and then to Electric Utilities before it is sold to a non-energy sector such as Steel. Other Crude Petroleum Products will be transferred to Refined Petroleum and sold directly to the steel industry.

The flow through some yet-to-be determined number of transactions between the stage described above and the stage containing the industries which sell directly to New Building Construction. The purpose for establishing this energy flow model or network is to permit the identification of nodes in the flow which may become control or limiting points for alternative material strategies. For example, it may be found that the products from 50 small industries which purchase energy directly are sold to some industry—X, which, in turn, sells its products to 50 other industries, each of which makes a small contribution to New Building Construction. Industry X will not show up in either the direct primary energy contributions to the economy resulting from New Building Construction, or in the direct contributions to New Building Construction of primary and embodied energy. The knowledge of this

intermediate industry is important since a restriction at this point will affect a substantial number of small paths which eventually lead to New Building Construction. It may, for example, turn out that if five of these small products are proposed as substitutes for some other product in order to reduce resource energy requirements, Sector X may have to be tripled in size since these five paths all flow through Sector X. A brief look at Sector X may indicate that a tripling in size is impossible and therefore, it will be necessary to either abandon this strategy or find alternate means for developing five substitute materials.

The identity and quantity of the primary and embodied energy contained in transactions directly with New Building Construction. This will include the transactions between New Building Construction and the five energy sectors and between New Building Construction and the non-energy sectors. The energy sector transactions will represent the total energy embodied in the products transferred from the energy sectors to New Building Construction. For example, in the case of gasoline consumed by building machinery, the quantity of energy indicated in the transaction will include the total amount of energy resource which was required eventually to deliver that gasoline to New Building Construction in addition to the actual useful energy contained in that gasoline. For the non-energy industry transactions, the magnitude of the transaction will simply represent the total energy resource required at the beginning of the flow to achieve this transaction at the end. In the case of a plastic product, for example, this will include the energy content of the petroleum-feedstock for the material, the energy required to extract that feedstock and the energy required for all of the transformations and the other processes which occur prior to the entry of that plastic material into the New Building Construction sector.

The following is a more detailed discussion of the Energy Model.

Conventions

The data which are used in the development of the Flow Model conform to several significant conventions.

New Building Construction is considered to sell only to Final Demand. That is, there are no inter-industry transactions involving sales from New Building Construction to other industries. Because of this the total demand for Primary Energy resource resulting from the eventual demand for embodied energy by the entire New Building Construction sector will equal the total embodied energy in the transactions from New Building Construction to Final Demand.

All Primary Energy resources are classified in four basic forms. These are Coal, Crude Petroleum, Non-fossil Electricity (electricity generated from sources other than the eventual products of Coal and Crude Petroleum), and Imported Products which are considered to have the same energy value as that which would be required as if these products were manufactured domestically. Primary Energy resources are considered to originate in their respective energy industry sectors. Coal, for example, is considered to originate in the Coal Mining sector. Because of this, the only demand which Coal makes for Primary Energy resources is for that energy resource which is required to mine and process the coal. The demand for the coal itself (the product of Coal Mining) is considered to occur at the transaction between the Coal Industry and the direct users of coal, such as Electric Utilities or the Steel Industry.

Final Demand is the ultimate user. When the transaction occurs—transferring the product to the ultimate user, all energy embodied in that product will have been used and no further energy requirements need be anticipated.

Schematic Model

A schematic model has been developed showing an energy flow pattern through n stages from Equivalent Primary Energy⁹ to New Building Construction. This model is represented graphically by Figures 10.1 through 10.8 and in detail by Wall Chart 2 which is in the pocket in the back cover. The graphic model is divided into stages represented by Columns 1, 2, 3, 4, $n-3$, $n-2$, $n-1$, and n ; and sets of flows between stages are represented by flow paths and identified as $1/2$, $2/3$, etc. The stages (columns) represent processes which occur within industries and the flows represent transactions between industries.

The graphic model has a vertical scale representing units of energy. There is no horizontal scale.

Five characteristic forms of energy are represented in the stages. These are:

The actual energy content of products in an energy sector such as the heat which would be produced by burning a gallon of oil. (See Figure 10.1)

Figure 10.1

The embodied energy in energy products resulting from the extraction and manufacturing processes. (See Figure 10.2) The sum of these first two energy forms represent the total energy value of energy products.

Figure 10.2

The actual energy content of energy product sold to non-energy industries such as the actual energy released by the burning of a gallon of oil by the steel industry. (See Figure 10.3)

Figure 10.3

The non-useful energy embodied in energy products consumed by non-energy industries such as the energy which was required to extract, process, and transport the gallon of oil consumed by the steel industry described above. (See Figure 10.4)

Figure 10.4

Figure 10.3 and 10.4 represent the total energy involved in direct transactions between energy industries and non-energy industries (the embodiment of energy into non-energy products).

The energy which has already been embodied in non-energy materials or products consumed by the industries in each particular stage. (See Figure 10.5)

Figure 10.5

Two characteristic forms of energy are shown in the flow portions of the diagram. These are:

The total energy involved in the transfer of energy products, that is, the actual energy content of the energy product itself plus the energy embodied in that product as a result of all extraction, processing and transportation to that point. (See Figure 10.6)

Figure 10.6

The energy embodied in non-energy products. (See Figure 10.7)

Figure 10.7

The actual values for three stages have been extracted from 1967 data. These are Stages 1, $n-1$, and n . The remaining stages and the interstage flows are hypothetical and intended only to represent the type of information which would be generated by a total flow analysis. The hypothetical non-energy sectors have been greatly simplified for clarity, and the flow between Stage 4 and Stage $n-3$ has been assumed as a single step. (See Figure 10.8)

Stage 1 represents the primary energy equivalent of an economy with no imports.

Flow 1/2 indicates the portion of the primary energy equivalents of stage 1 which are replaced by imports. In this hypothetical case, all energy imports are considered to replace demand for crude petroleum, and all non-energy imports are considered to replace demand for coal.

Stage 2 represents the actual domestic primary energy plus the primary energy equivalent of energy and non-energy imports.

Flow 2/3 represents all transactions between primary energy sectors and all energy sectors including primary energy sectors. No other transactions are considered. For example, in this hypothetical case, coal sold directly to electric utility industries for electricity generation is shown. However, coal which would be sold directly to the steel industry is simply carried forward for a later transaction.

Stage 3 indicates the configuration of energy industries plus imports following the transfer of all primary energy to the energy sectors which will eventually transfer energy products to the non-energy industries. The hypothetical electric industry in Stage 3 is now composed of the contributions from non-fossil electric generation plus the contributions of coal used for electric generation. It is assumed here that electric utilities do not use crude petroleum directly.

Flow 3/4 represents the transfer of non-primary energy products to energy sectors. At this point the oil and natural gas (non-primary energy products) which are burned to generate electricity are added to the Electric sector. However, the electricity which is used in the manufacture of refined petroleum and gas is subtracted from the Electric sector.

Stage 4 represents the final arrangement of energy products prior to their sale to non-energy industries and includes non-energy imports which have been carried forward directly from Sector 2.

Flow 4/ $n-3$ represents all sales from energy sectors to non-energy sectors which are three transactions removed from New Building Construction. All energy products which are not transferred at this point are simply carried forward for later transactions.

Stage $n-3$ represents all non-energy sectors which are three transactions removed from New Building Construction plus all energy products which are being carried forward for later transactions. Since the non-energy sectors in Stage $n-3$ are the first non-energy sectors in the total flow pattern, all energy inputs except imports will be contained in the actual and embodied energy of energy products.

Flow $n-3/n-2$ represents all transactions between sectors which are three transactions removed from New Building Construction and sectors which are two transactions removed from New Building Construction plus the carrying forward of energy products which are not utilized in Stage $n-2$.

Stage $n-2$ represents all non-energy industries which are two transactions removed from New Building Construction plus the energy products being carried forward. The non-energy

products of Stage $n-2$ differ from those of $n-3$ in that a portion of their energy input may result from the energy embodied in non-energy products.

Flow $n-2/n-1$ represents all transactions between sectors two transactions removed from New Building Construction, and sectors which are one transaction removed (i.e. which sell directly to New Building Construction).

Stage $n-1$ represents the configuration of all non-energy industries which transact directly with New Building Construction, and the energy products which have been carried forward from previous stages to be sold directly to New Building Construction. In the graphic representation of Stage $n-1$, 78 sectors, totaling 98 percent of all energy which is eventually embodied in New Building Construction through purchases of energy and non-energy products is represented. The remaining 2 percent are energy trans-

fers of less than 0.1 percent each. This is presented in tabular form in Chapter 4, Table 4.1.

Flow $n-1/n$ represents the transactions directly to New Building Construction.

Stage n represents the total energy committed to New Building Construction. The actual energy content indicated is that energy which is used in the processes of building construction. The embodied energy component of energy products is that energy which is required to deliver the energy needed for New Building Construction. These two sectors represent the total energy involved in energy product purchases directly by New Building Construction. The remaining portion of Stage n represents the total energy embodied in all non-energy products consumed by New Building Construction.

Figure 10.8 Energy Flow Model for New Building Construction

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Chapter 11

Labor per Unit of Building Material

Chapter 11 provides the means for determining the total labor embodied in building materials, components, and assemblies, and in buildings themselves. This information may be used to correlate the energy requirements with the labor requirements for alternative building approaches. It may also be used by itself in order to prepare an embodied labor take-off for a building project.

The data contained in this section deal with the embodied labor of goods and services as they are delivered to the jobsite. The on site labor required for the incorporation of these materials into the building is not included. However, this direct labor may be determined from data contained in any comprehensive cost estimating manual.

Data for labor intensity of building materials have been developed using labor intensity figures in units of full time employment (FTE) per dollar. The complete listing of labor intensities for all 399 industrial sectors is contained in Appendix C.

The format for the data regarding the embodied labor in building material and assemblies is the same as that used in Chapter 6 for the embodied energy. This permits the use of any take-offs which have been made for energy estimating

to be used directly to calculate embodied labor.

In addition to the detailed lists of labor embodied in building materials, Chapter 11 contains sample calculations for the three fireproof floor framing systems for which energy take-offs were made in Chapter 7. In addition to the determination of embodied labor for the three systems (which is a direct translation of the materials take-off), the direct labor requirements have been determined based on standard estimating procedures.

Not only does the total labor required for the three assemblies vary, but also, there are sharp differences in the relationships between direct and embodied labor. For example, in the standard steel system, direct labor represents approximately 23 percent of the total labor requirement, while in the concrete waffle slab, direct labor represents approximately 57 percent of total labor. Thus, while the concrete system requires only about three-quarters as much total labor as does the standard steel system, it requires about 1.8 times as much direct or on site labor. Chapter 11 permits the evaluation of what kinds of labor (i.e. construction versus industrial) are required for alternative building approaches as well as how much total labor is required.

SECTION 0 - DIRECT ENERGY*

0.1 GENERAL ALLOWANCE (excluding asphalt and road oil) - Labor Hour/sq ft of Building Type

Sector no.	Building type	Labor hr/ sq ft Allowance
23	Residential, one family	.0062
24	Residential, two-four family	.0064
25	Residential, garden apartments	.0067
26	Residential, high-rise apartments	.0101
27	Residential, alterations and additions	.0290**
28	Hotels and motels	.0163
29	Dormitories	.0240
30	Industrial buildings	.0098
31	Office buildings	.0260
32	Warehouses	.0065
33	Garages and service stations	.0116
34	Stores and restaurants	.0166
35	Religious buildings	.0198
36	Educational buildings	.0189
37	Hospital buildings	.0229
38	Other non-farm buildings	.0235
48	Farm residences	.0029
49	Farm service buildings	.0009

*Direct energy is used throughout the construction process. It is summarized here and therefore, the labor requirements for direct energy in each of the following sections is accounted for in this table and should be added to estimates.

**Use this factor to determine labor allowance for entire project - multiply labor estimate subtotal by factor and add result to subtotal.

SECTION 1 - OVERHEAD

1.1 GENERAL ALLOWANCE - Labor Hour/sq ft of Building Type

Sector no.	Building type	Labor hr/sq ft Allowance
23	Residential, one family	.0939
24	Residential, two-four family	.0859
25	Residential, garden apartments	.0648
26	Residential, high-rise apartments	.0819
27	Residential, alterations and additions	.0260**
28	Hotels and motels	.1230
29	Dormitories	.1510
30	Industrial buildings	.0396
31	Office buildings	.1690
32	Warehouses	.0260
33	Garages and service stations	.0577
34	Stores and restaurants	.0903
35	Religious buildings	.1310
36	Educational buildings	.1400
37	Hospital buildings	.2110
38	Other non-farm buildings	.1440
48	Farm residences	.0444
49	Farm service buildings	.0036

*Use this factor to determine labor allowance for entire project - multiply labor estimate subtotal by factor and add result to subtotal.

SECTION 3 - SITE WORK

2.1	SITE DRAINAGE	Unit	Labor Hour/Unit at Jobsite
2.1.1	Non-Reinforced Concrete Drainage Pipe	lb	.0034
	4" diameter (16 lb/lin ft)	lin ft	.0544
	6" diameter (23 lb/lin ft)	lin ft	.0782
	8" diameter (37 lb/lin ft)	lin ft	.1260
	10" diameter (51 lb/lin ft)	lin ft	.1730
	12" diameter (67 lb/lin ft)	lin ft	.2230
	15" diameter (97 lb/lin ft)	lin ft	.3300
	18" diameter (144 lb/lin ft)	lin ft	.4900
	21" diameter (162 lb/lin ft)	lin ft	.5510
	24" diameter (224 lb/lin ft)	lin ft	.7620
2.1.2	Vitrified Clay Sewer Pipe	lb	.0092
	4" diameter (9 lb/lin ft)	lin ft	.0828
	6" diameter (16 lb/lin ft)	lin ft	.1470
	8" diameter (23 lb/lin ft)	lin ft	.2120
	10" diameter (36 lb/lin ft)	lin ft	.3310
	12" diameter (48 lb/lin ft)	lin ft	.4420
	15" diameter (72 lb/lin ft)	lin ft	.6620
2.1.3	Perforated Plastic Pipe (PVC) (200 psi)	lb	.1030
	1½" diameter (.36 lb/lin ft)	lin ft	.0350
	2" diameter (.53 lb/lin ft)	lin ft	.0546
	2½" diameter (.78 lb/lin ft)	lin ft	.0803
	3" diameter (1.16 lb/lin ft)	lin ft	.1200
	4" diameter (1.91 lb/lin ft)	lin ft	.1230
	5" diameter (2.93 lb/lin ft)	lin ft	.3020
	6" diameter (4.61 lb/lin ft)	lin ft	.4750
	8" diameter (7.05 lb/lin ft)	lin ft	.7260
	10" diameter (10.02 lb/lin ft)	lin ft	1.0300
	12" diameter (15.55 lb/lin ft)	lin ft	1.6000
2.1.4	Cement Asbestos Pipe		
	Non-pressure sewer pipe	lb	.0202
	4" diameter (6.5 lb/lin ft)	lin ft	.1310
	5" diameter (8.9 lb/lin ft)	lin ft	.1800
	6" diameter (10.3 lb/lin ft)	lin ft	.2080
	8" diameter (14.5 lb/lin ft)	lin ft	.2930
	10" diameter (20.5 lb/lin ft)	lin ft	.4140
	12" diameter (27.0 lb/lin ft)	lin ft	.5450
	16" diameter (41.1 lb/lin ft)	lin ft	.8300
	18" diameter (48.9 lb/lin ft)	lin ft	.9880
	20" diameter (57.1 lb/lin ft)	lin ft	1.1500
	24" diameter (74.5 lb/lin ft)	lin ft	1.5000

2.1	SITE DRAINAGE (continued)	Unit	Labor Hour/Unit at Jobsite
2.1.4	Cement Asbestos Pipe (continued)		
	Pressure Pipe (200 psi)	lb	.0202
	4" diameter (8.8 lb/lin ft)	lin ft	.1780
	6" diameter (14.5 lb/lin ft)	lin ft	.2930
	8" diameter (22.2 lb/lin ft)	lin ft	.4480
	10" diameter (34.5 lb/lin ft)	lin ft	.6970
	12" diameter (48.2 lb/lin ft)	lin ft	.9740
	14" diameter (64.7 lb/lin ft)	lin ft	1.3100
	16" diameter (83.7 lb/lin ft)	lin ft	1.6900
2.2	CAISSONS AND PILINGS		
2.2.1	Concrete Caissons and Piles	See Section 3	
2.2.2	Steel Piles	See Section 5	
2.3	EARTHWORK	Included in Section O - Direct Energy	
2.4	PAVEMENT		
2.4.1	Concrete Paving		
	4" thick with 6 x 6 No. 5/5 wire mesh reinforcing	sq ft	.0314
	6" thick with 6 x 6 No. 5/5 wire mesh reinforcing	sq ft	.0467
2.4.2	Bituminous Paving		
	1½" thick wearing surface (base course not included)	sq ft	.0147
2.4.3	Paving Brick		
	Clay Paving Brick (2¼ x 3 5/8 x 7 5/8)	l brk	.0226
	Clay Paving Brick (5.2 bricks/sq ft)	sq ft	.0226

SECTION 3 - CONCRETE

3.2	CONCRETE REINFORCING	Unit	Labor Hour/Unit at Jobsite
3.2.1	Carbon Steel Reinforcing (ASTM Standard)		
		lb	.0119
	No. 2 bar (0.167 lb/ft)	lin ft	.0020

3.2	CONCRETE REINFORCING (continued)	Unit	Labor Hour/Unit at Jobsite
3.2.1	Carbon Steel Reinforcing (continued) (ASTM Standard)	lb	.0199
	No. 3 bar (0.376)	lin ft	.0045
	No. 4 bar (0.668)	lin ft	.0079
	No. 5 bar (1.043 lb/ft)	lin ft	.0124
	No. 6 bar (1.502 lb/ft)	lin ft	.0179
	No. 7 bar (2.044 lb/ft)	lin ft	.0243
	No. 8 bar (2.670 lb/ft)	lin ft	.0318
	No. 9 bar (3.400 lb/ft)	lin ft	.0405
	No. 10 bar (4.303 lb/ft)	lin ft	.0512
	No. 11 bar (5.313 lb/ft)	lin ft	.0632
	No. 14 bar (7.650 lb/ft)	lin ft	.0910
	No. 18 bar (13.60 lb/ft)	lin ft	.1620
3.2.2	Wire Strand for Prestressed Concrete	lb	.0337
	1/4" diameter (0.122 lb/ft)	lin ft	.0041
	3/8" diameter (0.274 lb/ft)	lin ft	.0092
	7/16" diameter (0.373 lb/ft)	lin ft	.0126
	1/2" diameter (0.494 lb/ft)	lin ft	.0166
	5/8" diameter (0.820 lb/ft)	lin ft	.0276
	3/4" diameter (1.160 lb/ft)	lin ft	.0391
	7/8" diameter (1.610 lb/ft)	lin ft	.0543
	1" diameter (2.060 lb/ft)	lin ft	.0694
	1 1/8" diameter (2.700 lb/ft)	lin ft	.0910
	1 1/4" diameter (3.350 lb/ft)	lin ft	.1130
	1 3/8" diameter (4.050 lb/ft)	lin ft	.1370
	1 1/2" diameter (4.840 lb/ft)	lin ft	.1630
	1 9/16" diameter (5.110 lb/ft)	lin ft	.1720
	1 5/8" diameter (5.520 lb/ft)	lin ft	.1860
	1 11/16" diameter (5.970 lb/ft)	lin ft	.2010
	1 3/4" diameter (6.450 lb/ft)	lin ft	.2170
	1 13/16" diameter (6.890 lb/ft)	lin ft	.2320
	1 7/8" diameter (7.370 lb/ft)	lin ft	.2480
	1 15/16" diameter (7.750 lb/ft)	lin ft	.2610
	2" diameter (8.260 lb/ft)	lin ft	.2780
3.2.3	Welded Wire Fabric	lb	.0183
	2 x 4 No. 14/14 (0.16 lb/sq ft)	sq ft	.0029
	2 x 12 No. 3/8 (1.05 lb/sq ft)	sq ft	.0192
	2 x 16 No. 5/10 (0.75 lb/sq ft)	sq ft	.0137
	3 x 16 No. 8/12 (0.32 lb/sq ft)	sq ft	.0059
	4 x 8 No. 13/13 (0.11 lb/sq ft)	sq ft	.0020
	4 x 12 No. 12/12 (0.13 lb/sq ft)	sq ft	.0024
	4 x 12 No. 9/12 (0.22 lb/sq ft)	sq ft	.0040
	4 x 16 No. 8/12 (0.25 lb/sq ft)	sq ft	.0046
	2 x 2 No. 12/12 (0.37 lb/sq ft)	sq ft	.0068
	2 x 2 No. 10/10 (0.60 lb/sq ft)	sq ft	.0110
	4 x 4 No. 12/12 (0.19 lb/sq ft)	sq ft	.0035
	4 x 4 No. 10/10 (0.31 lb/sq ft)	sq ft	.0057

3.2	CONCRETE REINFORCING (continued)	Unit	Labor Hour/Unit at Jobsite
3.2.3	Welded Wire Fabric (continued)	lb	.0183
	6 x 6 No. 10/10 (0.21 lb/sq ft)	sq ft	.0038
	6 x 6 No. 8/8 (.030 lb/sq ft)	sq ft	.0055
	6 x 6 No. 5/5 (0.49 lb/sq ft)	sq ft	.0090
	6 x 6 No. 3/3 (0.68 lb/sq ft)	sq ft	.0124
3.3	CAST-IN-PLACE CONCRETE		
3.3.1	Ready-Mix Concrete	lb	.0006
	(See Section 3.2 for reinforcing)	cu ft	.0915
		cu yd	2.4700
	Flat Slab Construction		
	4" Slab (50 lbs/sq ft)	sq ft	.0300
	6" Slab (75 lb/sq ft)	sq ft	.0450
	8" Slab (100 lb/sq ft)	sq ft	.0600
	10" Slab (125 lb/sq ft)	sq ft	.0750
	12" Slab (150 lb/sq ft)	sq ft	.0900
	One-Way Joist Construction		
	30" o.c., 6" wide joist, slab 2½" thick		
	8" deep (50 lb/sq ft)	sq ft	.0300
	10" deep (55 lb/sq ft)	sq ft	.0330
	12" deep (60.5 lb/sq ft)	sq ft	.0363
	14" deep (66 lb/sq ft)	sq ft	.0396
	16" deep (72 lb/sq ft)	sq ft	.0432
	20" deep (84 lb/sq ft)	sq ft	.0504
	30" o.c., 6" wide joist, slab 3" thick		
	8" deep (56 lb/sq ft)	sq ft	.0336
	10" deep (61 lb/sq ft)	sq ft	.0366
	12" deep (67 lb/sq ft)	sq ft	.0402
	14" deep (72 lb/sq ft)	sq ft	.0432
	16" deep (78 lb/sq ft)	sq ft	.0468
	20" deep (90 lb/sq ft)	sq ft	.0540
	30" o.c., 6" wide joist, slab 4½" thick		
	8" deep (75 lb/sq ft)	sq ft	.0450
	10" deep (80 lb/sq ft)	sq ft	.0480
	12" deep (86 lb/sq ft)	sq ft	.0516
	14" deep (92 lb/sq ft)	sq ft	.0552
	16" deep (97 lb/sq ft)	sq ft	.0468
	20" deep (110 lb/sq ft)	sq ft	.0660
	20" o.c., 5" wide joist, slab 2½" thick		
	8" deep (54 lb/sq ft)	sq ft	.0324
	10" deep (61 lb/sq ft)	sq ft	.0336
	12" deep (67 lb/sq ft)	sq ft	.0402
	14" deep (74 lb/sq ft)	sq ft	.0444
	16" deep (82 lb/sq ft)	sq ft	.0492
	20" deep (97 lb/sq ft)	sq ft	.0582

3.3	CAST-IN-PLACE CONCRETE (continued)	Unit	Labor Hour/Unit at Jobsite
3.3.1	Ready-Mix Concrete (continued)		
	20" o.c., 5" wide joist slab 3" thick		
	8" deep (60 lb/sq ft)	sq ft	.0360
	10" deep (67 lb/sq ft)	sq ft	.0402
	12" deep (74 lb/sq ft)	sq ft	.0444
	16" deep (88 lb/sq ft)	sq ft	.0528
	20" deep (104 lb/sq ft)	sq ft	.0624
	20" o.c., 5" wide joist, slab 4½" thick		
	8" deep (79 lb/sq ft)	sq ft	.0474
	10" deep (86 lb/sq ft)	sq ft	.0516
	12" deep (92 lb/sq ft)	sq ft	.0552
	14" deep (99 lb/sq ft)	sq ft	.0594
	16" deep (107 lb/sq ft)	sq ft	.0642
	20" deep (122 lb/sq ft)	sq ft	.0732
	Waffle Slab Construction		
	12" x 2'-0" x 2'-0" overall, void 8" x 19" x 19" (97 lb/sq ft)	sq ft	.0582
	void 10" x 19" x 19" (80 lb/sq ft)	sq ft	.0480
	16" x 2'-0" x 2'-0" overall, void 12" x 19" x 19" (117 lb/sq ft)	sq ft	.0702
	void 14" x 19" x 19" (107 lb/sq ft)	sq ft	.0642
	12" x 3'-0" x 3'-0" overall, void 8" x 30" x 30" (85 lb/sq ft)	sq ft	.0510
	14" x 3'-0" x 3'-0" overall, void 10" x 30" x 30" (96 lb/sq ft)	sq ft	.0576
	16" x 3'-0" x 3'-0" overall, void 12" x 30" x 30" (107 lb/sq ft)	sq ft	.0642
	18" x 3'-0" x 3'-0" overall, void 14" x 30" x 30" (114 lb/sq ft)	sq ft	.0684
	20" x 3'-0" x 3'-0" overall, void 16" x 30" x 30" (137 lb/sq ft)	sq ft	.0822
	24" x 3'-0" x 3'-0" overall, void 20" x 30" x 30" (148 lb/sq ft)	sq ft	.0888
	18" x 4'-0" x 4'-0" overall, void 14" x 41" x 41" (108 lb/sq ft)	sq ft	.0648
	20" x 4'-0" x 4'-0" overall, void 16" x 41" x 41" (131 lb/sq ft)	sq ft	.0785
	24" x 4'-0" x 4'-0" overall, void 20" x 41" x 41" (139 lb/sq ft)	sq ft	.0834

3.3 CAST-IN-PLACE CONCRETE (continued)

Unit

Labor Hour/Unit at Jobsite

Waffle Slab Construction (continued)

28" x 4'-0" x 4'-0" overall,
void 24" x 41" x 41" (159 lb/sq ft)

sq ft

.0954

Columns

6" x 6" (38 lb/lin ft)

lin ft

.0228

8" x 8" (67 lb/lin ft)

lin ft

.0402

10" x 10" (104 lb/lin ft)

lin ft

.0624

12" x 12" (150 lb/lin ft)

lin ft

.0900

4" round (13 lb/lin ft)

lin ft

.0078

6" round (29 lb/lin ft)

lin ft

.0174

8" round (50 lb/lin ft)

lin ft

.0300

10" round (82 lb/lin ft)

lin ft

.0492

12" round (118 lb/lin ft)

lin ft

.0708

16" round (209 lb/lin ft)

lin ft

.1250

3.4 PRECAST CONCRETE

3.4.1 Slabs - Prestressed roof and floor members (hollow core)

lb

.0041

cu ft

.0611

6" deep (45 lb/sq ft)

sq ft

.1850

6" deep with 2" topping (70 lb/sq ft)

sq ft

.2870

8" deep (57 lb/sq ft)

sq ft

.2340

8" deep with 2" topping (82 lb/sq ft)

sq ft

.3360

3.4.2 Single Tees - Prestressed

lb

.0041

6 T 12 (47.5 lb/sq ft)

sq ft

.1950

6 T 16 (53.1 lb/sq ft)

sq ft

.2180

6 T 20 (58.6 lb/sq ft)

sq ft

.2400

6 T 24 (64.1 lb/sq ft)

sq ft

.2630

6 T 28 (69.7 lb/sq ft)

sq ft

.2860

6 T 32 (75.2 lb/sq ft)

sq ft

.3080

6 T 36 (80.7 lb/sq ft)

sq ft

.3310

6 T 40 (86.3 lb/sq ft)

sq ft

.3540

6 T 44 (91.8 lb/sq ft)

sq ft

.3760

6 T 48 (97.4 lb/sq ft)

sq ft

.3990

8 T 12 (48.7 lb/sq ft)

sq ft

.2000

8 T 16 (52.9 lb/sq ft)

sq ft

.2170

8 T 20 (57.1 lb/sq ft)

sq ft

.2340

8 T 24 (61.2 lb/sq ft)

sq ft

.2510

8 T 28 (65.4 lb/sq ft)

sq ft

.2680

8 T 32 (69.6 lb/sq ft)

sq ft

.2850

8 T 36 (73.8 lb/sq ft)

sq ft

.3030

8 T 40 (77.9 lb/sq ft)

sq ft

.3190

8 T 44 (82.1 lb/sq ft)

sq ft

.3370

8 T 48 (86.3 lb/sq ft)

sq ft

.3540

3.4	PRECAST CONCRETE (continued)	Unit	Labor Hour/Unit at Jobsite
3.4.2	Single Tees - Prestressed (continued)	lb	.0041
	10 T 12 (51.8 lb/sq ft)	sq ft	.2120
	10 T 16 (55.1 lb/sq ft)	sq ft	.2260
	10 T 20 (58.5 lb/sq ft)	sq ft	.2400
	10 T 24 (61.8 lb/sq ft)	sq ft	.2530
	10 T 28 (65.1 lb/sq ft)	sq ft	.2670
	10 T 32 (68.4 lb/sq ft)	sq ft	.2800
	10 T 36 (71.8 lb/sq ft)	sq ft	.2940
	10 T 40 (75.1 lb/sq ft)	sq ft	.3080
	10 T 44 (78.4 lb/sq ft)	sq ft	.3210
	10 T 48 (81.8 lb/sq ft)	sq ft	.3350
3.4.3	Double Tees - Prestressed	lb	.0041
	16½" x 4'-0" (60 lb/sq ft)	sq ft	.2460
	16½" x 4'-0" with 2" topping (85 lb/sq ft)	sq ft	.3460
	18" x 5'-0" (58 lb/sq ft)	sq ft	.2380
	18" x 5'-0" with 2" topping (83 lb/sq ft)	sq ft	.3400
	18" x 5'-0" with 3" topping (96 lb/sq ft)	sq ft	.3940
3.4.4	Topping for Precast Decks	lb	.0006
	2" (25 lb/sq ft)	sq ft	.1500
	3" (38 lb/sq ft)	sq ft	.0228
	4" (50 lb/sq ft)	sq ft	.0300
	6" (63 lb/sq ft)	sq ft	.0378

SECTION 4 - MASONRY

4.1	MORTAR	Unit	Labor Hour/Unit at Jobsite
4.1.1	Prepared Hydraulic and Masonry Cements	lb	.0024
4.2	BRICK MASONRY		
(Does not include energy for brick ties or reinforcement- see Section 4.4)			
4.2.1	Building or Common Brick		
	Common Brick (2¼" x 3 5/8" x 7 5/8")	1 brk	.0126
	Common brick wall including mortar (6.75 brk/sq ft)	sq ft	.0996
	Solid common brick wall including mortar, 8" thick (13.5 brk/sq ft)	sq ft	.2070

4.2 BRICK MASONRY (continued)	Unit	Labor Hour/Unit at Jobsite
4.2.1 Building or Common Brick (continued)		
Cavity wall with 4" thick common brick (6.75 brk/sq ft) and 4" thick concrete block backup, 4" x 8" x 16" units (1.13 blocks/sq ft) including mortar	sq ft	.1217
Cavity wall with 4" thick common brick (6.75 brk/sq ft) and 6" thick concrete block backup, 6" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	.1540
Cavity wall with 4" thick common brick (6.75 brk/sq ft) and 8" thick concrete block backup, 8" x 8" x 16" units (1.13 blocks/sq ft) including mortar	sq ft	.1630
Jumbo Brick (7 5/8" x 3 5/8" x 7 5/8")	1 brk	.0427
4" Thick jumbo brick wall including mortar, (2.25 brk/sq ft)	sq ft	.1030
8" Thick solid jumbo brick wall including mortar, (4.50 brk/sq ft)	sq ft	.4860
Cavity wall with 4" thick jumbo brick (2.25 brk/sq ft) and 4" thick concrete block backup, 4" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	.2610
Cavity wall with 4" thick jumbo brick (2.25 brk/sq ft) and 6" thick concrete block backup, 6" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	.2940
Cavity wall with 4" thick jumbo brick (2.25 brk/sq ft) and 8" thick concrete block backup, 8" x 8" x 16" units, (1.13 blocks/sq ft) including mortar	sq ft	.3030
4.2.2 Paving and Flooring Brick		
Clay Flooring Brick (2.25 x 3 5/8" x 7 5/8")	1 brk	.0226
Clay Flooring Brick (5.2 brk/sq ft)	sq ft	.1180
4.3 BLOCK AND TILE MASONRY		
4.3.1 Structural Facing Tile, 4" thick (5 1/3" x 12" x 4")	1 brk	.2880

4.3	BLOCK AND TILE MASONRY (continued)	Unit	Labor Hour/Unit at Jobsite
4.3.1	Structural Facing Tile (continued)		
	4" Thick Structural Facing Tile wall, including mortar (2.1 tiles/sq ft)	sq ft	.5540
	6" Thick Structural Facing Tile, (5 1/3" x 12" x 6")	1 brk	.3980
	6" Thick Structural Facing Tile wall including mortar (2.1 tiles/sq ft)	sq ft	.8630
	Structural Facing Tile, 8" thick (5 1/3" x 12" x 8")	1 brk	.5110
	8" Thick Structural Facing Tile wall including mortar (2.1 tiles/sq ft)	sq ft	1.1100
4.3.2	Concrete Block (4" x 4" x 16")	1 blk	.0155
	4" Thick Concrete Block wall, 4" x 4" x 16" units, including mortar (2.25 blocks/sq ft)	sq ft	.0390
	Concrete Block (6" x 4" x 16")	1 blk	.0228
	6" Thick Concrete Block wall, 6" x 4" x 16" units, including mortar (2.25 blocks/sq ft)	sq ft	.0556
	Concrete Block (8" x 4" x 16")	1 blk	.0264
	8" Thick Concrete Block wall, 8" x 4" x 16" units, including mortar (2.25 blocks/sq ft)	sq ft	.0644
	Concrete Block (4" x 8" x 16")	1 blk	.0311
	4" Thick Concrete Block wall, 4" x 8" x 16" units, including mortar (1.13 blocks/sq ft)	sq ft	.0382
	Concrete Block (6" x 8" x 16")	1 blk	.0455
	6" Thick Concrete Block wall, 6" x 8" x 16" units, including mortar (1.13 blocks/sq ft)	sq ft	.0548
	Concrete Block (8" x 8" x 16")	1 blk	.0529
	8" Thick Concrete Block wall, 8" x 8" x 16" units, including mortar (1.13 blocks/sq ft)	sq ft	.0636

4.4 BLOCK AND TILE MASONRY (continued)

4.3.2 Concrete Block (continued)

Concrete Block
(12" x 8" x 16") 1 blk .0821

12" Thick Concrete Block wall, 12" x 8" x 16" units,
including mortar (1.13 blocks/sq ft) sq ft .0972

4.4 MASONRY REINFORCING

(For standard reinforcing bars, see Section 3.2)

4.4.1 Truss Horizontal Reinforcing

	lb	.0183
4" Standard (.178 lb/lin ft)	lin ft	.0033
4" Extra heavy (.247 lb/lin ft)	lin ft	.0045
6" Standard (.180 lb/lin ft)	lin ft	.0033
6" Extra heavy (.250 lb/lin ft)	lin ft	.0046
8" Standard (.187 lb/lin ft)	lin ft	.0034
8" Extra heavy (.257 lb/lin ft)	lin ft	.0047
12" Standard (.207 lb/lin ft)	lin ft	.0038
12" Extra heavy (.276 lb/lin ft)	lin ft	.0051
16" Standard (.236 lb/lin ft)	lin ft	.0043
16" Extra heavy (.306 lb/lin ft)	lin ft	.0056

4.4.2 Ladder-Type Masonry Reinforcing

	lb	.0183
4" Standard (.125 lb/lin ft)	lin ft	.0023
4" Extra heavy (.195 lb/lin ft)	lin ft	.0036
6" Standard (.132 lb/lin ft)	lin ft	.0024
6" Extra heavy (.202 lb/lin ft)	lin ft	.0037
8" Standard (.139 lb/lin ft)	lin ft	.0025
8" Extra heavy (.210 lb/lin ft)	lin ft	.0038
12" Standard (.155 lb/lin ft)	lin ft	.0028
12" Extra heavy (.225 lb/lin ft)	lin ft	.0041
16" Standard (.171 lb/lin ft)	lin ft	.0031
16" Extra heavy (.241 lb/lin ft)	lin ft	.0044

SECTION 5 - METALS

5.1 METALS AND ALLOYS

5.1.1 Steel

Carbon Steel:		
sheets (plain)	lb	.0127
sheets (galvanized)	lb	.0210
structural shapes	lb	.0365
pipe	lb	.0195

Alloy Steel:		
Structural shapes	lb	.0203

Stainless Steel:		
sheets (cold rolled)	lb	.1040

5.1	METALS AND ALLOYS (continued)	Unit	Labor Hours/Unit at Jobsite
5.1.1	Steel (continued)		
	Stainless Steel:		
	sheets (hot rolled)	lb	.0679
	plates	lb	.1202
	bars (cold rolled)	lb	.1460
	bars (hot rolled)	lb	.1190
5.1.2	Aluminum		
	structural shapes	lb	.0643
	plates and sheet	lb	.0809
5.1.3	Copper		
	Unalloyed Copper:		
	structural shapes	lb	.0687
	sheets, strips	lb	.1020
	pipe	lb	.1070
	Copper Alloy:		
	structural shapes	lb	.0712
	sheets, strips	lb	.0924
	pipe	lb	.1040
5.2	STRUCTURAL METALS		
5.2.1	Structural Aluminum Shapes	lb	.0643
	I Beams		
	3 I 1.67 (1.96 lb/lin ft)	lin ft	.1260
	4 I 2.25 (2.64 lb/lin ft)	lin ft	.1700
	5 I 2.92 (3.43 lb/lin ft)	lin ft	.2210
	6 I 3.66 (4.30 lb/lin ft)	lin ft	.2770
	7 I 4.48 (5.27 lb/lin ft)	lin ft	.3390
	8 I 5.40 (6.35 lb/lin ft)	lin ft	.4080
	9 I 6.38 (7.51 lb/lin ft)	lin ft	.4830
	10 I 7.45 (8.76 lb/lin ft)	lin ft	.5630
	12 I 9.35 (10.99 lb/lin ft)	lin ft	.7070
	Wide Flange		
	2½ WF 1.80 (1.80 lb/lin ft)	lin ft	.1160
	4 WF 4.76 (4.76 lb/lin ft)	lin ft	.3010
	5 WF 6.49 (6.49 lb/lin ft)	lin ft	.4160
	6 WF 7.85 (7.85 lb/lin ft)	lin ft	.5050
	8 WF 10.72 (10.72 lb/lin ft)	lin ft	.6890
	10 WF 7.30 (7.30 lb/lin ft)	lin ft	.4690
	Channels		
	3 C 1.42 (1.42 lb/lin ft)	lin ft	.0913
	4 C 1.85 (1.85 lb/lin ft)	lin ft	.1190
	6 C 2.83 (2.83 lb/lin ft)	lin ft	.1820
	8 C 6.48 (6.48 lb/lin ft)	lin ft	.4170
	10 C 8.84 (8.84 lb/lin ft)	lin ft	.5560
	12 C 10.37 (10.37 lb/lin ft)	lin ft	.6670

5.2	STRUCTURAL METALS (continued)	Unit	Labor Hours/Unit at Jobsite
5.2.1	Structural Aluminum Shapes (continued)	lb	.0643
	Angles		
	1 1/2 x 1 1/2 x 1/8 (.43 lb/lin ft)	lin ft	.0276
	2 x 2 x 1/8 (.49 lb/lin ft)	lin ft	.0315
	2 x 2 x 1/4 (.94 lb/lin ft)	lin ft	.0604
	3 x 3 x 3/8 (2.47 lb/lin ft)	lin ft	.1590
	4 x 4 x 3/8 (2.86 lb/lin ft)	lin ft	.1840
	5 x 5 x 1/2 (5.58 lb/lin ft)	lin ft	.3590
	6 x 6 x 1/2 (6.75 lb/lin ft)	lin ft	.4340
5.2.2	Structural Steel Shapes	lb	.0365
	Wide Flange Shapes		
	W 4 x 13 (13 lb/lin ft)	lin ft	.4750
	W 5 x 16 (16 lb/lin ft)	lin ft	.5840
	W 6 x 20 (20 lb/lin ft)	lin ft	.7300
	W 8 x 24 (24 lb/lin ft)	lin ft	.8670
	W 10 x 29 (29 lb/lin ft)	lin ft	1.0590
	W 12 x 36 (36 lb/lin ft)	lin ft	1.3100
	W 14 x 38 (38 lb/lin ft)	lin ft	1.3900
	W 16 x 50 (50 lb/lin ft)	lin ft	1.8300
	W 18 x 60 (60 lb/lin ft)	lin ft	2.1900
	W 21 x 73 (73 lb/lin ft)	lin ft	2.6600
	W 24 x 94 (94 lb/lin ft)	lin ft	3.4300
	W 27 x 102 (102 lb/lin ft)	lin ft	3.7200
	W 30 x 116 (116 lb/lin ft)	lin ft	4.2300
	W 36 x 135 (135 lb/lin ft)	lin ft	4.9300
	Channels		
	C 3 x 6 (6 lb/lin ft)	lin ft	.2190
	C 4 x 7 (7.25 lb/lin ft)	lin ft	.2650
	C 5 x 9 (9 lb/lin ft)	lin ft	.3290
	C 6 x 13 (13 lb/lin ft)	lin ft	.4750
	C 7 x 14.75 (14.75 lb/lin ft)	lin ft	.5830
	C 8 x 18.75 (18.75 lb/lin ft)	lin ft	.6840
	C 9 x 20 (20 lb/lin ft)	lin ft	.7300
	C 10 x 30 (30 lb/lin ft)	lin ft	1.1000
	C 12 x 30 (30 lb/lin ft)	lin ft	1.1000
	C 15 x 50 (50 lb/lin ft)	lin ft	1.8300
	Angles		
	L 1 x 1 x 1/4 (1.49 lb/lin ft)	lin ft	.0544
	L 1 1/2 x 1 1/2 x 1/4 (2.34 lb/lin ft)	lin ft	.0854
	L 2 x 2 x 3/8 (4.7 lb/lin ft)	lin ft	.1720
	L 3 x 3 x 1/2 (9.4 lb/lin ft)	lin ft	.3430
	L 4 x 4 x 3/4 (18.5 lb/lin ft)	lin ft	.6750
	L 5 x 5 x 7/8 (27.2 lb/lin ft)	lin ft	.9930
	L 6 x 6 x 1 (37.4 lb/lin ft)	lin ft	1.3700

5.2	STRUCTURAL METALS (continued)	Unit	Labor Hours/Unit at Jobsite
5.2.2	Structural Steel Shapes (continued)	lb	.0365
	Structural Tees		
	WT 2 x 6.5 (6.5 lb/lin ft)	lin ft	.2370
	WT 3 x 8 (8 lb/lin ft)	lin ft	.2920
	WT 4 x 10 (10 lb/lin ft)	lin ft	.3650
	WT 5 x 12.5 (12.5 lb/lin ft)	lin ft	.4560
	WT 6 x 15.5 (15.5 lb/lin ft)	lin ft	.5660
	WT 8 x 20 (20 lb/lin ft)	lin ft	.7300
	WT 10 x 22 (22 lb/lin ft)	lin ft	.8030
5.2.3	Stainless Steel Shapes		
	Angles (Hot Rolled)	lb	.1190
	1" x 1" x 1/4" (1.49 lb/lin ft)	lin ft	.1770
	2" x 2" x 1/4" (3.19 lb/lin ft)	lin ft	.3800
	3" x 3" x 1/4" (4.90 lb/lin ft)	lin ft	.5830
	3" x 3" x 5/16" (6.10 lb/lin ft)	lin ft	.7620
	3" x 3" x 3/8" (7.20 lb/lin ft)	lin ft	.8570
	3" x 3" x 1/2" (11.10 lb/lin ft)	lin ft	1.3200
	Angles (Cold Rolled)	lb	.1460
	1/2" x 1/2" x 1/8" (.38 lb/lin ft)	lin ft	.0555
	3/4" x 3/4" x 1/8" (.59 lb/lin ft)	lin ft	.0861
	1" x 1" x 1/8" (.80 lb/lin ft)	lin ft	.1170
	1" x 1" x 3/16" (1.16 lb/lin ft)	lin ft	.1690
	2" x 2" x 1/8" (1.65 lb/lin ft)	lin ft	.2410
	2" x 2" x 3/16" (2.44 lb/lin ft)	lin ft	.3560
	Channels (Hot Rolled)	lb	.1190
	1" x 1/2" x 1/8" (.75 lb/lin ft)	lin ft	.0890
	1 1/2" x 1/2" x 1/8" (.96 lb/lin ft)	lin ft	.1140
	2" x 3/4" x 3/16" (2.02 lb/lin ft)	lin ft	.2400
	3" x 1 3/8" x 3/16" (4.10 lb/lin ft)	lin ft	.4880
	Channels (Cold Rolled)	lb	.1460
	1/2" x 1/2" x .093" (.40 lb/lin ft)	lin ft	.0584
	3/4" x 3/4" x .093" (.57 lb/lin ft)	lin ft	.0832
	1" x 1" x .109" (1.03 lb/lin ft)	lin ft	.1500
	1 1/4" x 1 1/4" x .109" (1.32 lb/lin ft)	lin ft	.1930
	2" x 2" x .125" (2.41 lb/lin ft)	lin ft	.3520
5.3	METAL JOISTS AND DECKS		
5.3.1	Longspan Steel Joists	lb	.0211
	18 LH 02 (13 lb/lin ft)	lin ft	.2740
	20 LH 05 (17 lb/lin ft)	lin ft	.3590

5.3	METAL JOISTS AND DECKS (continued)	Unit	Labor Hour/Unit at Jobsite
5.3.1	Longspan Steel Joists (continued)	lb	.0211
	24 LH 06 (19 lb/lin ft)	lin ft	.4010
	28 LH 09 (24 lb/lin ft)	lin ft	.5060
	32 LH 13 (36 lb/lin ft)	lin ft	.7600
	36 LH 15 (41 lb/lin ft)	lin ft	.8650
5.3.2	Metal Decking		
	Corrugated Steel Decking (Galvanized) 2½ x ½ inch	lb	.0210
	12 gauge .1084" thick (4.94 lb/sq ft)	sq ft	.1037
	14 gauge .0785" thick (3.58 lb/sq ft)	sq ft	.0752
	16 gauge .0635" thick (2.90 lb/sq ft)	sq ft	.0609
	18 gauge .0516" thick (2.35 lb/sq ft)	sq ft	.0494
	20 gauge .0396" thick (1.81 lb/sq ft)	sq ft	.0380
	22 gauge .0336" thick (1.53 lb/sq ft)	sq ft	.0321
	24 gauge .0276" thick (1.26 lb/sq ft)	sq ft	.0265
	26 gauge .0217" thick (0.99 lb/sq ft)	sq ft	.0208
	28 gauge .0187" thick (0.85 lb/sq ft)	sq ft	.0179
	29 gauge .0172" thick (0.78 lb/sq ft)	sq ft	.0164
5.4	MISCELLANEOUS AND ORNAMENTAL METALS		
5.4.1	Aluminum Railings (anodized)	lb	.0643
	1" outside diameter, .065" wall thickness (.225 lb/lin ft)	lin ft	.0145
	1" outside diameter, .083" wall thickness (.281 lb/lin ft)	lin ft	.0181
	1" outside diameter, .095" wall thickness (.318 lb/lin ft)	lin ft	.0204
	1½" outside diameter, .078" wall thickness (.338 lb/lin ft)	lin ft	.0217
	1½" outside diameter, .094" wall thickness (.402 lb/lin ft)	lin ft	.0258
	1½" outside diameter, .125" wall thickness (.520 lb/lin ft)	lin ft	.0334
	1½" outside diameter, .094" wall thickness (.488 lb/lin ft)	lin ft	.0314
	1½" outside diameter, .125" wall thickness (.635 lb/lin ft)	lin ft	.0408
	1½" outside diameter, .156" wall thickness (.775 lb/lin ft)	lin ft	.0498

5.4	MISCELLANEOUS AND ORNAMENTAL METALS (continued)	Unit	Labor Hour/Unit at Jobsite
5.4.1	Aluminum Railings (continued)	lb	.0643
	1½" outside diameter, .188" wall thickness (.911 lb/lin ft)	lin ft	.0586
	1½" outside diameter, .250" wall thickness (1.15 lb/lin ft)	lin ft	.0739
	2" outside diameter, .125" wall thickness (.866 lb/lin ft)	lin ft	.0557
	2" outside diameter, .156" wall thickness (1.06 lb/lin ft)	lin ft	.0682
	2" outside diameter, .188" wall thickness (1.26 lb/lin ft)	lin ft	.0810
	2" outside diameter, .250" wall thickness (1.62 lb/lin ft)	lin ft	.1040
	2" outside diameter, .313" wall thickness (1.95 lb/lin ft)	lin ft	.1250
	2" outside diameter, .375" wall thickness (2.25 lb/lin ft)	lin ft	.1450
5.4.2	Steel Railings	lb	.0221
	1.05" outside diameter, .113" wall thickness (1.13 lb/lin ft)	lin ft	.0250
	1.05" outside diameter, .154" wall thickness (1.54 lb/lin ft)	lin ft	.0340
	1.32" outside diameter, .133" wall thickness (1.68 lb/lin ft)	lin ft	.0371
	1.32" outside diameter, .179" wall thickness (2.17 lb/lin ft)	lin ft	.0480
	1.66" outside diameter, .140" wall thickness (2.27 lb/lin ft)	lin ft	.0502
	1.66" outside diameter, .191" wall thickness (3.00 lb/lin ft)	lin ft	.0663
	1.90" outside diameter, .145" wall thickness (2.72 lb/lin ft)	lin ft	.0601
	1.90" outside diameter, .200" wall thickness (3.63 lb/lin ft)	lin ft	.0802
	2.38" outside diameter, .154" wall thickness (3.65 lb/lin ft)	lin ft	.0807

5.4	MISCELLANEOUS AND ORNAMENTAL METALS (continued)	Unit	Labor Hour/Unit at Jobsite
5.4.2	Steel Railings (continued)	lb	.0221
	2.38" outside diameter, .218" wall thickness (5.18 lb/lin ft)	lin ft	.1150
5.4.3	Stainless Steel Railings (Cold Rolled)	lb	.1180
	1" outside diameter, .120" wall thickness (1.128 lb/lin ft)	lin ft	.1330
	1" outside diameter, .187" wall thickness (1.630 lb/lin ft)	lin ft	.1920
	1" outside diameter, .250" wall thickness (2.003 lb/lin ft)	lin ft	.2360
	1½" outside diameter, .083" wall thickness (1.256 lb/lin ft)	lin ft	.1480
	1½" outside diameter, .120" wall thickness (1.769 lb/lin ft)	lin ft	.2090
	1½" outside diameter, .187" wall thickness (2.634 lb/lin ft)	lin ft	.3110
	1½" outside diameter, .250" wall thickness (3.338 lb/lin ft)	lin ft	.3940
	1¾" outside diameter, .065" wall thickness (1.170 lb/lin ft)	lin ft	.1380
	1¾" outside diameter, .083" wall thickness (1.478 lb/lin ft)	lin ft	.1740
	1¾" outside diameter, .120" wall thickness (2.089 lb/lin ft)	lin ft	.2470
	1¾" outside diameter, .187" wall thickness (3.136 lb/lin ft)	lin ft	.3700
	2" outside diameter, .083" wall thickness (1.699 lb/lin ft)	lin ft	.2010
	2" outside diameter, .120" wall thickness (2.409 lb/lin ft)	lin ft	.2840
	2" outside diameter, .187" wall thickness (3.638 lb/lin ft)	lin ft	.4290
	2" outside diameter, .250" wall thickness (4.673 lb/lin ft)	lin ft	.5510

5.8	METAL FASTENERS	Unit	Labor Hour/Unit at Jobsite
5.8.1	Steel High Strength Bolts	lb	.0727
	1/2" diameter 1" length (.17 lb ea)	ea	.0124
	1/2" diameter 1 1/4" length (.18 lb ea)	ea	.0131
	1/2" diameter, 1 1/2" length (.19 lb ea)	ea	.0138
	1/2" diameter, 2" length (.22 lb ea)	ea	.0160
	1/2" diameter, 3" length (.27 lb ea)	ea	.0196
	1/2" diameter, 4" length (.33 lb ea)	ea	.0240
	1/2" diameter, 5" length (.39 lb ea)	ea	.0284
	1/2" diameter, 6" length (.44 lb ea)	ea	.0320
	5/8" diameter, 1" length (.29 lb ea)	ea	.0211
	5/8" diameter, 1 1/2" length (.33 lb ea)	ea	.0240
	5/8" diameter, 2" length (.37 lb ea)	ea	.0269
	5/8" diameter, 3" length (.46 lb ea)	ea	.0334
	5/8" diameter, 4" length (.55 lb ea)	ea	.0400
	5/8" diameter, 5" length (.63 lb ea)	ea	.0458
	5/8" diameter, 6" length (.72 lb ea)	ea	.0523
	5/8" diameter, 7" length (.81 lb ea)	ea	.0589
	1" diameter, 1 1/2" length (1.09 lb ea)	ea	.0792
	1" diameter, 2" length (1.19 lb ea)	ea	.0865
	1" diameter, 3" length (1.41 lb ea)	ea	.1030
	1" diameter, 4" length (1.62 lb ea)	ea	.1180
	1" diameter, 5" length (1.84 lb ea)	ea	.1340
	1" diameter, 6" length (2.07 lb ea)	ea	.1510
	1" diameter, 7" length (2.29 lb ea)	ea	.1670
	1" diameter, 8" length (2.51 lb ea)	ea	.1830
	1 1/2" diameter, 2" length (3.44 lb ea)	ea	.2500
	1 1/2" diameter, 3" length (3.91 lb ea)	ea	.2840
	1 1/2" diameter, 4" length (4.41 lb ea)	ea	.3210
	1 1/2" diameter, 5" length (4.90 lb ea)	ea	.3560
	1 1/2" diameter, 6" length (5.40 lb ea)	ea	.3930
	1 1/2" diameter, 7" length (5.89 lb ea)	ea	.4280
	1 1/2" diameter, 8" length (6.39 lb ea)	ea	.4650
5.8.2	Structural Rivets (High Button or Acorn Heads)	lb	.0475
	1/2" diameter, 1 1/2" length (.12 lb ea)	ea	.0057
	1/2" diameter, 2" length (.15 lb ea)	ea	.0071
	1/2" diameter, 3" length (.21 lb ea)	ea	.0100
	1/2" diameter, 4" length (.26 lb ea)	ea	.0124
	5/8" diameter, 2" length (.24 lb ea)	ea	.0114
	5/8" diameter, 3" length (.33 lb ea)	ea	.0157
	5/8" diameter, 4" length (.41 lb ea)	ea	.0195
	5/8" diameter, 5" length (.50 lb ea)	ea	.0238
	3/4" diameter, 2" length (.37 lb ea)	ea	.0176
	3/4" diameter, 3" length (.50 lb ea)	ea	.0238
	3/4" diameter, 4" length (.62 lb ea)	ea	.0295
	3/4" diameter, 5" length (.74 lb ea)	ea	.0352
	3/4" diameter, 6" length (.87 lb ea)	ea	.0413
	3/4" diameter, 7" length (1.00 lb ea)	ea	.0475
	1" diameter, 2" length (.72 ea)	ea	.0342
	1" diameter, 3" length (.94 lb ea)	ea	.0447
	1" diameter, 4" length (1.16 lb ea)	ea	.0551

6.1 ROUGH CARPENTRY (continued)	Unit	Labor Hour/Unit at Jobsite
6.1.2 Exterior Grade Plywood		
1/4" thick	sq ft	.0149
5/16" thick	sq ft	.0186
3/8" thick	sq ft	.0224
1/2" thick	sq ft	.0298
5/8" thick	sq ft	.0373
3/4" thick	sq ft	.0477
6.2 FINISH CARPENTRY		
6.2.1 Molding	bd ft	.0950
Base Molding		
1/2" x 3" (1/8 bd ft)	lin ft	.0120
1/2" x 4" (1/6 bd ft)	lin ft	.0160
6.2.2 Miscellaneous Hardwood	bd ft	.0427
1" x 1" (1/12 bd ft)	lin ft	.0036
1" x 2" (1/6 bd ft)	lin ft	.0071
1" x 3" (1/4 bd ft)	lin ft	.0107
1" x 4" (1/3 bd ft)	lin ft	.1420
6.2.3 Prefinished Paneling (1/8" thick)	sq ft	.0178
6.2.4 Exterior Siding		
Red Cedar Shingles	sq ft	.0450
Particleboard, 3/4" thick	sq ft	.0294
Plywood, 3/8" thick	sq ft	.0224
6.3 LAMINATED CONSTRUCTION		
6.3.1 Laminated Framing	bd ft	.0745
Net Finished Sizes		
2 1/4" x 9 3/4" (3 bd ft)	lin ft	.2240
5" x 6 1/2" (4 bd ft)	lin ft	.2980
5" x 8 1/8" (5 bd ft)	lin ft	.3730
5 1/4" x 9 3/4" (6 bd ft)	lin ft	.4470
7" x 9 3/4" (8 bd ft)	lin ft	.5960
9" x 9 3/4" (10 bd ft)	lin ft	.7450
7" x 14 5/8" (12 bd ft)	lin ft	.8940
9" x 14 5/8" (15 bd ft)	lin ft	1.1200
5" x 26" (16 bd ft)	lin ft	1.1900
7" x 24 3/8" (20 bd ft)	lin ft	1.4900

5.0	METAL FASTENERS (continued)	Unit	Labor Hour/Unit at Jobsite
5.8.2	Structural Rivets (continued)	lb	.0475
	1" diameter, 5" length (1.38 lb ea)	ea	.0656
	1" diameter, 6" length (1.61 lb ea)	ea	.0765
	1" diameter, 7" length (1.83 lb ea)	ea	.0869
	1" diameter, 8" length (2.05 lb ea)	ea	.0974
	1 1/4" diameter, 2" length (1.22 lb ea)	ea	.0580
	1 1/4" diameter, 3" length (1.56 lb ea)	ea	.0741
	1 1/4" diameter, 4" length (1.91 lb ea)	ea	.0907
	1 1/4" diameter, 5" length (2.26 lb ea)	ea	.1070
	1 1/4" diameter, 6" length (2.61 lb ea)	ea	.1240
	1 1/4" diameter, 7" length (2.95 lb ea)	ea	.1400
	1 1/4" diameter, 8" length (3.30 lb ea)	ea	.1570
5.8.3	Common Nails	lb	.0257

SECTION 6 - CARPENTRY

6.1	ROUGH CARPENTRY	Unit	Labor Hour/Unit at Jobsite
6.1.1	Softwood Framing	bd ft	.0331
	1 x 2 (1/6 bd ft)	lin ft	.0055
	1 x 3 (1/4 bd ft)	lin ft	.0083
	1 x 4 (1/3 bd ft)	lin ft	.0110
	1 x 6 (1/2 bd ft)	lin ft	.0166
	1 x 8 (2/3 bd ft)	lin ft	.0221
	2 x 2 (1/3 bd ft)	lin ft	.0110
	2 x 3 (1/2 bd ft)	lin ft	.0166
	2 x 4 (2/3 bd ft)	lin ft	.0221
	2 x 6 (1 bd ft)	lin ft	.0331
	2 x 8 (1 1/3 bd ft)	lin ft	.0441
	2 x 10 (1 2/3 bd ft)	lin ft	.0552
	2 x 12 (2 bd ft)	lin ft	.0662
	3 x 4 (1 bd ft)	lin ft	.0331
	3 x 6 (1 1/2 bd ft)	lin ft	.0497
	3 x 8 (2 bd ft)	lin ft	.0062
	3 x 10 (2 1/2 bd ft)	lin ft	.0828
	3 x 12 (3 bd ft)	lin ft	.0993
	4 x 4 (1 1/3 bd ft)	lin ft	.0441
	4 x 6 (2 bd ft)	lin ft	.0662
	4 x 8 (2 2/3 bd ft)	lin ft	.0882
	4 x 10 (3 1/2 bd ft)	lin ft	.1160
	4 x 12 (4 bd ft)	lin ft	.1320
	6 x 6 (3 bd ft)	lin ft	.0993
	6 x 8 (4 bd ft)	lin ft	.1320
	6 x 10 (5 bd ft)	lin ft	.1660
	8 x 8 (5 1/3 bd ft)	lin ft	.1770
	10 x 10 (8 1/3 bd ft)	lin ft	.2760
	12 x 12 (12 bd ft)	lin ft	.3970

SECTION 7 - MOISTURE PROTECTION

7.1	WATERPROOFING	Unit	Labor Hour/Unit at Jobsite
7.1.1	Asphalt Coating	Gal	.0248
7.1.2	Building Paper	lb	.0183
	1 ply (.05 lb/sq ft)	sq ft	.0009
	2 ply (.10 lb/sq ft)	sq ft	.0018
	3 ply (.15 lb/sq ft)	sq ft	.0027
	4 ply (.20 lb/sq ft)	sq ft	.0037
7.2	BUILDING INSULATION		
7.2.1	Insulating Board (wood fiber with cement, 22 lb/cu ft)	lb	.0267
	1" thick (1.83 lb/sq ft)	sq ft	.0489
	2" thick (3.67 lb/sq ft)	sq ft	.0980
	2½" thick (4.58 lb/sq ft)	sq ft	.1220
	3" thick (5.50 lb/sq ft)	sq ft	.1470
	3½" thick (6.42 lb/sq ft)	sq ft	.1710
	4" thick (7.34 lb/sq ft)	sq ft	.1960
7.2.2	Rigid Insulation (Polystyrene, 2.4 lb/cu ft)	lb	.1680
	1" thick (.20 lb/sq ft)	sq ft	.0336
	1½" thick (.30 lb/sq ft)	sq ft	.0504
	2" thick (.40 lb/sq ft)	sq ft	.0672
	2½" thick (.50 lb/sq ft)	sq ft	.0840
	3" thick (.60 lb/sq ft)	sq ft	.1010
	3½" thick (.70 lb/sq ft)	sq ft	.1180
	4" thick (.80 lb/sq ft)	sq ft	.1340
	4½" thick (.90 lb/sq ft)	sq ft	.1510
	5" thick (1.00 lb/sq ft)	sq ft	.1680
7.2.3	Batt Insulation (Mineral Wool)		
	2½" thick	sq ft	.0079
	3½" thick	sq ft	.0095
	4½" thick	sq ft	.0108
	5½" thick	sq ft	.0121
	6½" thick	sq ft	.0136
	7½" thick	sq ft	.0150
	9½" thick	sq ft	.0166
7.2.4	Loose Fiber Insulation (3 lb/cu ft)	lb	.0089
7.3	SHINGLES AND SIDING		
7.3.1	Asphalt Strip Shingles (Self sealing)	sq ft	.0148

7.3	SHINGLES AND SIDING (continued)	Unit	Labor Hour/Unit at Jobsite
7.3.2	Regular Asphalt Strip Shingles	sq ft	.0126
7.3.3	Red Cedar Shingles	sq ft	.0450
7.3.4	Aluminum Siding	lb	.0809
	8" wide horizontal siding .024" thick (.45 lb/sq ft)	sq ft	.0364
	4" wide horizontal siding .019" thick (.40 lb/sq ft)	sq ft	.0324
7.3.5	Asbestos Siding and Shingles	sq ft	.0360
7.4	ROOFING		
7.4.1	Rolled Asphalt Roofing	sq ft	.0039
7.4.2	Asphalt Saturated Felts (.05 lb/sq ft)	sq ft	.0068
7.4.3	Tar Saturated Felts (.15 lb/sq ft)	sq ft	.0084
7.4.4	Aluminum Roofing	lb	.0809
	Ribbed 4":		
	.027" thick (.55 lb/sq ft)	sq ft	.0445
	.032" thick (.73 lb/sq ft)	sq ft	.0591
	.040" thick (.90 lb/sq ft)	sq ft	.0728
	Corrugated		
	.024" thick (.42 lb/sq ft)	sq ft	.0340
	.032" thick (.55 lb/sq ft)	sq ft	.0445
	.040" thick (.69 lb/sq ft)	sq ft	.0558
	Standing Seam:		
	.032" thick (.58 lb/sq ft)	sq ft	.0469
	.040" thick (.73 lb/sq ft)	sq ft	.0591
	12" Vertical Panel		
	.032" thick (.64 lb/sq ft)	sq ft	.0518
	.040" thick (.80 lb/sq ft)	sq ft	.0647
7.4.5	Steel Roofing	lb	.0210
	2½" x ½" Corrugated		
	18 gauge (2.35 lb/sq ft)	sq ft	.0494

7.4	ROOFING (continued)	Unit	Labor Hour/Unit at Jobsite
7.4.5	Steel Roofing (continued)	lb	.0210
	2½"x ½" Corrugated (continued)		
	18 gauge (2.35 lb/sq ft)	sq ft	.0494
	20 gauge (1.81 lb/sq ft)	sq ft	.0380
	22 gauge (1.53 lb/sq ft)	sq ft	.0321
	24 gauge (1.26 lb/sq ft)	sq ft	.0265
	6" Ribbed:		
	18 gauge (2.84 lb/sq ft)	sq ft	.0596
	20 gauge (2.13 lb/sq ft)	sq ft	.0447
	22 gauge (1.73 lb/sq ft)	sq ft	.0363
	24 gauge (1.43 lb/sq ft)	sq ft	.0300
7.4.6	Copper Roofing	lb	.0924
	16 oz Standing Seam (1.25 lb/sq ft)	sq ft	.1160
	20 oz Batten Seam (1.55 lb/sq ft)	sq ft	.1430
7.4.7	Stainless Steel Roofing	lb	.1650
	28 gauge Continuous Weld (.72 lb/sq ft)	sq ft	.1190
	32 gauge Standing Seam (.58 lb/sq ft)	sq ft	.0957
7.4.8	Corrugated Plastic Roofing	lb	.1110
	2.67" Corrugations, 9/16" deep (.40 lb/sq ft)	sq ft	.0441
7.6	FLASHING		
7.6.1	Aluminum Flashing	lb	.0670
	.016" thick (.224 lb/sq ft)	sq ft	.0150
	.019" thick (.280 lb/sq ft)	sq ft	.0188
	.032" thick (.451 lb/sq ft)	sq ft	.0302
	.040" thick (.563 lb/sq ft)	sq ft	.0377
	.050" thick (.718 lb/sq ft)	sq ft	.0481
	Copper Flashing	lb	.0942
	10 oz (.625 lb/sq ft)	sq ft	.0578
	16 oz (1.00 lb/sq ft)	sq ft	.0924
	20 oz (1.25 lb/sq ft)	sq ft	.1160
	24 oz (1.50 lb/sq ft)	sq ft	.1390
	32 oz (2.00 lb/sq ft)	sq ft	.1850

7.6 FLASHING (continued)	Unit	Labor Hour/Unit at Jobsite
Stainless Steel Flashing	lb	.0611
30 gauge, .0125" thick (.526 lb/sq ft)	sq ft	.0321
28 gauge, .0156" thick (.656 lb/sq ft)	sq ft	.0401
26 gauge, .0188" thick (.788 lb/sq ft)	sq ft	.0481
24 gauge, .0250" thick (1.05 lb/sq ft)	sq ft	.0642
22 gauge, .0313" thick (1.31 lb/sq ft)	sq ft	.0800
20 gauge, .0375" thick (1.58 lb/sq ft)	sq ft	.0965
18 gauge, .0500" thick (2.10 lb/sq ft)	sq ft	.1280
16 gauge, .0625" thick (2.63 lb/sq ft)	sq ft	.1610
14 gauge, .0781" thick (3.28 lb/sq ft)	sq ft	.2000
Galvanized Steel Flashing	lb	.0210
30 gauge, .016" thick (.656 lb/sq ft)	sq ft	.0138
28 gauge, .019" thick (.781 lb/sq ft)	sq ft	.0164
26 gauge, .022" thick (.906 lb/sq ft)	sq ft	.0190
24 gauge, .028" thick (1.16 lb/sq ft)	sq ft	.0244
22 gauge, .034" thick (1.41 lb/sq ft)	sq ft	.0296
20 gauge, .040" thick (1.66 lb/sq ft)	sq ft	.0349
18 gauge, .052" thick (2.16 lb/sq ft)	sq ft	.0454
16 gauge, .064" thick (2.66 lb/sq ft)	sq ft	.0559
14 gauge, .080" thick (3.28 lb/sq ft)	sq ft	.0689

SECTION 8 - DOORS AND WINDOWS

8.1 METAL DOORS	Unit	Labor Hour/Unit at Jobsite
8.1.1 Flush Hollow Metal Doors		
(20 gauge with 22 gauge stiffeners)		
2'-0" x 6'-8"	ea	3.6800
2'-6" x 6'-8"	ea	4.6000
2'-8" x 6'-8"	ea	4.8100
3'-0" x 6'-8"	ea	5.5300
3'-4" x 6'-8"	ea	6.2200
3'-6" x 6'-8"	ea	6.4500
8.1.2 Flush Hollow Metal Doors		
(18 gauge with 22 gauge stiffeners)		
2'-0" x 6'-8"	ea	4.4600
2'-6" x 6'-8"	ea	5.5700
2'-8" x 6'-8"	ea	5.8600
3'-0" x 6'-8"	ea	6.7000
3'-4" x 6'-8"	ea	7.5200
8.1.2 Flush Hollow Metal Doors		
(16 gauge with 22 gauge stiffeners)		
2'-0" x 6'-8"	ea	5.2300
2'-6" x 6'-8"	ea	6.5600

8.1	METAL DOORS (continued)	Unit	Labor Hour/Unit at Jobsite
8.1.3	Flush Hollow Metal Doors (continued) (16 gauge with 22 gauge stiffeners)		
	2'-8" x 6'-8"	ea	6.9000
	3'-0" x 6'-8"	ea	7.8600
	3'-4" x 6'-8"	ea	8.8300
	3'-6" x 6'-8"	ea	9.1800
8.2	WOOD DOORS		
8.2.1	Wood Panel Doors		
	2'-4" x 6'-8"	ea	3.6300
	2'-6" x 6'-8"	ea	3.9000
	2'-8" x 6'-8"	ea	4.2900
	3'-0" x 6'-8"	ea	4.6800
	3'-4" x 6'-8"	ea	6.5900
8.2.2	Wood Hollow Core Doors		
	2'-4" x 6'-8"	ea	1.4300
	2'-6" x 6'-8"	ea	1.5300
	2'-8" x 6'-8"	ea	1.6300
	3'-0" x 6'-8"	ea	1.8600
	3'-4" x 6'-8"	ea	2.0400
8.2.3	Wood Solid Core Doors		
	2'-4" x 6'-8"	ea	4.9000
	2'-6" x 6'-8"	ea	5.2600
	2'-8" x 6'-8"	ea	5.6200
	3'-0" x 6'-8"	ea	6.3800
	3'-4" x 6'-8"	ea	7.0200
8.3	METAL WINDOWS		
8.3.1	Aluminum Residential Casement, Sliders, and Double Hung		
	(single glazed)		
	2'-0" x 3'-0"	ea	1.8600
	3'-0" x 4'-0"	ea	2.5800
	4'-0" x 4'-0"	ea	2.9300
	4'-0" x 6'-0"	ea	3.9200
	(double glazed)		
	2'-0" x 3'-0"	ea	1.9700
	3'-0" x 4'-0"	ea	2.8300
	4'-0" x 4'-0"	ea	3.3000
	4'-6" x 4'-0"	ea	3.7100
	4'-0" x 6'-0"	ea	4.4500

8.3	METAL WINDOWS (continued)	Unit	Labor Hour/Unit at Jobsite
8.3.2	Aluminum Commercial Casement, Sliders, Double Hung, and Pivot		
	(single glazed)		
	2'-0" x 3'-0"	ea	3.3000
	3'-0" x 4'-0"	ea	4.5700
	4'-0" x 4'-0"	ea	5.2700
	4'-0" x 6'-0"	ea	6.9300
	(double glazed)		
	2'-0" x 3'-0"	ea	3.4100
	3'-0" x 4'-0"	ea	4.9200
	4'-0" x 4'-0"	ea	7.6700
	4'-0" x 6'-0"	ea	7.4900
8.3.3	Fixed Commercial Windows		
	(single glazed)		
	2'-0" x 3'-0"	ea	1.3700
	3'-0" x 4'-0"	ea	2.0100
	4'-0" x 4'-0"	ea	2.3600
	4'-0" x 6'-0"	ea	3.0600
	(double glazed)		
	2'-0" x 3'-0"	ea	1.5000
	3'-0" x 4'-0"	ea	2.3000
	4'-0" x 4'-0"	ea	2.7500
	4'-0" x 6'-0"	ea	3.6700
8.4	WOOD WINDOWS		
8.4.1	Wood Casement, Double Hung or Sliders		
	(single glazed)		
	2'-0" x 3'-0"	ea	4.6400
	3'-0" x 4'-0"	ea	5.5200
	4'-0" x 4'-0"	ea	6.0000
	4'-0" x 6'-0"	ea	7.1800
	(double glazed)		
	2'-0" x 3'-0"	ea	4.9600
	3'-0" x 4'-0"	ea	6.2700
	4'-0" x 4'-0"	ea	7.2400
	4'-0" x 6'-0"	ea	8.7400
8.5	GLAZING		
8.5.1	Sheet Glass		
	Single Strength - 3/32" thick	sq ft	.0304
	Double Strength - 1/8" thick	sq ft	.0341

8.5	GLAZING (continued)	Unit	Labor Hour/Unit at Jobsite
8.5.2	Plate and Float Glass		
	1/8" thick	sq ft	.0831
	1/4" thick	sq ft	.0342
8.5.3	Tempered Glass	sq ft	.1610
8.5.4	Laminated Glass		
	Laminated Sheet Glass	sq ft	.2510
	Laminated Plate Glass	sq ft	.4270
8.6	HARDWARE (General Allowance - Labor Hour/sq ft of Building Type)		

Sector no.	Building type	Low	Average	High
23	Residential, one family	.0079	.0240	.0030
24	Residential, two-four family	.0014	.0240	.0031
25	Residential, garden apartments	.0170	.0260	.0031
26	Residential, high-rise apartments	.0156	.0170	.0180
27	Residential, alterations and additions	.0100*	.0130*	.0140*
28	Hotels and motels	.0440	.0480	.0520
29	Dormitories	.0611	.0650	.0690
30	Industrial buildings	.0069	.0090	.0410
31	Office buildings	.0380	.0490	.0690
32	Warehouses	.0045	.0056	.0059
33	Garages and service stations	.0066	.0084	.0095
34	Stores and restaurants	.0057	.0099	.0130
35	Religious buildings	.0330	.0440	.0510
36	Educational buildings	.0050	.0830	.1200
37	Hospital buildings	.1100	.1100	.1200
38	Other non-farm buildings	.0310	.0430	.0470
48	Farm residences	.0058	.0180	.0260
49	Farm service buildings	.0011	.0021	.0042

*Use this factor to determine labor allowance for entire project - multiply labor estimate subtotal by factor and add result to subtotal.

SECTION 9 - FINISHES

9.1	LATH, PLASTER AND DRYWALL	Unit	Labor Hour/Unit at Jobsite
9.1.1	Expanded Metal Lath	sq yd	.0692
9.1.2	Steel Studs	lb	.0141
	25 Gauge:		
	1 5/8" stud (.28 lb/lin ft)	lin ft	.0039
	2 1/2" stud (.32 lb/lin ft)	lin ft	.0045
	3 5/8" stud (.39 lb/lin ft)	lin ft	.0055
	4" stud (.42 lb/lin ft)	lin ft	.0059
	6" stud (.55 lb/lin ft)	lin ft	.0078

9.1	LATH, PLASTER AND DRYWALL (continued)	Unit	Labor Hour/Unit at Jobsite
9.1.2	Steel Studs (continued)		
	20 Gauge:		
	2 1/2" stud (.53 lb/lin ft)	lin ft	.0075
	3 5/8" stud (.67 lb/lin ft)	lin ft	.0094
	4" stud (.71 lb/lin ft)	lin ft	.0100
	6" stud (.94 lb/lin ft)	lin ft	.0133
9.1.3	Wood Studs	bd ft	.0331
	2 x 3 (1/2 bd ft/lin ft)	lin ft	.0166
	2 x 4 (2/3 bd ft/lin ft)	lin ft	.0221
	2 x 6 (1 bd ft/lin ft)	lin ft	.0331
9.1.4	Gypsum Plasterboard	lb	.0044
	1/2" thick (2 lb/sq ft)	sq ft	.0088
	3/8" thick (1.52 lb/sq ft)	sq ft	.0067
	5/8" thick (2.5 lb/sq ft)	sq ft	.0110
9.1.5	Partition Walls		
	2 x 3 wood studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	.0314
	2 x 4 wood studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	.0359
	2 x 6 wood studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	.0451
	2 1/2" 25 ga metal studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	.0213
	3 5/8" 25 ga metal studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	.0222
	4" 25 ga metal studs, 16" o.c., with 1/2" gyp bd both sides	sq ft	.0225
	2 1/2" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	.0269
	3 5/8" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	.0298
	4" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	.0303
	6" 20 ga metal studs, 16" o.c., with 5/8" gyp bd both sides	sq ft	.0330

9.2	TILE WORK	Unit	Labor Hour/Unit at Jobsite
9.2.1	Glazed Ceramic Tile	sq ft	.1690
9.2.2	Unglazed Ceramic Tile	sq ft	.1560
9.2.3	Quarry Tile	sq ft	.1260
9.3	FLOORING		
9.3.1	Vinyl Resilient Tile	lb	.1270
	.050" thick (.40 lb/sq ft)	sq ft	.0508
	.093" thick (.75 lb/sq ft)	sq ft	.0953
	.125" thick (1.00 lb/sq ft)	sq ft	.1270
9.3.2	Hardwood Flooring	bd ft	.0793
	25/32" thick (2/3 bd ft/sq ft)	sq ft	.0529
9.3.3	Softwood Flooring	bd ft	.0448
	3/4" thick (3/4 bd ft/sq ft)	sq ft	.0336
9.3.4	Asphalt Floor Tile	sq ft	.0331
9.3.5	Vinyl Asbestos Floor Tile	sq ft	.0400
9.4	PAINTING		
9.4.1	Exterior Oil-Base Paint	gal	.9950
	Exterior oil-base paint on wood walls or masonry (350 sq ft/gal per coat)	sq ft	.0028
	Exterior oil-base paint on exterior trim (525 sq ft/gal per coat)	sq ft	.0019
9.4.2	Exterior Water-Base Paint	gal	.9950
	Exterior water-base paint on exterior wood walls or masonry (350 sq ft/gal per coat)	sq ft	.0028
	Exterior water-base paint on exterior trim (525 sq ft/gal per coat)	sq ft	.0019
9.4.3	Interior Oil-Base Paint	gal	1.0400
	Interior oil-base paint on interior walls masonry, trim (475 sq ft/gal per coat)	sq ft	.0022
9.4.4	Interior Water-Base Paint	gal	.8890
	Interior water-base paint on interior walls masonry, trim (475 sq ft/gal per coat)	sq ft	.0019

SECTION 10 - SPECIALTIES
SECTION 11 - EQUIPMENT, CABINETS AND BUILT-IN FURNISHINGS

11.1 GENERAL ALLOWANCE - Labor Hour/ sq ft of Building Type

Sector no.	Building type	Low	Average	High
23	Residential, one family	.0530	.1600	.2000
24	Residential, two-four family	.0450	.1400	.1800
25	Residential, garden apartments	.1100	.1700	.2100
26	Residential, high-rise apartments	.1200	.1300	.1400
27	Residential, alterations and additions	.1200*	.1400*	.1500*
28	Hotels and motels	.0560	.0600	.0640
29	Dormitories	.0650	.0690	.0730
30	Industrial buildings	.0110	.0140	.0660
31	Office buildings	.0340	.0430	.0620
32	Warehouses	.0110	.0130	.0140
33	Garages and service stations	.0100	.0130	.0140
34	Stores and restaurants	.0130	.0530	.0720
35	Religious buildings	.0850	.0960	.1100
36	Educational buildings	.0720	.1200	.1700
37	Hospital buildings	.1500	.1500	.1800
38	Other non-farm buildings	.1000	.1100	.1200
48	Farm residences	.0500	.1500	.1900
49	Farm service buildings	.0061	.0084	.0097

*Use this factor to determine labor allowance for entire project - multiply labor estimate subtotal by factor and add result to subtotal.

11.2 KITCHEN APPLIANCES

Unit

Labor Hour/Unit at Jobsite

11.2.1 Electric Ranges

Free Standing:

23" to 32" wide	ea	24.2000
33" wide and over	ea	26.9000

Built-in:

Single oven	ea	18.6000
Twin oven	ea	41.6000
Surface cooking tops	ea	9.4100
Drop-in ranges	ea	23.1000

11.2.2 Gas Ranges

Free Standing:

24" to 32" wide	ea	18.7000
33" wide and over	ea	19.9000

Built-in (all types)

Surface cooking tops	ea	19.8000
	ea	7.4400

11.2.3 Refrigerators/Freezers

6.5 to 9.4 cubic feet	ea	18.1000
9.4 to 13.4 cubic feet	ea	21.6000
13.5 to 17.4 cubic feet	ea	31.1000
17.5 to 19.4 cubic feet	ea	43.2000

11.2	KITCHEN APPLIANCES (continued)	Unit	Labor Hour/Unit at Jobsite
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11.2.4	Laundry Equipment		
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Washing Machines (all types)	ea	24.2000
Dryers:		
Electric	ea	20.1000
Gas	ea	17.5000

SECTION 14 - CONVEYING SYSTEMS

14.1 GENERAL ALLOWANCE - Labor Hour/sq ft of Building Type

Sector no.	Building type	Low	Average	High
23	Residential, one family	----	----	----
24	Residential, two-four family	----	----	----
25	Residential, garden apartments	----	----	----
26	Residential, high-rise apartments	.0230	.0250	.0270
27	Residential, alterations and additions	----	----	----
28	Hotels and motels	.0110	.0190	.0200
29	Dormitories	.0160	.0190	.0210
30	Industrial buildings	.0014	.0032	.0120
31	Office buildings	.0482	.0530	.0740
32	Warehouses	.0014	.0028	.0096
33	Garages and service stations	.0030	.0036	.0045
34	Stores and restaurants	.0062	.0074	.0095
35	Religious buildings	----	----	----
36	Educational buildings	.0052	.0061	.0079
37	Hospital buildings	.0910	.0970	.1100
38	Other non-farm buildings	.0200	.0210	.0240
48	Farm residences	----	----	----
49	Farm service Buildings	----	----	----

SECTION 15 - MECHANICAL EQUIPMENT

15.1 PLUMBING (General Allowance -Labor Hour/sq ft by Building Type)

Sector no.	Building type	Low	Average	High
23	Residential, one family	.1500	.1700	.2600
24	Residential, two-four family	.1300	.1400	.2200
25	Residential, garden apartments	.1300	.1900	.2700
26	Residential, high-rise apartments	.0740	.0840	.0910
27	Residential, alterations and additions	.1400*	.1700*	.1800*
28	Hotels and motels	.1400	.1400	.1600
29	Dormitories	.1200	.1300	.1500
30	Industrial buildings	.1100	.1300	.1700
31	Office buildings	.0800	.0910	.0950
32	Warehouses	.0420	.0470	.0540
33	Garages and service stations	.0400	.0490	.0580
34	Stores and restaurants	.0460	.0670	.0750

15.1 MECHANICAL EQUIPMENT (General Allowance - Labor Hour/sq ft by Building Type, continued)

Sector no.	Building type	Low	Average	High
35	Religious buildings	.1200	.1600	.1900
36	Educational buildings	.2600	.2900	.3200
38	Other non-farm buildings	.1400	.1600	.1700
48	Farm residences	.1500	.1700	.2600
49	Farm service buildings	.0051	.0065	.0082

*Use this factor to determine labor allowance for entire project - multiply labor estimate subtotal by factor and add result to subtotal.

15.2 PIPE AND FITTINGS

	Unit	Labor Hour/Unit at Jobsite
15.2.1 Cast Iron Pipe (50 psi)	lb	.0056
4" diameter (19 lb/lin ft)	lin ft	.1060
6" diameter (30 lb/lin ft)	lin ft	.1680
8" diameter (42 lb/lin ft)	lin ft	.2350
10" diameter (52 lb/lin ft)	lin ft	.2910
12" diameter (73 lb/lin ft)	lin ft	.4090
14" diameter (85 lb/lin ft)	lin ft	.4760
16" diameter (105 lb/lin ft)	lin ft	.5880
18" diameter (128 lb/lin ft)	lin ft	.7170
20" diameter (140 lb/lin ft)	lin ft	.8340
24" diameter (198 lb/lin ft)	lin ft	1.1100
15.2.2 Copper Pipe	lb	.1070
1/4" diameter (.500 lb/lin ft)	lin ft	.0535
3/8" diameter (.750 lb/lin ft)	lin ft	.0803
1/2" diameter (.980 lb/lin ft)	lin ft	.1050
5/8" diameter (1.220 lb/lin ft)	lin ft	.1310
3/4" diameter (1.308 lb/lin ft)	lin ft	.1400
1" diameter (1.944 lb/lin ft)	lin ft	.2080
1 1/4" diameter (2.630 lb/lin ft)	lin ft	.2810
1 1/2" diameter (3.130 lb/lin ft)	lin ft	.3350
2" diameter (3.930 lb/lin ft)	lin ft	.4210
2 1/2" diameter (4.900 lb/lin ft)	lin ft	.5240
3" diameter (7.90 lb/lin ft)	lin ft	.8450
15.2.3 Plastic Pipe (200 psi)	lb	.1030
1 1/2" diameter (.340 lb/lin ft)	lin ft	.0350
2" diameter (.530 lb/lin ft)	lin ft	.0546
2 1/2" diameter (.780 lb/lin ft)	lin ft	.0803
3" diameter (1.16 lb/lin ft)	lin ft	.1200
4" diameter (1.91 lb/lin ft)	lin ft	.1970
5" diameter (2.93 lb/lin ft)	lin ft	.3020
6" diameter (4.61 lb/lin ft)	lin ft	.4750
8" diameter (7.05 lb/lin ft)	lin ft	.7260
10" diameter (10.02 lb/lin ft)	lin ft	1.0300
12" diameter (15.55 lb/lin ft)	lin ft	1.0600

15.2	PIPE AND FITTINGS (continued)	Unit	Labor Hour/Unit at Jobsite
15.2.4	Steel Pipe (Standard Weight)	lb	.0195
	1/2" diameter (.85 lb/lin ft)	lin ft	.0166
	3/4" diameter (1.13 lb/lin ft)	lin ft	.0220
	1" diameter (1.68 lb/lin ft)	lin ft	.0328
	1 1/4" diameter (2.27 lb/lin ft)	lin ft	.0443
	1 1/2" diameter (2.72 lb/lin ft)	lin ft	.0530
	2" diameter (3.65 lb/lin ft)	lin ft	.0712
	3" diameter (7.58 lb/lin ft)	lin ft	.1480
	4" diameter (10.79 lb/lin ft)	lin ft	.2100
	5" diameter (14.62 lb/lin ft)	lin ft	.2850
	6" diameter (18.79 lb/lin ft)	lin ft	.3660
	8" diameter (28.55 lb/lin ft)	lin ft	.5670
	10" diameter (40.48 lb/lin ft)	lin ft	.7890
	12" diameter (49.56 lb/lin ft)	lin ft	.9660
15.2.5	Bath and Shower Fittings		
	Combination bath and shower fittings (including single control faucets)	ea	3.4500
	Shower fittings (with shower head)	ea	2.3400
	Bath drains and overflows	ea	1.7800
15.2.6	Lavatory Fittings (including single control faucets)	ea	2.7300
15.2.7	Sink Fittings (including single control faucets)	ea	2.7200
15.3	PLUMBING FIXTURES		
15.3.1	Bathtubs		
	Cast iron (3'-0" x 5'-0")	ea	16.1000
	Steel (3'-0" x 5'-0")	ea	8.0600
15.3.2	Drinking Fountains (all types)	ea	10.5000
15.3.3	Lavatories		
	Cast Iron	ea	3.5900
	Steel	ea	1.7800
	Vitreous	ea	3.2200
15.3.4	Sink and Laundry Tray Combinations (all types)	ea	8.5900
15.3.5	Showerstalls (all types, including fittings)	ea	14.7000
15.3.6	Kitchen Sinks		
	Steel porcelain enameled	ea	3.1600
	Stainless steel	ea	6.0600

15.3	PLUMBING FIXTURES (continued)	Unit	Labor Hour/Unit at Jobsite	
15.3.7	Urinals (all types)	ea	10.5300	
15.3.8	Water Closets			
	Wall hung one-piece	ea	3.4000	
	Two-piece (with flush tank)	ea	6.2000	
15.4	PLUMBING APPLIANCES			
15.4.1	Residential Electric Water Heaters			
	Storage type for permanent installation (average)	ea	8.4000	
15.4.2	Residential Gas-Fired Water Heaters			
	Underfired Storage and sidearm types (average)	ea	8.3300	
15.4.3	Residential Oil-Fired Water Heaters			
	Underfired storage and sidearm (average)	ea	29.9000	
	Indirect water heaters (average)	ea	19.8000	
15.5	HVAC (General Allowance - Labor Hour/sq ft of Building Type)			
Sector no.	Building type	Low	Average	High
23	Residential, one family	.2400	.2400	.2600
24	Residential, two-four family	.2600	.2600	.2800
25	Residential, garden apartments	.2300	.2600	.3300
26	Residential, high-rise apartments	.1500	.1600	.1900
27	Residential, alterations and additions	.1200*	.1300*	.1400*
28	Hotels and motels	.2000	.2200	.2600
29	Dormitories	.2600	.3100	.3400
30	Industrial buildings	.1600	.2400	.3000
31	Office buildings	.3700	.4500	.4900
32	Warehouses	.0700	.0840	.0920
33	Garages and service stations	.1700	.1900	.2200
34	Stores and restaurants	.3100	.3100	.3700
35	Religious buildings	.2700	.2800	.2800
36	Educational buildings	.3900	.4700	.5300
37	Hospital buildings	.5200	.6500	.7200
38	Other non-farm buildings	.3200	.3700	.4100
48	Farm residences	.2400	.2400	.2600
49	Farm service buildings	.0920	.0110	.1300

*Use this factor to determine labor allowance for entire project - multiply labor estimate subtotal by factor and add result to subtotal.

15.6 HEATING	Unit	Labor Hour/Unit at Jobsite
15.6.1 Oil Burners		
Residential Atomizing (average)	ea	14.2600
Residential draft vaporizing and rotary (average)	ea	16.2600
Industrial low-pressure atomizing (average)	ea	186.0000
Industrial high-pressure atomizing (average)	ea	115.0000
Industrial rotary atomizing (average)	ea	374.0000
15.6.2 Gas Burners		
Gas conversion burners (average)	ea	28.5000
15.6.3 Boilers		
Residential cast iron	ea	104.0000
Steel - 294 sq ft of heating surface or less	ea	124.0000
Steel - 294 sq ft of heating surface, horizontal firebox type	ea	1110.0000
Steel - over 294 sq ft of heating surface, scotch type	ea	580.0000
15.6.3 Warm Air Furnaces - Forced Air Type		
Solid Fuel:		
150,000 Btu Bonnet and under	ea	78.4000
Over 150,000 Btu Bonnet output	ea	279.0000
Oil:		
150,000 Btu Bonnet output and under	ea	54.8000
Over 150,000 Btu Bonnet output	ea	115.0000
Gas:		
150,000 Btu Bonnet output and under	ea	36.1000
Over 150,000 Btu Bonnet output	ea	171.0000
15.6.4 Warm Air Furnaces - Gravity Flow Type		
Solid Fuel (average)	ea	45.4000
Gas (average)	ea	127.0000
15.6.5 Radiators and Convectors		
Cast iron - all types	sq ft	.2300
Residential aluminum, including baseboard and finned tube types	sq ft	.1250
Industrial and special types of aluminum	sq ft	.1540

15.6	HEATING (continued)	Unit	Labor Hour/Unit at Jobsite
15.6.6	Domestic Heating Stoves		
	Gas:		
	Vented Circulators	ea	18.9000
	Unvented Circulators	ea	6.2600
	Radiants	ea	5.7400
	Wood (sheet-metal air-tight types)	ea	1.1700
	Coal and Wood:		
	Circulators (standard and magazine types)	ea	22.7000
	Magazine radiants	ea	9.6700
	Kerosene, Gasoline and Fuel Oil:		
	Flue connected circulators and radiant circulators	ea	16.9000

SECTION 16 - ELECTRICAL

16.1 ELECTRICAL (General Allowance - Labor Hour/sq ft of Building Type)

Sector no.	Building type	Low	Average	High
23	Residential, one family	.0610	.0720	.0940
24	Residential, two-four family	.0790	.0900	.1200
25	Residential, garden apartments	.0890	.1100	.1500
26	Residential, high-rise apartments	.1300	.1300	.1400
27	Residential, alterations and additions	.2600*	.2800*	.2900*
28	Hotels and motels	.1400	.1800	.2000
29	Dormitories	.2000	.2100	.2400
30	Industrial buildings	.1300	.1700	.1900
31	Office buildings	.3000	.3200	.4000
32	Warehouses	.0630	.0770	.0890
33	Garages and service stations	.0490	.0529	.0590
34	Stores and restaurants	.1700	.1900	.2100
35	Religious buildings	.1400	.1500	.1800
36	Educational buildings	.4000	.4700	.4100
37	Hospital buildings	.4700	.5700	.6200
38	Other non-farm buildings	.2100	.2500	.2600
48	Farm residences	.0610	.0720	.0940
49	Farm service buildings	.0220	.0240	.0250

*Use this factor to determine labor allowance for entire project - multiply labor estimate subtotal by factor and add result to subtotal.

16.2	CONDUCTORS	Unit	Labor Hour/Unit at Jobsite
16.2.2	Copper Stranded Wire (bare wire weight does not include insulation)	lb	.0942
	No. 18 (.0050 lb/lin ft)	lin ft	.0005
	No. 16 (.0077 lb/lin ft)	lin ft	.0007
	No. 14 (.0124 lb/lin ft)	lin ft	.0012
	No. 12 (.0197 lb/lin ft)	lin ft	.0019

16.2 CONDUCTORS (continued)	Unit	Labor Hour/Unit at Jobsite
16.2.2 Copper Stranded Wire (continued)		
No. 10 (.0313 lb/lin ft)	lin ft	.0029
No. 8 (.0502 lb/lin ft)	lin ft	.0047
No. 6 (.1034 lb/lin ft)	lin ft	.0097
No. 4 (.1622 lb/lin ft)	lin ft	.0153
No. 2 (.2586 lb/lin ft)	lin ft	.0244
No. 1 (.3360 lb/lin ft)	lin ft	.0317
16.2.3 Aluminum Stranded Wire (bare wire weight/lin ft, does not include insulation)		
	lb	.1640
No. 18 (.0014 lb/lin ft)	lin ft	.0002
No. 16 (.0023 lb/lin ft)	lin ft	.0004
No. 14 (.0036 lb/lin ft)	lin ft	.0006
No. 12 (.0058 lb/lin ft)	lin ft	.0010
No. 10 (.0093 lb/lin ft)	lin ft	.0015
No. 8 (.0149 lb/lin ft)	lin ft	.0024
No. 6 (.0209 lb/lin ft)	lin ft	.0034
No. 4 (.0481 lb/lin ft)	lin ft	.0079
No. 2 (.0767 lb/lin ft)	lin ft	.0126
No. 1 (.0997 lb/lin ft)	lin ft	.0164

Table 11.1 Labor Hours in Typical Building Assemblies - Reinforced Concrete System

Table 11—Labor Hours in Typical Building Assemblies: Reinforced Concrete System

Direct Labor

Item	Crew	Daily output		Work required		Labor hours
		Labor Hours	Quantity	Quantity	Percent of daily crew output	
Concrete: 24" waffle slab including form and reinforcing	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	750 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

Total

181.7

Embodied Labor

Item	CAC sectors (399 order)		Quantity	Labor hour/unit	Total embodied labor hours
	Number	Name			
Concrete	206	Ready-mix concrete	26.56 CY	2.47	65.60
Reinforcing bars	217	Steel products	440 lb	.01	44.00
Wire mesh			711 lb	.02	14.22
3/4" Plywood forms (4 uses)	139	Veneer, plywood	900 SF	.05	45.00

Total

168.82

Table 11.2 Labor Hours in Typical Building Assemblies - Composite Steel System

Direct Labor

Item	Crew	Daily output		Work required		Labor hours
		Labor Hours	Quantity	Quantity	Percent of daily crew output	
Bolted structural steel	E2	64	6.5 T	2.4 T	0.37	23.6
Steel deck	E5	72	8600 SF	900 SF	0.10	7.2
Reinforcing mesh	2 Rodm	16	34 CSF	9 CSF	0.26	4.2
Reinforcing bars no.4	4Rodm	32	2.5 T	0.2 T	0.08	2.6
4" Concrete deck	C8	56	1850 SF	900 SF	0.49	27.4
Ceiling suspension system	1Carp	8	450 SF	900 SF	1.91	15.3
½" Gypsum board	2Carp	16	1800 SF	900 SF	0.50	8.0
Taping and finishing	2Carp	16	2000 SF	900 SF	0.45	7.2

Total 95.5

Embodied Labor

Item	CAC sectors (399 order)		Quantity	Labor hour/unit	Total embodied labor hours
	Number	Name			
Structural steel	241	Fabricated structural steel	5112.4 lb	.04	204.50
Wire hangers			17 lb	.03	.51
Steel deck	217	Steel Products	1935 lb	.02	38.70
Reinforced mesh			270 lb	.02	5.40
Reinforced bars			401 lb	.01	4.01
Bolts, studs	246	Screw machine products	272 lb	.07	19.04
Concrete	206	Ready-mix concrete	11.11 cu yd	2.47	27.44
Gypsum board	208	Gypsum products	0.90 T	8.80	7.92

Total 307.52

Table 11.3 Labor Hours in Typical Building Assemblies - Standard Steel System

Direct Labor

Item	Crew	Daily output		Work required		Labor hours
		Labor Hours	Quantity	Quantity	Percent of daily crew output	
Bolted structural steel	E2	64	6.5 T	3.2 T	0.49	31.4
Steel deck	E5	72	8600 SF	900 SF	0.10	7.2
Concrete reinforcing	2Rodmn	16	34 CSF	9 CSF	0.26	4.2
4" Concrete deck	C8	56	1850 SF	900 SF	0.49	27.4
Ceiling suspension system	1Carp	8	450 SF	900 SF	1.91	15.3
½" Gypsum board	2Carp	16	1800 SF	900 SF	0.50	8.0
Taping and finishing	2Carp	16	200 SF	900 SF	0.45	7.2
Total						100.7

Embodied Labor

Item	CAC sectors (399 order)		Quantity	Labor hour/unit	Total embodied labor hours
	Number	Name			
Structural steel	240	Fabricated structural steel	7002 lb	.04	280.88
Wire hangers			17 lb	.03	.51
Steel deck	217	Steel products	1935 lb	.02	38.70
Reinforcing mesh			270 lb	.02	5.40
Bolts	246	Screw machine products	20 lb	.07	1.40
Concrete	206	Ready-mix concrete	11.11 CY	2.47	27.44
Gypsum board	208	Gypsum products	0.90 T	8.80	7.92
Total					361.45

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Appendices

There are three Appendices. Appendix A outlines the procedures used for deriving the data used throughout the manual. Appendix B reports the total primary energy intensities for the 399 Industrial sectors contained in the energy input output matrix produced by the Energy Research Group at the University of Illinois at Urbana. These figures are reported in Btu per Btu (i.e. reflecting the energy required to manufacture the final energy product). Appendix C reports the total primary labor intensities for

the 399 Industrial sectors. These figures represent units of full time employment (i.e. labor years) per dollar (1967). With the exception of the five energy sectors which are reported as units of full time employment per Btu. Appendix D lists all of the 399 Industrial Sectors which sell their products to New Building Construction and provides a brief description of the products and services contained in each.

Appendix A—Methodology

The data in Chapters 2 through 5 are taken directly from Hannon and Stein in ENERGY USE FOR BUILDING CONSTRUCTION (EBC) Report and Supplement. The format of this material has been reorganized to facilitate its use by design professional. The material in Chapter 6 is based on statistics developed in EBC which have been modified for ease of use. A sample of the original presentation of data is presented in Figure A-1.

In order to determine the energy embodied in specific units of building material, it was necessary first to determine the dollar per unit of that material. This was done by dividing the dollar values of total annual sales by the number of units of material involved in those sales for each industry in question, yielding the cost per unit. The energy intensity figures were then applied to these costs to determine the embodied energy per unit.¹⁰ Two sets of energy intensity figures were used. The first describes the sum of all energy requires to produce the particular material up to the point at which it is ready to be sold to the construction industry. This includes all energy required for extraction and processing of raw materials, transportation of these materials, refinement, fabrication, and so forth, but does not include the energy required in the transactions between the supply industry and the construction industry or the transportation between the supply industry and the construction industry or the transportation from the supplier to the construction site. These energy costs are called margins. The second set of energy intensities describe these margins. Energy intensities, including the margins, are reported in Appendix B.

In eight cases, the reporting of energy per unit of material

or piece of equipment was either always or partially impractical. For these cases allowances have been developed. These allowances have been generated in the following way. First, the total Btu per square foot of each building type noted. Second, the 399 order sectors which contribute to each allowance were identified. For example, in the case of the direct energy allowance, the sectors would be numbers 1 through 5- Coal mining, crude petroleum, refined petroleum, electric utilities and gas utilities. Third, the percentage which each of these contributing sectors represented for each of the 18 New Building Construction sectors was determined from data contained within the energy input/output model. These fractions were then totalled and this total multiplied by the overall square foot. This figure represents the average Btu per square foot for the allowance category for each of the new building construction sectors. Because of the tremendous variations from building to building within a single category, ranges for each figure were established based on reported patterns of building cost variations and professional judgement.

The materials in Chapters 7 and 8 are direct applications of the data in Chapter 6. The material in Chapter 9 is the direct recording of the data contained within the energy input/output matrix. The material in Chapter 10 was developed for EBC and has been reorganized here for ease of use. The material in Chapter 11 represents the application of the labor intensities contained in Appendix C to the construction materials contained in Chapter 6. The unit for labor has been changed from units of full time employment (FTE) to hours of labor, using a multiplier of 2111.2 hours of labor per unit of full time employment. This is based on data from the Bureau of Labor Statistics.

Figure A-1

1967 ENERGY EMBODIMENT PER UNIT OF MATERIAL

PRIMARY IRON & STEEL

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)
217	331	STEEL PRODUCTS ¹	-	-	-	-	266,980	-	13,910	-	-
	33151	NONINSULATED FERROUS WIRE	-	-	-	-	-	-	-	-	-
	33151, 35	WIRE STRAND FOR PRESTRESSED CONCRETE	LB	119.6	19.0	.1589	"	42,423	"	2,210	44,633

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Appendix B Total Primary Energy Intensities - 399 Order, 1967

Appendix B—Total Primary Energy Intensities - 399 Order, 1967
(First Five in Btu/Btu; Rest in Btu/\$)

399 Order	I/O	Name	Primary Energy Intensity	Margin	Total Energy Intensity
1	700	Coal mining	.10068E+05	0.	.10068E+01
2	800	Crude petro, gas	.10574E+01	0.	.10574E+01
3	3101	Petro refin prod	.11981E+01	.16333E-01	.12145E+01
4	6801	Electric util	.37893E+01	0.	.37893E+01
5	6802	Gas utilities	.11015E+01	0.	.11015E+01
6	101	Dairy	.62204E+05	0.	.62204E+05
7	102	Poultry, eggs	.77872E+05	0.	.77872E+05
8	103	Meat, animal prod	.65295E+05	0.	.65295E+05
9	201	Cotton	.10064E+06	0.	.10064E+06
10	202	Feed grains	.68823E+05	.68610E+05	.13743E+06
11	203	Tobacco	.63300E+05	0.	.63300E+05
12	204	Fruits	.43621E+05	0.	.43621E+05
13	205	Vegt, misc crops	.42874E+05	0.	.42874E+05
14	206	Oil bearing crop	.51053E+05	0.	.51053E+05
15	207	For, grhouse, nurs	.55895E+05	.88274E+04	.64722E+05
16	300	Forest fish prod	.65207E+05	0.	.65207E+05
17	400	Ag for, fish ser	.33760E+05	0.	.33760E+05
18	500	Iron ore mining	.12730E+06	0.	.12730E+06
19	601	Copper mining	.13023E+06	0.	.13023E+06
20	602	Nonferr mining	.12796E+06	0.	.12796E+06
21	900	Stone clay mining	.10415E+06	.31048E+05	.13520E+06
22	1000	Chem mineral mining	.19834E+06	0.	.19834E+06
23	110101	New const Res - 1 fam	.56570E+05	0.	.56570E+05
24	110102	New const Res - 2-4 fam	.53014E+05	0.	.53014E+05
25	110103	New const Res - garden apt	.54155E+05	0.	.54155E+05
26	110104	New const Highrise apt	.60693E+05	0.	.60693E+05
27	110105	New const Res - alt, add	.52145E+05	0.	.52145E+05
28	110106	New const Hotel, motel	.70223E+05	0.	.70223E+05
29	110107	New const Dormitories	.72379E+05	0.	.72379E+05
30	110201	New const Indust bldg	.71698E+05	0.	.71698E+05
31	110202	New const Office bldg	.69812E+05	0.	.69812E+05
32	110203	New const Warehouses	.78621E+05	0.	.78621E+05
33	110204	New const Car, srv sta	.77868E+05	0.	.77868E+05
34	110205	New const Store, restrnt	.74654E+05	0.	.74654E+05
35	110206	New const Relig bldg	.66434E+05	0.	.66434E+05
36	110207	New const Educ bldg	.68802E+05	0.	.68802E+05
37	110208	New const Hospital bldg	.61228E+05	0.	.61228E+05
38	110209	New const Other non-farm	.70921E+05	0.	.70921E+05
39	110301	New const Phone, teleg	.67809E+05	0.	.67809E+05
40	110302	New const Railroads	.78933E+05	0.	.78933E+05
41	110303	New const Elect util	.67940E+05	0.	.67940E+05
42	110304	New const Gas util	.14627E+06	0.	.14627E+06
43	110305	New const Petrol pipe	.15508E+06	0.	.15508E+06
44	110306	New const Water supply	.75689E+05	0.	.75689E+05
45	110307	New const Sewer	.79125E+05	0.	.79125E+05
46	110308	New const Loc transit	.64167E+05	0.	.64167E+05
47	110400	New const Highways	.13137E+06	0.	.13137E+06
48	110501	New const Farm resid	.54449E+05	0.	.54449E+05
49	110502	New const Farm service	.76185E+05	0.	.76185E+05
50	110503	New const Oil/Gas wells	.12246E+06	0.	.12246E+06
51	110504	New const Oil/Gas explor	.10313E+06	0.	.10313E+06
52	110505	New const Military	.80115E+05	0.	.80115E+05
53	110506	New const Conserv devlp	.91464E+05	0.	.91464E+05
54	110507	New const Oth non-bldg	.94037E+05	0.	.94037E+05
55	120100	Maint const Residence	.50718E+05	0.	.50718E+05
56	120201	Maint const Oth non-farm	.51004E+05	0.	.51004E+05
57	120202	Maint const Farm resid	.72199E+05	0.	.72199E+05
58	120203	Maint const Farm service	.99176E+05	0.	.99176E+05
59	120204	Maint const Phone, teleg	.36619E+05	0.	.36619E+05
60	120205	Maint const Railroads	.43827E+05	0.	.43827E+05
61	120206	Maint const Elect util	.27056E+05	0.	.27056E+05
62	120207	Maint const Gas util	.87397E+05	0.	.87397E+05
63	120208	Maint const Petrol pipe	.12534E+06	0.	.12534E+06
64	120209	Maint const Water supply	.64693E+05	0.	.64693E+05
65	120210	Maint const Sewer	.46974E+05	0.	.46974E+05

Appendix B Total Primary Energy Intensities - 399 Order, 1967 (continued)

399 Order	I/O	Name	Primary Energy Intensity	Margin	Total Energy Intensity
66	120211	Maint const Loc transit	.50406E+05	0.	.50406E+05
67	120212	Maint const Military	.65649E+05	0.	.65649E+05
68	120213	Maint const Conser devel	.10597E+06	0.	.10597E+06
69	120214	Maint const Highways	.82373E+05	0.	.82373E+05
70	120215	Main const Oil/Gas wells	.11442E+06	0.	.11442E+06
71	120216	Maint const Oth non-bldg	.67910E+05	0.	.67910E+05
72	1301	Guided missiles	.29808E+05	0.	.29808E+05
73	1302	Ammunition	.95185E+05	0.	.95185E+05
74	1303	Tanks	.99282E+05	0.	.99282E+05
75	1304	Fire control equip	.41160E+05	0.	.41160E+05
76	1305	Small arms	.50164E+05	0.	.50164E+05
77	1306	Small arms ammun	.89451E+05	0.	.89451E+05
78	1307	Other Ordnance	.67846E+05	0.	.67846E+05
79	1401	Meat products	.68280E+05	0.	.68280E+05
80	1402	Butter	.78345E+05	0.	.78345E+05
81	1403	Cheese	.72443E+05	0.	.72443E+05
82	1404	Condensed milk	.76151E+05	0.	.76151E+05
83	1405	Ice cream	.61082E+05	0.	.61082E+05
84	1406	Fluid milk	.60329E+05	0.	.60329E+05
85	1407	Canned sea foods	.59203E+05	0.	.59203E+05
86	1408	Canned specialty	.72649E+05	0.	.72649E+05
87	1409	Canned fruit, veg	.74342E+05	0.	.74342E+05
88	1410	Dehydrated prod	.65600E+05	0.	.65600E+05
89	1411	Pickles, dressing	.71490E+05	0.	.71490E+05
90	1412	Fish	.60029E+05	0.	.60029E+05
91	1413	Frozen fruit, veg	.73058E+05	0.	.73058E+05
92	1414	Flour, cereals	.68989E+05	0.	.68989E+05
93	1415	Prep animal feed	.81860E+05	0.	.81860E+05
94	1416	Rice milling	.64811E+05	0.	.64811E+05
95	1417	Wet corn milling	.12568E+06	0.	.12568E+06
96	1418	Bakery products	.47002E+05	0.	.47002E+05
97	1419	Sugar	.11694E+06	0.	.11694E+06
98	1420	Confectionery	.56273E+05	0.	.56273E+05
99	1421	Alcoholic bev	.44061E+05	0.	.44061E+05
100	1422	Soft drinks	.59105E+05	0.	.59105E+05
101	1423	Flavorings	.48994E+05	0.	.48994E+05
102	1424	Cottonseed mills	.11680E+06	0.	.11680E+06
103	1425	Soybean mills	.74179E+05	0.	.74179E+05
104	1426	Veg oil mills	.61457E+05	0.	.61457E+05
105	1427	Animal fats	.10781E+06	0.	.10781E+06
106	1428	Coffee	.31500E+05	0.	.31500E+05
107	1429	Cooking oils	.86897E+05	0.	.86897E+05
108	1430	Manufactured ice	.13661E+06	0.	.13661E+06
109	1431	Macaroni	.58251E+05	0.	.58251E+05
110	1432	Food preparation	.58748E+05	0.	.58748E+05
111	1501	Cigarettes	.28440E+05	0.	.28440E+05
112	1502	Tobacco stemming	.55182E+05	0.	.55182E+05
113	1601	Broad fab mills	.99040E+05	.31342E+04	.10218E+06
114	1602	Narrow fabric mills	.79507E+05	0.	.79507E+05
115	1603	Yarn mills	.10166E+06	0.	.10166E+06
116	1604	Thread mills	.91399E+05	0.	.91399E+05
117	1701	Floor coverings	.90006E+05	.58002E+04	.95807E+05
118	1702	Felt goods	.62375E+05	0.	.62375E+05
119	1703	Lace goods	.74382E+05	0.	.74382E+05
120	1704	Upholstery fill	.64615E+05	0.	.64615E+05
121	1705	Proc tes waste	.66822E+05	0.	.66822E+05
122	1706	Coated fabrics	.94003E+05	.35741E+04	.97577E+05
123	1707	Tire cord	.14282E+06	0.	.14282E+06
124	1708	Scouring plants	.59046E+05	0.	.59046E+05
125	1709	Cordage, twine	.67438E+05	.93811E+04	.76819E+05
126	1710	Textile goods	.78321E+05	0.	.78321E+05
127	1801	Hosiery	.67638E+05	0.	.67638E+05
128	1802	Knit apprl mills	.63154E+05	0.	.63154E+05
129	1803	Knit fab mills	.10495E+06	0.	.10495E+06
130	1804	Apparl, purch mat	.50329E+05	.64072E+04	.56736E+05
131	1901	Curtains	.65352E+05	0.	.65352E+05
132	1902	Housefurnishings	.82860E+05	0.	.82860E+05
133	1903	Fab textile prod	.61992E+05	0.	.61992E+05
134	2001	Logging	.54443E+05	0.	.54443E+05
135	2002	Sawmills	.65323E+05	.29768E+05	.95091E+05

Appendix B Total Primary Energy Intensities - 399 Order, 1967 (continued)

399 Order	I/O	Name	Primary Energy Intensity	Margin	Total Energy Intensity
136	2003	Hardwood flooring	.55547E+05	.30486E+05	.86032E+05
137	2004	Spec prod sawmil	.39339E+05	.22127E+05	.61466E+05
138	2005	Millwork	.47381E+05	.15775E+05	.63156E+05
139	2006	Veneer, plywood	.67761E+05	.21372E+05	.89132E+05
140	2007	Prefab wd struc	.55214E+05	.77510E+04	.62965E+05
141	2008	Wood preserving	.10066E+06	.81042E+04	.10877E+06
142	2009	Wood products	.71368E+05	.16017E+05	.87385E+05
143	2100	Wood containers	.48756E+05	0.	.48756E+05
144	2201	Wood h'hold furn	.46085E+05	.36507E+04	.49736E+05
145	2202	Uph h'hold furn	.47621E+05	0.	.47621E+05
146	2203	Met h'hold furn	.89353E+05	.48010E+04	.94154E+05
147	2204	Mattresses	.60160E+05	0.	.60160E+05
148	2301	Wood office furn	.49753E+05	0.	.49753E+05
149	2302	Metal office furn	.69068E+05	0.	.69068E+05
150	2303	Public bldg furn	.63684E+05	.64627E+04	.70147E+05
151	2304	Wood fixtures	.47926E+05	.47752E+04	.52701E+05
152	2305	Met fixtures	.84198E+05	.71482E+04	.91346E+05
153	2306	Blinds, shades	.76537E+05	0.	.76537E+05
154	2307	Furn, fixtures	.61355E+05	0.	.61355E+05
155	2401	Pulp mills	.19992E+06	0.	.19992E+06
156	2402	Paper mills	.20069E+06	0.	.20069E+06
157	2403	Paperboard mills	.21861E+06	0.	.21861E+06
158	2404	Envelopes	.87437E+05	.97986E+04	.97235E+05
159	2405	Sanit paper prod	.10245E+06	0.	.10245E+06
160	2406	Building paper	.18994E+06	.35177E+05	.22511E+06
161	2407	Conv paper prod	.10420E+06	.72379E+04	.11144E+06
162	2500	Paperboard cont	.11825E+06	0.	.11825E+06
163	2601	Newspapers	.54585E+05	0.	.54585E+05
164	2602	Periodicals	.52492E+05	0.	.52492E+05
165	2603	Book publishing	.45727E+05	.54531E+04	.51180E+05
166	2604	Misc publishing	.35070E+05	0.	.35070E+05
167	2605	Comm printing	.70999E+05	0.	.70999E+05
168	2606	Business forms	.67514E+05	0.	.67514E+05
169	2607	Greeting cards	.42267E+05	0.	.42267E+05
170	2608	Misc printing	.37810E+05	0.	.37810E+05
171	2701	Inorg-org chem	.28172E+06	.28956E+04	.28461E+06
172	2702	Fertilizers	.17362E+06	0.	.17362E+06
173	2703	Ag chemicals	.16732E+06	0.	.16732E+06
174	2704	Misc chem prod	.18304E+06	.68700E+04	.18991E+06
175	2801	Plastics	.21619E+06	0.	.21619E+06
176	2802	Sin rubber	.29221E+06	0.	.29221E+06
177	2803	Man-made fibers	.20784E+06	0.	.20784E+06
178	2804	Organic fibers	.14139E+06	0.	.14139E+06
179	2901	Drugs	.55524E+05	0.	.55524E+05
180	2902	Cleaning prep	.99292E+05	0.	.99292E+05
181	2903	Toilet prep	.66396E+05	0.	.66396E+05
182	3000	Paint products	.12243E+06	.22373E+05	.14480E+06
183	3102	Paving	.55854E+06	.29562E+04	.56149E+06
184	3103	Asphalt	.47868E+06	.15233E+05	.49391E+06
185	3201	Tires	.98792E+05	.12643E+05	.11144E+06
186	3202	Rubber footwear	.64388E+05	0.	.64388E+05
187	3203	Misc rubber prod	.95037E+05	.13008E+05	.10804E+06
188	3204	Misc plastics	.99814E+05	.11485E+05	.11130E+06
189	3300	Indust leather	.55779E+05	0.	.55779E+05
190	3401	Footware cut stk	.65173E+05	0.	.65173E+05
191	3402	Footward exc rub	.40572E+05	0.	.40572E+05
192	3403	Misc leather	.47282E+05	0.	.47282E+05
193	3501	Glass products	.10285E+06	.15258E+05	.11811E+06
194	3502	Glass containers	.15288E+06	0.	.15288E+06
195	3601	Cement	.47969E+06	.17493E+05	.49718E+06
196	3602	Bricks	.34036E+06	.17879E+05	.35824E+06
197	3603	Ceramic tile	.11065E+06	.10554E+05	.12120E+06
198	3604	Clay refract	.17963E+06	.86385E+04	.18827E+06
199	3605	Clay products	.25984E+06	.17263E+05	.27710E+06
200	3606	Plumbing fixtures	.91073E+05	.18061E+05	.10913E+06
201	3607	Food utensils	.95204E+05	0.	.95204E+05
202	3608	Porcel elec supp	.74533E+05	0.	.74533E+05
203	3609	Pottery products	.89623E+05	0.	.89623E+05
204	3610	Concrete blocks	.14167E+06	.13691E+05	.15536E+06
205	3611	Concrete product	.10852E+06	.62631E+04	.11478E+06

Appendix B Total Primary Energy Intensities - 399 Order, 1967 (continued)

399 Order	I/O	Name	Primary Energy Intensity	Margin	Total Energy Intensity
206	3612	Ready-mix concr	.18018E+06	.65557E+03	.18084E+06
207	3613	Lime	.50707E+06	.37515E+05	.54458E+06
208	3614	Gypsum products	.15860E+06	.20017E+05	.17861E+06
209	3615	Stone products	.52638E+05	.89305E+04	.61569E+05
210	3616	Abrasive product	.70920E+05	.16679E+05	.87599E+05
211	3617	Asbestos product	.11014E+06	.21777E+05	.13192E+06
212	3618	Gaskets	.84347E+05	.12205E+05	.96552E+05
213	3619	Treated minerals	.14131E+06	.28507E+05	.16981E+06
214	3620	Mineral wool	.15591E+06	.19107E+05	.17502E+06
215	3621	Nonclay refract	.15038E+06	.89643E+04	.15935E+06
216	3622	Nonmet min prod	.93657E+05	.16195E+05	.10985E+06
217	3701	Steel prod	.26703E+06	.13920E+05	.28095E+06
218	3702	Ir, stl foundries	.98051E+05	.25169E+04	.10057E+06
219	3703	Ir, stl forging	.17057E+06	0.	.17057E+06
220	3704	Primary met prod	.14892E+06	.21780E+05	.17070E+06
221	3801	Primary copper	.13931E+06	0.	.13931E+06
222	3802	Primary lead	.10989E+06	0.	.10989E+06
223	3803	Primary zinc	.27417E+06	0.	.27417E+06
224	3804	Primary aluminum	.38704E+06	0.	.38704E+06
225	3805	Primary nonfer met	.15677E+06	0.	.15677E+06
226	3806	Sec nonfer met	.74702E+05	0.	.74702E+05
227	3807	Copper rolling	.10173E+06	.26448E+04	.10438E+06
228	3808	Aluminum rolling	.24426E+06	.34818E+04	.24774E+06
229	3809	Nonfer rolling	.11563E+06	.21945E+04	.11783E+06
230	3810	Nonfer wire	.91463E+05	.32926E+04	.94756E+05
231	3811	Aluminum castings	.13832E+06	0.	.13832E+06
232	3812	Brass, other cast	.86950E+05	0.	.86950E+05
233	3813	Nonfer casting	.10849E+06	0.	.10849E+06
234	3814	Nonfer Forging	.14832E+06	0.	.14832E+06
235	3901	Metal cans	.14085E+06	0.	.14085E+06
236	3902	Metal barrels	.14090E+06	0.	.14090E+06
237	4001	Metal sanit ware	.98424E+05	.16325E+05	.11475E+06
238	4002	Plumb fittings	.74689E+05	.12869E+05	.87558E+05
239	4003	Heating equip	.71243E+05	.13993E+05	.85236E+05
240	4004	Fab struc steel	.12435E+06	.57087E+04	.13006E+06
241	4005	Metal doors	.11683E+06	.93099E+04	.12614E+06
242	4006	Fab plate work	.10494E+06	.28540E+04	.10779E+06
243	4007	Sheet metal work	.11415E+06	.64141E+04	.12056E+06
244	4008	Arch metal work	.11852E+06	.38316E+04	.12235E+06
245	4009	Misc metal work	.13984E+06	.55449E+04	.14539E+06
246	4101	Screw mach prod	.85838E+05	.15862E+05	.10170E+06
247	4102	Metal stampings	.11157E+06	.18904E+04	.11346E+06
248	4201	Cutlery	.50152E+05	0.	.50152E+05
249	4202	Handtools	.67016E+05	.10267E+05	.77284E+05
250	4203	Hardware	.74431E+05	.17496E+05	.91927E+05
251	4204	Coat, engrav ser	.78774E+05	0.	.78774E+05
252	4205	Fab wire product	.15393E+06	.97830E+04	.16371E+06
253	4206	Safes, vaults	.66510E+05	0.	.66510E+05
254	4207	Steel springs	.12706E+06	0.	.12706E+06
255	4208	Pipe	.74038E+05	.74031E+04	.81441E+05
256	4209	Collapsible tube	.10454E+06	0.	.10454E+06
257	4210	Metal foil, leaf	.12989E+06	0.	.12989E+06
258	4211	Fab metal prod	.10393E+06	0.	.10393E+06
259	4301	Steam engines	.69830E+05	0.	.69830E+05
260	4302	Int combustion eng	.61578E+05	0.	.61578E+05
261	4400	Farm machinery	.71672E+05	0.	.71672E+05
262	4501	Const machinery	.67871E+05	.16436E+05	.84307E+05
263	4502	Mining machinery	.71202E+05	0.	.71202E+05
264	4503	Oil field mach	.72115E+05	0.	.72115E+05
265	4601	Elevators	.58240E+05	.34548E+04	.61695E+05
266	4602	Conveyors	.64183E+05	.29741E+04	.67157E+05
267	4603	Hoists, cranes	.66167E+05	.25285E+04	.68695E+05
268	4604	Industrial truck	.59034E+05	0.	.59034E+05
269	4701	Met cutting tool	.41309E+05	0.	.41309E+05
270	4702	Met forming tool	.57555E+05	0.	.57555E+05
271	4703	Special die tool	.54888E+05	.54531E+04	.60341E+05
272	4704	Met working mach	.55996E+05	0.	.55996E+05
273	4801	Food prod mach	.50738E+05	0.	.50738E+05
274	4802	Textile mach	.58689E+05	0.	.58689E+05
275	4803	Woodworking mach	.48968E+05	0.	.48968E+05

Appendix B Total Primary Energy Intensities - 399 Order, 1967 (continued)

399 Order	I/O	Name	Primary Energy Intensity	Margin	Total Energy Intensity
276	4804	Paper ind mach	.60810E+05	0.	.60810E+05
277	4805	Printing mach	.42262E+05	0.	.42262E+05
278	4806	Special Ind mach	.58446E+05	0.	.58446E+05
279	4901	Pumps, compressors	.55097E+05	.15613E+05	.70710E+05
280	4902	Bearings	.80255E+05	0.	.80255E+05
281	4903	Blowers	.62177E+05	.35805E+04	.65757E+05
282	4904	Indust patterns	.43686E+05	0.	.43686E+05
283	4905	Power trans equip	.59463E+05	0.	.59463E+05
284	4906	Indus furnaces	.71368E+05	0.	.71368E+05
285	4907	General ind mach	.64200E+05	0.	.64200E+05
286	5000	Mach shop prod	.55233E+05	.45583E+04	.59791E+05
287	5101	Computing mach	.36213E+05	0.	.36213E+05
288	5102	Typewriters	.33083E+05	0.	.33083E+05
289	5103	Scales	.55281E+05	0.	.55281E+05
290	5104	Office machines	.43723E+05	0.	.43723E+05
291	5201	Merch'dise mach	.60464E+05	0.	.60464E+05
292	5202	Laundry equip	.67273E+05	0.	.67273E+05
293	5203	Refrig mach	.66854E+05	.50034E+04	.71858E+05
294	5204	Measuring pumps	.52739E+05	0.	.52739E+05
295	5205	Service ind mach	.64444E+05	0.	.64444E+05
296	5301	Elec meas instr	.34764E+05	0.	.34764E+05
297	5302	Transformers	.73346E+05	.59284E+04	.79274E+05
298	5303	Switchgear	.46302E+05	.33122E+04	.49614E+05
299	5304	Motors, generators	.62559E+05	0.	.62559E+05
300	5305	Ind controls	.38456E+05	0.	.38456E+05
301	5306	Welding apparat	.83173E+05	.90559E+04	.92229E+05
302	5307	Carbon products	.14870E+06	0.	.14870E+06
303	5308	Elec ind apparat	.58813E+05	0.	.58813E+05
304	5401	H'hold cook equip	.78988E+05	0.	.78988E+05
305	5402	H'hold refrig equip	.75557E+05	0.	.75557E+05
306	5403	H'hold laundry	.82648E+05	0.	.82648E+05
307	5404	Electric H'wares	.69495E+05	.50336E+04	.74529E+05
308	5405	H'hold vacuums	.56702E+05	.13876E+05	.70578E+05
309	5406	Sewing machines	.53707E+05	0.	.53707E+05
310	5407	H'hold appliance	.82292E+05	.59186E+04	.88211E+05
311	5501	Electric lamps	.44672E+05	.32223E+04	.47894E+05
312	5502	Light fixtures	.70588E+05	.75089E+04	.78097E+05
313	5503	Wiring devices	.72512E+05	.80140E+04	.80526E+05
314	5601	Radio, TV sets	.42629E+05	0.	.42629E+05
315	5602	Phono records	.56876E+05	0.	.56876E+05
316	5603	Phone, telegr equip	.36287E+05	0.	.36287E+05
317	5604	Radio, TV commun equip	.31932E+05	.64839E+03	.32580E+05
318	5701	Electron tubes	.52251E+05	0.	.52251E+05
319	5702	Semiconductors	.50506E+05	0.	.50506E+05
320	5703	Electronic comp	.50946E+05	0.	.50946E+05
321	5801	Storage battery	.94778E+05	.77128E+04	.10249E+06
322	5802	Primary battery	.61453E+05	.54531E+04	.66907E+05
323	5803	X-ray equipment	.35402E+05	0.	.35402E+05
324	5804	Engine elec equip	.60155E+05	.10773E+05	.70927E+05
325	5805	Electrical equip	.63625E+05	.15655E+05	.79280E+05
326	5901	Truck, bus bodies	.76950E+05	0.	.76950E+05
327	5902	Truck trailers	.83080E+05	0.	.83080E+05
328	5903	Motor vehicle and parts	.66580E+05	0.	.66580E+05
329	6001	Aircraft	.38537E+05	0.	.38537E+05
330	6002	Aircraft engines	.48227E+05	0.	.48227E+05
331	6003	Aircraft propell	.62660E+05	0.	.62660E+05
332	6004	Aircraft equip	.45067E+05	0.	.45067E+05
333	6101	Shipbuilding	.63497E+05	0.	.63497E+05
334	6102	Boatbuilding	.63532E+05	0.	.63532E+05
335	6103	Locomotives	.54261E+05	0.	.54261E+05
336	6104	RR, street cars	.10948E+06	0.	.10948E+06
337	6105	Motor, bicycles	.72484E+05	0.	.72484E+05
338	6106	Trailer coaches	.69964E+05	0.	.69964E+05
339	6107	Transport equip	.96084E+05	.17723E+05	.11381E+06
340	6201	Scien instr	.44769E+05	0.	.44769E+05

Appendix B Total Primary Energy Intensities - 399 Order, 1967 (continued)

399 Order	I/O	Name	Primary Energy Intensity	Margin	Total Energy Intensity
341	6202	Mech meas device	.44444E+05	0.	.44444E+05
342	5203	Temp controls	.43495E+05	.29225E+04	.46417E+05
343	5204	Medical instr	.62280E+05	0.	.62280E+05
344	6205	Surgical supply	.49786E+05	0.	.49786E+05
345	6206	Dental equipment	.50130E+05	0.	.50130E+05
346	6207	Watches, clocks	.43441E+05	.47261E+04	.48167E+05
347	6301	Optical instr	.39942E+05	0.	.39942E+05
348	6302	Ophthalmic goods	.46440E+05	0.	.46440E+05
349	6303	Photographic eq	.46744E+05	0.	.46744E+05
350	6401	Jewelry	.46394E+05	0.	.46394E+05
351	6402	Musical instr	.54620E+05	0.	.54620E+05
352	6403	Games	.65298E+05	0.	.65298E+05
353	6404	Athletic equip	.60150E+05	0.	.60150E+05
354	6405	Pens and pencils	.55598E+05	0.	.55598E+05
355	6406	Artificial flowers	.79399E+05	0.	.79399E+05
356	6407	Cloth fasteners	.64942E+05	0.	.64942E+05
357	6408	Brushes	.65317E+05	.87798E+04	.74097E+05
358	6409	Hard floor cov	.73443E+05	.14583E+05	.88026E+05
359	6410	Mortician goods	.69120E+05	0.	.69120E+05
360	6411	Signs, ads	.60939E+05	.12691E+05	.73630E+05
361	6412	Misc meg	.56760E+05	.23630E+04	.59123E+05
362	6501	Railroad	.75880E+05	0.	.75880E+05
363	6502	Local transport	.66463E+05	0.	.66463E+05
364	6503	Motor fgt transp	.45840E+05	0.	.45840E+05
365	6504	Water transport	.22215E+06	0.	.22215E+06
366	6505	Air transport	.19088E+06	0.	.19088E+06
367	6506	Pipe line transp	.96166E+05	0.	.96166E+05
368	6507	Transp services	.68957E+04	0.	.68957E+04
369	6600	Communications	.16769E+05	0.	.16769E+05
370	6700	R-TV Broadcast	.29164E+05	0.	.29164E+05
371	6803	Water, sanit serv	.10919E+06	0.	.10919E+06
372	6901	Wholesale trade	.35445E+05	0.	.35445E+05
373	6902	Retail trade	.35274E+05	0.	.35274E+05
374	7001	Banking	.18264E+05	0.	.18264E+05
375	7002	Credit agencies	.72378E+05	0.	.72378E+05
376	7003	Sec, commod brok	.11593E+05	0.	.11593E+05
377	7004	Insur carriers	.20719E+05	0.	.20719E+05
378	7005	Insurance agents	.24178E+05	0.	.24178E+05
379	7101	Owner-occ dwlg	.69354E+04	0.	.69354E+04
380	7102	Real estate	.22485E+05	0.	.22485E+05
381	7201	Hotels	.76660E+05	0.	.76660E+05
382	7202	Personal service	.52097E+05	0.	.52097E+05
383	7203	Barb, beaut shops	.16871E+05	0.	.16871E+05
384	7301	Misc bus service	.26845E+05	0.	.26845E+05
385	7302	Advertising	.44752E+05	0.	.44752E+05
386	7303	Misc prof ser	.24883E+05	0.	.24883E+05
387	7500	Auto repair	.48917E+05	0.	.48917E+05
388	7601	Motion picture	.32640E+05	0.	.32640E+05
389	7602	Amusmnt, rec ser	.24275E+05	0.	.24275E+05
390	7701	Doctors, dentists	.14739E+05	0.	.14739E+05
391	7702	Hospitals	.51170E+05	0.	.51170E+05
392	7703	Med, health ser	.47340E+05	0.	.47340E+05
393	7704	Educational ser	.56712E+05	0.	.56712E+05
394	7705	Nonprofit org	.58293E+05	0.	.58293E+05
395	7801	Post Office	.36964E+05	0.	.36964E+05
396	7804	Fed Govt enterp	.36084E+05	0.	.36084E+05
397	7903	St, loc govt entr	.10421E+06	0.	.10421E+06
398	8100	Business travel	.96423E+05	.16389E+05	.11281E+06
399	8200	Office supplies	.71255E+05	.83474E+04	.79603E+05

Appendix C Total Primary Labor Hour Intensities - 399 Order, 1967

Information for Computing Total Labor Cost
per Physical Unit for 399-Order Products
Including Delivery to New Building Construction Job Site
(1967: FTE/BTU in 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 \$ Before 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	0.37572E-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	0.10503E-03	0.0	0.10503E-03
9	Cotton	0.16414E-03	0.0	0.16414E-03
10	Feed grains	0.87760E-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	Vegt, misc crops	0.13801E-03	0.0	0.13801E-03
14	Oil bearing crop	0.74479E-04	0.0	0.74479E-04
15	For, grhouse, nurs	0.14352E-03	0.15637E-04	0.15916E-03
16	Forest fish prod	0.90588E-04	0.0	0.90588E-04
17	Ag for, fish ser	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 mining	0.75954E-04	0.40807E-04	0.11676E-03
22	Chem mineral mining	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 - garden apt	-0.10000E 01	0.0	-0.10000E 01
26	New const Highrise 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 Hotel, motel	-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 Car, srv sta	-0.10000E 01	0.0	-0.10000E 01
34	New const Store, restrnt	-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 Other non-farm	-0.10000E 01	0.0	-0.10000E 01
39	New const Phone, teleg	-0.10000E 01	0.0	-0.10000E 01
40	New const Railroads	-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 Conserv dev	-0.10000E 01	0.0	-0.10000E 01
54	New const Oth non-bldg	-0.10000E 01	0.0	-0.10000E 01
55	Maint const Residence	-0.10000E 01	0.0	-0.10000E 01
56	Maint const Oth non-farm	-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 Phone, teleg	-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 Petrol pipe	-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

Appendix C Total Primary Labor Hour Intensities - 399 Order, 1967 (continued)

399-Order Index	Name	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)	Labor Margin Factor	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)
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 Conser, 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/Gas wells	-0.10000E 01	0.0	-0.10000E 01
71	Maint const Oth non-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	Fire control equip	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 fruit, veg	0.10395E-03	0.0	0.10395E-03
88	Dehydrated prod	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
106	Coffee	0.29827E-04	0.0	0.29827E-04
107	Cooking oils	0.81334E-04	0.0	0.81334E-04
108	Manufactured ice	0.14176E-03	0.0	0.14176E-03
109	Macaroni	0.86110E-04	0.0	0.86110E-04
110	Food preparation	0.81455E-04	0.0	0.81455E-04
111	Cigarettes	0.67838E-04	0.0	0.67838E-04
112	Tobacco stemming	0.18563E-03	0.0	0.18563E-03
113	Broad fab mills	0.11347E-03	0.67691E-05	0.12024E-03
114	Nar fabric mills	0.11523E-03	0.0	0.11523E-03
115	Yarn mills	0.10853E-03	0.0	0.10853E-03
116	Thread mills	0.10961E-03	0.0	0.10961E-03
117	Floor coverings	0.94337E-04	0.12691E-04	0.10703E-03
118	Felt goods	0.92546E-04	0.0	0.92546E-04
119	Lace goods	0.13928E-03	0.0	0.13928E-03
120	Upholstery fill	0.95145E-04	0.0	0.95145E-04
121	Proc tex waste	0.98898E-04	0.0	0.98898E-04
122	Coated fabrics	0.83081E-04	0.87820E-05	0.91863E-04
123	Tire cord	0.89849E-04	0.0	0.89849E-04
124	Scouring plants	0.87438E-04	0.0	0.87438E-04
125	Cordage, twine	0.10360E-03	0.22042E-04	0.12565E-03
126	Textile goods	0.82898E-04	0.0	0.82898E-04
127	Hosiery	0.13803E-03	0.0	0.13803E-03
128	Knit appll mills	0.12595E-03	0.0	0.12595E-03
129	Knit fab mills	0.93398E-04	0.0	0.93398E-04
130	Apparl, purch mat	0.14039E-03	0.13834E-04	0.15423E-03
131	Curtains	0.12470E-03	0.0	0.12470E-03
132	House furnishings	0.11382E-03	0.0	0.11382E-03
133	Fab textile prod	0.11286E-03	0.0	0.11286E-03
134	Logging	0.86944E-04	0.0	0.86944E-04
135	Sawmills	0.11980E-03	0.75951E-04	0.19575E-03

Appendix C Total Primary Labor Hour Intensities - 399 Order, 1967 (continued)

399-Order Index	Name	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)	Labor Margin Factor	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)
136	Hardwd flooring	0.14755E-03	0.78387E-04	0.22593E-03
137	Spec prod sawmil	0.12754E-03	0.51557E-04	0.17909E-03
138	M'llwork	0.11477E-03	0.45587E-04	0.16036E-03
139	Veneer, plywood	0.11055E-03	0.52925E-04	0.16347E-03
140	Prefab wd struc	0.11037E-03	0.22611E-04	0.13298E-03
141	Wood preserving	0.99755E-04	0.13359E-04	0.11311E-03
142	Wood products	0.11632E-03	0.42833E-04	0.15915E-03
143	Wood containers	0.14442E-03	0.0	0.14442E-03
144	Wood h'hold furn	0.12475E-03	0.69902E-05	0.13174E-03
145	Uph h'hold furn	0.12481E-03	0.0	0.12481E-03
146	Met h'hold furn	0.10455E-03	0.10606E-04	0.11515E-03
147	Mattresses	0.11189E-03	0.0	0.11189E-03
148	Wood ofc furn	0.10304E-03	0.0	0.10304E-03
149	Metal ofc furn	0.87873E-04	0.0	0.87873E-04
150	Public bldg furn	0.11562E-03	0.14436E-04	0.13006E-03
151	Wood fixtures	0.10499E-03	0.99133E-05	0.11490E-03
152	Met fixtures	0.89592E-04	0.12494E-04	0.10209E-03
153	Blinds, shades	0.11011E-03	0.0	0.11011E-03
154	Furn, fixtures	0.10687E-03	0.0	0.10687E-03
155	Pulp mills	0.79994E-04	0.0	0.79994E-04
156	Paper mills	0.82983E-04	0.0	0.82983E-04
157	Paperboard mills	0.70050E-04	0.0	0.70050E-04
158	Envelopes	0.95903E-04	0.23740E-04	0.11964E-03
159	Sanit paper prod	0.65356E-04	0.0	0.65356E-04
160	Building paper	0.94908E-04	0.91135E-04	0.18604E-03
161	Conv paper prod	0.79724E-04	0.17099E-04	0.96822E-04
162	Paperboard cont	0.83018E-04	0.0	0.83018E-04
163	Newspapers	0.10445E-03	0.0	0.10445E-03
164	Periodicals	0.82106E-04	0.0	0.82106E-04
165	Book publishing	0.84956E-04	0.13916E-04	0.98873E-04
166	Misc publishing	0.86646E-04	0.0	0.86646E-04
167	Comm printing	0.95910E-04	0.0	0.95910E-04
168	Business forms	0.83081E-04	0.0	0.83081E-04
169	Greeting cards	0.89395E-04	0.0	0.89395E-04
170	Misc printing	0.10624E-03	0.0	0.10624E-03
171	Inorg-org chem	0.58119E-04	0.57955E-05	0.63915E-04
172	Fertilizers	0.71424E-04	0.0	0.71424E-04
173	Ag chemicals	0.62003E-04	0.0	0.62003E-04
174	Misc chem prod	0.76234E-04	0.14913E-04	0.91147E-04
175	Plastics	0.70513E-04	0.0	0.70513E-04
176	Syn rubber	0.60424E-04	0.0	0.60424E-04
177	Man-made fibers	0.78212E-04	0.0	0.78212E-04
178	Organic fibers	0.69603E-04	0.0	0.69603E-04
179	Drugs	0.63598E-04	0.0	0.63598E-04
180	Cleaning prep	0.65859E-04	0.0	0.65859E-04
181	Toilet prep	0.79500E-04	0.0	0.79500E-04
182	Paint products	0.70020E-04	0.69533E-04	0.13955E-03
183	Paving	0.63967E-04	0.78470E-05	0.71814E-04
184	Asphalt	0.79454E-04	0.37233E-04	0.11669E-03
185	Tires	0.64041E-04	0.38561E-04	0.10260E-03
186	Rubber footwear	0.10814E-03	0.0	0.10814E-03
187	Misc rubber prod	0.88985E-04	0.40087E-04	0.12907E-03
188	Misc plastics	0.84598E-04	0.31626E-04	0.11622E-03
189	Indust leather	0.64539E-04	0.0	0.64539E-04
190	Footware cut stk	0.10003E-03	0.0	0.10003E-03
191	Footware exc rub	0.12214E-03	0.0	0.12214E-03
192	Misc leather	0.12198E-03	0.0	0.12198E-03
193	Glass products	0.81485E-04	0.42557E-04	0.12404E-03
194	Glass containers	0.84872E-04	0.0	0.84872E-04
195	Cement	0.69821E-04	0.31400E-04	0.10122E-03
196	Bricks	0.11417E-03	0.35584E-04	0.14976E-03
197	Ceramic tile	0.11517E-03	0.25883E-04	0.14106E-03
198	Clay refract	0.10154E-03	0.14012E-04	0.11555E-03
199	Clay products	0.10159E-03	0.37464E-04	0.13905E-03
200	Plumbing fixture	0.74977E-04	0.44225E-04	0.11920E-03
201	Food utensils	0.13454E-03	0.0	0.13454E-03
202	Porcel Elec supp	0.86684E-04	0.0	0.86684E-04
203	Pottery products	0.12813E-03	0.0	0.12813E-03
204	Concrete blocks	0.88653E-04	0.33680E-04	0.12233E-03
205	Concrete product	0.86934E-04	0.17488E-04	0.10442E-03

Appendix C Total Primary Labor Hour Intensities - 399 Order, 1967 (continued)

399-Order Index	Name	Total Primary Labor Intensity (Producer & Before Delivery to Job Site)	Labor Margin Factor	Total Primary Labor Intensity (Producer & Before Delivery to Job Site)
206	Ready-mix concr	0.79871E-04	0.16730E-05	0.81544E-04
207	Lime	0.78872E-04	0.83481E-04	0.16235E-03
208	Gypsum products	0.68416E-04	0.38917E-04	0.10733E-03
209	Stone products	0.10896E-03	0.20266E-04	0.12923E-03
210	Abrasive products	0.82246E-04	0.49974E-04	0.13222E-03
211	Asbestos product	0.84725E-04	0.49921E-04	0.13465E-03
212	Gaskets	0.98740E-04	0.20143E-04	0.11888E-03
213	Treated minerals	0.89057E-04	0.60744E-04	0.14980E-03
214	Mineral wool	0.76986E-04	0.37470E-04	0.11446E-03
215	Nonclay refract	0.79304E-04	0.12575E-04	0.91879E-04
216	Nonmet min prod	0.97145E-04	0.28476E-04	0.12562E-03
217	Steel prod	0.74103E-04	0.26551E-04	0.10065E-03
218	Ir, stl foundries	0.85402E-04	0.46492E-05	0.90051E-04
219	Ir, stl forging	0.82557E-04	0.0	0.82557E-04
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 nonfer 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, othr 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	Met working 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

Appendix C Total Primary Labor Hour Intensities - 399 Order, 1967 (continued)

399-Order Index	Name	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)	Labor Margin Factor	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)
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, compressors	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 equip	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 shoe 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	Merch'dise mach	0.10229E-03	0.0	0.10229E-03
292	Laundry equip	0.91954E-04	0.0	0.91954E-04
293	Refrig mach	0.29622E-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 equip	0.91510E-04	0.0	0.91510E-04
305	H'hold refrig equip	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	0.68358E-04	0.44341E-04	0.11270E-03
309	Sewing machines	0.10787E-03	0.0	0.10787E-03
310	H'hold appliance	0.81819E-04	0.13591E-04	0.95409E-04
311	Electric lamps	0.79852E-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 equip	0.87385E-04	0.0	0.87385E-04
317	R-TV commun equip	0.82424E-04	0.16547E-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 equip	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
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

Appendix C Total Primary Labor Hour Intensities - 399 Order, 1967 (continued)

399-Order Index	Name	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)	Labor Margin Factor	Total Primary Labor Intensity (Producer \$ Before Delivery to Job Site)
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 equip	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	Artificial flower	0.11237E-03	0.0	0.11237E-03
356	Cloth fasteners	0.11718E-03	0.0	0.11718E-03
357	Brushes	0.10094E-03	0.21699E-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-RV Broadcast	0.85090E-04	0.0	0.85090E-04
371	Water, sanit ser	0.77823E-04	0.0	0.77823E-04
372	Wholesale 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-04	0.0	0.12728E-04
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
395	Post Office			
394	Nonprofit	0.15105E-03	0.0	0.15105E-03
395	Post Office	0.16014E-03	0.0	0.16014E-03
396	Fed gov't enterp	0.38027E-04	0.0	0.38027E-04
397	St, loc gov't	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

Appendix D Description of Center for Advanced Computation (CAC) Categories

Number	Title	Description
21	Stone, clay mining	Mined and quarried dimension stone; crushed and broken stone; sand and gravel; and clay, ceramic and refractory minerals
117	Floor covering	Woven and tufted carpets and rugs; floor covering made of coir, twisted paper, grass, reed, sisal, jute and rag
135	Sawmills	Rough lumber
136	Hardwood flooring	Hardwood dimensions lumber, semifabricated hardwood dimension and hardwood flooring
138	Millwork	Fabricated millwork including door trim, doors, floor baseboards, wood garage doors, moldings, door and window sash, staircases, trim, weather-strip, window frames, interior and ornamental woodwork
139	Veneer, plywood	Hardwood and softwood veneer and plywood
140	Prefabricated wood structures	Prefabricated wood buildings, sections and panels
141	Wood preserving	Wood treated with creosote or other preservatives to prevent decay and protect against fire and insects
142	Wood products	Wood products not classified elsewhere including cork, panelboard, wood knobs, and scaffolds
144	Wood household furniture	Unholstered and unupholstered wood household furniture
146	Metal household furniture	Padded and plain metal household furniture
151	Wood fixtures	Wood partitions, shelving, lockers, counters, and display cases and cabinets
152	Metal fixtures	Metal partitions, shelving, lockers, counters and display cases and cabinets
172	Miscellaneous chemical products	Adhesives, glues, caulking, sealants, linoleum, concrete curing compounds, concrete hardening compounds, heat insulating compounds and plastic wood
182	Paint products	Paints, varnishes, lacquers, enamels, wood fillers and sealers, and paint and varnish removers
183	Paving	Asphalt and tar paving mixtures, paving blocks made of asphalt, creosoted wood, and various compositions of asphalt or tar with other materials
184	Asphalt	Asphalt felt in roll or shingle form, roofing cements and coating, impregnated insulated siding
188	Miscellaneous plastics	Floor and wall covering, insulation, pipe and pipe fittings

Appendix D Description of Center for Advanced Computation (CAC) Categories (continued)

Number	Title	Description
193	Glass products	Flat glass including laminated glass
195	Cement	Portland and other prepared or mixed hydraulic and manonry cements
196	Bricks	Brick and structural clay tile
197	Ceramic tile	Glazed and unglazed ceramic wall and floor tile
198	Clay refractory products	Clay firebrick and other heat resisting clay products
199	Clay products	Structural clay products not elsewhere classified including architectural terra cotta, chimney pipes and tops, drain tile, sewer tile, and roofing tile
200	Plumbing fixtures	China plumbing fixtures, china and earthenware fittings, and bathroom accessories
204	Concrete blocks	Decorative and structural concrete brick and block
205	Concrete products	Artificial building stone, bathtubs, columns, prestressed pipe, drain tile, fireplaces, floor filler tiles, floor slabs, incinerators, joists, pipe, steps, window sills
206	Ready-mix concrete	Central-mixed, ready-mixed, shrink-mixed and transit-mixed concrete
207	Lime	Quick lime, hydrated lime, and dead burned dolomite
208	Gypsum products	Plaster and plasterboard
209	Stone products	Dimension stone for buildings, slate roofing, paving stone, and flagstone
211	Asbestos products	Molded asbestos for insulation, floor tile, roofing and siding
214	Mineral wool	Acoustical board and tile, and fiberglass insulation
215	Nonclay refractory products	Chrome, magnesite, silica and other nonclay refractory brick
217	Steel products	Pig iron and steel products including plates, bars, sheets, slabs, strips, pipes, tubing, wire, nails and staples
218	Iron and steel foundries	Iron and steel castings including pipes and fittings
227	Copper rolling	Rolled, drawn and extruded copper and copper-based alloy mill products, including sheets, wire, and plumbing pipe and tubing
230	Nonferrous wire	Alloyed and unalloyed wire for electrical transmission
237	Metal sanitary ware	Enamelled iron, cast iron or pressed metal bathroom fixtures
238	Plumbing fittings	Drains, faucets, showerheads, and sanitary pipe fittings

Appendix D Description of Center for Advanced Computation (CAC) Categories (continued)

Number	Title	Description
239	Heating equipment	Boilers, burners, hot air furnaces and hot water heaters
240	Fabricated structural steel	Structural steel shapes
241	Metal doors	Metal doors, sash, frames, moldings, and trim
242	Fabricated plate work	Metal tanks including basement oil and septic tanks
243	Sheet metal work	Roofing, siding, and roof drainage equipment
244	Architectural metal work	Acoustical suspension systems, balconies, bannisters, railings, ornamental brasswork, grating, staircases and scaffolds
245	Miscellaneous metal work	Expanded metal lath, fabricated bar joists
250	Hardware	Door bolts and checks, door locks and lock sets, hinges, metal fasteners, spring and coiled steel
252	Fabricated wire products	Concrete reinforcing mesh, screening, partitions, grill work, and staples
255	Pipe	Pipe bends, coils, couplings, manifolds and nipples
265	Elevators	Passenger and freight elevator equipment, automobile lifts, dumbwaiters, escalators
267	Hoists and cranes	Cranes, hoists and monorail systems for installations in factories, warehouses and other commercial and industrial establishments
279	Pumps and compressors	Pumps and compressors for general industrial use
293	Refrigeration machines	Refrigeration and service industry machinery including automatic merchandising machines; commercial laundry, dry cleaning and pressing machines; air conditioning; warm air heating equipment; commercial and industrial refrigeration equipment; sanding machines; water filters, and ovens
298	Switchgear	Power switches, circuit breakers, power switching equipment, switchboards, metering panels, and power fuse mountings
307	Electric houseware	Electric houseware and fans including space and wall heating units, fan dehumidifiers
310	Household appliances	Dishwashing machines, floorwaxers and polishers, garbage disposal units, trash compactors, and water heaters
312	Light fixtures	Lamps, florescent lighting fixtures and lamp shades
313	Wiring devices	Attachment plugs and caps, convenience outlets, lamp sockets, lamp receptacles, snap switches, conductor connectors, overhead trolley line material, rail bonds for propulsion and signal circuits, sighting arrestors, and other lighting protective equipment

Appendix D Description of Center for Advanced Computation (CAC) Categories (continued)

Number	Title	Description
362	Railroad transportation	
364	Motor freight transportation	
365	Water transportation	
372	Wholesale trade	
373	Retail trade	
342	Temperature controls	Heating and air conditioning installations and refrigeration applications which are electrically, electronically and pneumatically actuated and which measure and control variables such as temperature and humidity, and automatic regulators used as components in household appliances
358	Hard floor covering	Linoleum, asphalted felt base and other hard surface floor covering
377	Insurance carriers	Services provided by insurance agents and brokers, and organizations providing services to insurance companies and policy holders
380	Real estate	Services provided by real estate brokers, managers, appraisers and agents
384	Miscellaneous business services	Research and development laboratories, management consulting and public relations services, detective agencies and protective services, equipment rental and leasing services
385	Advertising	Advertising agencies and services
386	Miscellaneous professional services	Engineering, architectural and surveying services; noncommercial scientific and research organizations; auditing and bookkeeping services
387	Automobile repair	Includes top and body repair shops, tire retreading and repair shops, paint shops, general automotive repair shops
398	Business travel	

Notes

1. The material in this document is based on 1967 data. When the computations were made in 1976 through 1977, this was the most recent year for which full data were available.
2. For detailed explanation of input/output modeling, see "The Input-Output Structure of the United States Economy," published by SCIENTIFIC AMERICAN, San Francisco, 1970.
3. The direct energy figure includes asphalt and road oil, which are petroleum products. These represent 8 percent of the energy input into New Building Construction. Fuel (refined petroleum, and natural gas) and electricity represent about 7 percent of the energy input into New Building Construction.
4. The following terms are used throughout the manual:
Embodied Energy is the total amount of energy required for the production of a material, assembly or building, including the extraction of raw materials, processing, fabricating, assembly, transportation and maintenance of offices and plants.
Direct Energy is the energy used directly by a sector in its part of the production chain. This may be in the form of a refined petroleum product, coal, natural gas, or synthetic gas; electricity, etc. Renewable energy, from such energy sources as sun, wind, and such, are not included in these calculations. The total value attributed to direct energy includes both the energy value that can be extracted from the product itself plus the energy that it took to manufacture the product. For example, a gallon of No. 2 oil may have an energy value of 138,000 Btu when it is converted to work. It takes about 15,000 Btu to extract, process, and transport that gallon of oil, so the total energy value of that gallon would be 153,000 Btu. of which 15,000 would be embodied energy.
5. This work was performed under U.S. ERDA Contract Number EY-76-S-02-02791, the Energy Use for Building Construction study and is described in the Appendices.
6. The source of the square footage figures was: F.W. Dodge Co., DODGE CONSTRUCTION STATISTICS, UNITED STATES SUMMARY BULLETIN FOR DECEMBER, 1967, McGraw-Hill, Inc. New York.
7. An average bathroom consists of:
1 steel bathtub and fittings = 4,030,000 Btu
1 cast iron lavatory and fittings = 2,140,000 Btu
1 toilet w/flush tank = 2,300,000 Btu
9 ft of ¾" copper pipe @ 96,000 Btu/lin ft*
11 ft of 1½" steel pipe @ 70,000 Btu/lin ft*
1 ft of 4" steel pipe @ 279,000 Btu/lin ft*
totals 10,400,000 Btu.
*length of piping required to main stack.
8. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, CLIMATOGRAPHY OF THE UNITED STATES No. 81: MONTHLY NORMALS OF TEMPERATURE PRECIPITATION AND HEATING AND COOLING DEGREE DAYS 1941-1970, Vols. for New York, Georgia, and Illinois, National Climatic Center, Asheville, N.C., August, 1973.
9. Equivalent primary energy is the total primary energy which would be required to produce the designated output, in this case New Building Construction, if all of the products which eventually go into that output were produced domestically. In other words, products which are imported are assumed to make the same demand for primary energy as the same product would if it were manufactured domestically.
10. The energy intensity figures describe 1967 conditions. Btu per dollar values must be adjusted for other years to account for inflation. However, the energy requirements per square foot of building and per unit of building material (i.e. the data in Chapters 3 through 9) are unaffected by inflation. Therefore, except for variations caused by new manufacturing processes, this material remains unchanged.

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Energy Input Fraction of the 49 Construction Sectors

Wall Chart 1

This wall chart presents the major energy inputs to each of the 49 construction sectors as percentages of each sector's total energy use. The graphic presentation permits a rapid comparison between the various construction sectors. The energy inputs are arranged into 9 categories (Direct Energy, Wood Products, Paint, Paving, and Asphalt Products, Stone and Clay Products, Metal Products, Transportation, Trade, Miscellaneous Services, and Miscellaneous). The chart further breaks down the major energy input categories into approximately 20 energy inputs. Input sectors with an average contribution of less than 0.1 percent are grouped together in the Miscellaneous category at the bottom of each graph.

Appl	310	Household appliances
Arch mtl	244	Architectural metal work
Asb	211	Asbestos products
Asph	184	Asphalt
Blk	204	Concrete blocks
Brk	196	Bricks
Bus	384	Miscellaneous business services
Cem	195	Cement
Clay	199	Clay products
Clay refr	198	Clay refractory products
Conc	206	Ready-mix concrete
Conc prod	205	Concrete products
Cop	227	Copper rolling
Drs	241	Metal doors
Elev	265	Elevators
Fab mtl	258	Fabricated metal products
Fab wire	252	Fabricated wire products
Fl cov	117	Floor covering
Gyp	208	Gypsum products
H&C	267	Hoists and cranes
Htg	239	Heating equipment
Lt	312	Light fixtures
Min	21	Stone clay mining
MinW	214	Mineral wool
Misc mtl	245	Miscellaneous metal products
Misc plas	188	Miscellaneous plastic products
MWk	138	Millwork
N-C refr	215	Nonclay refractory products
Non fer	230	Nonferrous wire
Oil mach	264	Oil machine product
Pap	160	Paper products
Pav	183	Paving
Pipe	255	Pipe
Plt	242	Fabricated plate work
Plas	175	Plastics
Plb	238	Plumbing fittings
Pnt	183	Paint products
Porc	202	Porcelain electrical supplies
Pre fab	140	Prefabricated wood structures
Prof	386	Miscellaneous professional services
Pwd	139	Plywood, veneer
Ref	293	Refrigeration machinery
Ref pet	3	Refined petroleum products
Retail	373	Retail trade
RR	362	Railroad
RTV	317	Radio television
Sawm	135	Sawmills
Sht mtl	243	Sheet metal work
Scr mach	246	Screw machine products
Str eng	259	Steam engines
Stl fndy	218	Iron, steel foundry
Stl prod	217	Steel products
Str stl	240	Structural steel
Trav	398	Business travel
Truc	364	Motor freight transportation
Wd pres	141	Wood preserving
Whol	364	Wholesale trade
Wire	313	Wiring devices
Wood	142	Wood products

Wall Chart 1 (CONTINUED)

Energy Flow Model
for New Building Construction