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# **OPTIMIZE**

**A method for Estimating  
the Lifecycle Energy  
and  
Environmental  
Impact of a house  
(Appendices)**

## **APPENDIX I**

**A Review of Resource Materials**

## **APPENDIX II**

**Program Documentation and Reference  
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# **OPTIMIZE**

**A Canadian Database and Computer Program  
for Estimating the Lifecycle Energy  
and Environmental Impact of Residential Buildings**

## **APPENDIX I**

### **A REVIEW OF RESOURCE MATERIALS**



## **1.0 RESOURCE MATERIALS**

A small number of Canadian and international studies had a major influence on the eventual design of optimize. This brief section will briefly describe these studies and explain how they contributed.

### **BAIRD AND AUN**

The most comprehensive study found was completed in 1983 by George Baird and Chan Seong Aun at the School of Architecture, Victoria University of Wellington, New Zealand. The study titled *Energy cost of houses and light construction buildings* does a comprehensive review of embodied energy research, and builds a detailed data set for the New Zealand economy. Baird and Aun use this data set to compare the energy intensity of building materials in New Zealand with other countries. They take the process one interesting step further by comparing house construction styles from one country to another. Replicating this study for the Canadian economy would on its own be a significant contribution for designers and researchers.

### **KOHLER**

Niklaus Kohler at the Swiss Federal Institute of Technology has done a similar study for the Switzerland Economy titled *Energy Consumption and Pollution of Building Construction*. Kohler uses the input output model of the Switzerland Economy to construct embodied energy data for each building material. The small size of the economy and the thorough manner in which they collect statistical data allows a fairly high degree of confidence in this data. Kohler has been working since 1987 on embodied energy and has introduced life cycling accounting for building design including repair and maintenance and demolition. Kohler also does a pollution analysis by assuming that all non-feedstock energy is combusted and released into the ambient air. Kohler is now working on determining more accurate embodied energy data and pollutant data by doing engineering process analysis on a plant by plant basis.

### **CORRIM**

A major study was undertaken by the U.S. National Science Foundation Committee on Renewable Resources for Industrial Materials (CORRIM). The study titled *Analysis of Materials used in Residential Light Frame Construction, 1979*, was sponsored to look at the potential of renewable resources to meet the needs for building materials in the future. The study completed a comprehensive analysis of the flow of resources and energy in the wood manufacturing industries. The study uses this data to compare the energy intensity of different building material options in residential construction and makes some interesting conclusions. The comparisons included three roof systems, eight exterior wall systems, three interior wall systems, and six floor

systems. The study is now dated given that it was completed in 1976. The interest in this study lies in excellent analysis completed on different wood products, especially the more highly processed, such as fibreboard, particle board and plywood.

## DREXEL UNIVERSITY

Drexel University developed a data base on the energy analysis of 108 Industrial Processes in 1977. Some of these industries produce building materials. The study, titled *Energy Analysis of 108 Industrial Processes*, presents a wealth of information on the energy used at each step of an engineering process. The data is based on statistical information at two levels of industry classification (2 and 4 digit levels) and is verified by a limited number of on-site plant surveys. The major purpose of the study was to assess the quantity and quality of waste energy which may be economically practical to recover in the industrial sector. The study is an excellent reference for showing where the major sources of energy use are by industry type and by product.

## KREIGER - STEIN AND SERBER

Two studies, one by P.C. Kreigger in Europe (1981) and the other by Stein and Serber at the University of Illinois (1979), collect data on embodied energy of building materials. These studies are interesting for comparative purposes but are now dated by the limited depth of their analysis. Both works began the work of assembling a handbook on the energy intensity of building materials to be used for architectural design. Only limited analysis was done on the choice of building design or total life cycle energy. The Stein and Serber study was published in Energy Conservation Through Building Design, An Architectural Record Book, 1978, under the title *Energy Required for Building Construction*.

## PACE UNIVERSITY

A landmark study was completed by Pace University of New York for the U.S. DOE and the State of New York in 1990. The report titled *Environmental Costs of Electricity* reviews studies that quantify the externality costs of environmental damage caused by electric power utilities. The study is important because it gives a dollar value to the cost of pollution from the combustion of fossil fuels. It makes the assumption that, at the moment, externality costs are zero, and any number above zero is an improvement. The pollutants that are emphasized are CO<sub>2</sub>, SO<sub>2</sub>, NO<sup>x</sup>, and particulates and the report examines all environmental impacts that are measurable including global warming and human health. The costs were found to be relatively conservative in our estimation, but are a good first step at giving us a framework for measuring the environmental impact of building materials.

## EMISSION FACTORS

Energy Mines and Resources Canada produced a report in 1990 titled *Emission Factors for Greenhouse and other Gases by Fuel Type: An Inventory*. The report gives a thorough review of the evidence on emission factors for the combustion of fossil fuels by sector: residential, commercial, and industrial. This report was relied upon for the analysis of pollutants from the combustion of fuels to produce building materials. It was a convenient and reliable source for this purpose. The study acknowledges that the emission factors for nitrous oxide are included but are subject to considerable error. The study shows that the variation in emission coefficients for different moisture contents of coal vary as much as the difference between all other fuel types. It shows the inherent difficulty in using an average emission coefficient for coal burning in Canada. Unfortunately, our study could not address this considerable problem.

Two publications were relied upon to create the format and data for the Quantity Take-off form.

## MEANS

The *Means Residential Cost Data - 1984* published by R.S. Means Company, Kingston, Massachusetts was used to give each building product a unique identification Code based on the Construction Specifications Institute. The format of the Means publication was also used to give an identification code for all assemblies in a house. Finally, the cost data was used to estimate the final retail price of building materials sold in Canada in 1984 in order to calculate the average cost per weight of material. The cost per weight of material was crucial for our analysis because our data from statistics Canada gave energy intensity in MJ per final retail price.

## TIMBERLINE

**Timberline** Software Corporation of Beaverton, Oregon, publishes a computerized quantity take-off program for use with light construction. It is currently the most successful program on the market. The program is again based on the Construction Specification Institutes code for building materials. The program is organized by how builders would view the ordering of materials during the actual construction of the building. It is not how the designer would approach the selection of building materials. QTOP can be automatically sorted by assembly or by systems for the use of designers. The program starts with excavation and proceeds to foundation work and so on. The same organizational structure was used for the design of QTOP. The program can be easily re-sorted so that building materials are organized by assembly (windows, exterior finish) or by system (first floor exterior walls) and more convenient to the designer.

## **ENERGY CONSERVATION**

Energy Mines and Resources Canada publishes a yearly report on changes in energy efficiency for thirteen industrial sectors of the economy. The publication titled *Canadian Industry Program for Energy Conservation* shows a 28.8% improvement in energy efficiency per unit of output across all industries surveyed between 1973 and 1988. Some sectors such as plastics processing have shown improvements in excess of 50% over this same period. This dramatic change in the use of fuels by Canadian industry since the oil crisis emphasises the importance of using current information for selecting building materials. This history of rapid change means that our assumptions about the best choices of building materials may not remain true in the future.

## **POWER GENERATION**

Energy Mines and Resources Canada also publishes a yearly report on the use of fuels for electrical power generation in Canada. The publication is titled *Electric Power in Canada* and supplies a detailed breakdown of the quantities of fossil fuels used. In the 1960's 92% of Canada's power generation was by hydro whereas by 1988 this figure had dropped to 62%. We can expect to see the amount of electricity generated by fossil fuels, especially coal, to continue to grow. The publication is an important reference document for determining the environmental impact of using electricity on a province by province basis.

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# **OPTIMIZE**

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## **APPENDIX II**

### **PROGRAM DOCUMENTATION AND REFERENCE MATERIALS**

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**APPENDIX II**  
**PROGRAM DOCUMENTATION AND REFERENCE MATERIALS**

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## **2.1 INTRODUCTION**

Appendix II gives supporting documentation and reference tables for interpreting the energy intensity data in OPTIMIZE.

Section 2 of this appendix is written by Kirk Hamilton and explains the process of constructing a detailed energy disposition data base.

Section 3 is a reprinted portion of the New Zealand Study<sup>1</sup> which explains the history and conventions of energy analysis and discusses the advantages and disadvantages of input output analysis, process analysis, and the hybrid approach.

Section 4 includes a series of tables that were constructed to assist designers in understanding how the energy related inputs to OPTIMIZE were compiled. This understanding is essential for those designers interested in customizing OPTIMIZE for their own uses.

## **2.2 THE DETAILED ENERGY DISPOSITION DATA BASE FROM STATSCAN**

### **2.2.1 Introduction**

Input/Output (I-O) based energy analysis dates back some 15 years to the work of Herendeen<sup>2</sup>. It has proven to be a valuable tool for measuring the total energy intensiveness of goods and services - for example, for an automobile you can measure not only the energy used on the production line (the direct energy) but the energy required to produce the material inputs to the auto (the indirect energy in the steel, glass, plastic, rubber etc., making up an auto). The data base supporting I-O energy analysis provides a detailed sectoral breakdown of energy use in physical quantity. Recently Hamilton<sup>3</sup> has used this data base and I-O energy analysis to decompose changes in the energy/GDP ratio into effects owing to sectoral energy efficiency, technology, and structural changes in final consumption and external trade.

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<sup>1</sup> "Energy cost of houses and light construction buildings" by George Baird and Chan Seong Aun at the School of Architecture, Victoria University of Wellington, New Zealand, 1983.

<sup>2</sup> Herendeen, R.A., The Energy Cost of Goods and Services, Oak Ridge National Laboratory, ORNL-NSF-58, Oct. 1973.

<sup>3</sup> Hamilton, K.E., Energy Analysis of Canadian External Trade: 1971 and 1976, Research Paper No. 11, Analytical Studies Branch, Statistics Canada, 1988.

By combining the Input-output tables, physical quantity fuel data from the Census of Manufacturers and the Census of Mines and Quarries, and the national energy balances, a detailed and high quality data base of energy disposition can be produced. The current project is concerned with constructing the data base for 1981 and 1984 (the most recent year for which constant dollar I-O tables are available).

## 2.2.2 Methodology of Construction

The detailed energy disposition data base was previously produced at Statistics Canada for the years 1966, 1971, 1974 and 1976. The basic methods of construction were outlined by Deachman and Hamilton<sup>4</sup>.

The time series of I-O tables at the level of 161 industrial sectors (i.e. primary, secondary, and service sectors - a list is attached to the end of this note) and 602 commodities is available from 1961 to 1984. These represent the most comprehensive and consistent set of economic accounts in Canada. The construction methods for the I-O tables ensure a balance of domestic supply (production plus imports less exports) and domestic disposition (use of commodities by industries, households and governments, plus net inventory accumulation) for each of the 602 commodities in dollars. The accounts draw on a large amount of data, including the census of agriculture, census of manufacturers, census of mines and quarries, the quinquennial census of service establishments, government expenditures, external trade, special studies, and so on. Estimations are performed of taxes, wholesale and retail margins to arrive at a valuation of all commodities in the tables, in producer's prices.

The energy commodities measured in the tables are: crude oil, natural gas, coal, motor gasoline, aviation gasoline, fuel oil, liquefied petroleum gases, electricity and coke. The tables contain figures on dollars of consumption of these commodities for each of the 161 industrial sectors, as well as consumption of the commodities by households (categorized by function, e.g. expenditures on automobile operation) and governments. Production, inventory change, export and import data are also measured and integrated.

The I-O tables are built on the principles of national accounting, which has two consequences for energy data:

- \* Only market transactions are recorded, so that the use of own product by energy producers and the consumption of self-generated electricity do not appear in the tables.

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<sup>4</sup> Deachman, J. and K. Hamilton, Energy Availability, Detailed Disposition and Industrial Demand Coefficients for Canada, 1971, Statistics Canada, Structural Analysis Division Working Paper 78-08-01.

- \* Energy for household operation (e.g. heating, cooling, hot water, lighting, appliances) is split between final demand, where direct sales from utilities to consumers are recorded, and the real estate sector, where the owners of apartment buildings buy energy from the utilities and rent is charged to the tenant.

The steps in constructing the detailed energy disposition data base are as follows:

- i. Compile, at the level of 161 industrial sectors, all of the data on purchases of energy which are available in physical quantities. This covers the majority of industrial energy use since physical data are available for logging, mining, manufacturing, and commercial transportation.
- ii. Compile physical quantity data on purchases of energy for non-energy use - this comes mostly from census data for the iron and steel, iron foundry, chemical fertilizer, and industrial chemicals sectors.
- iii. Make adjustments for undercoverage in these data. This involves making the assumption that energy use per dollar of value added in the establishments of a particular sector is roughly constant. Establishments in logging, manufacturing and commercial transportation are not 100% covered by detailed questionnaires which ask for physical quantities of energy consumed. Less detailed surveys and estimation procedures produce figures for value added for those establishments excluded - in manufacturing only about 2% of total value added is not covered by detailed questionnaires.
- iv. Collect the physical data on internal use of own product by the energy supply industries. This appears in the energy balance publication (57-003 Quarterly Report on Energy Supply and Demand in Canada).
- v. Obtain the data on use of self-generated electricity by industrial establishments from internal working files of the Energy Section.
- vi. At this point all of the detailed physical quantity data available will have been amassed. For each fuel type sum the physical quantity data - this may be referred to as the "hard" data. The difference between the sum of the hard data and the availability figure in the energy balance is the "residual" energy - given the sectors covered by hard data we know that the residual energy must be consumed in the agriculture, fishing and hunting, service, household and government sectors.

- vii. For all sectors not covered by hard data, use the dollars of energy consumed in the Input/Output tables to distribute *pro rata* the "residual" energy quantity to these sectors.

The result of this process is a data base of energy disposition which combines hard data and estimated data. It has the virtue of summing to published availability figures by fuel type - we can have considerable confidence in the availability data since the statistical system covering production, imports and exports is strong. It has the additional virtue of using the most detailed and comprehensive data on the supply and disposition of energy goods in dollars - the I-O tables - as the basis of estimates of energy use in sectors where hard data do not exist. Much of this value data is based on surveys which simply do not ask for physical quantities, for example the census of service establishments and surveys of farm input costs, so that amounts of imputation are kept to a minimum. Finally, the data base will include non-market energy use, such as self-generated electricity, thus overcoming one of the limitations of the I-O tables for energy analysis.

One point which is obvious but needs stating is that the data base so constructed will be confidential, since it relies on many confidential data sets within Statistics Canada. "Confidentiality" generally being related to the level of detail of the data, we can say that analyses carried out using the data will be as accurate as possible. Non-confidential aggregates of the data will be made available to outside users.

### 2.2.3 Quality Assurance

There will be a certain amount of variation in the availability of hard data from year to year - the case that comes to mind is agriculture where, since 1981 was a census year, a complete picture of farm input costs, including physical quantities of energy, was available for 1981 but not 1984. Data quality for such sectors will be higher when hard data are available.

There are two types of checks of the data which will be carried out:

- i. Since there are several data bases available prior to 1981 and 1984, the direct energy use per dollar of value added (obtained by summing Joules of secondary energy inputs, for instance) for individual sectors can be compared over time. While variation in these energy/output ratios can be expected, large divergences may indicate important pieces of data which were overlooked. Of course fixing problems found this way may simply ensure that one is both consistent and wrong in the treatment of individual sectors.
- ii. The distribution *pro rata* of the "residual" energy over I-O dollar figures implicitly defines a price for the energy commodity in question. since the I-O values are adjusted to reflect producer's

valuation, the implicit price is in fact the producer's price. Therefore comparing the implicit price with the producer's price measured from the surveys of energy production sectors will give an indication of whether large quantities of individual fuels have been overlooked. The real world being what it is, some degree of variation between the figures can be expected.

#### 2.2.4 Consistency

The data base construction methodology ensures consistency with large amounts of published data - for example the energy used in mining and manufacturing will, within a couple percent (owing to the adjustment for undercoverage), match publications such as 57-208 "Consumption of Purchased Fuel and Electricity".

There will be some variation between the detailed disposition data base and the energy balance (57-003) however. The sum of disposition in the data base will match availability for some aggregation of energy commodities - this is an artefact of the construction methodology, but the sectoral disposition figures in the energy balance may not match those in the data base even for sectors where hard data are available. This can be explained by the different survey vehicles which produced the two data sets.

The energy balance is based on surveys of energy producers, the 500 or so largest energy consuming establishments, and energy distributors. There is some degree of undercoverage, therefore, of energy consuming establishments compared with the census of manufactures (which is used in the detailed data base). Moreover, many of the other disposition figures in the energy balance are based on a classification of their customers by energy distributors. This will produce a degree of uncertainty, not in quantity of energy consumed, but in its distribution among consuming sectors.

By relying on far more extensive and complete data the detailed disposition data base should provide sharper estimates of where exactly energy is consumed.

### 2.3 ENERGY ANALYSIS

Energy analysis is a formalised method for calculating the energy required to produce goods and services. These requirements include not only the fuel and electricity consumed directly by the particular process in question, but also the fuel and power used indirectly to produce the goods and services associated with the process. Thus the energy required to build a house includes the fuel and power used at the building site and in transporting the materials to the site, together with that used to manufacture the materials, the tools and machinery plus the energy required to extract the raw materials, and so on.

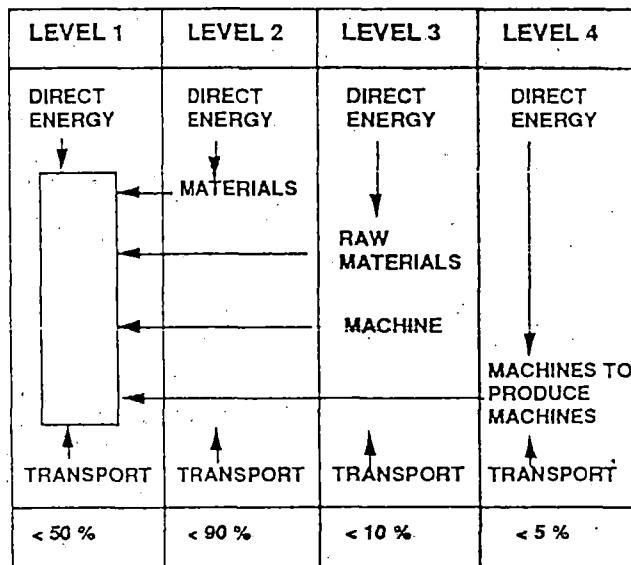
There are many methods and conventions for evaluating the energy requirements of a product or service. Calculations of energy requirements carried out using different conventions and methods will often give very widely different results. Terminologies, procedures and conventions established at the Energy Analysis Workshop on Methodology and Convention, International Federation of Institutes for Advanced Study, Stockholm, 1976 (IFIAS) are the most frequently used and will be adopted in this report. They provide a coherent framework for carrying out the analysis and for comparing the results of different researchers. The methodologies and conventions will be summarized in this section.

### 2.3.1 Conventions

Many researchers have found the equating of energy to enthalpy of combustion of fuels adequate for energy analysis. Enthalpy is the thermo-dynamicist's definition of "heat content". But to analyze the production of a product or service in terms of heat can in certain circumstances be very misleading. The IFAIS workshop examined Enthalpy and Free Energy, among others, as units of measure for energy, and concluded that it was necessary to adopt a convention. The workshop recommended that "where Energy Analysis is concerned with depletion of the resource base, all figures should be expressed in terms of Free Energy. However, recognizing that in many cases it is impossible to compute the free energy changes of actual processes, it is sufficiently accurate in the case of intensive fuels to express figures in terms of gross enthalpy".

The first law of thermodynamics states that energy can neither be created nor destroyed; or stated another way, the total energy of a system and its surroundings remain constant. Thus, when a fuel is burnt its energy is not lost. It is merely converted to another form. Free energy, however diminishes every time a fuel is burnt, and is not recoverable. Enthalpy is therefore not always a good indicator of the "usefulness" of the energy. This is the main reason for the IFAIS workshop's finding that Free Energy rather than Enthalpy Cost expresses the objectives of Energy Analysis. Another reason for adopting Free Energy is that it more than adequately describes the useful work available from low intensity energy resources like the ocean which exist in vast quantities.

**Figure 2.3.1**  
**Levels in the Definition of the**  
**System Boundary IFIAS, 1975 (2)**



For intensive fuels, such as oil and coal, the error in taking enthalpy rather than Free Energy is only approximately 10 percent. In extremely complex systems, as in the growth of plants, it is not usually possible to estimate the free energy to better than one order of magnitude.

### 2.3.2 System Boundary

In energy analysis it is often only possible or necessary to calculate the process energy requirement of a product. In such cases, it is necessary to draw the boundary between energy supply and demand. The boundary adopted depends in part on the availability of data but mainly on the overall aims and thus the assumptions that are made. IFLAS 1974 suggests that for most materials four boundary levels can be drawn as illustrated in Figure 2.3.1. A process will require decreasing amounts of energy with an increase in the boundary level. Table 2.3.2 further illustrates this.

**Table 2.3.2**  
**IFIAS System Boundaries**

<b>Level</b>	<b>Percent Ger *</b>	<b>Boundary</b>	<b>Analysis Method</b>
1	Less than 50%	Energy to process only	Single process analysis
2	Approximately 90%	Energy to extract material included	Many combined process analyses
3	Rarely greater than 10%	Energy to make capital equipment	Industry Input-output table
4	Very low	Energy to make machines that make machines	National Input-output tables

**NOTES** Typical amount of total Gross Energy Requirement (GER). This is only an approximate guide from the IFAIS. How far the analysis is taken depends on the overall aims.

### *Human Energy*

Considerable controversy exists as to what part of the energy support of humans as consumers should be included in the calculation of energy requirements. Odum, H.T. suggests that "because of its high quality and thus high energy cost, human service is the major part of any energy analysis and cannot be omitted". The 1974 IFAIS workshop however, recommended that "where the analysis refers to developed or industrialised economies it is not necessary to consider the energy for life-support or man-power. Where the analysis considers low intensity agriculture, man-power considerations play an important role in the calculations". Most researchers involved with the calculations of energy requirements for building materials have not included the human energy factor. Hill, R.K. took a compromise approach and included direct energy requirements but not indirect. Thus the energy needed for a workman to drive a typical distance to and from work, about 48 GJ/yr, was included.

Bearing in mind the labour intensiveness of the building process, and that in some instances an energy intensive process can in part be replaced by human labour, the importance of considering it in any analysis of the energy requirements for construction is clear. However, the method for assessing the contribution of human labour and what to include is not yet satisfactorily

resolved. It is mainly for this reason that the contribution of human labour has not been included in the analyses carried out in this report.

### *Environmental Effects*

Mining and quarrying operations result in disrupted underground water circulation, damaged landscapes, and soil run-off due to stripped vegetation, that reduce the productive land area. Hydro-electric power projects can result in lower quantities of water being supplied to farm areas, flooding of valuable agricultural land and sometimes damage to the fishing industry. Disposed industrial wastes in rivers and lakes result in poorer water quality both for farming and recreation. These indirect costs and "hidden subsidies" due to "loss of ecological capital" are included in the analysis carried out by Odum. The 1974 IFIAS workshop however, made no specific recommendations on a method or convention for analysis of these environmental costs. There is also no wide agreement among researchers on conventions. Most energy analysts have ignored it. Lacking New Zealand data and a proper framework to compare with results from other sources this report has not included these environmental costs in the analysis outlined in the following sections.

#### **2.3.3 Methods of Analysis**

Four methods of analysis are available:

- i. statistical analysis;
- ii. input-output analysis;
- iii. process analysis; and
- iv. eco-energetics

The method used will depend mainly on the overall objectives of the analysis and the availability of data. Statistical, input-output and process analysis appear to be the more widely used methods for calculating the energy requirements of building materials.

##### **i. Statistical Analysis**

The supply of energy to an industry, along with data on its output, can usually be obtained from published national statistics. This data allows the estimation of the energy requirements per unit of output. However, for a number of reasons, the results obtained can be misleading.

- There is aggregation of diverse industries into a group.
- Sometimes only the costs of fuels are published and different fuels are sometimes aggregated.

- The amount of material used and product sold are not completely listed, with only dollar values given in some cases.
- The energy requirements associated with the consumption of raw materials, plant depreciation and delivery of materials and products, can be difficult to estimate from the published information.
- Data is not published to avoid disclosure of confidential information.

In general this method can provide an order of magnitude estimate of the energy requirements of products classified by industry.

## ii. Input-Output Analysis

Input-Output (I-O) Tables present an overview of the inter-relationship between different sectors of the economy by showing the dollar value transactions between different sectors of the economy. Two sets of I-O Tables are available for New Zealand, a 25-Industry Table and a 130-Industry Table. If the energy cost (MJ/\$) to each industry were known, then it would be possible to calculate the direct energy requirements of the industrial sector from their purchases from the energy supply sectors. All the indirect energy, the energy requirements for materials, administration, transport and capital, could then be calculated from the table. The ability to capture most indirect energy requirements is one of the major advantages of the I-O technique of analysis.

There are however three major disadvantages in using I-O analysis.

- The data is often outdated by about five years. The New Zealand 130-Industry I-O Tables for 1976-77, for example, will only become available towards the end of 1980.
- There is often insufficient breakdown of information, and two products for which coefficients are required may be combined into the same industrial group.
- Where companies produce varied products, they are classified according to their principal product and the energy intensity (MJ/\$) for the principal and secondary product may be different, causing considerable inaccuracies in a diverse industry group.

### iii. Process Analysis

Process analysis is the most frequently used method. It involves the study of the inputs and outputs in a process. The energy requirements of a process or product are determined from all the material, equipment and energy inputs into the process.

Unfortunately, many problems can arise at the detail level for this apparently simple method.

- In many cases, data on the energy and material inputs to a production process are confidential or difficult to separate from aggregated company records.
- The direct energy inputs to any production process can vary considerably among producers and also from one year to the next for the same producer. Variations can occur because of the differences in locality, processing techniques, age and type of processing plant, and efficiency with which energy and materials are used.
- In any production process, a base-load exists, where a certain level of energy is expended regardless of the production level. This marginal energy requirement can be a problem in industries where the operating capacity fluctuates much below the 100 percent mark.
- Then there is the problem of partitioning. When a factory produces a multitude of products, it becomes difficult to apportion the energy use. The IFIAS workshop 1974 suggested assigning in proportion to some physical parameter such as weight or volume. The regression techniques put forward by Cleland and Boag appear much more acceptable. Their method can also be applied to assess the base load.

### iv. Eco-Energetics

Eco-Energetics is the term used by Pearson to describe the techniques used by Howard Odum and the Florida school of analysts. Odum's methods are described in his book "Environment, Power and Society". His methods cover a far broader range of factors and have a much wider boundary than those defined at the 1974 IFIAS workshop. There are several basic differences between Odum's methods and those of other analysts. First, he places a weighting value on all forms of energy. A unit of electricity is valued as four units of fossil fuel, for example. Second, the energy requirements of labour and of environment damage are included.

## **2.4 ENERGY INTENSITIES**

### **2.4.1 Processing of the Detailed Energy Disposition Data Base**

The energy intensity data for Canadian building products was supplied by Statistics Canada (StatsCan) and is based on the Input Output model for the Canadian economy using 1984 data (see section 2 of the Appendix for a detailed description of StatsCan's Energy Disposition Database).<sup>5</sup> The data was expressed in MJ/\$ of commodity, for 602 commodities, and for 8 different sources of energy. The 602 commodities were reduced to 58 commodities, by reviewing the Industry Commodity Classifications within each I-O commodity group, and selecting only those I-O commodities that include building materials. A list of the 58 commodities, with energy intensities for each fuel type and for all sources is presented in Table 2.4.1.

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<sup>5</sup> Stats Canada Data is now available for 1989, but this more recent data has not been incorporated into Optimize due to budgeting constraintment.

**Table 2.4.1**  
**Disaggregation of Embodied Energy**  
**by Fuel Type and Commodity**

Source: I/O analysis of Canadian Economy (			EMBODIED ENERGY:		Redistribution to allow for generation of electricity by other fuel types:							
			18.4%	1.0%	0.0%	2.1%	0.0%	11.6%	66.7%	0.0%	0.3%	Distribution
			29.7%	33.0%	28.5%	28.5%	33.0%	28.7%	87.0%	29.7%	28.7%	Efficiency
			0.618	0.030	0.000	0.073	0.000	0.404	0.766	0.000	0.011	Elect.Mult.
						MJ/kg		(including feedstock energy)				
Code	Commodity	Coal	Nat.gas	Gasoline	Fuel oil	LPG	Nuclear	Hydro	Coke	Other	Total	
49	SAND AND GRAVEL	0.006	0.008	0.004	0.017	0.001	0.003	0.006	0.001	0.002	0.048	
50	STONE,CRUDE	0.018	0.040	0.007	0.035	0.001	0.010	0.018	0.007	0.003	0.139	
131	RUBBER SHEETING SHOE STOCK ETC	9.457	25.793	2.641	8.609	0.576	5.993	11.364	1.529	1.319	67.281	
135	PLASTIC PIPE FITTINGS & SHEET	27.125	65.723	7.111	21.845	1.470	17.180	32.578	3.431	3.854	180.317	
138	PLASTIC HOSE,PAILS&END PROD.NES	17.931	43.642	4.704	13.926	0.961	11.388	21.595	1.643	2.588	118.379	
170	CARPETING&FABRIC RUGS,MATS,ETC	11.392	36.210	2.797	12.693	0.851	7.286	13.816	0.890	1.373	87.309	
191	LUMBER & TIMBER	1.028	1.791	0.571	2.287	0.114	0.655	1.243	0.155	0.172	8.016	
195	VENeer AND PLYWOOD	2.107	5.341	0.911	3.089	0.240	1.348	2.557	0.276	0.288	16.157	
196	MILLWORK (WOODWORK)	1.360	2.804	0.977	1.977	0.155	0.848	1.607	0.441	0.206	10.374	
197	WOOD FABRICATED MAT FOR STRUCT	1.624	3.346	1.184	2.382	0.187	1.014	1.923	0.537	0.249	12.447	
201	MISC. WOOD	1.338	3.820	0.523	1.989	0.109	0.855	1.621	0.179	0.197	10.632	
216	BLDG.PAPER	1.873	2.871	0.315	2.660	0.082	1.087	2.061	0.338	0.519	11.806	
222	CONVERTED PAPER,GUM,WAX OR PRI	0.874	1.215	0.144	0.892	0.040	0.534	1.012	0.066	0.074	4.850	
239	STEEL BARS AND RODS	1.954	3.738	0.242	1.890	0.074	1.185	2.247	6.711	0.134	18.175	
250	STEEL PIPES & TUBES NES	4.569	10.371	0.731	4.352	0.195	2.806	5.321	12.053	0.324	40.723	
252	CAST&WROUGHT IRON PIPE&FITTING	4.368	7.879	0.950	3.324	0.305	2.723	5.164	4.012	0.347	29.072	
265	COPPER PROD.CAST,ROLLED&EXTRUDE	6.766	5.808	0.523	3.608	0.232	4.097	7.769	0.620	0.297	29.719	
273	TANKS	2.184	4.518	0.647	2.300	0.146	1.343	2.547	4.527	0.190	18.403	
276	BEAMS AND OTHER STRUCT. STEEL	2.456	4.758	0.389	2.436	0.107	1.493	2.832	7.914	0.179	22.564	
279	METAL PRODUCTS NES	2.716	5.769	0.900	2.397	0.193	1.664	3.156	2.481	0.249	19.525	
283	METAL PIPES,FITTINGS & SIDINGS	10.655	19.557	2.246	9.289	0.612	6.508	12.341	12.961	0.824	74.993	
288	WIRE FENCING,SCREENING&NETTING	1.670	3.709	0.333	1.392	0.096	1.032	1.957	2.912	0.124	13.225	
292	BOLTS,NUTS,SCREWS,WASHERS ETC.	1.454	3.295	0.339	1.211	0.092	0.898	1.704	2.528	0.109	11.630	
293	BUILDERS' HARDWARE	2.682	5.194	1.011	2.398	0.171	1.660	3.148	3.408	0.237	19.910	
300	HEATING EQ,HOT WATER&STEAM ETC	11.810	24.689	3.830	12.201	0.885	7.267	13.781	22.580	1.049	98.092	
301	HEATING EQ,WARM AIR EX.PIPES&E	11.728	25.527	4.758	11.794	1.080	7.214	13.680	18.266	1.106	95.152	
302	UNIT&WATER TANK HEATERS NON-EL	9.657	21.114	3.730	9.196	0.806	5.925	11.235	12.634	0.936	75.233	
304	COM.APPLIANCES,COOK&WARMING FO	28.568	59.845	10.387	26.043	2.080	17.676	33.519	32.320	2.752	213.191	
308	PIPE FITTINGS,NOT IRON & STEEL	4.616	10.566	1.326	4.201	0.281	2.852	5.408	4.590	0.462	34.302	
317	PUMPS,COMPRESSORS&BLOWERS ETC.	10.276	20.431	3.605	9.423	0.739	6.355	12.051	12.203	0.938	76.022	
320	FANS,AIR CIRCULATORS&AIR UNITS	11.672	24.052	4.241	10.831	0.850	7.205	13.662	14.190	1.084	87.786	
321	PKG.MACH,LUB.EQ&OTH.MISC.MACH.	7.194	14.069	2.527	6.782	0.495	4.450	8.438	10.504	0.642	55.101	
326	REFRIG&AIR CON.EQ.EX.HOUSEHOLD	10.101	19.314	3.194	8.984	0.785	6.203	11.762	9.992	0.890	71.224	
353	SMALL ELEC.APPLIANCES,DOMESTIC	11.678	26.273	5.400	11.107	1.056	7.202	13.657	12.675	1.230	90.278	
354	SPACE HEATER,HEATING STOVES ET	13.900	29.080	5.934	13.441	1.344	8.386	15.902	22.140	1.346	111.473	
355	REFRIG,FREEZERS&COMB. DOMESTIC	13.756	30.396	5.514	12.686	1.112	8.490	16.100	15.897	1.338	105.289	

Source: I/O analysis of Canadian Economy (			EMBODIED ENERGY:			Redistribution to allow for generation of electricity by other fuel types:						
			18.4%	1.0%	0.0%	2.1%	0.0%	11.6%	66.7%	0.0%	0.3% Distribution	
			29.7%	33.0%	28.5%	28.5%	33.0%	28.7%	87.0%	29.7%	28.7% Efficiency	
			0.618	0.030	0.000	0.073	0.000	0.404	0.766	0.000	0.011 Elect.Mult.	
						MJ/kg	(including feedstock energy)					
Code	Commodity		Coal	Nat. gas	Gasoline	Fuel oil	LPG	Nuclear	Hydro	Coke	Other	
356	GAS RANGES&ELEC.STOVES,DOMESTIC		14.355	32.599	6.347	13.575	1.280	8.876	16.831	15.167	1.484	110.513
363	INTERIOR SIGNAL,ALARM&CLOCK SYS		7.636	13.520	3.188	6.637	0.554	4.706	8.924	4.784	0.720	50.668
370	WIRE AND CABLE, INSULATED		5.230	6.839	0.742	3.317	0.250	3.209	6.085	0.710	0.363	26.744
372	ENCLOSED SAFETY SWITCHES ETC.		4.942	8.509	1.614	3.789	0.413	2.667	5.057	12.461	0.432	39.884
374	ELECTRIC LIGHTING FIXTURES ETC		10.228	17.819	3.674	7.978	0.917	5.490	10.411	26.857	0.917	84.290
375	CEMENT		0.034	0.029	0.001	0.008	0.000	0.005	0.009	0.005	0.000	0.091
377	CONCRETE BASIC PRODUCTS		0.172	0.278	0.040	0.152	0.007	0.047	0.089	0.055	0.011	0.851
378	SAND LIME BRICKS AND BLOCKS		0.144	0.269	0.037	0.132	0.006	0.043	0.081	0.050	0.010	0.773
379	READY-MIX CONCRETE		0.141	0.151	0.016	0.114	0.003	0.028	0.052	0.025	0.007	0.536
380	BRICKS AND TILES, CLAY		0.163	1.571	0.043	0.312	0.017	0.096	0.182	0.032	0.020	2.437
384	NATURAL STONE BASIC PROD,STRUC		0.067	0.152	0.007	0.047	0.002	0.033	0.063	0.081	0.004	0.456
386	PLASTERS&OTH.GYPSUM BASIC PROD		0.831	1.895	0.093	0.586	0.024	0.413	0.783	1.003	0.052	5.680
387	MIN.WOOL&THERMAL INSUL.MAT.NES		3.170	7.227	0.354	2.237	0.092	1.575	2.986	3.827	0.198	21.665
390	GLASS, PLATE, SHEET, WOOL		2.714	11.018	0.521	2.089	0.167	1.604	3.041	1.289	0.224	22.667
392	GLASS TABLEWRE&HOUSEWRE,END&NE		4.098	22.959	1.071	3.387	0.348	2.574	4.881	0.806	0.380	40.503
397	LUBRICATING OILS AND GREASES		5.382	18.295	2.401	14.917	1.078	3.157	5.987	3.854	21.410	76.482
401	ASPHALT AND COAL OILS, N.E.S.		0.119	0.417	0.050	0.307	0.021	0.069	0.130	0.073	0.398	1.584
409	PAINTS & RELATED PRODUCTS		5.849	19.818	1.686	5.078	0.359	3.628	6.880	1.427	1.287	46.012
482	ADHESIVES		11.444	63.159	2.687	10.214	0.650	7.240	13.729	2.083	2.560	113.767
499	MISC MEASURE&CONTROL INSTRUMENT		28.497	54.712	13.800	27.217	2.356	17.656	33.480	8.488	3.004	189.209
511	TILING, RUBBER, PLASTIC		2.260	7.096	0.609	1.949	0.160	1.430	2.712	0.309	0.302	16.827

## 2.4.2 Electricity Breakdown

The Electricity data was broken out into proportions of electricity supplied by hydro, nuclear, and thermal for the 1984 Canadian Economy<sup>6</sup>. Thermally generated electricity was further broken into coal, natural gas, oil, etc..

Thermal generation of electricity is notoriously inefficient. The consumption of fossil fuels was inflated based on the generating efficiency of different thermal electric plants and transmission line losses using U.S. data.<sup>7</sup> The breakdown of electricity into eight categories of energy, and the efficiency factors applied to thermal generation, are presented in Table 2.4.2.

**Table 2.4.2**  
**Breakdown of Electrical Energy By Source,**  
**Including Efficiency Factor**

Source	Coal	Oil	Nat Gas	Nuclear	Hydro	Other	Total
GW-h	77964	8770	4170	49266	283138	1300	424608
% of total	18.4%	2.1%	1.0%	11.6%	66.7%	0.3%	100.0%
Efficiency Factor	0.297	0.285	0.330	0.287	0.870	0.287	n/a

Note: The Efficiency Factor (EF) consists of a factor due to the conversion efficiency of the power plant and a factor of 0.87 for distribution losses. As a result, the total amount of coal energy (for example), required to produce 1 kWh of electricity is  $1/EF = 3.37$  kWh. The conversion efficiency for the category "Other" is assumed to be 0.330.

<sup>6</sup> Electric Power in Canada 1984, Ministry of Energy, Mines, and Resources, Canada.

<sup>7</sup> "Environmental Costs of Electricity" by Pace University.

### **2.4.3 Energy to Produce Fuels**

The upstream energy consumed by the production of fossil fuels, and the energy consumed in the process of delivering energy to the consumer has been included in the StatsCan energy intensities for each commodity group.

### **2.4.4 Price Corrections**

The energy intensity data provided by StatsCan is expressed in MJ per 1984 dollar (purchaser's price). To permit use of 1991 prices in the database, conversion factors were obtained at a commodity level by comparison of prices between the two years as based on the 1984 and 1991 Means Cost Data books. Changes in prices of building products over this 7 year period were highly variable between different commodities, with some commodities actually dropping in price, despite inflation. Price conversion factors are listed in Table 2.4.3<sup>8</sup>.

**Table 2.4.3  
Price Ratios For 58 Commodity Groups, 1991/1984**

I-O Code	Commodity	Weighted 91/84 Ratio
49	Sand/Gravel	2.41
50	Stone,Crude	1.52
131	Rubber Sheathing	1.18
135	Plastic Pipe Fittings&Sheet	0.88
138	Plastic Hose, Pails & End Products	1.05
170	Carpeting & Fabric Rugs, Mats	1.30
191	Lumber & Timber	1.10
195	Veneer & Plywood	0.70
196	Millwork (Woodwork)	1.51
197	Wood, Fabricated for Structural Use	1.03
201	Miscellaneous Wood	1.29
216	Building Paper	0.62
222	Converted Paper,Gum,Wax,Etc.	1.44
239	Steel Bars & Rods	1.02
250	Steel Pipes & Tubes	0.98
252	Cast & Wrought Iron Pipe & Fittings	0.82
265	Copper Products	2.00
273	Tanks	1.68
276	Beams & Other Structural Steel	1.13

<sup>8</sup> Now done on a commodity by commodity basis for improved accuracy.

**Table 2.4.3 (continued)**  
**Price Ratios For 58 Commodity Groups, 1991/1984**

I-O Code	Commodity	Weighted 91/84 Ratio
279	Metal Products	1.15
283	Metal Pipes, Fittings, & Siding	0.98
288	Wire Fencing, Screening & Netting	0.93
292	Bolts, Nuts, Screws, Washers	2.26
293	Builders Hardware	0.80
300	Heating Eq. Hot Water & Steam	1.20
301	Heating Eq., Warm Air & Pipes	1.15
302	Unit & Water Tank Heaters, Non-Electric	1.25
304	Com. Appliances, Cook & Warming	0.45
308	Pipe Fittings, not Iron or Steel	1.43
317	Pumps, Compressors & Blowers	1.21
320	Fans,Air Circulators & Air Units	1.03
321	Pkg. Mach.,Lub. Eq.& Other Misc. Machines	1.78
326	Refrig. & Air Conditioning	1.30
353	Small Electric Appliances	1.12
354	Space Heater,Heating Stoves	1.00
355	Refrigerators & Freezers	0.95
356	Gas Ranges & Electric Stoves	0.90
363	Interior Signal, Alarm & Clock	1.39
370	Wire & Cable, Insulated	2.03
372	Enclosed Safety Switches	1.11
374	Electric Lighting Fixtures	1.55
375	Cement	1.00
377	Concrete Basic Products	1.14
378	Sand Lime Bricks & Blocks	1.24
379	Ready-Mix Concrete	1.12
380	Clay Bricks & Tiles	1.24
384	Natural Stone Basic Prod.	1.11
386	Plasters & Other Gypsum Prod	1.00
387	Min. Wool & Thermal Insul	1.51
390	Glass Plate, Sheet, Wool	1.38
392	Glass Tableware & Houseware	1.38
397	Lubricating Oils & Greases	1.00
401	Asphalt & Coal Oils	1.00
409	Paints & Related Prod.	1.12
482	Adhesives	0.90
499	Misc. Measure & Control Instrum.	0.41
511	Tiling, Rubber, Plastic	1.55

## **2.4.5 Transportation Energy**

The energy intensity data includes the energy required to transport the commodities from the producer to the supplier. The program has been designed to allow for additional energy consumption in cases where extra transportation is required. Typical distances travelled by each commodity from producer to supplier were estimated using data from StatsCan publication "Trucking in Canada 1985". These estimates are listed for each commodity in Table 2.4.5(a). These values can be augmented for remote sites by entering the extra kilometres travelled in the OPTIMIZE input form. If the user chooses to augment the transportation distances for material, this additional transportation is assumed to be a mix of fuels in proportion to the fuel usage by the entire Canadian trucking industry: diesel 65%; gasoline 30%; and, propane 5%. An alternate mix can be specified by users of the program, if known.

The energy consumption per tonne km is based on the total cost of fuel used in the private trucking sector and the total tonne km transported. Information in Table 2.4.5(b) and 2.4.5(c) is used to convert the fuel cost to an energy value. The average consumption is calculated to be 4.8 MJ/tonne km. The weight of each commodity can thus be multiplied by the average km travelled, and by the consumption rate, to give an augmented transportation energy value for all of the house materials.

**Table 2.4.5(a)**  
**Typical Transportation Distances & Rates**

	Tonne	Tonne-km	Trans. to Suppl (km)
049 Sand and Gravel	16660202	1326869486	80
050 Stone, Crude	16660202	1326869486	80
131 Rubber Sheeting Shoe Stock Etc.	101000	42595000	422
135 Plastic Pipe Fittings & Sheet	101000	42595000	422
138 Plastic Hose, Pails & End Prod. Nes	30000	15785000	526
170 Carpeting & Fabric Rugs, Mats, Etc.	286484	183547002	641
191 Lumber & Timber	8339292	2812971519	337
195 Veneer and Plywood	233173	240049757	1029
196 Millwork (Woodwork)	745097	252163987	338
197 Wood Fabricated Mat for Struct	560000	256029000	457
201 Misc. Wood	942012	395524141	420
216 Bldg. Paper	445701	132971038	298
222 Converted Paper, Gum, Wax or Pri.	18000	12200000	678
239 Steel Bars and Rods	700734	242378978	346
250 Steel Pipes & Tubes Nes.	1118801	585545952	523
252 Cast & Wrought Iron Pipe & Fitting	114460	91439850	799
265 Copper Prod. Cast, Rolled & Extruded	310200	147281367	475
273 Tanks	98000	40035000	409
276 Beams and other struct. Steel	343006	93692433	273
279 Metal Products Nes.	713479	346784959	486
283 Metal Pipes, Fittings & Sidings	713479	346784959	486
288 Wire Fencing, Screening & Netting	59824	28295189	473
292 Bolts, Nuts, Screws, Washers Etc.	1466989	746632746	509
293 Builders' Hardware	1466989	746632746	509
300 Heating Eq. Hot Water & Steam Etc.	35000	23364000	668
301 Heating Eq. Warm Air Ex. Pipe S & E	33000	19373000	587
302 Unit & Water Tank Heaters Non-El.	46633	27578162	591
304 Com. Appliances, Cook & Warming Fo.	33000	22892000	694
308 Pipe Fittings, Not Iron & Steel	154807	57360762	371
317 Pumps, Compressors & Blowers Etc.	66837	933022019	1396

**Table 2.4.5(a) Continued**  
**Typical Transportation Distances & Rates**

	Tonne	Tonne-km	Trans. to Suppl. (km)
320 Fans, Air Circulators & Air Units	5700	31975000	561
321 Pkg. Mach. Lub. Eq. & Oth. Misc. Mach.	27000	27153000	1006
326 Refrig. & Air Con. Eq. Ex. Household	57000	31975000	561
353 Small Elec. Appliances, Domestic	379771	162637911	428
354 Space Heater, Heating Stove Etc.	3500	23364000	668
355 Refrig., Freezers & Com. Domestic	379771	162637911	428
356 Gas Ranges & Elec. Stoves, Domestic	33000	22892000	694
363 Interior Signal, Alarm & Clock Sys.	7000	4088000	584
370 Wire and Cable, Insulated	466413	204019028	437
372 Enclosed Safety Switches Etc.	79265	59793228	754
374 Electric Lighting Fixtures Etc.	59000	26111000	443
375 Cement	10213362	1405028481	138
377 Concrete Basic Products	10213362	1405028481	138
378 Sand Lime Bricks and Blocks	10213362	1405028481	138
379 Ready-Mix Concrete	0	0	0
380 Bricks and Tiles, Clay	956473	236988287	248
384 Natural Stone Basic Prod. Struc.	16660202	1326869486	80
386 Plasters & Oth. Gypsum Basic Prod.	3608996	1304283878	361
387 Min. Wool & Thermal Insul. Mat. Nes	3608996	1304283878	361
390 Glass, Plate, Sheet, Wool	837601	357395218	427
392 Glass Tableware & Housewre End & Ne	6700	21814000	326
397 Lubricating Oils and Greases	137864	70253304	510
401 Asphalt and Coal Oils, N.E.S.	14770395	1745135455	118
409 Paints & Related Products	338257	173223304	512
482 Adhesives	42000	36512000	869
499 Misc. Measure & Control Instrument	7000	4088000	584
511 Tiling, Rubber, Plastic	84000	51974000	619

**Table 2.4.5(b)**  
**Price of Fuels, 1984**

Propane	\$1.18 .06/m <sup>3</sup>	(F.O.B) Alberta Plant)
Natural Gas	\$12.56 /m <sup>3</sup>	(industrial)
Light Oil	\$278.40/1000 L.	(Ave.)
Heavy Oil	\$215.16/1000 L.	(Industrial)
Heavy Oil	\$180.47/1000 L.	(Electricity Generation)
Electricity Cost	\$0.0335/KWH	(Industrial)
Coal	\$68.87/Tonne	(Avg.)
Coke	\$77.9/Tonne	(Industrial)
Diesel	\$.335/L	(Transportation)

Note: Statistics Unit, Economic & Financial Analysis, EMR, Clatton Gilders (613)996-8643. Data is available on CANSUM and was previously published monthly in hard copy as the "Energy Statistics Handbook"

**Table 2.4.5(c)**  
**Energy Content of Fuels**

Nat. Gas	37.82	TJ/GLitre (KJ/l)
Motor Gasoline	34.66	TJ/ML (MJ/l)
Heavy Fuel Oil	41.73	TJ/ML (MJ/l)
Propane	25.53	TJ/ML (MJ/l)
Coke	28.83	TJ/Ktonne (GJ/tonne)
Coal	27.35	TJ/Ktonne (GJ/tonne) (avg. of Canadian Ontario & Quebec Bituminous)

#### **2.4.6 Converting Dollars to Kg for each Commodity**

StatsCan energy intensity data is expressed in MJ/\$. For greater ease of use, these values have been converted to MJ/Kg (see Table 2.4.6).

**Table 2.4.6**  
**ENERGY INTENSITY DATA**

Commodity	Conversion to weight, Total MJ/\$		Conversion Markup 1984 to 1991 cents/kg		Total MJ/kg (not adjusted for electricity generation)	Total MJ/kg (adjusted for electricity generation)	Total Feedstock MJ/kg	Total Embodied MJ/kg
	1991 retail cents/kg	1991 cents/kg	1984 retail cents/kg	1984 cents/kg				
SAND AND GRAVEL	14.716	0.7	2.41	0.3	0.044	0.051	0.000	0.051
STONE,CRUDE	18.529	1.0	1.52	0.7	0.122	0.140	0.000	0.140
RUBBER SHEETING SHOE STOCK ETC	15.171	400.0	1.18	339.0	51.428	63.678	46.878	110.556
PLASTIC PIPE FITTINGS & SHEET	18.134	643.8	0.88	731.6	132.665	167.384	21.207	188.591
PLASTIC HOSE,PAILS&END PROD.NES	17.524	494.4	1.05	470.9	82.515	104.318	21.207	125.525
CARPETING&FABRIC RUGS,MATS,ETC	16.920	468.6	1.30	360.5	60.991	74.417	0.000	74.417
LUMBER & TIMBER	12.864	53.5	1.10	48.6	6.252	7.376	0.000	7.376
VENEER AND PLYWOOD	14.188	60.0	0.70	85.7	12.161	14.623	0.000	14.623
MILLWORK (WOODWORK)	10.263	120.6	1.51	79.9	8.197	9.872	0.000	9.872
WOOD FABRICATED MAT.FOR STRUCT	10.203	100.0	1.03	97.1	9.906	11.855	0.000	11.855
MISC. WOOD	16.091	60.0	1.29	46.5	7.484	8.962	0.000	8.962
BLDG.PAPER	21.579	23.2	0.62	37.5	8.082	10.039	1.972	12.011
CONVERTED PAPER,GUM,WAX OR PRI	19.111	25.0	1.44	17.4	3.318	4.364	0.000	4.364
STEEL BARS AND RODS	42.820	34.3	1.02	33.6	14.382	16.804	1.094	17.898
STEEL PIPES & TUBES NES	29.667	106.1	0.98	108.2	32.113	37.819	1.094	38.913
CAST&WROUGHT IRON PIPE&FITTING	17.708	100.0	0.82	122.0	21.596	26.871	1.364	28.235
COPPER PROD.CAST,ROLLED&EXTRUDED	26.073	150.0	2.00	75.0	19.555	27.853	1.600	29.453
TANKS	16.528	150.0	1.68	89.3	14.757	17.507	1.094	18.601
BEAMS AND OTHER STRUCT. STEEL	30.985	61.4	1.13	54.4	16.847	19.685	1.094	20.779
METAL PRODUCTS NES	16.562	100.0	1.15	87.0	14.402	17.678	1.993	19.671
METAL PIPES,FITTINGS & SIDINGS	19.422	272.4	0.98	278.0	53.985	66.420	1.600	68.020
WIRE FENCING,SCREENING&NETTING	22.166	42.0	0.93	45.2	10.010	12.054	1.993	14.047
BOLTS,NUTS,SCREWS,WASHERS ETC.	19.176	95.4	2.26	42.2	8.095	9.705	1.094	10.799
BUILDERS' HARDWARE	11.681	100.0	0.80	125.0	14.601	17.618	1.094	18.712
HEATING EQ,HOT WATER&STEAM ETC	14.471	600.0	1.20	500.0	72.357	85.734	0.000	85.734
HEATING EQ,WARM AIR EX.PIPE&E	13.506	600.0	1.15	521.7	70.465	83.786	0.000	83.786
UNIT&WATER TANK HEATERS NON-EL	11.835	600.0	1.25	480.0	56.807	67.986	0.000	67.986
COM.APPLIANCES,COOK&WARMING FO	12.221	600.0	0.45	1333.3	162.950	197.888	0.000	197.888
PIPE FITTINGS,NOT IRON & STEEL	17.318	200.0	1.43	139.9	24.222	29.369	0.000	29.369
PUMPS,COMPRESSORS&BLOWERS ETC.	12.350	600.0	1.21	495.9	61.241	74.495	0.000	74.495
FANS,AIR CIRCULATORS&AIR UNITS	11.467	600.0	1.03	582.5	66.800	80.883	0.000	80.883
PKG.MACH,LUB.EQ&OTH.MISC.MACH.	12.612	612.0	1.78	343.8	43.364	52.460	0.000	52.460
REFRIG&AIR CON.EQ,EX.HOUSEHOLD	12.088	600.0	1.30	461.5	55.790	68.864	0.000	68.864
SMALL ELEC.APPLIANCES,DOMESTIC	10.650	700.0	1.12	625.0	66.561	80.106	0.000	80.106
SPACE HEATER,HEATING STOVES ET	13.644	600.0	1.00	600.0	81.866	97.515	0.000	97.515
REFRIG,FREEZERS&COMB. DOMESTIC	11.514	600.0	0.95	631.6	72.721	87.849	0.000	87.849
GAS RANGES&ELEC.STOVES,DOMESTIC	11.669	600.0	0.90	666.7	77.794	93.952	0.000	93.952
INTERIOR SIGNAL,ALARM&CLOCK SYS	8.104	700.0	1.39	503.6	40.811	50.449	0.000	50.449
WIRE AND CABLE, INSULATED	17.445	200.0	2.03	98.5	17.187	23.071	0.000	23.071
ENCLOSED SAFETY SWITCHES ETC.	15.660	200.0	1.11	180.2	28.215	32.956	0.000	32.956
ELECTRIC LIGHTING FIXTURES ETC	15.754	600.0	1.55	387.1	60.982	71.023	0.000	71.023
CEMENT	57.772	0.1	1.00	0.1	0.069	0.078	0.000	0.078
CONCRETE BASIC PRODUCTS	20.506	4.0	1.14	3.5	0.712	0.806	0.000	0.806
SAND LIME BRICKS AND BLOCKS	19.680	4.0	1.24	3.2	0.635	0.713	0.000	0.713
READY-MIX CONCRETE	30.558	1.7	1.12	1.6	0.475	0.536	0.000	0.536
BRICKS AND TILES, CLAY	37.038	6.5	1.24	5.3	1.953	2.143	0.000	2.143
NATURAL STONE BASIC PROD,STRUC	34.476	1.0	1.11	0.9	0.311	0.368	0.000	0.368
PLASTERS&OTH.GYPSUM BASIC PROD	33.842	11.2	1.00	11.2	3.797	4.479	0.000	4.479
MIN.WOOL&THERMAL INSUL.MAT.NES	36.235	64.6	1.51	42.8	15.507	18.348	0.000	18.348
GLASS, PLATE, SHEET, WOOL	25.134	100.0	1.38	72.5	18.213	21.547	0.000	21.547
GLASS TABLEWRE&HOUSEWRE,END&NE	16.064	200.0	1.38	144.9	23.281	27.232	0.000	27.232
LUBRICATING OILS AND GREASES	17.072	350.0	1.00	350.0	59.754	66.098	7.669	73.767
ASPHALT AND COAL OILS, N.E.S.	18.730	7.1	1.00	7.1	1.326	1.466	0.982	2.448
PAINTS & RELATED PRODUCTS	19.497	192.1	1.12	171.5	33.444	40.324	0.012	40.336
ADHESIVES	25.153	300.0	0.90	333.3	83.843	97.306	0.000	97.306
MISC.MEASURE&CONTROL INSTRUMENT	10.100	600.0	0.41	1463.4	147.808	185.126	0.000	185.126
TLING, RUBBER, PLASTIC	17.072	108.7	1.55	70.1	11.968	14.607	17.216	31.823

The MJ/kg is based on the average cost of products within a commodity grouping. The default values are based on weights for the unique product mix in the standard Canadian house. Another style of house would give slightly different values. Calculation based on a typical house was necessary because the variety of products that may be achieved within any one commodity group.

The conversion of energy intensity expressed in MJ/\$ (as provided by StatsCan) to energy intensity expressed in MJ/kg requires knowledge of the average cost of a commodity per unit weight. However, this information can be obtained easily for very few of the commodities (since any given commodity may contain many products which vary greatly in terms of their price/weight ratio). In this study, this problem is simplified by considering only those products that appear in our standard house.

The procedures used to obtain the MJ/kg of a commodity are:

- 1) Obtain prices and weights for each building product in QTOP.
- 2) Using the quantities of products present in our standard house, compute for each commodity:
  - i) the total dollar cost, and
  - ii) the total weight.
- 3) The average cost/weight ratio is taken to be the total dollar cost divided by the total weight.
- 4) The MJ/kg values are then obtained by multiplying the MJ/\$ energy intensities by the average cost/weight ratio.

Note that an average cost/weight ratio represents a weighted average of costs in which the weighting factors are based on the actual quantities of products in the house. As a result, the MJ/kg values will vary slightly depending on the composition of the house used in this determination.

#### 2.4.7 Incorporating Feed Stock Energy Values

"Feed stock" energy refers to the petroleum and petro chemicals physically incorporated into a product. The energy value of the feed stock material must be included in the total embodied energy value for all those commodities which incorporate energy as feedstock. The StatsCan energy intensity data do not include feedstock energy. Although StatsCan does keep track of the feedstock energy for purposes of energy accounting, these values are not categorized by commodity codes, but rather by the "System of National

Accounts" (SNAs). Incorporating the StatsCan data in the database therefore required a number of conversions. Firstly the SNAs were correlated with the commodities as closely as possible for the materials most relevant to construction. Next a ratio of \$/kg was established from other published StatsCan data for 1984<sup>9</sup>, for primary materials, and used to create a MJ/kg energy intensity for feedstock energy for each commodity containing these primary materials. As a cross check on the results, feedstock energy for each commodity group was determined from other published sources<sup>10</sup>, and compared with the StatsCan data. Values were generally in agreement, with some notable exceptions: StatsCan values for some products were lower than expected, especially for paints and asphalt products, and to some extent for plastics; StatsCan listed feedstock energy for non-ferrous metals.

Feedstock energy intensities are listed in Table 2.4.7, for all commodities that incorporate petroleum products. These energy values are included in the total embodied energy calculated by OPTIMIZE.

**Table 2.4.7 Feedstock Energy Values**

1984 Feedstock Energy Intensity by Commodity, Canada in MJ/kg						
Commodity	Coal	Nat.gas	Fuel oil	LPG	Coke	Total
RUBBER SHEETING SHOE STOCK ETC	0.099	46.643	0.132	0.004	0.000	46.878
PLASTIC PIPE FITTINGS & SHEET	0.045	21.100	0.060	0.002	0.000	21.207
PLASTIC HOSE,PAILS&END PROD.NES	0.045	21.100	0.060	0.002	0.000	21.207
BLDG.PAPER	0.000	0.000	0.043	1.782	0.147	1.972
STEEL BARS AND RODS	0.078	0.000	0.216	0.000	0.800	1.094
STEEL PIPES & TUBES NES	0.078	0.000	0.216	0.000	0.800	1.094
CAST&WROUGHT IRON PIPE&FITTING	0.121	0.000	0.000	0.000	1.243	1.364
COPPER PROD.CAST,ROLLED&EXTRUDED	0.000	0.000	0.000	0.000	1.600	1.600
TANKS	0.078	0.000	0.216	0.000	0.800	1.094
BEAMS AND OTHER STRUCT. STEEL	0.078	0.000	0.216	0.000	0.800	1.094
METAL PRODUCTS NES	0.000	0.000	0.000	0.000	1.993	1.993
METAL PIPES,FITTINGS & SIDINGS	0.000	0.000	0.000	0.000	1.600	1.600
WIRE FENCING,SCREENING&NETTING	0.000	0.000	0.000	0.000	1.993	1.993
BOLTS,NUTS,SCREWS,WASHERS ETC.	0.078	0.000	0.216	0.000	0.800	1.094
BUILDERS' HARDWARE	0.078	0.000	0.216	0.000	0.800	1.094
LUBRICATING OILS AND GREASES	0.000	0.000	0.167	6.930	0.572	7.669
ASPHALT AND COAL OILS, N.E.S.	0.000	0.000	0.021	0.888	0.073	0.982
PAINTS & RELATED PRODUCTS	0.000	0.000	0.000	0.012	0.000	0.012
TILING, RUBBER, PLASTIC	0.036	17.129	0.049	0.002	0.000	17.216

<sup>9</sup> "Value of Products Shipped" Statistics Canada Catalogue No.

<sup>10</sup> Boustead, I., and G. F. Hancock. 1979. Handbook of Industrial Energy Analysis. Ellis Horwood Publishers Limited.

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# **OPTIMIZE**

**A Canadian Database and Computer Program  
for Estimating the Lifecycle Energy  
and Environmental Impact of Residential Buildings**

## **APPENDIX III**

### **QUANTIFYING ENVIRONMENTAL IMPACTS**

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**APPENDIX III**  
**QUANTIFYING ENVIRONMENTAL IMPACTS**

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### 3.1 CATEGORIZING EXTERNALITIES

Environmental impact of a material can be categorized in various ways. Most commonly the categorization is by effect, primarily by those effects which are most direct and quantifiable.

Some of the more direct effects are:

- \* Air contamination by emissions from fuel combustion.
- \* Air contamination by emissions from other (non-fuel related) industrial processes.
- \* Liquid contamination by discharges from all processes.
- \* Thermal/liquid discharges.
- \* Solid waste production.

Some of the more indirect (and usually more difficult to quantify) effects are:

- \* Depletion of non-renewable fuel and mineral resources.
- \* Long term consequences of persistent hazardous waste.
- \* Loss of habitats (human and other) due to industrial activity.
- \* Loss of agricultural capacity.

Environmental factors can be categorized as "minor stressors" such as air discharges of low hazard particulates (by a gravel pit for example) or liquid discharges of high turbidity caused by low risk suspended solids. On the next scale of effects might be thermal and nutrient liquid discharges which eventually lead to eutrophication.

Higher up the scale are emissions which have more direct health consequences such as those which are respiratory irritants. Further yet are those which have more serious toxic effects, and at the top of the scale are the known carcinogens and cumulative toxins (such as heavy metals).

In general the "effects" approach uses characterizations which derive from the "public health and environmental damage" implications of each factor.

Another means of categorizing environmental factors is by the *vectors* through which they operate. This is the usual organization of regulatory agencies and specialized research where *air pollution, water pollution and solid waste* are

divided from one another. This is, in fact, the form in which most environmental data is available.

There is probably no ideal method of categorization because there is always a great deal of crossover of any boundaries placed on complex systems. One emission, for example, may have global warming effects, urban smog effects, and acidic precipitation effects. Vectors are also imperfect because, for example, a particulate may begin as an air pollutant, fall out and become a soil contaminant, then dissolve and become a water pollutant.

There may be merit in the "effects" approach because multiple effect attributes can be described without specific need to reference the vector (air, liquid etc.) at work. Vector categorizations, on the other hand, must still be categorized by effect or "risk level."

### **3.2 A REVIEW OF DATA SOURCES**

As mentioned above, most data is organized by vector since this reflects the administrative division of regulatory agencies and research branches. There is quite a lot of data available on *air discharges* by industries, there is somewhat less on *liquid emissions*. There is less on *solid waste* production.

Environment Canada has compiled estimates of *industrial air emissions* for several years based on numerous data sources, in part industry reporting, in part provincial license monitoring, in part research monitoring and in part process studies and averaging. The latter method is actually the basis of most air emissions evaluations.

The U.S. EPA produces an air emissions factor index for the NAPAP program which is a compilation of several hundred individual studies of industries. The most recent is for 1985. This data provides particulate emissions, carbon monoxide, sulphur dioxide, nitrogen oxides and other hydrocarbons from several hundred processes expressed as *kilos of emission per ton of product*, or other similar ratio. One limitation of the data is that it is generally given as "uncontrolled emissions" and very little is offered about the usual effectiveness of emissions controls and their prevalence in use. Fortunately others such as Sittig and Billings (in Sax) have data, though it is dated, on emission controls and effectiveness.

Conversations with Environment Canada indicate that they actually use the U.S. EPA emissions factors for Canadian inventories by factoring in the estimated emissions controls in use nationally. Generally, to date, there are particulate emissions controls in place on many dusty industries which range in effectiveness from 50% to 60% for simple wet down operations in crushing and screening plants up to 95% for electrostatic stack precipitators on kilns or smelters. It is generally assumed that sulphur dioxide is the only other

significantly controlled gas and that control is advancing rapidly driven by acidic precipitation legislation. Nitrogen oxides and fugitive hydrocarbons are generally only reduced by technological change in combustion equipment and other process equipment, and this change advances slowly. Carbon monoxide is thought to be affected only slightly by technological change.

Carbon dioxide is the other significant air emission in terms of global effects. Carbon dioxide values are simply derived from fuel combustion using factors developed by Marland and Rotty for the U.S. DOE.

Clearly there are only a few categories of air emissions which are single components ( $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{SO}_2$ ,  $\text{NO}_x$ ). These can be treated simply. Particulates represent a wide range of agents from simple carbon and silica through toxic metals, asbestos fibres etc. Hydrocarbons also represent everything from methane through to very complex volatiles and semi-volatiles, some of which may be carcinogenic (coal tars for example). These two categories must be treated in some more detail based on their risk levels.

Less has been done on a liquid emissions though Ontario and B.C. have produced measured and estimated data on outfall emissions from pulp and paper, mining and smelting and some other industries. Process studies, again by Sittig and Billings (in Sax) provide some useful summary data on water emissions but they are generally in more difficult to use ratios, i.e. volume of discharge containing suspended solids per hour or per paper machine etc. There is some useful data here on some industries, but a fair bit of work is required to put it into the form of factors of emissions per unit of material.

There is even less data on solid waste but this should not be as much concern. Solid wastes are generally not "fugitive" and are not "released and diluted" as gaseous and liquid are. Solid waste is a long term management problem and need not carry the same weight in the analysis as fugitive air and liquid contaminants.

Regulatory frameworks change and industry must respond. The recent Canadian Environmental Protection Act (CEPA) and the new U.S. Clean Air Act both will affect emissions levels in the next few years through mandating controls. The cross boundary acidic precipitation agreement is also changing the regulatory ground through requiring equivalence of many U.S. and Canadian regulations.

As a consequence the environmental attributes of materials will be changing over the next few years. The emissions standards set by government in many cases only have a minor relationship to the risk levels or toxicity levels of environmental contaminants. They more often reflect "what is feasible" or "what can be reasonably expected by compromise", or "what the regional environment can be reasonably expected to absorb without undue damage".

### **3.3 APPROACHES TO EXPRESSING THE IMPACT OF POLLUTANTS**

Emissions factors per material unit should ideally be organized and weighted based on their environmental effects. The purpose is to convert them to a form of equivalent values which can be added up to either a single number or a small group of associated numbers.

Some of the data can be manipulated by simple methods. For example energy use in production can be simply converted into air pollutant emissions through using emissions factors from the data (Sittig, NAPAP etc.). There are assumptions which must be made about burner type and efficiency, sulphur content of fuels etc., but most can be reasonably calculated. There is a good deal of overlap between "fuel emissions" and "non-fuel emissions" which must be sorted out. Generally the particulates and hydrocarbons listed in the data are not primarily fuel related but are non-fuel process related. Most of the carbon monoxide, carbon dioxide and nitrogen oxides are fuel related, though some, such as steel smelter emissions, are not directly fuel related but come from oxygen lancing and other oxidation processes.

Other parts of the data can be dealt with individually. For example fluorides from aluminum manufacture, brick kilning or glass manufacture are an important factor which is related to raw material make-up and flux additives. There are several other important items which could be brought out such as PAH's produced by coal coking and aluminum smelting.

Once the emissions factors are collected they can be weighted in several different ways. Kohler suggests an "equivalence method", an approach which is also being tried by the UBC Environmental Research Group. The method involves simply dividing each quantity of emission by its respective regulated limit. The limit can be a legislative one (such as CEPA), or, better yet, it can be a true health and environmental effects limit such as a Threshold Limit Value (TLV) or time Weighted Average (TWA). Recommended exposure limits for human health risks are readily available from the toxicology literature. Agents such as sulphur dioxide may be better regulated by limits on environmental effects. For carbon dioxide there is no appropriate concentration limit, only a total amount.

Once weighted as "equivalent amounts of air or water which has been polluted to the limit by this emission" these can be added into a single air pollution factor or water pollution factor.

Another approach offered by the Pace University review of The Environmental Costs of Electricity is to make economic evaluations of the various factors and thus convert them into dollar terms. The dollar value method can be done in several ways. Some of them are:

The dollar cost of avoidance of the risk. For example it has been suggested that it will cost from \$200 to \$500 per ton to prevent carbon dioxide release from fuel combustion. Sulphur dioxide prevention is simpler and less costly. This approach evaluates the cost of emission control technology.

The dollar cost of substitution of renewable or more benign technology.

The dollar cost of environmental losses due to unmitigated effects. This is an effort to evaluate the dollar cost of lost agricultural capacity, increased health effects requiring health care, damage to property such as building claddings etc. It may even go so far as to evaluate lost recreational potential, loss of wildlife etc.

Once the effects are converted to dollar values they are equivalents and can be added into a single factor or group of factors. Though dollar value equivalents do make carbon dioxide (global warming) and sulphur dioxide (acidic precipitation and urban smog) additive they may mask important distinctions.

For a computer program like OPTIMIZE it is most useful to limit the analysis primarily to quantifiable effects. The long term cost of hazardous waste management, for example, is difficult to know and can be best characterized by a descriptor. Likewise the depletion of a non-renewable resource is difficult to quantify. One could use estimates of known existing world reserves, but this is problematic.

Another important guiding principle for program design is primarily those effects which are uncontrolled or difficult to control. Solid waste, for example, which is not fugitive, can be considered as a management problem, and not added to the factors.

If output is expressed as a small series of related factors such as "global warming index", "acidic precipitation index", "ozone depletion index", "regional air pollution index and "water pollution index" for example it can provide more detail for comparison.

### **3.4 QUANTIFYING THE EMISSIONS OF AIR POLLUTANTS, AND THEIR COSTS**

#### **3.4.1 Emission Coefficients**

The emission coefficients for each fuel type in OPTIMIZE are based on an EMR publication<sup>1</sup> and are summarized in Table 3.4.1.<sup>2</sup> Seven pollutants are

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<sup>1</sup> "Emission Factors for Greenhouse and other Gases by Fuel Type: An Inventory", 1990

associated with each of the fossil fuels: Carbon dioxide, Particulates, Nitrogen Oxides, Sulphur Dioxide, VOCs, Methane and Carbon Monoxide.<sup>3</sup> An additional group of metals and toxic emissions are associated with Oil and Coal combustion, as shown in Table 3.4.2.

Table 3.4.1 POLLUTANT EMISSION RATES FOR DIFFERENT FUELS Fuel Type						
Pollutant	Coal	Nat. Gas	Gasoline	Fuel Oil	LPG	Coke
CO2 Tonnes/TJ	85	49.7	68	73.1	59.8	86
Particulate Tonnes/PJ	64.6	1.29	100	153.8	1.29 *	64 *
Nitrogen Oxides Tonnes/PJ	250	42	390	60	43	240
Sulphur Dioxide Tonnes/PJ	330	0.2	11.7	102.3	0.2	330 *
VOC's Tonnes/PJ	1.5	1.2	630	0.6	1.1	1.4
Methane Tonnes/PJ	0.54	1.3	70	0.16	1.1	0.51
Carbon Monoxide Tonnes/PJ	93	8.5	5365	15.5	10	88

\* assumed values based on data from next most similar fuel type.

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<sup>2</sup> Coal figure is a rough average of different coals used by province and by type. Gasoline output is the average for automobiles in 1987. SO<sub>2</sub> is based on an average between Ontario and Quebec bituminous coal. Sulphur content between different coals varies greatly.

<sup>3</sup> These emission rates assume zero control efficiency.

The emission rates are expressed in terms of tonnes per PJ (or TJ), and are used to quantify the total output of pollutants once they have been factored by the embodied energy values for a house.<sup>4</sup>

**Table 3.4.2  
Metals and Toxic Emissions Associated  
with Oil and Coal Combustion**

	Oil (kg/TJ)	Coal (kg/TJ)
Arsenic	0.0082	0.294
Beryllium	0.0018	0.035
Cadmium	0.0068	0.0191
Chromium	0.0090	.606
Copper	0.12	1.97
Mercury	0.07	0.365
Manganese	0.014	.0069
Nickel	0.542	0.499
Lead	0.012	0.136
POM	0.0036	n/a
Formaldehyde	0.174	0.056

### 3.4.2 Feedstock Energy Excluded

Since feed stock energy is not transformed through combustion, it does not immediately generate air pollutants. Thus pollutant emissions are based on embodied energy values exclusive of feedstock energy.

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<sup>4</sup> Source: Emission Factors for Greenhouse and other Gases by fuel type: an inventory. Definitions: Terajoules = joules  $\times 10^{12}$ . Ad Hoc Committee on Emission Factors, Energy Mines and Resources, December 1990. Petajoules = joules  $\times 10^{15}$ . Source for particulates was "Environmental Cost of Electricity" by Pace University

### **3.4.3 Environmental Externality Costs**

Four pollutants are of major concern when attempting to quantify environmental impact:

carbon dioxide  
sulphur dioxide  
nitrogen dioxide, and  
particulates.

It is these four pollutants that are closely related to use of fossil fuels, and that have a measurable impact on the environment, given today's analysis techniques.

In addition, the use of nuclear power, hydro, and renewables, all have an environmental impact that can be quantified to some degree. Nuclear plants need to be de-commissioned; hydro requires land and water resources; renewables may require land resources, or generate pollutants similar to other fuels.

The OPTIMIZE data base is set-up to quantify the weight of pollutants and the total energy by source. These quantities are then used to calculate the environmental externality cost/kg of a commodity. The environmental externality cost use factors developed by Pace University. The externality cost factors, in Canadian dollars, are presented in Table 3.4.3<sup>5</sup>

**Table 3.4.3  
EXTERNALITY COSTS**

Carbon Dioxide	\$0.15/kg
Sulphur Dioxide	\$1.80/kg
Nitrogen Dioxide	\$4.47/kg
Particulate	\$2.62/kg
Nuclear	\$8.08/GJ (2.91¢/Kwh)
Hydro	.33/GJ (.12¢/Kwh)
Renewable	\$1.11/GJ (.4¢/Kwh)

<sup>5</sup> For a rationale of the dollar values, refer to the Pace University report. Values shown above are Canadian dollars.

### **3.4.4 Pollutants from Manufacturing**

Non-energy-related pollutants that are produced during manufacturing of products should also be considered by builders/designers while selecting products. These include air, water, and soil pollutants.

Unfortunately it is difficult at present to quantify the non-energy related pollutants because they vary considerably from one facility to another, depending upon such factors as age of technology employed and the control efficiencies.

Some of the most significant non-energy related air pollutants are CFCs and particulates. OPTIMIZE is designed to quantify both these pollutants, and add their totals to the net environmental impact. However no reliable data has yet been obtained for Canadian industry, and so no values have been entered in the database.<sup>6</sup>

Building products which either contain CFC's or use CFC's or HCFC's in their manufacture are:

- Polyurethane insulation boards
- Sprayed polyurethane insulation
- Phenolic foam insulation
- Extruded polystyrene insulation
- Polyethylene sheet
- Refrigerators<sup>7</sup>

### **3.4.5 Indoor Emissions**

Indoor emission rates for volatile organic compounds (VOCs) have been established for a variety of building products. The emission rates, by mass, for each VOC and for each building material, are presented in Table 4.5. As more information becomes available on the emission rates for specific materials, the OPTIMIZE database could be expanded to incorporate commodities with more precise emission rates. At the same time a more elaborate indoor air quality prediction model could be built into Optimize.

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<sup>6</sup> Environment Canada has recently surveyed Canadian industry for CFC usage, but data is still considered confidential.

<sup>7</sup> "Survey of Consumer & Commercial Products Containing or Manufactured with CFC's in Canada" prepared by Stevenson, Kellog, Ernst & Whinney, Management Consultants for Envirolan.

**Table 4.5**  
**IAQ EMISSIONS by Mass**

Building Component Materials (with high emissions)	Aldehyde	Aromatics			Alkane		Terpene		Ether	
	Formaldehyde	Benzene	Toluene	Xylene	Nonane	Undecane	Limonene	A-pinene	Ethylebenxene	
Flooring	D	E	F	G	H	I	J	K	L	
Particle Board	300				10			25		
Plywood	20									
Vinyl Flooring	30									40
Carpet and Underpad	10		60	0.4		12				
Adhesive							190			
Walls										
drywall					6.4		90			
paint		7.2	150					50		
cove base adhesive		51.0						190		670
caulking		5.2	20	41.0						2
wallpaper	15		50		10	18				
Ceiling										
drywall					6.4		90			
paint		7.2	150					50		
Utilities										
PVC Plumbing					0.4					
Wiring					5.0		6			4
Furniture & Cabinets										
particle board	300				10					
plywood	20									
paint		7.2	150							
Consumer products (wet)										
floor wax								153	54	
grease cleaners							66			

Note: Blank cells indicate that information is unavailable, however emission rate is unlikely to be significant

To adequately describe the contribution of individual sources to the pollutant concentrations in the indoor air, in buildings, the following characteristics of the source may have to be identified and processed:

1. Effective surface area;
2. Relative humidity of the local air;
3. Temperature of the air (maybe of the surface);
4. Concentration of the pollutant, just above the surface;
5. Age of the specimen;
6. Time since installation;
7. Basic emission rate (at time zero);
8. Time constant(s) of the emission rate;
9. Effective air change rates;
10. Sink characteristics (chemical dependent); and
11. Storage characteristics (chemical dependent).

### 1. Effective Surface Area

The rate at which chemicals are released into the indoor area will be a function of not only the total surface area of the material (or product), but of the ability of those surfaces to communicate with the indoor air. If a piece of particle board is tightly nailed and edge glued to a sub-floor that is virtually air tight, it will release formaldehyde into the air above it from both the upper surface and its edges, but not likely from its back (lower) surface. If, however, it is just loosely applied to the sub-floor, and that sub-floor is air leaky to the basement of the house, and as deformed as most such floors tend to be, the total surface of the particle board may be an effective emission surface. Note that the time constants of the emission rate may differ between these two cases, but that data does not likely exist at this point.

### 2. Relative Humidity of the Local Air

We live on a water planet, and many of the materials that we use are affected by water, to some extent. For a considerable number of materials and chemicals, we can expect that the release rate (and time constants) will prove to be humidity-level-dependent. For most of those, the "experts" now predict a Relative Humidity dependence, as opposed to an Absolute Humidity controlling effect. Conversion could be done later, as temperature is also recorded and used, so the choice of RH or AH is not critical at this time.

### 3. Temperature of the Air

For very predictable chemistry reasons, the temperature of the material (we may be able to use the air temperature next to it as an adequate surrogate) affects the release rate of most chemicals, simply because higher temperatures lead to higher chemical energy levels, even before reactions and decomposition

is taken into account. It may be necessary to account for this dependency by using an equation that includes temperature, and likely humidity as well, rather than just a look-up table, if the data requirements are to be kept manageable. For indoor surfaces that are out of the sun, or are otherwise protected from intense radiative fields, the air temperature may be an excellent surrogate for the temperature of concern. For materials used on poorly-insulated, outdoor-facing surfaces (envelope walls, ceilings and floors), the indoor air temperature may not always prove to be an adequate surrogate. Since we should be working towards well-insulated structures for all buildings of interest, but the problem exists, and will have to be addressed in some cases, even if by adjusting the release rates used, before a simulation is done.

#### 4. Concentration of the Pollutant

At least for some chemicals (formaldehyde and water are the ones we will most commonly meet), the emission rate of the chemical drops off, all other things being equal, when the concentration above the specimen is high enough for some measurable return of the chemical to the surface. The surface sees a partly-saturated atmosphere above it, and seeks a local equilibrium between the air and near-surface transfer rates. Formaldehyde and water vapour may be the only two chemicals which display this characteristic, since their airborne concentrations are high enough to make the air-to-surface transfer rate a significant one, but the process exists in all cases. It is truly insignificant for most chemicals, however, and may safely be ignored for most of them. The need for this correction for formaldehyde is highly unfortunate, since it will likely result in a need for some sort of iteration (or historical tracer of the last-step concentration), if correct concentrations are to be determined by analysis programs. At the moment, many emission test programs also ignore the problem, but that may have to change. When we are studying drying of wet materials, it will have to be taken into account, for any reasonable level of accuracy.

#### 5. Age of the Specimen

Although we may not always have the ability to record and use this piece of information, some materials have such short time constants, even in their packaged configuration for shipping, that the time since they were produced is of concern. If packaging, bundling or other practices prevent an easy loss of the pollutant of concern, this piece of data may not be needed, and will be replaced by "Time Since Installation".

#### 6. Time Space Installation

The release rate of chemicals from materials is often a function of time, (if the chemical has a reasonably small mass), and usually if the material is held as a vapour, or on surfaces within a material. The release may not start, however, until the packaging is opened and the material installed and open to the air.

Even in cases where "5. Age of Specimen" is the correct time, it may not be available, and the time since installation may have to be the data used. Perhaps it will be possible to use this latter time as the standard, using a modifier for those cases where time since manufacture is of significant importance.

## 7. Basic Emission Rate

Finally we get to some of the more conventional measures of emissions from materials. The "Time Zero" rate of emission of the chemical in question is the basic piece of data needed, and will likely be expressed as either a mass release rate, per unit of surface area and time, or per item and unit of time. I am presuming that we will later have useable data on the emission rate of chairs and cupboards, etc., to further our study of "real" houses. A European based company already has its own standard for the release rate of formaldehyde from some of the furniture it sells, because it is seen to be a significant selling advantage in Europe (and especially in Scandinavia), even though it has not caught on here. They have, however, been able to reduce Canadian complaint rates on some furniture by implementing their emission rate controls on much of the furniture that they market.

## 8. Time Constraint(s)

Virtually all materials that have been measured to date display a decreasing source emission rate over time, under constant conditions for other variables. As the mass of pollutant in the material falls off, its vapour pressure also drops, delivering it to the surface at a lower rate, through the internal resistances to flow. Even without a significant back-pressure in the air above the material, this internal resistance produces a non-constant source strength characteristic. It is further modified by the resistance of the air film above the material, and the concentration of the pollutant in the air, when that concentration results in a significant vapour pressure (compared to the internal vapour pressure). From first principles, one would expect a quasi-exponential shape to the emission rate curve, but that has not always occurred, for reasons not yet well known (so much to learn, and so few learning).

## 9. Effective Air Change Rate

The resistance of the air film above the material, to the flow of the pollutant chemical into the mixed air volume, is a function of the velocity of the air flow above the surface in question. As that film velocity goes up, the flow resistance (for movement of the chemical into the main body of air) goes down, approaching a minimum value that will be a function of the surface roughness of the material. In most cases, we will not find precise relationships between air change rates and actual film velocities (therefore film resistances), so there will likely continue to be differences in release rates shown in different chambers which have a different relationship between the air change rate and

the film velocity. It is hoped that this problem will soon be addressed, in a Spring 1992 ASTM Symposium, and then in ASTM standards.

## 10. Sink Characteristics

Most surfaces in buildings are not truly chemically inert, nor are the chemicals under study totally stable, especially if the surfaces in question act as catalysts to chemical reactions of or between contaminants. Wadden and Scheff suggested that those surfaces could be well modelled as "equivalent" air change rate surrogates, and most testing has shown that to be true. All of the needed research has not been done, however, and no consensus has been achieved as to how that effect should best be modelled, and should therefore be presented in data bases of spreadsheets. Some sort of effect will have to be defined and included, however, so that some provision should be made, even if it must later be changed.

## 11. Storage Characteristics

Materials like carpets have recently been shown to display powerful storage effects, storing contaminants when the airborne concentrations are high, then releasing them again as concentrations began to drop. They act as both negative and positive sources, and sometimes powerful ones. It is highly likely that much of the theoretical work in this area will concentrate on water storage in cellulose-based materials and on VOC storage in carpets and paper. Later on, many other materials will also be studied, and storage effects will sometime be shown to be significant. Since all of the materials accessing the indoor air can become sinks, we will be needing sink and storage data for all materials, before we obtain good correlations between predictions and measurements.

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# **OPTIMIZE**

**A Canadian Database and Computer Program  
for Estimating the Lifecycle Energy  
and Environmental Impact of Residential Buildings**

## **APPENDIX IV**

**QTOP VARIABLES, CONVERSION FACTORS,  
AND PRINT-OUTS OF THE QTOP FORMS**



## Appendix IV

### QTOP VARIABLES AND CONVERSION FACTORS

#### 5.1 INTRODUCTION

A complete printout of the QTOP input form is provided at the end of this document. It may be useful to enter quantity take-offs onto these forms by hand before transferring the data to the program. Note that the column headings are somewhat abbreviated in this listing in order to allow the display of all of the columns on a single page. Also the default values are shown for all entries (other than quantities).

It should be noted that all of the data listed in QTOP is user-alterable. Hence, if the user has specific product information that is different from what is shown in QTOP, then the user can (and should) make the necessary changes to increase the accuracy.

Each of the column headings in the QTOP spreadsheet is defined in the paragraphs below.

**Line Listings** - (not present on the paper print-out) Line numbers simply keep track of the rows so the order of listings in the computer file can be re-established if necessary. Intervals in line numbers permit inserts by users, should someone wish to include a new product.

**Stage** - Stage numbers help to organize each task chronologically, and are used to flag the titles that are needed for summary reporting.

**Item** - Items refer to the materials used in construction of a house. Typically items are specific products that can be purchased in the building supply store, or from a building sub-trade. In a few cases the item is an "activity", such as moving earth from one location to another, although the user will still be expected to input a quantity of materials, (in this example,  $\text{yd}^3$  of soil). In other cases the item may be a component of very different materials (eg. an aluminum window), and the user must break down the item into quantities of its component parts prior to entry into QTOP (eg. 4 aluminum windows must be converted into 4 aluminum window frames and 4 x N panes of glass, where N is the number of panes in the glazing).

**Quantity (and Builder's Units)** - The quantity of any product required for a house is listed in this column, in builder's units, (ie. the most common units used by Canadian builders and designers).

**% Exposed to Interior** - The percentage of any product that is exposed to the interior is listed as a default value, which may be altered by the user. The % exposed values are used to sum the total mass of different materials which are

emitting pollutants to the indoor environment. The program automatically converts the mass to an area value, to permit the use of area emission rates. A product is assumed to be 100% exposed to the indoor air unless it is:

- i) remote from the finished portions of the house (eg. a retaining wall)
- ii) isolated from indoor air by vapour barrier (eg. exterior siding) or,
- iii) sealed from the indoors by an impermeable, vapour tight coating or sheeting (eg. a counter top with undersides and edges sealed with urethane)

Some products are equally exposed to both indoors and outdoors, (eg. a window, a door or a masonry fireplace) and have been allocated a 50% exposure value.

### Assembly Number

All products listed in QTOP are coded according to the assembly to which they belong. There are 87 assemblies, in the MEANS Residential Cost Data publication. The assembly numbers in QTOP have been reduced somewhat for ease of use. Each assembly number consists of three digits. The first digit is the construction stage, as listed in Table 1.

Table 1 Construction Stages Referenced In The Assembly Numbers	
1	Site Work
2	Foundations
3	Framing
4	Exterior Walls
5	Roofing
6	Interiors
7	Specialties
8	Mechanical
9	Electrical
10	Other

The second two digits of the assembly numbers constitute a unique identification number for each assembly, and are used to differentiate between different assemblies in one stage, (eg. between an interior door and a closet door). A complete list of assemblies is presented in Table 2. For each of these

assemblies there are numerous combinations of materials that could be used to make up the assembly.

For example a Thin Coat and Dry Wall Assembly could use 3/8" gypsum board, or 1/2" gypsum board. Many of these material options are broken down as assembly options within the MEANS publication. A similar breakdown of assemblies in the OPTIMIZE database allows users to correlate the products in an assembly with the existing library of assembly options in the database.

**System I.D.** - The System Identification is a letter code used to describe houses in terms of their larger systems (eg. Wall Exterior Framed is WEF, Ceiling Interior is CI). The System I.D. provides an alternative method of presenting the products and commodities in a house, and may be more appropriate for optimizing the design of a house in broad terms.

System I.D. codes and descriptions are listed in Table 3.

**Table 2**  
**List of Assemblies**

Assembly Numbers and Descriptions	
Assembly No.	Assembly Description
100	Site Work
204	Foundation Footings
212	Concrete Foundation Wall
216	Foundation Floor Slab
220	Wood Wall Foundation
222	Exterior Basement Stairs
304	Wood Floor Framing
308	Exterior Wall Framing
316	Roof Framing
348	Interior Partition Framing
400	Exterior Wall Finishes
420	Insulation
434	Wood Casement Window
442	Aluminum Sliding Window
452	Exterior Door
456	Garage Door
460	Storm Door
470	Exterior Misc. Carpentry
500	Roof Finishes
532	Skylight
604	Drywall/Thincoat Wall
608	Drywall/Thincoat Ceiling
620	Interior Door
624	Closet Door
662	Floor Finishes
690	Stairways
704	Laundry Room Systems
708	Kitchen Systems
712	Appliances
716	Bathroom Accessories
724	Masonry Fireplace
730	Prefab. Fireplace
740	Wood Deck
750	Porch and Balcony
760	Interior Misc. Carpentry
802	Bathroom Fixtures
850	Plumbing
862	HVAC System
900	Electrical Roughin
950	Electrical Fixtures

**Table 3**  
**System Identification Codes Used in QTOP**

Foundations	
F	
FF	Foundation footings
FSW	Foundation stem wall
FBW	Foundation basement wall
FPF	Foundation pad footing
FBP	Foundation basement preserved wood
FE	Foundation earthworks
Walls	
W	
WEF	Wall exterior framed
WIF	Wall interior framed
WIM	Wall interior masonry
WEM	Wall exterior masonry
WR	Wall retaining
WC	Wall column
WCF	Wall crawlspace framed
Floors	
L	
LI	Floor interior framed
LE	Floor exterior frame
LD	Floor outside deck
LS	Floor slab
LC	Floor skim coat
LSS	Floor structural slab

Ceilings	
C	
CE	Ceilings exterior
CET	Ceiling exterior truss
CI	Ceilings interior
Exterior Work	
E	
EL	Exterior landscaping
ECF	Exterior concrete flat work (driveways, sidewalks, patios)
EDS	Exterior drainage systems
EE	Exterior earth works
EWF	Exterior wood framing (decks etc.)
Services	
S	
SP	Services Plumbing
SH	Service Heating
SV	Services Ventilation
SE	Services Electrical
SS	Services Sprinklers
SSD	Services Sewage Disposal
Stairs	
I	
IC	Stairs concrete
IF	Stairs framed
Fireplaces	
MF	Masonry fire places
TF	Metal fireplaces (inserts & zero clearance)

### Product Number

Building materials are coded with a unique 10 digit product number according to the Construction Specifications Index (CSI) (Canada) "MASTERFORMAT".

New products can be added to this system by following a simple 3 step procedure. Based on Means Residential Cost Data modification of the CSI. For example, a Product Number of 611540050 breaks down into three parts:

*	the division (first 2 or 3 digits)	61
*	the major classification (middle 3 digits)	154
*	the individual line number (last 4 digits)	0050

**\$/Unit** - The prices for products are based on the Means "Residential Cost Data - 1991" and have been corrected from U.S. to Canadian Costs by adding 10%. Although Means presents costs in U.S. dollars, the prices are based on sampling both U.S. and Canadian building supply outlets. OPTIMIZE can be updated yearly with the annual publication of Means, to reflect current Canadian costs, or as part of updating energy intensities from StatsCan. For products which were not listed in the Means book, prices were obtained from local contractor supply stores. In a few cases prices were estimated.

#### I-O Code

All products are labelled with a commodity code. The 2,000 to 3,000 products used in typical residential construction are categorized under 58 commodity codes. The 58 commodities are a subset of 602 commodities that describe all commodities produced in Canada, as part of the Input - Output (I-O) model for the Canadian Economy that was used to create energy intensities. A master list from Statistics Canada provides a LINK between the 5000 products classified by Canadian industries (the Industrial Classification or ICC System) and the 602 commodity codes (from the I-O system).

**Kg Conversion Factor** - This is a conversion factor to translate the builder's units into Kilograms of product used. For each product, a multiplication factor to convert to kg was usually obtained using one or more of the following methods:

- 1) direct conversion of units (e.g. lbs of nails to kg of nails),
- 2) calculation based on item description and known densities of the building material, or,
- 3) weights supplied by local sources (i.e., suppliers, manufacturers).

As with the cost data, there were a few items for which weight information was not available and the values in QTOP are estimates.

In those few cases where no new product is used, the conversion factor translates the activity into the associated energy product. For example, for site clearing activities ( I-O Code = 0), and energy value is calculated based upon the following assumptions:

### Excavation

In 8 hrs.,  $24' \times 38' \times 8' = 7296$  c.f. can be excavated with a total fuel use of 36L (diesel) (using a Hitachi 07).

### Demolition

Approximately 40 L of diesel fuel will be consumed by an excavator in order to fill a 60 c.y. bin

$$40\text{L}/60\text{c.y.} \times 38.68 \text{ MJ}/1\text{L} = 25.8 \text{ MJ/c.y.}$$

### **CFC Totals**

A column in the QTOP spreadsheet can be used to list the quantity of chlorofluorocarbons (CFCs) associated with each product, in terms of kg CFC/kg product. No values have been entered as quantitative data were not available. In general, values in this column will be zero except for a very few products where CFCs are used in the manufacturing process, or where the product itself is composed partly of CFC. The ratios can be altered, if users are proposing to select materials that are specially manufactured so as to minimize CFC consumption.

### **Waste Factor**

The total quantity of a product used by a house over its life time is inflated by the amount of wastage during construction and replacement. The default wastage factors are different for each product but are usually close to 5%.<sup>1</sup> Wastage factors for specific materials are listed in Table 4.

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<sup>1</sup> Figures are largely borrowed from an in depth study of British construction practices in "Waste Prevention on Site" by E. Skoyle and John R. Skoyle.

**Table 4**  
**Average Wastage for Specific Building Materials**

Item	Average Wastage	Original BRE - BRE Digest 247 March 1981 "Waste of building materials"
Concrete, ready mix	4%	3%
Re-bar	5%	
Re-mesh	4%	
Bricks, common	8%	8%
Bricks, Facing	12%	12%
Blocks, concrete	8%	10%
Timber, framing	10%	10%
Timber, finishing (housing)	7%	
Nails & Screws	5%	
Plumbing, internal, copper	2%	
Plumbing, internal, plastic	7%	11%
Gyproc, ceiling	12%	
Gyproc, wall	10%	
Plaster	5%	
Windows, preglazed	5%	
Painting	1%	

#### Maintenance and Replacement Intervals

Maintenance and replacement factors for building components had been previously compiled by the Research Division of CMHC.<sup>2</sup> These figures are used as defaults. Maintenance occurs periodically, and is assumed to involve replacing less than 100% of a product. Replacement refers to total replacement, (100%), and occurs periodically as well. The maintenance and replacement intervals are expressed in years.

Because the CMHC replacement intervals were listed for specific sub-assemblies (eg. gypsum board on an exterior wall with masonry veneer), they were not always appropriate for defining product life, or for defining the life of the more generic forms of assemblies used by QTOP. Consequently a simplified list of assembly lifetimes was generated, using averages wherever

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<sup>2</sup> Anticipated Maintenance, Repair, Servicing, Refurbishing and Replacement Frequencies in Low-Rise Housing, DRAFT, obtained from Wayne Webster, Research Division, CMHC.

possible. The user can change the percentage values, or the intervals, based on their own experience or on more comprehensive data, when it becomes available. The default lifetimes for specific building assemblies were listed earlier as part of Table 2.

A formula in OPTIMIZE is used to create a "replacement factor" which relates the maintenance interval with the expected lifetime of the product, and the lifetime of the house.

## DERIVATION OF THE REPLACEMENT FACTOR

### Abbreviations & Definitions

- HL - House Life (yrs)
- PL - Product Life (yrs)
- RP - Repair Percentage (%)
- RI - Repair Interval (yrs)
- NE - Cut-off Value for being Near the End of a life-cycle
- TR - # of times a product is totally Replaced
- RCC - # of Repair Cycles in a Completed life-cycle of a product
- RCI - # of Repair Cycles in Incompleted life-cycle of a product (i.e., at the end of the house life-cycle)
- RF - Replacement Factor

### Assumptions & Rationale

1. TR is essentially the integer part of  $HL \div PL$ ; however, if the last replacement of the product occurs near the end of the house life (relative to the product life!), then TR is decreased by 1. This adjustment reflects the idea that towards the end of the house life, it is economically prudent to avoid non-essential repairs/replacements.

#### EXCEL FORMULA:

$$TR = INT(HL/PL) - IF(HL/PL - TRUNC(HL/PL) < NE, 1, 0)$$

2. Maintenance requirements can be categorized into two types: maintenance incurred during a completed life-cycle of a product (see (3) below), and maintenance incurred during the incompletely completed life-cycle of a product (due to the expiration of the life-cycle of the house) (see (4) below).
3. For a product which completes its lifecycle, the number of maintenance (repair) cycles required is essentially given by  $PL \div RI$ ; however, as in we must correct for the possibility of forgone repairs near the end of the product life.

**EXCEL FORMULA:**

RCC = INT (RL/RI) - IF (PL/RI - TRUNC (PL/RI) , NE, 1,0)

4. For the last replacement of a product, the number of repair cycles will depend on the years remaining before the life of the house expires, rather than the product life.

**EXCEL FORMULA:**

RCI = INT (HL-PL\*TR/RI) - IF (HL-PL\*TR/RI - TRUNC (HL-PL\*TR/RI),NE,1,0)

5. The replacement factor is the sum of all of the quantities due to initial construction, total replacements, repairs during completed product life-cycles, and repairs during the final product life-cycle at the end.

**EXCEL FORMULA:**

RF = 1 + TR + RP/100\* (RCC\*TR + RCI)

**Input Default Values (if unknown)**

HL = 50 yrs; PL = 50 yrs; RP = 0%; RI = 1 yr; NE = 0.20

**QTOP Input Forms**

The following pages are a print-out of QTOP as it normally appears in its expanded form on the computer monitor. The forms do not include quantities for any of the products listed. These forms are a useful guide to the quantities that must be obtained, and may be completed in advance of computer data entry if this proves convenient.

Other factors that are shown on the form are default values, suitable for a standard platform frame house. New values, or even new products, can be entered into QTOP, where necessary, following instructions in the Users Manual.

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	Emiss.	Const.	prcentage	interval
1	<b>SECTION 1 SITE WORK</b>													
1.1	<b>SITE CLEARING</b>			0										
Site clearing	Tree & Shrub Clearing		Yd3	0	100	EE	211040010	0.00	0	955		5	30	15
Site clearing												5	30	15
Site clearing												5	30	15
1.2	<b>EARTHWORKS</b>													
Earthworks	Excavation		Yd3	0	100	FE	222380010	0.00	0	955		5	30	15
Earthworks	Backfill		Yd3	0	100	FE	222040010	0.00	0	955		5	30	15
Earthworks												5	30	15
Earthworks												5	30	15
1.3	<b>SEWAGE DISPOSAL SYSTEM</b>													
Sewage disposal system	Excavation		Yd3	0	100	SSD	222380010	0.00	0	955		5	30	15
Sewage disposal system	Septic tank, precast conc., 600 gal.		No	0	100	SSD	274040010	473.00	377	3175		0	0	1
Sewage disposal system	Distribution box, precast conc.		Yd3	0	100	SSD	274041000	56.10	377	136.1		0	0	1
Sewage disposal system	Drainage pipe, clay, 6"		Ft	0	100	SSD	271725020	1.93	380	7.3		5	0	1
Sewage disposal system	Gravel cover		Yd3	0	100	SSD	274042600	11.94	49	1468		5	0	1
Sewage disposal system	Backfill		Yd3	0	100	SSD	222040010	0.00	0	955		5	30	15
Sewage disposal system												5	30	15
Sewage disposal system												5	30	15
1.4	<b>LANDSCAPING</b>													
Landscaping	Excavation		Yd3	0	100	EL	222380010	0.00	0	955		5	30	15
Landscaping	Retaining walls		Ft2	0	100	EL	227160010	7.87	384	1971		5	30	15
Landscaping	Sod		Ft2	0	100	EL	293120010	0.16	0	955		5	30	15
Landscaping	Topsoil		Yd3	0	100	EL	292082000	23.00	0	955		5	30	15
Landscaping												5	30	15
Landscaping												5	30	15
1.5	<b>CONCRETE FLATWORK</b>													
Concrete flatwork	Driveway		Yd3	0	100	ECF	251280350	56.16	379	1797		4	0	1
Concrete flatwork	Sidewalks		Yd3	0	100	ECF	251280350	56.16	379	1797		4	0	1
Concrete flatwork	Patio		Yd3	0	100	ECF	251280350	56.16	379	1797		4	0	1
Concrete flatwork												4	0	1
Concrete flatwork												4	0	1
1.6	<b>SITE DRAINAGE</b>													
Site drainage	Precast conc. splash blocks		No	0	100	EDS	348050010	0.90	377	11.34		8	0	1
Site drainage	4" perforated plastic pipe perimeter		Ft	0	100	EDS	271682000	0.75	135	0.5		5	0	1
Site drainage	6" perforated plastic pipe perimeter		Ft	0	100	EDS	271682040	1.82	135	0.8		5	0	1
Site drainage	3/4" coarse gravel backfill		Yd3	0	100	EDS	222120320	16.72	49	1468		5	0	1
Site drainage	Driveway drains		No	0	100	EDS	1511252000	36.30	308	5		5	0	1
Site drainage												5	0	1
Site drainage												5	0	1
2	<b>SECTION 2 CONCRETE</b>													
2.1	<b>FORMWORK</b>													
2.1.1	BASEMENT FOUNDATION													

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	prcentage	interval	entirely
Bsmt foundation formwork	Strip footing forms, 2x10		Ft	0	204	FF	311581560	0.18	191	1.695		5	0	1	200	
Bsmt foundation formwork	Pad footing forms, 2x2		Ft	0	204	FPF	311581600	0.04	191	0.339		5	0	1	200	
Bsmt foundation formwork	Pedestal forms, 2x6		Ft	0	204	FPF	311581650	0.11	191	1.018		5	0	1	200	
Bsmt foundation formwork	Curbs, 2x8		Ft2	0	220	FLS	311702000	1.47	191	1.357		5	0	1	200	
Bsmt foundation formwork	Slab edge forms, 2x4		Ft	0	220	FLS	311703000	0.25	191	0.678		5	0	1	200	
Bsmt foundation formwork	Grade beam forms, 5/8"		Shts	0	204	FF	311620010	45.76	195	24.39		5	0	1	200	
Bsmt foundation formwork	Foundation wall forms, 5/8"		Shts	0	212	FBW	311820010	45.76	195	24.39		5	0	1	200	
Bsmt foundation formwork	Retaining wall forms, 5/8"		Shts	0	212	WR	311820050	45.76	195	24.39		5	0	1	200	
Bsmt foundation formwork	1x2 level strip		Ft	0	204	FF	311580900	0.03	191	0.169		5	0	1	200	
Bsmt foundation formwork	Exterior bsmnt strs frms, 5/8"		Shts	0	222	IC	311740010	45.76	195	24.39		5	0	1	200	
Bsmt foundation formwork	Exterior bsmnt strs frms, 2x6		Ft	0	222	IC	311740200	0.11	191	1.018		5	0	1	200	
Bsmt foundation formwork	Exterior steps forms, 5/8"		Shts	0	222	IC	311740020	45.76	195	24.39		5	0	1	200	
Bsmt foundation formwork	Exterior steps forms, 2x6		Ft	0	222	IC	311740030	0.11	191	1.018		5	0	1	200	
Bsmt foundation formwork	2x2 nailing strip		Ft	0	204	FF	311581000	0.04	191	0.339		5	0	1	200	
Bsmt foundation formwork	2x4 keyway		Ft	0	204	FF	311581500	0.08	191	0.678		5	0	1	200	
Bsmt foundation formwork	2x4 recess		Ft	0	204	FF	311581530	0.08	191	0.678		5	0	1	200	
Bsmt foundation formwork	1x4 stake and spreaders		Ft2	0	204	FF	311585000	1.16	191	0.339		5	0	1	200	
Bsmt foundation formwork	Upstands,2x8		Ft	0	212	FBW	311702100	1.47	191	1.357		5	0	1	200	
Bsmt foundation formwork													5	0	1	200
2.1.2	CRAWLSPACE															
Crwlspc formwork	Strip footing forms, 2x10		Ft	0	204	FF	311581560	0.18	191	1.695		5	0	1	200	
Crwlspc formwork	Pad footing forms, 2x2		Ft	0	204	FPF	311581600	0.04	191	0.339		5	0	1	200	
Crwlspc formwork	Pedestal forms, 2x6		Ft	0	204	FPF	311581650	0.11	191	1.018		5	0	1	200	
Crwlspc formwork	Curbs, 2x8		Ft2	0	220	FLS	311702000	1.47	191	1.357		5	0	1	200	
Crwlspc formwork	Slab edge forms,2x4		Ft	0	220	FLS	311703000	0.25	191	0.678		5	0	1	200	
Crwlspc formwork	Grade beam forms, 5/8"		Shts	0	204	FF	311620010	45.76	195	24.39		5	0	1	200	
Crwlspc formwork	Foundation wall forms, 5/8"		Shts	0	212	FSW	311820010	45.76	195	24.39		5	0	1	200	
Crwlspc formwork	1x2 level strip		Ft	0	204	FF	311580900	0.03	191	0.169		5	0	1	200	
Crwlspc formwork	Exterior steps forms, 5/8"		Shts	0	222	IC	311740020	45.76	195	24.39		5	0	1	200	
Crwlspc formwork	Exterior steps forms, 2x6		Ft	0	222	IC	311740030	0.11	191	1.018		5	0	1	200	
Crwlspc formwork	2x2 nailing strip		Ft	0	204	FF	311581000	0.04	191	0.339		5	0	1	200	
Crwlspc formwork	2x4 keyway		Ft	0	204	FF	311581500	0.08	191	0.678		5	0	1	200	
Crwlspc formwork	2x4 recess		Ft	0	204	FF	311581530	0.08	191	0.678		5	0	1	200	
Crwlspc formwork	1x4 stake and spreaders		Ft2	0	204	FF	311585000	1.16	191	0.339		5	0	1	200	
Crwlspc formwork													5	0	1	200
2.1.3	SLAB ON GRADE															
Slab-on-grade formwork	Strip footings, 2x10		Ft	0	204	FF	311581560	0.18	191	1.695		5	0	1	200	
Slab-on-grade formwork	Footing pads, 2x2		Ft	0	204	FPF	311581600	0.04	191	0.339		5	0	1	200	
Slab-on-grade formwork	Foundation wall, 5/8"		Shts	0	212	FSW	311820010	45.76	195	24.39		5	0	1	200	
Slab-on-grade formwork	Pedestals, 2x6		Ft	0	204	FPF	311581650	0.11	191	1.018		5	0	1	200	
Slab-on-grade formwork	Curbs, 2x8		Ft2	0	220	FLS	311702000	1.47	191	1.357		5	0	1	200	
Slab-on-grade formwork	Slab edges, 2x4		Ft	0	220	FLS	311703050	0.08	191	0.678		5	0	1	200	
Slab-on-grade formwork	Exterior steps forms, 5/8"		Shts	0	222	IC	311740020	45.76	195	24.39		5	0	1	200	

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcntage	Interval	entirely
		Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)
Slab-on-grade formwork	Exterior steps forms, 2x6		Ft	0	222	IC	311740030	0.11	191	1.018		5	0	1	200
Slab-on-grade formwork												5	0	1	200
Slab-on-grade formwork												5	0	1	200
2.2	<b>poured CONCRETE</b>														
2.2.1	<b>BASEMENT FOUNDATION</b>														
Bsmt foundation poured concr.	Strip Footings	Yd3	0	204	FF	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Footing pads	Yd3	0	204	FPF	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Pedestals	Yd3	0	204	FPF	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Curbs	Yd3	0	220	FLS	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Basement floor slab	Yd3	0	220	FLS	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Garage floor slab	Yd3	0	220	FLS	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Grade beam	Yd3	0	204	FF	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Piles	Yd3	0	204	FP	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Foundation wall	Yd3	0	212	FBW	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Ext basement stairs	Yd3	0	222	IC	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Exterior steps	Yd3	0	222	IC	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Window wells	Yd3	0	212	WR	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.	Retaining walls	Yd3	0	212	WR	331260150	56.16	379	1797		4	0	1	75	
Bsmt foundation poured concr.												4	0	1	75
2.2.2	<b>CRAWLSPACE FOUNDATION</b>														
Crwlspc foundation poured concr.	Strip Footings	Yd3	0	204	FF	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Footing pads	Yd3	0	204	FPF	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Pedestals	Yd3	0	204	FPF	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Curbs	Yd3	0	220	FLS	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Skim coat	Yd3	0	220	FLC	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Garage floor slab	Yd3	0	220	FLS	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Grade beam	Yd3	0	204	FF	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Piles	Yd3	0	204	FP	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Foundation wall	Yd3	0	212	FSW	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Exterior steps	Yd3	0	222	IC	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.	Retaining walls	Yd3	0	212	WR	331260150	56.16	379	1797		4	0	1	75	
Crwlspc foundation poured concr.												4	0	1	75
2.2.3	<b>SLAB ON GRADE</b>														
Slab-on-grade foundation poured concr.	Strip footings	Yd3	0	204	FF	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Footing Pads	Yd3	0	204	FPF	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Pedestals	Yd3	0	204	FPF	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Curbs	Yd3	0	220	FLS	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Floor slab	Yd3	0	220	FLS	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Garage floor slab	Yd3	0	220	FLS	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Grade beam	Yd3	0	204	FF	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Piles	Yd3	0	204	FP	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Foundation wall	Yd3	0	212	FSW	331260150	56.16	379	1797		4	5	15	50	
Slab-on-grade foundation poured concr.	Exterior steps	Yd3	0	222	IC	331260150	56.16	379	1797		4	5	15	50	

## Optimize Quantity Takeoff

		Bldr's Qnty	Bldr's Units	% exp to int.	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Conv to kg	CFC (mg/kg)	% Emiss. Waste	Maintaince Const. (%)	Replace prcentage (yrs)	Replace interval (yrs)
Stage	Item														entirely
Slab-on-grade foundation poured concr.	Retaining walls		Yd3	0	212	WR	331260150	56.16	379	1797		4	5	15	50
Slab-on-grade foundation poured concr.												4	5	15	50
Slab-on-grade foundation poured concr.												4	5	15	50
2.3	<b>REINFORCING</b>														
2.3.1	<b>BASEMENT FOUNDATION</b>														
Bsmt foundation reinforcing	Strip footing rebar, #5		Ft	0	204	FF	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Footing pad rebar, #5		Ft	0	204	FPF	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Foundation wall rebar, #5		Ft	0	212	FBW	321070700	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Pedestals rebar, #5		Ft	0	204	FPF	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Basement floor slab rebar, #5		Ft	0	220	FLS	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Basement floor slab w.w.m., #10 6x6		Ft2	0	220	FLS	322070010	0.08	288	0.1		4	0	1	75
Bsmt foundation reinforcing	Grade beams rebar, #5		Ft	0	204	FF	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Piles rebar, #5		Ft	0	204	FP	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Retaining wall rebar, #13		Ft	0	212	WR	321070750	0.30	239	3.47		5	0	1	75
Bsmt foundation reinforcing	Structural slabs rebar, #5		Ft	0	220	FLL	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Garage floor slab rebar, #5		Ft	0	220	FLS	321070500	0.30	239	0.473		5	0	1	75
Bsmt foundation reinforcing	Garage floor slab w.w.m., #10 6x6		Ft2	0	220	FLS	322070010	0.08	288	0.1		4	0	1	75
Bsmt foundation reinforcing												5	0	1	75
2.3.2	<b>CRAWLSPACE FOUNDATION</b>														
Crwlspc foundation reinforcing	Strip footing rebar, #5		Ft	0	204	FF	321070500	0.30	239	0.473		5	0	1	75
Crwlspc foundation reinforcing	Footing pad rebar, #5		Ft	0	204	FPF	321070500	0.30	239	0.473		5	0	1	75
Crwlspc foundation reinforcing	Foundation wall rebar, #5		Ft	0	212	FSW	321070700	0.30	239	0.473		5	0	1	75
Crwlspc foundation reinforcing	Pedestals rebar, #5		Ft	0	204	FPF	321070500	0.30	239	0.473		5	0	1	75
Crwlspc foundation reinforcing	Garage floor slab rebar, #5		Ft	0	220	FLS	321070500	0.30	239	0.473		5	0	1	75
Crwlspc foundation reinforcing	Garage floor slab w.w.m., #10 6x6		Ft2	0	220	FLS	322070010	0.08	288	0.1		4	0	1	75
Crwlspc foundation reinforcing												5	0	1	75
2.3.3	<b>SLAB ON GRADE FOUNDATION</b>														
Slab-on-grade foundation reinforcing	Strip footing rebar, #5		Ft	0	204	FF	321070500	0.30	239	0.473		5	0	1	50
Slab-on-grade foundation reinforcing	Footing pad rebar, #5		Ft	0	204	FPF	321070500	0.30	239	0.473		5	0	1	50
Slab-on-grade foundation reinforcing	Foundation wall rebar, #5		Ft	0	212	FSW	321070700	0.30	239	0.473		5	0	1	50
Slab-on-grade foundation reinforcing	Pedestals rebar, #5		Ft	0	204	FPF	321070500	0.30	239	0.473		5	0	1	50
Slab-on-grade foundation reinforcing	Garage floor slab rebar, #5		Ft	0	220	FLS	321070500	0.30	239	0.473		5	0	1	50
Slab-on-grade foundation reinforcing	Garage floor slab w.w.m., #10 6x6		Ft2	0	220	FLS	322070010	0.08	288	0.1		4	0	1	50
Slab-on-grade foundation reinforcing												5	0	1	75
2.4	<b>CONCRETE ACCESSORIES</b>														
Concrete accessories	1/2" dia Anchor bolts, 4" w/nut&wshr		No	0	212	F	311100020	0.39	292	0.13		5	0	1	75
Concrete accessories	Damproofing, smooth surf.		Ft2	0	212	F	716020030	0.09	401	0.68		5	25	40	75
Concrete accessories	form ties		No	0	212	F	311280100	0.45	292	0.091		5	0	1	200
Concrete accessories	Granular fill under bsmnt slab		Yd3	0	220	FLS	222120320	16.72	49	1127		5	0	1	200
Concrete accessories	Granular fill under garage slab		Yd3	0	220	FLS	222120320	16.72	49	1127		5	0	1	200
Concrete accessories	Sand under garage slab		Yd3	0	220	FLS	222120500	3.63	49	1089		5	0	1	200
Concrete accessories	Sand under skim slab		Yd3	0	220	FLC	222120500	3.63	49	1089		5	0	1	200
Concrete accessories	6 mil poly moisture barrier		Ft2	50	212	F	719220900	0.03	135	0.013		5	25	40	75

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	Emiss.	Const.	prcentage	interval	
Concrete accessories	1/2" expansion joint filler		Ft	0	220	FLS	311320010	0.90	135	0.045		5	0	1	200
Concrete accessories	Form oil		Gal	0	212	F	312000010	5.67	397	3.863		5	0	1	200
Concrete accessories												5	0	1	200
Concrete accessories												5	0	1	200
<b>3</b>	<b>SECTION 3 MASONRY</b>														
<b>3.1</b>	<b>CONCRETE BLOCK WALLS</b>														
Concrete block walls	12"x8"x16" grade blocks		No	0	400	F	422321300	2.38	377	28.58		8	20	25	75
Concrete block walls	12"x8"x16" corner blocks		No	0	400	F	422321300	2.38	377	28.58		8	20	25	75
Concrete block walls	12"x8"x8" corner blocks		No	0	400	F	422321375	2.20	377	13.95		8	20	25	75
Concrete block walls	8"x8"x16" corner blocks		No	0	400	F	422321200	1.56	377	18.6		8	20	25	75
Concrete block walls	8"x8"x8" corner blocks		No	0	400	F	422321210	1.20	377	9.98		8	20	25	75
Concrete block walls	12"x8"x16" reg. block		No	0	400	F	422321300	2.38	377	28.58		8	20	25	75
Concrete block walls	8"x8"x16" solid blocks		No	0	400	F	422421200	1.50	377	22.68		8	20	25	75
Concrete block walls	4"x8"x16" solid blocks		No	0	400	F	422421100	0.90	377	11.34		8	20	25	75
Concrete block walls												8	20	25	75
Concrete block walls	Mortar, 70 lb bag		Bag	0	400	F	410080010	6.44	375	31.75		5	20	25	75
Concrete block walls												8	20	25	75
Concrete block walls	Reinforcing wall ties		No	0	400	F	415200010	0.04	292	0.057		5	20	25	75
Concrete block walls												8	20	25	75
Concrete block walls												8	20	25	75
<b>3.2</b>	<b>MASONRY VENEER</b>														
Masonry veneer	Common bricks, 8"		No	0	400	W	421100010	0.24	380	3.1		8	20	25	75
Masonry veneer	Face bricks		No	0	400	W	425542000	0.28	380	2.04		12	20	25	75
Masonry veneer	Mortar, 70 lb bag		Bag	0	400	W	410080010	6.44	375	31.75		5	20	25	75
Masonry veneer	Metal wall ties		No	0	400	W	415200010	0.04	292	0.057		5	20	25	75
Masonry veneer	Flashings, 5" girth		Ft	0	400	W	505082400	0.06	283	0.042		5	20	25	75
Masonry veneer	Stone		Ton	0	400	W	447040020	143.00	50	907.2		5	20	25	75
Masonry veneer	Split face conc. block, 4"x8"x16"		No	0	400	W	422205100	1.71	377	15.5		5	20	25	75
Masonry veneer												5	20	25	75
Masonry veneer												5	20	25	75
<b>3.3</b>	<b>MASONRY FIREPLACES</b>														
Masonry fireplaces	Common bricks, 8"		No		724	MF	421100010	0.24	380	2.04		8	25	20	60
Masonry fireplaces	Face bricks		No	50	724	MF	425542000	0.28	380	2.04		12	25	20	60
Masonry fireplaces	Fire bricks		No	50	724	MF	456560200	1.20	380	3.31		5	25	20	60
Masonry fireplaces	8"x12"x8" flue linings		No	50	724	MF	455540100	3.37	380	8.5		5	25	20	60
Masonry fireplaces	12"x12"x8" flue linings		No	50	724	MF	455540200	4.21	380	10.6		5	25	20	60
Masonry fireplaces	12"x16"x8" flue linings		No	50	724	MF	455540250	7.73	380	12.7		5	25	20	60
Masonry fireplaces	16"x16"x8" flue linings		No	50	724	MF	455540275	11.24	380	14.8		5	25	20	60
Masonry fireplaces	Mortar, 70 lb bag		Bag	50	724	MF	410080010	6.44	375	31.75		5	25	20	60
Masonry fireplaces	Metal wall ties		No	50	724	MF	415200010	0.04	292	0.057		5	25	20	60
Masonry fireplaces	8"x8" cast iron clean out doors		No	50	724	MF	1031040400	14.08	252	4.536		5	25	20	60
Masonry fireplaces	5"x8" cast iron ash dumps		No	50	724	MF	1031040700	27.50	252	3.18		5	30	15	50
Masonry fireplaces	Metal dome damper		No	50	724	MF	1031040800	55.00	354	10.21		5	25	20	60

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Const.	prcentage	Interval	entirely
Masonry fireplaces	Fireplace lintel angles, 2' 6"		No	50	724	MF	512320010	0.05	276	6.27		5	25	20	60
Masonry fireplaces	Hearth finish, 16" x 48" slate		No	50	724	MF	1031045000	82.50	379	10		5	30	15	50
Masonry fireplaces	Combustion air kit		No	50	724	MF	1031042900	55.00	354	5		5	30	15	50
Masonry fireplaces	Tight fitting glass doors		No	50	724	MF	1031044000	407.00	390	40		5	30	15	50
Masonry fireplaces	Flashings, 5" girth		Ft.	100	724	MF	505082400	0.06	283	0.042		5	25	20	60
Masonry fireplaces				50								5	25	20	60
Masonry fireplaces												5	25	20	60
Masonry fireplaces	Brick, fireplace facing, 8"		No	50	724	MF	425540010	0.24	380	3.1		12	25	20	60
Masonry fireplaces	Stone, fireplace facing		Yd3	50	724	MF	447040050	57.02	378	2105		5	25	20	60
Masonry fireplaces	Marble, fireplace facing		Ft2	50	724	MF	445541000	30.20	378	0.296		5	25	20	60
Masonry fireplaces	Fireplace mantle beam, 4"x8"		Ft	100	724	MF	627200010	4.02	196	2.71		7	0	1	40
Masonry fireplaces												5	25	20	60
Masonry fireplaces												5	25	20	60
<b>4</b>	<b>SECTION 4 METALS</b>														
4.1	<b>STRUCTURAL STEEL</b>														
4.1.1	Steel Beams														
Steel Beams	W6x9		Ft	100	304	L	512600050	6.60	276	4.082		5	0	1	50
Steel Beams	W8x10		Ft	100	304	L	512600100	7.70	276	4.536		5	0	1	50
Steel Beams												5	0	1	50
4.1.2	Steel columns														
Steel columns	3" dia steel columns, 8' hollow tube		No	0	308	WC	512201500	61.92	250	31.84		5	0	1	50
Steel columns												5	0	1	50
4.1.3	Steel lintels														
Steel lintels	Steel angle lintels, 3 1/2" x 3" x 1/4"		Ft.	0	400	WEM	512322000	2.97	276	2.43		5	20	25	75
Steel lintels												5	20	25	75
4.1.4	Steel guard rail														
Steel guard rail	Steel guard rail, 1 1/4" dia		Ft.	0	222	IC	552030500	7.54	279	1.89		5	0	1	50
Steel guard rail												5	0	1	50
Steel guard rail												5	0	1	50
4.2	<b>FASTENERS &amp; SUPPORTS</b>														
4.2.1	<b>NAILS</b>														
Nails	Roof - Roofing		Lb	0	500	R	605042900	0.99	292	0.454		5	10	20	40
Nails	Ext. wall framing - Common		Lb	0	308	WEF	605040600	0.77	292	0.454		5	0	1	50
Nails	Int. wall framing - Common		Lb	100	348	WIF	605040600	0.77	292	0.454		5	0	1	50
Nails	Floor framing - Common		Lb	100	304	LI	605040600	0.77	292	0.454		5	0	1	50
Nails	Ceiling framing - Common		Lb	0	304	CE	605040600	0.77	292	0.454		5	0	1	50
Nails	Ext. walls - Finish		Lb	100	604	WEF	605041800	0.83	292	0.454		5	10	25	50
Nails	Int. walls - Finish		Lb	100	604	WIF	605041800	0.83	292	0.454		5	15	25	40
Nails	Formwork - Duplex		Lb	0	204	F	605045305	0.64	292	0.454		5	0	1	200
Nails	Ext. walls - sheathing		Lb	0	308	WEF	605050020	0.70	292	0.454		5	0	1	50
Nails	Ext. walls - Drywall nails		Lb	100	604	WEF	605041400	1.08	292	0.454		5	10	25	50
Nails	Ext. walls - Drywall screws		Lb	100	604	WEF	928041170	1.73	283	0.454		5	10	25	50
Nails												5	0	1	50

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcntage	interval	
Stage	Item	Qnty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)
Nails	Int. walls - Drywall nails		Lb	100	604	WIF	605041400	1.08	292	0.454		5	15	25	40
Nails	Int. walls - Drywall screws		Lb	100	604	WIF	928041170	1.73	292	0.454		5	15	25	40
Nails												5	0	1	50
Nails	Int. ceilings - Drywall nails		Lb	100	608	CI	605041400	1.08	292	0.454		5	10	25	50
Nails	Int. ceilings - Drywall screws		Lb	100	608	CI	928041170	1.73	292	0.454		5	10	25	50
Nails												5	0	1	50
Nails	Ext. ceilings - Drywall nails		Lb	100	608	CE	605041400	1.08	292	0.454		5	10	25	50
Nails	Ext. ceilings - Drywall screws		Lb	100	608	CE	928041170	1.73	292	0.454		5	10	25	50
Nails	Ext. ceilings - Concrete nails		Lb	0	212	F	505204000	1.19	292	0.454		5	10	25	50
Nails												5	0	1	50
Nails												5	0	1	50
4.2.2	JOIST HANGERS														
Joist hangers	Single, Int. floor		No	100	304	LI	605121400	0.61	292	0.454		5	0	1	50
Joist hangers	Single, Ext. floor		No	0	304	LE	605121400	0.61	292	0.454		5	0	1	50
Joist hangers	Single, Decks		No	0	740	LD	605121400	0.61	292	0.454		5	0	1	15
Joist hangers												5	0	1	50
Joist hangers	Double, Int. floor		No	100	304	LI	605122000	1.21	292	0.57		5	0	1	50
Joist hangers	Double, Ext. floor		No	0	304	LE	605122000	1.21	292	0.57		5	0	1	50
Joist hangers	Double, Decks		No	0	740	LD	605122000	1.21	292	0.57		5	0	1	15
Joist hangers												5	0	1	50
Joist hangers	Triple, Int. floor		No	100	304	LI	605122400	5.34	292	0.68		5	0	1	50
Joist hangers	Triple, Ext. floor		No	0	304	LE	605122400	5.34	292	0.68		5	0	1	50
Joist hangers	Triple, Decks		No	0	740	LD	605122400	5.34	292	0.68		5	0	1	15
4.2.3	TRUSS HANGERS														
Truss hangers	Truss hangers		No	0	316	CE	605125450	0.15	292	0.091		5	0	1	50
Truss hangers												5	0	1	50
4.2.4	MISC. METALS														
Misc. metals	Steel angle brackets, 2' 6"		No	100	304	L	512322000	2.97	292	6.275		5	0	1	50
Misc. metals	Column anchors		No	100	348	WI	512201560	0.61	292	0.113		5	0	1	50
Misc. metals	Bolts and nuts		No	100	304	L	505080010	0.06	292	0.862		5	0	1	50
Misc. metals	metal plates		No	100	304	L	605120100	15.18	292	1.36		5	0	1	50
Misc. metals	Kwik bolts		No	0	212	F	505200200	0.56	292	0.015		5	0	1	75
Misc. metals	Nailing plates		No	0	212	F	605125200	6.77	292	0.4		5	0	1	75
Misc. metals	Stucco wire		Ft2	0	400	W	923041600	0.31	288	0.122		5	0	1	50
Misc. metals	Metal Lath, 2 1/2 lb per Ft2		Ft2	0	400	W	920583600	0.20	283	0.105		5	0	1	50
Misc. metals	Beam to column bracket		No	100	304	LI	605120100	15.18	292	1.36		5	0	1	50
Misc. metals												5	0	1	50
Misc. metals												5	0	1	50
Misc. metals												5	0	1	50
5	SECTION 5 CARPENTRY														
5.1	ROUGH CARPENTRY														
5.1.1	EXTERIOR FRAMING														
5.1.1.1	Exterior framing: Deck Joists														

## Optimize Quantity Takeoff

		Bldr's Qnty	Bldr's Units	% exp to int.	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Conv (mg/kg)	CFC Emiss.	% Const.	Maintenance prcntage	Replace interval
Stage	Item														entirely
Ext. framing: Deck Joists	2x8 SPF		Ft	0	740	LD	611142150	0.59	191	1.33		10	0	1	15
Ext. framing: Deck Joists	2x8 D. Fir		Ft	0	740	LD	611142160	0.66	191	1.717		10	0	1	15
Ext. framing: Deck Joists	2x10 SPF		Ft	0	740	LD	611142200	0.92	191	1.695		10	0	1	15
Ext. framing: Deck Joists	2x10 D. Fir		Ft	0	740	LD	611142210	0.99	191	2.142		10	0	1	15
Ext. framing: Deck Joists	2x12 SPF		Ft	0	740	LD	611142250	1.12	191	2.036		10	0	1	15
Ext. framing: Deck Joists	2x12 D.Fir		Ft	0	740	LD	611142260	1.21	191	2.572		10	0	1	15
Ext. framing: Deck Joists												10	0	1	15
5.1.1.2	Exterior framing: Beams														
Ext. framing: Beams	2x8 built up 3x, D. Fir beams		Ft	0	740	LD	611103025	1.98	191	5.151		10	0	1	50
Ext. framing: Beams	2x10 built up 3x, D. Fir beams		Ft	0	740	LD	611103045	3.03	191	6.426		10	0	1	50
Ext. framing: Beams	2x12 built up 3x, D. Fir beams		Ft	0	740	LD	611103065	3.63	191	7.716		10	0	1	50
Ext. framing: Beams												10	0	1	50
Ext. framing: Beams	2x8 built up 3x, SPF beams		Ft	0	740	LD	611103020	1.82	191	4.077		10	0	1	50
Ext. framing: Beams	2x10 built up 3x, SPF beams		Ft	0	740	LD	611103040	2.79	191	5.085		10	0	1	50
Ext. framing: Beams	2x12 built up 3x, SPF beams		Ft	0	740	LD	611103060	3.41	191	6.108		10	0	1	50
Ext. framing: Beams												10	0	1	50
5.1.1.3	Exterior framing: Posts (SPF)														
Ext. framing: Posts (SPF)	4x4		Ft	0	740	LD	611180100	0.94	191	1.357		10	0	1	50
Ext. framing: Posts (SPF)	6x6		Ft	0	740	LD	611180250	2.37	191	3.053		10	0	1	50
Ext. framing: Posts (SPF)	8x8		Ft	0	740	LD	611180360	4.19	191	5.428		10	0	1	50
Ext. framing: Posts (SPF)												10	0	1	50
5.1.1.4	Exterior framing: Decking														
Ext. framing: Decking	5/8" T&G Plywood		Shts	0	740	LD	611640100	13.73	195	24.39		5	0	1	15
Ext. framing: Decking	3/4" T&G Plywood		Shts	0	740	LD	611640200	16.19	195	29.26		5	0	1	15
Ext. framing: Decking												5	0	1	15
5.1.1.5	Exterior framing: Stairs														
Ext. framing: Stairs	Stringers, 2x10		Ft	0	740	LD	611168000	0.96	191	1.695		10	25	40	60
Ext. framing: Stairs	Treads, 2x10		Ft	0	740	LD	611168300	0.96	191	1.695		10	25	40	60
Ext. framing: Stairs	Risers, 2x6		Ft	0	740	LD	611168400	0.45	191	1.018		10	25	40	60
Ext. framing: Stairs												10	25	40	60
5.1.2	BASEMENT FOUNDATION WALL														
5.1.2.1	Basement foundation wall: Studs														
Bsmt foundation wall: Studs	Precut 8' 2x4		No	0	216	FBW	611285140	2.38	191	5.291		10	0	1	50
Bsmt foundation wall: Studs	Precut 8' 2x6		No	0	216	FBW	611285160	3.52	191	7.91		10	0	1	50
Bsmt foundation wall: Studs	2x3		Ft	0	216	FBW	611285000	0.23	191	0.509		10	0	1	50
Bsmt foundation wall: Studs	2x4		Ft	0	216	FBW	611285020	0.30	191	0.678		10	0	1	50
Bsmt foundation wall: Studs	2x6		Ft	0	216	FBW	611285040	0.45	191	1.018		10	0	1	50
Bsmt foundation wall: Studs												10	0	1	50
5.1.2.2	Basement foundation wall: Plates														
Bsmt foundation wall: Plates	2x3		Ft	0	216	FBW	611285000	0.23	191	0.509		10	0	1	50
Bsmt foundation wall: Plates	2x4		Ft	0	216	FBW	611285020	0.30	191	0.678		10	0	1	50
Bsmt foundation wall: Plates	2x6		Ft	0	216	FBW	611285040	0.45	191	1.018		10	0	1	50
Bsmt foundation wall: Plates												10	0	1	50

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Fact	Emiss.	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	Const.	prcntage	interval	entirely
5.1.2.3	Basement foundation wall: Headers															
Bsmt foundation wall: Headers	2x6		Ft	0	348	FBW	611282000	0.44	191	1,018		10	0	1	40	
Bsmt foundation wall: Headers	2x8		Ft	0	348	FBW	611282050	0.59	191	1,357		10	0	1	40	
Bsmt foundation wall: Headers	2x10		Ft	0	348	FBW	611282100	0.92	191	1,696		10	0	1	40	
Bsmt foundation wall: Headers	2x12		Ft	0	348	FBW	611282150	1.12	191	2,035		10	0	1	40	
Bsmt foundation wall: Headers												10	0	1	40	
5.1.2.4	Basement foundation wall: Furring studs															
Bsmt foundation wall: Furring studs	2x3		Ft	0	348	FBW	611285120	0.23	191	0.509		10	0	1	50	
Bsmt foundation wall: Furring studs	2x4		Ft	0	348	FBW	611285120	0.30	191	0.678		10	0	1	50	
Bsmt foundation wall: Furring studs												10	0	1	50	
5.1.2.5	Basement foundation wall: Furring Plates												10	0	1	50
Bsmt foundation wall: Furring Plates	2x3		Ft	0	348	FBW	611285000	0.23	191	0.509		10	0	1	50	
Bsmt foundation wall: Furring Plates	2x4		Ft	0	348	FBW	611285020	0.30	191	0.678		10	0	1	50	
Bsmt foundation wall: Furring Plates												10	0	1	50	
5.1.2.6	Basement foundation wall: Felts															
Bsmt foundation wall: Felts	45# Asphalt felt (interconnecting)		Ft2	0	216	FBW	752040400	0.56	216	0.047		5	0	1	50	
Bsmt foundation wall: Felts												5	0	1	50	
5.1.2.7	Basement foundation wall: Polyethylene															
Bsmt foundation wall: Polyethylene	6 mil polyethylene (interconnecting)		Ft2	50	216	FBW	719220900	0.03	135	0.013		5	0	1	50	
Bsmt foundation wall: Polyethylene												5	0	1	50	
Bsmt foundation wall: Polyethylene												5	0	1	50	
5.1.3	BASEMENT INTERIOR WALLS															
5.1.3.1	Basement interior wall: Studs															
Bsmt int. wall: Studs	Precut 8' 2x4		No	100	348	WIF	611285120	2.38	191	5,291		10	0	1	40	
Bsmt int. wall: Studs	Precut 8' 2x6		No	100	348	WIF	611285160	3.52	191	7,91		10	0	1	40	
Bsmt int. wall: Studs	2x3		Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40	
Bsmt int. wall: Studs	2x4		Ft	100	348	WIF	611285020	0.30	191	0.678		10	0	1	40	
Bsmt int. wall: Studs	2x6		Ft	100	348	WIF	611285040	0.45	191	1,018		10	0	1	40	
Bsmt int. wall: Studs												10	0	1	40	
5.1.3.2	Basement interior wall: Plates															
Bsmt int. wall: Plates	2x3		Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40	
Bsmt int. wall: Plates	2x4		Ft	100	348	WIF	611285020	0.30	191	0.678		10	0	1	40	
Bsmt int. wall: Plates	2x6		Ft	100	348	WIF	611285040	0.45	191	1,018		10	0	1	40	
Bsmt int. wall: Plates												10	0	1	40	
5.1.3.3	Basement interior wall: Posts and Columns (SPF)															
Bsmt int. wall: Posts and Columns (SPF) 4x4			Ft	100	348	WIF	611180100	0.94	191	1,357		10	0	1	40	
Bsmt int. wall: Posts and Columns (SPF) 6x6			Ft	100	348	WIF	611180250	2.37	191	6,353		10	0	1	40	
Bsmt int. wall: Posts and Columns (SPF) 8x8			Ft	100	348	WIF	611180350	4.19	191	5,428		10	0	1	40	
Bsmt int. wall: Posts and Columns (SPF) 3' diameter steel column, 8' hollow			No	100	348	WIF	512201500	61.92	250	31.84		5	0	1	40	
Bsmt int. wall: Posts and Columns (SPF)												10	0	1	40	
5.1.3.4	Basement interior wall: Felts															
Bsmt int. wall: Felts	45# Asphalt felt (interconnecting)		Ft2	0	348	WIF	752040400	0.56	216	0.047		5	0	1	40	
Bsmt int. wall: Felts												5	0	1	40	

## Optimize Quantity Takeoff

											Conv	CFC	%	Maintenance	Replace
Stage	Item	Bldr's Qnty	Bldr's Units	% exp to int.	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Const. Waste	prcentage (%)	interval (yrs)	entirely (yrs)
5.1.3.5	Basement interior wall: Polyethylene														
Bsmt int. wall: Polyethylene	6 mil polyethylene (interconnecting		Ft2	50	348	WIF	719220900	0.03	135	0.013		5	0	1	40
Bsmt int. wall: Polyethylene												5	0	1	40
Bsmt int. wall: Polyethylene												5	0	1	40
5.1.4	BASEMENT FLOOR ON SLAB														
5.1.4.1	Bsmt floor on slab: Sleepers														
Bsmt floor on slab: Sleepers	1x2		Ft	100	304	LI	611240100	0.13	191	0.169		10	0	1	25
Bsmt floor on slab: Sleepers	1x3		Ft	100	304	LI	611240150	0.21	191	0.254		10	0	1	25
Bsmt floor on slab: Sleepers	2x4		Ft	100	304	LI	611240200	0.41	191	0.678		10	0	1	25
Bsmt floor on slab: Sleepers	2x6		Ft	100	304	LI	611240250	0.61	191	1.018		10	0	1	25
Bsmt floor on slab: Sleepers	1x2 P.T.		Ft	100	304	LI	611240105	0.12	191	0.169		10	0	1	25
Bsmt floor on slab: Sleepers	1x3 P.T.		Ft	100	304	LI	611240155	0.19	191	0.254		10	0	1	25
Bsmt floor on slab: Sleepers	2x4 P.T.		Ft	100	304	LI	611240205	0.37	191	0.678		10	0	1	25
Bsmt floor on slab: Sleepers	2x6 P.T.		Ft	100	304	LI	611240255	0.55	191	1.018		10	0	1	25
Bsmt floor on slab: Sleepers												10	0	1	25
5.1.4.2	Bsmt floor on slab: Floor Sheathing														
Bsmt floor on slab: Floor Sheathing	3/8" Plywood		Shts	100	304	LI	611640000	8.80	195	14.63		5	5	10	25
Bsmt floor on slab: Floor Sheathing	3/8" OSB		Shts	100	304	LI	611641800	8.25	201	9.791		5	5	10	25
Bsmt floor on slab: Floor Sheathing	1/2" Plywood		Shts	100	304	LI	611640010	11.26	195	19.5		5	5	10	25
Bsmt floor on slab: Floor Sheathing	1/2" OSB		Shts	100	304	LI	611641900	8.25	201	13		5	5	10	25
Bsmt floor on slab: Floor Sheathing	5/8" Plywood		Shts	100	304	LI	611640100	13.73	195	24.39		5	5	10	25
Bsmt floor on slab: Floor Sheathing	5/8" OSB		Shts	100	304	LI	611642000	11.50	201	16.27		5	5	10	25
Bsmt floor on slab: Floor Sheathing												5	5	10	25
5.1.4.3	Bsmt floor on slab: Beams														
Bsmt floor on slab: Beams	2x8 built up 3x, D. Fir beams		Ft	100	304	LI	611103025	1.98	191	5.151		10	0	1	50
Bsmt floor on slab: Beams	2x10 built up 3x, D. Fir beams		Ft	100	304	LI	611103045	3.03	191	6.426		10	0	1	50
Bsmt floor on slab: Beams	2x12 built up 3x, D. Fir beams		Ft	100	304	LI	611103065	3.63	191	7.716		10	0	1	50
Bsmt floor on slab: Beams												10	0	1	50
Bsmt floor on slab: Beams	2x8 built up 3x, SPF beams		Ft	100	304	LI	611103020	1.82	191	4.077		10	0	1	50
Bsmt floor on slab: Beams	2x10 built up 3x, SPF beams		Ft	100	304	LI	611103040	2.79	191	5.085		10	0	1	50
Bsmt floor on slab: Beams	2x12 built up 3x, SPF beams		Ft	100	304	LI	611103060	3.41	191	6.108		10	0	1	50
Bsmt floor on slab: Beams												10	0	1	50
Bsmt floor on slab: Beams	6x10 beam, sawn D. Fir		Ft	100	304	LI	613040020	4.68	191	6.43		10	0	1	50
Bsmt floor on slab: Beams	6x10 beam, sawn SPF		Ft	100	304	LI	613040010	3.58	191	5.088		10	0	1	50
Bsmt floor on slab: Beams	Glulam beam, 5.1x25.6 SPF		Ft	100	304	LI	618040200	10.56	197	12.34		10	0	1	50
Bsmt floor on slab: Beams	L.V.L beam, 3 1/2" x 16"		Ft	100	304	LI	615080105	14.30	197	7.357		10	0	1	50
Bsmt floor on slab: Beams	Steel beam, W6x9		Ft	100	304	LI	512600010	6.60	276	4.08		5	0	1	50
Bsmt floor on slab: Beams												10	0	1	50
Bsmt floor on slab: Beams												10	0	1	50
5.1.5	CRAWLSPACE FOUNDATION WALL														
5.1.5.1	Crawlspac foundation wall: Studs														
Crwlspc foundation wall: Studs	2x3		Ft	0	216	WCF	611285000	0.23	191	0.509		10	0	1	50
Crwlspc foundation wall: Studs	2x4		Ft	0	216	WCF	611285020	0.30	191	0.678		10	0	1	50

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcntage	Interval	
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)
Crwlspc foundation wall: Studs	2x6		Ft	0	216	WCF	611285040	0.45	191	1.018		10	0	1	50
Crwlspc foundation wall: Studs												10	0	1	50
5.1.5.2	Crawlspce foundation wall: Plates														
Crwlspc foundation wall: Plates	2x3		Ft	0	216	WCF	611285000	0.23	191	0.509		10	0	1	50
Crwlspc foundation wall: Plates	2x4		Ft	0	216	WCF	611285020	0.30	191	0.678		10	0	1	50
Crwlspc foundation wall: Plates	2x6		Ft	0	216	WCF	611285040	0.45	191	1.018		10	0	1	50
Crwlspc foundation wall: Plates												10	0	1	50
5.1.5.3	Crawlspce foundation wall: Headers														
Crwlspc foundation wall: Headers	2x6		Ft	0	216	WCF	611282000	0.44	191	1.018		10	0	1	40
Crwlspc foundation wall: Headers	2x8		Ft	0	216	WCF	611282050	0.59	191	1.359		10	0	1	40
Crwlspc foundation wall: Headers	2x10		Ft	0	216	WCF	611282100	0.92	191	1.695		10	0	1	40
Crwlspc foundation wall: Headers	2x12		Ft	0	216	WCF	611282150	1.12	191	2.035		10	0	1	40
Crwlspc foundation wall: Headers												10	0	1	40
5.1.5.4	Crawlspce foundation wall: Sheathing														
Crwlspc foundation wall: Sheathing	3/8" Plywood		Shts	0	216	WCF	611540500	8.80	195	14.63		5	0	1	50
Crwlspc foundation wall: Sheathing	3/8" OSB		Shts	0	216	WCF	611543900	8.25	201	9.791		5	0	1	50
Crwlspc foundation wall: Sheathing	1/2" Plywood		Shts	0	216	WCF	611540600	11.26	195	19.5		5	0	1	50
Crwlspc foundation wall: Sheathing	1/2" OSB		Shts	0	216	WCF	611544000	8.25	201	13		5	0	1	50
Crwlspc foundation wall: Sheathing	5/8" Plywood		Shts	0	216	WCF	611540700	13.73	195	24.39		5	0	1	50
Crwlspc foundation wall: Sheathing	5/8" OSB		Shts	0	216	WCF	611544100	11.50	201	16.27		5	0	1	50
Crwlspc foundation wall: Sheathing												5	0	1	50
5.1.5.5	Crawlspce foundation wall: Felts														
Crwlspc foundation wall: Felts	45# Asphalt felt (interconnecting)		Ft2	0	216	WCF	752040400	0.56	216	0.047		5	0	1	50
Crwlspc foundation wall: Felts												5	0	1	50
5.1.5.6	Crawlspce foundation wall: Polyethylene														
Crwlspc foundation wall: Polyethylene	6 mil polyethylene (interconnecting)		Ft2	50	216	WCF	719220900	0.03	135	0.013		5	0	1	50
Crwlspc foundation wall: Polyethylene												5	0	1	50
Crwlspc foundation wall: Polyethylene												5	0	1	50
5.1.6	CRAWLSPACE INTERIOR WALLS														
5.1.6.1	Crawlspce interior wall: Studs														
Crwlspc int. wall: Studs	2x3		Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40
Crwlspc int. wall: Studs	2x4		Ft	100	348	WIF	611285020	0.30	191	0.678		10	0	1	40
Crwlspc int. wall: Studs	2x6		Ft	100	348	WIF	611285040	0.45	191	1.018		10	0	1	40
Crwlspc int. wall: Studs												10	0	1	40
5.1.6.2	Crawlspce interior wall: Plates														
Crwlspc int. wall: Plates	2x3		Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40
Crwlspc int. wall: Plates	2x4		Ft	100	348	WIF	611285020	0.30	191	0.678		10	0	1	40
Crwlspc int. wall: Plates	2x6		Ft	100	348	WIF	611285040	0.45	191	1.018		10	0	1	40
Crwlspc int. wall: Plates												10	0	1	40
5.1.6.3	Crawlspce interior wall: Headers														
Crwlspc int. wall: Headers	2x6		Ft	100	348	WIF	611282000	0.44	191	1.018		10	0	1	40
Crwlspc int. wall: Headers	2x8		Ft	100	348	WIF	611282050	0.59	191	1.359		10	0	1	40
Crwlspc int. wall: Headers	2x10		Ft	100	348	WIF	611282100	0.92	191	1.695		10	0	1	40

Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Const.	prcntage	interval	
Crwlspc int. wall: Headers	2x12		Ft	100	348	WIF	611282150	1.12	191	2.035		10	0	1	40
Crwlspc int. wall: Headers												10	0	1	40
5.1.6.4	Crawlspac interior wall: Sheathing														
Crwlspc int. wall: Sheathing	3/8" Plywood		Shts	100	348	WIF	611540500	8.80	195	14.63		5	0	1	40
Crwlspc int. wall: Sheathing	3/8" OSB		Shts	100	348	WIF	611543900	6.80	201	9.791		5	0	1	40
Crwlspc int. wall: Sheathing	1/2" Plywood		Shts	100	348	WIF	611540600	11.26	195	19.5		5	0	1	40
Crwlspc int. wall: Sheathing	1/2" OSB		Shts	100	348	WIF	611544000	8.25	201	13		5	0	1	40
Crwlspc int. wall: Sheathing	5/8" Plywood		Shts	100	348	WIF	611540700	13.73	195	24.39		5	0	1	40
Crwlspc int. wall: Sheathing	5/8" OSB		Shts	100	348	WIF	611544100	11.55	201	16.27		5	0	1	40
Crwlspc int. wall: Sheathing												5	0	1	40
5.1.6.5	Crawlspac interior wall: Beams														
Crwlspc int. wall: Beams	2x8 built up 3x, D. Fir beams		Ft	100	348	WIF	611103025	1.98	191	5.151		10	0	1	40
Crwlspc int. wall: Beams	2x10 built up 3x, D. Fir beams		Ft	100	348	WIF	611103045	3.03	191	6.426		10	0	1	40
Crwlspc int. wall: Beams	2x12 built up 3x, D. Fir beams		Ft	100	348	WIF	611103065	3.63	191	7.716		10	0	1	40
Crwlspc int. wall: Beams												10	0	1	40
Crwlspc int. wall: Beams	2x8 built up 3x, SPF beams		Ft	100	348	WIF	611103020	1.82	191	4.077		10	0	1	40
Crwlspc int. wall: Beams	2x10 built up 3x, SPF beams		Ft	100	348	WIF	611103040	2.79	191	5.085		10	0	1	40
Crwlspc int. wall: Beams	2x12 built up 3x, SPF beams		Ft	100	348	WIF	611103060	3.41	191	6.108		10	0	1	40
Crwlspc int. wall: Beams												10	0	1	40
Crwlspc int. wall: Beams	6x10 beam, sawn D. Fir		Ft	100	348	WIF	613040020	4.68	191	6.43		10	0	1	40
Crwlspc int. wall: Beams	6x10 beam, sawn SPF		Ft	100	348	WIF	613040010	3.58	191	5.088		10	0	1	40
Crwlspc int. wall: Beams	Glulam beam, 5.1x25.6 SPF		Ft	100	348	WIF	618040200	10.56	197	12.34		10	0	1	40
Crwlspc int. wall: Beams	L.V.L beam, 3 1/2" x 16"		Ft	100	348	WIF	615080105	14.30	197	7.357		10	0	1	40
Crwlspc int. wall: Beams	Steel beam, W6x9		Ft	100	348	WIF	512600010	6.60	276	4.08		5	0	1	40
5.1.6.7	Crawlspac interior wall: Felts														
Crwlspc interior wall: Felts	45# Asphalt felt (interconnecting)		Ft2	0	348	WIF	752040400	0.56	216	0.047		5	0	1	40
Crwlspc interior wall: Felts												5	0	1	40
5.1.6.8	Crawlspac interior wall: Polyethylene														
Crwlspc int. wall: Polyethylene	6 mil polyethylene (interconnecting)		Ft2	50	348	WIF	719220900	0.03	135	0.013		5	0	1	40
Crwlspc int. wall: Polyethylene												5	0	1	40
5.1.7	FIRST STOREY FLOOR FRAMING														
5.1.7.1	First storey floor: Joists														
First storey floor: Joists	2x8 SPF		Ft	100	304	LI	611142150	0.59	191	1.359		10	0	1	50
First storey floor: Joists	2x8 D. Fir		Ft	100	304	LI	611142160	0.66	191	1.717		10	0	1	50
First storey floor: Joists	2x10 SPF		Ft	100	304	LI	611142200	0.92	191	1.695		10	0	1	50
First storey floor: Joists	2x10 D. Fir		Ft	100	304	LI	611142210	0.99	191	2.142		10	0	1	50
First storey floor: Joists	2x12 SPF		Ft	100	304	LI	611142250	1.12	191	2.036		10	0	1	50
First storey floor: Joists	2x12 D.Fir		Ft	100	304	LI	611142260	1.21	191	2.572		10	0	1	50
First storey floor: Joists	Wood I joists, 2x4, 1 1/2" x 1 1/2" x 11		Ft	100	304	LI	615080100	2.25	197	1.497		10	0	1	50
First storey floor: Joists												10	0	1	50
5.1.7.2	First storey floor: Cross bridging														
First storey floor: Cross bridging	2x2 for 2x10 @ 16"O.C.*		No	100	304	LI	611060020	0.22	191	0.509		10	0	1	50
First storey floor: Cross bridging	2x2 for 2x10 @ 12"O.C.		No	100	304	LI	611060030	0.20	191	0.396		10	0	1	50

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	prcentage	interval	
First storey floor: Cross bridging												10	0	1	50
5.1.7.3	First storey floor: Solid Blocking														
First storey floor: Solid Blocking	2x8		Ft	100	304	LI	611022100	0.61	191	1,359		10	0	1	50
First storey floor: Solid Blocking	2x10		Ft	100	304	LI	611022150	0.95	191	1,695		10	0	1	50
First storey floor: Solid Blocking	2x12		Ft	100	304	LI	611022200	1.12	191	2,036		10	0	1	50
First storey floor: Solid Blocking												10	0	1	50
5.1.7.4	First storey floor: Continuous Tie														
First storey floor: Continuous Tie	1x4		Ft	100	304	LI	611240160	0.21	191	0.339		10	0	1	50
First storey floor: Continuous Tie												10	0	1	50
5.1.7.5	First storey floor: Ledgers														
First storey floor: Ledgers	2x6		Ft	100	304	LI	611222050	0.45	191	1,018		10	0	1	50
First storey floor: Ledgers	2x8		Ft	100	304	LI	611222055	0.59	191	1,359		10	0	1	50
First storey floor: Ledgers	2x10		Ft	100	304	LI	611222065	0.95	191	1,695		10	0	1	50
First storey floor: Ledgers	2x12		Ft	100	304	LI	611222070	1.12	191	2,036		10	0	1	50
First storey floor: Ledgers												10	0	1	50
5.1.7.6	First storey floor: Sill Plates														
First storey floor: Sill Plates	2x4		Ft	100	304	LI	611285020	0.30	191	0.678		10	0	1	50
First storey floor: Sill Plates	2x6		Ft	100	304	LI	611285040	0.45	191	1,018		10	0	1	50
First storey floor: Sill Plates												10	0	1	50
5.1.7.7	First storey floor: Capillary Break														
First storey floor: Capillary Break	45# Asphalt felt (interconnecting		Ft2	0	304	LI	752040400	0.56	216	0.047		5	0	1	50
First storey floor: Capillary Break	6 mil polyethylene (interconnecting		Ft2	50	304	LI	719220900	0.03	135	0.013		5	0	1	50
First storey floor: Capillary Break	Polyethylene foam sill gasket		Ft	50	304	LI	719220950	0.08	135	0.001		5	10	8	18
First storey floor: Capillary Break												5	0	1	50
5.1.7.8	First storey floor: Subflooring														
First storey floor: Subflooring	5/8" T&G Plywood		Shts	100	304	LI	611640100	13.73	195	24.39		5	5	5	50
First storey floor: Subflooring	5/8" T&G OSB		Shts	100	304	LI	611642000	11.50	201	16.27		5	5	5	50
First storey floor: Subflooring	3/4" T&G Plywood		Shts	100	304	LI	611640200	16.19	195	29.26		5	5	5	50
First storey floor: Subflooring	3/4" T&G OSB		Shts	100	304	LI	611642100	13.79	201	19.52		5	5	5	50
First storey floor: Subflooring												5	5	5	50
5.1.7.9	First storey floor: Adhesives														
First storey floor: Adhesives	Subfloor adhesive		No	100	304	LI	606000010	6.90	482	0.91		5	5	5	50
First storey floor: Adhesives												5	5	5	50
First storey floor: Adhesives												5	5	5	50
5.1.8	FIRST STOREY EXTERIOR WALLS														
5.1.8.1	First storey exterior wall: Studs														
First storey ext. wall: Studs	Precut 8' 2x4		No	0	308	WEF	611285140	2.38	191	5,268		10	0	1	50
First storey ext. wall: Studs	Precut 8' 2x6		No	0	308	WEF	611285160	3.52	191	7.91		10	0	1	50
First storey ext. wall: Studs	2x3		Ft	0	308	WEF	611285000	0.23	191	0.509		10	0	1	50
First storey ext. wall: Studs	2x4		Ft	0	308	WEF	611285020	0.30	191	0.678		10	0	1	50
First storey ext. wall: Studs	2x6		Ft	0	308	WEF	611285040	0.45	191	1,018		10	0	1	50
First storey ext. wall: Studs												10	0	1	50

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units to int.	No.	ID	Number	bldr's	Code	to kg	Emiss.	Const.	prcentage	Interval	entirely	
5.1.8.2	First storey exterior wall: Plates														
First storey ext. wall: Plates	2x3		Ft	0	308	WEF	611285000	0.23	191	0.509		10	0	1	50
First storey ext. wall: Plates	2x4		Ft	0	308	WEF	611285020	0.30	191	0.678		10	0	1	50
First storey ext. wall: Plates	2x6		Ft	0	308	WEF	611285040	0.45	191	1.018		10	0	1	50
First storey ext. wall: Plates												10	0	1	50
5.1.8.3	First storey exterior wall: Headers														
First storey ext. wall: Headers	2x6		Ft	0	308	WEF	611282000	0.44	191	1.018		10	0	1	40
First storey ext. wall: Headers	2x8		Ft	0	308	WEF	611282050	0.59	191	1.359		10	0	1	40
First storey ext. wall: Headers	2x10		Ft	0	308	WEF	611282100	0.92	191	1.695		10	0	1	40
First storey ext. wall: Headers	2x12		Ft	0	308	WEF	611282150	1.12	191	2.036		10	0	1	40
First storey ext. wall: Headers												10	0	1	40
5.1.8.4	First storey exterior wall: Sheathing														
First storey ext. wall: Sheathing	3/8" Plywood		Shts	0	308	WEF	611540500	8.80	195	14.63		5	10	25	50
First storey ext. wall: Sheathing	3/8" OSB		Shts	0	308	WEF	611543900	6.80	201	9.791		5	10	25	50
First storey ext. wall: Sheathing	1/2" Plywood		Shts	0	308	WEF	611540600	11.26	195	19.5		5	10	25	50
First storey ext. wall: Sheathing	1/2" OSB		Shts	0	308	WEF	611544000	8.25	201	13.02		5	10	25	50
First storey ext. wall: Sheathing	5/8" Plywood		Shts	0	308	WEF	611540700	13.73	195	24.39		5	10	25	50
First storey ext. wall: Sheathing	5/8" OSB		Shts	0	308	WEF	611544100	11.55	201	16.27		5	10	25	50
First storey ext. wall: Sheathing												5	10	25	50
First storey ext. wall: Sheathing												5	10	25	50
5.1.8.5	First storey exterior wall: Beams														
First storey ext. wall: Beams	2x8 built up 3x, D. Fir beams		Ft	0	308	WEF	611103025	1.98	191	5.151		10	0	1	50
First storey ext. wall: Beams	2x10 built up 3x, D. Fir beams		Ft	0	308	WEF	611103045	3.03	191	6.426		10	0	1	50
First storey ext. wall: Beams	2x12 built up 3x, D. Fir beams		Ft	0	308	WEF	611103065	3.63	191	7.716		10	0	1	50
First storey ext. wall: Beams												10	0	1	50
First storey ext. wall: Beams	2x8 built up 3x, SPF beams		Ft	0	308	WEF	611103020	1.82	191	4.077		10	0	1	50
First storey ext. wall: Beams	2x10 built up 3x, SPF beams		Ft	0	308	WEF	611103040	2.79	191	5.085		10	0	1	50
First storey ext. wall: Beams	2x12 built up 3x, SPF beams		Ft	0	308	WEF	611103060	3.41	191	6.108		10	0	1	50
First storey ext. wall: Beams												10	0	1	50
First storey ext. wall: Beams	6x10 beam, sawn D. Fir		Ft	0	308	WEF	613040020	4.68	191	6.43		10	0	1	50
First storey ext. wall: Beams	6x10 beam, sawn SPF		Ft	0	308	WEF	613040010	3.58	191	5.088		10	0	1	50
First storey ext. wall: Beams	Glulam beam, 5.1x25.6 SPF		Ft	0	308	WEF	618040200	10.56	197	12.34		10	0	1	50
First storey ext. wall: Beams	L.V.L beam, 3 1/2" x 16"		Ft	0	308	WEF	615080105	14.30	197	7.357		10	0	1	50
First storey ext. wall: Beams	Steel beam, W6x9		Ft	0	308	WEF	512600010	6.60	276	4.08		5	0	1	50
First storey ext. wall: Beams												10	0	1	50
5.1.8.5	First storey exterior wall: Diagonal bracing														
First storey ext. wall: Diagonal bracing	1x4		Ft	0	308	WEF	611240160	0.21	191	0.339		10	0	1	50
First storey ext. wall: Diagonal bracing												10	0	1	50
First storey ext. wall: Diagonal bracing												10	0	1	50
5.1.8.6	First storey exterior wall: Posts and Columns														
First storey ext. wall: Posts and Columns	4x4		Ft	0	308	WEF	611180100	0.94	191	1.357		10	0	1	50
First storey ext. wall: Posts and Columns	6x6		Ft	0	308	WEF	611180250	2.37	191	3.053		10	0	1	50
First storey ext. wall: Posts and Columns	8x8		Ft	0	308	WEF	611180350	4.19	191	5.428		10	0	1	50

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's Qnty	Bldr's Units	% exp to Int.	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Const. Waste	prcntage (%)	Interval (yrs)	entirely (yrs)
First storey ext. wall: Posts and Columns	3" dia steel column, 8' hollow tube	No	0	308	WEF	512201500	61.92	250	31.84		5	0	1	50	
First storey ext. wall: Posts and Columns											10	0	1	50	
5.1.9	FIRST STOREY INTERIOR WALLS														
5.1.9.1	First storey interior wall: Studs														
First storey int. wall: Studs	Precut 8' 2x4	No	100	348	WIF	611285140	2.38	191	5.268		10	0	1	40	
First storey int. wall: Studs	Precut 8' 2x6 (plumbing chase)	No	100	348	WIF	611285160	3.52	191	7.91		10	0	1	40	
First storey int. wall: Studs	2x3	Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40	
First storey int. wall: Studs	2x4	Ft	100	348	WIF	611285020	0.30	191	0.681		10	0	1	40	
First storey int. wall: Studs	2x6	Ft	100	348	WIF	611285040	0.45	191	1.018		10	0	1	40	
First storey int. wall: Studs											10	0	1	40	
5.1.9.2	First storey interior wall: Plates														
First storey int. wall: Plates	2x3	Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40	
First storey int. wall: Plates	2x4	Ft	100	348	WIF	611285020	0.30	191	0.681		10	0	1	40	
First storey int. wall: Plates	2x6	Ft	100	348	WIF	611285040	0.45	191	1.018		10	0	1	40	
First storey int. wall: Plates											10	0	1	40	
5.1.9.3	First storey interior wall: Headers														
First storey int. wall: Headers	2x6	Ft	100	348	WIF	611282000	0.44	191	1.018		10	0	1	40	
First storey int. wall: Headers	2x8	Ft	100	348	WIF	611282050	0.59	191	1.359		10	0	1	40	
First storey int. wall: Headers	2x10	Ft	100	348	WIF	611282100	92.40	191	1.695		10	0	1	40	
First storey int. wall: Headers	2x12	Ft	100	348	WIF	611282150	1.12	191	2.036		10	0	1	40	
First storey int. wall: Headers											10	0	1	40	
5.1.9.4	First storey interior wall: Sheathing														
First storey int. wall: Sheathing	3/8" Plywood	Shts	100	348	WIF	611540500	8.80	195	14.63		5	0	1	40	
First storey int. wall: Sheathing	3/8" OSB	Shts	100	348	WIF	611543900	6.80	201	9.791		5	0	1	40	
First storey int. wall: Sheathing	1/2" Plywood	Shts	100	348	WIF	611540600	11.26	195	19.5		5	0	1	40	
First storey int. wall: Sheathing	1/2" OSB	Shts	100	348	WIF	611544000	8.25	201	13.02		5	0	1	40	
First storey int. wall: Sheathing	5/8" Plywood	Shts	100	348	WIF	611540700	13.73	195	24.39		5	0	1	40	
First storey int. wall: Sheathing	5/8" OSB	Shts	100	348	WIF	611544100	11.55	201	16.27		5	0	1	40	
First storey int. wall: Sheathing											5	0	1	40	
First storey int. wall: Sheathing											5	0	1	40	
5.1.9.5	First storey interior wall: Beams														
First storey int. wall: Beams	2x8 built up 3x, D. Fir beams	Ft	100	348	WIF	611103025	1.98	191	5.151		10	0	1	40	
First storey int. wall: Beams	2x10 built up 3x, D. Fir beams	Ft	100	348	WIF	611103045	3.03	191	6.426		10	0	1	40	
First storey int. wall: Beams	2x12 built up 3x, D. Fir beams	Ft	100	348	WIF	611103065	3.63	191	7.716		10	0	1	40	
First storey int. wall: Beams											10	0	1	40	
First storey int. wall: Beams	2x8 built up 3x, SPF beams	Ft	100	348	WIF	611103020	1.82	191	4.077		10	0	1	40	
First storey int. wall: Beams	2x10 built up 3x, SPF beams	Ft	100	348	WIF	611103040	2.79	191	5.085		10	0	1	40	
First storey int. wall: Beams	2x12 built up 3x, SPF beams	Ft	100	348	WIF	611103060	3.41	191	6.108		10	0	1	40	
First storey int. wall: Beams											10	0	1	40	
First storey int. wall: Beams	6x10 beam, sawn D. Fir	Ft	100	348	WIF	613040020	4.68	191	6.43		10	0	1	40	
First storey int. wall: Beams	6x10 beam, sawn SPF	Ft	100	348	WIF	613040010	3.58	191	5.088		10	0	1	40	
First storey int. wall: Beams	Glulam beam, 5.1x25.6 SPF	Ft	100	348	WIF	618040200	10.56	197	12.34		10	0	1	40	
First storey int. wall: Beams	L.V.L beam, 3 1/2" x 16"	Ft	100	348	WIF	615080105	14.30	197	7.357		10	0	1	40	

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's Qnty	Bldr's Units to int.	% exp No.	Asmby ID	System Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Waste	Const. (%)	prcentage (yrs)	interval (yrs)	
First storey int. wall: Beams	Steel beam, W6x9		Ft	100	348	WIF	512600010	6.60	276	4.08		5	0	1	40
First storey int. wall: Beams												10	0	1	40
5.1.9.6	First storey interior wall: Diagonal bracing														
First storey int. wall: Diagonal bracing	1x4		Ft	100	348	WIF	611240160	0.21	191	0.339		10	0	1	40
First storey int. wall: Diagonal bracing												10	0	1	40
5.1.9.7	First storey interior wall: Posts and Columns														
First storey int. wall: Posts and Columns	4x4		Ft	100	348	WIF	611180100	0.94	191	1.357		10	0	1	40
First storey int. wall: Posts and Columns	6x6		Ft	100	348	WIF	611180250	2.37	191	3.053		10	0	1	40
First storey int. wall: Posts and Columns	8x8		Ft	100	348	WIF	611180350	4.19	191	5.428		10	0	1	40
First storey int. wall: Posts and Columns	3" dia steel column, 8' hollow tube		No	100	348	WIF	512201500	61.92	250	31.84		5	0	1	40
First storey int. wall: Posts and Columns												10	0	1	40
5.1.10	SECOND STOREY FLOOR														
5.1.10.1	Second storey floor: Joists														
Sec. storey floor: Joists	2x8 SPF		Ft	100	304	LI	611142150	0.59	191	1.359		10	0	1	50
Sec. storey floor: Joists	2x8 D. Fir		Ft	100	304	LI	611142160	0.66	191	1.717		10	0	1	50
Sec. storey floor: Joists	2x10 SPF		Ft	100	304	LI	611142200	0.92	191	1.695		10	0	1	50
Sec. storey floor: Joists	2x10 D. Fir		Ft	100	304	LI	611142210	0.99	191	2.142		10	0	1	50
Sec. storey floor: Joists	2x12 SPF		Ft	100	304	LI	611142250	1.12	191	2.036		10	0	1	50
Sec. storey floor: Joists	2x12 D. Fir		Ft	100	304	LI	611142260	1.21	191	2.572		10	0	1	50
Sec. storey floor: Joists	Wood I joists, 2x4, 1 1/2 x 1 1/2 x 11		Ft	100	304	LI	615080100	2.25	197	1.497		10	0	1	50
Sec. storey floor: Joists												10	0	1	50
5.1.10.2	Second storey floor: Cross bridging														
Sec. storey floor: Cross bridging	2x2 for 2x10 @ 16"O.C.		No	100	304	LI	611060020	0.22	191	0.509		10	0	1	50
Sec. storey floor: Cross bridging	2x2 for 2x10 @ 12"O.C.		No	100	304	LI	611060030	0.20	191	0.396		10	0	1	50
Sec. storey floor: Cross bridging												10	0	1	50
5.1.10.3	Second storey floor: Solid Blocking														
Sec. storey floor: Solid Blocking	2x8		Ft	100	304	LI	611022100	0.61	191	1.359		10	0	1	50
Sec. storey floor: Solid Blocking	2x10		Ft	100	304	LI	611022150	0.95	191	1.695		10	0	1	50
Sec. storey floor: Solid Blocking	2x12		Ft	100	304	LI	611022200	1.12	191	2.036		10	0	1	50
Sec. storey floor: Solid Blocking												10	0	1	50
5.1.10.4	Second storey floor: Subflooring														
Sec. storey floor: Subflooring	5/8" T&G Plywood		Shts	100	304	LI	611640100	13.73	195	24.39		5	5	5	50
Sec. storey floor: Subflooring	5/8" T&G OSB		Shts	100	304	LI	611642000	11.50	201	16.27		5	5	5	50
Sec. storey floor: Subflooring	3/4" T&G Plywood		Shts	100	304	LI	611640200	16.19	195	29.26		5	5	5	50
Sec. storey floor: Subflooring	3/4" T&G OSB		Shts	100	304	LI	611642100	13.79	201	19.52		5	5	5	50
Sec. storey floor: Subflooring												5	5	5	50
5.1.10.5	Second storey floor: Adhesive														
Sec. storey floor: Adhesive	Subfloor adhesive		No	100	304	LI	606000010	6.90	482	0.91		5	5	5	50
Sec. storey floor: Adhesive												5	5	5	50
5.1.11	SECOND STORY EXTERIOR WALLS														
5.1.11.1	Second storey exterior wall: Studs														
Sec. storey ext. wall: Studs	Precut 8' 2x4		No	0	308	WIF	611285140	2.38	191	5.268		10	0	1	50
Sec. storey ext. wall: Studs	Precut 8' 2x6		No	0	308	WEF	611285160	3.52	191	7.91		10	0	1	50

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcentage	Interval	entirely
		Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)
Sec. storey ext. wall: Studs	2x3		Ft	0	308	WIF	611285000	0.23	191	0.509		10	0	1	50
Sec. storey ext. wall: Studs	2x4		Ft	0	308	WIF	611285020	0.30	191	0.678		10	0	1	50
Sec. storey ext. wall: Studs	2x6		Ft	0	308	WEF	611285040	0.45	191	1.018		10	0	1	50
Sec. storey ext. wall: Studs												10	0	1	50
5.1.11.2	Second storey exterior wall: Plates														
Sec. storey ext. wall: Plates	2x3		Ft	0	308	WIF	611285000	0.23	191	0.509		10	0	1	50
Sec. storey ext. wall: Plates	2x4		Ft	0	308	WIF	611285020	0.30	191	0.678		10	0	1	50
Sec. storey ext. wall: Plates	2x6		Ft	0	308	WEF	611285040	0.45	191	1.018		10	0	1	50
Sec. storey ext. wall: Plates												10	0	1	50
5.1.11.3	Second storey exterior wall: Headers														
Sec. storey ext. wall: Headers	2x6		Ft	0	308	WEF	611282000	0.44	191	1.018		10	0	1	40
Sec. storey ext. wall: Headers	2x8		Ft	0	308	WEF	611282050	0.59	191	1.359		10	0	1	40
Sec. storey ext. wall: Headers	2x10		Ft	0	308	WEF	611282100	0.92	191	1.695		10	0	1	40
Sec. storey ext. wall: Headers	2x12		Ft	0	308	WEF	611282150	1.12	191	2.036		10	0	1	40
Sec. storey ext. wall: Headers												10	0	1	40
5.1.11.4	Second storey exterior wall: Sheathing														
Sec. storey ext. wall: Sheathing	3/8" Plywood		Shts	0	308	WEF	611540500	8.80	195	14.63		5	10	25	50
Sec. storey ext. wall: Sheathing	3/8" OSB		Shts	0	308	WEF	611543900	6.80	201	9.791		5	10	25	50
Sec. storey ext. wall: Sheathing	1/2" Plywood		Shts	0	308	WEF	611540600	11.26	195	19.5		5	10	25	50
Sec. storey ext. wall: Sheathing	1/2" OSB		Shts	0	308	WEF	611544000	8.25	201	13.02		5	10	25	50
Sec. storey ext. wall: Sheathing	5/8" Plywood		Shts	0	308	WEF	611540700	13.73	195	24.39		5	10	25	50
Sec. storey ext. wall: Sheathing	5/8" OSB		Shts	0	308	WEF	611544100	11.55	201	16.27		5	10	25	50
Sec. storey ext. wall: Sheathing												5	10	25	50
Sec. storey ext. wall: Sheathing												5	10	25	50
5.1.11.5	Second storey exterior wall: Beams														
Sec. storey ext. wall: Beams	2x8 built up 3x, D. Fir beams		Ft	0	308	WEF	611103025	1.98	191	5.151		10	0	1	50
Sec. storey ext. wall: Beams	2x10 built up 3x, D. Fir beams		Ft	0	308	WEF	611103045	3.03	191	6.426		10	0	1	50
Sec. storey ext. wall: Beams	2x12 built up 3x, D. Fir beams		Ft	0	308	WEF	611103065	3.63	191	7.716		10	0	1	50
Sec. storey ext. wall: Beams												10	0	1	50
Sec. storey ext. wall: Beams	2x8 built up 3x, SPF beams		Ft	0	308	WEF	611103020	1.82	191	4.077		10	0	1	50
Sec. storey ext. wall: Beams	2x10 built up 3x, SPF beams		Ft	0	308	WEF	611103040	2.79	191	5.085		10	0	1	50
Sec. storey ext. wall: Beams	2x12 built up 3x, SPF beams		Ft	0	308	WEF	611103060	3.41	191	6.108		10	0	1	50
Sec. storey ext. wall: Beams												10	0	1	50
Sec. storey ext. wall: Beams	6x10 beam, sawn D. Fir		Ft	0	308	WEF	613040020	4.68	191	6.43		10	0	1	50
Sec. storey ext. wall: Beams	6x10 beam, sawn SPF		Ft	0	308	WEF	613040010	3.58	191	5.088		10	0	1	50
Sec. storey ext. wall: Beams	Glulam beam, 5.1x25.6 SPF		Ft	0	308	WEF	618040200	10.56	197	12.34		10	0	1	50
Sec. storey ext. wall: Beams	L.V.L beam, 3 1/2" x 16"		Ft	0	308	WEF	615080105	14.30	197	7.357		10	0	1	50
Sec. storey ext. wall: Beams	Steel beam, W6x9		Ft	0	308	WEF	512600010	6.60	276	4.08		5	0	1	50
Sec. storey ext. wall: Beams												10	0	1	50
5.1.11.6	Second storey exterior wall: Diagonal bracing														
Sec. storey ext. wall: Diagonal bracing	1x4		Ft	0	308	WEF	611240160	0.21	191	0.339		10	0	1	50
Sec. storey ext. wall: Diagonal bracing												10	0	1	50
5.1.11.7	Second storey exterior wall: Posts and Columns														

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	to int.	No.	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcentage	interval	
Sec. storey ext. wall: Posts and Column	4x4		Ft	0	308	WEF	611180100	0.94	191	1.357		10	0	1	50
Sec. storey ext. wall: Posts and Column	6x6		Ft	0	308	WEF	611180250	2.37	191	3.053		10	0	1	50
Sec. storey ext. wall: Posts and Column	8x8		Ft	0	308	WEF	611180350	4.19	191	5.428		10	0	1	50
Sec. storey ext. wall: Posts and Column	3" dia steel column, 8' hollow tube		Ft	0	308	WEF	512201500	61.92	250	31.84		5	0	1	50
Sec. storey ext. wall: Posts and Columns												10	0	1	50
5.1.12	SECOND STORY INTERIOR WALLS														
5.1.12.1	Second storey interior wall: Studs														
Sec. storey int. wall: Studs	Precut 8' 2x4		No	100	348	WIF	611285140	2.38	191	5.268		10	0	1	40
Sec. storey int. wall: Studs	Precut 8' 2x6		No	100	348	WIF	611285160	3.52	191	7.91		10	0	1	40
Sec. storey int. wall: Studs	2x3		Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40
Sec. storey int. wall: Studs	2x4		Ft	100	348	WIF	611285020	0.30	191	0.681		10	0	1	40
Sec. storey int. wall: Studs	2x6		Ft	100	348	WIF	611285040	0.45	191	1.018		10	0	1	40
Sec. storey int. wall: Studs												10	0	1	40
5.1.12.2	Second storey interior wall: Plates														
Sec. storey int. wall: Plates	2x3		Ft	100	348	WIF	611285000	0.23	191	0.509		10	0	1	40
Sec. storey int. wall: Plates	2x4		Ft	100	348	WIF	611285020	0.30	191	0.681		10	0	1	40
Sec. storey int. wall: Plates	2x6		Ft	100	348	WIF	611285040	0.45	191	1.018		10	0	1	40
Sec. storey int. wall: Plates												10	0	1	40
5.1.12.3	Second storey interior wall: Headers														
Sec. storey int. wall: Headers	2x6		Ft	100	348	WIF	611282000	0.44	191	1.018		10	0	1	40
Sec. storey int. wall: Headers	2x8		Ft	100	348	WIF	611282050	0.59	191	1.359		10	0	1	40
Sec. storey int. wall: Headers	2x10		Ft	100	348	WIF	611282100	0.92	191	1.695		10	0	1	40
Sec. storey int. wall: Headers	2x12		Ft	100	348	WIF	611282150	1.12	191	2.036		10	0	1	40
Sec. storey int. wall: Headers												10	0	1	40
5.1.12.4	Second storey interior wall: Sheathing														
Sec. storey int. wall: Sheathing	3/8" Plywood		Shts	100	348	WIF	611540500	8.80	195	14.63		5	0	1	40
Sec. storey int. wall: Sheathing	3/8" OSB		Shts	100	348	WIF	611543900	6.80	201	9.791		5	0	1	40
Sec. storey int. wall: Sheathing	1/2" Plywood		Shts	100	348	WIF	611540600	11.26	195	19.5		5	0	1	40
Sec. storey int. wall: Sheathing	1/2" OSB		Shts	100	348	WIF	611544000	8.25	201	13.02		5	0	1	40
Sec. storey int. wall: Sheathing	5/8" Plywood		Shts	100	348	WIF	611540700	13.73	195	24.39		5	0	1	40
Sec. storey int. wall: Sheathing	5/8" OSB		Shts	100	348	WIF	611544100	11.55	201	16.27		5	0	1	40
Sec. storey int. wall: Sheathing												5	0	1	40
Sec. storey int. wall: Sheathing												5	0	1	40
5.1.12.5	Second storey interior wall: Beams														
Sec. storey int. wall: Beams	2x8 built up 3x, D. Fir beams		Ft	100	348	WIF	611103025	1.98	191	5.151		10	0	1	40
Sec. storey int. wall: Beams	2x10 built up 3x, D. Fir beams		Ft	100	348	WIF	611103045	3.03	191	6.426		10	0	1	40
Sec. storey int. wall: Beams	2x12 built up 3x, D. Fir beams		Ft	100	348	WIF	611103065	3.63	191	7.716		10	0	1	40
Sec. storey int. wall: Beams												10	0	1	40
Sec. storey int. wall: Beams	2x8 built up 3x, SPF beams		Ft	100	348	WIF	611103020	1.82	191	4.077		10	0	1	40
Sec. storey int. wall: Beams	2x10 built up 3x, SPF beams		Ft	100	348	WIF	611103040	2.79	191	5.085		10	0	1	40
Sec. storey int. wall: Beams	2x12 built up 3x, SPF beams		Ft	100	348	WIF	611103060	3.41	191	6.108		10	0	1	40
Sec. storey int. wall: Beams												10	0	1	40
Sec. storey int. wall: Beams	6x10 beam, sawn D. Fir		Ft	100	348	WIF	613040020	4.68	191	6.43		10	0	1	40

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Const.	prcentage	interval	
Sec. storey int. wall: Beams	6x10 beam, sawn SPF		Ft	100	348	WIF	613040010	3.58	191	5.088		10	0	1	40
Sec. storey int. wall: Beams	Glulam beam, 5.1x25.6 SPF		Ft	100	348	WIF	618040200	10.56	197	12.34		10	0	1	40
Sec. storey int. wall: Beams	L.V.L beam, 3 1/2" x 16"		Ft	100	348	WIF	615080105	14.30	197	7.357		10	0	1	40
Sec. storey int. wall: Beams	Steel beam, W6x9		Ft	100	348	WIF	512600010	6.60	276	4.08		5	0	1	40
Sec. storey int. wall: Beams												10	0	1	40
5.1.12.6	Second storey interior wall: Diagonal bracing														
Sec. storey int. wall: Diagonal bracing	1x4		Ft	100	348	WIF	611240160	0.21	191	0.339		10	0	1	40
Sec. storey int. wall: Diagonal bracing												10	0	1	40
5.1.12.7	Second storey interior wall: Posts and Columns														
Sec. storey int. wall: Posts and Columns 4x4			Ft	100	348	WIF	611180100	0.94	191	1.357		10	0	1	40
Sec. storey int. wall: Posts and Columns 6x6			Ft	100	348	WIF	611180250	2.37	191	3.053		10	0	1	40
Sec. storey int. wall: Posts and Columns 8x8			Ft	100	348	WIF	611180350	4.19	191	5.428		10	0	1	40
Sec. storey int. wall: Posts and Columns 3" dia steel column, 8' hollow tube		No	100	348			512201500	61.92	250	31.84		5	0	1	40
Sec. storey int. wall: Posts and Columns												10	0	1	40
5.1.13	ROOF SYSTEM														
5.1.13.1	Roof: Trusses														
Roof: Trusses	20'		No	0	316	CE	619085050	40.70	197	40.82		10	0	1	40
Roof: Trusses	24'		No	0	316	CE	619085100	48.40	197	49.9		10	0	1	40
Roof: Trusses	26'		No	0	316	CE	619085150	51.70	197	56.7		10	0	1	40
Roof: Trusses	28'		No	0	316	CE	619085200	56.10	197	61.24		10	0	1	40
Roof: Trusses	30'		No	0	316	CE	619085240	59.40	197	63.5		10	0	1	40
Roof: Trusses	32'		No	0	316	CE	619085250	63.80	197	72.58		10	0	1	40
Roof: Trusses	34'		No	0	316	CE	619085280	68.20	197	81.65		10	0	1	40
Roof: Trusses												10	0	1	40
5.1.13.1	Roof: Ceiling Joists														
Roof: Ceiling Joists	2x4 SPF		Ft	0	316	CE	611142000	0.30	191	0.678		10	0	1	40
Roof: Ceiling Joists	2x4 D. Fir		Ft	0	316	CE	611142010	0.34	191	0.861		10	0	1	40
Roof: Ceiling Joists	2x6 SPF		Ft	0	316	CE	611142100	0.45	191	1.018		10	0	1	40
Roof: Ceiling Joists	2x6 D. Fir		Ft	0	316	CE	611142110	0.53	191	1.286		10	0	1	40
Roof: Ceiling Joists	2x8 SPF		Ft	0	316	CE	611142150	0.59	191	1.359		10	0	1	40
Roof: Ceiling Joists	2x8 D. Fir		Ft	0	316	CE	611142160	0.66	191	1.717		10	0	1	40
Roof: Ceiling Joists												10	0	1	40
5.1.13.3	Roof: Ceiling joist cont. tie														
Roof: Ceiling joist cont. tie	1x4		Ft	0	316	CE	611240160	0.21	191	0.339		10	0	1	40
Roof: Ceiling joist cont. tie												10	0	1	40
5.1.13.4	Dropped ceiling furring														
Dropped ceiling furring	2x4		Ft	0	316	CE	611285020	0.30	191	0.678		10	0	1	40
Dropped ceiling furring												10	0	1	40
5.1.13.5	Roof: Strongbacks														
Roof: Strongbacks	2x6		Ft	0	316	CE	611285040	0.45	191	1.018		10	0	1	40
Roof: Strongbacks												10	0	1	40
5.1.13.6	Skylight chase framing														
Skylight chase framing	2x4		Ft	0	316	CE	611285020	0.30	191	0.678		10	0	1	40

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace		
Stage	Item	Qnty	Bldr's Units	% exp to int.	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Waste	Const. (%)	prcntage	interval	entirely
Skylight chase framing	2x6		Ft	0	316	CE	611285040	0.45	191	1.018		10	0	1	40	
Skylight chase framing												10	0	1	40	
Skylight chase framing												10	0	1	40	
Skylight chase framing												10	0	1	40	
5.1.13.7	Roof: Rafters															
Roof: Rafters	2x8 SPF		Ft	0	316	R	611142150	0.59	191	1.359		10	0	1	40	
Roof: Rafters	2x8 D. Fir		Ft	0	316	R	611142160	0.66	191	1.717		10	0	1	40	
Roof: Rafters	2x10 SPF		Ft	0	316	R	611142200	0.92	191	1.695		10	0	1	40	
Roof: Rafters	2x10 D. Fir		Ft	0	316	R	611142210	0.99	191	2.142		10	0	1	40	
Roof: Rafters	2x12 SPF		Ft	0	316	R	611142250	1.12	191	2.036		10	0	1	40	
Roof: Rafters	2x12 D.Fir		Ft	0	316	R	611142260	1.21	191	2.572		10	0	1	40	
Roof: Rafters												10	0	1	40	
5.1.13.8	Roof: Rafters															
Roof: Rafters	2x4		Ft	0	316	R	611285020	0.30	191	0.678		10	0	1	40	
Roof: Rafters	2x6		Ft	0	316	R	611285040	0.45	191	1.018		10	0	1	40	
Roof: Rafters												10	0	1	40	
5.1.13.9	Roof: Ridge board															
Roof: Ridge board	2x8		Ft	0	316	R	611142155	0.59	191	1.359		10	0	1	40	
Roof: Ridge board	2x10		Ft	0	316	R	611142205	0.92	191	1.695		10	0	1	40	
Roof: Ridge board	2x12		Ft	0	316	R	611142255	1.12	191	2.036		10	0	1	40	
Roof: Ridge board												10	0	1	40	
5.1.13.10	Roof: Collar ties															
Roof: Collar ties	2x4		Ft	0	316	R	611285020	0.30	191	0.678		10	0	1	40	
Roof: Collar ties	2x6		Ft	0	316	R	611285040	0.45	191	1.018		10	0	1	40	
Roof: Collar ties												10	0	1	40	
5.1.13.11	Roof: Joists															
Roof: Joists	2x10 SPF		Ft	0	316	R	611142205	0.92	191	1.695		10	0	1	40	
Roof: Joists	2x10 D. Fir		Ft	0	316	R	611142210	0.99	191	2.142		10	0	1	40	
Roof: Joists	2x12 SPF		Ft	0	316	R	611142255	1.12	191	2.036		10	0	1	40	
Roof: Joists	2x12 D.Fir		Ft	0	316	R	611142260	1.21	191	2.572		10	0	1	40	
Roof: Joists	Wood I joists, 2x4, 1 1/2 x 1 1/2 x 11		Ft	0	316	R	615080100	2.25	197	1.497		10	0	1	40	
5.1.13.12	Roof: Ties															
Roof: Ties	1x4 Cont. ties		Ft	0	316	R	611240160	0.21	191	0.339		10	0	1	40	
Roof: Ties												10	0	1	40	
5.1.13.13	Roof: Exterior Soffit Framing															
Roof: ext. Soffit Framing	2x4		Ft	0	316	R	611285020	0.30	191	0.678		10	0	1	40	
Roof: ext. Soffit Framing	2x6		Ft	0	316	R	611285040	0.45	191	1.018		10	0	1	40	
Roof: ext. Soffit Framing												10	0	1	40	
5.1.13.14	Roof: Ledgers															
Roof: Ledgers	2x4		Ft	0	316	R	611222045	0.30	191	0.678		10	0	1	40	
Roof: Ledgers	2x6		Ft	0	316	R	611222050	0.45	191	1.018		10	0	1	40	
Roof: Ledgers	2x8		Ft	0	316	R	611222055	0.59	191	1.359		10	0	1	40	
Roof: Ledgers	2x10		Ft	0	316	R	611222065	0.92	191	1.695		10	0	1	40	

Optimize Quantity Takeoff

			Bldr's Qty	Units to Int.	Asmbly No.	System ID	Product Number	\$/unit bldr's	I/O Code	Conv to kg	CFC (mg/kg)	Emiss. Waste	% Const.	Maintenance prcentage (%)	Replace interval (yrs)	Replace entirely (yrs)
Stage	Item															
Roof: Ledgers	2x12			Ft 0	316 R		611222070	1.12	191	2.036		10	0	1	40	
Roof: Ledgers												10	0	1	40	
5.1.13.15	Roof: Sheathing															
Roof: Sheathing	1/2" Plywood			Shts 0	316 R		611540600	11.26	195	19.5		5	0	1	40	
Roof: Sheathing	1/2" OSB			Shts 0	316 R		611544000	8.25	201	13.02		5	0	1	40	
Roof: Sheathing	5/8 " Plywood			Shts 0	316 R		611540700	13.73	195	24.39		5	0	1	40	
Roof: Sheathing	5/8" OSB			Shts 0	316 R		611544100	11.55	201	16.27		5	0	1	40	
Roof: Sheathing												5	0	1	40	
5.1.13.16	Roof: Strapping															
Roof: Strapping	2x4			Ft 0	316 R		611285020	0.30	191	0.678		10	0	1	40	
Roof: Strapping	1x4			Ft 0	316 R		611240160	0.21	191	0.339		10	0	1	40	
Roof: Strapping												10	0	1	40	
5.1.13.17	Roof: Clips															
Roof: Clips	H Clips			No 0	316 R		605122900	0.07	292	9E-04		5	0	1	40	
Roof: Clips												5	0	1	40	
Roof: Clips												5	0	1	40	
5.2	EXTERIOR FINISH CARPENTRY															
5.2.1	EXTERIOR FINISH															
5.2.1.1	Siding															
Siding	Cedar, 1x4			Ft 0	400 WEF		746093800	2.01	191	0.291		7	0	1	50	
Siding	Cedar, 1x6			Ft 0	400 WEF		746093805	2.68	191	0.434		7	0	1	50	
Siding	Cedar, 1x8			Ft 0	400 WEF		746093810	3.58	191	0.59		7	0	1	50	
Siding	Cedar, 1x10			Ft 0	400 WEF		746093815	4.76	191	0.723		7	0	1	50	
Siding	Vinyl, 10" wide			Ft 0	400 WEF		746070010	0.55	135	0.375		5	0	1	50	
Siding	Aluminum, 8" wide			Ft 0	400 WEF		746020011	0.62	283	0.267		5	0	1	60	
Siding	Stucco, 7/8 " thick			Ft2 0	400 WEF		923040010	0.62	50	4.536		5	0	1	50	
Siding	Brick veneer			No 0	400 WEF		425542000	0.28	380	2.04		5	0	1	75	
Siding	Stone veneer, 2 " granite			Ft2 0	400 WEF		446510100	9.50	50	13.61		5	0	1	75	
Siding	Building Paper, 15#			Ft2 0	308 WEF		719220400	0.03	216	0.022		5	0	1	50	
Siding	Housewrap			Ft2 0	308 WEF		719220450	0.11	135	0.005		5	25	40	50	
Siding												5	0	1	50	
Siding	1/2" Plywood			Shts 0	400 WEF		611540600	11.26	195	19.5		5	0	1	50	
Siding	1/2" OSB			Shts 0	400 WEF		611544000	8.25	201	13		5	0	1	50	
Siding	5/8 " Plywood			Shts 0	400 WEF		611540700	13.73	195	24.39		5	0	1	50	
Siding	5/8" OSB			Shts 0	400 WEF		611544100	11.55	201	16.27		5	0	1	50	
Siding												5	0	1	50	
5.2.2	Corner trim, wood															
Corner trim, wood	1x4			Ft 0	400 WEF		611240160	0.21	191	0.34		7	0	1	50	
Corner trim, wood												7	0	1	50	
5.2.3	SOFFIT AND FASCIA															
5.2.3.1	Fascia board															
Fascia board	2x8			Ft 0	500 R		622205600	0.59	196	1.359		7	0	1	50	
Fascia board	2x10			Ft 0	500 R		622205700	0.92	196	1.695		7	0	1	50	

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's Qty	Bldr's Units	% exp to Int.	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Const. Waste	prcentage (%)	Interval (yrs)	entirely (yrs)
Fascia board													7	0	1
5.2.3.2	Barge board														50
Barge board	2x8		Ft	0	500	R	611202000	0.59	191	1.359			7	0	1
Barge board	2x10		Ft	0	500	R	611202100	0.92	191	1.695			7	0	1
Barge board													7	0	1
5.2.3.3	Soffit														50
Soffit	1x4 V joint cedar		Ft	0	500	R	627750600	2.12	196	0.291			7	0	1
Soffit	Perforated aluminum		Ft2	0	500	R	746026900	1.43	283	0.091			5	20	12
Soffit	Stucco, 7/8"		Ft2	0	500	R	923040010	0.62	50	4.536			5	0	1
Soffit	3/8" exterior grade plywood		Shts	0	500	R	627751050	8.80	196	14.63			5	20	10
Soffit													5	0	1
5.2.3.4	Hidden gutters														50
Hidden gutters	4x4 cant strip		Ft	0	500	R	611285025	0.30	191	0.678			7	0	1
Hidden gutters													7	0	1
5.2.4	PORCH AND BALCONY TRIM														
5.2.4.1	Balcony Railing														
Balcony Railing	2x4		Ft	0	750	EWF	611285020	0.30	196	0.678			7	0	1
Balcony Railing	2x6		Ft	0	750	EWF	611285040	0.45	196	1.018			7	0	1
Balcony Railing	2x8		Ft	0	750	EWF	611142155	0.59	196	1.359			7	0	1
5.2.4.2	Balcony Balusters														
Balcony Balusters	Balusters, 30° turned		No	0	750	EWF	643080010	4.29	196	0.239			7	0	1
5.2.4.3	Balcony Corner Posts														
Balcony Corner Posts	Corner Posts, 6x6 SPF		Ft	0	750	EWF	643084000	2.37	196	3.053			7	0	1
Balcony Corner Posts													7	0	1
5.2.4.4	Balcony Stair stringers														
Balcony Stair stringers	2x8		Ft	0	750	EWF	611168005	0.59	191	1.359			7	0	1
Balcony Stair stringers	2x10		Ft	0	750	EWF	611168010	0.92	191	1.695			7	0	1
Balcony Stair stringers	2x12		Ft	0	750	EWF	611168015	1.12	191	2.036			7	0	1
Balcony Stair stringers													7	0	1
5.2.4.5	Balcony Stair treads														
Balcony Stair treads	2x8		Ft	0	750	EWF	611168305	0.59	191	1.359			7	0	1
Balcony Stair treads	2x10		Ft	0	750	EWF	611168310	0.92	191	1.695			7	0	1
Balcony Stair treads	2x12		Ft	0	750	EWF	611168315	1.12	191	2.036			7	0	1
Balcony Stair treads													7	0	1
5.2.5	EXTERIOR MISC MILLWORK														
Ext. misc. millwork	Louvred shutters		No	0	470	EWF	627600010	13.75	196	20			7	0	1
Ext. misc. millwork	Lattice		Ft2	0	470	EWF	627300500	0.68	196	0.25			7	0	1
Ext. misc. millwork	Fretwork		Ft	0	470	EWF	627300600	1.65	196	0.339			7	0	1
Ext. misc. millwork	Brackets		No	0	470	EWF	627300700	16.50	196	0.5			7	0	1
Ext. misc. millwork													7	0	1
5.3	INTERIOR FINISH CARPENTRY														
5.3.1	INTERIOR WOOD TRIM														
Int. wood trim	Base boards, 9/16" x 3 1/2"		Ft	100	348	WEF	622080010	0.88	196	0.167			7	0	1
															50

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcntage	interval	entirely
		Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)
Int. wood trim	Railings, 2x4		Ft	100	690	IF	643100300	0.28	196	0.678		7	0	1	50
Int. wood trim	Casings, 11/16" x 2 1/2"		Ft	100	470	WEF	622120700	0.65	196	0.146		7	0	1	50
Int. wood trim	Misc. Moldings, 1x12 birch		Ft	100	604	WIF	622041020	2.31	196	1.018		7	0	1	50
Int. wood trim												7	0	1	50
5.3.2	INTERIOR UNDERLayment														
Int. underlayment	3/8" GIS Plywood under vinyl floors		Shts	100	662	LI	611680010	8.80	195	14.63		5	0	1	50
Int. underlayment												5	0	1	50
5.3.3	BASEMENT TO FIRST STOREY														
5.3.3.1	Basement stairs: Stringers														
Bsmt stairs: Stringers	2x8		Ft	100	690	IF	611168005	0.59	191	1.359		7	25	40	60
Bsmt stairs: Stringers	2x10		Ft	100	690	IF	611168010	0.92	191	1.695		7	25	40	60
Bsmt stairs: Stringers	2x12		Ft	100	690	IF	611168015	1.12	191	2.036		7	25	40	60
Bsmt stairs: Stringers												7	25	40	60
5.3.3.2	Basement stairs: Treads														
Bsmt stairs: Treads	2x8		Ft	100	690	IF	611168305	0.59	191	1.359		7	25	40	60
Bsmt stairs: Treads	2x10		Ft	100	690	IF	611168310	0.92	191	1.695		7	25	40	60
Bsmt stairs: Treads	2x12		Ft	100	690	IF	611168315	1.12	191	2.036		7	25	40	60
Bsmt stairs: Treads												7	25	40	60
5.3.3.3	Basement stairs: Risers														
Bsmt stairs: Risers	2x6		Ft	100	690	IF	611168400	0.45	191	1.018		7	25	40	60
Bsmt stairs: Risers	2x8		Ft	100	690	IF	611168405	0.59	191	1.359		7	25	40	60
Bsmt stairs: Risers	2x10		Ft	100	690	IF	611168410	0.92	191	1.695		7	25	40	60
Bsmt stairs: Risers												7	25	40	60
5.3.3.4	Basement stairs: Plywood														
Bsmt stairs: Plywood	1/2" Plywood		Shts	100	690	IF	611640010	11.26	195	19.5		5	25	40	60
Bsmt stairs: Plywood	1/2" OSB		Shts	100	690	IF	611641900	8.25	201	13.02		5	25	40	60
Bsmt stairs: Plywood	5/8 " Plywood		Shts	100	690	IF	611640100	13.73	195	24.39		5	25	40	60
Bsmt stairs: Plywood	5/8" OSB		Shts	100	690	IF	611642000	11.50	201	16.27		5	25	40	60
Bsmt stairs: Plywood												5	25	40	60
5.3.3.6	Basement stairs: Handrail														
Bsmt stairs: Handrail	2x4		Ft	100	690	IF	611285020	0.30	196	0.678		7	25	40	60
Bsmt stairs: Handrail	2x6		Ft	100	690	IF	611285040	0.45	196	1.018		7	25	40	60
Bsmt stairs: Handrail												7	25	40	60
5.3.3.7	Basement stairs: Balusters														
Bsmt stairs: Balusters	Basement stair Balusters		No	100	690	IF	643080010	4.29	196	0.239		7	25	40	60
Bsmt stairs: Balusters												7	25	40	60
5.3.3.8	Basement stairs: Newels														
Bsmt stairs: Newels	Newels, Oak/Hemlock		No	100	690	IF	643084005	47.14	196	7.08		7	25	40	60
Bsmt stairs: Newels												7	25	40	60
5.3.3.9	Basement stairs: Landing joists														
Bsmt stairs: Landing joists	2x8 SPF		Ft	100	690	LI	611142150	0.59	191	1.359		7	25	40	60
Bsmt stairs: Landing joists	2x8 D. Fir		Ft	100	690	LI	611142160	0.66	191	1.717		7	25	40	60

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	Const. prcentage	Interval	entirely
Bsmt stairs: Landing joists	2x10 SPF		Ft	100	690	LI	611142200	0.92	191	1.695		7	25	40	60
Bsmt stairs: Landing joists	2x10 D. Fir		Ft	100	690	LI	611142210	0.99	191	2.142		7	25	40	60
Bsmt stairs: Landing joists	2x12 SPF		Ft	100	690	LI	611142250	1.12	191	2.036		7	25	40	60
Bsmt stairs: Landing joists	2x12 D.Fir		Ft	100	690	LI	611142260	1.21	191	2.572		7	25	40	60
Bsmt stairs: Landing joists												7	25	40	60
5.3.3.10	Basement stairs: Landing sheathing														
Bsmt stairs: Landing sheathing	5/8" Plywood		Shts	100	690	IF	611640100	13.73	195	24.39		5	25	40	60
Bsmt stairs: Landing sheathing	3/4" Plywood		Shts	100	690	IF	611640200	16.19	195	29.26		5	25	40	60
Bsmt stairs: Landing sheathing	5/8" OSB		Shts	100	690	IF	611642000	11.55	201	16.27		5	25	40	60
Bsmt stairs: Landing sheathing	3/4" OSB		Shts	100	690	IF	611642100	12.36	201	19.52		5	25	40	60
Bsmt stairs: Landing sheathing												5	25	40	60
5.3.3.11	Premanufact. basement stairs														
Premanufact. basement stairs	Premanf curved stair, spiral oak, 4' 6" diam., 9' high		No	100	690	IF	643064400	3300	196	250		5	25	40	60
Premanufact. basement stairs												5	25	40	60
5.3.4	FIRST TO SECOND STOREY														
5.3.4.1	Upper storey stairs: Stringers														
Upper storey stairs: Stringers	2x8		Ft	100	690	IF	611168005	0.59	191	1.359		7	25	40	60
Upper storey stairs: Stringers	2x10		Ft	100	690	IF	611168010	0.92	191	1.695		7	25	40	60
Upper storey stairs: Stringers	2x12		Ft	100	690	IF	611168015	1.12	191	2.036		7	25	40	60
Upper storey stairs: Stringers												7	25	40	60
5.3.4.2	Upper storey stairs: Treads														
Upper storey stairs: Treads	2x8		Ft	100	690	IF	611168305	0.59	191	1.359		7	25	40	60
Upper storey stairs: Treads	2x10		Ft	100	690	IF	611168310	0.92	191	1.695		7	25	40	60
Upper storey stairs: Treads	2x12		Ft	100	690	IF	611168315	1.12	191	2.036		7	25	40	60
Upper storey stairs: Treads												7	25	40	60
5.3.4.3	Upper storey stairs: Risers														
Upper storey stairs: Risers	2x6		Ft	100	690	IF	611168400	0.45	191	1.018		7	25	40	60
Upper storey stairs: Risers	2x8		Ft	100	690	IF	611168405	0.59	191	1.359		7	25	40	60
Upper storey stairs: Risers	2x10		Ft	100	690	IF	611168410	0.92	191	1.695		7	25	40	60
Upper storey stairs: Risers												7	25	40	60
5.3.4.4	Upper storey stairs: Plywood														
Upper storey stairs: Plywood	1/2" Plywood		Shts	100	690	IF	611640010	11.26	195	19.5		5	25	40	60
Upper storey stairs: Plywood	1/2" OSB		Shts	100	690	IF	611641900	8.25	201	13.02		5	25	40	60
Upper storey stairs: Plywood	5/8" Plywood		Shts	100	690	IF	611640100	13.73	195	24.39		5	25	40	60
Upper storey stairs: Plywood	5/8" OSB		Shts	100	690	IF	611642000	11.50	201	16.27		5	25	40	60
Upper storey stairs: Plywood												5	25	40	60
Upper storey stairs: Plywood												5	25	40	60
5.3.4.6	Upper storey stairs: Handrail														
Upper storey stairs: Handrail	2x4		Ft	100	690	IF	611285020	0.30	196	0.678		7	25	40	60
Upper storey stairs: Handrail	2x6		Ft	100	690	IF	611285040	0.45	196	1.018		7	25	40	60
Upper storey stairs: Handrail												7	25	40	60
5.3.4.7	Upper storey stairs: Balusters														

Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace		
Stage	Item	Qnty	Units	to Int.	No.	ID	Product Number	\$/unit	bldr's Code	I/O to kg	Fact (mg/kg)	Emiss.	Const.	prcntage	interval	entirely
Upper storey stairs; Balusters	Balusters		No	100	690	IF	643080010	4.29	196	0.239		7	25	40	60	
Upper storey stairs; Balusters												7	25	40	60	
5.3.4.8	Upper storey stairs: Newels															
Upper storey stairs; Newels	Newels, Oak/Hemlock		No	100	690	IF	643084005	47.14	196	7.08		7	25	40	60	
Upper storey stairs; Newels												7	25	40	60	
5.3.4.9	Upper storey stairs: Landing joists															
Upper storey stairs; Landing joists	2x8 SPF		Ft	100	690	LI	611142150	0.59	191	1.359		7	25	40	60	
Upper storey stairs; Landing joists	2x8 D. Fir		Ft	100	690	LI	611142160	0.66	191	1.717		7	25	40	60	
Upper storey stairs; Landing joists	2x10 SPF		Ft	100	690	LI	611142200	0.92	191	1.695		7	25	40	60	
Upper storey stairs; Landing joists	2x10 D. Fir		Ft	100	690	LI	611142210	0.99	191	2.142		7	25	40	60	
Upper storey stairs; Landing joists	2x12 SPF		Ft	100	690	LI	611142250	1.12	191	2.036		7	25	40	60	
Upper storey stairs; Landing joists	2x12 D.Fir		Ft	100	690	LI	611142260	1.21	191	2.572		7	25	40	60	
Upper storey stairs; Landing joists																
5.3.4.10	Upper storey Landing sheathing															
Upper storey Landing sheathing	5/8"Plywood		Shts	100	690	IF	611640100	13.73	195	24.39		5	25	40	60	
Upper storey Landing sheathing	3/4" Plywood		Shts	100	690	IF	611640200	16.19	195	29.26		5	25	40	60	
Upper storey Landing sheathing	5/8" OSB		Shts	100	690	IF	611642000	11.55	201	16.27		5	25	40	60	
Upper storey Landing sheathing	3/4" OSB		Shts	100	690	IF	611642100	12.36	201	19.52		5	25	40	60	
5.3.4.11	Upper storey Premanufact. curved stair															
Upper storey Premanufact. curved stair	Premarf curved stair, spiral oak, 4' 6"		No	100	690	IF	643064400	3300	196	250		5	25	40	60	
Upper storey Premanufact. curved stair												5	25	40	60	
Upper storey Premanufact. curved stair												5	25	40	60	
<b>6</b>	<b>SECTION 6 INSULATION AND MOISTURE PROTECTION</b>															
6.1	<b>INSULATION</b>															
6.1.1	Floor over unheated areas															
6.1.1.1	Floor over unheated areas: Fiberglass															
Floor over unheated areas: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)		Ft2	0	420	LE	721180820	0.23	387	0.104		5	0	1	50	
Floor over unheated areas: Fiberglass	152 mm (5 1/2" ) batt (RSI 3.5 / R20)		Ft2	0	420	LE	721180860	0.40	387	0.171		5	0	1	50	
Floor over unheated areas: Fiberglass	202mm (8") batt (RSI 4.9 / R28)		Ft2	0	420	LE	721180890	0.53	387	0.263		5	0	1	50	
Floor over unheated areas: Fiberglass												5	0	1	50	
6.1.2	Floor over unheated crawlspace															
6.1.2.1	Floor over unheated crawlspace:															
Floor over unheated Crwlspc: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)		Ft2	0	420	LE	721180820	0.23	387	0.104		5	0	1	50	
Floor over unheated Crwlspc: Fiberglass	152 mm (5 1/2" ) batt (RSI 3.5 / R20)		Ft2	0	420	LE	721180860	0.40	387	0.171		5	0	1	50	
Floor over unheated Crwlspc: Fiberglass	202mm (8") batt (RSI 4.9 / R28)		Ft2	0	420	LE	721180890	0.53	387	0.263		5	0	1	50	
Floor over unheated Crwlspc: Fiberglass												5	0	1	50	
6.1.3	Basement walls															
6.1.3.1	Basement walls: Fiberglass															
Bsmt walls: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)		Ft2	0	420	FBW	721180820	0.23	387	0.104		5	25	40	50	
Bsmt walls: Fiberglass	152 mm (5 1/2" ) batt (RSI 3.5 / R20)		Ft2	0	420	FBW	721180860	0.40	387	0.171		5	25	40	50	
Bsmt walls: Fiberglass	202mm (8") batt (RSI 4.9 / R28)		Ft2	0	420	FBW	721180890	0.53	387	0.263		5	25	40	50	
Bsmt walls: Fiberglass	75mm (3") rigid board (RSI 2.1 / R12)		Ft2	0	420	FBW	721160120	0.65	387	0.34		5	25	40	50	
Bsmt walls: Fiberglass												5	25	40	50	

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to Int.	No.	ID	Number	bldr's	Code	Fact	Emiss.	Const.	prcntage	Interval	
6.1.3.2	Basement walls: Extruded Polystyrene														
Bsmt walls: Extruded Polystyrene	25mm (1") board (RSI .88 / RS)		Ft2	0	420	FBW	721161920	0.48	135	0.217		5	25	40	50
Bsmt walls: Extruded Polystyrene	37.5mm (1 1/2") board (RSI 1.32 /		Ft2	0	420	FBW	721161940	0.74	135	0.249		5	25	40	50
Bsmt walls: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)		Ft2	0	420	FBW	721161960	0.97	135	0.282		5	25	40	50
Bsmt walls: Extruded Polystyrene												5	25	40	50
6.1.3.3	Basement walls: Expanded														
Bsmt walls: Expanded polystyrene	25mm (1") board (RSI .7 / R4)		Ft2	0	420	FBW	721162100	0.19	135	0.057		5	25	40	50
Bsmt walls: Expanded polystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)		Ft2	0	420	FBW	721162120	0.30	135	0.085		5	25	40	50
Bsmt walls: Expanded polystyrene	50 mm (2") board (RSI 1.4 / R8)		Ft2	0	420	FBW	721162140	0.37	135	0.113		5	25	40	50
Bsmt walls: Expanded polystyrene	75mm(3") board (RSI 2.1 / R12)		Ft2	0	420	WEF	721162170	0.56	135	0.17		5	25	40	50
Bsmt walls: Expanded polystyrene	100 mm (4") board (RSI 2.8 / R16)		Ft2	0	420	FBW	721162180	0.75	135	0.227		5	25	40	50
Bsmt walls: Expanded polystyrene												5	25	40	50
6.1.3.4	Basement walls: Cellulose														
Bsmt walls: Cellulose	89mm (3 1/2") spray (RSI 2.2 / R12.5)		Ft2	0	420	FBW	721010025	0.18	222	0.205		5	25	40	50
Bsmt walls: Cellulose	152 mm (5 1/2") spray (RSI 3.4 /		Ft2	0	420	FBW	721010035	0.28	222	0.351		5	25	40	50
Bsmt walls: Cellulose	202mm (8") spray (RSI 4.5 / R25.4)		Ft2	0	420	FBW	721010045	0.41	222	0.469		5	25	40	50
Bsmt walls: Cellulose												5	25	40	50
6.1.4	First floor walls														
6.1.4.1	First storey walls: Fiberglass														
First storey walls: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)		Ft2	0	420	WEF	721180820	0.23	387	0.104		5	25	40	50
First storey walls: Fiberglass	152 mm (5 1/2") batt (RSI 3.5 / R20)		Ft2	0	420	WEF	721180860	0.40	387	0.171		5	25	40	50
First storey walls: Fiberglass	202mm (8") batt (RSI 4.9 / R28)		Ft2	0	420	WEF	721180890	0.53	387	0.263		5	25	40	50
First storey walls: Fiberglass	25 mm (1") sheathing (RSI .7 / R4)		Ft2	0	420	WEF	721160040	0.20	387	0.113		5	25	40	50
First storey walls: Fiberglass	37.5mm (1 1/2") sheathing (RSI 1.06 /		Ft2	0	420	WEF	721160060	0.32	387	0.17		5	25	40	50
First storey walls: Fiberglass												5	25	40	50
6.1.4.2	First storey walls: Extruded														
First storey walls: Extruded Polystyrene	25mm (1") board (RSI .88 / RS)		Ft2	0	420	WEF	721161920	0.48	135	0.217		5	25	40	50
First storey walls: Extruded Polystyrene	37.5mm (1 1/2") board (RSI 1.32 /		Ft2	0	420	WEF	721161940	0.74	135	0.249		5	25	40	50
First storey walls: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)		Ft2	0	420	WEF	721161960	0.97	135	0.282		5	25	40	50
First storey walls: Extruded Polystyrene												5	25	40	50
6.1.4.3	First storey walls: Expanded														
First storey walls: Expanded polystyrene	25mm (1") board (RSI .7 / R4)		Ft2	0	420	WEF	721162100	0.19	135	0.057		5	25	40	50
First storey walls: Expanded polystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)		Ft2	0	420	WEF	721162120	0.30	135	0.085		5	25	40	50
First storey walls: Expanded polystyrene	50 mm (2") board (RSI 1.4 / R8)		Ft2	0	420	WEF	721162140	0.37	135	0.113		5	25	40	50
First storey walls: Expanded polystyrene	75mm(3") board (RSI 2.1 / R12)		Ft2	0	420	WEF	721162170	0.56	135	0.17		5	25	40	50
First storey walls: Expanded polystyrene	100 mm (4") board (RSI 2.8 / R16)		Ft2	0	420	WEF	721162180	0.75	135	0.227		5	25	40	50
First storey walls: Expanded polystyrene												5	25	40	50
6.1.4.4	First storey walls: Cellulose														
First storey walls: Cellulose	89mm (3 1/2") spray (RSI 2.2 / R12.5)		Ft2	0	420	WEF	721010025	0.18	222	0.205		5	25	40	50
First storey walls: Cellulose	152 mm (5 1/2") spray (RSI 3.4 /		Ft2	0	420	WEF	721010035	0.28	222	0.351		5	25	40	50
First storey walls: Cellulose	202mm (8") spray (RSI 4.5 / R25.4)		Ft2	0	420	WEF	721010045	0.41	222	0.469		5	25	40	50
First storey walls: Cellulose												5	25	40	50
6.1.5	Second floor walls														

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qty	Units	to Int.	No.	ID	Number	bldr's	Code	Fact	Emiss.	Const.	prcentage	interval
6.1.5.2	Second storey walls: Fiberglass													
Sec. storey walls: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)	Ft2	0	420	WEF	721180820	0.23	387	0.104		5	25	40	50
Sec. storey walls: Fiberglass	152 mm (5 1/2") batt (RSI 3.5 / R20)	Ft2	0	420	WEF	721180860	0.40	387	0.171		5	25	40	50
Sec. storey walls: Fiberglass	202mm (8") batt (RSI 4.9 / R28)	Ft2	0	420	WEF	721180890	0.53	387	0.263		5	25	40	50
Sec. storey walls: Fiberglass	25 mm (1") sheathing (RSI .7 / R4)	Ft2	0	420	WEF	721160040	0.20	387	0.113		5	25	40	50
Sec. storey walls: Fiberglass	37.5mm (1 1/2") sheathing (RSI 1.06 /	Ft2	0	420	WEF	721160060	0.32	387	0.17		5	25	40	50
Sec. storey walls: Fiberglass											5	25	40	50
6.1.5.3	Second storey walls: Extruded													
Sec. storey walls: Extruded Polystyrene	25mm (1") board (RSI .88 / R5)	Ft2	0	420	WEF	721161920	0.48	135	0.217		5	25	40	50
Sec. storey walls: Extruded Polystyrene	37.5mm (1 1/2") board (RSI 1.32 /	Ft2	0	420	WEF	721161940	0.74	135	0.249		5	25	40	50
Sec. storey walls: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)	Ft2	0	420	WEF	721161960	0.97	135	0.282		5	25	40	50
Sec. storey walls: Extruded Polystyrene											5	25	40	50
6.1.5.4	Second storey walls: Expanded													
Sec. storey walls: Expanded polystyrene	25mm (1") board (RSI .7 / R4)	Ft2	0	420	WEF	721162100	0.19	135	0.057		5	25	40	50
Sec. storey walls: Expanded polystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)	Ft2	0	420	WEF	721162120	0.30	135	0.085		5	25	40	50
Sec. storey walls: Expanded polystyrene	50 mm (2") board (RSI 1.4 / R8)	Ft2	0	420	WEF	721162140	0.37	135	0.113		5	25	40	50
Sec. storey walls: Expanded polystyrene	75mm(3") board (RSI 2.1 / R12)	Ft2	0	420	WEF	721162170	0.56	135	0.17		5	25	40	50
Sec. storey walls: Expanded polystyrene	100 mm (4") board (RSI 2.8 / R16)	Ft2	0	420	WEF	721162180	0.75	135	0.227		5	25	40	50
Sec. storey walls: Expanded polystyrene											5	25	40	50
6.1.5.5	Second storey walls: Cellulose													
Sec. storey walls: Cellulose	89mm (3 1/2") spray (RSI 2.2 / R12.5)	Ft2	0	420	WEF	721010025	0.18	222	0.205		5	25	40	50
Sec. storey walls: Cellulose	152 mm (5 1/2") spray (RSI 3.4 /	Ft2	0	420	WEF	721010035	0.28	222	0.351		5	25	40	50
Sec. storey walls: Cellulose	202mm (8") spray (RSI 4.5 / R25.4)	Ft2	0	420	WEF	721010045	0.41	222	0.469		5	25	40	50
Sec. storey walls: Cellulose											5	25	40	50
6.1.6	Skylight chase													
6.1.6.1	Skylight chase: Fiberglass													
Skylight chase: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)	Ft2	0	420	WEF	721180820	0.23	387	0.104		5	25	40	50
Skylight chase: Fiberglass	152 mm (5 1/2") batt (RSI 3.5 / R20)	Ft2	0	420	WEF	721180860	0.40	387	0.171		5	25	40	50
Skylight chase: Fiberglass	202mm (8") batt (RSI 4.9 / R28)	Ft2	0	420	WEF	721180890	0.53	387	0.263		5	25	40	50
Skylight chase: Fiberglass	25 mm (1") sheathing (RSI .7 / R4)	Ft2	0	420	WEF	721160040	0.20	387	0.113		5	25	40	50
Skylight chase: Fiberglass	37.5mm (1 1/2") sheathing (RSI 1.06 /	Ft2	0	420	WEF	721160060	0.32	387	0.17		5	25	40	50
Skylight chase: Fiberglass											5	25	40	50
6.1.6.2	Skylight chase: Extruded Polystyrene													
Skylight chase: Extruded Polystyrene	25mm (1") board (RSI .88 / R5)	Ft2	0	420	WEF	721161920	0.48	135	0.217		5	25	40	50
Skylight chase: Extruded Polystyrene	37.5mm (1 1/2") board (RSI 1.32 /	Ft2	0	420	WEF	721161940	0.74	135	0.249		5	25	40	50
Skylight chase: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)	Ft2	0	420	WEF	721161960	0.97	135	0.282		5	25	40	50
Skylight chase: Extruded Polystyrene											5	25	40	50
6.1.6.3	Skylight chase: Expanded ploystyrene													
Skylight chase: Expanded ploystyrene	25mm (1") board (RSI .7 / R4)	Ft2	0	420	WEF	721162100	0.19	135	0.057		5	25	40	50
Skylight chase: Expanded ploystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)	Ft2	0	420	WEF	721162120	0.30	135	0.085		5	25	40	50
Skylight chase: Expanded ploystyrene	50 mm (2") board (RSI 1.4 / R8)	Ft2	0	420	WEF	721162140	0.37	135	0.113		5	25	40	50
Skylight chase: Expanded ploystyrene	75mm(3") board (RSI 2.1 / R12)	Ft2	0	420	WEF	721162170	0.56	135	0.17		5	25	40	50
Skylight chase: Expanded ploystyrene	100 mm (4") board (RSI 2.8 / R16)	Ft2	0	420	WEF	721162180	0.75	135	0.227		5	25	40	50

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	%	Maintenance	Replace	
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	prcentage	Interval	entirely
Skylight chase: Expanded polystyrene													5	25	40	50
6.1.6.4	Skylight chase: Cellulose															
Skylight chase: Cellulose	89mm (3 1/2") spray (RSI 2.2 / R12.5)	Ft2	0	420	WEF	721010025	0.18	222	0.205			5	25	40	50	
Skylight chase: Cellulose	152 mm (5 1/2") spray (RSI 3.4 /	Ft2	0	420	WEF	721010035	0.28	222	0.351			5	25	40	50	
Skylight chase: Cellulose	202mm (8") spray (RSI 4.5 / R25.4)	Ft2	0	420	WEF	721010045	0.41	222	0.469			5	25	40	50	
Skylight chase: Cellulose												5	25	40	50	
6.1.7	Attics															
6.1.7.1	Attic: Fiberglass															
Attic: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)	Ft2	0	420	CE	721180820	0.23	387	0.104			5	5	5	50	
Attic: Fiberglass	152 mm (5 1/2") batt (RSI 3.5 / R20)	Ft2	0	420	CE	721180860	0.40	387	0.171			5	5	5	50	
Attic: Fiberglass	202mm (8") batt (RSI 4.9 / R28)	Ft2	0	420	CE	721180890	0.53	387	0.263			5	5	5	50	
Attic: Fiberglass	175 mm (7") blown (RSI 3.5 / R20)	Ft2	0	420	CE	721011100	0.25	387	0.252			5	5	5	50	
Attic: Fiberglass	258mm (10.3") blown (RSI 5.3 / R30)	Ft2	0	420	CE	721011400	0.37	387	0.366			5	5	5	50	
Attic: Fiberglass	300mm(12") blown (RSI 6.2 / R35)	Ft2	0	420	CE	721011500	0.42	387	0.425			5	5	5	50	
Attic: Fiberglass	350mm (14") blown (RSI 7 / R40)	Ft2	0	420	CE	721011600	0.50	387	0.496			5	5	5	50	
Attic: Fiberglass	525mm (21") blown (RSI 10.6 / R60)	Ft2	0	420	CE	721011700	0.74	387	0.744			5	5	5	50	
Attic: Fiberglass												5	5	5	50	
6.1.7.2	Attic: Cellulose															
Attic: Cellulose	140mm(5.6") blown (RSI 3.5 / R20)	Ft2	0	420	CE	721010050	0.28	222	0.324			5	5	5	50	
Attic: Cellulose	208mm(8.3") blown (RSI 5.3 / R30)	Ft2	0	420	CE	721010055	0.41	222	0.486			5	5	5	50	
Attic: Cellulose	243mm (9.3") blown (RSI 6.2 / R35)	Ft2	0	420	CE	721010060	0.46	222	0.545			5	5	5	50	
Attic: Cellulose	278mm (11.1") blown (RSI 7 / R40)	Ft2	0	420	CE	721010065	0.55	222	0.65			5	5	5	50	
Attic: Cellulose	418(16.7") blown (RSI 10.6 / R60)	Ft2	0	420	CE	721010070	0.84	222	0.978			5	5	5	50	
Attic: Cellulose												5	5	5	50	
6.1.7.3	Attic: Mineral wool															
Attic: Mineral wool	150mm (6") blown (RSI 3.5 / R20)	Ft2	0	420	CE	721012050	0.34	387	0.44			5	5	5	50	
Attic: Mineral wool	225mm (9") blown (RSI 5.3 / R30)	Ft2	0	420	CE	721012100	0.46	387	0.667			5	5	5	50	
Attic: Mineral wool	265 mm (10.6") blown (RSI 6.2 / R35)	Ft2	0	420	CE	721012120	0.55	387	0.76			5	5	5	50	
Attic: Mineral wool	300 mm (12") blown (RSI 7 / R40)	Ft2	0	420	CE	721012150	0.63	387	0.871			5	5	5	50	
Attic: Mineral wool	450mm (18") blown (RSI 10.6 / R60)	Ft2	0	420	CE	721012200	0.94	387	1.37			5	5	5	50	
Attic: Mineral wool												5	5	5	50	
6.1.8	Vaulted ceilings															
6.1.8.1	Vaulted ceiling: Fiberglass															
Vaulted ceiling: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)	Ft2	0	420	CE	721180820	0.23	387	0.104			5	5	5	50	
Vaulted ceiling: Fiberglass	152 mm (5 1/2") batt (RSI 3.5 / R20)	Ft2	0	420	CE	721180860	0.40	387	0.171			5	5	5	50	
Vaulted ceiling: Fiberglass	202mm (8") batt (RSI 4.9 / R28)	Ft2	0	420	CE	721180890	0.53	387	0.263			5	5	5	50	
Vaulted ceiling: Fiberglass	175 mm (7") blown (RSI 3.5 / R20)	Ft2	0	420	CE	721011100	0.30	387	0.252			5	5	5	50	
Vaulted ceiling: Fiberglass	258mm (10.3") blown (RSI 5.3 / R30)	Ft2	0	420	CE	721011400	0.37	387	0.366			5	5	5	50	
Vaulted ceiling: Fiberglass	300mm(12") blown (RSI 6.2 / R35)	Ft2	0	420	CE	721011500	0.42	387	0.425			5	5	5	50	
Vaulted ceiling: Fiberglass	350mm (14") blown (RSI 7 / R40)	Ft2	0	420	CE	721011600	0.50	387	0.496			5	5	5	50	
Vaulted ceiling: Fiberglass												5	5	5	50	
6.1.8.2	Vaulted ceiling: Cellulose															
Vaulted ceiling: Cellulose	140mm(5.6") blown (RSI 3.5 / R20)	Ft2	0	420	CE	721010050	0.28	222	0.324			5	5	5	50	

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcentage	interval	entirely
		bldr's	bldr's	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)
Vaulted ceiling: Cellulose	208mm(8.3") blown (RSI 5.3 / R30)	Ft2	0	420	CE	721010055	0.41	222	0.486		5	5	5	50	
Vaulted ceiling: Cellulose	243mm (9.3") blown (RSI 6.2 / R35)	Ft2	0	420	CE	721010060	0.46	222	0.545		5	5	5	50	
Vaulted ceiling: Cellulose	278mm (11.1") blown (RSI 7 / R40)	Ft2	0	420	CE	721010065	0.55	222	0.65		5	5	5	50	
Vaulted ceiling: Cellulose											5	5	5	50	
6.1.8.3	Vaulted ceiling: Mineral wool														
Vaulted ceiling: Mineral wool	150mm (6") blown (RSI 3.5 / R20)	Ft2	0	420	CE	721012050	0.34	387	0.44		5	5	5	50	
Vaulted ceiling: Mineral wool	225mm (9") blown (RSI 5.3 / R30)	Ft2	0	420	CE	721012100	0.46	387	0.667		5	5	5	50	
Vaulted ceiling: Mineral wool	265 mm (10.6") blown (RSI 6.2 / R35)	Ft2	0	420	CE	721012100	0.55	387	0.76		5	5	5	50	
Vaulted ceiling: Mineral wool	300 mm (12") blown (RSI 7 / R40)	Ft2	0	420	CE	721012150	0.63	387	0.871		5	5	5	50	
Vaulted ceiling: Mineral wool											5	5	5	50	
6.1.8.4	Vaulted ceiling: Extruded Polystyrene														
Vaulted ceiling: Extruded Polystyrene	25mm (1") board (RSI .88 / R5)	Ft2	0	420	CE	721161920	0.48	135	0.217		5	5	5	50	
Vaulted ceiling: Extruded Polystyrene	37.5mm (1 1/2") board (RSI 1.32 /	Ft2	0	420	CE	721161940	0.74	135	0.249		5	5	5	50	
Vaulted ceiling: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)	Ft2	0	420	CE	721161960	0.97	135	0.282		5	5	5	50	
Vaulted ceiling: Extruded Polystyrene											5	5	5	50	
6.1.8.5	Vaulted ceiling: Expanded polystyrene														
Vaulted ceiling: Expanded polystyrene	25mm (1") board (RSI .7 / R4)	Ft2	0	420	CE	721162100	0.19	135	0.057		5	5	5	50	
Vaulted ceiling: Expanded polystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)	Ft2	0	420	CE	721162120	0.30	135	0.085		5	5	5	50	
Vaulted ceiling: Expanded polystyrene	50 mm (2") board (RSI 1.4 / R8)	Ft2	0	420	CE	721162140	0.37	135	0.113		5	5	5	50	
Vaulted ceiling: Expanded polystyrene	75mm(3") board (RSI 2.1 / R12)	Ft2	0	420	CE	721162170	0.56	135	0.17		5	5	5	50	
Vaulted ceiling: Expanded polystyrene	100 mm (4") board (RSI 2.8 / R16)	Ft2	0	420	CE	721162180	0.75	135	0.227		5	5	5	50	
Vaulted ceiling: Expanded polystyrene											5	5	5	50	
6.1.9	Band joists														
6.1.9.1	Band joists: Fiberglass														
Band joists: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)	Ft2	0	420	WEF	721180820	0.23	387	0.104		5	5	5	50	
Band joists: Fiberglass	152 mm (5 1/2" ) batt (RSI 3.5 / R20)	Ft2	0	420	WEF	721180860	0.40	387	0.171		5	5	5	50	
Band joists: Fiberglass	202mm (8") batt (RSI 4.9 / R28)	Ft2	0	420	WEF	721180890	0.53	387	0.263		5	5	5	50	
Band joists: Fiberglass											5	5	5	50	
6.1.9.2	Band joists: Extruded Polystyrene														
Band joists: Extruded Polystyrene	25mm (1") board (RSI .88 / R5)	Ft2	0	420	WEF	721161920	0.48	135	0.217		5	5	5	50	
Band joists: Extruded Polystyrene	37.5mm (1 1/2") board (RSI 1.32 /	Ft2	0	420	WEF	721161940	0.74	135	0.249		5	5	5	50	
Band joists: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)	Ft2	0	420	WEF	721161960	0.97	135	0.282		5	5	5	50	
Band joists: Extruded Polystyrene											5	5	5	50	
6.1.9.3	Band joists: Expanded polystyrene														
Band joists: Expanded polystyrene	25mm (1") board (RSI .7 / R4)	Ft2	0	420	WEF	721162100	0.19	135	0.057		5	5	5	50	
Band joists: Expanded polystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)	Ft2	0	420	WEF	721162120	0.30	135	0.085		5	5	5	50	
Band joists: Expanded polystyrene	50 mm (2")board (RSI 1.4 / R8)	Ft2	0	420	WEF	721162140	0.37	135	0.113		5	5	5	50	
Band joists: Expanded polystyrene											5	5	5	50	
6.1.10	Foundation wall (crawlspace)														
6.1.10.1	Crawlspace wall: Fiberglass														
Crwlspc wall: Fiberglass	89mm (3 1/2") batt (RSI 2.1 / R12)	Ft2	0	420	FSW	721180820	0.23	387	0.104		5	25	40	50	
Crwlspc wall: Fiberglass	152 mm (5 1/2" ) batt (RSI 3.5 / R20)	Ft2	0	420	FSW	721180860	0.40	387	0.171		5	25	40	50	
Crwlspc wall: Fiberglass	202mm (8") batt (RSI 4.9 / R28)	Ft2	0	420	FSW	721180890	0.53	387	0.263		5	25	40	50	

Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's Qnty	Bldr's Units	% exp to int.	Asmbly No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Const. Waste	prcntage (%)	interval (yrs)	entirely (yrs)
Crwlspc wall: Fiberglass	75mm (3") rigid board (RSI 2.1 / R12)		Ft2	0	420	FSW	721160120	0.65	387	0.34		5	25	40	50
Crwlspc wall: Fiberglass												5	25	40	50
6.1.10.2	Crawlspac wall: Extruded														
Crwlspc wall: Extruded Polystyrene	25mm (1") board (RSI .88 / R5)		Ft2	0	420	FSW	721161920	0.48	135	0.217		5	25	40	50
Crwlspc wall: Extruded Polystyrene	37.5mm (1 1/2") board RSI 1.32 /		Ft2	0	420	FSW	721161940	0.74	135	0.249		5	25	40	50
Crwlspc wall: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)		Ft2	0	420	FSW	721161960	0.97	135	0.282		5	25	40	50
Crwlspc wall: Extruded Polystyrene												5	25	40	50
6.1.10.3	Crawlspac wall: Expanded														
Crwlspc wall: Expanded polystyrene	25mm (1") board (RSI .7 / R4)		Ft2	0	420	FSW	721162100	0.19	135	0.057		5	25	40	50
Crwlspc wall: Expanded polystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)		Ft2	0	420	FSW	721162120	0.30	135	0.085		5	25	40	50
Crwlspc wall: Expanded polystyrene	50 mm (2") board (RSI 1.4 / R8)		Ft2	0	420	FSW	721162140	0.37	135	0.113		5	25	40	50
Crwlspc wall: Expanded polystyrene	75mm(3") board (RSI 2.1 / R12)		Ft2	0	420	FSW	721162170	0.56	135	0.17		5	25	40	50
Crwlspc wall: Expanded polystyrene	100 mm (4") board (RSI 2.8 / R16)		Ft2	0	420	FSW	721162180	0.75	135	0.227		5	25	40	50
6.1.10.4	Insulation stops at eaves														
Insulation stops at eaves	Insulation stops at eaves		No	0	420	CE	721014500	2.20	222	0.1		7	0	1	40
6.1.11	Underslab insulation														
6.1.11.1	Underslab: Extruded Polystyrene														
Underslab: Extruded Polystyrene	25mm (1") board (RSI .88 / R5)		Ft2	0	420	LS	721161920	0.48	135	0.217		5	0	1	50
Underslab: Extruded Polystyrene	37.5mm (1 1/2") board (RSI 1.32 /		Ft2	0	420	LS	721161940	0.74	135	0.249		5	0	1	50
Underslab: Extruded Polystyrene	50 mm (2") board (RSI 1.76 / R10)		Ft2	0	420	LS	721161960	0.97	135	0.282		5	0	1	50
Underslab: Extruded Polystyrene												5	0	1	50
6.1.11.2	Underslab: Expanded polystyrene														
Underslab: Expanded polystyrene	25mm (1") board (RSI .7 / R4)		Ft2	0	420	LS	721162100	0.19	135	0.057		5	0	1	50
Underslab: Expanded polystyrene	37.5mm (1 1/2") board (RSI 1.06 / R6)		Ft2	0	420	LS	721162120	0.30	135	0.085		5	0	1	50
Underslab: Expanded polystyrene	50 mm (2") board (RSI 1.4 / R8)		Ft2	0	420	LS	721162140	0.37	135	0.113		5	0	1	50
Underslab: Expanded polystyrene	75mm(3") sheathing (RSI 2.1 / R12)		Ft2	0	420	LS	721162170	0.56	135	0.17		5	0	1	50
Underslab: Expanded polystyrene	100 mm (4") board (RSI 2.8 / R16)		Ft2	0	420	LS	721162180	0.75	135	0.227		5	0	1	50
Underslab: Expanded polystyrene												5	0	1	50
6.2	DAMPROOFING														
Damproofing	Basement under slab 6 mil poly		Ft2	50	220	F	719220900	0.03	135	0.013		5	0	1	50
Damproofing	Crawlspac under slab 6 mil poly		Ft2	50	220	F	719220900	0.03	135	0.013		5	0	1	50
Damproofing	S.O.G. under slab 6 mil poly		Ft2	50	220	F	719220900	0.03	135	0.013		5	0	1	50
Damproofing	Basement wall spray on dampproofing		Ft2	0	212	F	716020030	0.09	401	0.68		5	25	40	75
Damproofing	Crawlspac wall spray on		Ft2	0	212	F	716020030	0.09	401	0.68		5	25	40	75
Damproofing	Basement wall 6 mil poly		Ft2	50	212	F	719220900	0.03	135	0.013		5	25	40	75
Damproofing												5	25	40	75
Damproofing	45# Asphalt felt		Ft2	0	212	F	752040400	0.56	216	0.047		5	25	40	50
Damproofing	Sill gasket		Ft	50	212	F	719220950	0.08	131	0.001		5	10	8	18
Damproofing												5	25	40	75
6.3	VAPOUR BARRIER														
Vapour barrier	Basement walls		Ft2	50	400	FBW	719220900	0.03	135	0.013		5	0	1	50
Vapour barrier	First floor walls		Ft2	50	400	WEF	719220900	0.03	135	0.013		5	0	1	50
Vapour barrier	Second floor walls		Ft2	50	400	WEF	719220900	0.03	135	0.013		5	0	1	50

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Bldr's Units	Bldr's % exp	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Const. Waste	prcntage (%)	interval (yrs)	entirely (yrs)
Vapour barrier	Skylight chase		Ft2	50	500	WEF	719220900	0.03	135	0.013		5	0	1	50
Vapour barrier	Attics		Ft2	50	500	CE	719220900	0.03	135	0.013		5	0	1	50
Vapour barrier	Vaulted ceilings		Ft2	50	500	CE	719220900	0.03	135	0.013		5	0	1	50
Vapour barrier	Band joists		Ft2	50	400	WEF	719220900	0.03	135	0.013		5	0	1	50
Vapour barrier	Foundation wall (crawlspacce)		Ft2	50	212	FSW	719220900	0.03	135	0.013		5	0	1	50
Vapour barrier												5	0	1	50
Vapour barrier												5	0	1	50
6.4	AIR BARRIER														
6.4.1	Basement walls: Air Barrier														
Bsmt walls: Air Barrier	Gasket (rubber/plastic)		Ft	50	212	FBW	873080100	0.55	131	0.023		2	0	1	40
Bsmt walls: Air Barrier	Caulking, 1/2 lb tube		No	50	212	FBW	792043400	3.50	409	0.227		5	30	15	50
Bsmt walls: Air Barrier												5	30	15	50
6.4.2	First storey walls: Air Barrier														
First storey walls: Air Barrier	Gasket (rubber/plastic)		Ft	50	400	WEF	873080100	0.55	131	0.023		2	0	1	40
First storey walls: Air Barrier	Caulking, 1/2 lb tube		No	50	400	WEF	792043400	3.50	409	0.227		5	30	15	50
First storey walls: Air Barrier												5	30	15	50
6.4.3	Second storey walls: Air Barrier														
Sec. storey walls: Air Barrier	Gasket (rubber/plastic)		Ft	50	400	WEF	873080100	0.55	131	0.023		2	0	1	40
Sec. storey walls: Air Barrier	Caulking, 1/2 lb tube		No	50	400	WEF	792043400	3.50	409	0.227		5	30	15	50
Sec. storey walls: Air Barrier												5	30	15	50
6.4.4	Skylight chase: Air Barrier														
Skylight chase: Air Barrier	Gasket (rubber/plastic)		Ft	50	532	WEF	873080100	0.55	131	0.023		2	0	1	40
Skylight chase: Air Barrier	Caulking, 1/2 lb tube		No	50	532	WEF	792043400	3.50	409	0.227		5	30	15	50
Skylight chase: Air Barrier												5	30	15	50
6.4.5	Attic ceiling: Air Barrier														
Attic ceiling: Air Barrier	Gasket (rubber/plastic)		Ft	50	500	CE	873080100	0.55	131	0.023		7	0	1	40
Attic ceiling: Air Barrier	Caulking, 1/2 lb tube		No	50	500	CE	792043400	3.50	409	0.227		5	30	15	50
Attic ceiling: Air Barrier												5	30	15	50
6.4.6	Vaulted ceiling: Air Barrier														
Vaulted ceiling: Air Barrier	Gasket (rubber/plastic)		Ft	50	500	CE	873080100	0.55	131	0.023		7	0	1	40
Vaulted ceiling: Air Barrier	Caulking, 1/2 lb tube		No	50	500	CE	792043400	3.50	409	0.227		5	30	15	50
Vaulted ceiling: Air Barrier												5	30	15	50
Vaulted ceiling: Air Barrier												5	30	15	50
6.4.7	Band joists: Air Barrier														
Band joists: Air Barrier	Gasket (rubber/plastic)		Ft	50	400	WEF	873080100	0.55	131	0.023		5	25	20	60
Band joists: Air Barrier	Caulking, 1/2 lb tube		No	50	400	WEF	792043400	3.50	409	0.227		5	30	15	50
Band joists: Air Barrier	Foam blocking		Ft2	50	400	WEF	721161920	0.61	135	0.085		5	30	15	50
Band joists: Air Barrier												5	30	15	50
6.4.8	Slab on grade: Air Barrier														
Slab on grade: Air Barrier	Gasket (rubber/plastic)		Ft	50	212	FBW	873080100	0.55	131	0.023		7	0	1	50
Slab on grade: Air Barrier	Caulking, 1/2 lb tube		No	50	212	FBW	792043400	3.50	409	0.227		5	30	15	50
Slab on grade: Air Barrier												5	30	15	50
6.4.9	Crawlspacce walls: Air Barrier														

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Bldr's Qty	Bldr's Units	% exp to Int.	Asmby No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Const. Waste	prcntage (%)	Interval (yrs)	entirely (yrs)
Crwlspc walls: Air Barrier	Gasket (rubber/plastic)		Ft	50	212	FSW	873080100	0.55	131	0.023		7	0	1	50
Crwlspc walls: Air Barrier	Caulking, 1/2 lb tube		No	50	212	FSW	792043400	3.50	409	0.227		5	30	15	50
Crwlspc walls: Air Barrier												5	30	15	50
Crwlspc walls: Air Barrier												5	30	15	50
6.5	<b>FLASHING AND SHEET METAL</b>														
Flashing and Sheet metal	Wall to roof flashing, 5" girth		Ft	0	400	WEF	762020010	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	Window and door head flashings		Ft	0	452	WEF	762020010	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	Flashing for hidden gutters		Ft	0	500	R	762020010	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	Z flashing (band boards)		Ft	0	400	WEF	762020010	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	2' aluminum soffit, vented		Ft	0	500	R	746026960	2.20	283	0.4		5	0	1	50
Flashing and Sheet metal	Gutter, aluminum		Ft	0	500	R	762050010	0.88	283	0.162		5	0	1	50
Flashing and Sheet metal	Downpipe		Ft	0	500	R	762010010	0.88	283	0.2		5	0	1	50
Flashing and Sheet metal	Valley flashing		Ft	0	500	R	762020300	1.30	283	0.233		5	0	1	50
Flashing and Sheet metal	Skylight flashing		Ft	0	500	R	762020010	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	Gable vents		No	0	500	R	1021040010	6.60	283	2		5	0	1	50
Flashing and Sheet metal	Roof vents		Ft	0	500	R	1021042300	2.76	283	0.2		5	0	1	50
Flashing and Sheet metal	Roof edge		Ft	0	500	R	762020010	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	5"x7" leaf flashing		Ft	0	724	MF	762020015	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	Counter flashing		Ft	0	500	R	762020020	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal	Chimney chase caps		No	0	724	MF	1031041500	22.00	354	2		7	0	1	50
Flashing and Sheet metal	16"x8" louvered crawlspace vnts		No	0	212	FSW	1021040275	13.20	283	1		5	0	1	50
Flashing and Sheet metal	Termite shield		Ft	0	400	WEF	762190010	1.10	283	0.17		5	0	1	50
Flashing and Sheet metal	Deck edge flashing		Ft	0	740	EWF	762020010	0.14	283	0.042		5	0	1	50
Flashing and Sheet metal												5	0	1	50
6.6	<b>ROOFING MATERIALS</b>														
6.6.1	Roofing: Building Paper														
Roofing: Building Paper	15# Building Paper		Ft2	0	500	R	719220400	0.03	216	0.022		5	10	10	40
Roofing: Building Paper												5	10	10	40
6.6.2	Roofing finish														
Roofing finish	Asphalt shingles		Ft2	0	500	R	731040150	0.35	216	0.953		5	10	20	40
Roofing finish	Cedar shingles, 7 1/2" exposure		Ft2	0	500	R	731080010	0.84	201	0.726		5	10	20	40
Roofing finish	Concrete tile		Ft2	0	500	R	732040010	0.63	377	4.31		5	10	20	40
Roofing finish	Corrugated aluminum		Ft2	0	500	R	741010010	0.64	283	1.184		5	10	20	40
Roofing finish	Builtpup roofing, 4 ply with gravel		Ft2	0	500	R	751010010	0.06	216	2.499		5	10	20	50
Roofing finish	Rubber membrane roofing, EPDM		Ft2	0	500	R	751050010	0.45	131	0.138		5	0	1	50
Roofing finish												5	10	20	40
6.6.3	Gutter liner														
Gutter liner	Butyl rubber cncl'd gutter liner		Ft2	0	500	R	751050200	2.70	409	0.12		5	15	14	70
Gutter liner												5	15	14	70
Gutter liner												5	15	14	70
6.6.4	Roof/Gutter caulking														
Roof/Gutter caulking	Caulking		No	0	500	R	792043400	3.50	409	0.227		5	10	25	40
Roof/Gutter caulking												5	10	25	40

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace		
Stage	Item	Qty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Emmiss.	Const.	prcentage	interval	entirely
Roof/Gutter caulking												5	10	25	40	
6.7	WATERPROOF MEMBRANE															
6.7.1	Waterproof membrane deck															
Waterproof membrane deck	Waterproof membrane deck finish	Ft2	0	740	LD	717540010	0.61	409	0.02			5	5	1	15	
Waterproof membrane deck												5	5	1	15	
Waterproof membrane deck												5	5	1	15	
Waterproof membrane deck												5	5	1	15	
7	SECTION 7 DOORS WINDOWS AND FINISH HARDWARE															
7.1	DOORS & FRAMES															
7.1.1	EXTERIOR SWINGING															
7.1.1.1	Exterior swinging door & frame: 3'-0"															
ext. swinging door & frame: 3'-0"x6'-8"	1 3/4" thick solid core wood	No	50	452	WEF	820540400	171.60	196	70			5	15	10	40	
ext. swinging door & frame: 3'-0"x6'-8"	1 3/4" thick metal clad: wood core	No	50	452	WEF	811140040	78.10	196	22.68			5	15	14	70	
ext. swinging door & frame: 3'-0"x6'-8"	1 3/4" thick metal clad: steel	No	50	452	WEF	811140040	181.50	279	34.1			5	15	14	70	
ext. swinging door & frame: 3'-0"x6'-8"												5	15	10	40	
7.1.1.2	Exterior swing door & frame: 2'-8"x6'-															
ext. swinging door & frame: 2'-8"x6'-8"	1 3/4" thick solid core wood	No	50	452	WEF	820540405	165.00	196	61			5	15	10	40	
ext. swinging door & frame: 2'-8"x6'-8"	1 3/4" thick metal clad: wood core	No	50	452	WEF	811140030	77.00	196	22.68			5	15	14	70	
ext. swinging door & frame: 2'-8"x6'-8"	1 3/4" thick metal clad: steel	No	50	452	WEF	811140030	176.00	279	30.3			5	15	14	70	
ext. swinging door & frame: 2'-8"x6'-8"												5	15	10	40	
7.1.1.3	Exterior door & frame: 3'-0"x6'-8"															
ext. door & frame: 3'-0"x6'-8" French	1 3/4" thick solid core wood: wood	No	50	452	WEF	820540410	275.00	196	43.5			5	25	20	60	
ext. door & frame: 3'-0"x6'-8" French	1 3/4" thick solid core wood: glass	No	50	452	WEF	820540410	44.00	390	10.5			5	25	20	60	
ext. door & frame: 3'-0"x6'-8" French	1 3/4" thick metal clad: wood core	No	50	452	WEF	811140240	77.00	196	22.68			5	25	20	70	
ext. door & frame: 3'-0"x6'-8" French	1 3/4" thick metal clad: steel	No	50	452	WEF	811140240	198.00	279	20.48			5	25	20	70	
ext. door & frame: 3'-0"x6'-8" French	1 3/4" thick metal clad: glass	No	50	452	WEF	811140240	44.00	390	10.5			5	25	20	70	
ext. door & frame: 3'-0"x6'-8" French												5	25	20	60	
7.1.1.4	Exterior door & frame: 2'-8"x6'-															
ext. door & frame: 2'-8"x6'-8" French	1 3/4" thick solid core wood: wood	No	50	452	WEF	820540415	242.00	196	42.7			5	25	20	60	
ext. door & frame: 2'-8"x6'-8" French	1 3/4" thick solid core wood: glass	No	50	452	WEF	820540415	38.50	390	9			5	25	20	60	
ext. door & frame: 2'-8"x6'-8" French	1 3/4" thick metal clad: wood core	No	50	452	WEF	811140230	77.00	196	22.68			5	25	20	70	
ext. door & frame: 2'-8"x6'-8" French	1 3/4" thick metal clad: steel	No	50	452	WEF	811140230	165.00	279	18.67			5	25	20	70	
ext. door & frame: 2'-8"x6'-8" French	1 3/4" thick metal clad: glass	No	50	452	WEF	811140230	38.50	390	9			5	25	20	70	
ext. door & frame: 2'-8"x6'-8" French												5	25	20	60	
7.1.2	EXTERIOR DOOR SIDELIGHTS															
ext. door sidelights	1'-0"x5'-0", wood frame: wood	No	50	452	WEF	820664700	80.30	196	3			5	25	20	60	
ext. door sidelights	1'-0"x5'-0", wood frame: glass	No	50	452	WEF	820664700	35.20	390	15.1			5	25	20	60	
ext. door sidelights												5	25	20	60	
7.1.3	INTERIOR SWINGING DOORS															
int. swinging doors	3'-0"x6'-8"	No	100	620	WIF	820787500	34.10	196	14.52			5	15	7	30	
int. swinging doors	2'-8"x6'-8"	No	100	620	WIF	820787480	31.90	196	13.15			5	15	7	30	
int. swinging doors	2'-6"x6'-8"	No	100	620	WIF	820787460	31.90	196	12.25			5	15	7	30	
int. swinging doors	2'-4"x6'-8"	No	100	620	WIF	820787450	30.80	196	11.34			5	15	7	30	

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	to int.	No.	ID	Number	bldr's	Code	Emiss.	Const.	prcntage	interval	entirely	
int. swinging doors	2'-0"x6'-8"		No	100	620	WIF	820787440	30.80	196	9.53		5	15	7	30
int. swinging doors												5	15	7	30
7.1.4	INTERIOR BI-FOLD DOORS														
int. folding doors	2'-0"x6'-8", 2 panel		No	100	624	WIF	820782700	53.90	196	12.7		5	15	7	30
int. folding doors	2'-6"x6'-8", 2 panel		No	100	624	WIF	820782720	56.10	196	15.42		5	15	7	30
int. folding doors	3'-0"x6'-8", 2 panel		No	100	624	WIF	820782740	60.50	196	17.62		5	15	7	30
int. folding doors	4'-0"x6'-8", 4 panel		No	100	624	WIF	820782760	97.90	196	24.94		5	15	7	30
int. folding doors	5'-0"x6'-8", 4 panel		No	100	624	WIF	820782780	107.80	196	30.39		5	15	7	30
int. folding doors	6'-0"x6'-8", 4 panel		No	100	624	WIF	820782800	115.50	196	34.93		5	15	7	30
int. folding doors												5	15	7	30
7.1.5	INTERIOR POCKET DOORS c/w														
int. pocket doors; c/w track & hardware	2'-4"x6'-8"		No	100	620	WIF	820543605	66.00	196	15.88		5	15	7	30
int. pocket doors; c/w track & hardware	2'-6"x6'-8"		No	100	620	WIF	820543610	67.50	196	16.33		5	15	7	30
int. pocket doors; c/w track & hardware	2'-8"x6'-8"		No	100	620	WIF	820543615	72.80	196	16.78		5	15	7	30
int. pocket doors; c/w track & hardware	3'-0"x6'-8"		No	100	620	WIF	820543620	77.50	196	17.69		5	15	7	30
int. pocket doors; c/w track & hardware															
7.1.6	INTERIOR BY-PASS DOORS														
int. by-pass doors (unmirrored)	3'-0"x6'-8"		No	100	624	WIF	820784410	75.90	196	17.24		5	15	7	30
int. by-pass doors (unmirrored)	4'-0"x6'-8"		No	100	624	WIF	820784420	82.50	196	22.68		5	15	7	30
int. by-pass doors (unmirrored)	5'-0"x6'-8"		No	100	624	WIF	820784440	91.30	196	26.31		5	15	7	30
int. by-pass doors (unmirrored)	6'-0"x6'-8"		No	100	624	WIF	820784460	99.00	196	29.48		5	15	7	30
int. by-pass doors (unmirrored)	7'-6"x6'-8"		No	100	624	WIF	820784470	99.00	196	36.29		5	15	7	30
int. by-pass doors (unmirrored)	9'-0"x6'-8"		No	100	624	WIF	820784480	116.60	196	44.45		5	15	7	30
int. by-pass doors (unmirrored)												5	15	7	30
7.1.7	SLIDING GLASS DOORS														
Sliding glass doors	5'-0"x6'-8": frame		No	50	452	WIF	831040460	52.67	279	11.5		5	15	12	65
Sliding glass doors	5'-0"x6'-8": glass		No	50	452	WIF	831040460	210.69	380	59.7		5	15	12	65
Sliding glass doors	6'-0"x6'-8": frame		No	50	452	WIF	831040450	44.12	279	12.1		5	15	12	65
Sliding glass doors	6'-0"x6'-8": glass		No	50	452	WIF	831040450	176.45	380	72.6		5	15	12	65
Sliding glass doors	8'-0"x6'-8": frame		No	50	452	WIF	831040550	69.82	279	13.4		5	15	12	65
Sliding glass doors	8'-0"x6'-8": glass		No	50	452	WIF	831040550	279.29	380	96.76		5	15	12	65
Sliding glass doors												5	15	12	65
Sliding glass doors												5	15	12	65
Sliding glass doors												5	15	12	65
7.1.8	OVERHEAD GARAGE DOORS														
Overhead garage doors	8'x7'		No	0	456	WEF	836060890	183.00	279	39.92		5	15	10	24
Overhead garage doors	9'x7'		No	0	456	WEF	836060900	291.50	196	51.45		5	30	8	16
Overhead garage doors	9'x8'		No	0	456	WEF	836060920	330.00	196	58.79		5	30	8	16
Overhead garage doors	16'x7'		No	0	456	WEF	836061000	583.00	196	91.45		5	30	8	16
Overhead garage doors	16'x8'		No	0	456	WEF	836061010	660.00	196	104.5		5	30	8	16
Overhead garage doors	18'x7'		No	0	456	WEF	836061020	682.00	196	102.9		5	30	8	16
Overhead garage doors	18'x8'		No	0	456	WEF	836061030	770.00	196	117.6		5	30	8	16
Overhead garage doors												5	30	8	16

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace		
Stage	Item	Bldr's Qnty	Bldr's Units	% exp to int.	Asmbly No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Waste	Const. (%)	prcntage	interval	entirely
7.1.9	AUTOMATIC GARAGE DOOR															
Automatic garage door opener	Automatic Opener	No	0	456	WEF	836064000	203.50	321	18.14		5	0	1	50		
7.1.10	STORM DOORS															
Storm doors	Storm door: aluminum	No	0	460	WEF	839040420	132.00	279	15		5	25	5	20		
Storm doors	Storm door: glass	No	0	460	WEF	839040420	66.00	390	15		5	25	5	20		
Storm doors											5	25	5	20		
Storm doors											5	25	5	20		
Storm doors											5	25	5	20		
7.2	WINDOWS, WOOD, CASEMENT															
Wood windows	2'-0"x2'-0" window frame (wood)	No	50	434	WEF	861050010	66.00	196	2.014		5	0	1	50		
Wood windows	2'-0"x2'-0" window glass (single)	No	50	434	WEF	861050010	15.02	390	6.045		5	0	1	50		
Wood windows	2'-0"x2'-6" window frame (wood)	No	50	434	WEF	861050015	70.00	196	2.26		5	0	1	50		
Wood windows	2'-0"x2'-6" window glass (single)	No	50	434	WEF	861050015	17.50	390	7.56		5	0	1	50		
Wood windows	2'-0"x3'-0" window frame (wood)	No	50	434	WEF	861050020	74.00	196	2.52		5	0	1	50		
Wood windows	2'-0"x3'-0" window glass (single)	No	50	434	WEF	861050020	19.00	390	9.07		5	0	1	50		
Wood windows	2'-0"x3'-6" window frame (wood)	No	50	434	WEF	861050025	77.00	196	2.77		5	0	1	50		
Wood windows	2'-0"x3'-6" window glass (single)	No	50	434	WEF	861050025	21.00	390	10.59		5	0	1	50		
Wood windows	2'-0"x4'-0" window frame (wood)	No	50	434	WEF	861050030	80.00	196	3.01		5	0	1	50		
Wood windows	2'-0"x4'-0" window glass (single)	No	50	434	WEF	861050030	21.51	390	12.1		5	0	1	50		
Wood windows	2'-0"x5'-0" window frame (wood)	No	50	434	WEF	861050035	92.99	196	3.77		5	0	1	50		
Wood windows	2'-0"x5'-0" window glass (single)	No	50	434	WEF	861050035	25.50	390	15.12		5	0	1	50		
Wood windows	2'-0"x6'-0" window frame (wood)	No	50	434	WEF	861050040	105.00	196	5.17		5	0	1	50		
Wood windows	2'-0"x6'-0" window glass (single)	No	50	434	WEF	861050040	30.00	390	18.15		5	0	1	50		
Wood windows	3'-0"x2'-0" window frame (wood)	No	50	434	WEF	861050055	74.00	196	2.52		5	0	1	50		
Wood windows	3'-0"x2'-0" window glass (single)	No	50	434	WEF	861050055	19.00	390	9.07		5	0	1	50		
Wood windows	3'-0"x2'-6" window frame (wood)	No	50	434	WEF	861050060	78.00	196	2.77		5	0	1	50		
Wood windows	3'-0"x2'-6" window glass (single)	No	50	434	WEF	861050060	21.00	390	11.34		5	0	1	50		
Wood windows	3'-0"x3'-0" window frame (wood)	No	50	434	WEF	861050065	79.00	196	3.17		5	0	1	50		
Wood windows	3'-0"x3'-0" window glass (single)	No	50	434	WEF	861050065	22.50	390	13.61		5	0	1	50		
Wood windows	3'-0"x3'-6" window frame (wood)	No	50	434	WEF	861050070	95.00	196	4.7		5	0	1	50		
Wood windows	3'-0"x3'-6" window glass (single)	No	50	434	WEF	861050070	26.00	390	15.88		5	0	1	50		
Wood windows	3'-0"x4'-0" window frame (wood)	No	50	434	WEF	861050075	105.00	196	4.53		5	0	1	50		
Wood windows	3'-0"x4'-0" window glass (single)	No	50	434	WEF	861050075	30.00	390	18.4		5	0	1	50		
Wood windows	3'-0"x5'-0" window frame (wood)	No	50	434	WEF	861050080	103.99	196	5.43		5	0	1	50		
Wood windows	3'-0"x5'-0" window glass (single)	No	50	434	WEF	861050080	31.52	390	22.68		5	0	1	50		
Wood windows	3'-0"x6'-0" window frame (wood)	No	50	434	WEF	861050085	116.00	196	7.18		5	0	1	50		
Wood windows	3'-0"x6'-0" window glass (single)	No	50	434	WEF	861050085	37.00	390	27.22		5	0	1	50		
Wood windows											5	0	1	50		
Wood windows											5	0	1	50		
Wood windows											5	0	1	50		
Wood windows	4'-0"x2'-0" window frame (wood)	No	50	434	WEF	861050100	80.00	196	3.02		5	0	1	50		
Wood windows	4'-0"x2'-0" window glass (single)	No	50	434	WEF	861050100	21.51	390	12.1		5	0	1	50		

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcentage	interval
		Units	to Int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(%)	(yrs)	(yrs)
Wood windows	4'-0"x2'-6" window frame (wood)	No	50	434	WEF	861050105	85.00	196	3.51		5	0	1	50	
Wood windows	4'-0"x2'-6" window glass (single)	No	50	434	WEF	861050105	24.50	390	15.12		5	0	1	50	
Wood windows	4'-0"x3'-0" window frame (wood)	No	50	434	WEF	861050110	89.00	196	4.53		5	0	1	50	
Wood windows	4'-0"x3'-0" window glass (single)	No	50	434	WEF	861050110	26.50	390	18.15		5	0	1	50	
Wood windows	4'-0"x3'-6" window frame (wood)	No	50	434	WEF	861050115	100.00	196	5.29		5	0	1	50	
Wood windows	4'-0"x3'-6" window glass (single)	No	50	434	WEF	861050115	30.00	390	21.17		5	0	1	50	
Wood windows	4'-0"x4'-0" window frame (wood)	No	50	434	WEF	861050120	110.00	196	6.05		5	0	1	50	
Wood windows	4'-0"x4'-0" window glass (single)	No	50	434	WEF	861050120	33.00	390	24.19		5	0	1	50	
Wood windows	4'-0"x5'-0" window frame (wood)	No	50	434	WEF	861050125	119.00	196	7.56		5	0	1	50	
Wood windows	4'-0"x5'-0" window glass (single)	No	50	434	WEF	861050125	52.50	390	30.24		5	0	1	50	
Wood windows	4'-0"x6'-0" window frame (wood)	No	50	434	WEF	861050130	129.00	196	9.07		5	0	1	50	
Wood windows	4'-0"x6'-0" window glass (single)	No	50	434	WEF	861050130	72.00	390	36.29		5	0	1	50	
Wood windows											5	0	1	50	
Wood windows											5	0	1	50	
Wood windows											5	0	1	50	
Wood windows											5	0	1	50	
Wood windows	5'-0"x2'-0" window frame (wood)	No	50	434	WEF	861050190	92.99	196	3.78		5	0	1	50	
Wood windows	5'-0"x2'-0" window glass (single)	No	50	434	WEF	861050190	25.50	390	15.12		5	0	1	50	
Wood windows	5'-0"x2'-6" window frame (wood)	No	50	434	WEF	861050195	99.00	196	4.83		5	0	1	50	
Wood windows	5'-0"x2'-6" window glass (single)	No	50	434	WEF	861050195	28.49	390	18.9		5	0	1	50	
Wood windows	5'-0"x3'-0" window frame (wood)	No	50	434	WEF	861050200	103.99	196	5.44		5	0	1	50	
Wood windows	5'-0"x3'-0" window glass (single)	No	50	434	WEF	861050200	31.50	390	22.68		5	0	1	50	
Wood windows	5'-0"x3'-6" window frame (wood)	No	50	434	WEF	861050205	112.00	196	6.59		5	0	1	50	
Wood windows	5'-0"x3'-6" window glass (single)	No	50	434	WEF	861050205	42.00	390	26.46		5	0	1	50	
Wood windows	5'-0"x4'-0" window frame (wood)	No	50	434	WEF	861050210	119.00	196	7.56		5	0	1	50	
Wood windows	5'-0"x4'-0" window glass (single)	No	50	434	WEF	861050210	52.50	390	30.24		5	0	1	50	
Wood windows	5'-0"x5'-0" window frame (wood)	No	50	434	WEF	861050215	125.99	196	9.23		5	0	1	50	
Wood windows	5'-0"x5'-0" window glass (single)	No	50	434	WEF	861050215	66.00	390	37.8		5	0	1	50	
Wood windows	5'-0"x6'-0" window frame (wood)	No	50	434	WEF	861050220	133.00	196	10.98		5	0	1	50	
Wood windows	5'-0"x6'-0" window glass (single)	No	50	434	WEF	861050220	79.50	390	45.36		5	0	1	50	
Wood windows											5	0	1	50	
Wood windows											5	0	1	50	
Wood windows											5	0	1	50	
Wood windows											5	0	1	50	
Wood windows	6'-0"x2'-0" window frame (wood)	No	50	434	WEF	861050235	105.00	196	5.18		5	0	1	50	
Wood windows	6'-0"x2'-0" window glass (single)	No	50	434	WEF	861050235	30.00	390	18.4		5	0	1	50	
Wood windows	6'-0"x2'-6" window frame (wood)	No	50	434	WEF	861050240	111.00	196	5.78		5	0	1	50	
Wood windows	6'-0"x2'-6" window glass (single)	No	50	434	WEF	861050240	33.50	390	22.68		5	0	1	50	
Wood windows	6'-0"x3'-0" window frame (wood)	No	50	434	WEF	861050245	116.00	196	7.18		5	0	1	50	
Wood windows	6'-0"x3'-0" window glass (single)	No	50	434	WEF	861050245	37.00	390	27.22		5	0	1	50	
Wood windows	6'-0"x3'-6" window frame (wood)	No	50	434	WEF	861050250	123.00	196	8.17		5	0	1	50	
Wood windows	6'-0"x3'-6" window glass (single)	No	50	434	WEF	861050250	54.50	390	31.75		5	0	1	50	
Wood windows	6'-0"x4'-0" window frame (wood)	No	50	434	WEF	861050255	129.00	196	9.07		5	0	1	50	

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace			
Stage	Item	Qty	Units	Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcntage	interval	entirely
		No.	ID	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)	(yrs)	(yrs)	(yrs)	(yrs)	(yrs)	
Wood windows	6'-0"x4'-0" window glass (single)		No	50	434	WEF	861050255	72.00	390	36.29		5	0	1	50		
Wood windows	6'-0"x5'-0" window frame (wood)		No	50	434	WEF	861050260	142.00	196	10.97		5	0	1	50		
Wood windows	6'-0"x5'-0" window glass (single)		No	50	434	WEF	861050260	88.50	390	45.36		5	0	1	50		
Wood windows	6'-0"x6'-0" window frame (wood)		No	50	434	WEF	861050265	155.00	196	13.04		5	0	1	50		
Wood windows	6'-0"x6'-0" window glass (single)		No	50	434	WEF	861050265	105.00	390	54.43		5	0	1	50		
Wood windows												5	0	1	50		
Wood windows												5	0	1	50		
Wood windows												5	0	1	50		
Wood windows												5	0	1	50		
Wood windows	5' diameter 1/2 window frame (wood)		No	50	434	WEF	861050280	99.00	196	3.29		5	15	10	20		
Wood windows	5' diameter 1/2 window glass (single)		No	50	434	WEF	861050280	28.49	390	22.68		5	15	10	20		
Wood windows	4' diameter 1/2 window frame (wood)		No	50	434	WEF	861050285	79.97	196	2.82		5	15	10	20		
Wood windows	4' diameter 1/2 window glass (single)		No	50	434	WEF	861050285	21.51	390	20.41		5	15	10	20		
Wood windows												5	0	1	50		
7.3	WINDOWS, ALUMINUM, SLIDING																
Aluminum windows												5	0	1	75		
Aluminum windows												5	0	1	75		
Aluminum windows	2'-0"x2'-0" window frame (Al., sliding)		No	50	442	WEF	852100010	12.43	279	3.78		5	0	1	75		
Aluminum windows	2'-0"x2'-0" window glass (single)		No	50	442	WEF	852100010	24.85	390	6.045		5	0	1	75		
Aluminum windows	2'-0"x2'-6" window frame (Al., sliding)		No	50	442	WEF	852100015	13.85	279	4.36		5	0	1	75		
Aluminum windows	2'-0"x2'-6" window glass (single)		No	50	442	WEF	852100015	27.70	390	7.56		5	0	1	75		
Aluminum windows	2'-0"x3'-0" window frame (Al., sliding)		No	50	442	WEF	852100020	14.42	279	4.95		5	0	1	75		
Aluminum windows	2'-0"x3'-0" window glass (single)		No	50	442	WEF	852100020	28.70	390	9.07		5	0	1	75		
Aluminum windows	2'-0"x3'-6" window frame (Al., sliding)		No	50	442	WEF	852100025	15.00	279	5.53		5	0	1	75		
Aluminum windows	2'-0"x3'-6" window glass (single)		No	50	442	WEF	852100025	30.00	390	10.59		5	0	1	75		
Aluminum windows	2'-0"x4'-0" window frame (Al., sliding)		No	50	442	WEF	852100030	15.57	279	6.12		5	0	1	75		
Aluminum windows	2'-0"x4'-0" window glass (single)		No	50	442	WEF	852100030	31.15	390	12.1		5	0	1	75		
Aluminum windows	2'-0"x5'-0" window frame (Al., sliding)		No	50	442	WEF	852100035	17.14	279	7.28		5	0	1	75		
Aluminum windows	2'-0"x5'-0" window glass (single)		No	50	442	WEF	852100035	34.29	390	15.12		5	0	1	75		
Aluminum windows	2'-0"x6'-0" window frame (Al., sliding)		No	50	442	WEF	852100040	19.14	279	8.45		5	0	1	75		
Aluminum windows	2'-0"x6'-0" window glass (single)		No	50	442	WEF	852100040	38.29	390	18.15		5	0	1	75		
Aluminum windows												5	0	1	75		
Aluminum windows												5	0	1	75		
Aluminum windows												5	0	1	75		
Aluminum windows												5	0	1	75		
Aluminum windows	3'-0"x2'-0" window frame (Al., sliding)		No	50	442	WEF	852100055	13.57	279	4.49		5	0	1	75		
Aluminum windows	3'-0"x2'-0" window glass (single)		No	50	442	WEF	852100055	27.14	390	9.07		5	0	1	75		
Aluminum windows	3'-0"x2'-6" window frame (Al., sliding)		No	50	442	WEF	852100060	15.71	279	5.08		5	0	1	75		
Aluminum windows	3'-0"x2'-6" window glass (single)		No	50	442	WEF	852100060	31.43	390	11.34		5	0	1	75		
Aluminum windows	3'-0"x3'-0" window frame (Al., sliding)		No	50	442	WEF	852100065	16.29	279	5.66		5	0	1	75		
Aluminum windows	3'-0"x3'-0" window glass (single)		No	50	442	WEF	852100065	32.57	390	13.61		5	0	1	75		
Aluminum windows	3'-0"x3'-6" window frame (Al., sliding)		No	50	442	WEF	852100070	18.57	279	6.25		5	0	1	75		
Aluminum windows	3'-0"x3'-6" window glass (single)		No	50	442	WEF	852100070	37.15	390	15.88		5	0	1	75		

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	Fact	Emiss.	Const.	prcntage	Interval
Aluminum windows	3'-0"x4'-0" window frame (Al., sliding)	No	50	442	WEF	852100075	20.00	279	6.83		5	0	1	75
Aluminum windows	3'-0"x4'-0" window glass (single)	No	50	442	WEF	852100075	40.00	390	18.15		5	0	1	75
Aluminum windows	3'-0"x5'-0" window frame (Al., sliding)	No	50	442	WEF	852100080	21.13	279	8		5	0	1	75
Aluminum windows	3'-0"x5'-0" window glass (single)	No	50	442	WEF	852100080	42.28	390	22.68		5	0	1	75
Aluminum windows	3'-0"x6'-0" window frame (Al., sliding)	No	50	442	WEF	852100085	23.43	279	9.17		5	0	1	75
Aluminum windows	3'-0"x6'-0" window glass (single)	No	50	442	WEF	852100085	46.85	390	27.22		5	0	1	75
Aluminum windows											5	0	1	75
Aluminum windows											5	0	1	75
Aluminum windows											5	0	1	75
Aluminum windows											5	0	1	75
Aluminum windows	4'-0"x2'-0" window frame (Al., sliding)	No	50	442	WEF	852100100	15.57	279	5.21		5	0	1	75
Aluminum windows	4'-0"x2'-0" window glass (single)	No	50	442	WEF	852100100	31.15	390	12.1		5	0	1	75
Aluminum windows	4'-0"x2'-6" window frame (Al., sliding)	No	50	442	WEF	852100105	17.71	279	5.79		5	0	1	75
Aluminum windows	4'-0"x2'-6" window glass (single)	No	50	442	WEF	852100105	35.43	390	15.12		5	0	1	75
Aluminum windows	4'-0"x3'-0" window frame (Al., sliding)	No	50	442	WEF	852100110	18.71	279	6.37		5	0	1	75
Aluminum windows	4'-0"x3'-0" window glass (single)	No	50	442	WEF	852100110	37.43	390	18.15		5	0	1	75
Aluminum windows	4'-0"x3'-6" window frame (Al., sliding)	No	50	442	WEF	852100115	20.86	279	6.96		5	0	1	75
Aluminum windows	4'-0"x3'-6" window glass (single)	No	50	442	WEF	852100115	41.71	390	21.17		5	0	1	75
Aluminum windows	4'-0"x4'-0" window frame (Al., sliding)	No	50	442	WEF	852100120	22.29	279	7.55		5	0	1	75
Aluminum windows	4'-0"x4'-0" window glass (single)	No	50	442	WEF	852100120	44.57	390	24.19		5	0	1	75
Aluminum windows	4'-0"x5'-0" window frame (Al., sliding)	No	50	442	WEF	852100125	27.14	279	8.72		5	0	1	75
Aluminum windows	4'-0"x5'-0" window glass (single)	No	50	442	WEF	852100125	54.29	390	30.24		5	0	1	75
Aluminum windows	4'-0"x6'-0" window frame (Al., sliding)	No	50	442	WEF	852100130	28.00	279	9.88		5	0	1	75
Aluminum windows	4'-0"x6'-0" window glass (single)	No	50	442	WEF	852100130	56.00	390	36.29		5	0	1	75
Aluminum windows											5	0	1	75
Aluminum windows											5	0	1	75
Aluminum windows											5	0	1	75
Aluminum windows	5'-0"x2'-0" window frame (Al., sliding)	No	50	442	WEF	852100190	17.14	279	5.92		5	0	1	75
Aluminum windows	5'-0"x2'-0" window glass (single)	No	50	442	WEF	852100190	34.29	390	15.12		5	0	1	75
Aluminum windows	5'-0"x2'-6" window frame (Al., sliding)	No	50	442	WEF	852100195	19.71	279	6.51		5	0	1	75
Aluminum windows	5'-0"x2'-6" window glass (single)	No	50	442	WEF	852100195	39.43	390	18.9		5	0	1	75
Aluminum windows	5'-0"x3'-0" window frame (Al., sliding)	No	50	442	WEF	852100200	21.14	279	7.09		5	0	1	75
Aluminum windows	5'-0"x3'-0" window glass (single)	No	50	442	WEF	852100200	42.28	390	22.68		5	0	1	75
Aluminum windows	5'-0"x3'-6" window frame (Al., sliding)	No	50	442	WEF	852100205	23.29	279	7.68		5	0	1	75
Aluminum windows	5'-0"x3'-6" window glass (single)	No	50	442	WEF	852100205	46.57	390	26.46		5	0	1	75
Aluminum windows	5'-0"x4'-0" window frame (Al., sliding)	No	50	442	WEF	852100210	25.29	279	8.26		5	0	1	75
Aluminum windows	5'-0"x4'-0" window glass (single)	No	50	442	WEF	852100210	50.57	390	30.24		5	0	1	75
Aluminum windows	5'-0"x5'-0" window frame (Al., sliding)	No	50	442	WEF	852100215	30.00	279	9.43		5	0	1	75
Aluminum windows	5'-0"x5'-0" window glass (single)	No	50	442	WEF	852100215	60.00	390	37.8		5	0	1	75
Aluminum windows	5'-0"x6'-0" window frame (Al., sliding)	No	50	442	WEF	852100220	32.86	279	10.6		5	0	1	75
Aluminum windows	5'-0"x6'-0" window glass (single)	No	50	442	WEF	852100220	65.71	390	45.36		5	0	1	75
Aluminum windows											5	0	1	75

Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	CFC	%	Maintenance	Replace		
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	prcntage	interval	entirely
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows	6'-0"x2'-0" window frame (Al., sliding)	No	50	442	WEF	852100235	19.14	279	6.64			5	0	1	75	
Aluminum windows	6'-0"x2'-0" window glass (single)	No	50	442	WEF	852100235	38.29	390	18.15			5	0	1	75	
Aluminum windows	6'-0"x2'-6" window frame (Al., sliding)	No	50	442	WEF	852100240	21.29	279	7.22			5	0	1	75	
Aluminum windows	6'-0"x2'-6" window glass (single)	No	50	442	WEF	852100240	42.57	390	22.68			5	0	1	75	
Aluminum windows	6'-0"x3'-0" window frame (Al., sliding)	No	50	442	WEF	852100245	23.43	279	7.81			5	0	1	75	
Aluminum windows	6'-0"x3'-0" window glass (single)	No	50	442	WEF	852100245	46.85	390	27.22			5	0	1	75	
Aluminum windows	6'-0"x3'-6" window frame (Al., sliding)	No	50	442	WEF	852100250	25.86	279	8.4			5	0	1	75	
Aluminum windows	6'-0"x3'-6" window glass (single)	No	50	442	WEF	852100250	51.72	390	31.75			5	0	1	75	
Aluminum windows	6'-0"x4'-0" window frame (Al., sliding)	No	50	442	WEF	852100255	28.00	279	8.98			5	0	1	75	
Aluminum windows	6'-0"x4'-0" window glass (single)	No	50	442	WEF	852100255	56.00	390	36.29			5	0	1	75	
Aluminum windows	6'-0"x5'-0" window frame (Al., sliding)	No	50	442	WEF	852100260	32.86	279	10.15			5	0	1	75	
Aluminum windows	6'-0"x5'-0" window glass (single)	No	50	442	WEF	852100260	65.71	390	45.36			5	0	1	75	
Aluminum windows	6'-0"x6'-0" window frame (Al., sliding)	No	50	442	WEF	852100265	39.60	279	11.32			5	0	1	75	
Aluminum windows	6'-0"x6'-0" window glass (single)	No	50	442	WEF	852100265	79.20	390	54.43			5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
Aluminum windows												5	0	1	75	
7.4	SKYLIGHTS															
Skylights	Skylight	Ft2	0	532	R	781010300	22.00	138	0.78			5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
Skylights												5	0	1	50	
7.5	FINISH HARDWARE															
Finish hardware	Locksets	No	50	452	WEF	871200010	29.15	293	1.5			5	0	1	50	
Finish hardware	Passage Sets	No	100	620	WIF	871200020	32.45	293	1.5			5	0	1	50	
Finish hardware	Privacy Sets	No	100	620	WIF	871200100	33.00	293	1.5			5	0	1	50	
Finish hardware	Bifold Pulls	No	100	624	WIF	871200110	2.50	293	0.057			5	0	1	50	
Finish hardware	Door Stops	No	100	620	WIF	871100010	11.00	293	0.4			5	0	1	50	
Finish hardware	Butts exterior doors	No	100	452	WEF	871160010	30.00	293	0.454			5	0	1	50	

Optimize Quantity Takeoff

		Bldr's Qty	Bldr's Units	% exp to int.	Asmbly No.	System ID	Product Number	\$/unit bldr's	I/O Code	Conv to kg	CFC (mg/kg)	% Emiss.	Maintaince Const.	prcentage (%)	Maintaince interval (yrs)	Replace entirely (yrs)
Stage	Item															
Finish hardware	Butts interior doors		No	100	620	WIF	871160020	6.00	293	0.17		5	0	1	50	
Finish hardware	Thresholds (aluminum)		No	100	452	WEF	873040010	24.20	283	0.5		5	0	1	50	
Finish hardware	Sweeps (rubber/plastic)		No	100	452	WEF	873050010	10.78	131	0.023		5	0	1	50	
Finish hardware	Weather stripping (zinc)		No	100	452	WEF	873060010	9.35	283	0.089		5	0	1	50	
Finish hardware	Latch		No	100	452	WEF	871342000	1.43	293	0.3		5	0	1	50	
Finish hardware	Dead bolts		No	100	452	WEF	871120020	11.55	293	1.5		5	0	1	50	
Finish hardware	Safety chain		No	100	452	WEF	871120030	13.20	293	0.5		5	0	1	50	
Finish hardware												5	0	1	50	
Finish hardware												5	0	1	50	
Finish hardware	Closet Rods		Ft	100	760	WIF	622241000	0.22	196	0.084		5	0	1	50	
Finish hardware	Closet Shelves		Ft	100	760	WIF	623040600	1.14	196	0.914		5	0	1	50	
Finish hardware	Closet Rod Brackets		No	100	760	WIF	622241020	4.00	196	0.914		5	0	1	50	
Finish hardware	Closet Shelf Brackets		No	100	760	WIF	623040620	12.00	196	0.454		5	0	1	50	
Finish hardware												5	0	1	50	
Finish hardware	Handrail Brackets		No	100	690	WIF	871400010	15.00	293	0.17		5	0	1	50	
Finish hardware												5	0	1	50	
<b>8</b>	<b>SECTION 8 FINISHES</b>															
<b>8.1</b>	<b>GYPSUM BOARD</b>															
<b>8.1.1</b>	<b>BASEMENT EXTERIOR WALLS:</b>															
Bsmt ext. walls: Gypsum	1/2" regular		Ft2	100	604	WEF	926080300	0.19	386	0.911		10	10	25	50	
Bsmt ext. walls: Gypsum	5/8" regular		Ft2	100	604	WEF	926082000	0.23	386	1.134		10	10	25	50	
Bsmt ext. walls: Gypsum	1/2" water resistant		Ft2	100	604	WEF	926081200	0.30	386	0.911		10	10	25	50	
Bsmt ext. walls: Gypsum	5/8" type x		Ft2	100	604	WEF	926082100	0.25	386	1.134		10	10	25	50	
Bsmt ext. walls: Gypsum	Joint tape, 500 ft roll		No	100	604	WEF	928042000	6.95	482	1.59		5	10	25	50	
Bsmt ext. walls: Gypsum	Joint compound		Lb	100	604	WEF	928042500	0.35	409	0.454		5	10	25	50	
Bsmt ext. walls: Gypsum	Metal corner beads		Ft	100	604	WEF	928040300	0.09	283	0.054		5	10	25	50	
Bsmt ext. walls: Gypsum	Metal J beads		Ft	100	604	WEF	928041100	0.15	283	0.057		5	10	25	50	
Bsmt ext. walls: Gypsum	Paper corner beads		Ft	100	604	WEF	928040500	0.06	222	0.039		5	10	25	50	
Bsmt ext. walls: Gypsum												10	10	25	50	
<b>8.1.2</b>	<b>BASEMENT INTERIOR WALLS:</b>															
Bsmt int. walls: Gypsum	1/2" regular		Ft2	100	604	WIF	926080300	0.19	386	0.911		10	15	25	40	
Bsmt int. walls: Gypsum	5/8" regular		Ft2	100	604	WIF	926082000	0.23	386	1.134		10	15	25	40	
Bsmt int. walls: Gypsum	1/2" water resistant		Ft2	100	604	WIF	926081200	0.30	386	0.911		10	15	25	40	
Bsmt int. walls: Gypsum	5/8" type x		Ft2	100	604	WIF	926082100	0.25	386	1.134		10	15	25	40	
Bsmt int. walls: Gypsum	Joint tape, 500 ft roll		No	100	604	WIF	928042000	6.95	482	1.59		5	15	25	40	
Bsmt int. walls: Gypsum	Joint compound		Lb	100	604	WIF	928042500	0.35	409	0.454		5	15	25	40	
Bsmt int. walls: Gypsum	Metal corner beads		Ft	100	604	WIF	928040300	0.09	283	0.054		5	15	25	40	
Bsmt int. walls: Gypsum	Metal J beads		Ft	100	604	WIF	928041100	0.15	283	0.057		5	15	25	40	
Bsmt int. walls: Gypsum	Paper corner beads		Ft	100	604	WIF	928040500	0.06	222	0.039		5	15	25	40	
Bsmt int. walls: Gypsum												10	10	25	50	
<b>8.1.3</b>	<b>BASEMENT CEILINGS: GYPSUM</b>															
Bsmt Ceilings: Gypsum	5/8" regular		Ft2	100	608	CI	926082000	0.23	386	1.134		12	10	25	50	
Bsmt Ceilings: Gypsum	5/8" type x		Ft2	100	608	CI	926082100	0.25	386	1.134		12	10	25	50	

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to int.	No.	ID	Product	\$/unit	I/O	Fact	Emiss.	Const.	percentage	interval	
Bsmt Ceilings: Gypsum	Joint tape, 500 ft roll		No	100	608	CI	928042000	6.95	482	1.59		5	10	25	50
Bsmt Ceilings: Gypsum	Joint compound		Lb	100	608	CI	928042500	0.35	409	1.454		5	10	25	50
Bsmt Ceilings: Gypsum												12	10	25	50
8.1.4	FIRST STOREY EXTERIOR WALLS:														
First storey ext. walls: Gypsum	1/2" regular		Ft2	100	604	WEF	926080300	0.19	386	0.911		10	10	25	50
First storey ext. walls: Gypsum	5/8" regular		Ft2	100	604	WEF	926082000	0.23	386	1.134		10	10	25	50
First storey ext. walls: Gypsum	1/2" water resistant		Ft2	100	604	WEF	926081200	0.30	386	0.911		10	10	25	50
First storey ext. walls: Gypsum	5/8" type x		Ft2	100	604	WEF	926082100	0.25	386	1.134		10	10	25	50
First storey ext. walls: Gypsum	Joint tape, 500 ft roll		No	100	604	WEF	928042000	6.95	482	1.59		5	10	25	50
First storey ext. walls: Gypsum	Joint compound		Lb	100	604	WEF	928042500	0.35	409	0.454		5	10	25	50
First storey ext. walls: Gypsum	Metal corner beads		Ft	100	604	WEF	928040300	0.09	283	0.054		5	10	25	50
First storey ext. walls: Gypsum	Metal J beads		Ft	100	604	WEF	928041100	0.15	283	0.057		5	10	25	50
First storey ext. walls: Gypsum	Paper corner beads		Ft	100	604	WEF	928040500	0.06	222	0.039		5	10	25	50
First storey ext. walls: Gypsum												10	10	25	50
8.1.5	FIRST FLOOR INTERIOR WALLS														
First storey int. walls: Gypsum	1/2" regular		Ft2	100	604	WIF	926080300	0.19	386	0.911		10	15	25	40
First storey int. walls: Gypsum	5/8" regular		Ft2	100	604	WIF	926082000	0.23	386	1.134		10	15	25	40
First storey int. walls: Gypsum	1/2" water resistant		Ft2	100	604	WIF	926081200	0.30	386	0.911		10	15	25	40
First storey int. walls: Gypsum	5/8" type x		Ft2	100	604	WIF	926082100	0.25	386	1.134		10	15	25	40
First storey int. walls: Gypsum	Joint tape, 500 ft roll		No	100	604	WIF	928042000	6.95	482	1.59		5	15	25	40
First storey int. walls: Gypsum	Joint compound		Lb	100	604	WIF	928042500	0.35	409	0.454		5	15	25	40
First storey int. walls: Gypsum	Metal corner beads		Ft	100	604	WIF	928040300	0.09	283	0.054		5	15	25	40
First storey int. walls: Gypsum	Metal J beads		Ft	100	604	WIF	928041100	0.15	283	0.057		5	15	25	40
First storey int. walls: Gypsum	Paper corner beads		Ft	100	604	WIF	928040500	0.06	222	0.039		5	15	25	40
First storey int. walls: Gypsum												10	15	25	40
8.1.6	FIRST FLOOR CEILINGS														
First storey ceilings: Gypsum	5/8" regular		Ft2	100	608	CI	926082000	0.23	386	1.134		12	10	25	50
First storey ceilings: Gypsum	5/8" type x		Ft2	100	608	CI	926082100	0.25	386	1.134		12	10	25	50
First storey ceilings: Gypsum	Joint tape, 500 ft roll		No	100	608	CI	928042000	6.95	482	1.59		5	10	25	50
First storey ceilings: Gypsum	Joint compound		Lb	100	608	CI	928042500	0.35	409	0.454		5	10	25	50
First storey ceilings: Gypsum												12	10	25	50
8.1.7	SECOND FLOOR EXTERIOR WALLS														
Sec. storey ext. walls: Gypsum	1/2" regular		Ft2	100	604	WEF	926080300	0.19	386	0.911		10	10	25	50
Sec. storey ext. walls: Gypsum	5/8" regular		Ft2	100	604	WEF	926082000	0.23	386	1.134		10	10	25	50
Sec. storey ext. walls: Gypsum	1/2" water resistant		Ft2	100	604	WEF	926081200	0.30	386	0.911		10	10	25	50
Sec. storey ext. walls: Gypsum	5/8" type x		Ft2	100	604	WEF	926082100	0.25	386	1.134		10	10	25	50
Sec. storey ext. walls: Gypsum	Joint tape, 500 ft roll, rolls		No	100	604	WEF	928042000	6.95	482	1.59		5	10	25	50
Sec. storey ext. walls: Gypsum	Joint compound		Lb	100	604	WEF	928042500	0.35	409	0.454		5	10	25	50
Sec. storey ext. walls: Gypsum	Metal corner beads		Ft	100	604	WEF	928040300	0.09	283	0.054		5	10	25	50
Sec. storey ext. walls: Gypsum	Metal J beads		Ft	100	604	WEF	928041100	0.15	283	0.057		5	10	25	50
Sec. storey ext. walls: Gypsum	Paper corner beads		Ft	100	604	WEF	928040500	0.06	222	0.039		5	10	25	50
Sec. storey ext. walls: Gypsum												10	15	25	40
8.1.8	SECOND FLOOR INTERIOR WALLS														

Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qnty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	Emiss.	Const.	prcntage	interval	
Sec. storey int. walls: Gypsum	1/2" regular		Ft2	100	604	WIF	926080300	0.19	386	0.911		10	15	25	40
Sec. storey int. walls: Gypsum	5/8" regular		Ft2	100	604	WIF	926082000	0.23	386	1.134		10	15	25	40
Sec. storey int. walls: Gypsum	1/2" water resistant		Ft2	100	604	WIF	926081200	0.30	386	0.911		10	15	25	40
Sec. storey int. walls: Gypsum	5/8" type x		Ft2	100	604	WIF	926082100	0.25	386	1.134		10	15	25	40
Sec. storey int. walls: Gypsum	Joint tape, 500 ft roll, rolls	No	100		604	WIF	928042000	6.95	482	1.59		5	15	25	40
Sec. storey int. walls: Gypsum	Joint compound		Lb	100	604	WIF	928042500	0.35	409	0.454		5	15	25	40
Sec. storey int. walls: Gypsum	Metal corner beads		Ft	100	604	WIF	928040300	0.09	283	0.054		5	15	25	40
Sec. storey int. walls: Gypsum	Metal J beads		Ft	100	604	WIF	928041100	0.15	283	0.057		5	15	25	40
Sec. storey int. walls: Gypsum	Paper corner beads		Ft	100	604	WIF	928040500	0.06	222	0.039		5	15	25	40
Sec. storey int. walls: Gypsum												10	15	25	40
8.1.9	SECOND FLOOR CEILINGS														
Sec. storey ceilings: Gypsum	5/8" regular		Ft2	100	608	CE	926082000	0.23	386	1.134		12	10	25	50
Sec. storey ceilings: Gypsum	5/8" type x		Ft2	100	608	CE	926082100	0.25	386	1.134		12	10	25	50
Sec. storey ceilings: Gypsum	Joint tape, 500 ft roll, rolls	No	100		608	CE	928042000	6.95	482	1.59		5	10	25	50
Sec. storey ceilings: Gypsum	Joint compound		Lb	100	608	CE	928042500	0.35	409	0.454		5	10	25	50
Sec. storey ceilings: Gypsum												12	10	25	50
8.2	FLOORING														
8.2.1	VINYL														
Vinyl Flooring	1/8"		Ft2	100	662	LI	966018000	1.27	511	0.635		5	20	5	15
8.2.2	CERAMIC TILE														
Ceramic Tile Flooring	Ceramic Tile		Ft2	100	662	LI	931023000	3.25	380	1.451		5	40	10	25
Ceramic Tile Flooring												5	40	10	25
8.2.3	HARDWOOD														
Hardwood Flooring	7/8"		Ft2	100	662	LI	956040010	5.09	191	1.135		7	20	5	40
Hardwood Flooring	5/16"		Ft2	100	662	LI	956040010	2.04	191	0.567		7	20	5	40
Hardwood Flooring												7	20	5	40
Hardwood Flooring												7	20	5	40
8.2.4	CARPET														
Carpet Flooring	Carpet		Ft2	100	662	LI	968520900	2.00	170	0.233		5	20	5	10
Carpet Flooring												5	20	5	10
Carpet Flooring												5	20	5	10
Carpet Flooring												5	20	5	10
Carpet Flooring												5	20	5	10
Carpet Flooring												5	20	5	10
Carpet Flooring												5	20	5	10
8.3	PAINT (Single Coat)														
8.3.1	Interior														
int. Paint (Single coat)	Basement exterior walls		Ft2	100	604	FBW	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Basement interior walls		Ft2	100	604	WIF	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Basement ceiling		Ft2	100	608	LI	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	First floor exterior walls		Ft2	100	604	WEF	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	First floor interior walls		Ft2	100	604	WIF	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	First floor interior ceiling		Ft2	100	608	LI	992240010	0.04	409	0.012		1	0	1	5

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to int.	No.	ID	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcentage	Interval	entirely
		Bldr's	Bldr's	% exp	Asmby	System		bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	
int. Paint (Single coat)	First floor exterior ceiling		Ft2	100	608	CE	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Second floor exterior walls		Ft2	100	604	WEF	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Second floor interior walls		Ft2	100	604	WIF	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Second floor interior ceilings		Ft2	100	608	LI	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Second floor exterior ceilings		Ft2	100	608	CE	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Third floor exterior walls		Ft2	100	604	WEF	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Third floor interior walls		Ft2	100	604	WIF	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Third floor interior ceilings		Ft2	100	608	LI	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)	Third floor exterior ceilings		Ft2	100	608	CE	992240010	0.04	409	0.012		1	0	1	5
int. Paint (Single coat)												1	0	1	5
int. Paint (Single coat)												1	0	1	5
int. Paint (Single coat)												1	0	1	5
int. Paint (Single coat)												1	0	1	5
int. Paint (Single coat)												1	0	1	5
int. Paint (Single coat)												1	0	1	5
8.4	<b>WALL COVERINGS</b>														
8.4.1	Vinyl wall paper														
Vinyl wall paper	Basement exterior walls		Ft2	100	604	FBW	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Basement interior walls		Ft2	100	604	WIF	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Basement ceiling		Ft2	100	608	LI	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	First floor exterior walls		Ft2	100	604	WEF	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	First floor interior walls		Ft2	100	604	WIF	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	First floor interior ceiling		Ft2	100	608	LI	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	First floor exterior ceiling		Ft2	100	608	CE	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Second floor exterior walls		Ft2	100	604	WEF	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Second floor interior walls		Ft2	100	604	WIF	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Second floor interior ceilings		Ft2	100	608	LI	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Second floor exterior ceilings		Ft2	100	608	CE	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Third floor exterior walls		Ft2	100	604	WEF	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Third floor interior walls		Ft2	100	604	WIF	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Third floor interior ceilings		Ft2	100	608	LI	997013000	0.68	511	0.025		5	0	1	10
Vinyl wall paper	Third floor exterior ceilings		Ft2	100	608	CE	997013000	0.68	511	0.025		5	0	1	10
8.4.2	Wall paper														
Wall paper	Basement exterior walls		Ft2	100	604	FBW	997013700	0.24	222	0.017		5	0	1	5
Wall paper	Basement interior walls		Ft2	100	604	WIF	997013700	0.24	222	0.017		5	0	1	5
Wall paper	Basement ceiling		Ft2	100	608	LI	997013700	0.24	222	0.017		5	0	1	5
Wall paper	First floor exterior walls		Ft2	100	604	WEF	997013700	0.24	222	0.017		5	0	1	5
Wall paper	First floor interior walls		Ft2	100	604	WIF	997013700	0.24	222	0.017		5	0	1	5
Wall paper	First floor interior ceiling		Ft2	100	608	LI	997013700	0.24	222	0.017		5	0	1	5
Wall paper	First floor exterior ceiling		Ft2	100	608	CE	997013700	0.24	222	0.017		5	0	1	5
Wall paper	Second floor exterior walls		Ft2	100	604	WEF	997013700	0.24	222	0.017		5	0	1	5

Optimize Quantity Takeoff

									Conv	CFC	%	Maintenance	Replace		
Stage	Item	Bldr's Qnty	Bldr's Units	% exp to int.	Asmbly No.	System ID	Product Number	\$/unit bldr's	I/O Code	Fact to kg	Emiss. (mg/kg)	Const. Waste (%)	prcentage (%)	interval (yrs)	entirely (yrs)
Wall paper	Second floor interior walls	Ft2	100	604	WIF	997013700	0.24	222	0.017		5	0	1	5	
Wall paper	Second floor interior ceilings	Ft2	100	608	LI	997013700	0.24	222	0.017		5	0	1	5	
Wall paper	Second floor exterior ceilings.	Ft2	100	608	CE	997013700	0.24	222	0.017		5	0	1	5	
Wall paper	Third floor exterior walls	Ft2	100	604	WEF	997013700	0.24	222	0.017		5	0	1	5	
Wall paper	Third floor interior walls	Ft2	100	604	WIF	997013700	0.24	222	0.017		5	0	1	5	
Wall paper	Third floor interior ceilings	Ft2	100	608	LI	997013700	0.24	222	0.017		5	0	1	5	
Wall paper	Third floor exterior ceilings	Ft2	100	608	CE	997013700	0.24	222	0.017		5	0	1	5	
Wall paper											5	0	1	5	
8.4.3	Ceramic tile														
Ceramic tile	Basement exterior walls	Ft2	100	604	FBW	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Basement interior walls	Ft2	100	604	WIF	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Basement ceiling	Ft2	100	608	LI	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	First floor exterior walls	Ft2	100	604	WEF	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	First floor interior walls	Ft2	100	604	WIF	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	First floor interior ceiling	Ft2	100	608	LI	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	First floor exterior ceiling	Ft2	100	608	CE	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Second floor exterior walls	Ft2	100	604	WEF	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Second floor interior walls	Ft2	100	604	WIF	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Second floor interior ceilings	Ft2	100	608	LI	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Second floor exterior ceilings	Ft2	100	608	CE	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Third floor exterior walls	Ft2	100	604	WEF	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Third floor interior walls	Ft2	100	604	WIF	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Third floor interior ceilings	Ft2	100	608	LI	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile	Third floor exterior ceilings	Ft2	100	608	CE	931025400	2.04	380	1.451		5	0	1	50	
Ceramic tile											5	0	1	50	
8.4.4	Panelling,Plywood, 1/4"														
Panelling,Plywood	Basement exterior walls	Ft2	100	604	FBW	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Basement interior walls	Ft2	100	604	WIF	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Basement ceiling	Ft2	100	608	LI	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	First floor exterior walls	Ft2	100	604	WEF	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	First floor interior walls	Ft2	100	604	WIF	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	First floor interior ceiling	Ft2	100	608	LI	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	First floor exterior ceiling	Ft2	100	608	CE	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Second floor exterior walls	Ft2	100	604	WEF	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Second floor interior walls	Ft2	100	604	WIF	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Second floor interior ceilings	Ft2	100	608	LI	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Second floor exterior ceilings	Ft2	100	608	CE	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Third floor exterior walls	Ft2	100	604	WEF	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Third floor interior walls	Ft2	100	604	WIF	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Third floor interior ceilings	Ft2	100	608	LI	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood	Third floor exterior ceilings	Ft2	100	608	CE	625042400	2.97	196	0.305		5	0	1	50	
Panelling,Plywood											5	0	1	50	

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qnty	Units	to Int.	No.	ID	Number	bldr's	Code	Emiss.	Const.	prcentage	interval	entirely
8.5	INTERIOR GLASS BLOCKS													
int. glass blocks	6"X6"		Ft2	0	400	WEF	427040005	15.18	390	5.443		5	0	1
int. glass blocks	8"X8"		Ft2	0	400	WEF	427040010	16.17	390	5.443		5	0	1
int. glass blocks												5	0	1
int. glass blocks												5	0	1
9	SECTION 9 SPECIALTIES													
9.1	PREMANUFACTURED METAL													
Premanufactured metal fireplaces	Flues		Ft	50	730	TF	1030540500	5.50	354	2		0	25	10
Premanufactured metal fireplaces	Combustion Air Ducts		Ft	50	730	TF	1031043000	2.20	354	0.5		5	25	10
Premanufactured metal fireplaces	C.A.D. Hood		No	50	730	TF	1031043050	5.50	354	2		5	0	1
Premanufactured metal fireplaces	C.A.D. Insulation		Ft2	50	730	TF	1031043100	0.20	387	0.03		5	0	1
Premanufactured metal fireplaces	C.A.D. vapour barrier		Ft2	50	730	TF	719220900	0.03	135	0.013		5	0	1
Premanufactured metal fireplaces												0	25	10
Premanufactured metal fireplaces												0	25	10
Premanufactured metal fireplaces												0	25	10
Premanufactured metal fireplaces												0	25	10
Premanufactured metal fireplaces												0	25	10
9.2	PREMANUFACTURED METAL													
Premanufactured metal fireplace inserts	Flues		Ft	50	730	TF	1030540500	5.50	354	2		0	15	10
Premanufactured metal fireplace inserts	Combustion Air Ducts		Ft	50	730	TF	1031043000	2.20	354	0.5		5	10	6
Premanufactured metal fireplace inserts	C.A.D. Hood		No	50	730	TF	1031043050	5.50	354	2		5	10	5
Premanufactured metal fireplace inserts	C.A.D. Insulation		Ft2	50	730	TF	1031043100	0.20	387	0.03		5	0	1
Premanufactured metal fireplace inserts	C.A.D. vapour barrier		Ft2	50	730	TF	719220900	0.03	135	0.013		5	0	1
Premanufactured metal fireplace inserts												0	15	10
Premanufactured metal fireplace inserts												0	15	10
Premanufactured metal fireplace inserts												0	15	10
Premanufactured metal fireplace inserts												0	15	10
Premanufactured metal fireplace inserts												0	15	10
9.3	WOOD BURNING STOVES													
Wood burning stoves	Stove		No	50	730	TF	1032010010	605.00	354	125		5	10	6
Wood burning stoves	Flues		Ft	50	730	TF	1030540500	5.50	354	2		5	10	5
Wood burning stoves	Combustion Air Ducts		Ft	50	730	TF	1031043000	2.20	354	0.5		5	10	6
Wood burning stoves	C.A.D. Hood		No	50	730	TF	1031043050	5.50	354	2		5	10	6
Wood burning stoves	C.A.D. Insulation		Ft2	50	730	TF	1031043100	0.20	387	0.03		0	0	1
Wood burning stoves	C.A.D. vapour barrier		Ft2	50	730	TF	719220900	0.03	135	0.013		0	0	1
Wood burning stoves												5	10	6
Wood burning stoves												5	10	6
Wood burning stoves												5	10	6
Wood burning stoves												5	10	6
Wood burning stoves												5	10	6
Wood burning stoves												5	10	6

Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qty	Units to int.	No.	ID	Number	bldr's	Code	to kg	Emiss.	Const.	prcentage	interval	entirely
9.4	<b>BATHROOM ACCESSORIES</b>													
Bathroom Accessories	Towel bar, 24"	No	100	716	AB	1082046400	16.00	279	0.907	5	0	1	50	
Bathroom Accessories	Soap holder/grab bar	No	100	716	AB	1082040800	23.10	308	4	5	0	1	50	
Bathroom Accessories	Paper holder	No	100	716	AB	1082048500	8.00	279	0.454	5	0	1	50	
Bathroom Accessories	Shower curtain rod	No	100	716	AB	1082040200	22.00	279	1.5	5	0	1	50	
Bathroom Accessories	Shower doors	No	100	716	AB	1082040250	220.00	390	60	5	0	1	50	
Bathroom Accessories	Bath tub doors	No	100	716	AB	1082040275	220.00	390	50	5	0	1	50	
Bathroom Accessories	Medicine cabinets, 22" x 36": metal frame	No	100	716	AB	1082080010	88.00	279	7	5	0	1	50	
Bathroom Accessories	Medicine cabinets, 22" x 36": mirror doors	No	100	716	AB	1082080010	44.00	392	9	5	0	1	50	
Bathroom Accessories	Mirrors, 5'-0"x4'-0"	No	100	716	AB	881442015	178.20	392	30	5	0	1	50	
Bathroom Accessories	Mirrors, 6'-6"x4'-0"	No	100	716	AB	881442020	231.66	392	39.3	5	0	1	50	
Bathroom Accessories	Mirrors, 8'-0"x4'-0"	No	100	716	AB	881442025	285.12	392	48.4	5	0	1	50	
Bathroom Accessories										5	0	1	50	
Bathroom Accessories										5	0	1	50	
Bathroom Accessories										5	0	1	50	
Bathroom Accessories										5	0	1	50	
Bathroom Accessories										5	0	1	50	
Bathroom Accessories										5	0	1	50	
Bathroom Accessories										5	0	1	50	
10	<b>SECTION 10 CABINETS AND APPLIANCES</b>													
10.1	<b>CABINETS</b>													
Cabinets	Kitchen counter tops & wall splash	Ft	100	708	AC	624080010	11.66	196	7.5	5	10	10	30	
Cabinets	Kitchen base cabinets	Ft	100	708	AC	641020700	104.50	196	20	5	0	1	50	
Cabinets	Kitchen upper cabinets	Ft	100	708	AC	641024000	37.40	196	15	5	0	1	50	
Cabinets	Pantry & Broom closets, 2' x 2'	No	100	708	AC	641027000	154.00	196	82	5	0	1	50	
Cabinets	Bathroom vanity tops & wall splash	Ft	100	802	AC	624080050	11.66	196	7.5	5	10	10	30	
Cabinets	Bathroom base cabinets	Ft	100	802	AC	641020700	104.50	196	20	5	0	1	50	
Cabinets	Bathroom towel closets, 2' x 2'	Ft	100	802	AC	641027000	154.00	196	82	5	0	1	50	
Cabinets	Laundry counter tops & wall splash	Ft	100	704	AC	624080010	11.66	196	7.5	5	10	10	30	
Cabinets	Laundry room base cabinets	Ft	100	704	AC	641020700	104.50	196	20	5	0	1	50	
Cabinets	Laundry room upper cabinets	Ft	100	704	AC	641024000	37.40	196	15	5	0	1	50	
Cabinets	Laundry room linen cabinets	Ft	100	704	AC	641020700	104.50	196	20	5	0	1	50	
Cabinets	Dropped fluorescent ceiling, 2 x 4" tubes: wood frame	No	100	708	AC	1681706310	77.00	196	4	5	0	1	50	
Cabinets	Dropped fluorescent ceiling, 2 x 4" tubes: plastic cover	No	100	708	AC	1681706310	33.00	135	1.1	5	0	1	50	
Cabinets	Island	Ft	100	708	AC	641020700	104.50	196	20	5	0	1	50	
Cabinets										5	0	1	50	
Cabinets										5	0	1	50	
Cabinets										5	0	1	50	

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	Fact	Emiss.	Const.	prcntage	interval
									to kg	(mg/kg)	Waste	(%)	(yrs)	(yrs)
Cabinets												5	0	1
Cabinets												5	0	1
Cabinets												5	0	1
10.2	KITCHEN & LAUNDRY EQUIPMENT													
Kitchen/Laundry Equipment	Washer		No	100	712	AA	1140026650	654.50	353	70		5	0	1
Kitchen/Laundry Equipment	Dryer		No	100	712	AA	1140023200	539.00	353	70		5	0	1
Kitchen/Laundry Equipment	Refrigerator		No	100	712	AA	1140025750	764.50	355	80		5	0	1
Kitchen/Laundry Equipment	Range Hood		No	100	712	AA	1140024150	165.00	320	10		5	25	10
Kitchen/Laundry Equipment	Range, economy		No	100	712	AA	1140020010	297.00	356	50		5	0	1
Kitchen/Laundry Equipment	Counter top range, deluxe		No	100	712	AA	1140020050	#####	356	20		5	0	1
Kitchen/Laundry Equipment	Built in oven		No	100	712	AA	1140020350	781.00	356	35		5	0	1
Kitchen/Laundry Equipment	Microwave		No	100	712	AA	1140021250	893.75	304	35		5	0	1
Kitchen/Laundry Equipment	Dishwasher		No	100	712	AA	1140022750	341.00	353	55		5	0	1
Kitchen/Laundry Equipment	Garburator		No	100	712	AA	1140023300	137.50	353	15		5	0	1
Kitchen/Laundry Equipment												5	0	1
Kitchen/Laundry Equipment												5	0	1
Kitchen/Laundry Equipment												5	0	1
Kitchen/Laundry Equipment												5	0	1
Kitchen/Laundry Equipment												5	0	1
Kitchen/Laundry Equipment												5	0	1
11	SECTION 11 MECHANICAL													
11.1	ROUGH IN PLUMBING													
11.1.1	Polybutylene Supply Lines													
Polybutylene supply plumbing	1/2" dia piping		Ft	50	850	SP	1515600030	0.47	138	0.021		5	30	8
Polybutylene supply plumbing	3/4" piping		Ft	50	850	SP	1515600050	0.87	138	0.039		5	30	8
Polybutylene supply plumbing	1/2" t's		No	50	850	SP	1515600070	5.81	135	0.025		5	30	8
Polybutylene supply plumbing	3/4" T's		No	50	850	SP	1515600090	9.58	135	0.047		5	30	8
Polybutylene supply plumbing	1/2" connectors		No	50	850	SP	1515600110	3.95	135	0.227		5	30	8
Polybutylene supply plumbing	3/4" conectors		No	50	850	SP	1515600130	5.83	135	0.317		5	30	8
Polybutylene supply plumbing	Supply header		No	50	850	SP	1515600150	55.00	135	6.804		5	30	8
Polybutylene supply plumbing												5	30	8
11.1.2	ABS Waste Lines, cellular core													
ABS waste plumbing, cellular core	1 1/2" pipe		Ft	50	850	SP	1515514150	1.23	138	0.136		7	0	1
ABS waste plumbing, cellular core	1 1/2" 90 el		No	50	850	SP	1515582790	0.68	135	0.066		7	0	1
ABS waste plumbing, cellular core	1 1/2" 45 el		No	50	850	SP	1515582795	0.68	135	0.041		7	0	1
ABS waste plumbing, cellular core	1 1/2" T		No	50	850	SP	1515583220	1.06	135	0.09		7	0	1
ABS waste plumbing, cellular core	1 1/2" Trap, P		No	50	850	SP	1511816720	3.66	135	0.15		2	0	1
ABS waste plumbing, cellular core	1 1/2" Clean Out		No	50	850	SP	1511100200	1.16	135	0.098		2	0	1
ABS waste plumbing, cellular core	1 1/2" Couplings		No	50	850	SP	1515583420	0.55	135	0.027		7	0	1
ABS waste plumbing, cellular core	2" pipe		Ft	50	850	SP	1515511910	1.46	138	0.183		7	0	1
ABS waste plumbing, cellular core	2" 90 el		No	50	850	SP	1515582810	1.07	135	0.095		7	0	1
ABS waste plumbing, cellular core	2" 45 el		No	50	850	SP	1515582820	1.07	135	0.06		7	0	1
ABS waste plumbing, cellular core	2" T		No	50	850	SP	1515583230	1.57	135	0.147		7	0	1

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	prcentage	interval	entirely
ABS waste plumbing, cellular core	2" Trap		No	50	850	SP	1511816730	5.94	135	0.299		2	0	1	40
ABS waste plumbing, cellular core	2" Clean Outs		No	50	850	SP	1511100205	1.61	135	0.15		2	0	1	40
ABS waste plumbing, cellular core	2" Couplings		No	50	850	SP	1515583430	0.90	135	0.038		7	0	1	40
ABS waste plumbing, cellular core	3" pipe		Ft	50	850	SP	1515511930	2.66	138	0.374		7	0	1	40
ABS waste plumbing, cellular core	3" 90 el		No	50	850	SP	1515582830	3.86	135	0.342		7	0	1	40
ABS waste plumbing, cellular core	3" 45 el		No	50	850	SP	1515582835	3.86	135	0.204		7	0	1	40
ABS waste plumbing, cellular core	3" T		No	50	850	SP	1515583250	7.35	135	0.41		7	0	1	40
ABS waste plumbing, cellular core	3" Trap		No	50	850	SP	1511816740	27.50	135	0.892		2	0	1	40
ABS waste plumbing, cellular core	3" Clean Outs		No	50	850	SP	1511100210	6.99	135	0.39		2	0	1	40
ABS waste plumbing, cellular core	3" Couplings		No	50	850	SP	1515583450	3.25	135	0.141		7	0	1	40
ABS waste plumbing, cellular core	4" pipe		Ft	50	850	SP	1515511940	3.64	138	0.538		7	0	1	40
ABS waste plumbing, cellular core	4" 90 el		No	50	850	SP	1515582840	6.93	135	0.593		7	0	1	40
ABS waste plumbing, cellular core	4" 45 el		No	50	850	SP	1515582850	6.93	135	0.473		7	0	1	40
ABS waste plumbing, cellular core	4" T		No	50	850	SP	1515583260	12.25	135	0.812		7	0	1	40
ABS waste plumbing, cellular core	4" Trap		No	50	850	SP	1511816750	56.10	135	1.577		2	0	1	40
ABS waste plumbing, cellular core	4" Clean Outs		No	50	850	SP	1511100215	9.83	135	0.654		2	0	1	40
ABS waste plumbing, cellular core	4" Couplings		No	50	850	SP	1515583460	4.70	135	0.258		7	0	1	40
ABS waste plumbing, cellular core												7	0	1	40
ABS waste plumbing, cellular core												7	0	1	40
11.1.3	Copper plumbing														
Copper plumbing												5	0	1	50
Copper plumbing												5	0	1	50
Copper plumbing												5	0	1	50
Copper plumbing												5	0	1	50
11.2	PLUMBING FIXTURES														
Plumbing fixtures	Water heaters		No	100	850	SP	1531101000	158.40	302	75		0	30	10	20
Plumbing fixtures	Water closet		No	100	802	SP	1521800200	544.50	308	40		0	0	1	40
Plumbing fixtures	Bidets		No	100	802	SP	1521810010	330.00	308	25		0	0	1	40
Plumbing fixtures	Bathroom sink		No	100	802	SP	1521530010	253.00	308	20		0	10	10	40
Plumbing fixtures	Kitchen sink		No	100	708	SP	1521522200	239.80	308	25		0	10	10	40
Plumbing fixtures	Lavatories		No	100	802	SP	1521364040	286.00	308	5		0	0	1	40
Plumbing fixtures	Showers		No	100	802	SP	1521480050	267.30	308	50		0	10	10	40
Plumbing fixtures	Tub/shower		No	100	802	SP	1521044610	594.00	308	300		0	10	10	40
Plumbing fixtures	Hose bibs		No	100	704	SP	1511416000	11.00	308	0.1		5	0	1	50
Plumbing fixtures	Laundry connection		No	100	704	SP	1511411600	33.00	308	0.1		5	25	5	20
Plumbing fixtures	Laundry tub		No	100	704	SP	1521400050	316.80	308	10		0	10	10	40
Plumbing fixtures												0	0	1	40
Plumbing fixtures												0	0	1	40
Plumbing fixtures												0	0	1	40
Plumbing fixtures												0	0	1	40
Plumbing fixtures												0	0	1	40
11.3	HEATING														

## Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmbly	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace
Stage	Item	Qnty	Units	to int.	No.	ID	Number	bldr's	Code	to kg	Emiss.	Const.	prcentage	interval
11.3.1	FORCED AIR													
Forced air heating	Furnace										0	0	1	15
Forced air heating	Gas Furnace	No	100	862	SH	1554203020	440.00	301	85		0	0	1	15
Forced air heating	Oil Furnace	No	100	862	SH	1551206020	775.50	301	130		0	0	1	15
Forced air heating	Electric Furnace	No	100	862	SH	1554201020	319.00	301	45		0	0	1	15
Forced air heating	Heat Pump	No	100	862	SH	1571601020	#####	326	90		0	25	10	20
Forced air heating	Air handler	No	100	862	SH	1554207000	308.00	301	15		5	0	1	50
Forced air heating	Ductwork (supply, return and	Lb	100	862	SH	1572500010	2.70	283	0.454		0	10	20	50
Forced air heating	Thermostat, manual	No	100	862	SH	1574205030	17.93	499	0.3		0	0	1	50
Forced air heating	Filter, mechanical media	No	100	862	SH	1574013000	38.50	321	0.1		0	0	1	20
Forced air heating	Electrostatic filter	No	100	862	SH	1574012150	643.50	321	30		0	0	1	20
Forced air heating	Floor registers	No	100	862	SH	1574704020	11.83	283	0.5		0	10	20	50
Forced air heating	R/A grilles	No	100	862	SH	1574601000	7.87	283	0.5		0	10	20	50
Forced air heating	Dampers	No	100	862	SH	1574808100	18.81	283	0.25		0	10	20	50
Forced air heating	Gas piping	Ft	100	862	SH	268520550	3.26	250	0.5		5	0	1	50
Forced air heating	Electrical connection	No	100	862	SH	1621100020	1.17	372	0.1		5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
Forced air heating											5	0	1	50
11.3.2	HYDRONIC BASEBOARD													
Hydronic baseboard heating	Gas Boiler	No	100	862	SH	1551153000	#####	300	140		0	0	1	28
Hydronic baseboard heating	Oil Fired Boiler	No	100	862	SH	1551202000	#####	300	140		0	0	1	28
Hydronic baseboard heating	Electric Boiler	No	100	862	SH	1551101000	#####	300	45		0	0	1	28
Hydronic baseboard heating	Hot water distribution piping, 3/4"	Ft	100	862	SH	1514300300	0.99	308	0.588		0	0	1	50
Hydronic baseboard heating	Valves, 3/4"	No	100	862	SH	1519551860	12.10	308	0.08		0	0	1	50
Hydronic baseboard heating	Thermostat, manual	No	100	862	SH	1574205030	17.93	499	0.3		0	0	1	50
Hydronic baseboard heating	Pump	No	100	862	SH	1524100640	104.06	317	30		0	0	1	28
Hydronic baseboard heating	Fin tube radiators	No	100	862	SH	1556301320	8.47	300	2		0	20	20	50
Hydronic baseboard heating											0	0	1	50
11.3.3	HYDRONIC RADIANT													
Hydronic radiant heating	Gas Boiler	No	100	862	SH	1551153000	#####	300	140		0	0	1	28
Hydronic radiant heating	Oil Fired Boiler	No	100	862	SH	1551202000	#####	300	140		0	0	1	28
Hydronic radiant heating	Electric Boiler	No	100	862	SH	1551101000	#####	300	45		0	0	1	28
Hydronic radiant heating	Hot water distribution piping, 3/4"	Ft	100	862	SH	1514300300	0.99	308	0.588		0	0	1	50
Hydronic radiant heating	Valves, 3/4"	No	100	862	SH	1519551860	12.10	308	0.08		0	0	1	50
Hydronic radiant heating	Thermostat, manual	No	100	862	SH	1574205030	17.93	499	0.3		0	0	1	50
Hydronic radiant heating	Pump	No	100	862	SH	1524100640	104.06	317	30		0	0	1	50
Hydronic radiant heating											0	0	1	28

## Optimize Quantity Takeoff

										Conv	CFC	%	Maintenance	Replace	
		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Fact	Emiss.	Const.	prcentage	Interval	Replace
Stage	Item	Qty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Waste	(%)	(yrs)	entirely
11.3.4	ELECTRIC BASEBOARD														
Electric baseboard heating	Wiring		Ft	100	862	SH	1611450150	0.18	370	0.029		5	0	1	30
Electric baseboard heating	Baseboard units		No	100	862	SH	1681301200	49.50	354	4		5	0	1	30
Electric baseboard heating	Thermostat, manual		No	100	862	SH	1574205030	17.93	499	0.3		0	0	1	30
Electric baseboard heating												5	0	1	30
11.3.5	ELECTRIC RADIANT														
Electric radiant heating	Wiring		Ft	100	862	SH	1611450150	0.18	370	0.029		5	0	1	30
Electric radiant heating	Thermostat, manual		No	100	862	SH	1574205030	17.93	499	0.3		0	0	1	30
Electric radiant heating	Radiant sheet/panels		Ft2	100	862	SH	1681300400	6.24	283	0.275		5	0	1	30
Electric radiant heating												5	0	1	30
Electric radiant heating												5	0	1	30
Electric radiant heating												5	0	1	30
Electric radiant heating												5	0	1	30
Electric radiant heating												5	0	1	30
Electric radiant heating												5	0	1	30
11.4	COOLING														
Cooling System	Heat pump		No	100	862	SH	1571601020	#####	326	90		0	25	10	20
Cooling System	Fan coil		No	100	862	SH	1573000010	330.00	265	75		5	0	1	50
Cooling System	Air handler		No	100	862	SH	1554207000	308.00	300	15		5	0	1	50
Cooling System												5	0	1	50
11.5	VENTILATION														
Ventilation systems	Bath fans		No	100	862	SV	1681708260	19.80	320	2.5		0	15	10	20
Ventilation systems	Bath fan low sone		No	100	862	SV	1681708270	26.08	320	5		0	15	10	20
Ventilation systems	Central exhaust ventilator		No	100	862	SV	1572902000	379.50	320	15		0	15	10	20
Ventilation systems	Through wall supplies		No	100	862	SV	1572902025	9.90	283	0.25		0	15	10	20
Ventilation systems	Heat recovery ventilator		No	100	862	SV	1572902050	#####	320	60		0	0	1	50
Ventilation systems	Supply duct work, non-insul. 5" dia		Ft	100	862	SV	1572501540	0.91	283	9		5	15	10	20
Ventilation systems	Exhaust ductwork, non-insul. 5" dia		Ft	100	862	SV	1572501540	0.91	283	9		5	15	10	20
Ventilation systems	Supply duct work preinsulated flex, 5"		Ft	100	862	SV	1572902125	1.54	283	9.5		5	15	10	20
Ventilation systems	Exhaust ductwork preinsulated flex, 5" dia		Ft	100	862	SV	1572902150	1.54	283	9.5		5	15	10	20
Ventilation systems	Thermostat, manual		No	100	862	SV	1574205030	17.93	499	0.3		0	15	10	20
Ventilation systems	Flow measuring stations		No	100	862	SV	1572902200	27.50	499	0.25		0	0	1	50
Ventilation systems	Hoods		No	100	862	SV	1572902225	5.50	283	2		0	0	1	50
Ventilation systems	Grilles, 10" x 6"		No	100	862	SV	1574601020	9.08	283	0.5		0	15	10	20
Ventilation systems	Diffusers, 12" x 6"		No	100	862	SV	1574501020	41.69	283	1		0	15	10	20
Ventilation systems	Filters, mechanical media		No	100	862	SV	1574013000	38.50	321	0.1		0	15	10	20
Ventilation systems												0	0	1	50
Ventilation systems												0	0	1	50
Ventilation systems												0	0	1	50
Ventilation systems												0	0	1	50
Ventilation systems												0	0	1	50

## Optimize Quantity Takeoff

			Bldr's	Bldr's	% exp	Asmby	System	Product			Conv	CFC	%	Maintenance	Replace
Stage	Item	Qnty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	Emiss.	Const.	prcntage	Interval	entirely
										(mg/kg)	Waste	(%)	(yrs)	(yrs)	
Ventilation systems											0	0	1	50	
Ventilation systems											0	0	1	50	
<b>12</b>	<b>SECTION 12 ELECTRICAL</b>														
12.1	<b>ROUGH IN</b>														
12.1.1	Underground														
Underground electrical	U/G PVC connection box, 4x4x2		No	50	900	SE	1621200200	1.43	372	0.272		0	30	8	40
Underground electrical	2" PVC conduit, #40		Ft	50	900	SE	1602009150	1.87	372	0.322		5	30	8	40
Underground electrical	2" PVC L.B. Box		No	50	900	SE	1681700070	4.40	372	0.771		0	0	1	5
Underground electrical	2" PVC couplings		No	50	900	SE	1681700090	0.64	372	0.1		0	0	1	50
Underground electrical												5	30	8	40
Underground electrical												5	30	8	40
12.1.2	Circuits														
Electric circuits	#2 bare copper wire		Ft	50	900	SE	1618100600	0.59	265	0.091		5	30	8	40
Electric circuits	6'x5/8" galv st grndng rds		No	50	900	SE	1681700170	6.13	372	3		5	30	8	40
Electric circuits	200 amp service and panel		No	50	900	SE	1681701200	606.10	372	30		5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits	14-2 NMD copper wire		Ft	50	900	SE	1681450150	0.18	370	0.029		5	30	8	40
Electric circuits	14-3 NMD copper wire		Ft	50	900	SE	1681450200	0.33	370	0.038		5	30	8	40
Electric circuits	12-2 NMD copper wire		Ft	50	900	SE	1681450250	0.28	370	0.072		5	30	8	40
Electric circuits	10-3 NMD copper wire		Ft	50	900	SE	1681450400	0.69	370	0.122		5	30	8	40
Electric circuits	8-3 NMD copper wire		Ft	50	900	SE	1681450450	1.47	370	0.182		5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
Electric circuits												5	30	8	40
12.2	<b>FIXTURES</b>														
12.2.1	<b>WALL OUTLETS</b>														
Electrical: Wall outlets	Duplex		No	100	950	SE	1681704015	6.29	372	0.25		5	25	12	25
Electrical: Wall outlets	Half switched		No	100	950	SE	1681703110	12.58	372	0.25		5	25	12	25
Electrical: Wall outlets	G.F.I.		No	100	950	SE	1681704300	30.80	372	0.25		5	25	12	25
Electrical: Wall outlets	Waterproof		No	100	950	SE	1681704500	0.28	372	0.25		5	25	12	25
Electrical: Wall outlets												5	25	12	25
Electrical: Wall outlets												5	25	12	25
12.2.2	<b>SWITCHES</b>														
Electric switches	Single pole		No	100	950	SE	1681702110	6.29	372	0.25		5	25	12	25

Optimize Quantity Takeoff

		Bldr's	Bldr's	% exp	Asmby	System	Product	\$/unit	I/O	Conv	CFC	%	Maintenance	Replace	
Stage	Item	Qty	Units	to Int.	No.	ID	Number	bldr's	Code	to kg	(mg/kg)	Const.	prcntage	Interval	
Electric switches	3 way		No	100	950	SE	1681702150	10.41	372	0.5		5	25	12	25
Electric switches	4 way		No	100	950	SE	1681702200	20.42	372	0.5		5	25	12	25
Electric switches	timers		No	100	950	SE	1681702410	21.27	372	0.25		5	25	12	25
Electric switches												5	25	12	25
12.2.3	LIGHT FIXTURES (interior)														
int. electrical light fixtures	Recessed		No	100	950	SE	1661452700	55.00	374	2		5	25	12	25
int. electrical light fixtures	Surface mounted		No	100	950	SE	1661301100	55.00	374	2		5	25	12	25
int. electrical light fixtures	Pull chain		No	100	950	SE	1661307000	55.00	374	2		5	25	12	25
int. electrical light fixtures												5	25	12	25
12.2.4	LIGHT FIXTURES (exterior)														
ext. electrical light fixtures	Surface mount		No	100	950	SE	1661157500	55.00	374	2		5	25	12	25
ext. electrical light fixtures												5	25	12	25
ext. electrical light fixtures												5	25	12	25
12.2.5	MISC. CONNECTIONS														
Misc. electrical connections	Door chimes	1	100	950	SE	1681251000	23.10	363	0.5		0	0	1	40	
Misc. electrical connections	Smoke detector		No	100	950	SE	1681205200	53.90	363	0.25		0	0	1	40
Misc. electrical connections	Burglar Alarm		No	100	950	SE	1681200100	209.00	363	0.5		0	0	1	40
Misc. electrical connections	Dishwasher hook up		No	100	950	SE	1681704015	6.29	372	0.25		0	0	1	40
Misc. electrical connections	Furnace hook up		No	100	950	SE	1681709060	31.90	372	0.5		0	0	1	40
Misc. electrical connections	Air conditioner hook up		No	100	950	SE	1681709130	113.30	372	0.5		0	0	1	40
Misc. electrical connections	Bath fan hook up		No	100	950	SE	1681708200	3.77	372	0.25		0	0	1	40
Misc. electrical connections	Central exhaust ventilator hook up		No	100	950	SE	1681708500	33.00	372	0.5		0	0	1	40
Misc. electrical connections	Heat recovery ventilator hook up		No	100	950	SE	1681708580	33.00	372	0.5		0	0	1	40
Misc. electrical connections	Range hood hook up		No	100	950	SE	1681708200	3.77	372	0.25		0	0	1	40
Misc. electrical connections	Overhead door operator hook up		No	100	950	SE	1681704010	6.29	372	0.25		0	0	1	40
Misc. electrical connections	Washer hook up		No	100	950	SE	1681704010	6.29	372	0.25		0	0	1	40
Misc. electrical connections	30 amp dryer outlet		No	100	950	SE	1681704650	46.90	372	0.5		0	0	1	40
Misc. electrical connections	40 amp range outlet		No	100	950	SE	1681704700	78.94	372	0.5		0	0	1	40
Misc. electrical connections	Garburator hook up		No	100	950	SE	1681708050	19.25	372	0.5		0	0	1	40
Misc. electrical connections												0	0	1	40