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A CONCEPTUAL COST ESTIMATING COMPUTER SYSTEM FOR BUILDING PROJECTS

Ahmad Jrade

A Thesis

in

The Department

of

Building Civil & Environmental Engineering

Presented in Partial Fulfilment of the Requirements for the Degree of Master of Applied Science at Concordia University Montreal, Quebec, Canada

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Department of Building, Civil and Environmental Engineering

This is to certify that the thesis prepared

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Entitled: **A Conceptual Cost Estimating Computer System for Building Projects**

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complies with the regulations of the University and meets with the accepted standards with respect to originality and quality.

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ABSTRACT

A CONCEPTUAL COST ESTIMATING COMPUTER SYSTEM FOR BUILDING PROJECTS

Ahmad Jrade

Estimating the cost of construction is considered to be the most momentous and suspenseful task in the implementation life of any project. Vital decisions are based on that estimate. Hence the preparation of a reliable and realistic estimate to guide the management decision is a complicated assignment. Traditional methods and operations produced unsatisfactory aid due to lack of accuracy especially in the pre-design stage of a project. This participates in the increase of percentage of bankruptcy in the construction industry which has dramatically climbed up and ranked as 15 percent of the whole bankruptcies claimed in Canada (Statistic Canada 1998).

Nowadays, the construction industry is influenced by the rapid grow of using computers. This powerful tool is employed in many major aspects of construction, for instance cost estimating; planning and scheduling are little of many to list.

This research presents a methodology to develop a computer system "CSC-Estimate", Computer System for Construction Estimates, that stresses on the early and preliminary stages of estimating the construction costs of any

commercial building that also can be used for residential buildings if a reduction factor of 20 to 30 percent is considered. The methodology utilizes tools available between hands, Access 97 the database member of Microsoft Office 97 family and Visual Basic for Application, the child of the Object Oriented Programming Language Visual Basic (6.0).

The methodology introduces a new tool to be used for the construction industry in general and for the Canadian industry in particular. "CSC-Estimate" is designed to generate parametric and preliminary estimates to be used by the owner for feasibility purposes, by the architects and engineers for conceptual estimates or when considering alternatives, as well by the contractor for bidding purposes.

Two cases consist of actual projects are presented in order to illustrate the effectiveness and performance of the proposed model.

The proposed system automates the preparation of a parametric and preliminary cost estimate and its design allows further extensions and enhancements. The development made according to Yardsticks for Costing, the Cost Data for the Canadian Construction Industry, exhibits the powerful capabilities of Microsoft Access 97 and Visual Basic for Application to store, manipulate and edit all data for future use.

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CHAPTER 1

INTRODUCTION

1.1 General

Generally, the process of awarding any construction contract is based on a competitive bidding. Contractors will be invited to submit their bids to the owner who normally awards the lowest bid to construct the project. Beforehand, both the owner and contractor have to assess the construction cost of the proposed project. This is achieved through a construction cost estimate. Although, the actual total cost of construction is not known until the completion of the project, conceptual estimates can be a good start for the owner, engineer and contractor. The owner will be able to estimate in advance a range of the final cost, to secure the lowest cost to construct the project, and budget the necessary fund in advance. On the other hand, risks considerably affect the cost of the contractor, for example unforeseen costs, resource availability, severe weather conditions, inflation rates, and so on. Considering an adequate contingency percentage to the total estimated costs covers such risks. In order to win the contract, the contractor bid price has to be low enough to compete with other competitors, yet high enough to cover his risks and make some profit. Consequently, the importance of cost estimates is enormous for all project phases, moreover at the conceptual design or feasibility phase.

The preparation of any type of cost estimate depends on the experience of the estimator, the tools used, the time spent, and the information available.

Usually the preparation of an estimate starts by breaking down the project into packages or components, then taking off the quantities of the elements of each package and next pricing them all. Finally, by summing up the prices the direct construction cost is computed. This process is long and complex but the most complicated part of it is the quantity take off. Consequently, computers are considered to be effective tools in cost estimating, due to their capability of doing complex calculations and storing huge amount of data for future use.

Any decision concerning the construction of a project that has been or to be executed is based on one type of estimates, which are preliminary estimates. Despite their moderate level of accuracy owner, engineer and contractor consider them as the first choice estimates because they are inexpensive and fast to generate. Owner uses them to decide whether constructing a project is feasible and to evaluate contractors bids, while engineer to design within owner's budget and considering alternatives, and the contractor to know if bidding on a project is profitable or not. Consequently, in the proposed methodology the concentration is on the preliminary construction cost estimates with the emphasis on a computer model as an avail tool for estimators.

1.2 Research Objectives

Any construction project consists of four major parts that are Money, Materials, Manpower and Machines. After all, the most important one is Money or in other words the project cost. Thus, the way of success for any construction project starts with an accurate and efficient cost estimate. Inaccurate estimates outcome

a serious loss if the project is underestimated or going out of business if the project is overestimated.

The main objective of this research is to study the different types, methods and process of construction cost estimates. Aiming at modeling the process of construction cost estimates in a computerized environment.

The following list outlines the research objectives:

- Understand precisely the construction cost estimating process and classifying the different types of costs.
- Analyze the factors affecting the accuracy of estimating the cost of construction.
- Study the current status of using computers in construction cost estimating.
- Develop a computer based tool capable of estimating the construction costs of commercial buildings at their preliminary stages.

1.3 Methodology

In favor of achieving the foregoing objectives the following procedures are carried out:

1.3.1 Literature Review

A comprehensive literature review in the construction cost estimating area is fulfilled.

1.3.2 Interview

Interviewing the following construction firms: Magil Construction Corporation; Both Bell Robb; Leroux Chauhan Ouimet & Associes; and Cressey Development to discuss the types of cost estimating software they are utilizing.

1.3.3 Data Collection

The data used in the model development are based on the MASTERFORMAT divisions (Construction Specification Institute, 1995) collected from Yardsticks for Costing (Means, 1998). Coding adjustment is made for updating and editing purposes.

1.3.4 Development of the model

The developed computer model was presented to the specialists for comment, feed back and to test its effectiveness.

1.4 Thesis Organization

Chapter 2 introduces a summary of the intense literature review. This includes, types, methods, and process of construction cost estimates, as well as quantities take off, MASTERFORMAT and UNIFORMAT are briefly described. Emphasizes on conceptual and preliminary cost estimates, their importance and use.

Chapter 3 describes the role of computers in cost estimating. Listing the common computer cost estimating software, the advantages and disadvantages of such software, as well as the requirements for developing a satisfactory cost estimating database.

Chapter 4 explains the methodology followed in developing the proposed system. Its' structure, components and data flow.

Chapter 5 discusses the implementation of the system. It also illustrates the system's databases and their modules, and the required input and the expected output.

Chapter 6 presents the system performance through two actual projects.

Chapter 7 is the thesis conclusion, implementation and recommendations for future extensions of the current research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Cost estimating is an essential aspect for the business operations of construction firms. Construction is a unique industry that by nature is risky since most projects must be priced before they are constructed, whereas in other industries the selling price is based on known manufacturing costs. The success or failure of a project relies on the accuracy of several estimates done throughout the course of the project.

This chapter presents a review of the types, methods and current practices used in the construction cost estimating. Additionally, a brief review of the MASTERFORMAT and UNIFORMAT, quantity takeoff is provided. Computer applications as an effective tool to prepare construction cost estimates, common types of estimating software are listed and discussed in chapter 3.

2.2 Cost Estimating Definitions

Researchers and experts give cost estimating different definitions, thus the succeeding paragraph states some of them.

The Project Management Institute (PMI) defines the cost estimating to involve developing an approximation (estimate) of costs of the resources needed to complete project activities (Duncan 1996). Hendrickson specifies that a construction cost estimate serves one of the three basic functions that are design, bid, and control. Furthermore, he defines that at the very early stage of

design, the screening estimate or order of magnitude estimate is made before the facility is designed, therefore it relies on the cost data of similar facilities built in the past. While preliminary or conceptual estimate is based on the conceptual design of the facility at the state when the basic technologies for the design are known. Moreover, the detailed or definitive estimate is made when the scope of work is clearly defined and the detailed design is in progress. Also engineer's estimate is based on the completed plans and specifications when they are ready for the owner to solicit bids from construction contractors (Hendrickson 1989). Association for the Advancement of Cost Engineering (AACE) International defines the cost estimation to provide the basis for project management, business planning, budget preparation, and cost and schedule control. Included in these costs are assessments and an evaluation of risks and uncertainties (Uppal 1997). On the other hand, Carr defines it as being an accurate reflection of reality that shows the level of detail that is relevant to decisions (Carr 1989). Estimating is the process of looking into the future and trying to forecast project costs and resource requirements (Halpin 1985). An estimate is a judgement, opinion, forecast or prediction. It is a judgement or opinion of the cost of a process, product, project or service. It is a prediction or forecast of what a work output or work activity will cost (Stewart 1982). According to the National Estimating Society by Laws, March 1978 Estimating is the art of approximating the probable worth or cost of an activity based on information available at the time (Stewart 1982). Consequently, all those definitions are similar in one way or the other in describing cost estimate as being the process of guessing and

foreseeing the future costs of a project or product before it actually exist. Despite the likeness between cost estimating and pricing, one has to carefully distinguish the difference. Cost estimating involves developing an assessment of the likely quantitative result, how much will it cost to perform products or service involved. Pricing is a business decision, how much will be the charge for that product or service (Duncan 1996). Wood mentioned that in management terminology the cost refers to expenditure, not revenue, the price and cost are not the same. Thus, the price may be less than the cost in the case of a loss, or the price may be greater than the cost in the case of a profit (Wood 1974).

2.3 Purposes of Cost Estimates

Peculiar to the preceding definitions an estimate, at its best, is a close approximation of the actual costs. Hence the purpose of an estimate is to postulate the costs required to completing a project in accordance with the contract plans and specifications. Furthermore, it is important that management has as much information as possible when deciding on funding projects. Sutherland (1999) explains the purpose as to provide the client and design team with as precise an estimate of final cost as possible so that the project can be accomplished within the client's budget. Likewise, Westney (1997) outlines the purposes of a cost estimate through the following:

- Provides an assessment of capital cost for a specified piece of work.
- Forms the basic for planning and control by defining the scope of work and it's associated estimated cost.

- Provides much of the basic information (hours, resources, tasks, and durations) which is needed for preparing a schedule. It also states general resource requirements such as labor, material, and construction equipment.
- Provides the financial input required to prepare a cash flow curve.
- Provides an assistance to assess productivity and risk.
- Is a catalyst for discussion, idea generation, team participation, clarity, and buy-in. it ties together much of the relevant project information within a simple document.

2.4 Estimating and Project Management Roles

Both project management and estimator differently share responsibilities in performing an estimate at the decision level.

2.4.1 Project Management Estimating Responsibility

Decision-making requires a sequence of actions needed to be taken to perform the process from an initial status to a goal status (Hegazy 1993). Therefore, management must know what cost information is needed and how to use it in making decisions. Estimate development must be directed and approved by management prior to issue. Kerzner (1992) proclaims that the project manager is actively involved in the development of the estimate and is responsible for the final product. The project team is responsible for providing the necessary project deliverables and scope information to the estimator (Dysert 1997).

2.4.2 Estimator Responsibility

Estimating is a fundamental part of the construction industry. Cost estimating accuracy is the basis of a project success or failure. Accurate estimates optimize good contracting (Adrian 1993). Much of the credit for the fruition or dud of a construction enterprise is attributed to the accuracy and capability of its estimating department and personnel. An accurate, liable and realistic bid preparation demand good judgement and estimating skills. It is the estimator responsibility to ensure that a project team understands the information needs for the estimate, then ensure that the information provided is suitable to produce the quality of estimate desired (Dysert 1997). Estimators should compile and analyze data on all factors that might influence the cost like materials, labor, location and equipment (Cost Engineering Journal 1998). Estimating is not an easy process, it involves complex calculations, and when little information is available demand the estimator to imagine the elements of the projects. It is important that the estimator views the complete estimate in orderly steps that include quantity takeoff, costing of the work, determination of overhead costs, and the determination of an appropriate profit (Adrian 1993). Including all the items in the project neither more nor less challenges estimator. Prior to the design completion, estimator has to have the vision to see beyond the obvious components and their primary costs of construction (Carr 1989).

2.4.3 Estimator Skills

The challenge that faces a cost estimation is to have it close to the actual cost, this inquires good skill and experience. Dysert and Elliott (1999) avows that an

effective estimating organization requires highly knowledgeable personnel, possessing technical skills. Furthermore, they define a set of skills as estimating core competencies as follows:

- Understanding of the capital project process.
- Detailed understanding of the estimate requirements for each class of estimate.
- Engineering document reading.
- Code of accounts /work breakdown structures/project breakdown structures.
- Basic project controls (budgets, schedules, cost control, change management, progress measurements, earned value, forecasting).
- Data analysis (labor productivity, database standards and development, historical data analysis, and benchmarking).
- Strategic estimating skills (capacity factoring, equipment factoring, cost modeling, general factor, and ratio development).
- Detailed estimating skills (material takeoffs, pricing, and costing).
- General software.
- Estimating software.
- Presentation skills.
- Report writing.
- Listening.

2.5 Types of Estimates

The availability of design data to the estimator does influence the type of estimate to be chosen. Cost estimates may be divided into two different types, depending on the purpose for which they are prepared for and the amount of information known when estimates are prepared (Peurifoy 1989). Approximate and detailed estimates are the major types of construction cost estimates. Stewart (1982) classifies the cost estimating methods as the "top-down" or parametric approach that uses historical data from previous projects to develop the cost of new project based on increased or decreased factors; or the "ground-up" or industrial engineering approach that requires estimating and pricing the man-hours and materials of each element. Approximate estimates are commonly known as Conceptual, Preliminary, Order of Magnitude, and Budget or feasibility estimates. Meanwhile engineers, bid, and definitive estimates are other names for detailed estimates. The most common estimates' types used in building construction are 1) conceptual estimate, 2) preliminary estimate, 3) engineer's estimate, and 4) bid estimate. The four levels reflect the fact that as the project proceeds from concept through preliminary, to final and bidding phase, the level of detail increases, allowing the development of a more accurate estimate (Halpin 1985). AACE International has identified a progression of five types of estimates of construction costs during engineering design: order of magnitude, conceptual, preliminary, definitive, and control (Duncan 1996).

Furthermore, Westney (1997) classified the estimating types based on 1) How the estimate will be used. 2) The type, quality, and amount of information

available for preparing the estimate. 3) The range of accuracy desired in the estimate. 4) The calculation technique used to prepare the estimate. 5) The time allotted to produce the estimate. 6) The method of input and output (manual or computer) used in preparing the estimate. 7) The phase of project (feasibility, appropriation, and construction) related to the estimate. 8) For whom the estimate is prepared (owner, contractor, or insurance company). Generally, the estimating chore continues during the different phases of the project construction to ascertain whether the actual costs match with the bid's estimate. Although, numerous methods and level of accuracy are available to estimate the cost of constructing a project, all these estimates are approximated and are based on experience and judgement (Barrie and Paulson 1992). Certainly the total actual costs will be known just when the project construction is consummated. Table 2.1 lists the four commonly used estimates, when each one of them can be used according to the design progresses, in addition to the purpose of using each one of them.

Table 2.1: Types of Cost Estimates

Estimate Type	When ?	Why ?
Conceptual Estimate	Prior to Design	Useful for decisions in conceptual and budgetary stage
Preliminary Estimate	After preliminary design (40% of total design)	Offers the owner a pause to review design before the detail
Engineers Estimate	After detail design (100% of total design)	Ensures design is within financial resources and assists in evaluating bids
Bid Estimate	During bidding by contractor	Establish bid price

Ref.: El-Rayes (1999)

2.6 Approximate Estimates

Preliminary, Conceptual, Order of Magnitude, or Budget (feasibility) estimates are normally prepared by the owner, designer and contractor in different stages. The purpose of these kinds of estimates is to screen and eliminate unsound proposals without extensive engineering costs. If these estimates lead to a continuation rather than dismissal decision, additional detailed and accurate methods are required (Ostwald 1984). Dysert and Elliott (1999) pronounce that preparing estimates for capital projects is a key part of a company's strategic asset planning. It is one of the core processes that comprise total cost management. An estimate based on approximate quantities is often used for the cost check estimate; and is favored by the owner, because it provides a more detailed and reliable estimate of each building element (Park, Choi and Kim 1999).

2.6.1 Feasibility Estimate

In order to translate the idea of constructing a project from initiation to reality the thousands miles starts by a major step that is a feasibility estimate. Upon this estimate the owner decides whether the project will be executed or not. Early project cost estimates are significant to an owner because they need to be accurate enough to impart the confidence needed to commit additional funds to the project (Al-Tabtabai and Alex 1999). The feasibility of any project significantly depends on estimating its costs. These costs include initial construction, design, finance, and maintenance and repair costs (Adrian 1993).

Since the owner basically prepares this kind of estimate, one can use it for other purposes too. The owner's estimate (feasibility or budget) is used 1) to ensure that the design produced is within the owner's financial resources to construct, 2) to establish a reference point in evaluating the bids submitted by the competing contractors (Halpin 1985).

2.6.2 Preliminary Estimates

Preliminary estimate, known also as pre-construction estimate is defined as the one that is made in the formative stages of design (Ostwald 1984). Preliminary estimates provide an approximate indication of the total project cost during the pre-contract and construction stages. They are usually prepared before or during the early stages of preliminary design. They are quick and relatively inexpensive and they are the keystones for necessary action to be taken by owners or construction firms. Engineers and management use this kind of estimates to cut out uneconomical design at an early point. The main objective of an initial (preliminary) estimate is to generate a realistic final cost of the project with the information available. Many items are unknown at this early stage and the estimate will be a mixture of prices for scope that is identified, and allowances for scope that is not (Sutherland 1999). This type of estimate is important for the whole life of the project, from initiation to completion. Before feasibility studies or conceptual works for a project can start, some sort of estimates must be prepared. The preliminary estimates are considered the benchmark estimates. These estimates are continually modified and improved as the project is better defined (Uppal 1999). The preliminary estimate is requested at some point in the

initial evaluation. With a lack of facts and specific information the cost estimator is asked to provide this first estimate. The purpose of this estimate is dependable on the owner demands, the type and the size of the project. Additionally, It is used to evaluate possible design modifications and alternatives to keep the project within the owner's budget as well as to appraise contractors bids. Adrian (1993) classified the purposes of a preliminary estimate as follow:

- It supplements or serves as the owner's feasibility estimate.
- It aids the Architect and Engineer in designing to a specific budget.
- It assists in the establishment of the owner's funding.
- It serves as a means of evaluating contractor bids.
- It provides the basis for determining progress payments to be made to contractors.

Despite the lack of information available to the estimator at the time of preparing preliminary estimate, where drawings and specifications are not complete, it has to be as reasonable as possible since important decisions are based on it.

2.7 Detailed Estimate

Once the project design progresses, detailed estimates are established. For detailed estimates, the estimator should mentally construct the project, select the materials, equipment, and crews to fit the design. Then chooses the best resources information available to estimate the costs of performing the work (Carr 1989). Compared to preliminary estimate, detailed estimate is expensive and needs more time. The preparation of detailed estimate requires that the

estimator break the project into components and sub-components, then cost them accordingly. It is these costs that the estimator must develop on the basis of the characteristic resources required. Estimator normally follows certain steps to develop an estimate. 1) Break the project into cost centers. 2) Estimate the quantities required for each cost center (Quantity takeoff).

3) Price out the quantities determined in step (2). 4) Calculate the total price for each cost center (Halpin 1985).

Since a detailed estimate breaks down the project into series of elements, its level of accuracy is much higher compared to preliminary estimate. Detailed estimate is important to both the owner and the contractor, because it represents the bid price; the amount of money the owner must pay for completion of the project and the amount of money that the contractor will receive for building the project (Peuifoy 1989). The process of preparing a detailed estimate begins with a thorough review of the complete set of contract documents, the bidding and contract requirements, drawings, and technical specification (Kerzner 1992). To complete the total cost of the project, an organized list of all work items necessary to construct the project has to be compiled by taking off the quantities from detailed drawings. The work items are arranged according to a well-known approach such as the Construction Specification Institute (CSI) for building construction projects. Another approach uses a Work Breakdown Structure (WBS) to identify work items by their location on the project (Peuifoy 1989). Based on the author own experience, construction firms organize their estimate following the sixteen major divisions of the CSI approach with few adjustments

either by adding or waving divisions in accordance to their own construction processes. The prevalently known formats in the building construction industry are MASTERFORMAT and UNIFORMAT.

2.8 Estimate accuracy and affecting factors

Ordinarily, if an estimate is poorly done, no external analysis will improve it. Therefore the accuracy, reliability and quality of estimates are very important regardless of their types. Obviously the accuracy of the estimate depends on the amount and quality of information and the time available to prepare it (Ostwald 1984). Moreover Westney (1997) adds that the estimate accuracy is directly related to the availability of information, time, available resources (people, equipment, money), and estimating methodology.

2.8.1 Classification

The estimate level of accuracy depends on its type. Two major references, AACE International and R. S. Means, have classified this accuracy in different ways.

2.8.1.1 AACE Classification

Figure 2.1 illustrates the new AACE International expected accuracy ranges for each of the five classes of estimates. For each estimate class, the estimate should be developed with the same level of project definition, purpose, and preparation effort. Therefore, the expected accuracy range for an estimate should be at least similar, if not identical (Wendling and Lorance 1999).

2.8.1.2 R. S. Means Classification

Using R. S. Means' classification, the accuracy of the estimate varies from (± 20%) to (± 5%) as follows: (Alkass 1998)

- Order of magnitude estimate: ± 20 %
- Square or cubic foot estimate: ± 15%
- System estimates: ± 10 %
- Unit price estimates: ± 5%

2.8.2 Factors affecting estimate accuracy

Estimated costs are based on combination of historical data of previous projects and price quotations received from suppliers or vendors. Cost estimates are influenced by factors that arise from the operating environment. For instance, the cost varies if the proposed project is constructed near a city or in a rural location. Effective construction cost estimating is heavily dependent on experience (Al-Tabtabai and Alex 1999). Since estimating process is a forecast of the future cost of constructing a project, it is a process surrounded by uncertainty and risk. To produce a reliable estimate numerous factors should be considered. Errors during the estimating process have cost construction firms millions of dollars all over the years. Usually estimator uses cost data from past projects or published in estimating guides. Using such data arbitrary without knowing their similarity at hand will produce an inaccurate estimate because it is not based on the reality of the current project (Carr 1989). Regardless of the type, preparing an accurate estimate requires several skills. Adrian (1993) classifies three essential elements to an accurate estimate stated as follows:

1. Determination of the quantity of work.
2. Identification of the productivity needed to perform the most difficult to estimate, project drawings and the cost of rework.
3. Calculation of the unit cost of the resources to be used for the work.

2.8.2.1 Quantity Takeoff (Surveying)

Another common name of quantity takeoff is quantity surveying. The development of the quantities of work to be placed in appropriate units is referred to the quantity takeoff or surveying (Halpin 1985). Regardless of the type of the estimate, items to be estimated must be listed. This is the most important look of the contractor's estimating and bid functions. Taking off the quantities from drawings and specifications is a time consuming step. Adrian (1993) assorts the required time and accuracy level of quantity takeoff to be depending on:

- The skills and procedures used by the estimator.
- The quality of the project drawings and related documents prepared by the designer.
- The definition of the work items to be taken off the drawings.

Quantity takeoff may be done manually or by using electronic digitizers in conjunction with estimating software. Since it is one of the most time consuming activities in the estimating process, contractors and owners more frequently use computer systems (Westney 1997). Traditionally, quantity takeoff is done manually accordingly errors are most likely produced. Halpin (1985) lists some of the most common errors as being:

1. Arithmetic, errors in addition, subtraction, and multiplication.

ESTIMATE CLASS	LEVEL OF PROJECT DEFINITION Expressed as % of Complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE typical variation in low and high Ranges [a]	PREPARATION EFFORT Typical degree of effort relative to least costs index of 1 (b)
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models Judgment, or Analogy	L -20% to - 50% H +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Primarily Stochastic	L -15% to -30% H +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Mixed, but Primarily Stochastic	L - 10% to -20 % H +10% to +30%	3 to 10
Class 2	30% to 70%	Controls or Bid Tender	Primarily Deterministic	L -5% to -15% H +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid / Tender	Deterministic	L -3% to -10% H +3% to +15%	5 to 100

Figure 2.1 Cost Estimate Matrix for Process Industries: AACE International Recommended Practice No. 17R-97
Ref. Wending and Lorance (1999)

2. Transposition mistakes in copying or transferring figures, dimensions, or quantities.
3. Errors of Omission, overlooking items called for or required to accomplish the work.
4. Poor reference, scaling drawings rather than using the dimensions indicated.
5. Unrealistic waste or loss factor.

In addition to the foregoing list, Foster (1995) has added two more common errors that are 1) using wrong formula, and 2) using the wrong conversion factor.

2.8.2.2 Costing the quantity takeoff

Once the quantity takeoff is allocated to the work components, and the quantities of each element are tabulated, their cost must be indicated. First, estimator deals with the direct costs that consist of the cost of materials, labor, and equipment for each work components or elements. Doing so, typical mistakes occur, Foster (1995) includes the following:

- Errors in simple mathematics (careless extensions of quantities times unit prices).
- Using old or unverified material unit prices.
- Using wrong labor rates.
- Transposing figures after extensions are made.
- Inadvertently leaving elements of work off the pricing sheet.

Basically cost estimates are prepared from three sources of cost related data. These are 1) published cost information, 2) costs from similar projects and costs of project equipment, and 3) historical company cost data files and in-house

projects (Uppal 1997). The sources of outside cost data are many, listed are some of the most common ones.

- R. S. Means, it is a yearly publication that gives the cost of material, labor, and construction costs.
- Richardson, it is a yearly publication but updated quarterly, gives the costs of materials, labor, equipment, and construction cost.
- Conceptual Cost Estimating, it is a book published by Gulf Publishing, gives cost/size for a large number of major equipment items and materials, plus information on other categories of project cost.

2.9 Estimating Methods

Estimates are required at all stages of a project with varying amount of available information thus several methods are evolved. Estimator has to always consider the relationship between available information, project stage, method and estimate accuracy. Forecasting is the procedure for simulating the future by creation of a picture based on historical information (Dawood and Bates 1997). Yet forecasting contrived from publishing press is slightly accurate so forecast should be carried out on information related to the industry in which it is to serve. Different estimating methods are described in the midst of the succeeding paragraphs.

2.9.1 Cost Index

The historical cost data that an estimator refers to changes with the inflation rates therefore it has to be adjusted accordingly. Such adjustment is persuaded

through the use of indexes. To develop the index, there is one main requirement, the historical data. Without the data there can be no index creation. It has been said that the answer to the future lies in the past. The usefulness of such data has no end (Dawood and Bates 1997). Cost index provides a comparison of cost or price changes from year to year for a fixed quantity of work or service. Using equation [2.1], the estimator can forecast the cost of a similar type of work from the past to the present or future period (Adrian 1993).

$$C_c = C_r \left(\frac{I_C}{I_R} \right) \qquad [2.1]$$

Where C_c = present cost in dollars

C_r = original reference cost in dollars

I_C = index value at present time

I_R = index value at time reference cost was obtained

Properly applied index can yield accuracy around 20 to 30 % of actual costs and can provide this information with almost a negligible time and effort. Such information can be valuable for policy and planning decisions early in the life of a project (Barrie and Paulson 1992). There are varieties of cost indices available to the estimator the most widely known construction indexes are those published by Engineering News Record (ENR).

Before applying the cost indices, it is important to understand how they are derived, their limitations and the differences in the basic methods.

2.9.2 Cost Capacity Factor

In 1950 Chilton was the first to propose a cost to capacity relationship for chemical plants (Ellsworth 1998). With estimating for early project economics,

cost capacity factors apply to changes in size, scope, or capacity of projects of similar types. Capacity factors are widely used in the petrochemical sector of the industrial construction industry. The cost capacity factor is expressed by the equation [2.2] (Barrie and Paulson 1992)

$$C_2 = C_1 \left(\frac{Q_2}{Q_1} \right)^x \qquad [2.2]$$

Where C_2 = estimated cost of new facility of capacity Q_2

C_1 = known cost of facility of capacity Q_1

Q_1 = size of known facility

Q_2 = size of new facility

and x = cost capacity factor for this type of work.

2.9.3 Parameter Costs

According to the USA Department of Defense (1995) A parametric cost estimate is one that uses Cost Estimating Relationships and associated mathematical algorithms to establish cost estimates.

Recently a preliminary cost estimate method known as parameter estimate was developed. It is used by the owner for an approximate estimate and by the estimator to evaluate contractor bids (Adrian 1993). Conceptual estimates based on parameter costs are most commonly used in building construction. The parameter cost approach relates all costs of a project to just a few physical measures or parameters, which reflects the size or scope of that project (Barrie and Paulson 1992).

Meyer and Burns (1999) inform that parametric cost estimating uses factors based on engineering parameters to develop accurate cost estimates. The engineering parameters are developed from historical cost databases, construction practices, and engineering/construction technology. These parameters include physical properties that describe project characteristic.

Parameter cost estimate can be prepared long before detailed drawings are completed and an experienced estimator with the help of well documented records can quickly procreate an estimate that will influence the design and control costs in the early phases of a project.

2.9.4 Range estimating

Cost estimate is composed of many items including labor, materials, and equipment. The bottom line estimate is attained from the application of simple arithmetic (electronic spreadsheet, traditional estimating), but the real world is populated with probabilistic and ranges of possibilities. Since estimate is an approximate so it is uncertain.

The uncertainty measurement of a building cost estimate dependents on the skill and knowledge of the estimator, the characteristics of the building being proposed and the timing of the estimate. One mechanism of knowing and evaluating the uncertainty of an estimate is through the use of Range Estimating (Adrian 1993).

Range estimating is not an estimating system it is a decision technology (Curran 1989).

2.10 Different types of Costs

Albeit the determination of cost is the final step in the preparation of an estimate, estimator has to discern all types of costs to be engaged.

The estimator has to have the ability to understand the concept of a cost and its components. This is highlighted by the fact that the cost estimate serves to initiate the project and to engage the contractor who will build that project (Adrian 1993).

Halpin (1985) classifies costs into four major genera 1) Direct costs related to placing construction. 2) Subcontracior cost and repayment. 3) Job indirect costs (for mobilizing). 4) Markup.

A direct cost of an activity is physically traceable to the activity in an economic manner it is not counted if the activity is not performed. On the other hand, indirect costs, known as overheads, are business costs other than direct costs of construction activities, they are not physically traceable and are counted even the activity is not performed (Carr 1989). Construction direct costs are those resource costs required to place the elements of construction in a project. Meanwhile Carr (1989) classifies direct costs as costs of materials, labor, and equipment. Halpin (1985) includes the cost of small hand tools.

Traditionally, most contractors cover the project overhead costs by adding a percentage to the direct cost.

Assaf, Budshait and Atiyah (1999) consider this method to be inaccurate and recommend that project overhead costs can be estimated with some accuracy by

carefully examining contract conditions since they ponder overhead cost is not part of actual construction cost but an indirect cost.

Estimating project overhead costs is the most difficult ones to estimate with reasonable accuracy, especially for large and complex project (Collier 1984).

2.11 Tools and Methodologies for Cost Estimating

Regardless of the cost estimate type, the preparation requires specific tools and methodology in order to achieve the best out of it. Stewart (1982) list five basic tools for a cost estimate as follows 1) An estimator or team of estimators. 2) A methodological approach. 3) Knowledge or data concerning the project, process, product, or service. 4) A computation capability. 5) A publication capability.

Besides Westney (1997) pronounces that cost estimating tools include the forms, hardware, and software used to execute the estimating methodology. Estimating tools fall into the two broad classes of manual forms and computer software.

Additionally the Project Management Institute considers that computerized tools are widely used to assist with cost estimating (Duncan 1996). To be more specific the USA Department of Defense (1995) considers Parametric tools bring speed, accuracy and flexibility to estimating processes that are often bogged down in unnecessary detail.

Larry Aaron (a contributor in Westney book 1997) particularizes an effective methodology to consist of 1) A variety of estimating calculation techniques that is fitted to the information available at each project phase. 2) A relevant cost

estimating database with the hierarchical structure that provides continuity in information management and project controls.

2.12 MASTERFORMAT and UNIFORMAT

Based on the Construction Specifications Institute and Construction Specifications Canada (1995) MASTERFORMAT is a master list of numbers and titles, a uniform system to organize information about construction requirements, products, and activities in a standard sequence. Today MASTERFORMAT is the only system to organize construction specifications used in the United States and Canada. It arranges related construction products and activities into 16 divisions that are classified by numbers and titles. In cost estimating this format is used to identify unit prices and cost report items, to arrange a database of product and activity unit costs as well as to tabulate a project budget according to a product and activity breakdown and relate cost items to specifications and drawings. An identification scheme based on MASTERFORMAT can be flexible, vary with each construction project.

UNIFORMAT is an arrangement of construction information based on physical parts of a facility called systems and assemblies. It consists of 12 divisions and is recommended for organizing cost estimates used during value analysis.

2.13 Summary

This chapter has reviewed previous theories and practical works related to the process of construction cost estimating. The literature review reveals that the

most important type of construction cost estimates is the preliminary estimates. Major decisions are based on this estimate therefore the level of accuracy is an important issue. Many factors influence the process of producing accurate estimates. Besides the estimator experience, method and the amount of data available, are effective tools that will be most likely aid the estimating processes. Indeed computers are practically the first tools to consider in this task.

CHAPTER 3

COMPUTERS AND COST ESTIMATING

3.1 Introduction

This chapter exposes the role of computers, as an effective tool to increase the level of accuracy and reduce the time required in preparing a construction cost estimate. Computers have tremendous number and type of applications in construction business, which vary from accounting to scheduling, estimating and so forth. Based on chapter 2, fast and accurate estimate is one of the key factors that can make the difference between gaining a reasonable profit and running out of business. Therefore the use of computers is essential to fulfill this obligation.

3.2 Use of Computers in Construction

Most construction cost estimates in the past and newfangled are performed manually accordingly errors are most likely to occur. Thus the use of computers in the construction industry is growing rapidly. The early use of computers in construction and contracting were in applications concerning the payroll, accounts payable, and general accounting functions. Nowadays, computers increasingly are playing a big role in the contractor's project management functions, including estimating. Computers have introduced modern technology to the construction industry. The estimator is in search of any advantage that can assist in preparing an estimate (Jurkiewicz 1999). Computers play an essential role in cost estimating because estimating may involve complex and advanced mathematical calculations and techniques. Automating the process of

construction cost estimation is desirable not only for improving the efficiency, but also for reducing human errors as much as possible (Wu and Adeli 1998). Computers cannot do the entire estimating process, but they can ease the estimating procedure. The use of computers in documenting cost estimate, give estimators more time to study and analyze projects. Consequently, estimators will be able to generate more accurate estimates (Cost Engineering Journal 1998).

3.3 Computer the Estimating Tool

The accuracy of any estimate depends greatly on the tools used in its preparation. Cost engineers need a tool that not only forecasts and tracks costs, but is able to reduce considerably the burden of data entry as well as provide instantly reliable financial reports (Jurkiewicz 1999). One of the estimator's most important tools is the computer and associated software. Today, personal computer is most often the estimator's choice (Dysert and Elliott 1999). Once you learn to build an electronic estimate on the screen, you will be able to turnout more estimates, faster, with less chance of making an error, and analyze and manipulate numbers before you finalize your bid (Feldman 1996). The use of computers with cost estimating can simplify and facilitate rapid consideration of many costing alternatives (Duncan 1996). Listed are some of the activities that computers can be used for (Kitchens 1996):

- Performing quantity take-off using a digitizer.

- Performing extensions of units of labor, material, equipment, and other expenses to develop the estimate.
- Developing spreadsheets for bid preparation.

With digitizers, contractors can electronically make measurements from blueprints and prepare detailed estimates within a day (Cost Engineering Journal 1999). Hence computer estimating programs can greatly reduce the time it takes to perform quantities take-off and prepare bids, increase calculating accuracy, and create a professional looking estimate. As well as offering an easy way to evaluate job profitability.

3.4 Computer Software Cost Estimating

There is a large number of estimating software packages available to the construction industry. Yet computer programs encompass a significant portion of computer software that are prepared by a process known as programming. Adrian (1993) defined programming as being a prepared set of computer instructions that provides the mode of solving a specific problem. These programs are available to perform complex pricing, estimating, and analysis functions. It is difficult to generate overall ground rules or rules of thumb for computer software cost estimating because of the increasing number and types of computers and computer languages (Stewart 1982). Sigurdsen (1992) has grouped cost estimating software programs into two kinds:

1. Industry-dependent systems based on predefined historical data and equations with specialized reporting facilities. The equations are usually

concealed in the source code or in the data files, out of reach of the user. Normally they are written in a high-level language like C, C++, or Visual Basic.

2. Systems primarily focusing on production of cost reports generators. Historical data and algorithms are usually kept separate from the estimating system. These systems are written in a spreadsheet language or database.

The utilization of estimating software allows the contractor to breakdown costs to the last minute. They provide wide range of capabilities–from conceptual to final estimate, also they simplify the task of providing different cost views of an estimate. Most estimating computer programs are either written in-house or purchased from vendors. In both cases the result has not been entirely satisfactory in achieving the desired results because this satisfaction requires both the engineer and programmer to be highly trained and experienced in the field of estimating. Lederer (1998) has ranked the elements that affects the development of estimating software as following:

1. System size and complexity (in terms of the number of code lines or of functions, modules or program features).
2. Personnel capabilities and experience.
3. Hardware constraints.
4. The use of modern software tools and practices.
5. User understanding of the software.

Several software developers sell their estimating software with own quarterly database updates or third parties databases. In addition of considering most

estimating programs to be based on the use of some vendor's databases, Hicks (1992) listed the similarity of these programs as:

- Difficult to learn and to operate in a reasonable length of time.
- They have a tendency to shift the user's attention from estimate preparation to program manipulation.
- They have many auxiliary features more or less to estimating but unnecessary for estimate preparation.
- They lack the ability to do what is necessary for estimate closure and bid.

Although, Abouzisk (1994) has listed the advantage of these programs as the consistent organization and format for estimating, the capabilities of estimating item by item. He also listed the disadvantages as giving a rigid format and very few short cuts are permitted. In the same manner, Miller (1998) provides some of the problems that might be encountered by the use of vendors' databases 1) a database that has been developed in another country or state and does not match how things are done in the geographic area where the company is located. 2) The database generates too much information (i.e., the number of nails needed for forming). 3) The database contains formulas that use multiplication factors with no explanation of why they are there (in case of calculating quantities). Furthermore, as a solution for these problems Miller suggested to create own database from scratch, starting by the determination of the basic coding structure with respect to the industry standards. The databases available from vendors can be good guide on how to build a database with the requirement of modifying them in order to fit individual estimating methods. For

instance, R. S. Means and Richardson's databases have provided services to contractors from conceptual to preliminary ending by final estimates.

3.5 Industry programs

In general, the available estimating programs in the market typically require few days of training to get familiar with and to operate. Additionally, if other functions are to be tied into the estimating process then a modular package is required and in this case the training time span will be extended. Software developers have designed computer programs to meet the needs of a specific industry. Since industry programs are developed for a specific business or industry, they are referred to as the vertical market, because they are sold to one business type rather than many. TIMBERLINE, MC^2, BSD COSTLINK, WINEST and WINCOST PRO, and SOFTWARE SHOP are few of many industry programs. Some other computer applications aid in improving the efficiency and accuracy of the construction estimating process, such as Computer Aided Design (CAD) applications, Math Conversion applications, Database applications, and simulation applications (Adrian 1993).

Therefore a need for a practical and easy to use system exist. The research work tries to introduce an estimating system to be used at preliminary stage of estimation.

3.6 Summary

The foregoing paragraphs have given a generic overview of the importance of electronically generating the construction cost estimate due to the efficiency and accuracy level that it can be supplied. Additionally, they dealt with the common problems that might occur from using vendor's databases and providing a solution for such problems. Thus any estimating software has to be user friendly, simple, flexible and can be learned by the user in a short period of time. Besides that, the database included in the software has to be typically compatible with the user needs. Yet the database has to have the option of editing, modifying and manipulating data accordingly depending on the circumstances and type of the project. Chapters 2 and 3 are the groundwork to generate the idea of developing a computer tool to avail cost engineers and estimators when preparing preliminary estimates for commercial building. This methodology of developing the system model is detailed in chapter 4.

CHAPTER 4

Model Development Methodology

4.1 Introduction

This chapter evinces the methodology of developing a conceptual cost estimating computer model. The system requirements are distinguished, based on the literature review of chapters 2 and 3, along with the aspects to be considered in a practical system. The process of introducing a valiable approach is considered in order to enhance the benefits of the system under its classified requirements and development constraints. A good information system depends on the integration between databases, programming languages, and software engineering; its lifecycle incorporates the interrelated technologies of conceptual modeling and database design (Loucopoulos, 1992). Figure 4.1 illustrates the system

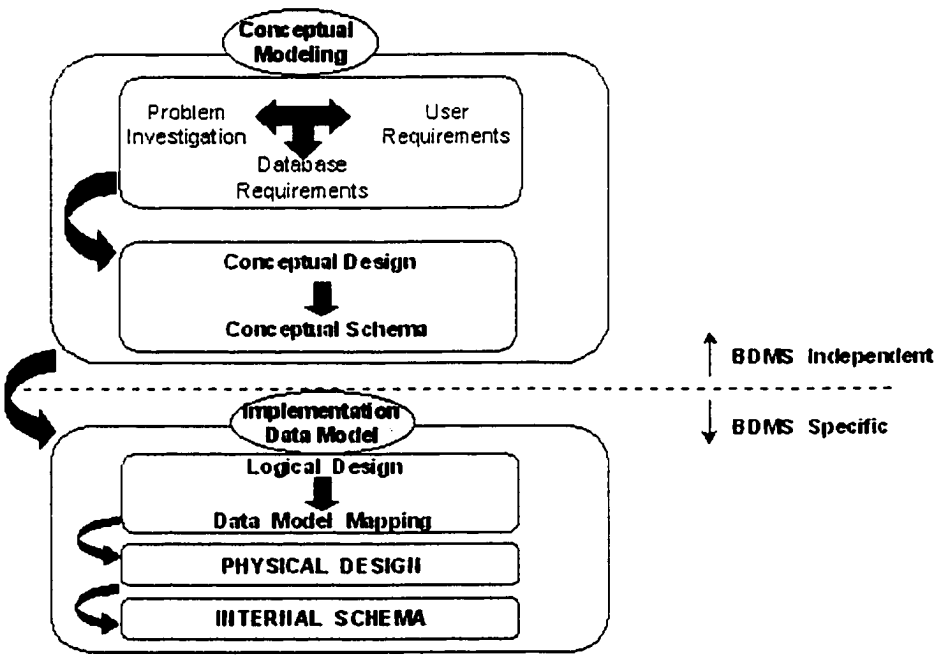


Figure 4-1 System Development Process

development process, derived after Elmasri and Navathe (1995), and Hoffer (1999). The process consists of two major phases: 1) the conceptual modeling phase, and 2) the Implementation phase.

The conceptual modeling phase will be discussed in the current chapter and includes problem investigation and user requirements, system architecture and components. Thereafter, the database requirements can be identified and the conceptual design can be carriedout then the conceptual schema (Entity-Relationship diagram) can be derived. All the proposed database modules will be explained and finally the proposed methodology will be established and shown through the current practice (data flow). The implementation phase will be discussed in chapter 5.

4.2 System Requirements

The problem investigation and user requirements are rooted on the literature review of chapters 2 and 3. The basis of an integrated methodology that fosters the preparation of timely, dependable, and efficient conceptual cost estimate incorporates the importance of having data available when needed and a computer tool to use for generating the estimate. To this end, a list of the specifications and basic requirements that was followed in developing the proposed estimate preparation system is shown in Table 4.1.

Besides such requirements, the system would be designed to have the following characteristics:

Table 4.1: Specifications of the conceptual cost estimate system preparation

	SPECIFICATIONS
1	Designing and implementing three different databases for imperial and metric parametric estimate, and preliminary estimate.
2	Utilizing cost of previously executed projects as handy historical data for parametric estimates.
3	Allowing adjustment to the previous projects costs according to city index and inflation rate.
4	Employing the Masterformat divisions and Uniformat elements for parametric estimate as WBS in both units: imperial and metric.
5	Employing Masterformat divisions for the preliminary estimate in both units: imperial and metric.
6	Provide built-in cost data based on Yardsticks for costing for all the Masterformat divisions and their items and the possibility of using own costs data.
7	Flexibility of updating the built-in costs when needed.
8	Generating various reports that can be used for bid preparation and summary costs.
9	Direct linkages between the generated items take off list and spreadsheet for scheduling purposes (future expansion) and word processing for bidding purposes.

- Information-intensive; incorporate different databases to store, process, and employ available data in order to improve the practicality of preparing a conceptual cost estimate.
- Efficient; user friendly and fast processing.
- Flexible; previously estimated projects can be added to built the historical data, costs and items can be edited and modified easily.
- Modular; allows future expansions and enhancements.
- Practical; includes fast calculations process by applying available tools (expressions and structured query language (SQL)).

4.3 System Components and Architecture

The developed system consists of components designed in a modular format, incorporating three modules: the imperial parametric estimate module, the metric parametric estimate module, and the preliminary estimate module. Figure 4.2 illustrates the system components used in the model methodology development. All the modules share a database system, which contains three databases assigned to preliminary cost estimate, imperial parametric cost estimate and metric parametric cost estimate; and managed by a database management system. The functions performed within each of the systems components and their local development are described in coming paragraphs.

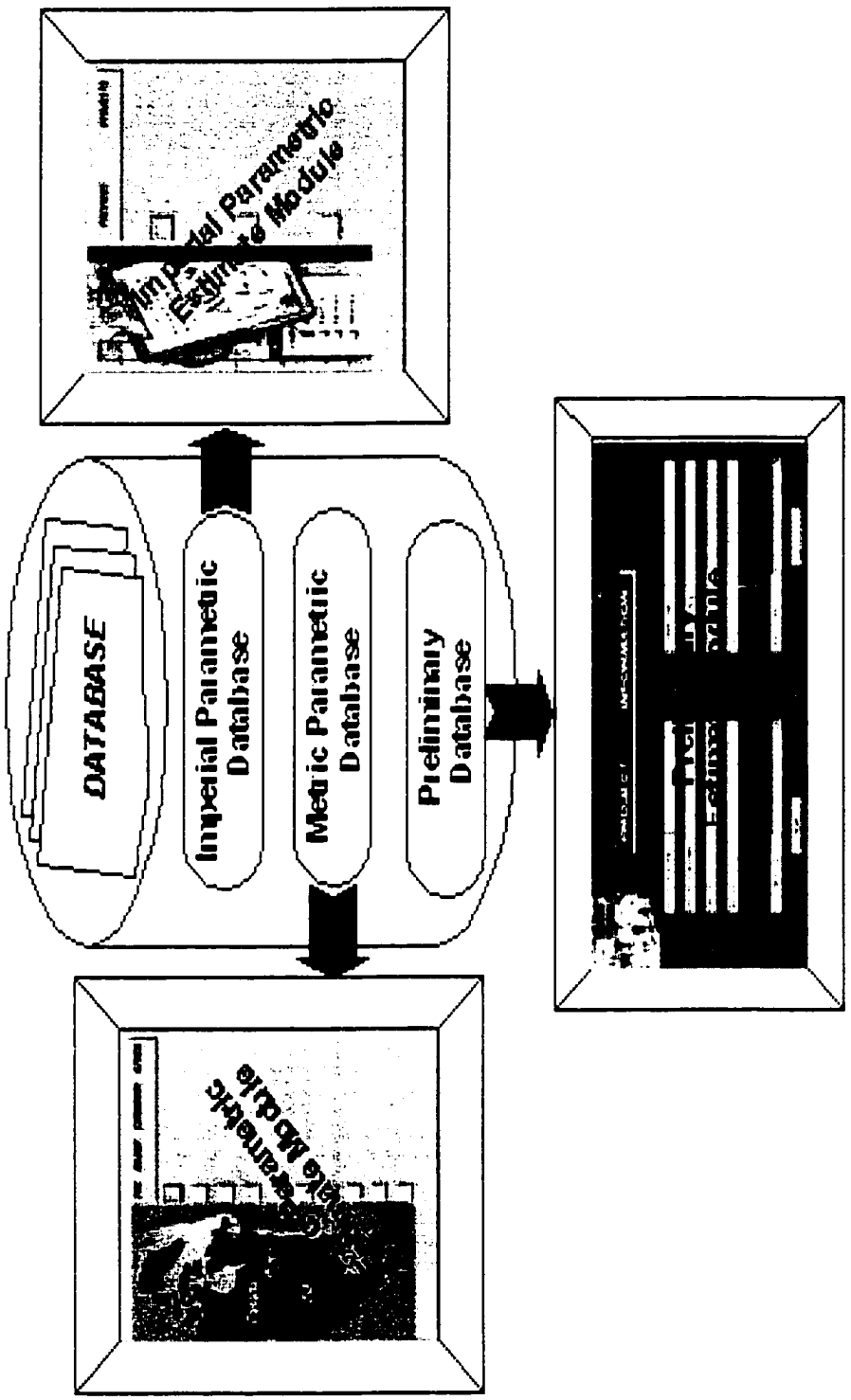


Figure 4.2 System Components

Based on the user's input, the system will be the guide throughout the estimating process. The imperial parametric estimate module, which integrates the imperial parametric database, assists the user in adjusting the costs of previously executed projects based on the Masterformat or the Uniformat according to the city index and the inflation rate. The user can quickly prepare an approximate estimate for any similar project listed in the supplied database all in the imperial units. Similarly, the metric parametric estimate module integrating the metric parametric database provides the same information and results except in the metric units. The preliminary estimate module that integrates the preliminary database based on Masterformat provides the user with the option of using Yardsticks cost data to calculate the direct and indirect costs of the chosen items. The user can also use own cost data in calculating the direct and indirect costs.

The selection methodology evaluates four selection criteria:

1. Workbreak Down Structure (WBS), either Masterformat or Uniformat.
2. Cost Adjustment, using city index and inflation rate.
3. Data Source, either Yardsticks or own cost data.
4. Units, imperial or metric.

The System Architecture is illustrated in Figure 4.3. The process starts with selecting the estimate type and accordingly entering the project information, selecting the cost data, unit, city and items quantity if the preliminary estimate is chosen. Meanwhile, the unit selection governs the parametric estimate databases and accordingly entering the WBS and the city selection.

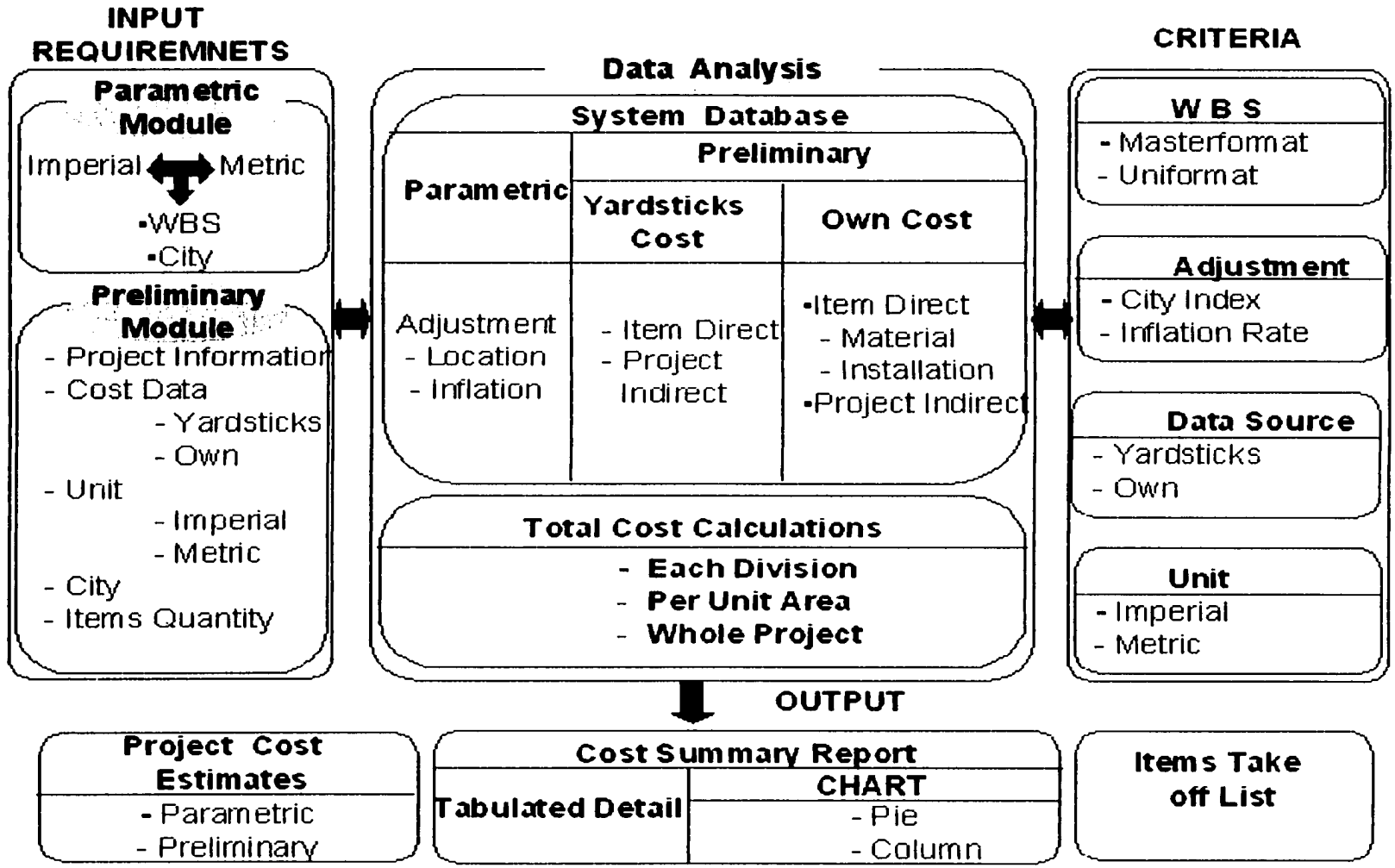


Figure 4.3 System Architecture

4.4 Database Conceptual Design

The conceptual cost estimate database has been created by slaving computers to minimize the required time in preparing an estimate, the ability to call up and modify costs data when needed for both the parametric and preliminary estimates, and to provide a professional output reports for bidding purposes. Utilizing computers has myriad benefits, perhaps the foremost of them is employing their immense capacity to store huge amount of data and the capability to retrieve it fast. The foregoing paragraphs have classified the system or database requirements thereafter the conceptual design can be established by identifying the components of the conceptual schema. The conceptual schema concentrates on describing the database entities, their attributes and relationships. The graphical representation of the conceptual schema is accomplished by using an approach known as Entity-Relationship diagram (ER diagram). The ER approach uses rectangles to specify entities, diamond-shaped to represent the available relationship between two or more entities and oval-shaped to represent the attributes. Figure 4.4 shows the ER-diagram used to conceptually design the model.

Entities are the primary data objects about which information is to be collected, and represent the cost estimate (real world) concepts that are stored in the database. The entity name is written inside the rectangle and the proposed database comprises 6 entities (Project, Division, Element, City, Cost estimate, Cost Source).

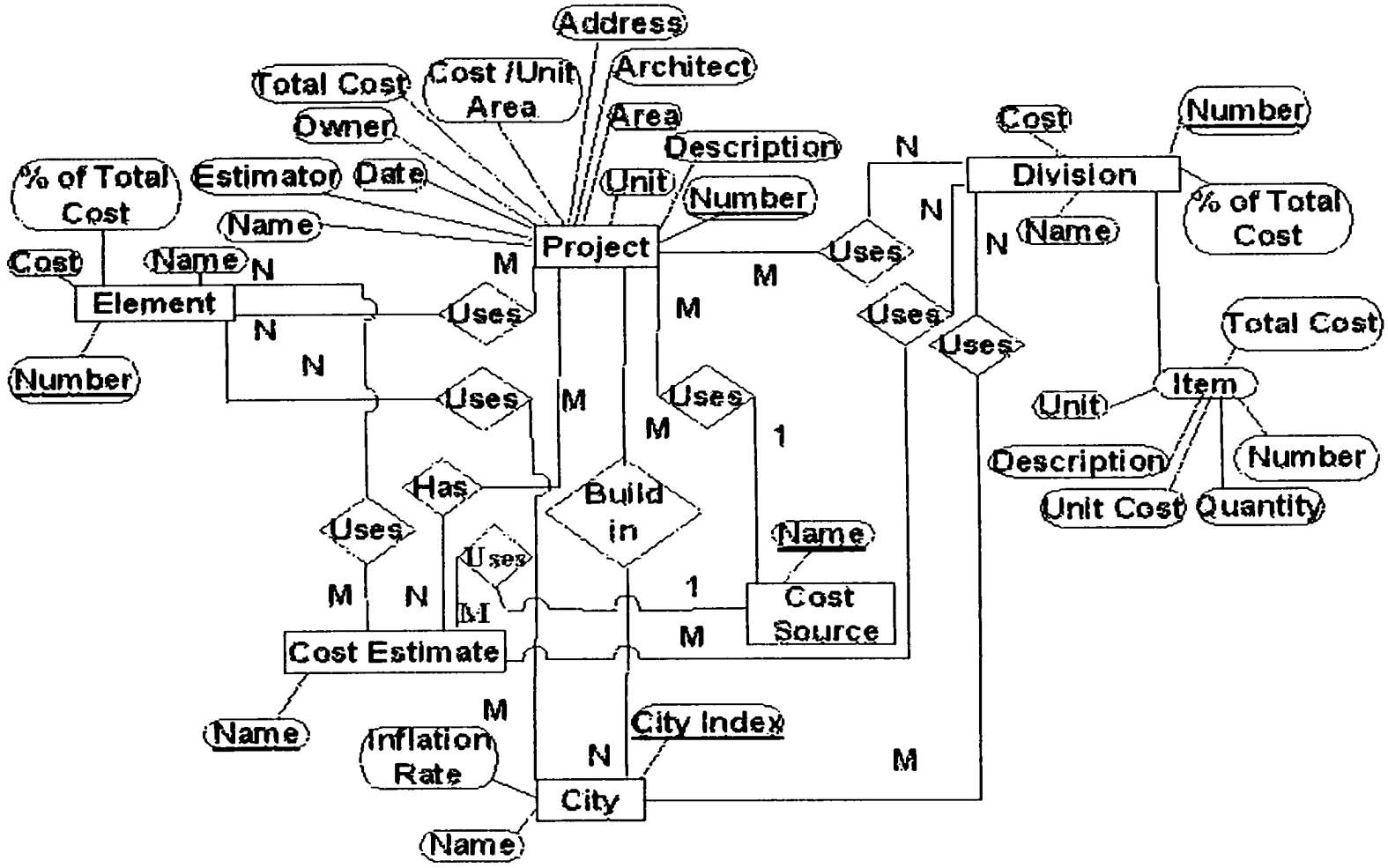


Figure 4.4 Database Entity Relationship Diagram (ER-Diagram)

- ***Relationships*** represent the associations among two or more entities. The different types of connectivity between entities are One-to-One (1:1), One-to-Many (1:M), and Many-to-Many (M:N). In the proposed database one type of connectivity has been used which is Many-to-Many (see Figure 4.4).
- ***Attributes*** are the entity characteristics that provide descriptive detail about that entity. Attributes opposite entities by having values, they are in two types either identifiers or descriptors. An identifier (or key) uniquely determines an instance of an entity and is underlined in the ER-diagram (see Figure 4.4, e.g. Number). Meanwhile a descriptor specifies a non-unique characteristic of a particular entity instance (e.g. Name, address).

4.5 Imperial Parametric Estimate Module

The objective of this module is to abet the user in preparing a fast parametric construction cost estimate of a project without having any information about it except the initiated idea using imperial units. In order to fulfill this task, the database integrated with this module accumulates historical data about projects previously executed and their total costs as well as the costs of the associated Work Breakdown Structures are also provided. The module is capable of calculating the adjusted costs of the chosen project according to 1) Location, and 2) Inflation.

4.5.1 Location Adjustment

To adjust the costs of the provided projects according to their location, for each of the eight major Canadian cities; St-Johns, Halifax, Montreal, Ottawa, Toronto, Winnipeg, Calgary, and Vancouver; the cities indices based on R. S. Means 1999 reference data,

have been stored in the database. The cost adjustment will be done for both the entire project and each main component of that project. The algorithm employed in such calculation use equation [2.1] listed in chapter 2, which is:

$$C_c = C_r \left(\frac{I_C}{I_R} \right) \qquad [4.1]$$

Where

C_c = the calculated cost in dollars

C_r = reference or actual project cost in dollars

I_C = the index value at present time

I_R = index value at the time where the reference cost was obtained

I_R in the module is considered to be equal to 100 %.

At the same time the module calculates the percentage cost of each project component in accordance with the total project cost using the following algorithm:

Component % cost = (Component individual cost/Total project cost)x100 [4.2]

The module flexibility allows the user to change the indices according to the reference data he or she would like to utilize, but this change has to be done manually. Additionally, the user can increase the current historical data by easily entering other projects that has been estimated in the past so they would be handy whenever needed in a professional format.

4.5.2 Inflation Adjustment

Once the user adjusts the project costs according to location, inflation adjustment can be easily consummated by entering the inflation rate and the number of years for which the project cost is needed. The module uses the following equation:

$$F = P \times (1+i)^{n} \qquad [4.3]$$

Where

F = Future or present total project cost

P = Past total project cost

i = Inflation rate

n = Number of years

The value of (P) taken by the module is the total project cost adjusted according to the location as explained in section 4.5.1.

4.6 Metric Parametric Estimate Module

This module integrates the Metric Parametric Database and is similar to the Imperial Parametric Estimate Module by providing the same information and calculation except it is in the metric units. It was designed independent of the preceding module to grant the user fast execution and calculation, in the addition of providing complete and wider operation of the stored data.

4.7 Preliminary Estimate Module

Reference to the literature review, direct and indirect costs are the parts that compound the project construction cost. The direct costs consist of three portions: material, labor, and equipment (if required). While the indirect costs are grouped in the General Conditions division and covers profit, contingency, project overhead, sales tax (when applicable), and Architecture fee. These cost types constitute the core of the module that integrates the Preliminary Database. The aim of this module is avail the user to

generate a reliable preliminary construction cost estimate in short time when some information about the project is known. To achieve this job, the module uses different algorithms in calculating the items' direct cost, the project direct cost and the project indirect cost depending on the user choice of which source data (Yardsticks or own cost data) to be used in both units (imperial and metric). Using the built-in Yardsticks cost data has many advantages one of them is the needless of using city index to adjust costs according to the eight cities since the supplied costs are gathered from different suppliers in each city separately.

4.7.1 Using Yardsticks Cost Data

To break down the project structure, Yardsticks uses fourteen out of the sixteen Masterformat divisions. For instance, they disregard division twelve (Furnishing) and thirteen (Special Constructions). The provided cost of each division's item consists of the cost of material, installation, equipment, transportation, and subcontractor profit. Therefore, the project costs generated from this cost data are only for preliminary estimate.

After entering the project general information and units, the user has to choose the city where the project is to be built so that its associated cost data can be called. To start building the item take off list, the user has to go through each division separately and pick the associated items. As soon as the user enters the quantity of each item the module automatically calculates the direct cost of that item using the following expression:

Item direct cost = (Item Quantity) x (Item unit cost) [4.4]

The module is equipped with many options like deleting a single item at a time, and clearing the whole take off list. Moreover, the module calculates the project total direct cost according to the selected items at any time the user asks for it, by applying the following expression:

Project present direct cost = $\sum$(Total item cost) [4.5]

After taking off all the project items and assigning their direct costs, the module can export that list to a spreadsheet so it can be modified and integrated with a scheduling tool in this case the Microsoft Project for scheduling the activities (this will be portion of the future expansion). Furthermore, the module will calculate the total project indirect costs according to the user input values of the following components: Sales Tax (ST), Profit (PR), Overhead (OH), Architecture Fee (AF), and Contingency (CT). The calculation of each component will be based on the total direct construction cost of the project as follows:

PR cost = (PR value entered) x (project direct cost)/100 [4.6]

OH cost = (OH value entered) x (project direct cost)/100 [4.7]

AF cost = (AF entered) x (project direct cost)/100 [4.8]

CT cost = (CT value entered) x (project direct cost)/100 [4.9]

ST cost = (ST value entered) x {(project direct cost) + (PR cost) + (OH cost) +

(AF cost) + (CT cost)} / 100 [4.10]

Those values will be provided in the summary report separately in a tabulated format. The module therewith calculates the Total project construction cost and the cost per unit area as follows:

Total project cost = Σ(project direct cost + ST cost + PR cost + OH cost +

AF cost + CT cost) [4.11]

Cost / Area = {(Total project cost) – (ST cost)} / (Total Area) [4.12]

Furthermore the module will calculate the total direct cost of each division separately and provide it in a tabulated partition using the SQL expressions as well as calculating the percentage cost of each division according to the project direct cost. The antecedent procedures is employed for both units the imperial and metric.

4.7.2 Using Own Cost Data

Similarly to Yardsticks option, the breaking down structure of the project is founded using the fourteen Masterformat divisions. However, none of the division's items are provided by specific direct cost because this task is left to the user to enter own cost data. In such case, when the user enters the unit cost of material and installation, and the quantity for each item respectively, thereupon the module will calculate the item total direct cost (item DC) using the following expression:

Item DC = Quantity x {(Material unit cost)+(Installation unit cost)} [4.13]

This process will be applied to build the take of list, and the same options provided in section (4.7.1) are available in this case too. To compute the total construction cost of the project the module uses the expressions from [4.5] to [4.12]. Additionally, it will generate the same format of the summary reports provided in section (4.7.1).

4.8 The Conceptual Estimate Methodology

Based on the previous discussion, the proposed step-by-step methodology that effectively incorporates the conceptual cost estimate, the functions fulfilled and the necessary input/output data links is outlined by the data flow diagram (current practice) as shown in Figure 4.5. This diagram simplifies the implementation and the development of the model. From a main module, the user will select the type of estimate he or she wants to use and accordingly a connection with its module will be created and its integrated database will be opened. Thus, the user will start the process of estimating the conceptual costs of constructing a project.

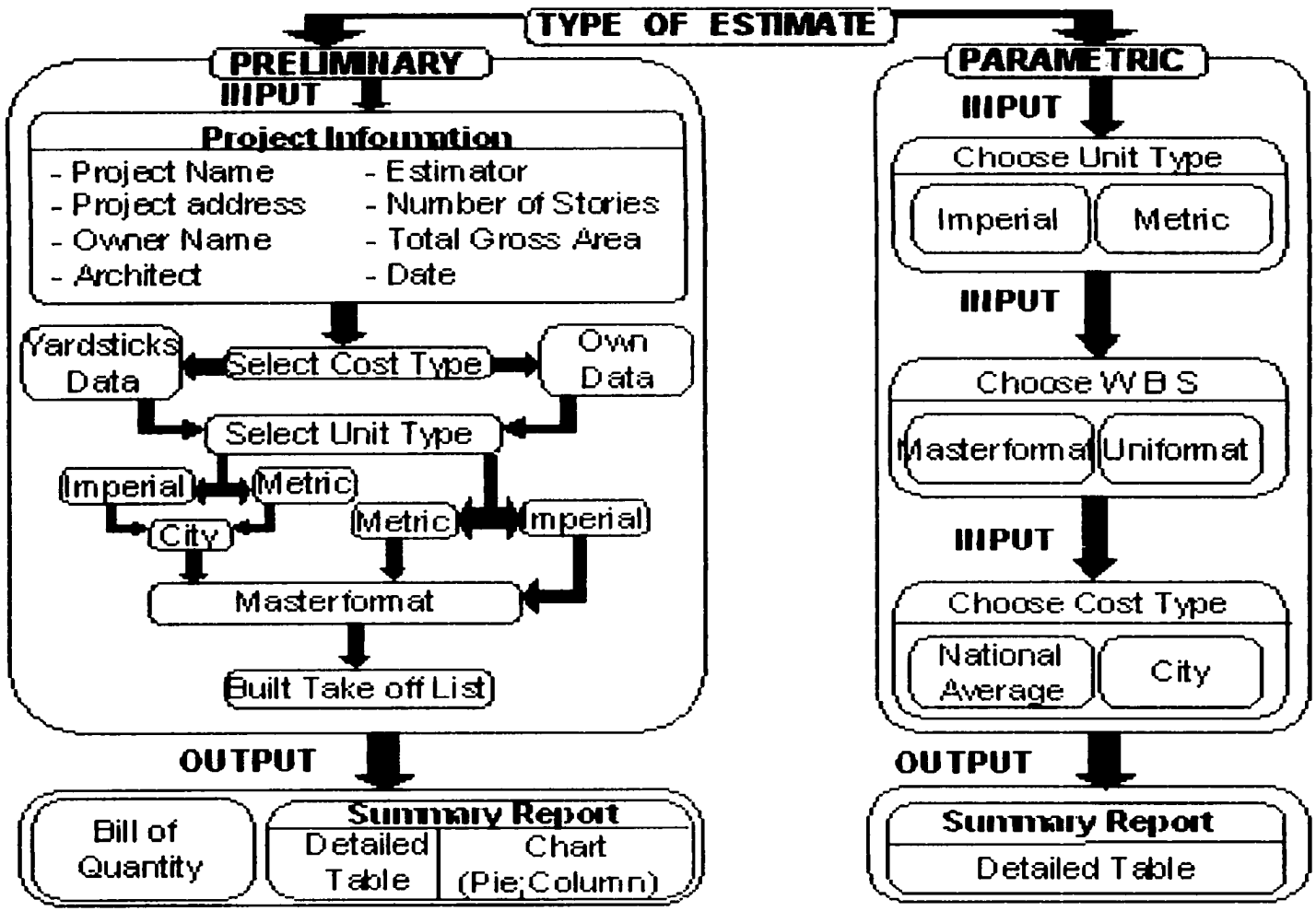


Figure 4.5 Methodology Data Flow (Current Practice)

4.9 Conclusion

This chapter proposed a methodology for a conceptual cost estimating model, using available tools (algorithms and database management systems) that can avail cost engineers and estimators to prepare parametric and preliminary cost estimates. A procedure for developing the methodology is applied based on a group of identified system requirements. The proposed system comprises three modules: 1) an Imperial parametric estimate module, 2) a Metric parametric estimate module, and 3) a preliminary estimate module. These individual modules are integrated through a database management system.

The parametric modules cover a fast preparation of a parametric estimate based on historical data of previously executed projects. The preliminary module utilizes built in cost data rooted on Yardsticks for costing the Canadian construction cost data, or user own cost data to produce a quick preliminary estimate. The proposed system, "SAVER" eases the preparation of a conceptual cost estimate in a favorable technique, efficient and accurate. This chapter stressed the conceptual modeling phase of the system development, founding a structured methodology for conceptually estimating the costs of constructing commercial building. The model implementation phase is presented in chapter 5, moreover the system performance is rendered in chapter 6 through two actual projects to be constructed in Montreal and Vancouver.

CHAPTER 5

Model Implementation Process

5.1 Introduction

Former chapter listed the phases of developing the system's methodology, dealt specifically with the conceptual phase and derived the conceptual schema. This chapter describes phase two of the development process that is the model implementation. It exhibits the process practiced in developing the computer model that comprises the system database, the imperial parametric estimate module, the metric parametric estimate module, and the preliminary estimate module. The performance of the prototype is evaluated in chapter 6 through two actual projects.

5.2 Database Implementation

The development starts by mapping the data model's components, which are entities, attributes and relationships within a Database Management System (DBMS). This is achieved by using Microsoft Access 97 through three steps of design the Preliminary Database, Imperial Parametric Database, and Metric Parametric Database respectively. The database development is conceptually pictured in the ER-diagram as shown in Figure 4.4 of chapter 4. The design of each database is considered separately in the succeeding paragraphs.

5.3 Preliminary Database

The components of this database are incorporated from the ER diagram as follows: Project, Cost Source, Division, and City. Each entity is used with partially or fully of its associated attributes. To design this database three major steps are performed sequentially. The data source used is based on Yardsticks for costing that uses the Masterformat to break down the project structure with some modifications made for design purposes as follows:

Step One

Having settled the data pertinent to this database, each division and its' associated sub-divisions and items have to be identified through a unique ID number. Yardsticks for costing uses five digits numbering in order to partition each division into categories, sub-categories and narrowscope lists as shown in Figure 5.1.

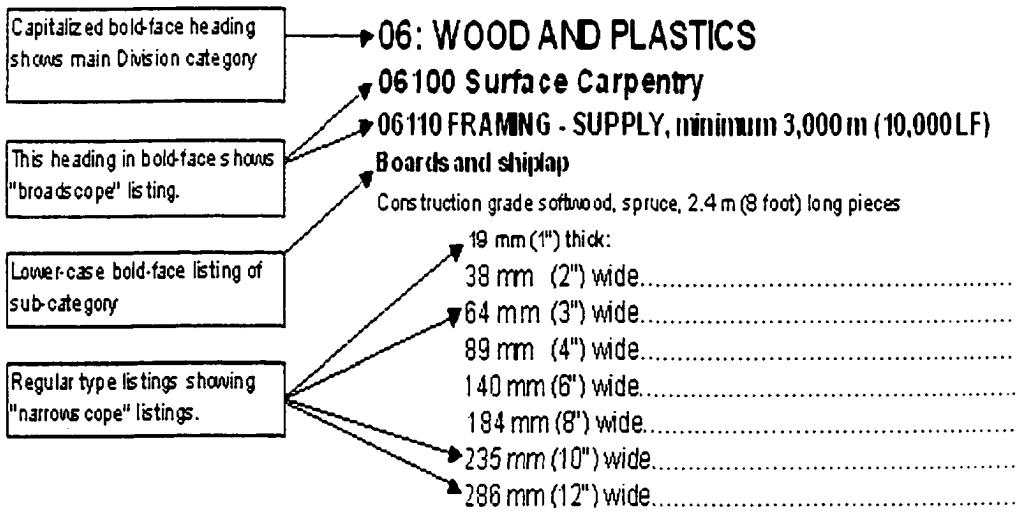


Figure 5.1 Yardsticks Numbering (Hanscomb 1998)

The importance of identifying each line items data by a unique number so that the database software (Microsoft Access 97) accepts it is necessary because it speeds the process of retrieving desired items and eliminates duplications. Accordingly, the numbering system used by R. S. Means is considered to be the foundation of the system that has been used in this database. The numbering system consists of ten-digit numbers partitioning each division into subdivision, medium scope, major classification and individual line item number. Figure 5.2 shows the structure of this system. Appendix A shows samples of R. S. Means and Yardsticks coding systems and data.

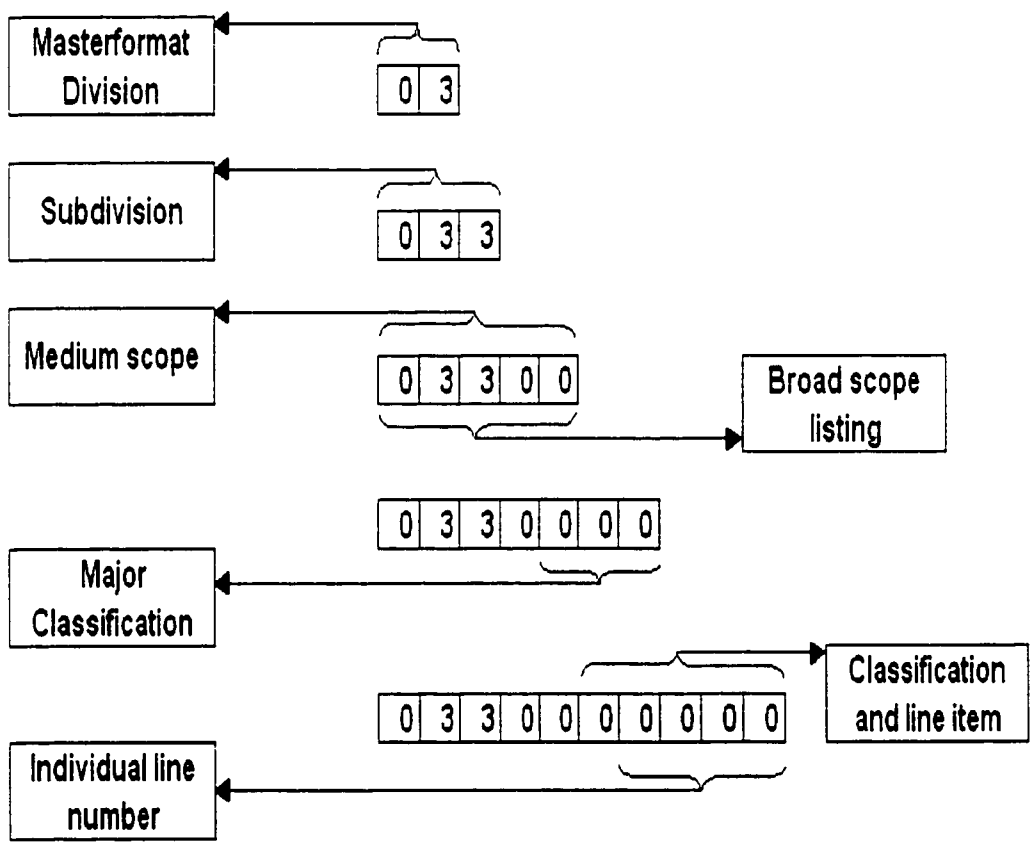


Figure 5.2 Numbering System after R. S. Means

The proposed numbering system considers the first five digits the same as of the Yardsticks in addition five more digits have been added so that the user can be able to append as many items as possible to enhance his or her cost data.

Step Two

Having the numbering system identified each division and associated items are given a unique number and then the operation of building the tables can be commenced. Normally a relational database is composed of a collection of tables that accommodate grouped data. Every division and its interrelated items are entered into two different tables. Entering data is the most time consuming process of the system development, as shown in Table 5.1 and Table 5.2 below.

Table 5.1 Sample Table 1 of Each Division Data.

Fields in Table 1	Field Type	Filed Size
Item ID	Text	10
Units	Text	15
Quantity	Number	Long Integer
Unit cost/ St-Johns	Currency	Currency
Unit cost/ Halifax	Currency	Currency
Unit cost/ Montreal	Currency	Currency
Unit cost/ Ottawa	Currency	Currency
Unit cost/ Toronto	Currency	Currency
Unit cost/ Winnipeg	Currency	Currency
Unit cost/ Calgary	Currency	Currency
Unit cost/ Vancouver	Currency	Currency

Table 5.2 Sample Table 2 of Each Division Data.

Fields in Table 2	Field Type	Filed Size
Item ID	Text	10
Item Description	Text	255

Afterward, the Item ID links these tables by one-to-one relationships because each division line item is unique and cannot be duplicated. The related tables are named after the name of each division with an abbreviation showing the unit used. Those criteria are used for both data source; in other words this database contains four different sets of tables, which are:

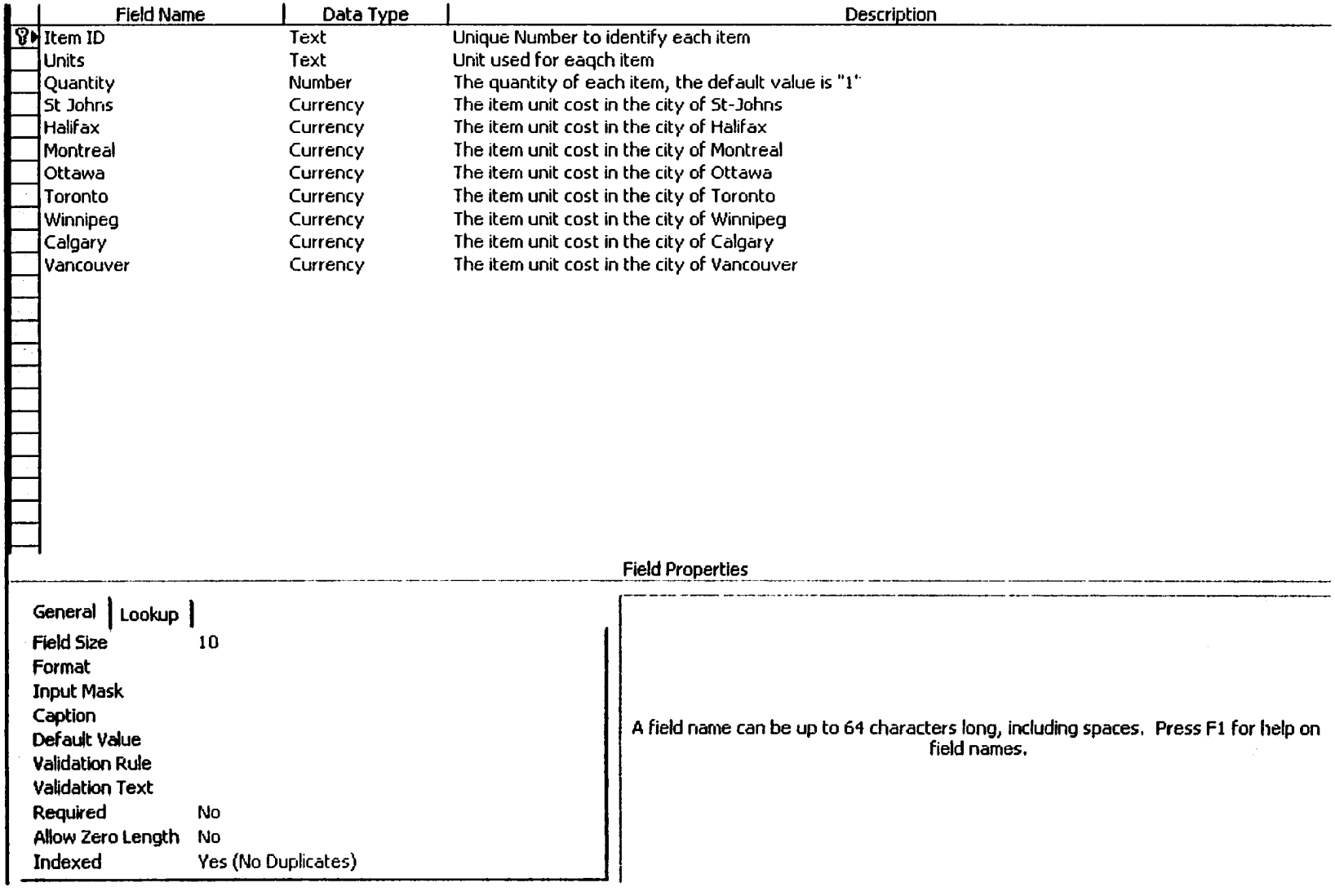
- Imperial Yardsticks cost data tables
- Metric Yardsticks cost data tables
- Imperial Own cost data tables
- Metric Own cost data tables

Besides these main tables, a set of vacant ones is ready for the user to utilize when building the items take off list depending on the city in question. Table 5.3 shows the components of these tables.

Table 5.3 Sample Table 3 of Item Take off List

Fields in Table 3	Field Type	Filed Size
Item ID	Text	10
Item Description	Text	255
Units	Text	15
Unit cost	Currency	Currency
Quantity	Number	Long Integer
Total	Currency	Currency

Additionally, there are few minor tables for the user to make use of. For instance, entering required data (e.g., project general information), selecting type of units to use (e.g., Imperial or Metric), and the source type (e.g., Yardsticks cost data or Own cost data). Figure 5.3 shows the design view of a table.



Field Name	Data Type	Description
Item ID	Text	Unique Number to identify each item
Units	Text	Unit used for eaqch item
Quantity	Number	The quantity of each item, the default value is "1"
St Johns	Currency	The item unit cost in the city of St-Johns
Halifax	Currency	The item unit cost in the city of Halifax
Montreal	Currency	The item unit cost in the city of Montreal
Ottawa	Currency	The item unit cost in the city of Ottawa
Toronto	Currency	The item unit cost in the city of Toronto
Winnipeg	Currency	The item unit cost in the city of Winnipeg
Calgary	Currency	The item unit cost in the city of Calgary
Vancouver	Currency	The item unit cost in the city of Vancouver

Figure 5.3 Screen Snapshot of a Table from the Database.

Sample of the available tables in this database are provided in Appendix B. Figure 5.4 shows a snapshot of the actual links between these tables.

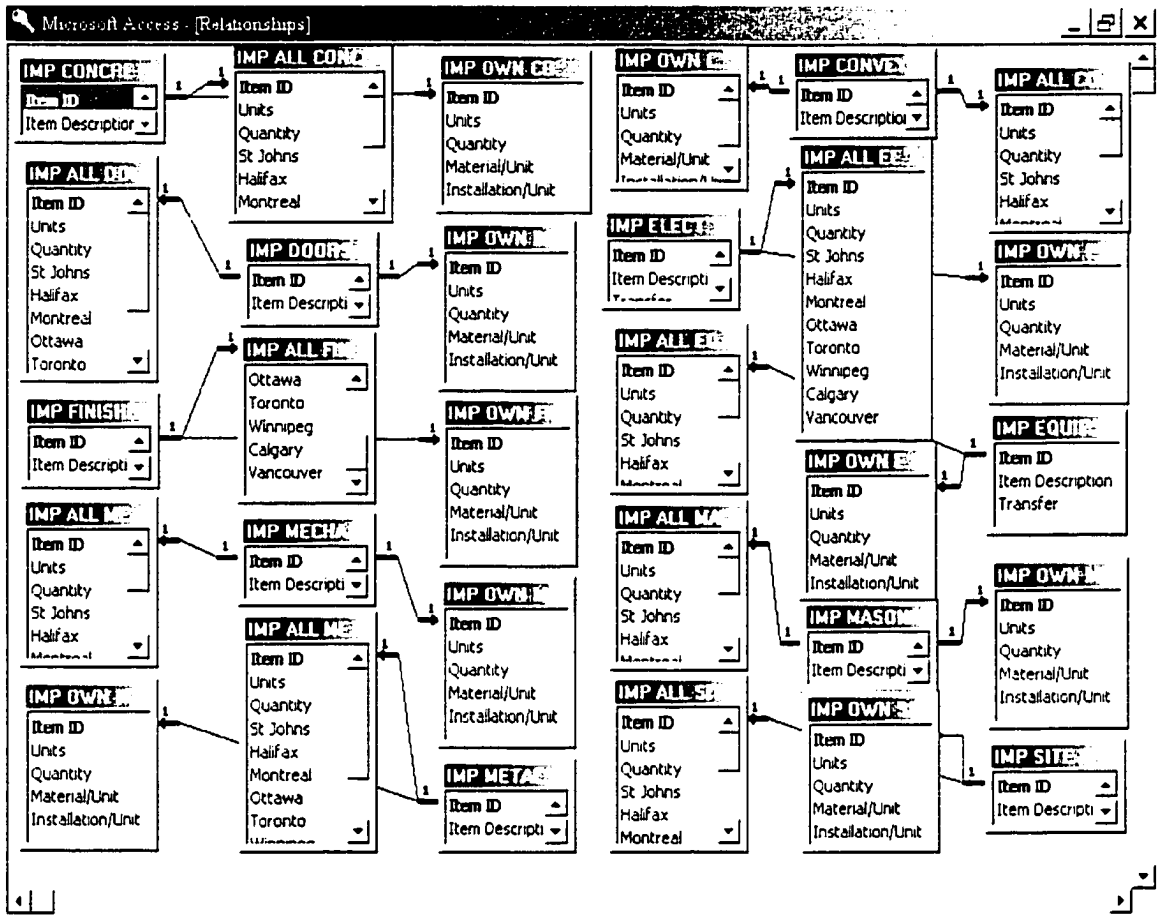


Figure 5.4 Snapshot of the Database tables and their Relationships

Because tables are rigid objects and do not permit any data manipulation, queries are utilized due to their flexibility and ability to do that job. Expressions are used in all the queries in order to carry out all the required calculations. All the employed queries are based on at least one or two related tables, and each one of them is specified to one division in a city in accordance to the data source.

Figure 5.5 shows one of these queries for Imperial Conveying System Division in the city of Ottawa.

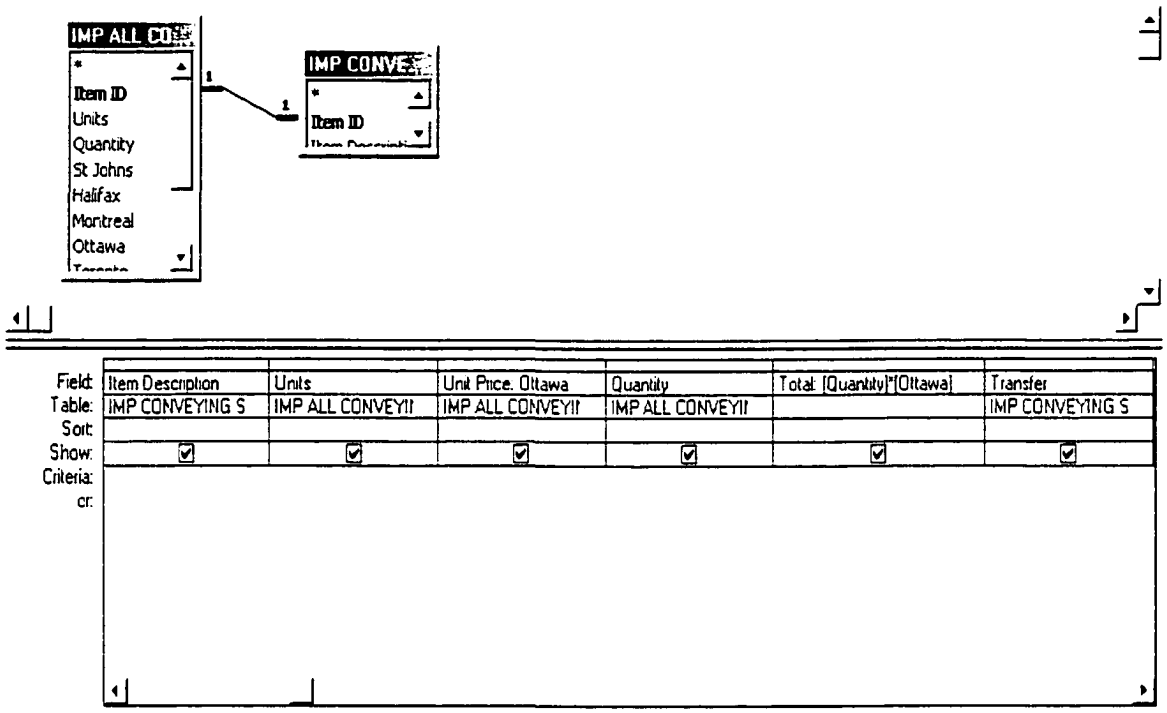


Figure 5.5 Screen Snapshot of a Sample Query from the Database

Appendix C contains sample of the available queries in this Database.

Step Three

Once all the appropriate data of this database are precisely listed into sets of tables and queries, the database interface is carried out. The goal of designing this database is to deliver a tool that comprises clearness, simplicity and user friendly. Thus, this aim is achieved through using sets of series of forms. Each series represents the Masterformat divisions in a specific unit for a specific city. Figure 5.6 illustrates a sample of the Electrical Division form for the city of

Toronto in the Imperial unit. This form is linked to a query called: "qry Imp Electrical Toronto", which provides the form with the required data, as well it

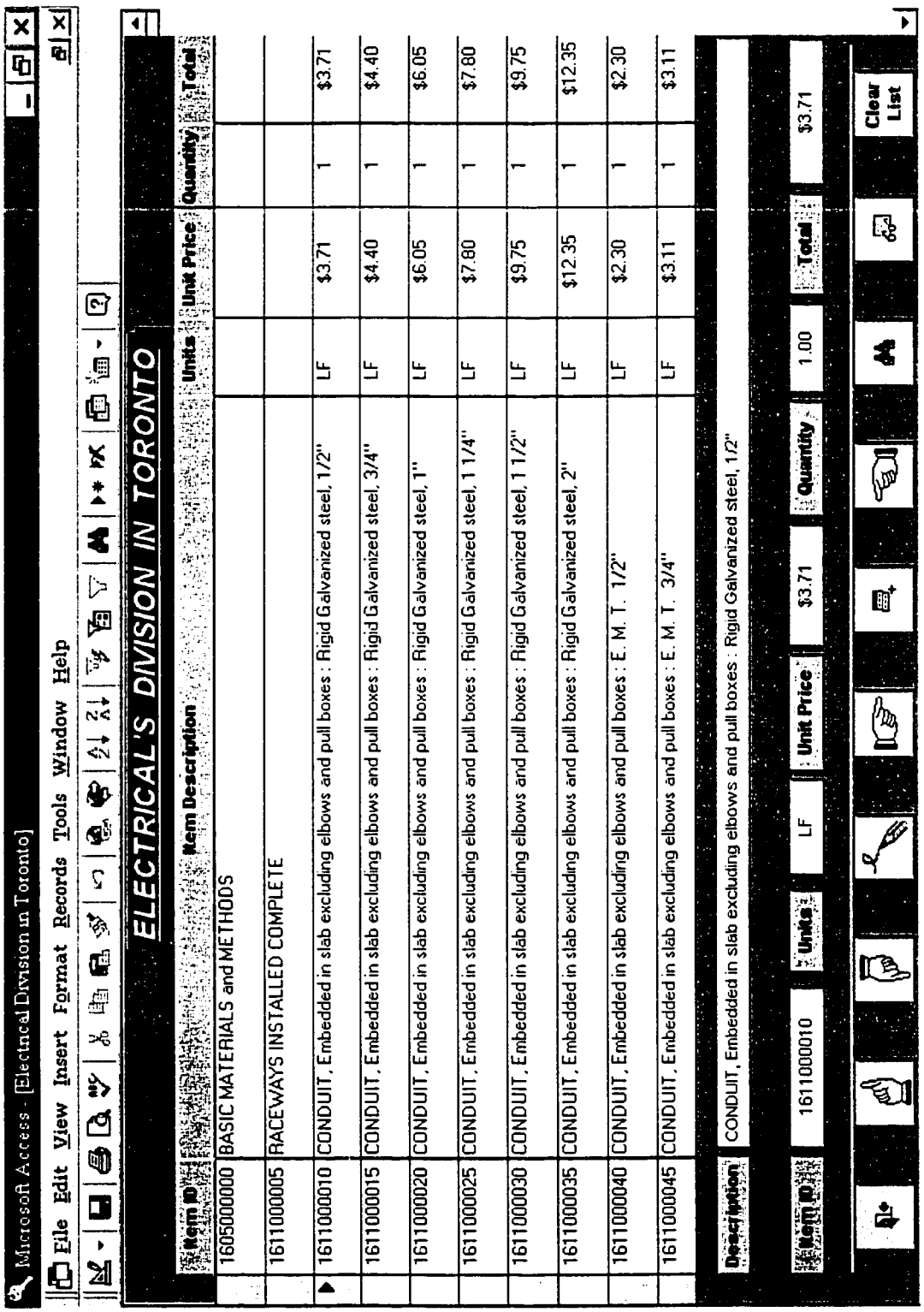


Figure 5.6 Sample Form of the Electrical Division For Toronto (Imperial).

stores all the modifications done by the user, besides executing all the calculations mentioned in chapter 4 for this database. It is to be noted that the unit costs provided in the form for this particular division is based on Yardsticks for costing data. Similarly, all the other divisions for the selected city are shown in similar forms. This process has been repeated for all the other seven cities. Figure 5.7 explains the role of each command button on the form and the event that it executes.

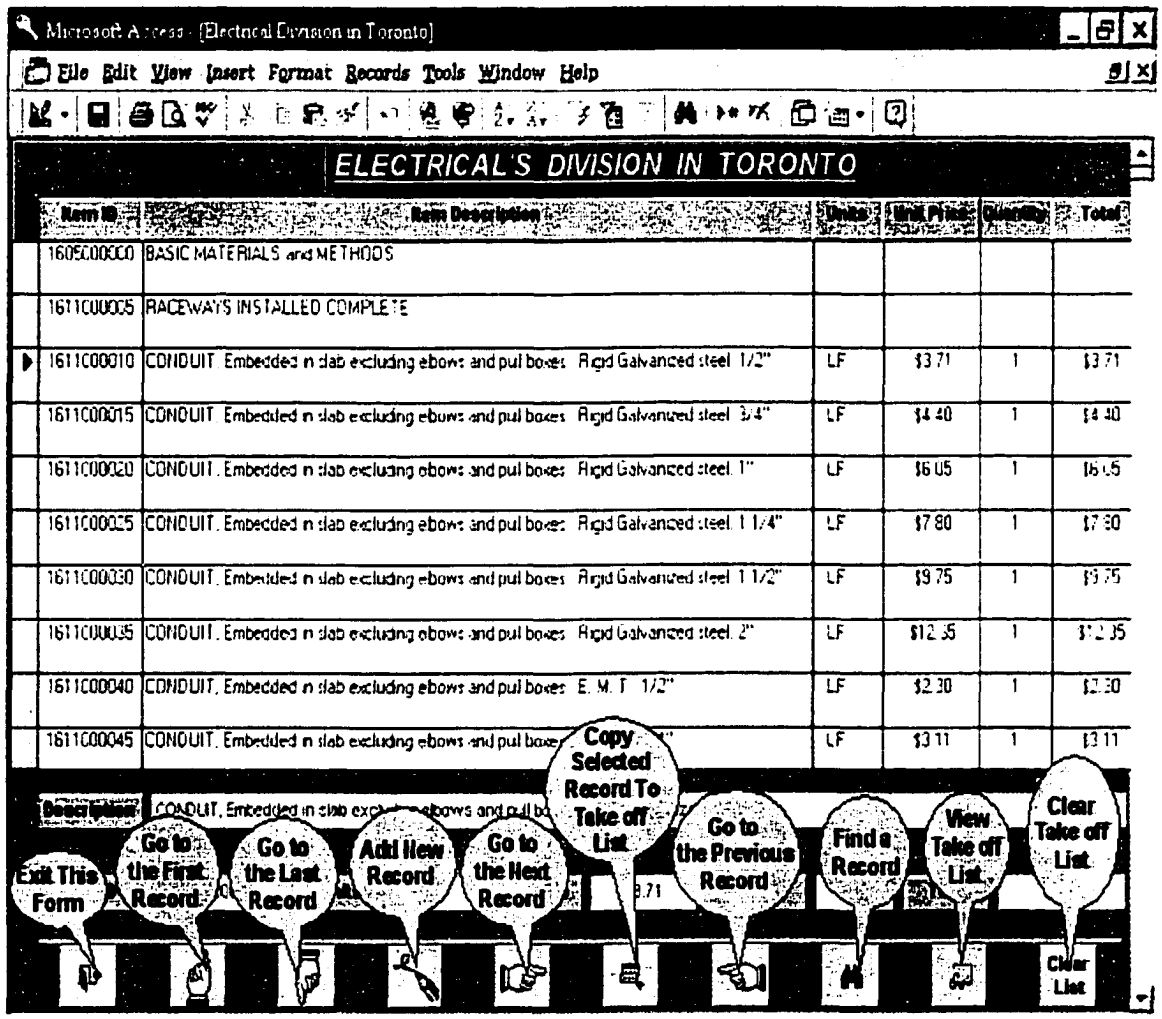


Figure 5.7 Form's Command Buttons Roles

Useful options are provided in each form, for instance, if the user accidentally hits the clear take off list button, this operation is not carried out immediately but a confirmation message is displayed and requires the user to accept or deny it. Figure 5.8 shows this operation.

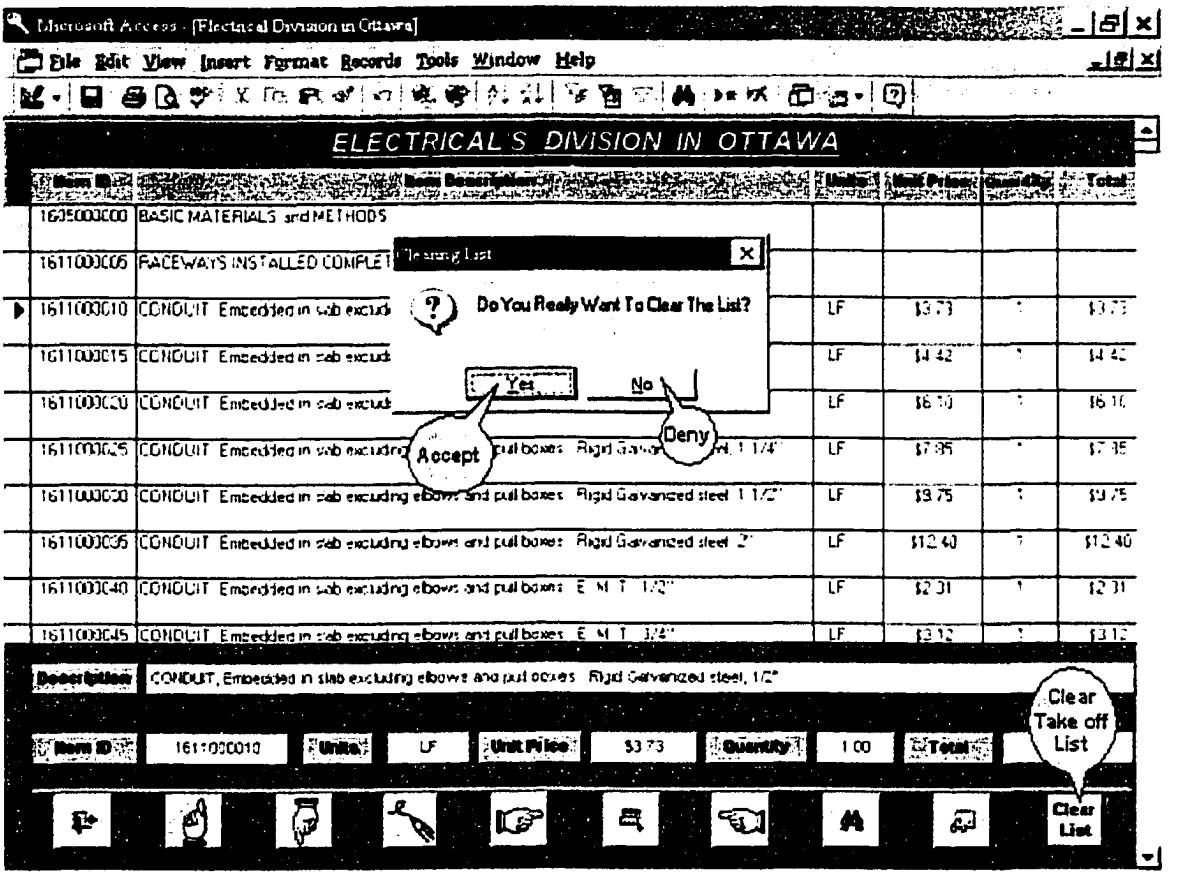


Figure 5.8 Useful Options

To build the item take off list, selected items are copied to a special form that is designed for this purpose, by clicking on the "Copy To List" button. To view that list the user all has to do is simply to click on the View List command button and the form is viewed. Before copying any item the form looks as shown in figure 5.9, which also illustrates the available command buttons on that form.

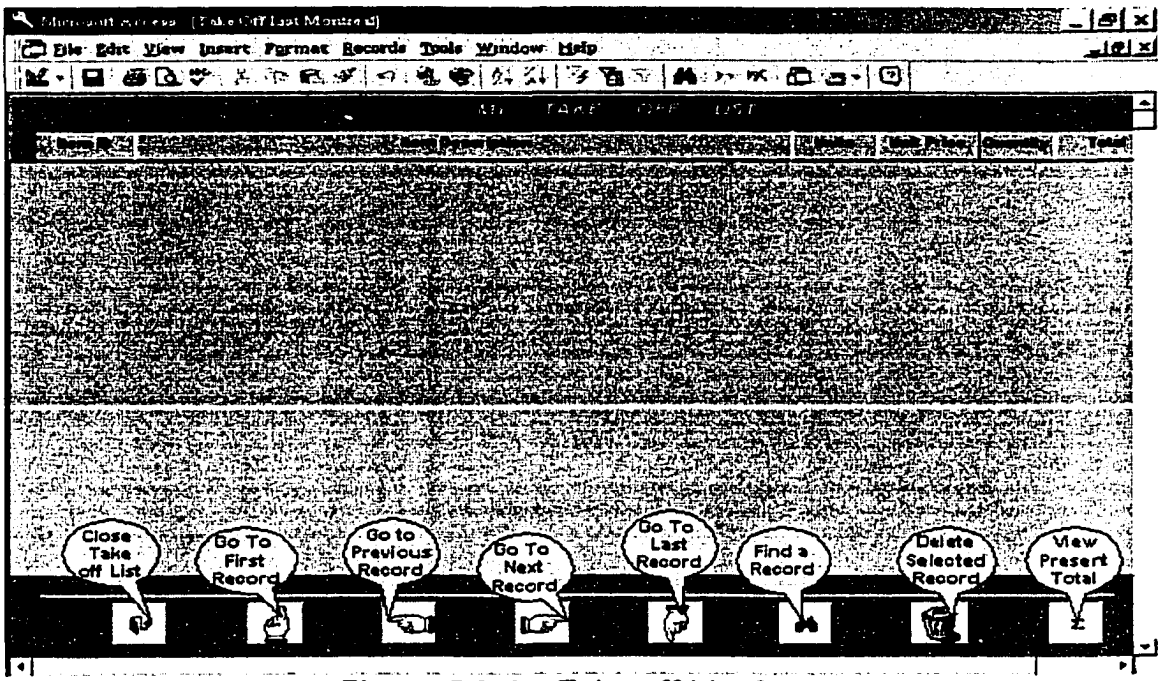


Figure 5.9 the Take off List form

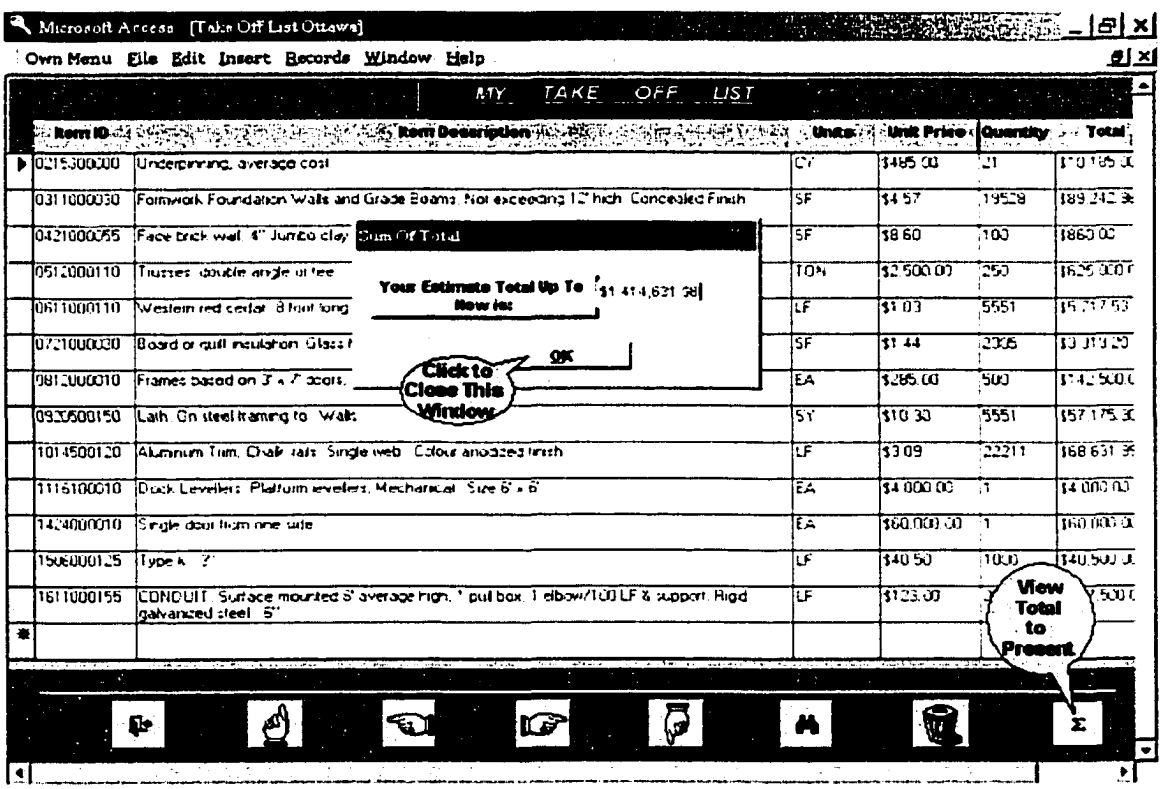


Figure 5.10 Preview the Total Sum at any instance

Once the user copies selected items to take off list, the undesired records can be deleted one at a time by using the trash symbol button. Furthermore, clicking the "Σ" symbol button instructs the interface to calculate the sum total of all the selected records at that instance and present it in a dialog window as illustrated in Figure 5.10. A customized menu is designed in all the forms to provide more options and make enhancements. When the take off list is generated, the user has many options to choose from this menu. For instance, he or she can choose to view the list in data sheet format as shown in Figure 5.11. From the data sheet view the user has the choice to export the take off list to Microsoft Excel for scheduling purposes (Future Expansion).

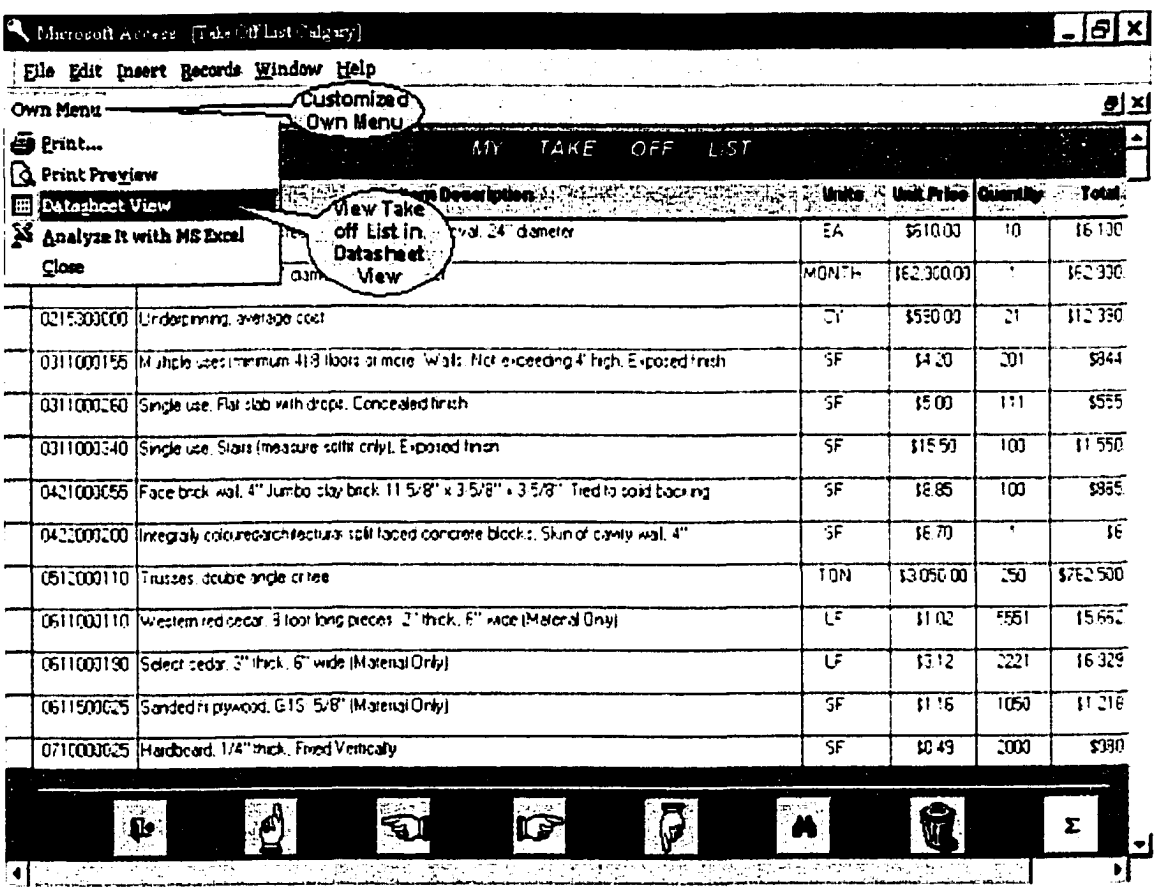


Figure 5.11 Customized Menu

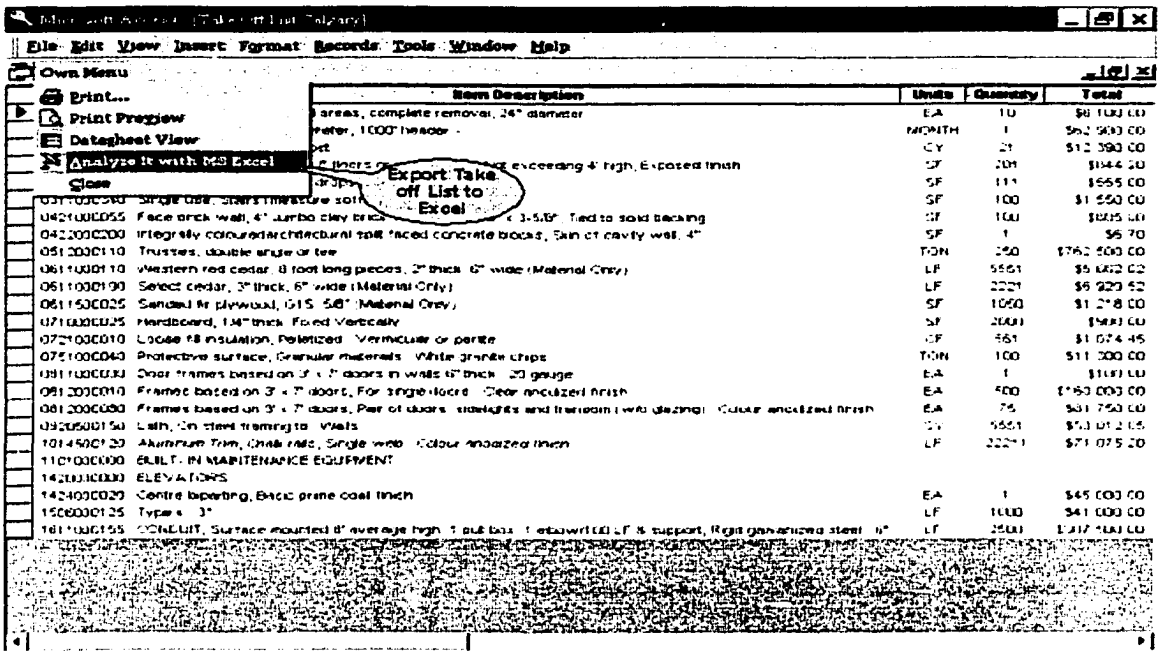


Figure 5.12 Before Exporting the Take off List to Excel

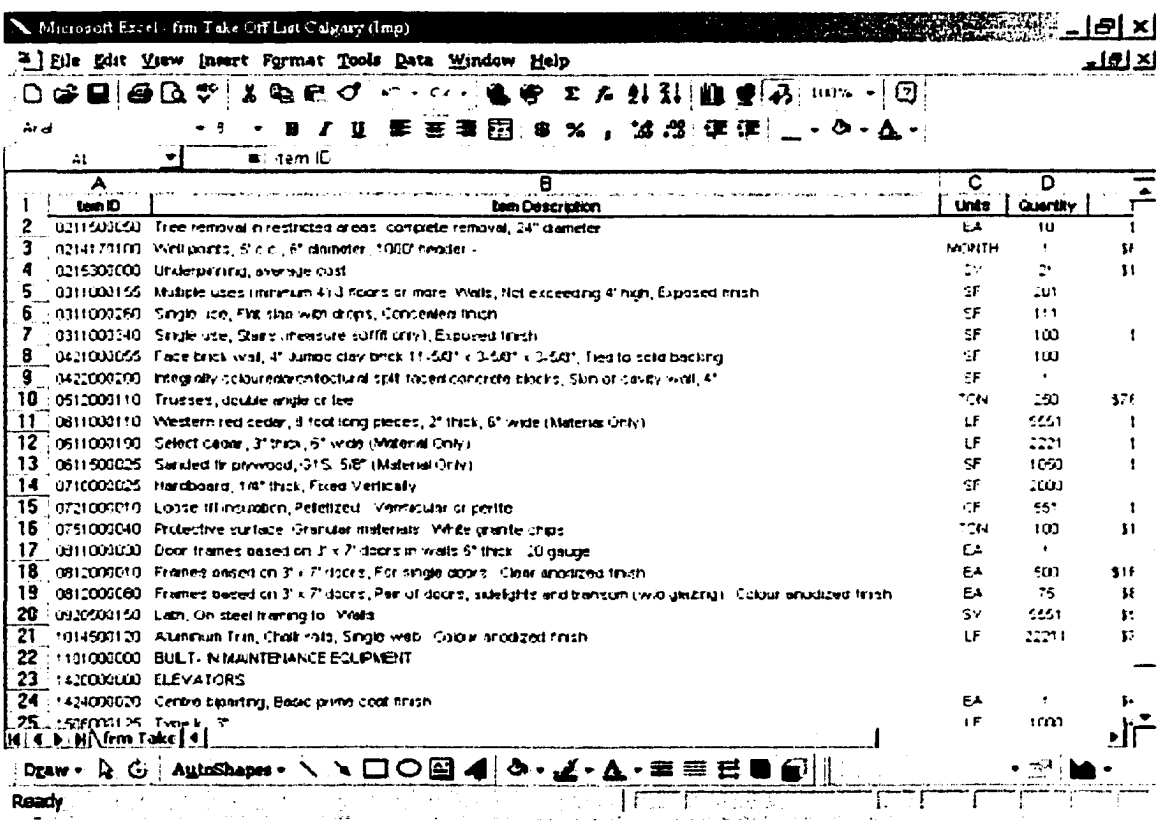


Figure 5.13 the List in Excel after Exportation

Figures 5.12 and 5.13 illustrate the list before and after the exportation. Beside the mentioned options, the user can print the list either from within Excel or the database itself. Different types of forms are designed in case the user chooses to enter own cost data, as illustrated in Figure 5.14. In this case the user is not provided with any unit cost of the items, instead he or she is asked to enter the costs of installation and material respectively as well the corresponding quantities. Afterwards, the queries that link these forms perform the necessary calculations.

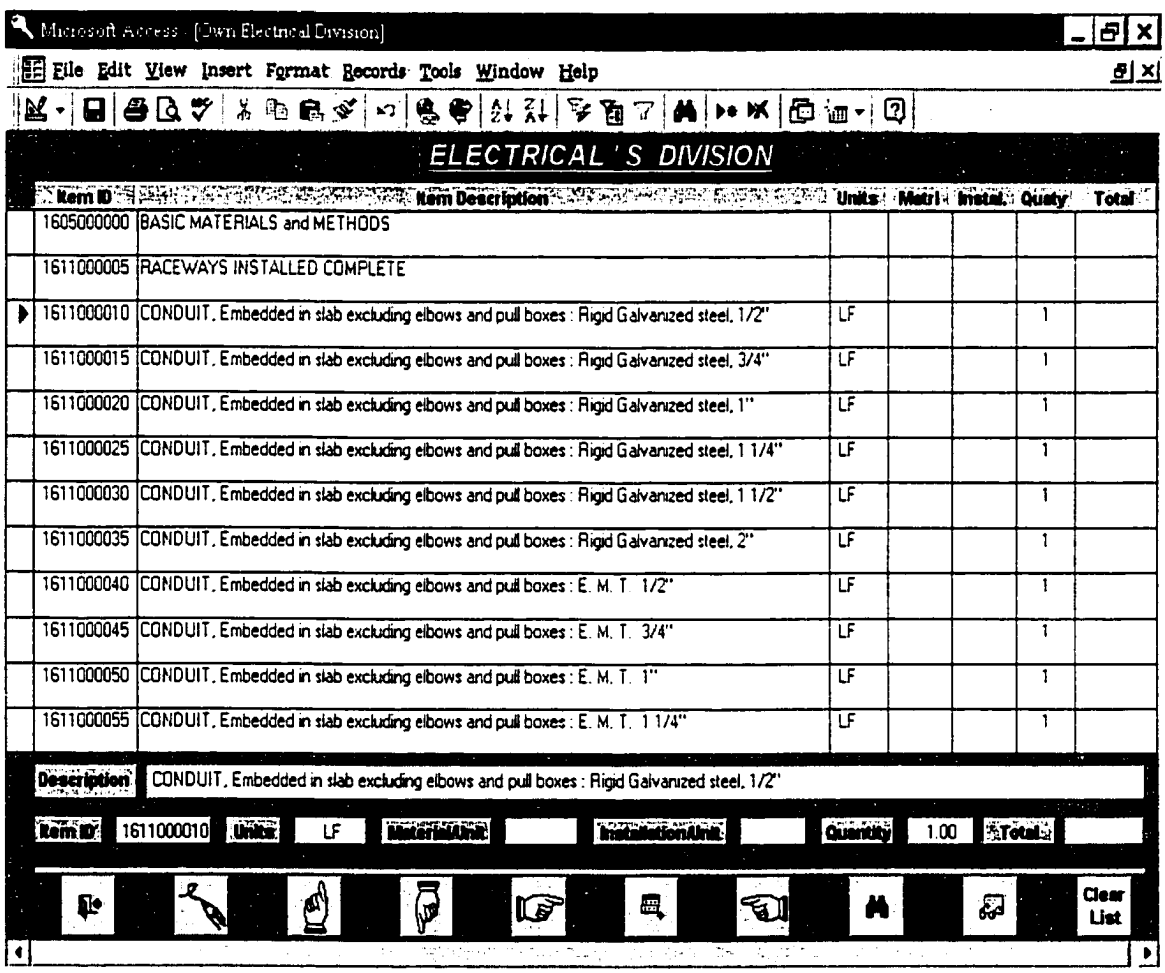


Figure 5.14 Case of Choosing to Use Own Cost Data.

These forms are outfitted with the same command buttons and their executed events as of the Yardsticks cost data forms. Likewise, the same design and options of the Take off List forms are also readied for this case.

Subsequently, to simplify the process of choosing one division at a time all the forms that contain the fourteen divisions cost data are linked by one simple form depending on the desired city. Figure 5.15 exemplifies this type of the form for the city of Toronto.

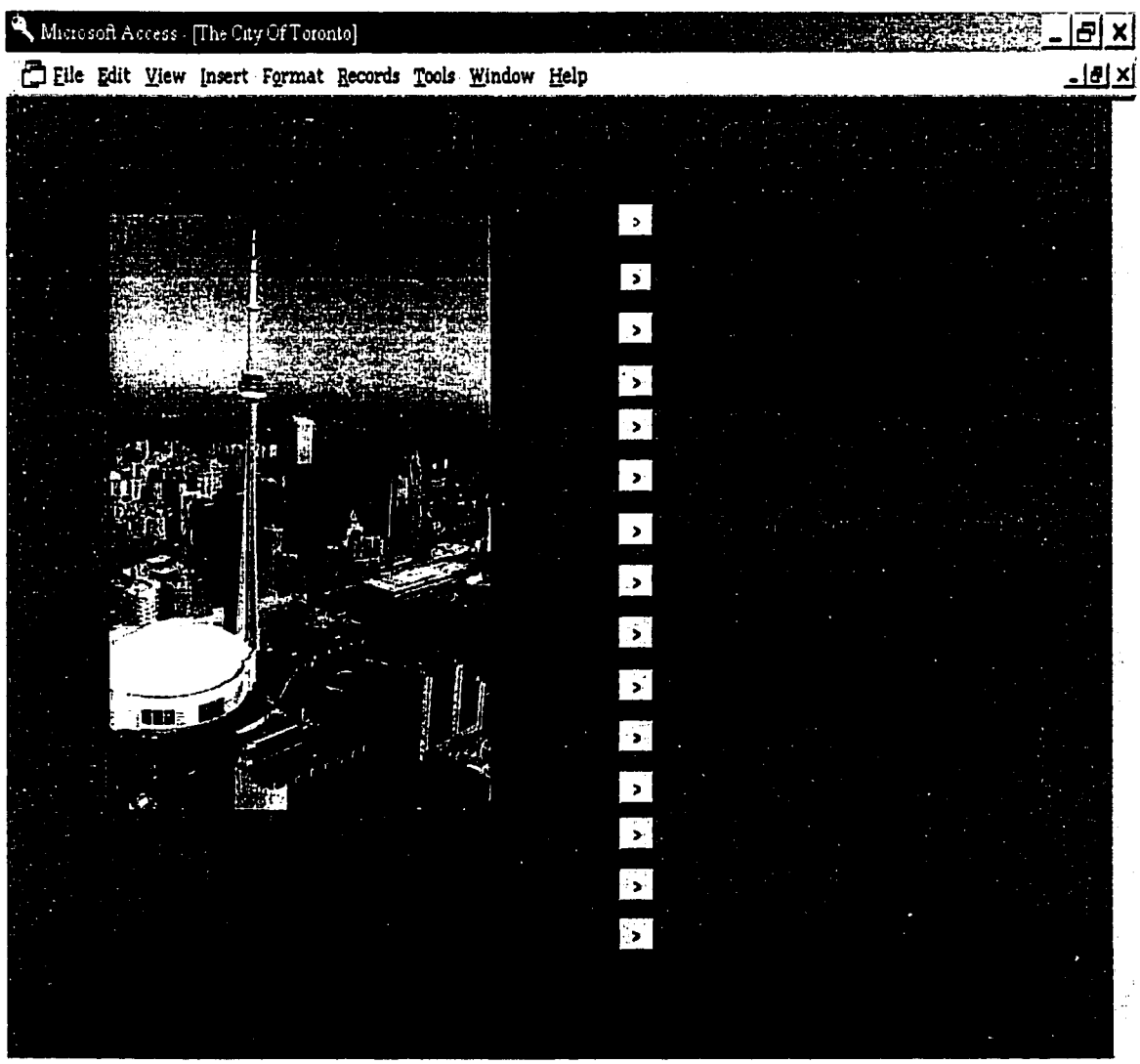


Figure 5.15 Divisions List for the City of Toronto

In a like manner, all the other cities' divisions are listed in forms that have the same design as the one shown for both units (Imperial and Metric) except for the photo that is for the associated city. As soon as the user clicks on the Exit button on any form similar to Figure 5.6 he or she returns to the form similar to the one in Figure 5.15 depending on the chosen city. It is to be noticed that the "General Conditions" button is disabled during the selection process from the other divisions, but once the user clicks on the last button "Finish" the interface send a

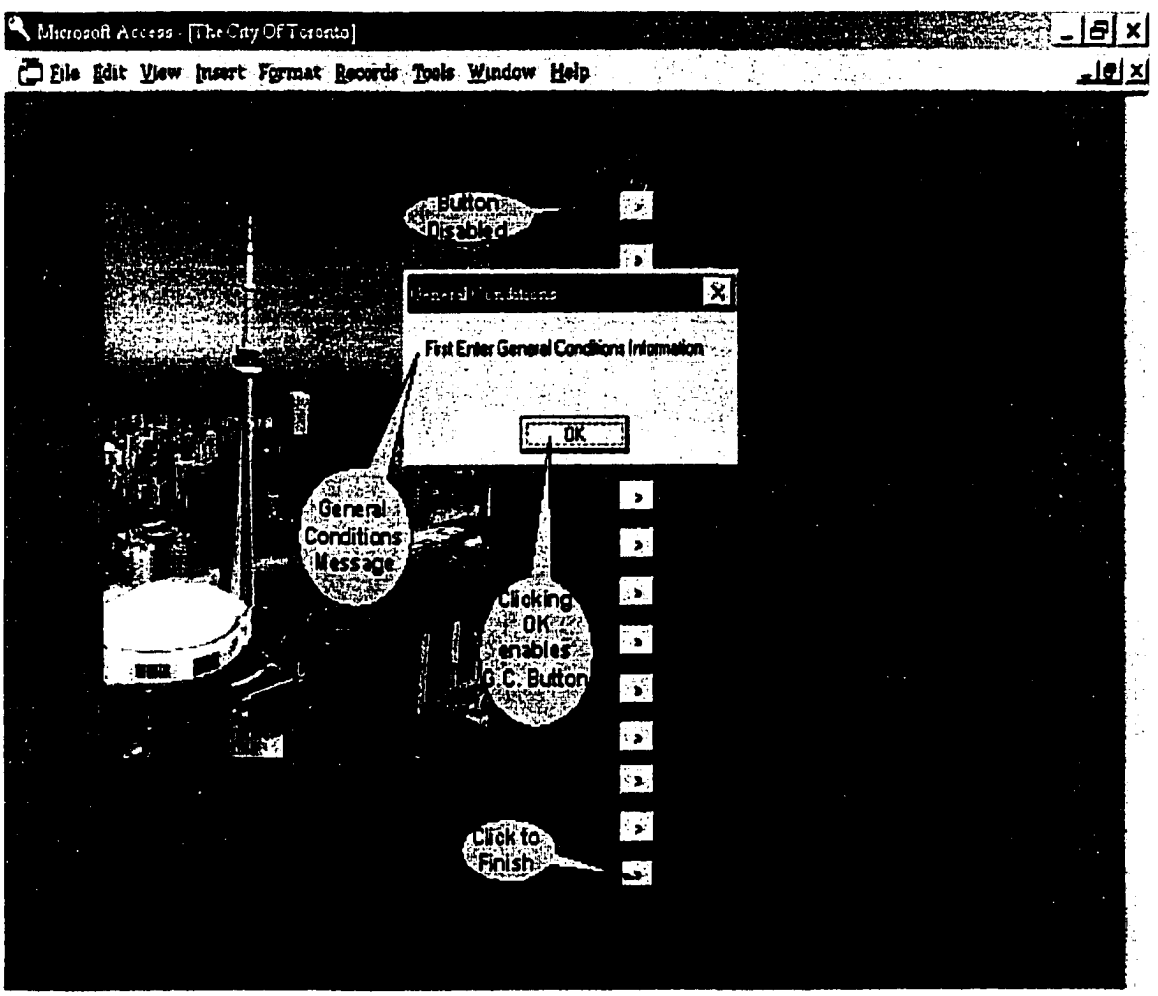


Figure 5.16 General Conditions Message

message to the user asking to enter the General Conditions Information, as shown in Figure 5.16.

Directly after the user clicks the "OK" button, the General Conditions button is enabled and by clicking it a dialog window appears asking to enter the General Conditions Information as Figure 5.17 exhibits.

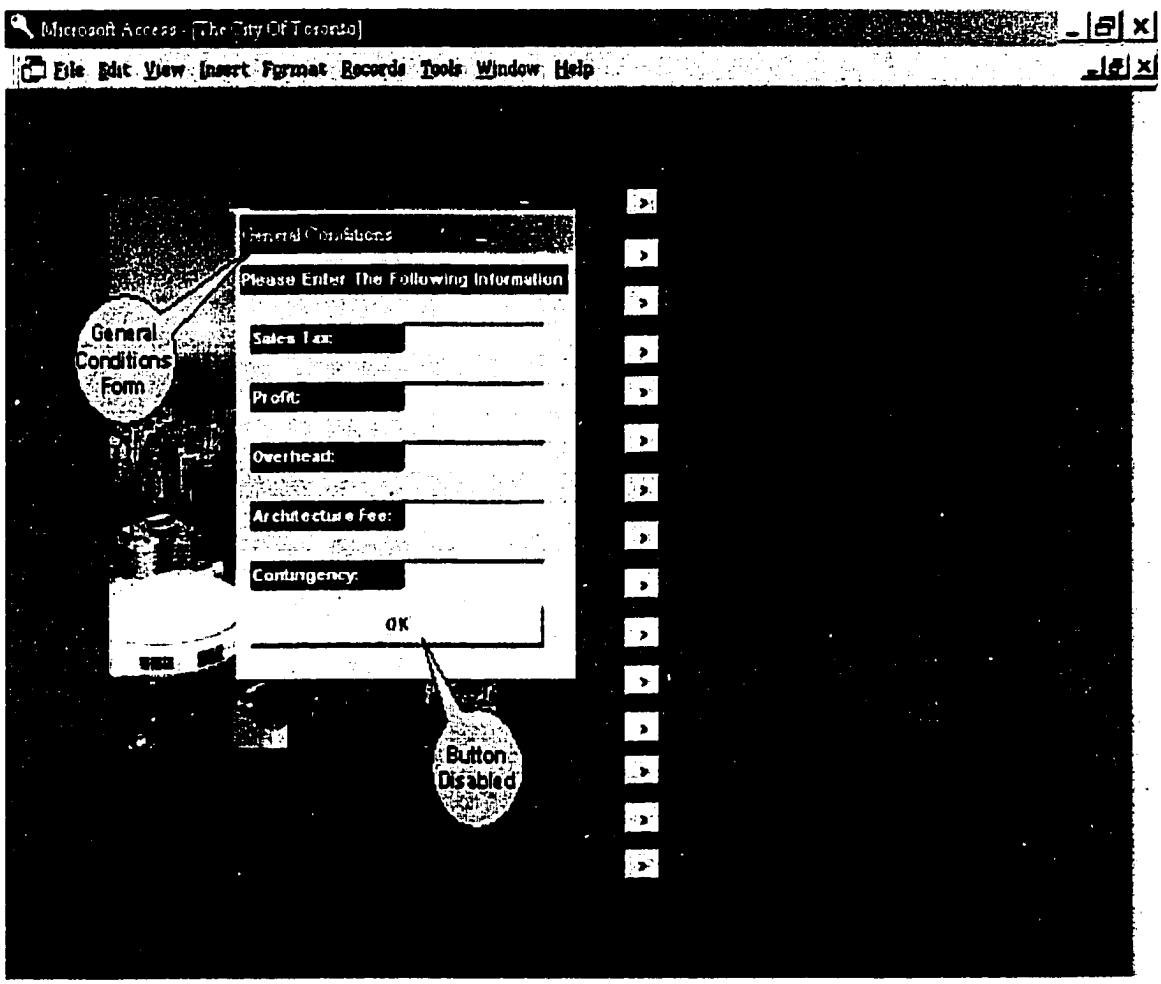


Figure 5.17 General Conditions Information Form

Many entries are necessary in such if they are not entered the "OK" button on the General Conditions form will not be enabled. Those entries are profit, overhead and contingency. The required data can be selected from default values or

entered, clicking the "OK" button displays another dialog window asking the user to choose the type of the summary report output he or she likes to generate. Three different reports and a complete Take off List by Division are available to choose from the drop down list as illustrated in Figure 5.18. Highlighting a selection and clicking the view button instructs the interface to generate the selected report type and displays it to the user.

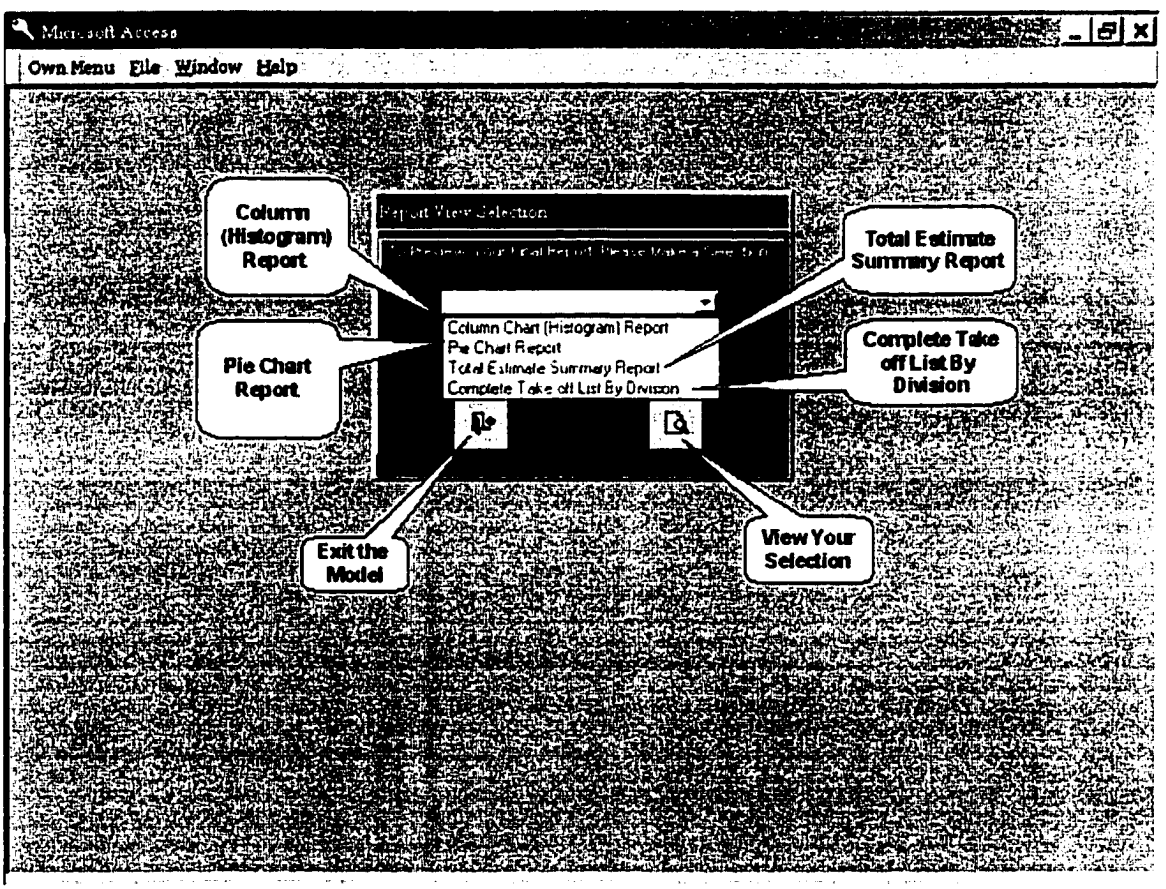
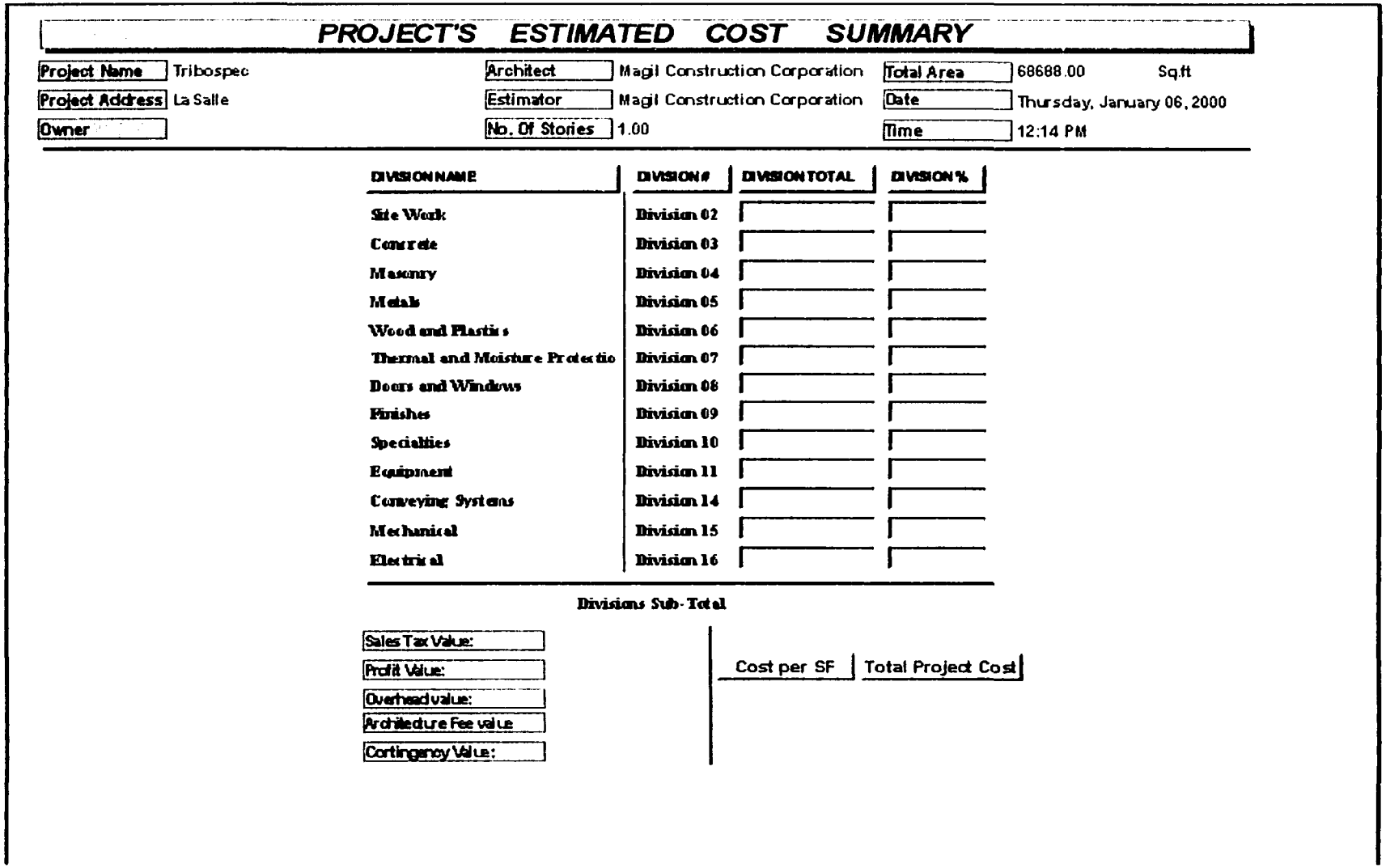


Figure 5.18 Select Report Type to View

Figures 5.19 and 5.20 show the project's final summary report type before and after building the take off list and entering the General Conditions information.



PROJECT'S ESTIMATED COST SUMMARY

Project Name	Tribospec	Architect	Magil Construction Corporation	Total Area	68688.00 Sq.ft
Project Address	La Salle	Estimator	Magil Construction Corporation	Date	Thursday, January 06, 2000
Owner		No. Of Stories	1.00	Time	12:14 PM

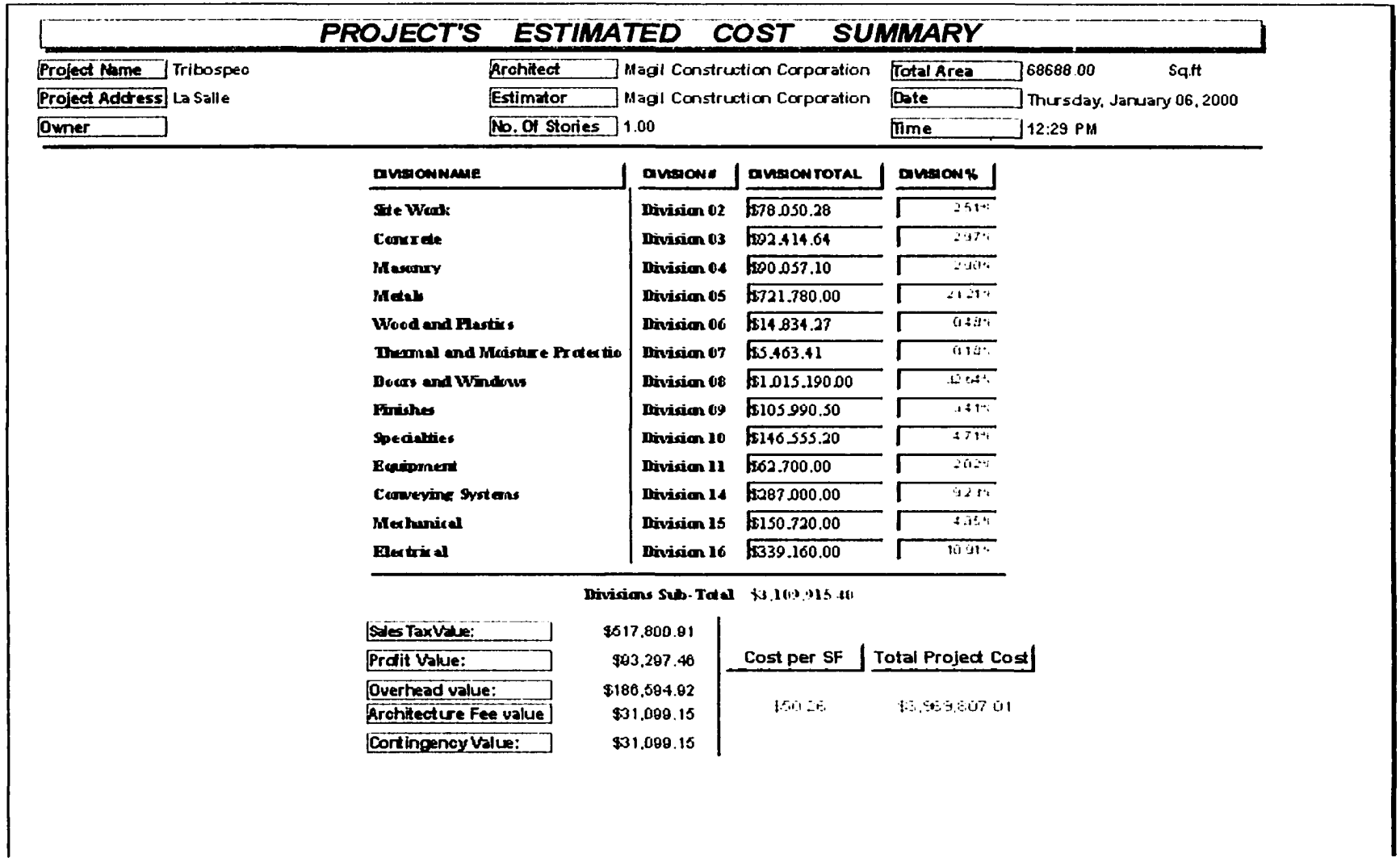
DIVISION NAME	DIVISION #	DIVISION TOTAL	DIVISION %
Site Work	Division 02		
Concrete	Division 03		
Masonry	Division 04		
Metals	Division 05		
Wood and Plastics	Division 06		
Thermal and Moisture Protectio	Division 07		
Doors and Windows	Division 08		
Finishes	Division 09		
Specialties	Division 10		
Equipment	Division 11		
Conveying Systems	Division 14		
Mechanical	Division 15		
Electrical	Division 16		

Divisions Sub-Total

Sales Tax Value:
Profit Value:
Overhead value:
Architecture Fee value
Contingency Value:

Cost per SF | Total Project Cost

Figure 5.19 Summary Report before Building the Take off List.



PROJECT'S ESTIMATED COST SUMMARY

Project Name	Tribospeo	Architect	Magil Construction Corporation	Total Area	68688.00 Sq.ft
Project Address	La Salle	Estimator	Magil Construction Corporation	Date	Thursday, January 06, 2000
Owner		No. Of Stories	1.00	Time	12:29 PM

DIVISION NAME	DIVISION #	DIVISION TOTAL	DIVISION %
Site Work	Division 02	$78,050.28	2.51%
Concrete	Division 03	$92,414.64	2.97%
Masonry	Division 04	$90,057.10	2.90%
Metals	Division 05	$721,780.00	23.21%
Wood and Plastics	Division 06	$14,834.27	0.48%
Thermal and Moisture Protectio	Division 07	$5,463.41	0.18%
Doors and Windows	Division 08	$1,015,190.00	32.64%
Finishes	Division 09	$105,990.50	3.41%
Specialties	Division 10	$146,555.20	4.71%
Equipment	Division 11	$62,700.00	2.02%
Conveying Systems	Division 14	$287,000.00	9.23%
Mechanical	Division 15	$150,720.00	4.85%
Electrical	Division 16	$339,160.00	10.91%
	Divisions Sub-Total	$3,109,915.40	

		Cost per SF	Total Project Cost
Sales Tax Value:	$617,800.91		
Profit Value:	$93,297.46		
Overhead value:	$186,594.92		
Architecture Fee value	$31,099.15	$50.26	$3,453,807.01
Contingency Value:	$31,099.15		

Figure 5.20 Summary Report after building the Take off List.

If the user chooses the "Complete Take off List by Division" option a professional printout report of the list showing each division, its associated items, and its total separately, Figures 5.21 and 5.22 illustrate the case before and after copying items to the list.

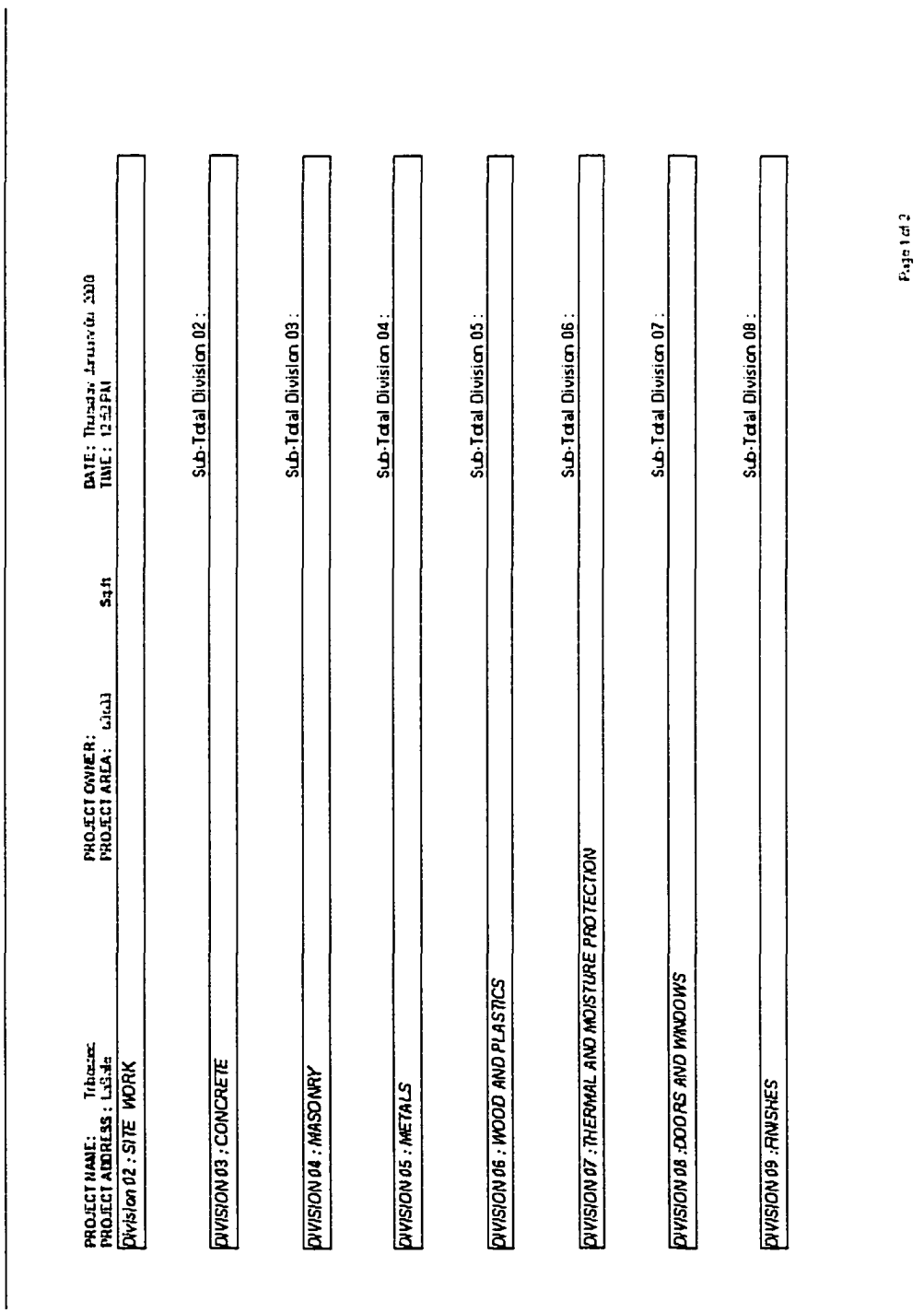


Figure 5.21 Complete Take off List By Division report before copying items

PROJECT NAME: [illegible] PROJECT OWNER: DATE: [illegible]
PROJECT ADDRESS : [illegible] PROJECT AREA: [illegible] Sqft TIME : [illegible]

Division 02 : SITE WORK

Item ID	Item Description	Units	Unit Price	Quantity	Total
0206000010	No salvage/ haulage included, based on building volume, Low rise Building, 10' floor to f	CF	$0.28	1	$0.28
0211500060	Tree removal in restricted areas, complete removal, 24" diameter	EA	$550.00	1	$550.00
0214170100	Well points, 5' o.c., 8" diameter, 1000' header -	MON	$77,500.00	1	$77,500.00
			Sub-Total Division 02 :		$78,050.28

DIVISION 03 : CONCRETE

Item ID	Item Description	Units	Unit Price	Quantity	Total
0311000030	Formwork Foundation Walls and Grade Beams, Not exceeding 12' high, Concealed Fini	SF	$4.63	19528	$90,414.64
0311000340	Single use, Stairs (measure soffit only), Exposed finish	SF	$20.00	100	$2,000.00
			Sub-Total Division 03 :		$92,414.64

DIVISION 04 : MASONRY

Item ID	Item Description	Units	Unit Price	Quantity	Total
0421000055	Face brick wall, 4" Jumbo clay brick 11-5/8" x 3-5/8" x 3-5/8", Tied to solid backing	SF	$9.40	100	$940.00
0422000020	Plain (lightweight) concrete blocks, Backup, 8" (Exterior Walls)	SF	$6.05	7168	$43,305.90
0422000105	Architectural split faced concrete blocks, Freestanding jointed and pointed, 4" Split Block	SF	$6.40	7168	$45,811.20
			Sub-Total Division 04 :		$90,057.10

DIVISION 05 : METALS

Item ID	Item Description	Units	Unit Price	Quantity	Total
0512000080	Spandrels, Light beams not exceeding 35 lbs / lf	TON	$2,050.00	1	$2,050.00
0512000110	Trusses, double angle or tee	TON	$2,475.00	250	$618,750.0
0521000005	65 ksi yield strength, Prime coated	TON	$1,980.00	51	$100,980.0
			Sub-Total Division 05 :		$721,780.00

DIVISION 06 : WOOD AND PLASTICS

			Sub-Total Division 06 :		$14,834.27

DIVISION 07 : THERMAL AND MOISTURE PROTECTION

Item ID	Item Description	Units	Unit Price	Quantity	Total
0721000010	Loose fill insulation, Pelletized : Vermicular or perlite	CF	$2.26	551	$1,245.26
0721000030	Board or quilt insulation, Glass fibre at-630 : 2"	SF	$1.83	2305	$4,218.15

Page 1 of 3

Figure 5.22 Complete Take Off List by Division report after copying items

The values in the take off list are taken arbitrary for illustration only. Similarly, Figures 5.23 to 5.26 illustrates the Column and Pie chart selection.

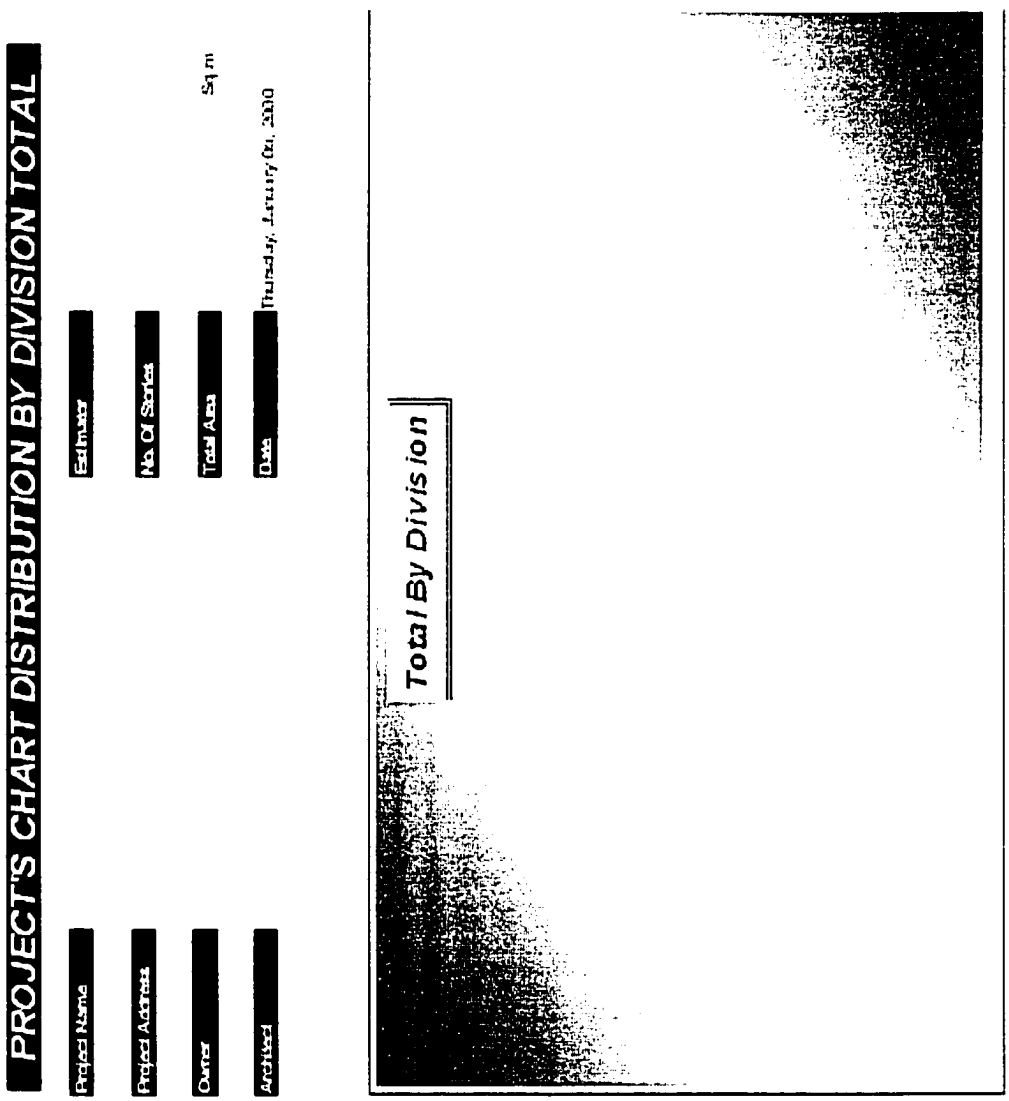


Figure 5.23 Column Chart Report before building Take off List

PROJECT'S CHART DISTRIBUTION BY DIVISION TOTAL

Project Name		Estimator	
Project Address		No. Of Stories	
Owner		Total Area	Sq ft
Architect		Date	Thursday, January 06, 2000

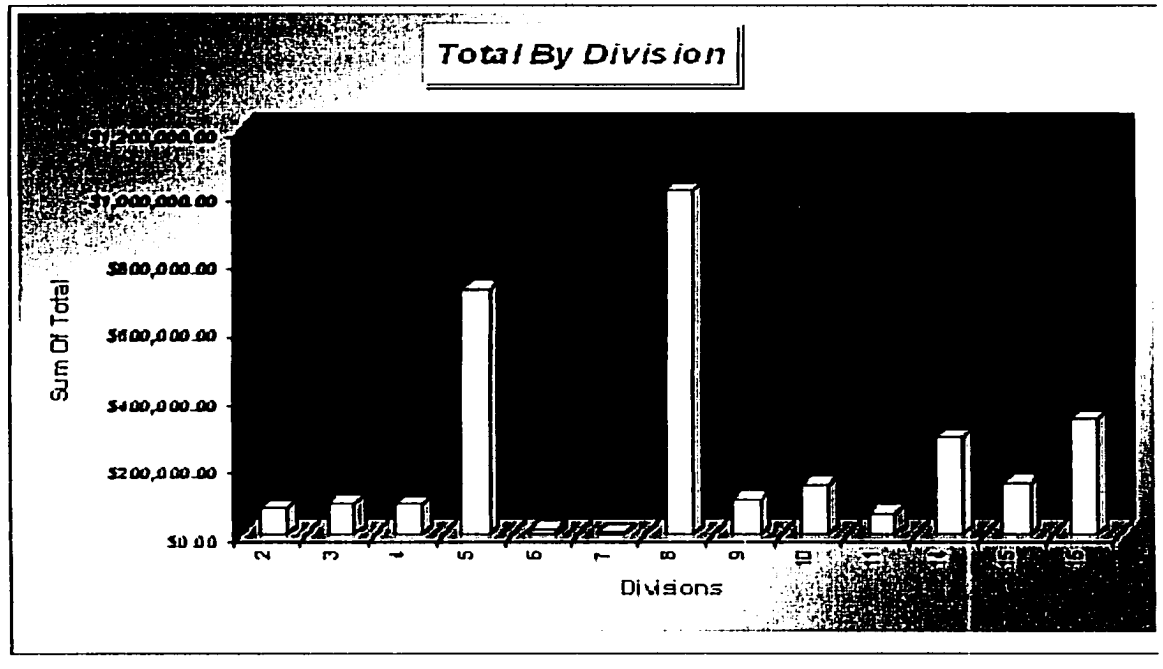


Figure 5.24 Column Chart Report after Building Take off List

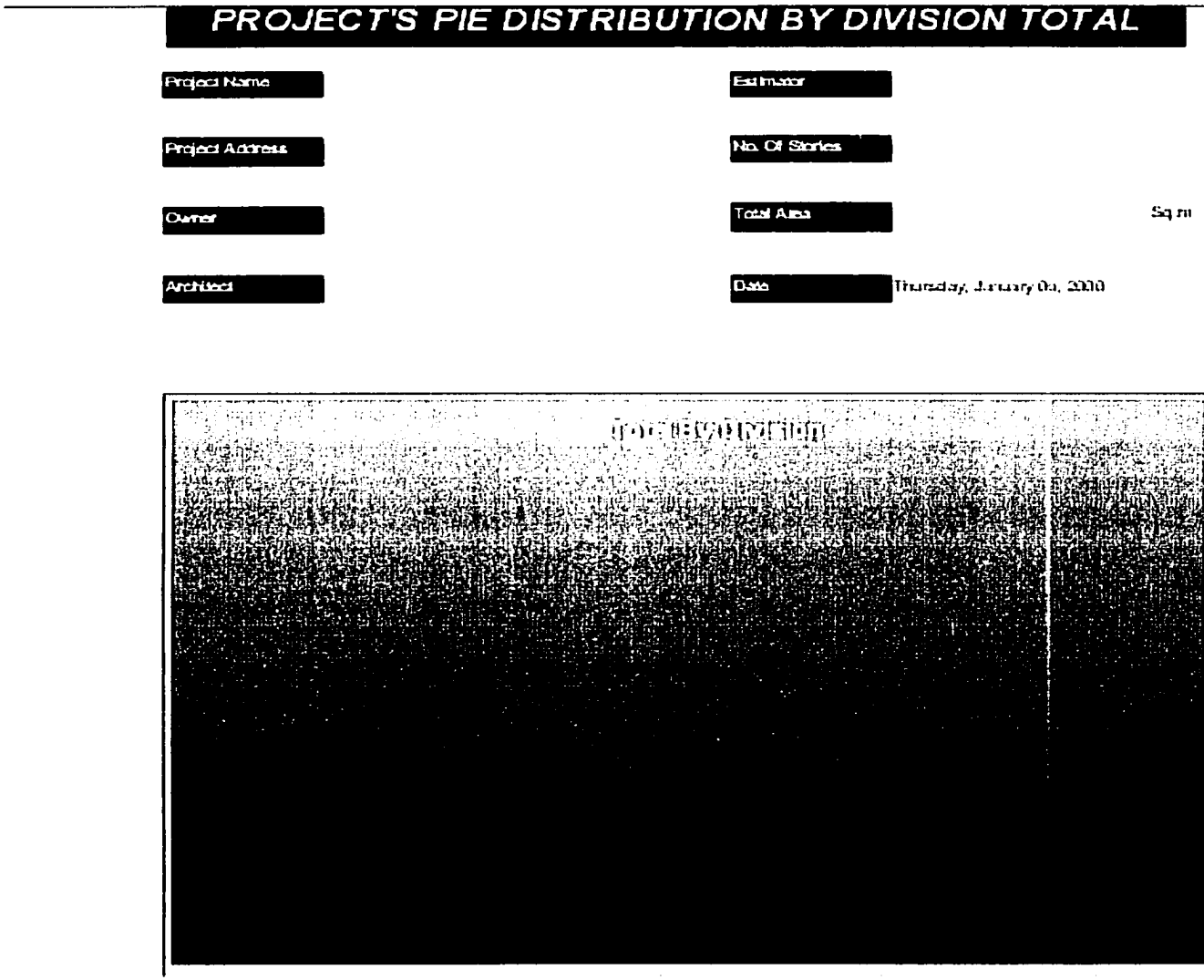


Figure 5.25 Pie Chart Report before Building Take off List

Figure 5.26 Pie Chart Report after Building Take off List

To make the city selection easy for the user, all cities are grouped into two main and different forms called "The Eight Major Canadian Cities", one for Imperial and the other for Metric. Figure 5.27 pictures one of these types of forms. The user has to simply click on the button beside the city name and immediately the Masterformat form associated with the chosen city is opened instantly similar to the one shown in Figure 5.15.

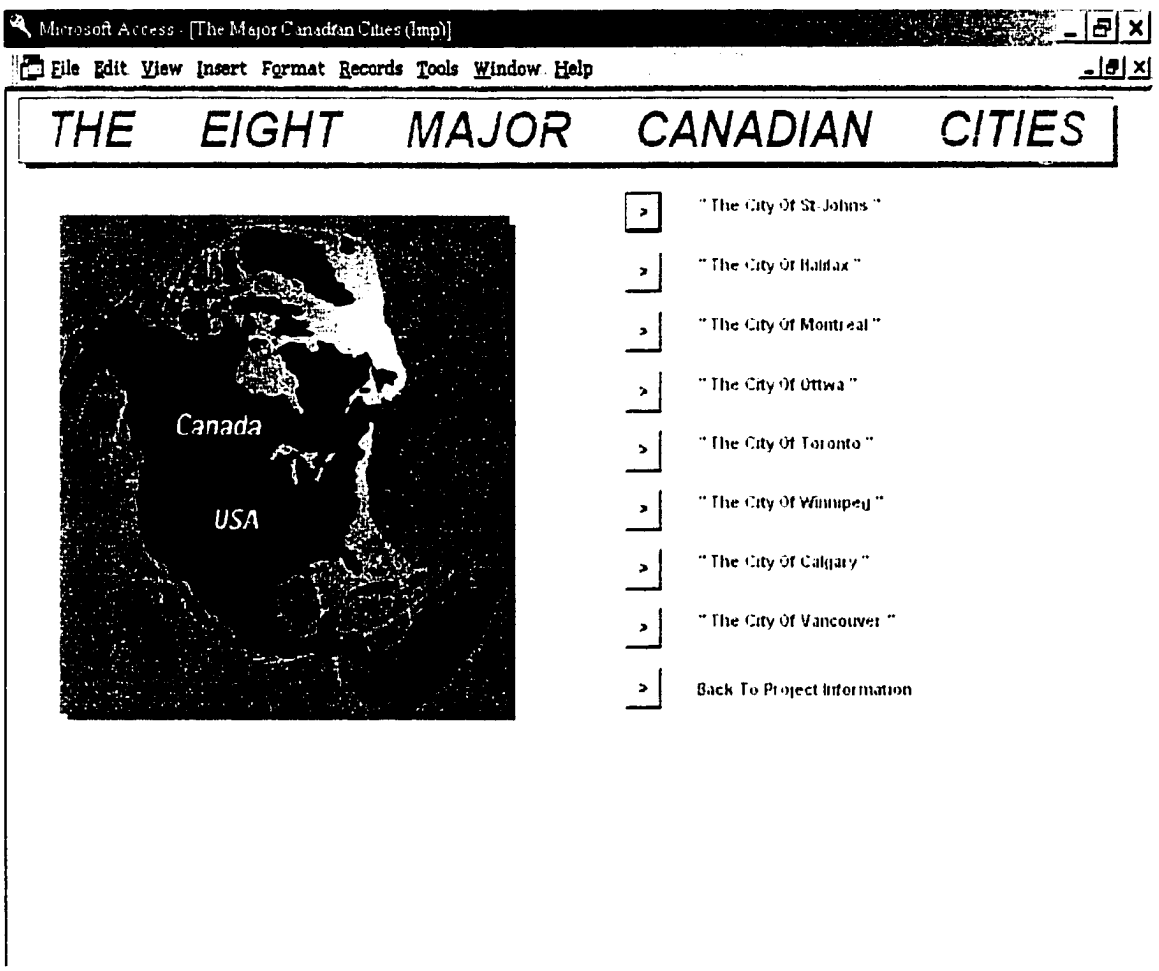


Figure 5.27 the Eight Major Canadian Cities

The key that culls all these forms in this database is the "Project Information" form, from which the user picks out the cost source data and the unit to estimate the required project. Figures 5.28 and 5.29 represent the data source selection and the unit selection. When opening this form, the unit box and the continue button are disabled, because it is designed to make the user select the data source type in order to continue otherwise all he or she can do is exit the application. Contiguously when the user makes a selection only the unit box is enabled to allow for another selection. At this stage the "continue" button is enabled, hitting it instructs the interface to analyze the selection combination and as a result the required form is opened.

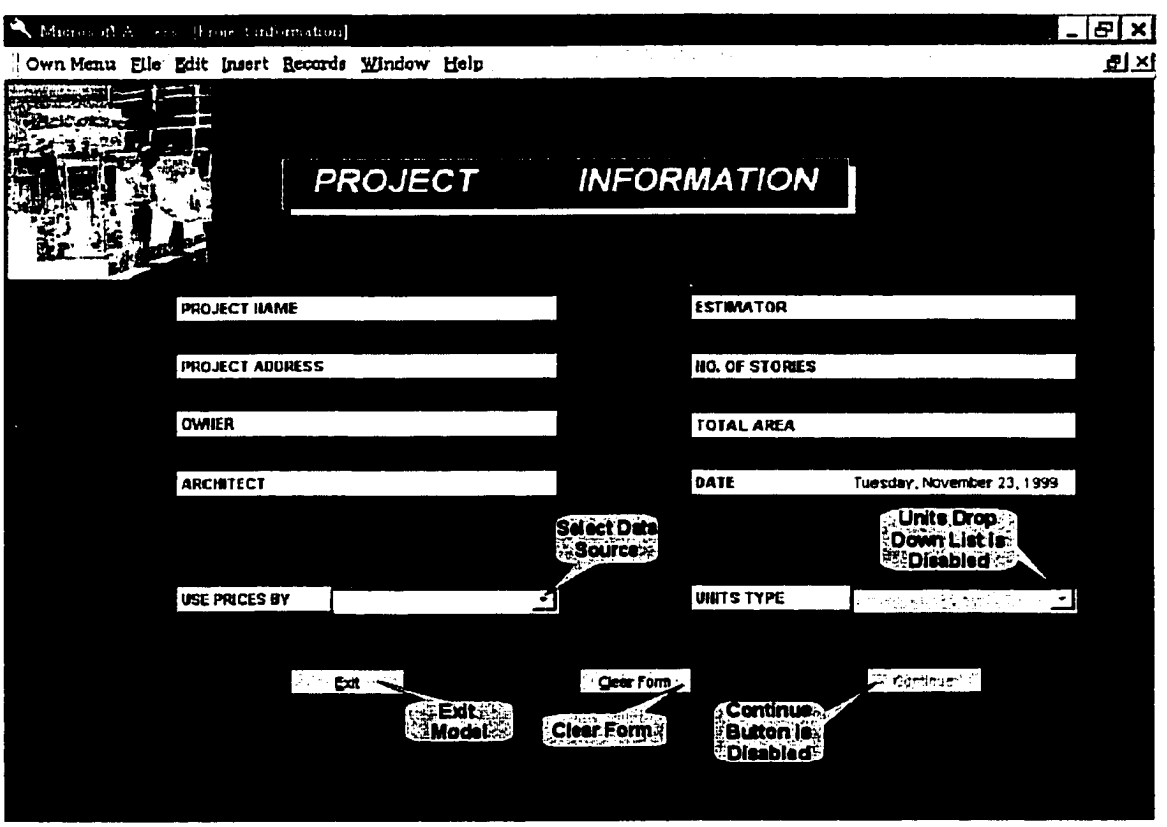


Figure 5.28 Units Type and Continue Button Disabled

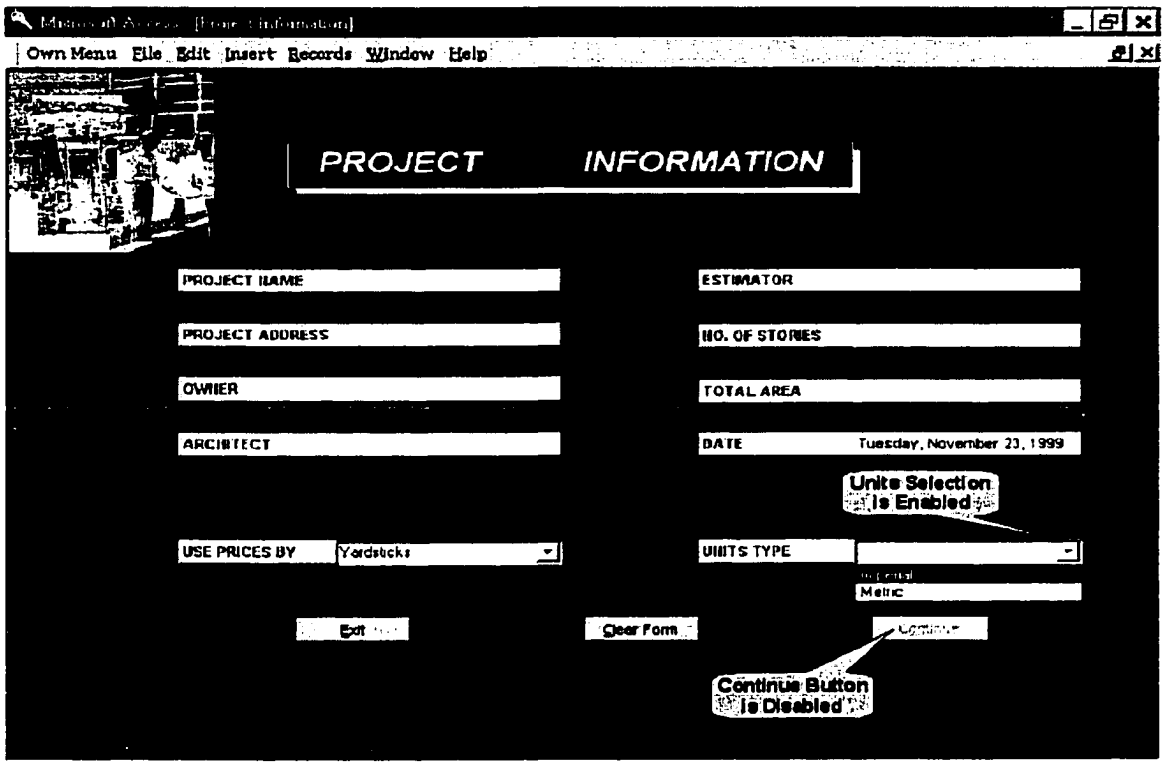


Figure 5.29 Continue Button is disabled

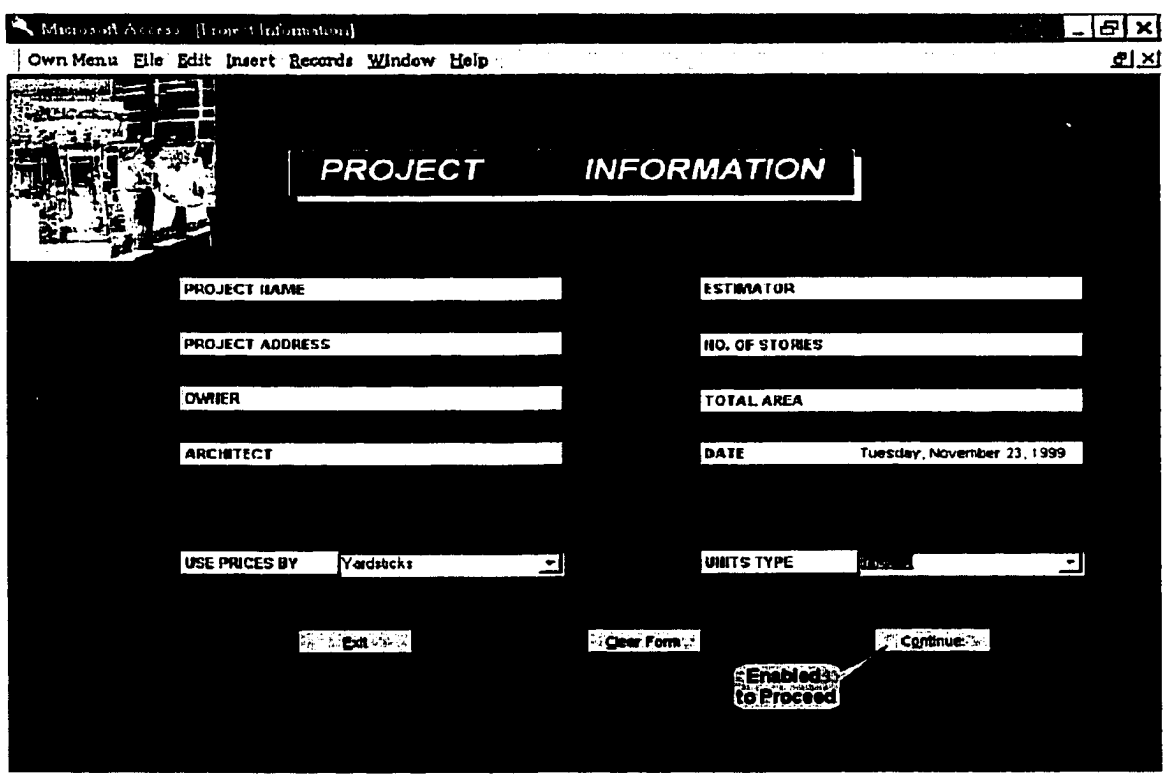


Figure 5.30 Data source and unit type are selected

Figure 5.30 shows the case that occurs after the user selects the data source type and the unit type, the "continue" button is enabled.

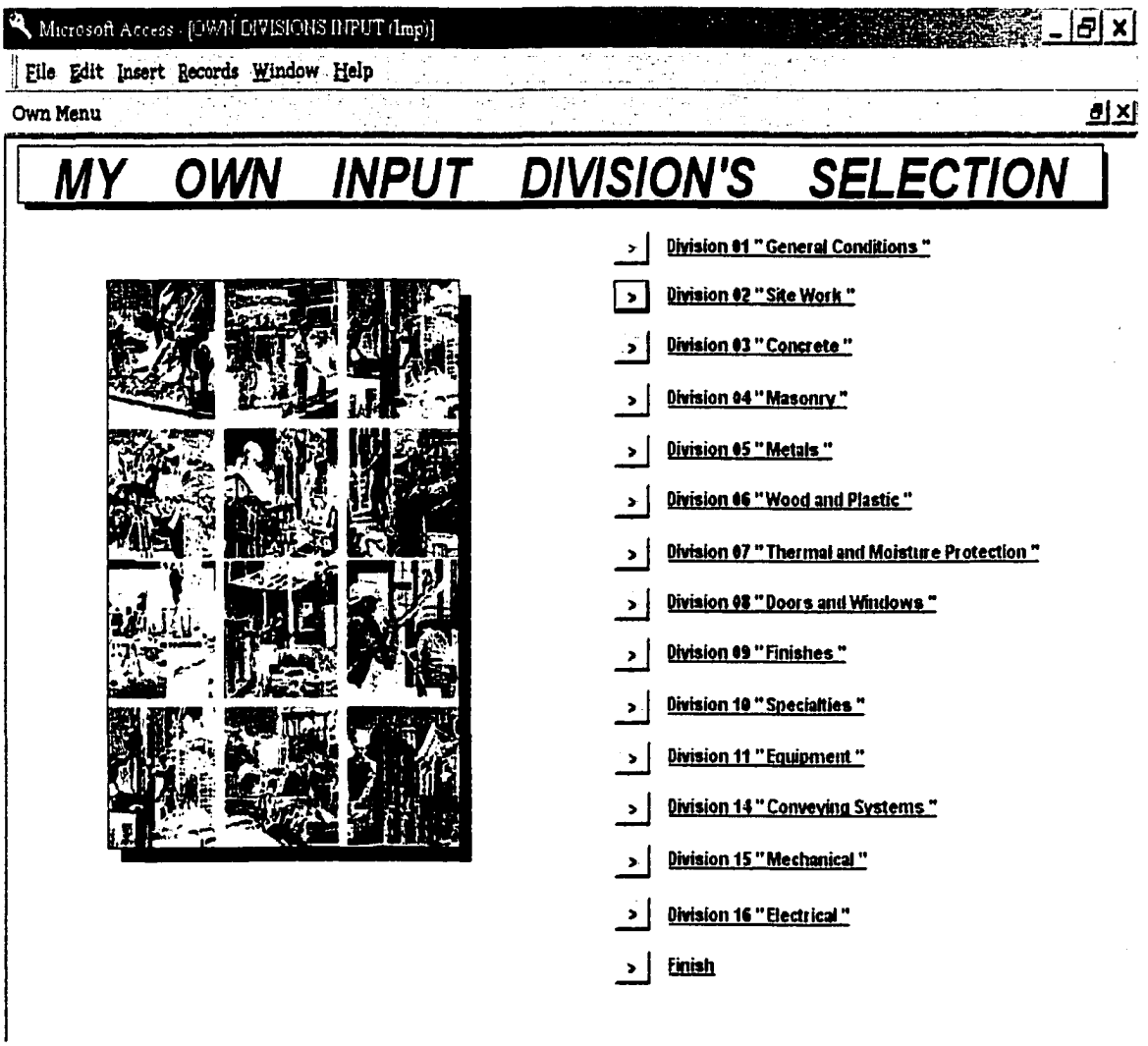


Figure 5.31 Result of Own data source and imperial unit type selection

Figure 5.31 pictures the form that the interface opens after analyzing a selection combination of own cost data type and imperial unit type. In favor of operating the database entirely, hundreds of coding lines are written in the interface so that the selection execution can be done fast and errorless. Furthermore, many variables have been declared in a module interface to be easily classified.

Figures 5.32 and 5.33 illustrate one of many subs used and one of the interface modules in the Preliminary database. The foregoing Figures demonstrated briefly the design process of the Preliminary Database, starting from entering data into tables, to queries and ending by forms and reports. As well interpreted how all the forms are operated from main forms for simplicity and flexibility.

5.4 Imperial Parametric Database

The ER-diagram mentioned in chapter 4 is the source from which the components of this database are detected. The database is comprised of two sets of previously executed projects gathered from different sources, such as Hanscomb's Yardsticks 1998 costs, and the Internet webs linked through R. S. Means web side. The first set incorporates 35 projects that have Uniformat (elements) as their work breakdown structure; on the other hand the second set comprises 67 projects that are based on Masterformat (divisions) and their costs are according to 1994. Appendix D provides lists of these projects.

Similarly to the Preliminary Database, the design of this database is divided into three main steps as follows:

Step One

All the projects' data are to be typed in, and arranged into two different sets of tables depending on their work breakdown structure. Tables 5.4 and 5.5 show the fields name, type and size for each type. Next, other types of tables are to be designed in order to adjust the cost of each project and its associated structure according to city index and inflation rate as shown in Tables 5.6 and 5.7.

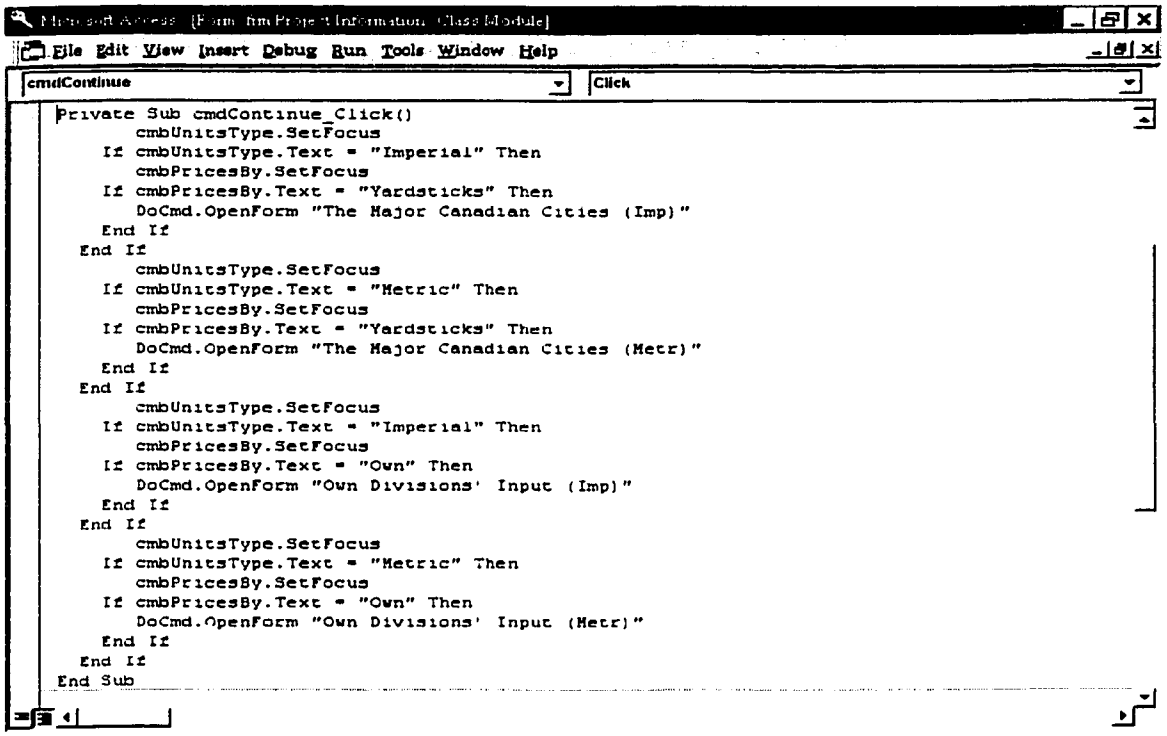


Figure 5.32 One Coding Sub in the Interface

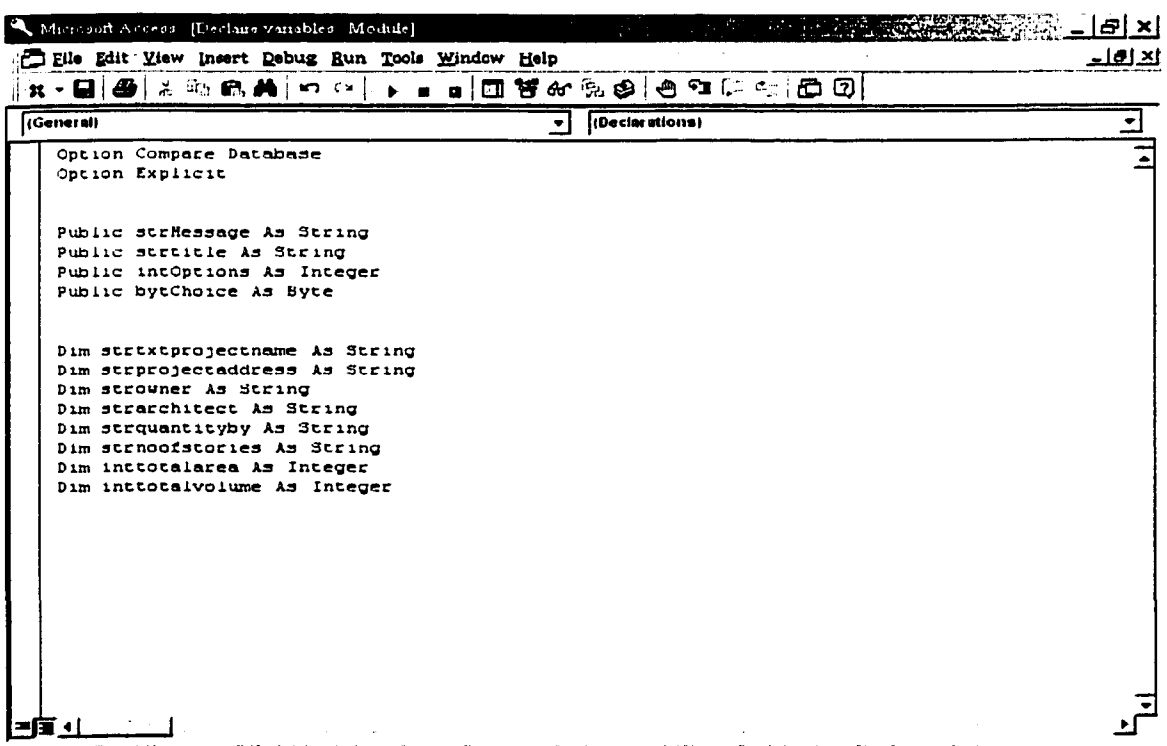


Figure 5.33 One of the Interface Modules to Declare Variables

Table 5.4 Fields of Table Projects by Masterformat

Field Name	Field Type	Field Size
Project Number	Auto Number	Long Integer
Description	Text	50
Building Size	Number	Long Integer
Cost per Square Foot	Currency	Currency
Construction Cost	Currency	Currency
General Requirements	Currency	Currency
Site Work (Building Related)	Currency	Currency
Concrete	Currency	Currency
Masonry	Currency	Currency
Metals	Currency	Currency
Wood and Plastics	Currency	Currency
Thermal and Moisture Protection	Currency	Currency
Doors and Windows	Currency	Currency
Finishes	Currency	Currency
Specialties	Currency	Currency
Equipment	Currency	Currency
Furnishings	Currency	Currency
Special Construction	Currency	Currency
Conveying Systems	Currency	Currency
Mechanical	Currency	Currency
Electrical	Currency	Currency

Table 5.5 Fields of Table Projects by Elements

Field Name	Field Type	Field Size
Project Number	Auto Number	Long Integer
Description	Text	50
Building Size	Number	Long Integer
Cost per Square Foot	Currency	Currency
Construction Cost	Currency	Currency
Substructure	Currency	Currency
Structure	Currency	Currency
Exterior Enclosure	Currency	Currency
Partitions and Doors	Currency	Currency
Finishes	Currency	Currency
Fittings and Equipment	Currency	Currency
Mechanical	Currency	Currency
Electrical	Currency	Currency
General Requirements and Fee	Currency	Currency

Table 5.6 Table of Adjusted Projects costs by Masterformat

Field Name	Field Type	Field Size
Project Number	Auto Number	Long Integer
Description	Text	50
Building Size	Number	Long Integer
City Index	Number	Single
Cost per Square Foot	Currency	Currency
Construction Cost	Currency	Currency
General Requirement Index	Number	Single
General Requirements	Currency	Currency
Site Work Index	Number	Single
Site Work (Building Related)	Currency	Currency
Concrete Index	Number	Single
Concrete	Currency	Currency
Masonry Index	Number	Single
Masonry	Currency	Currency
Metals Index	Number	Single
Metals	Currency	Currency
Wood and Plastics Index	Number	Single
Wood and Plastics	Currency	Currency
Thermal and Moisture Protection Index	Number	Single
Thermal and Moisture Protection	Currency	Currency
Doors and Windows Index	Number	Single
Doors and Windows	Currency	Currency
Finishes Index	Number	Single
Finishes	Currency	Currency
Specialties Index	Number	Single
Specialties	Currency	Currency
Equipment Index	Number	Single
Equipment	Currency	Currency
Furnishings Index	Number	Single
Furnishings	Currency	Currency
Special Construction Index	Number	Single
Special Construction	Currency	Currency
Conveying Systems Index	Number	Single
Conveying Systems	Currency	Currency
Mechanical Index	Number	Single
Mechanical	Currency	Currency
Electrical Index	Number	Single
Electrical	Currency	Currency
Inflation Rate	Number	Long Integer
Number of Years	Number	Byte

Tables 5.7 Table of Adjusted Projects costs by Elements

Field Name	Field Type	Field Size
Project Number	Auto Number	Long Integer
Description	Text	50
Building Size	Number	Long Integer
Cost per Square Foot	Currency	Currency
City Index	Number	Single
Construction Cost	Currency	Currency
Substructure	Currency	Currency
Substructure Index	Number	Single
Structure	Currency	Currency
Structure Index	Number	Single
Exterior Enclosure	Currency	Currency
Exterior Enclosure Index	Number	Single
Partitions and Doors	Currency	Currency
Partitions and Doors Index	Number	Single
Finishes	Currency	Currency
Finishes Index	Number	Single
Fittings and Equipment	Currency	Currency
Fittings and Equipment Index	Number	Single
Mechanical	Currency	Currency
Mechanical Index	Number	Single
Electrical	Currency	Currency
Electrical Index	Number	Single
General Requirements and Fee	Currency	Currency
General Requirements and Fee Index	Number	Single
Inflation Rate	Number	Single
Number of Years	Number	Byte

Subsequent to assigning the main fields names, fields' types and fields size the task of building the tables in the database can be initiated. Figures 5.34 and 5.35 illustrate snapshots of the datasheet view while designing these tables.

Step Two

As described earlier, tables are rigid objects while queries are flexible and allow data manipulations. Thus based on the tables designed in step one, sets of queries are to be implemented to carry out all the required calculations for this database. Consequently, their fields' name and type have to be specified as

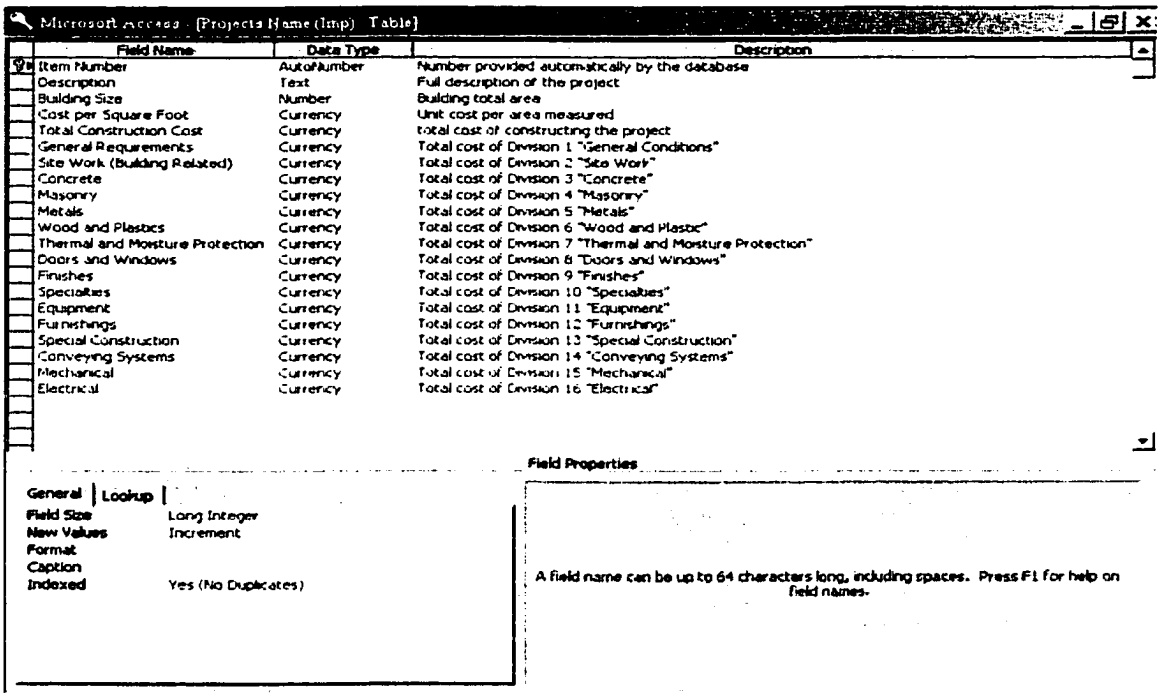


Figure 5.34 Screen Snapshot of Arranging Projects into Table

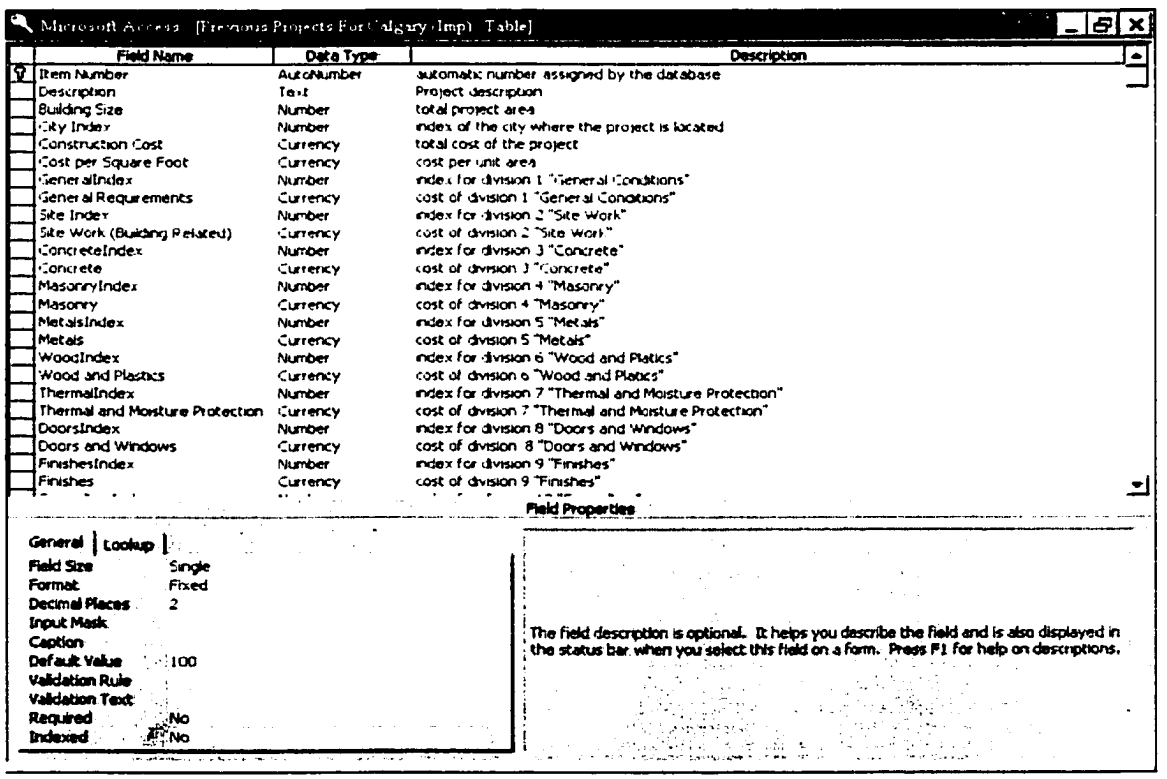


Figure 5.35 Screen Snapshot of the Adjusted Projects Table

shown in Tables 5.8 and 5.9.

Subsequently, assigning each query to one specific city in accordance to the project work breakdown structure attains the design of these queries. This illustration is provided in Figure 5.36.

Table 5.8 Query for Uniformat Adjustment Calculation per City

Field Name	Field Type
Project Number	Auto Number
Description	Text
Building Size	Number
City Index	Number
Square Foot Cost = ([Cost per SF]*[City Index])/100	Currency
Total Construction Cost = ([Building Size]*[Square Foot Cost])	Currency
Substructure Index	Number
Substructure = ([Substructure]*[Substructure Index])/100	Currency
Structure Index	Number
Structure = ([Structure]*[Structure Index])/100	Currency
Exterior Enclosure Index	Number
Exterior Enclosure Division: ([Exterior Enclosure]*[Exterior Enclosure Index])/100	Currency
Partitions and Doors Index	Number
Partitions = ([Partitions and Doors]*[Partitions Index])/100	Currency
Finishes Index	Number
Finishes = ([Finishes]*[Finishes Index])/100	Currency
Fittings and Equipment Index	Number
Fittings = ([Fittings and Equipment]*[Fittings Index])/100	Currency
Mechanical Index	Number
Mechanical = ([Mechanical]*[Mechanical Index])/100	Currency
Electrical Index	Number
Electrical = ([Electrical]*[Electrical Index])/100	Currency
General Requirements and Fee Index	Number
General = ([General Requirements and Fee]*[General Requirement Index])/100	Currency
Inflation Rate	Number
Number of Years	Number
Total Expected Cost =[Total Construction Cost]*((1+[Inflation Rate]/100)^([Number of Years]))	Currency

Table 5.9 Query for Masterformat Adjustment Calculation per City

Field Name	Field Type
Project Number	Auto Number
Description	Text
Building Size	Number
City Index	Number
Total Construction Cost = (Construction Cost) x (City Index)/100	Currency
Cost per Square Foot = (Total Construction cost)/(Building Size)	Currency
General Requirement Index	Number
Adjusted General Requirements = (General Requirements) x (General Requirements) / 100	Currency
Site Work Index	Number
Adjusted Site Work = (Site work) x (Site Work Index) / 100	Currency
Concrete Index	Number
Adjusted Concrete = (Concrete) x (Concrete Index) / 100	Currency
Masonry Index	Number
Adjusted Masonry = (Masonry) x (Masonry Index) / 100	Currency
Metals Index	Number
Adjusted Metals = (Metals) x (Metals Index) / 100	Currency
Wood and Plastics Index	Number
Adjusted Wood and Plastics = (Wood and Plastics) x (Wood and Plastics Index) / 100	Currency
Thermal and Moisture Protection Index	Number
Adjusted Thermal and Moisture Protection = (Thermal and Moisture) x (Thermal Index) / 100	Currency
Doors and Windows Index	Number
Adjusted Doors and Windows = (Doors and Windows) x (Doors and Windows Index) / 100	Currency
Finishes Index	Number
Adjusted Finishes = (Finishes) x (Finishes Index) / 100	Currency
Specialties Index	Number
Adjusted Specialties = (Specialties) x (Specialties Index) / 100	Currency
Equipment Index	Number
Adjusted Equipment = (Equipment) x (Equipment Index) / 100	Currency
Furnishings Index	Number
Adjusted Furnishings = (Furnishings) x (Furnishings Index) / 100	Currency
Special Construction Index	Number
Adjusted Special Construction = (Special Construction) x (Special Construction Index) / 100	Currency
Conveying Systems Index	Number
Adjusted Conveying Systems = (Conveying Systems) x (Conveying Systems Index) / 100	Currency
Mechanical Index	Number
Adjusted Mechanical = (Mechanical) x (Mechanical Index) / 100	Currency
Electrical Index	Number
Adjusted Electrical = (Electrical) x (Electrical Index) / 100	Currency
Inflation Rate	Number
Number of Years	Number
Total Project Cost =(Total Construction Cost)x((1+[Inflation Rate]/100)^([Number Of Years]))	Currency

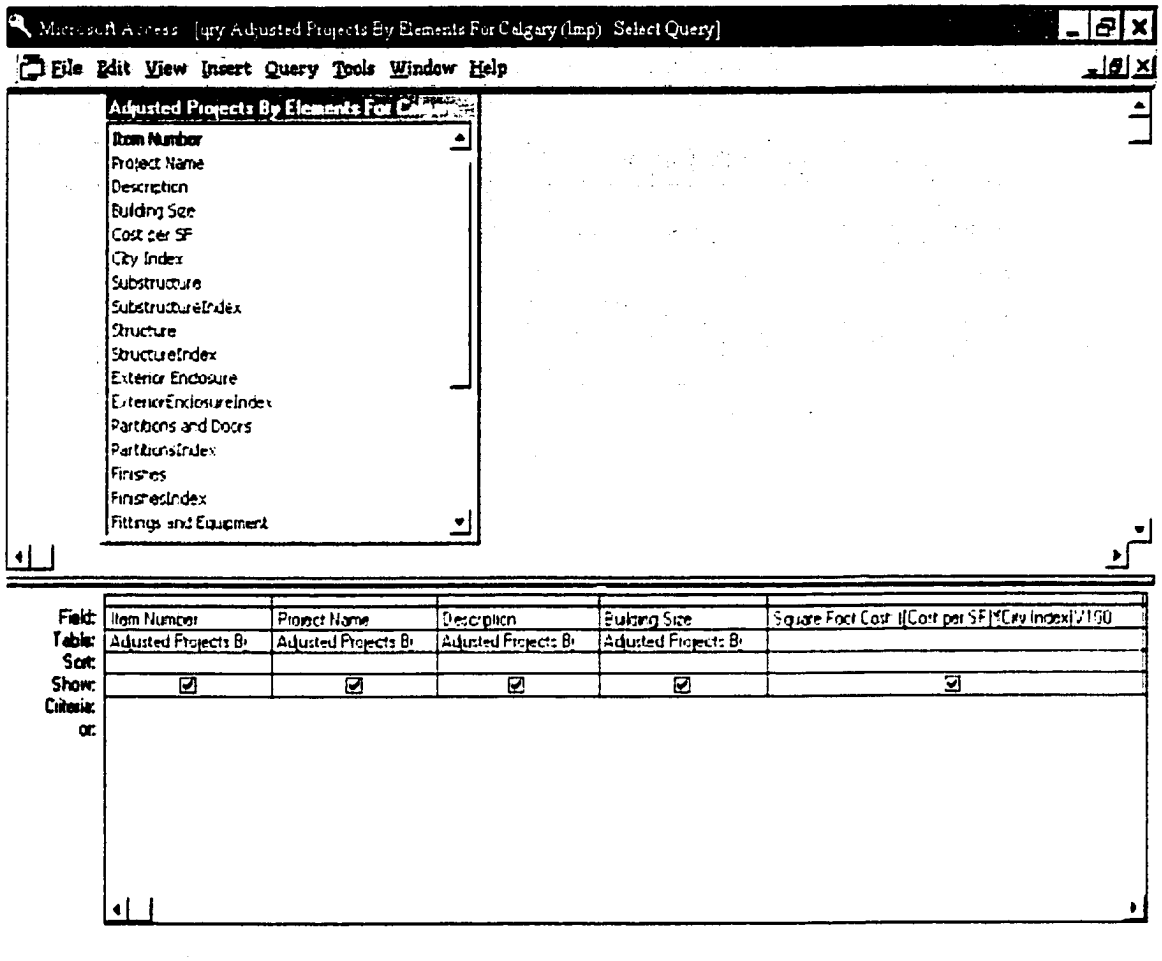


Figure 5.36 Query of Adjusted projects by Elements for Calgary

Step Three

In order to institute the interface all the projects historical data has been organized into sets of tables and queries. Groups of forms that have the queries as their data source are to be designed. Each form illustrates a list of the adjusted costs for previous projects and their associated structures for a specific city. Figures 5.37 and 5.38 represent two types of forms for each format; as well they give explanation of the available command buttons and their role. The same design type of these forms is used for all the cities.

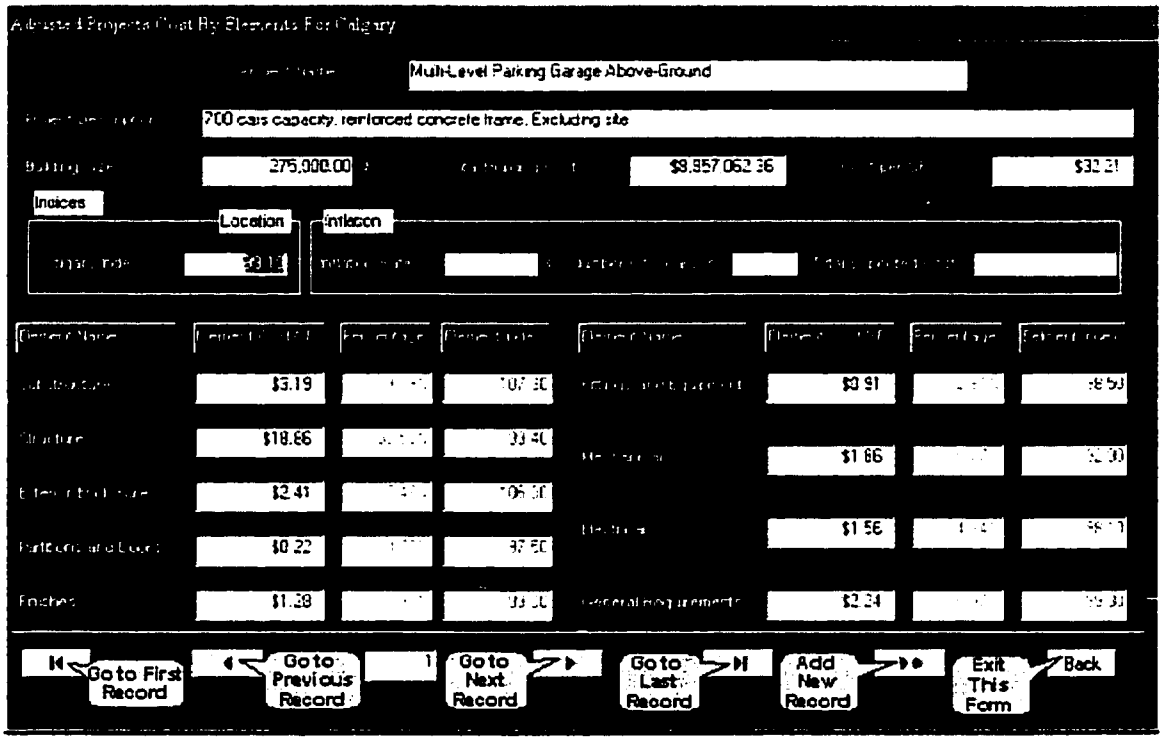


Figure 5.37 Adjusted Projects by Elements for Calgary

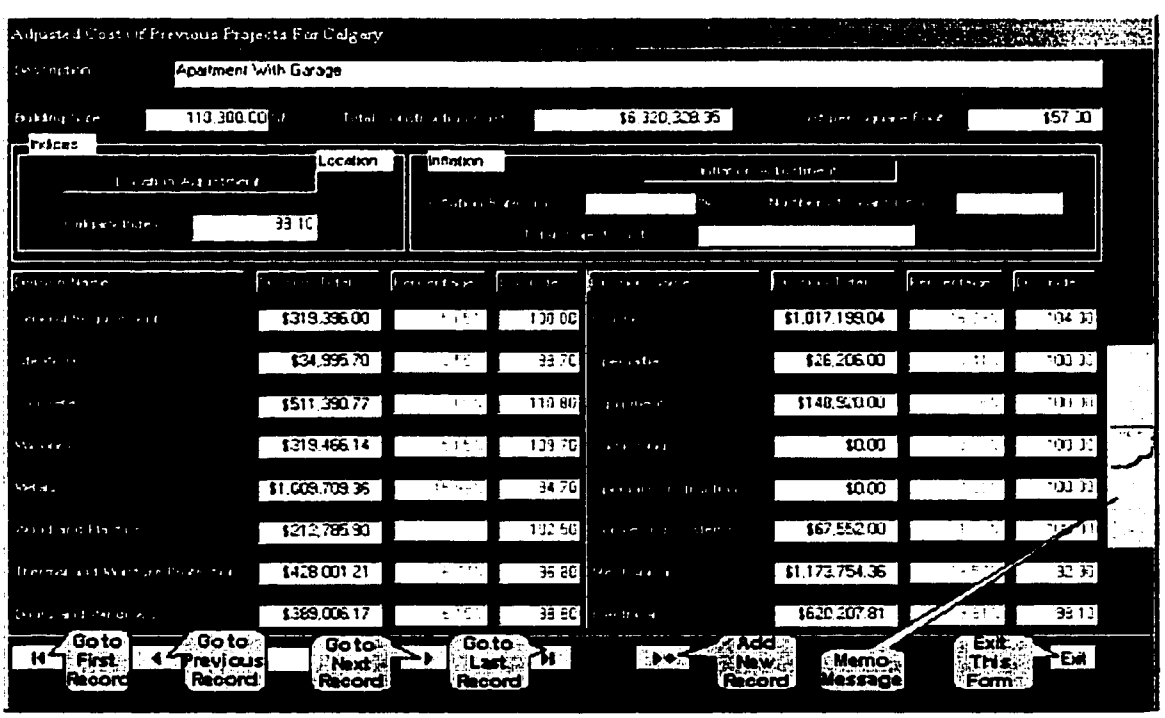


Figure 5.38 Adjusted Projects by Masterformat for Calgary

All the values of the indices used in this database are based on R. S. Means' historical data, therefore their recommendations of using these indices have to be taken into consideration. This is the reason behind including a memo message in the forms that supply adjusted costs for the projects based on Masterformat. Means instructs that to adjust the "Specialties", "Equipment", "Furnishings", "Special Construction", and "Conveying Systems" divisions one has to add their values and multiply the answer by a factor given for each city separately. Once the user clicks on the Memo button, a dialog window appears immediately listing a message. Figure 5.39 illustrates this case.

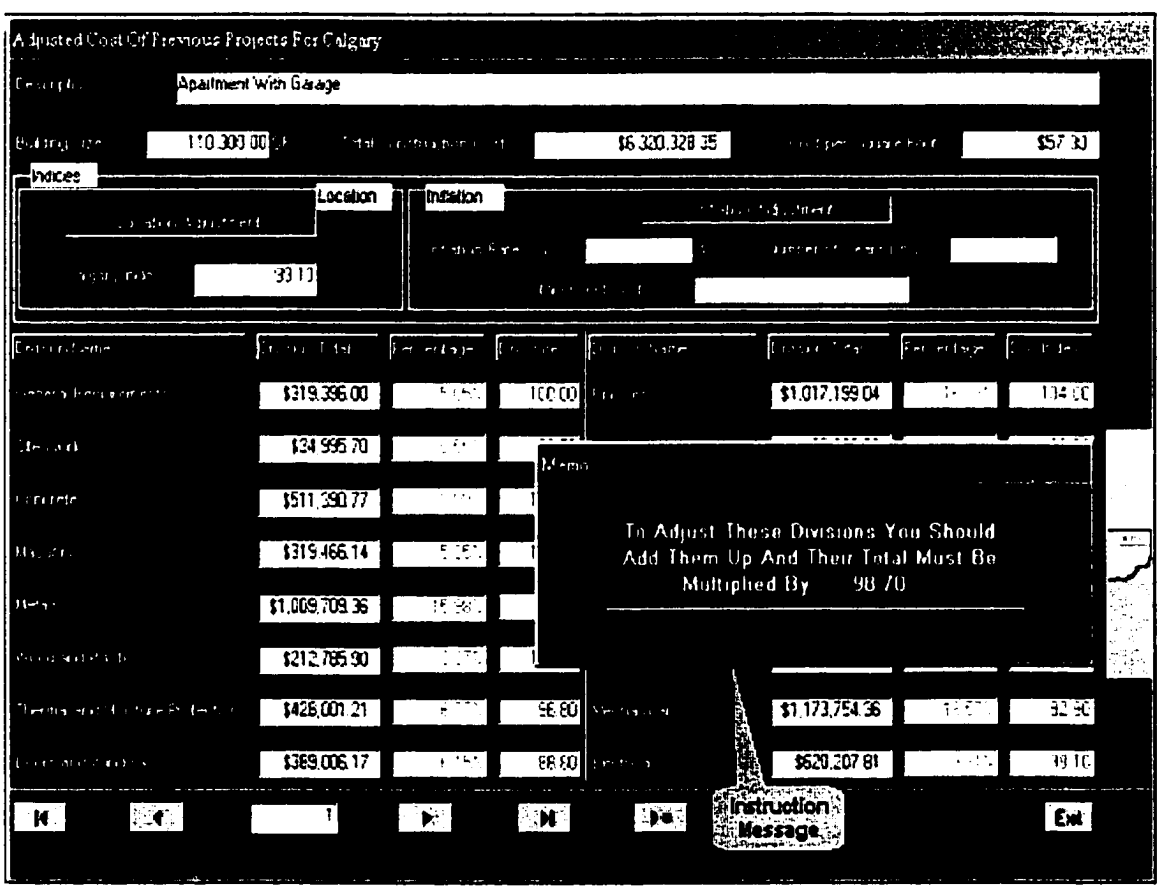


Figure 5.39 Instruction Memo to Adjust Divisions 10 to 14

Designating one form for each city associated with the type of the project structure format necessitate a main form to group all the cities in order to simplify the selection task for the user. Hence, two main forms are designed for this matter. The first, groups the cities according to Uniformat projects structure and the second groups them according to Masterformat projects structure. Figure 5.40 pictures one of these two forms.

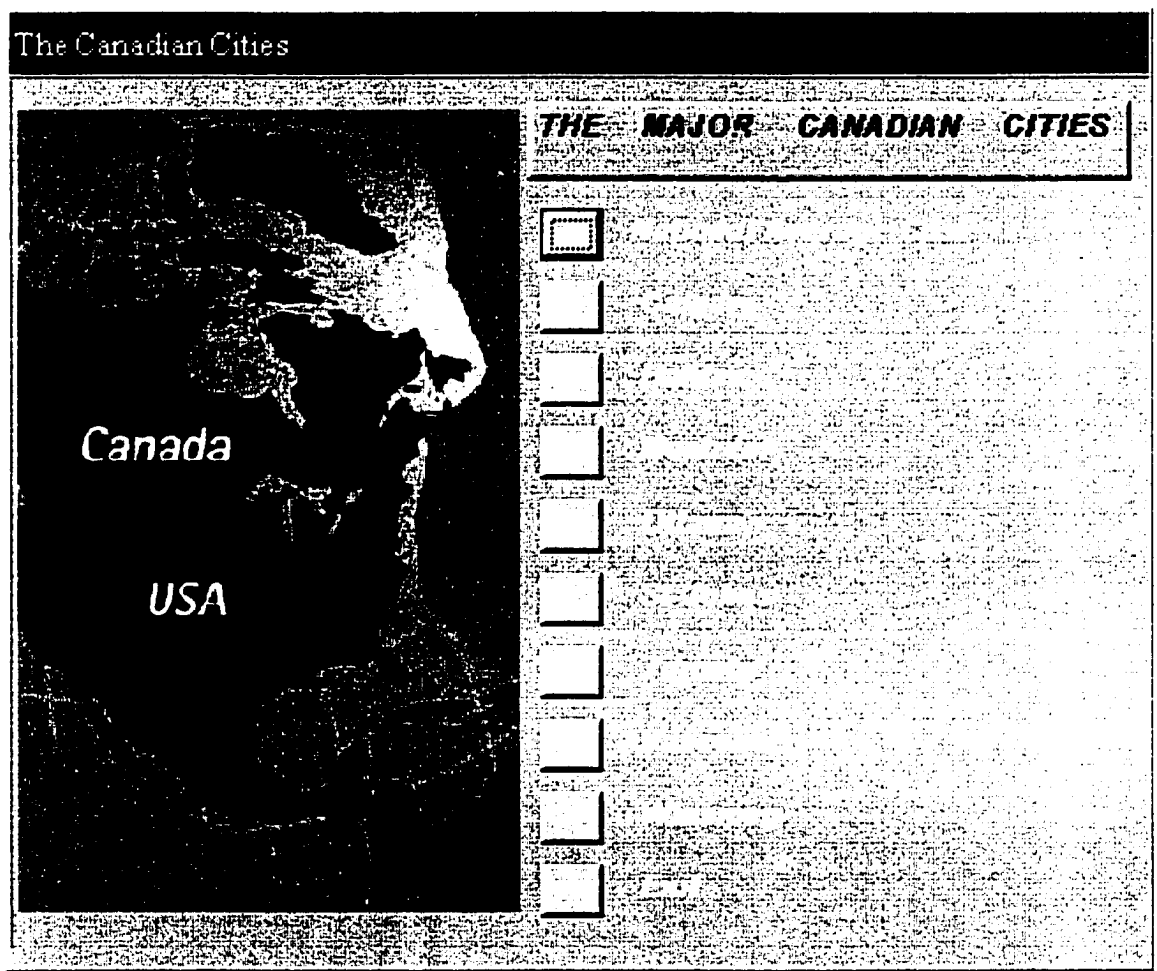


Figure 5.40 Main Form for City Selection

Forthwith the user hits the button beside the chosen city, the interface at once opens the form associated for this city, which is similar to the forms shown in Figures 5.37 and 5.38 and closes "the Canadian Cities" form.

When opening the database itself, a main or logo form for this specific database opens allowing the user to make a selection, either previewing or printing previous projects as shown in Figures 5.41.

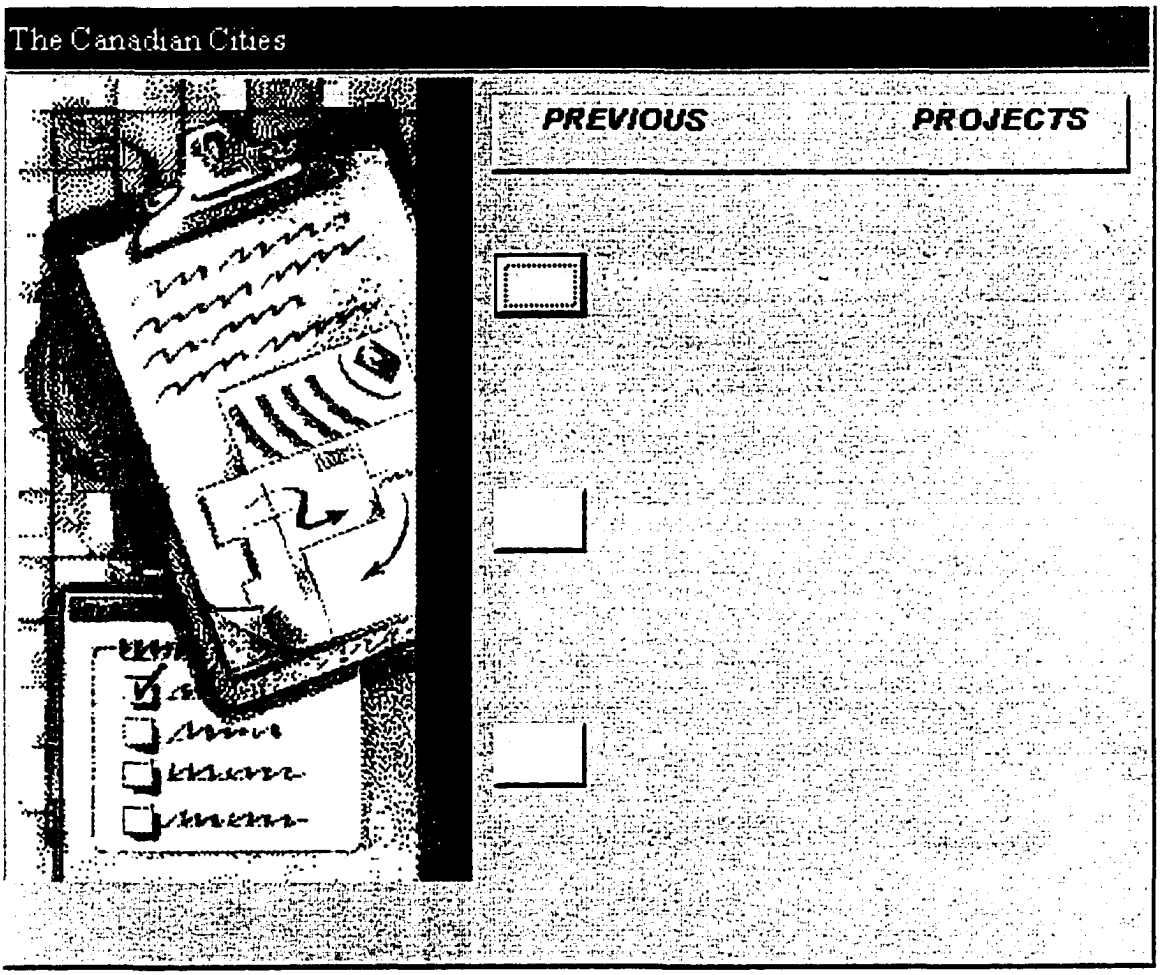


Figure 5.41 Selection Form

Figures 5.42 and 5.43 illustrate respectively the events when the user chooses to preview projects or to print report. If the first selection is chosen and "By Masterformat" is hit then the interface opens a form similar to that of Figure 5.38.

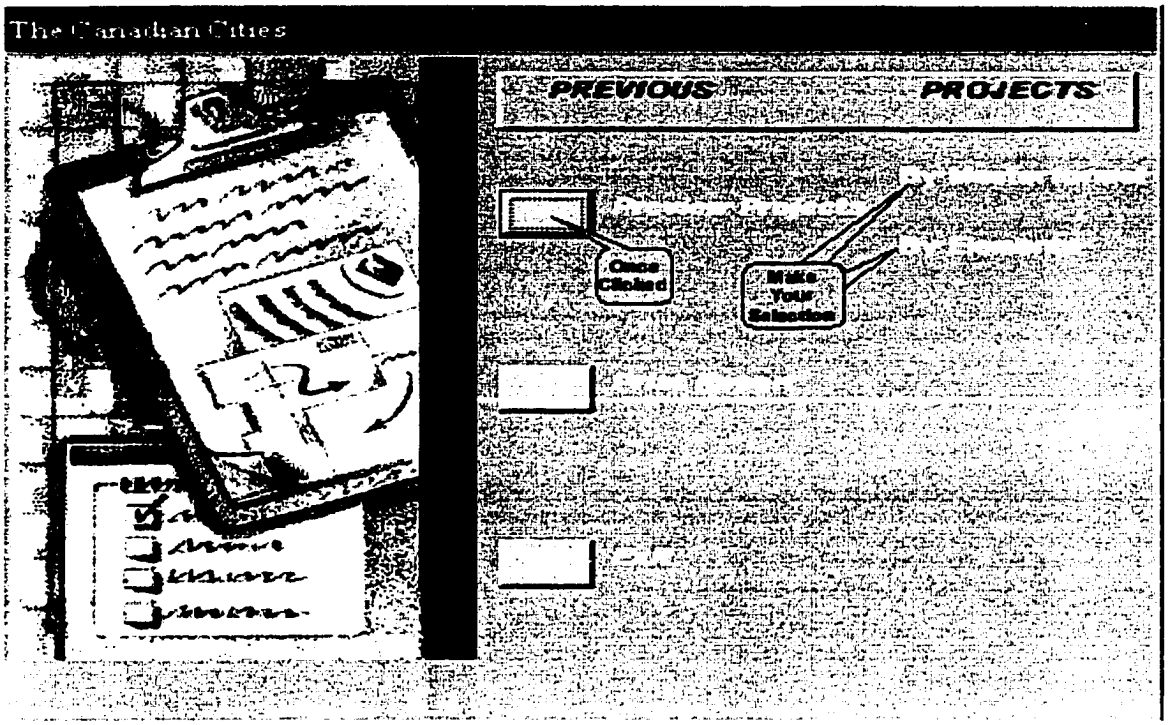


Figure 5.42 Case of Choosing to Preview Projects

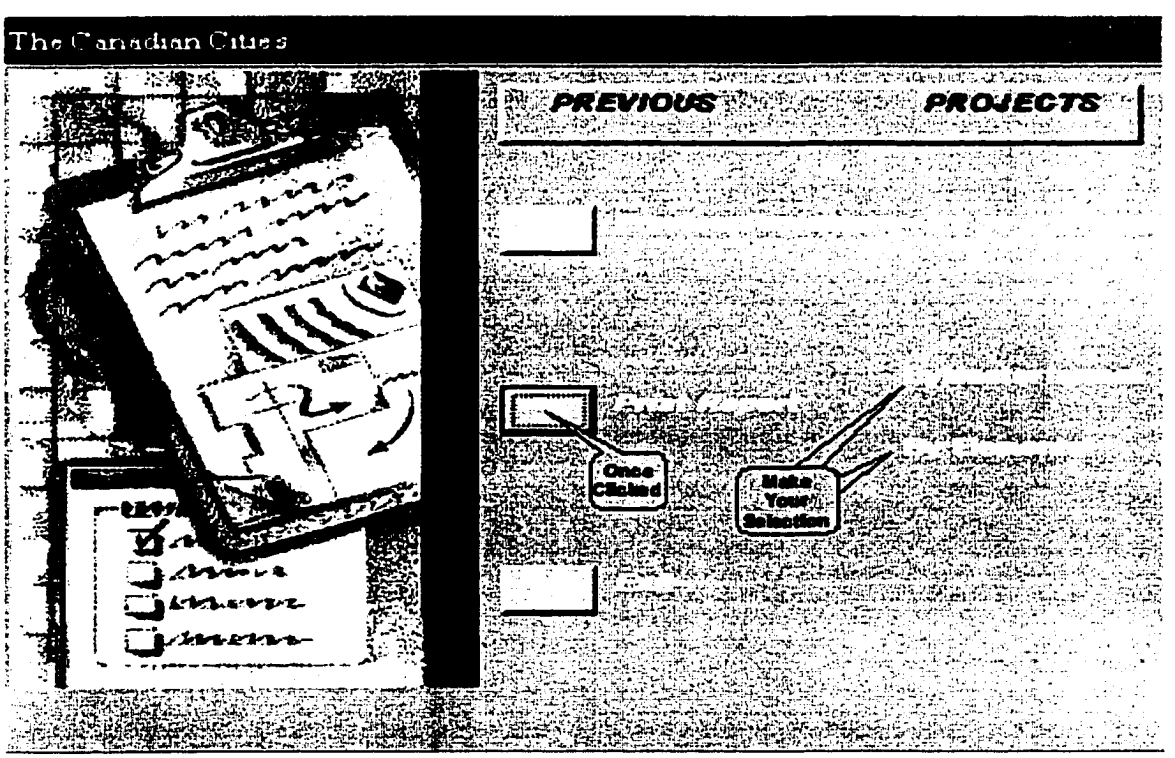


Figure 5.43 Case of Choosing to Print Report

On the other hand, if "By Elements" is hit then a form similar to that of Figure 5.37 is opened. Likewise, if the user chooses to print report and hits "By Masterformat" then the interface opens a pre-designed report format as shown in Figure 5.44.

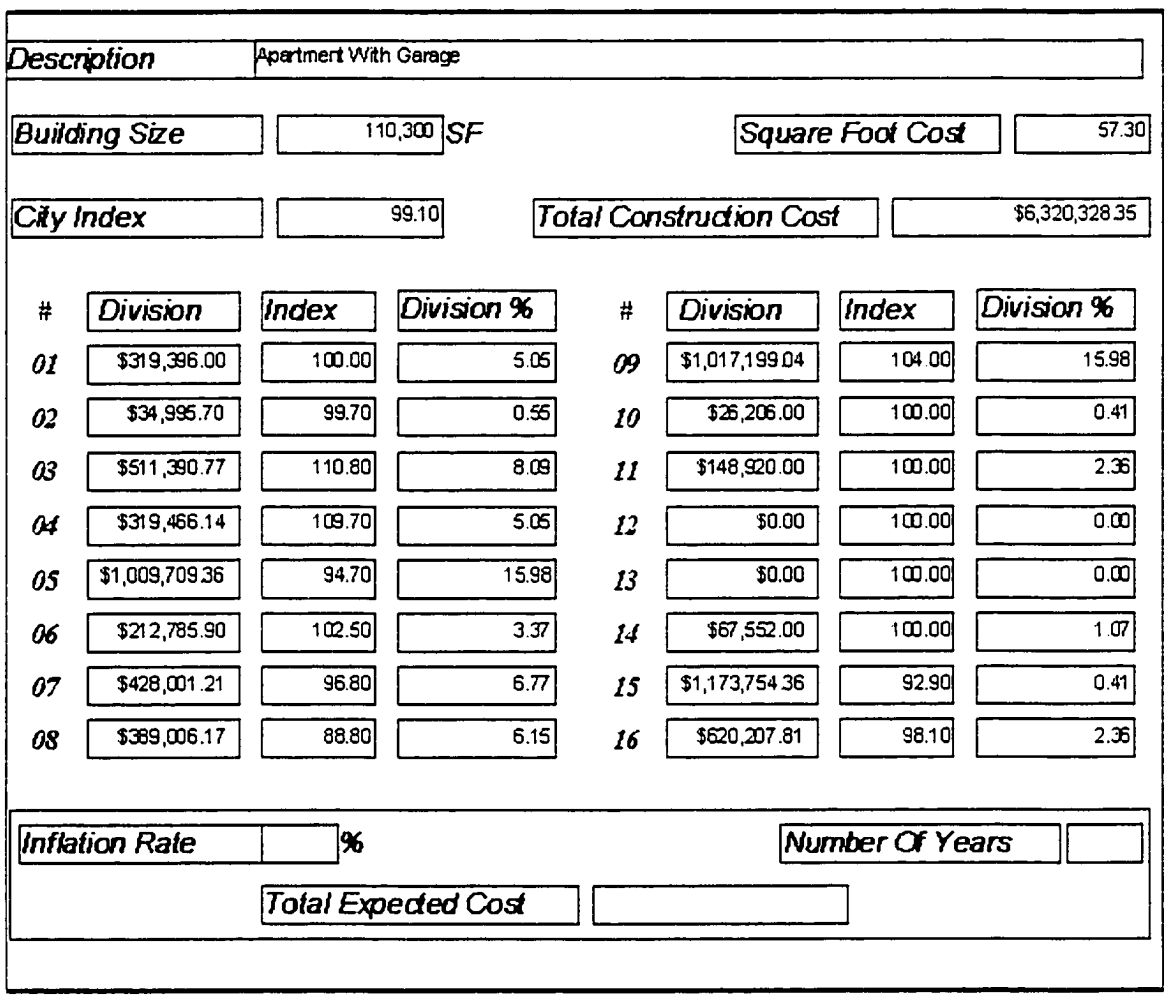


Figure 5.44 Report Format in Case of By Masterformat Selection

On the contrary, if "By Elements" is chosen then the report format is similar to the one shown in Figure 5.45.

The preceding three steps dealt with the stages of the design followed to implement the Imperial Parametric Database. The sequence of entering the

historical data into tables, the deriving queries, and ending by designing forms and build-in reports is described in

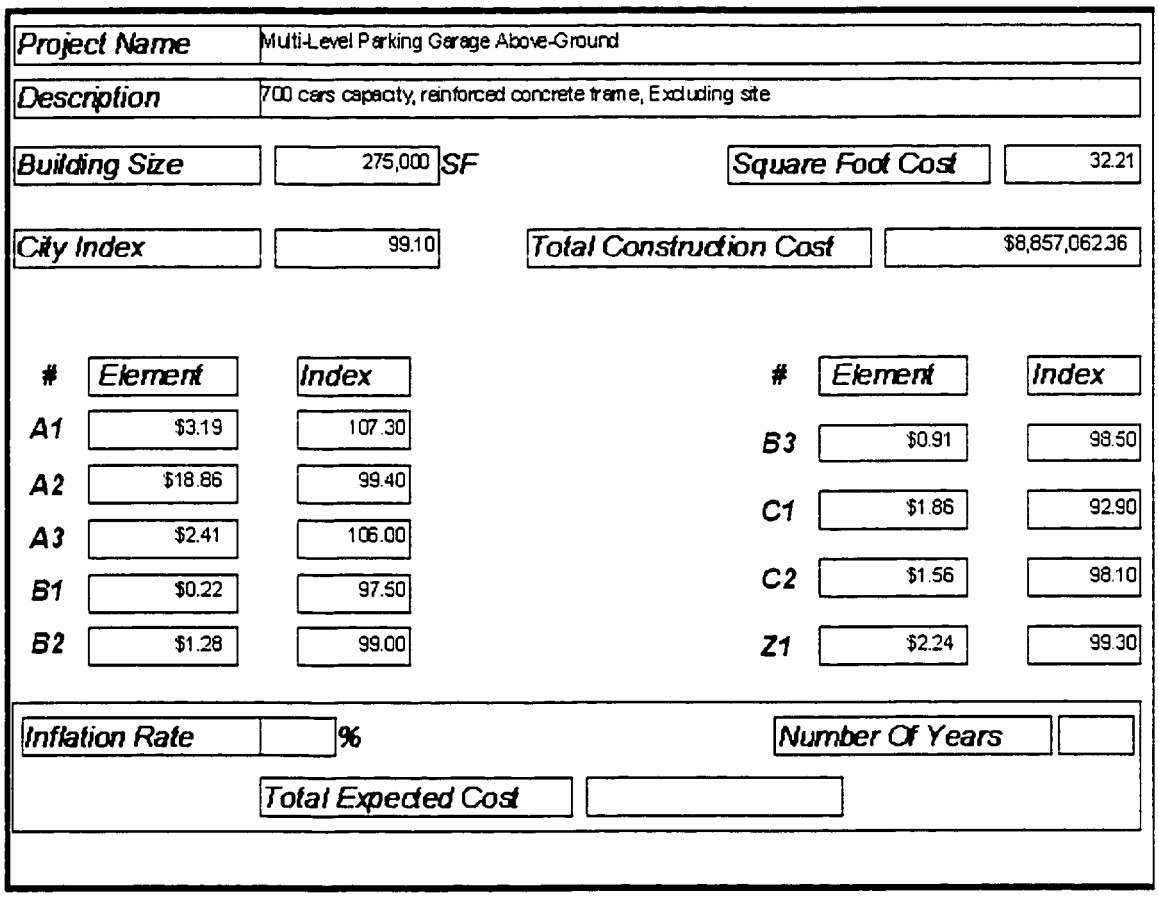


Figure 5.45 Report Format in Case of By Elements Selection

detail and supported by figures to briefly explain the undertaking procedures. Many coding lines have been written in order to eliminate any confusion and to provide an errorless interface for fast and easy access to the required data. Figure 5.46 shows few of these coding lines.

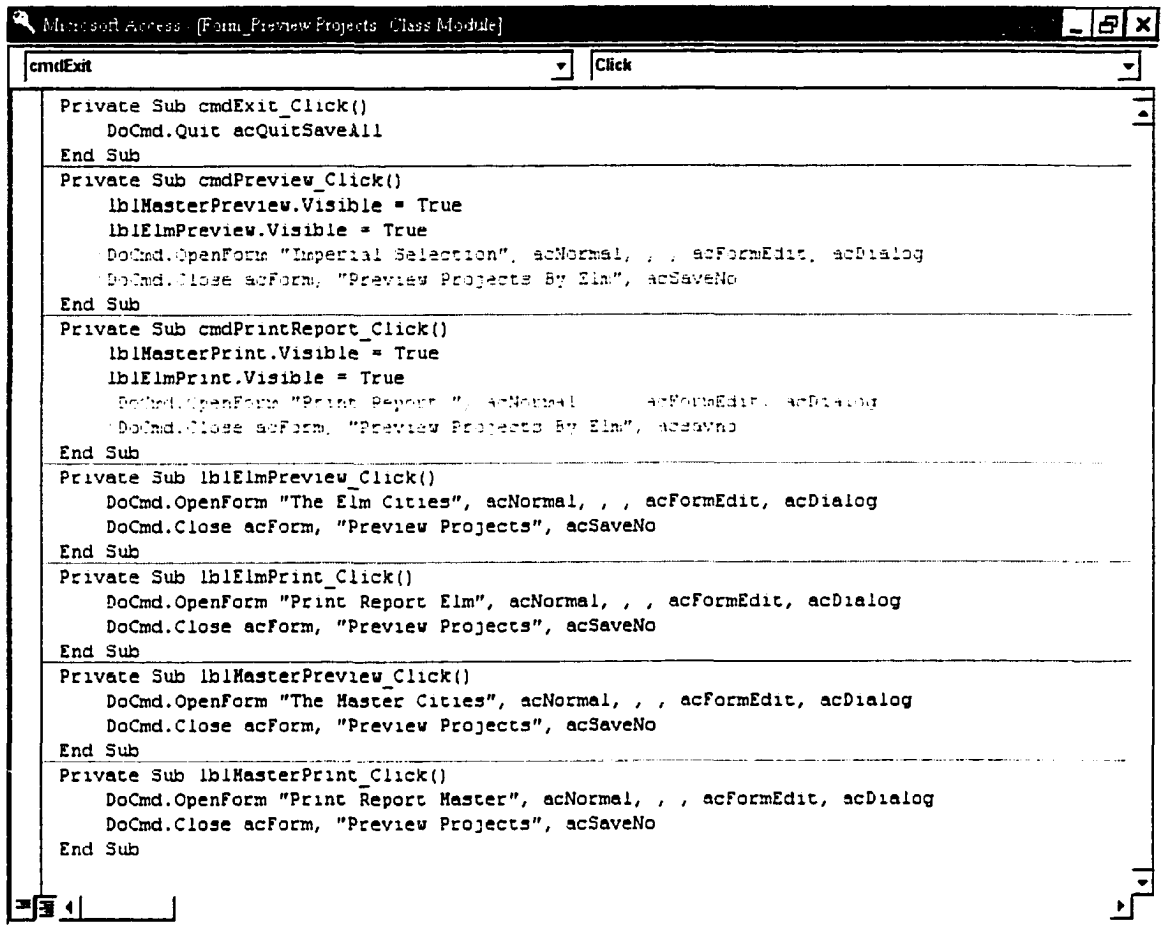


Figure 5.46 Sample of Coding Lines written for this Database

5.5 Metric Parametric Database

The design of this database is exactly the same as of the previous one "Imperial Parametric Database", except all the data used are in metric units. The motive of designing two separate databases is because the item description for the metric unit is unlike the one in the imperial unit.

To start, historical data has been grouped into tables that have the same fields' name, type and size as in Tables 5.4 to 5.9. The difference resides in the forms

and precisely in the project building size and the cost per square meter. Figures 5.47 and 5.48 picture

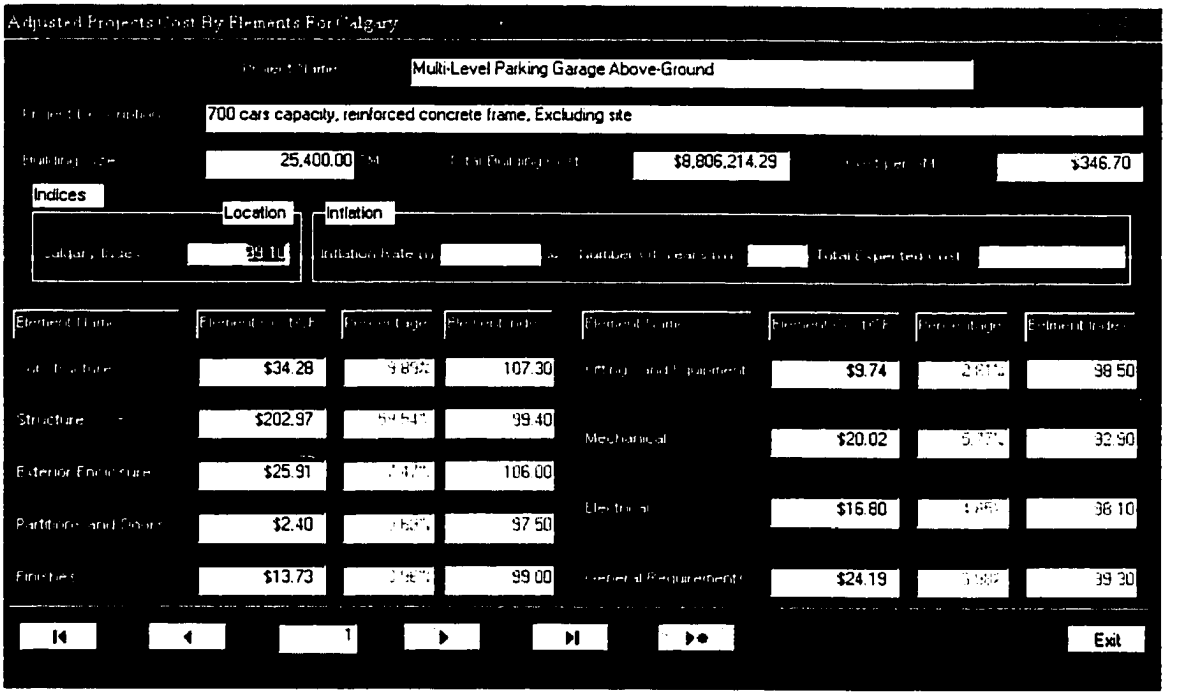


Figure 5.47 Sample of Metric Adjusted Projects by Elements

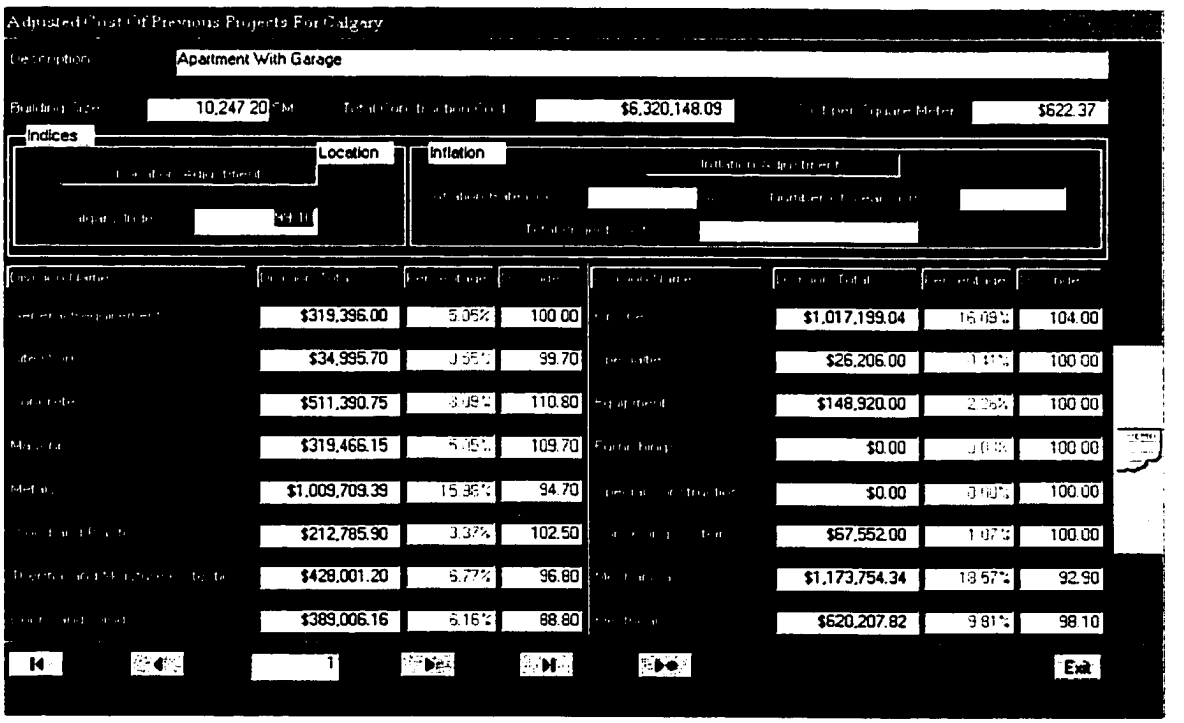
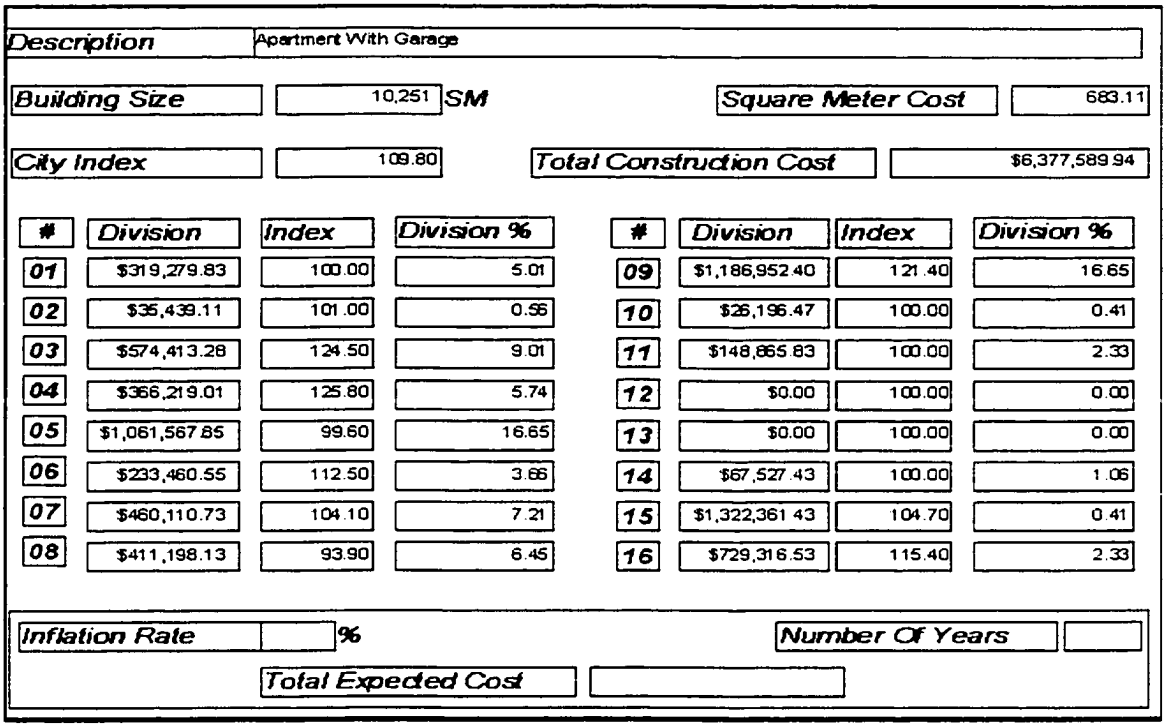


Figure 5.48 Sample of Metric Adjusted Projects by Masterformat

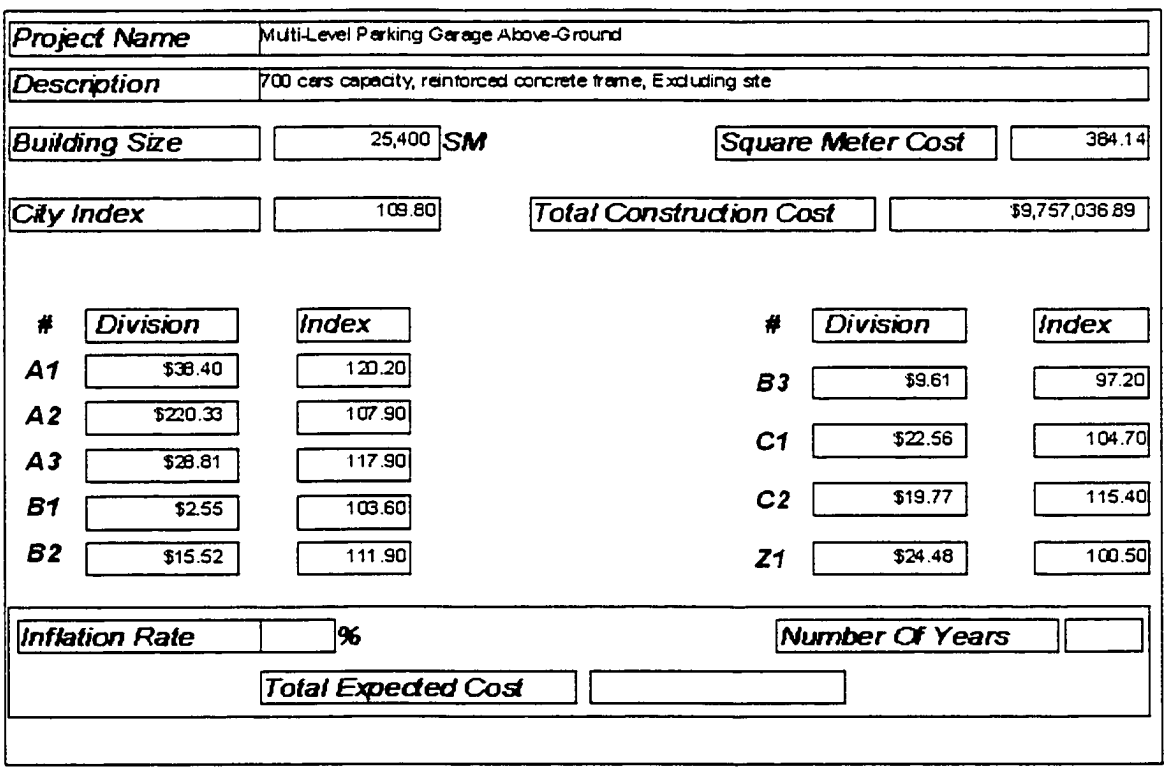


Description	Apartment With Garage		
Building Size	10,251 SM	Square Meter Cost	683.11
City Index	109.80	Total Construction Cost	$6,377,589.94

#	Division	Index	Division %	#	Division	Index	Division %
01	$319,279.83	100.00	5.01	09	$1,186,952.40	121.40	16.65
02	$35,439.11	101.00	0.56	10	$26,196.47	100.00	0.41
03	$574,413.28	124.50	9.01	11	$148,865.83	100.00	2.33
04	$366,219.01	125.80	5.74	12	$0.00	100.00	0.00
05	$1,061,567.85	99.60	16.65	13	$0.00	100.00	0.00
06	$233,460.55	112.50	3.66	14	$67,527.43	100.00	1.06
07	$460,110.73	104.10	7.21	15	$1,322,361.43	104.70	0.41
08	$411,198.13	93.90	6.45	16	$729,316.53	115.40	2.33

Inflation Rate	%	Number Of Years	
Total Expected Cost			

Figure 5.49 Sample Report in the Metric Database by Masterformat



Project Name	Multi-Level Parking Garage Above-Ground		
Description	700 cars capacity, reinforced concrete frame, Excluding site		
Building Size	25,400 SM	Square Meter Cost	384.14
City Index	109.80	Total Construction Cost	$9,757,036.89

#	Division	Index	#	Division	Index
A1	$38.40	120.20	B3	$9.61	97.20
A2	$220.33	107.90	C1	$22.56	104.70
A3	$28.81	117.90	C2	$19.77	115.40
B1	$2.55	103.60	Z1	$24.48	100.50
B2	$15.52	111.90			

Inflation Rate	%	Number Of Years	
Total Expected Cost			

Figure 5.50 Sample Report in the Metric Database by Elements

samples of the forms' type used in this database, also Figure 5.49 and 5.50 represent the build-in reports' type for both formats.

The remaining forms are specifically similar to the ones in the Imperial Parametric Database. Additionally, similar coding lines are used except when the unit, when has been changed to metric.

5.6 Main Module

Following the design of the three databases, it is necessary to design a simple procedure to be the gate for the user to access the database under choice. In other words, from that form the user assign the type of estimate he or she wants to use. Consequently, a main form, named "Type of Estimate" is designed in a way that links the three databases and by simple clicks the desired one opens. The first form that opens in this procedure is the logo screen as shown in Figure 5.51. It is designed with a timer that shuts the form down after few seconds.

Immediately after the logo screen form disappears, the "Terms, Conditions and Introduction" form is displayed listing to the user legal issues taken from Hanscomb's Yardsticks for costing hard copy. It also explains how to use their cost data and what is included in the cost of each item. At the bottom of this form there are two command buttons, one to exit the model and the second to continue. Hitting the "Continue" button, the interface opens the main or the gate form that links the three databases. Figures 5.52 and 5.53 show the two mentioned forms respectively.

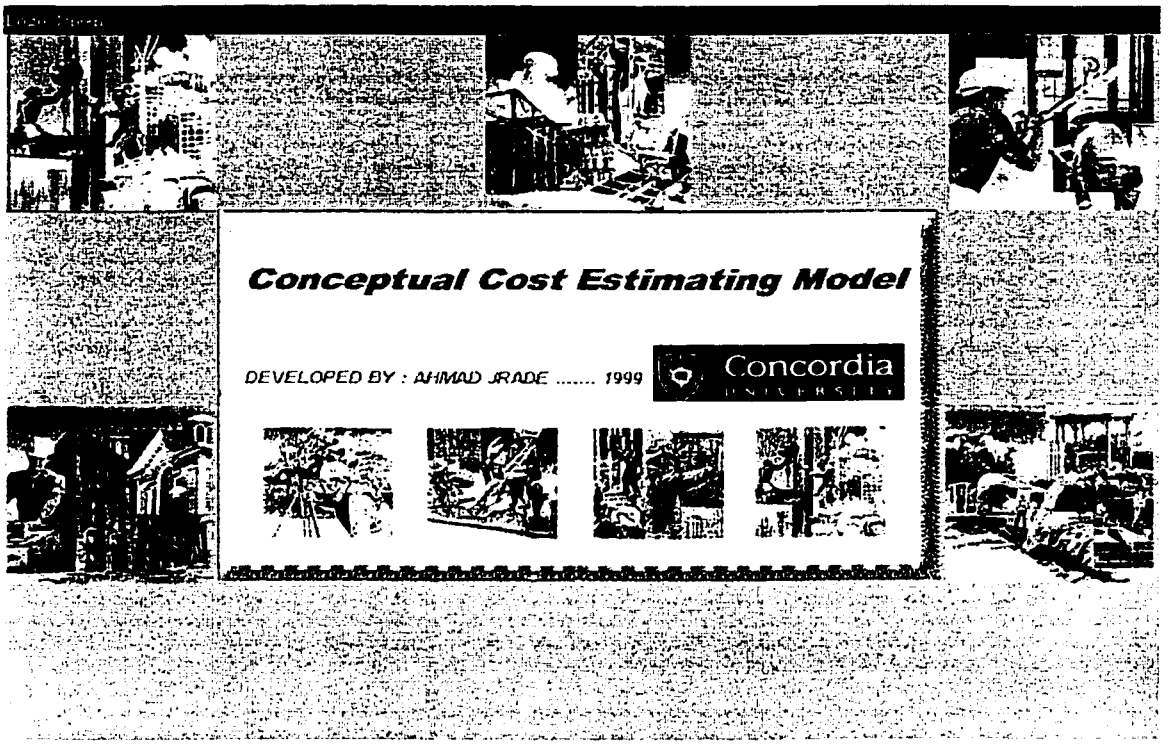


Figure 5.51 Snapshot of the Model Logo Screen

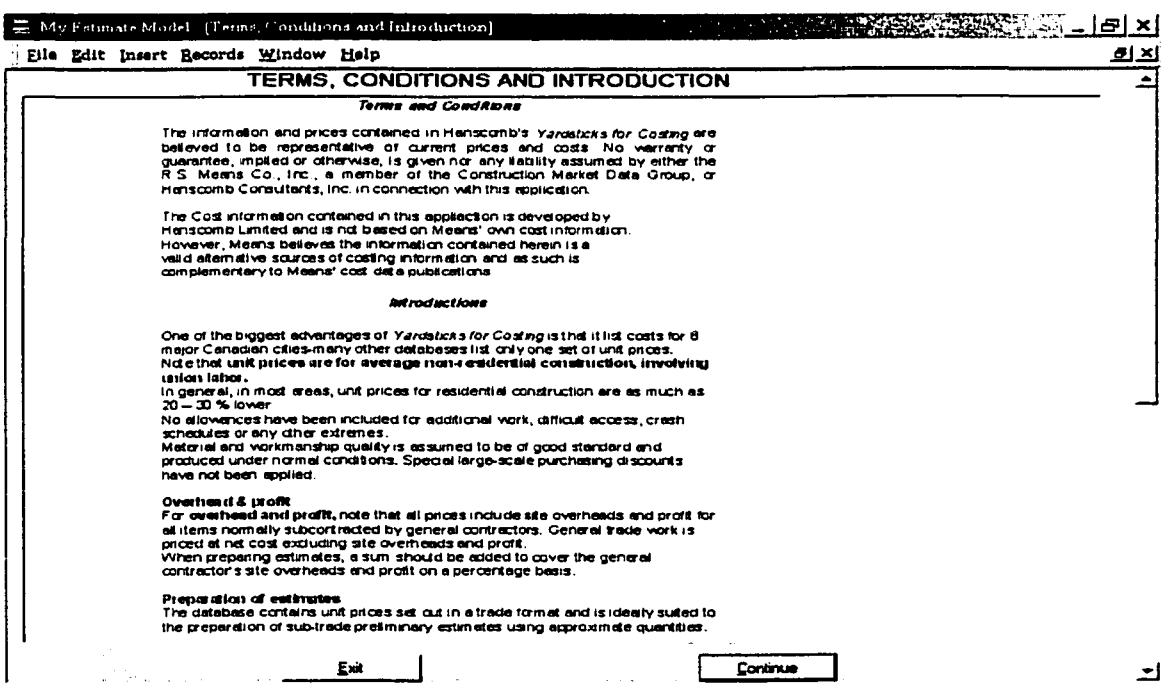


Figure 5.52 Snapshot of Terms, Conditions and Introduction Screen

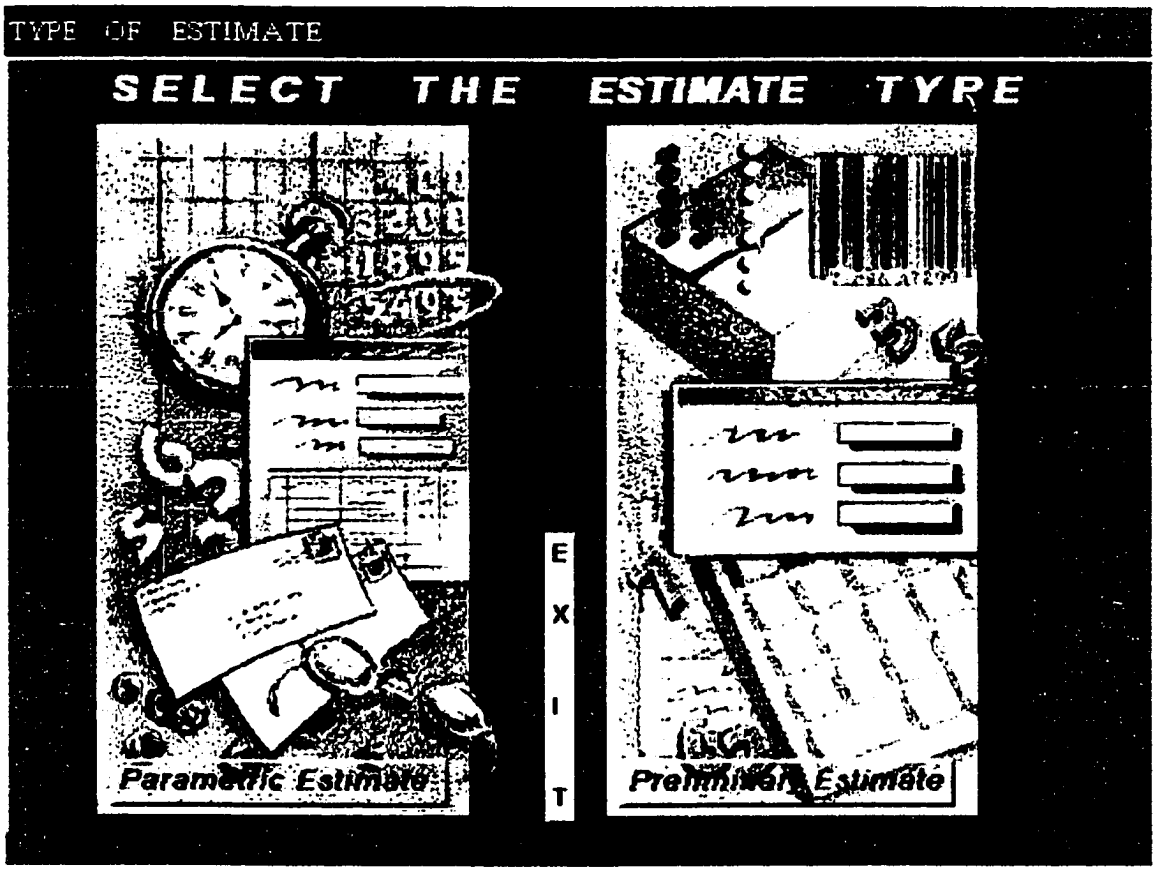


Figure 5.53 Snapshot of the Type of Estimate Screen

Once the user clicks on the "Parametric Estimate", immediately the two options "Imperial" and "Metric" appears. In this case the user has to choose one of them by clicking on the writing, if "Imperial" is the choice then the interface opens the "Imperial Parametric Database" and a form is displayed as shown in Figure 5.40. Similarly, if "Metric" is the choice then the "Metric Parametric Database" is opened and a form similar to Figure 5.40 is displayed, the difference resides in the unit type. Figure 5.54 illustrates the cases of different selection. On the other side clicking the "Preliminary Estimate" opens the Preliminary Database and the first form that is displayed is shown in Figure 5.28.

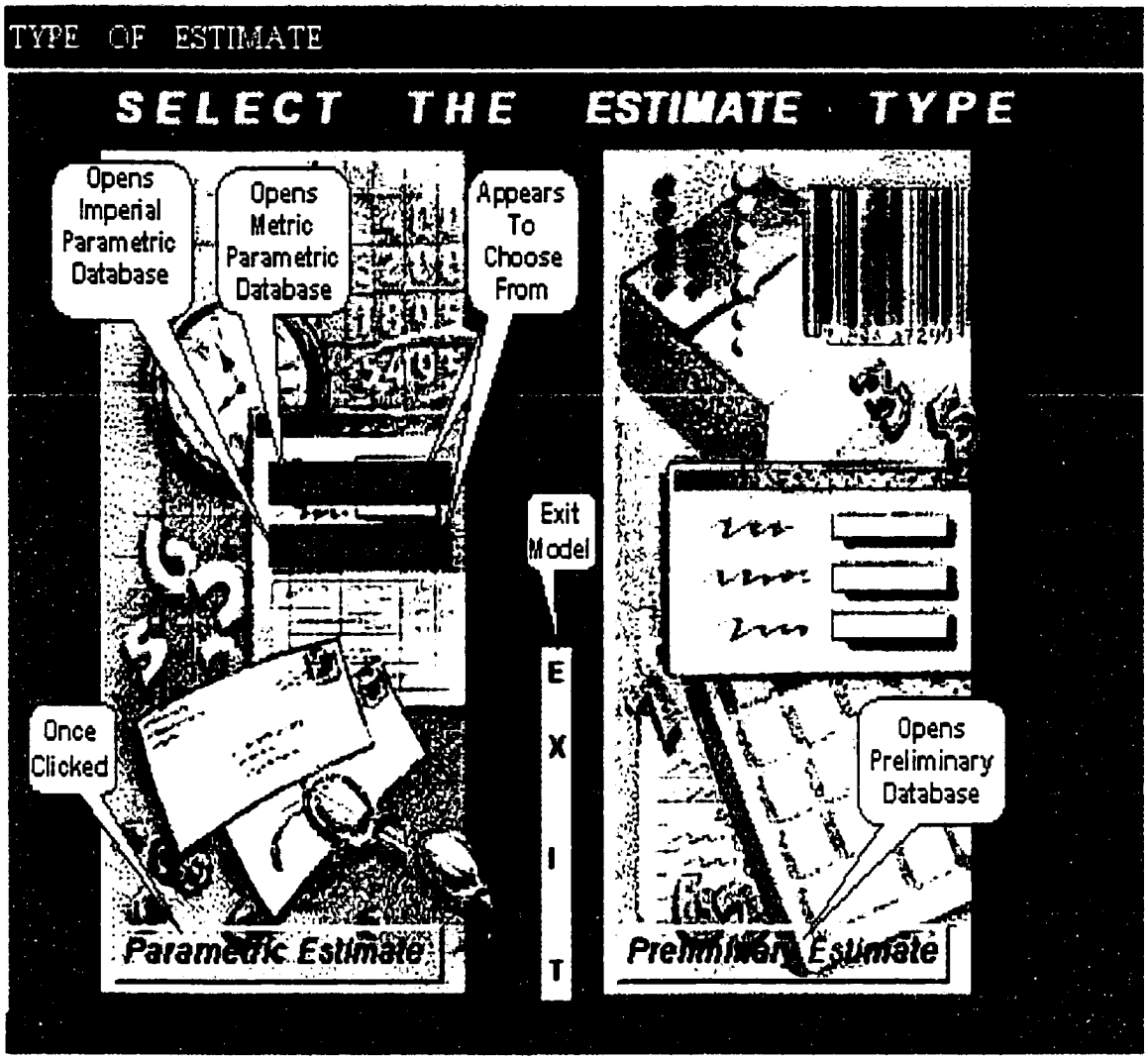


Figure 5.54 Explanation of the screen "TYPE OF ESTIMATE"

5.7 Conclusion

This chapter presented the physical development of the conceptual cost estimating system model using Microsoft Access 97 and Visual Basic for Applications. The development's design is accomplished in a way that provides the user with varieties of options to choose from, flexibility and fast retrieval of the required data. In addition it provides the freedom of selecting the type of output in

a professional format. All the undertaking processes have been described and supported by figures and tables. Testing the model on unseen project example showed its capabilities to analyze the user input and generate the required output. However, two actual projects are going to be used to examine the performance of the model as described in chapter 6.

CHAPTER 6

System Performance (Validation)

6.1 Introduction

This chapter describes the capabilities of the system with respect to its three modules: 1) Imperial Parametric Estimate Module, 2) Metric Parametric Estimate Module, and 3) Preliminary Estimate Module. The performance of the system is verified through two actual cases. The first case is used to demonstrate that all the system components run bugs free and consists of a project to be executed on the spring of year 2000 in Montreal. This project consists of a warehouse that contains eight big tanks to store chemical liquids, offices, decking area, and a workshop. The construction firm that won the bid "Magil Construction Corporation" has performed a detailed estimate of the project. The second case is used for comparison between the actual preliminary estimate and the one generated by the system, which consists of adding a marketplace building for the University of British Columbia. "Cressey Development Corporation" has prepared a preliminary estimate in order to bid on that job. The project is divided into three portions that are Parkade level, Commercial / Retail level, and Residential level. Appendix E contains copies of the actual projects estimates documents prepared by the two firms.

Case 1:

The project has a total gross area of 68,688 ft^2. Two types of estimates are going to be used to examine the model performance, the first is the preliminary estimate where complete take off cost list is to be generated and the second is

the parametric estimate, which is based on previous historical data. It is to be noted that the cost data available are based on Yardsticks for average rates and average conditions, which includes the cost of material, installation, equipment, transportation, and subcontract profit. Therefore, some divisions' costs might differ from those computed by the construction firm.

6.2 Preliminary Estimate Application

Due to the fact that the project drawings are not available, the quantities taken off by the construction firm are to be considered to build the cost list and accordingly estimate the total project cost. The first model screen is the logo screen as shown in Figure 5.51, which disappears after few seconds to display the Terms, Conditions and Introduction screen that is necessary to read on account of containing important information as pictured in Figure 5.52.

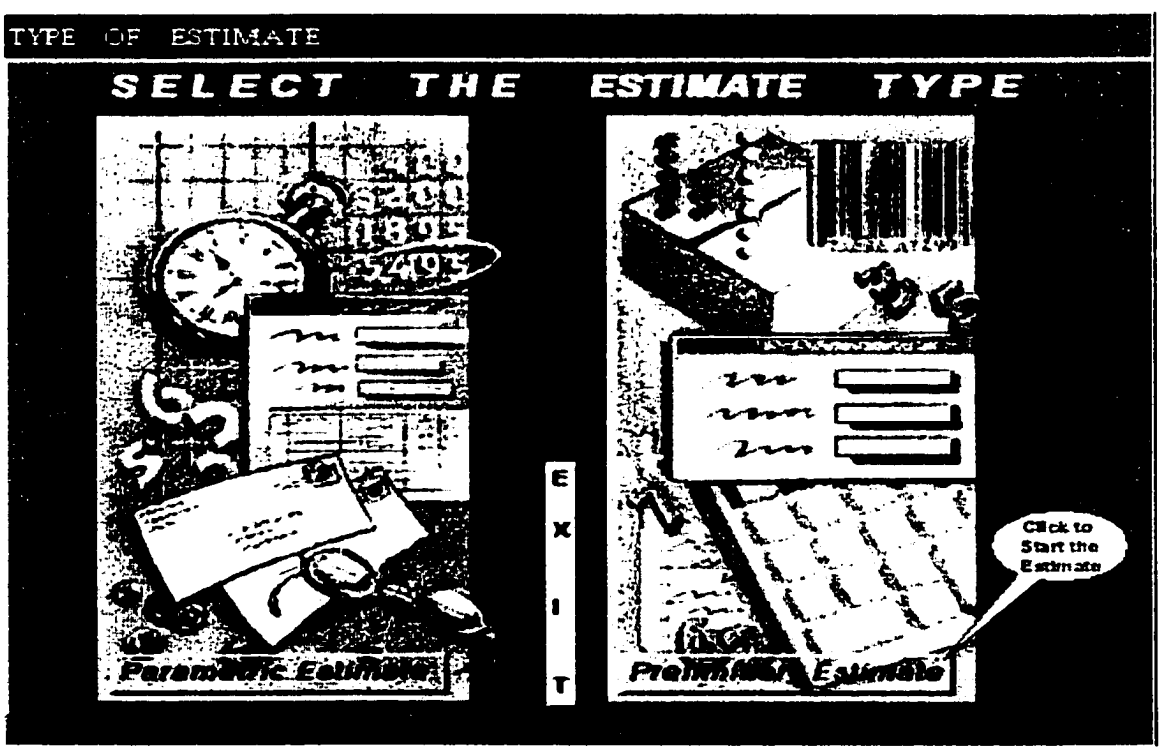


Figure 6.1 Estimate Selection (or Gate) Screen

Once we click the "continue" command button, the gate screen opens providing us with the option to choose i.e. the type of estimate to use. In this case the choice is Preliminary estimate as shown in Figure 6.1. As soon as we click on the "**Preliminary Estimate**", the project information screen opens for us to enter general information about the project as shown in Figure 6.2.

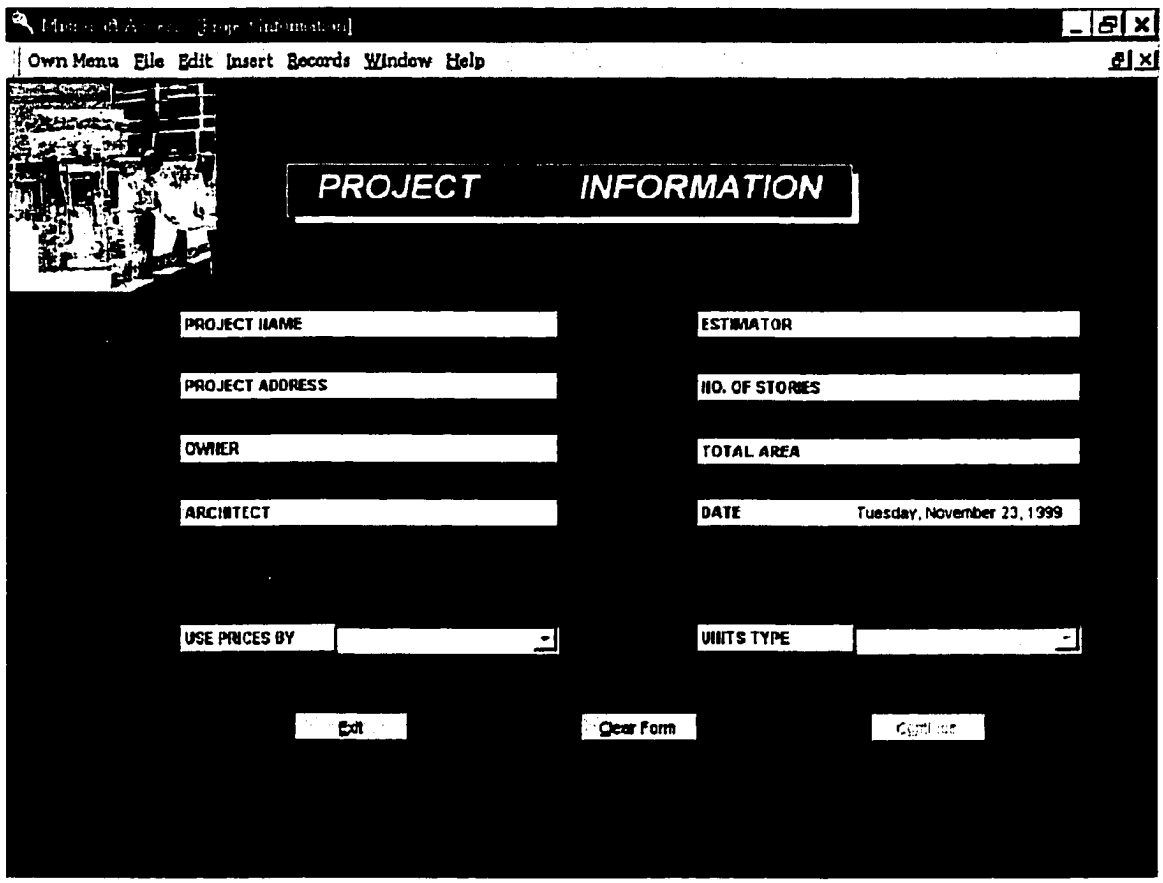


Figure 6.2 Project General Information Screen

After keying in all the project information, we choose the cost data type to be used in estimating the activities costs. In this case Yardsticks for costing data is chosen in order to compare the prices of the construction firm with those available in the database. Afterwards, we have to select the unit type before

being able to proceed. Figure 6.3 illustrates the project information screen after entering the project information and selecting the cost data and the unit type.

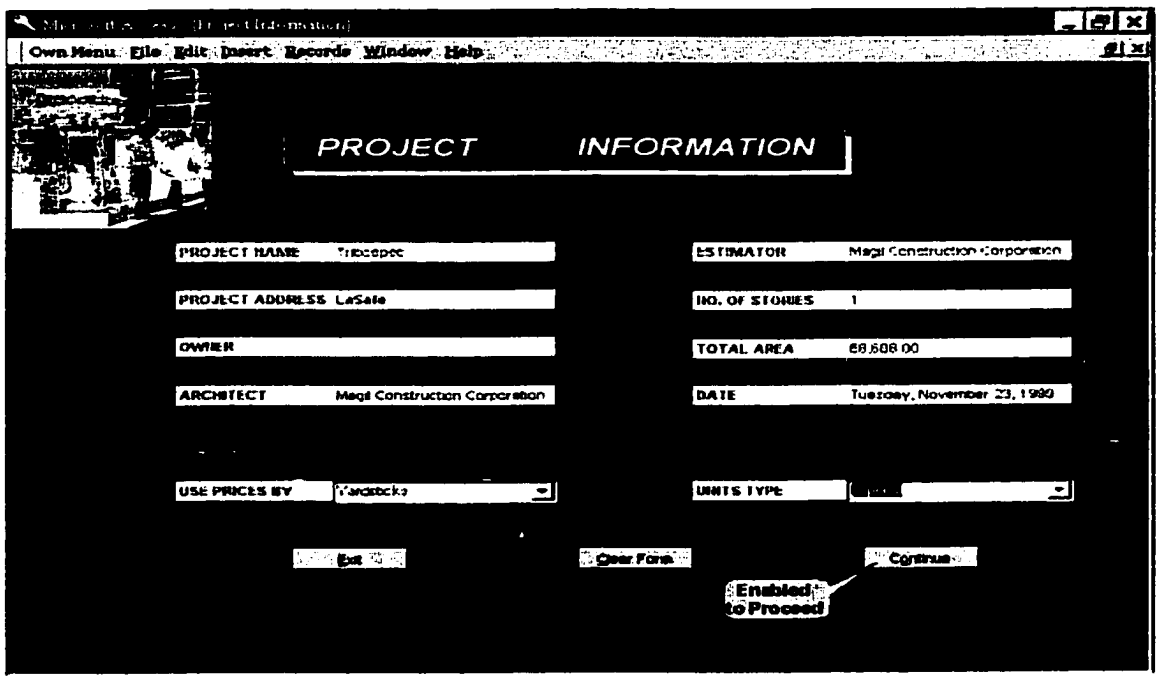


Figure 6.3 Entering Project Information and Selecting Data and Unit Type

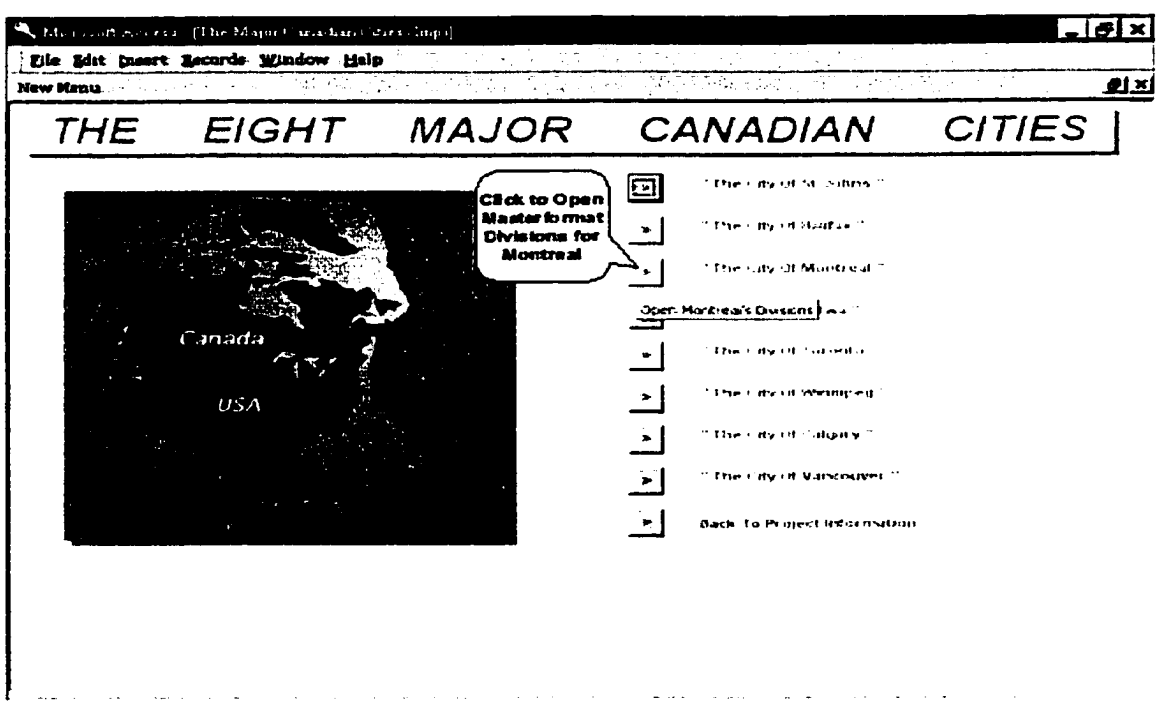


Figure 6.4 "Eight Major Canadian Cities" Screen

Hitting the "Continue" button, we are transferred to the "Eight Major Canadian Cities" screen in order to choose the city corresponding to the project studied as shown in Figure 6.4; Montreal is the city that interest us for this project. Just a simple click shifts us to the screen shown in Figure 6.5 and immediately we are capable to start selecting the different activities corresponding to each Masterformat division.

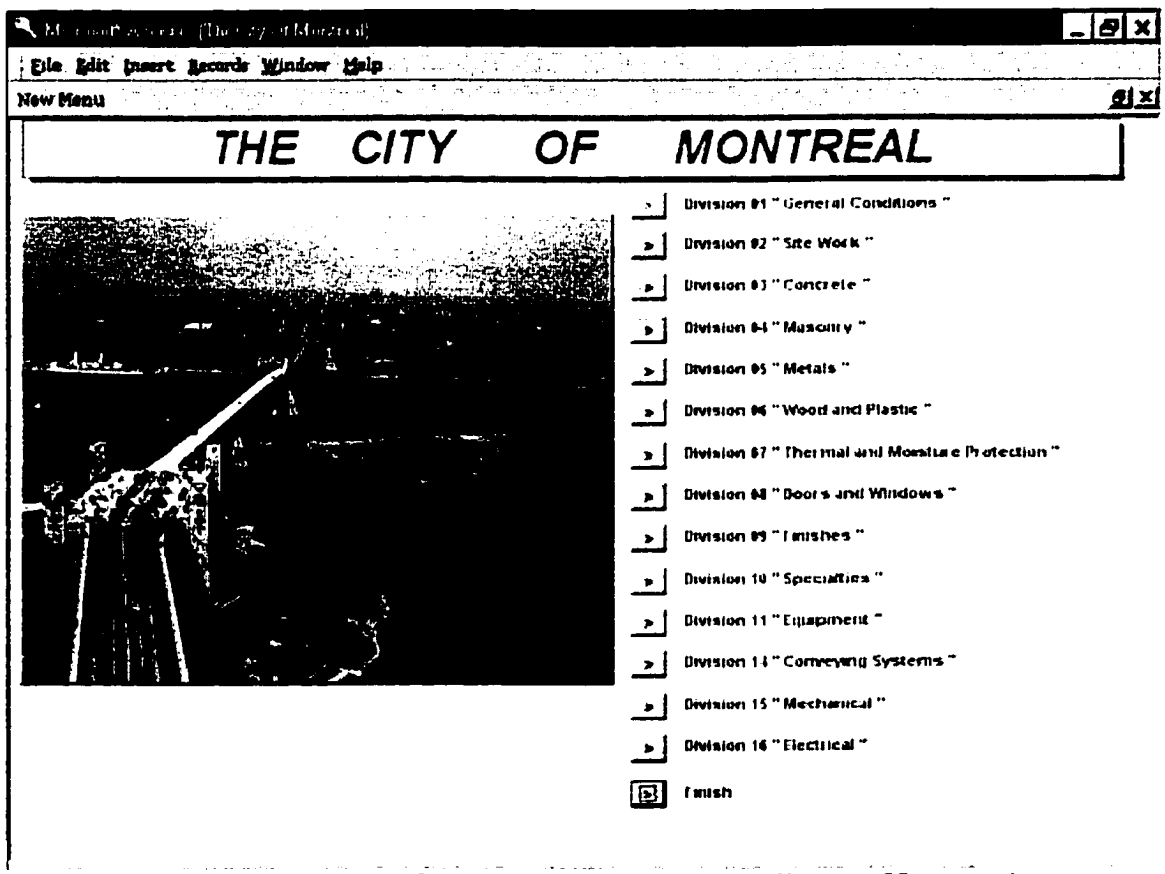


Figure 6.5 Masterformat Divisions According to Montreal

The first division to choose should be "General Conditions", but since this is an approximate estimate the value of the general conditions' division is taken into consideration after selecting all the activities of the other divisions as a percentage of their total. Therefore, the first division to start with is division 02 "Site Work". Table 6.1 includes all the activities related to this division according

to the construction firm's quantity take off. Few of those activities are not available in the database, therefore, the missing ones have been typed in, which enhances the database for future use and demonstrates the flexibility of the model. The added items are given ten digits unique number different than the ones used by the construction firm.

Table 6.1 Items of Site Work Division

Item #	Description	Quantity	Unit	Unit $	Total
2.101	Site Preparation	1	Lps		498,000.00
2.513	Street cut	2		2,500.00	5,000.00
2.690	Oil interceptor reservoir	1	Lps	20,000.00	20,000.00
2.710	Foundation Drainage				0.00
2.935	Sodding	1	Lps	5,000.00	5,000.00

Figures 6.6 and 6.7 illustrate snapshots of the Site Work division before and after

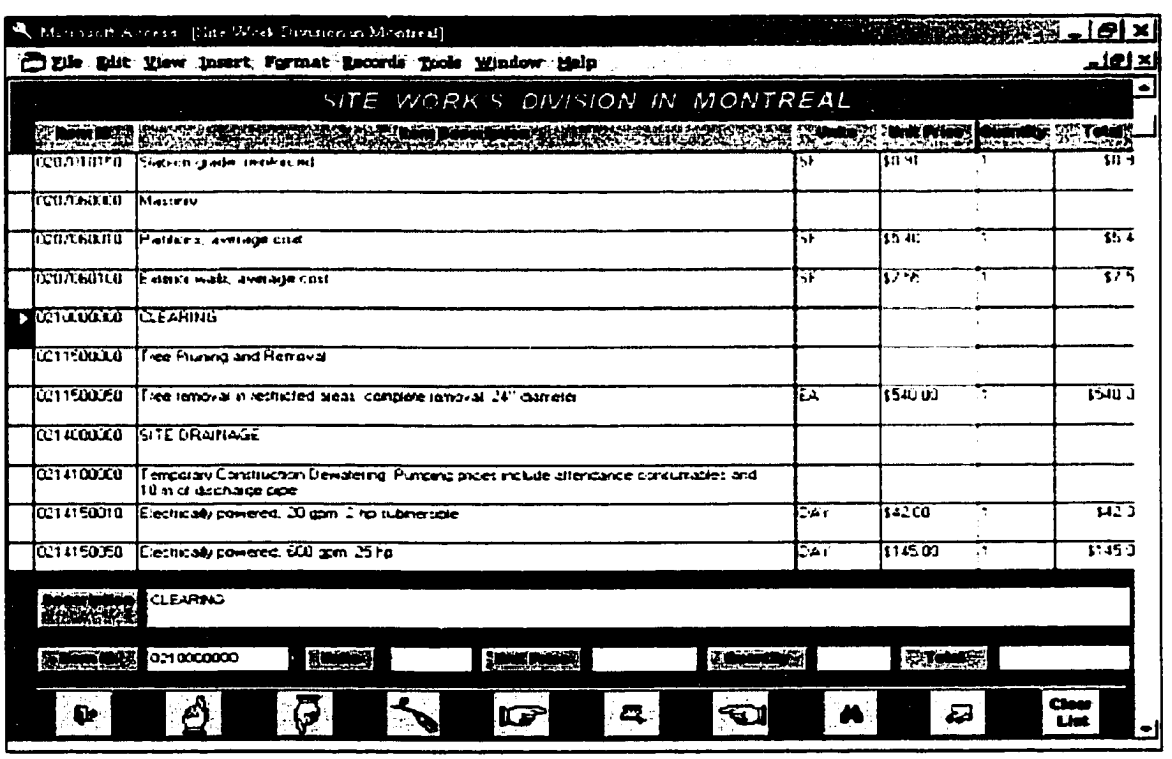


Figure 6.6 Site Work Division before adding the Site Preparation item

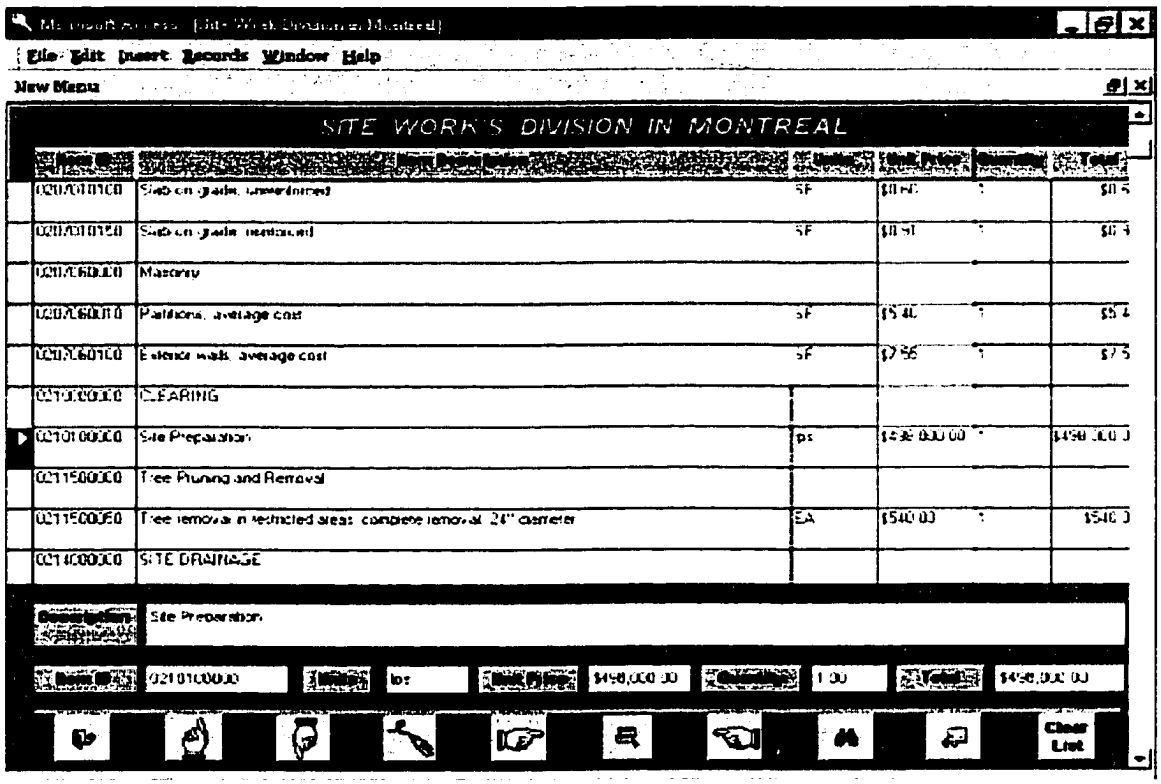


Figure 6.7 Site Work Division after adding the Site Preparation

adding the missing items respectively.

The roles of all the command buttons that exist on that screen have been explained in detail in Figure 5.7 of chapter 5. Before copying any item from this division, the take off list is empty and appears as was shown Figure 5.9, as soon as the items are copied to the list it looks as shown in Figure 6.8, which also shows the total sum at that instance of time. Having the Site Work's items selected and transferred we return to the Masterformat's Divisions by hitting the "Door" symbol on the bottom left corner of the screen. Next, Division 03 "Concrete" is the one that its activities are to be selected and copied to the list.

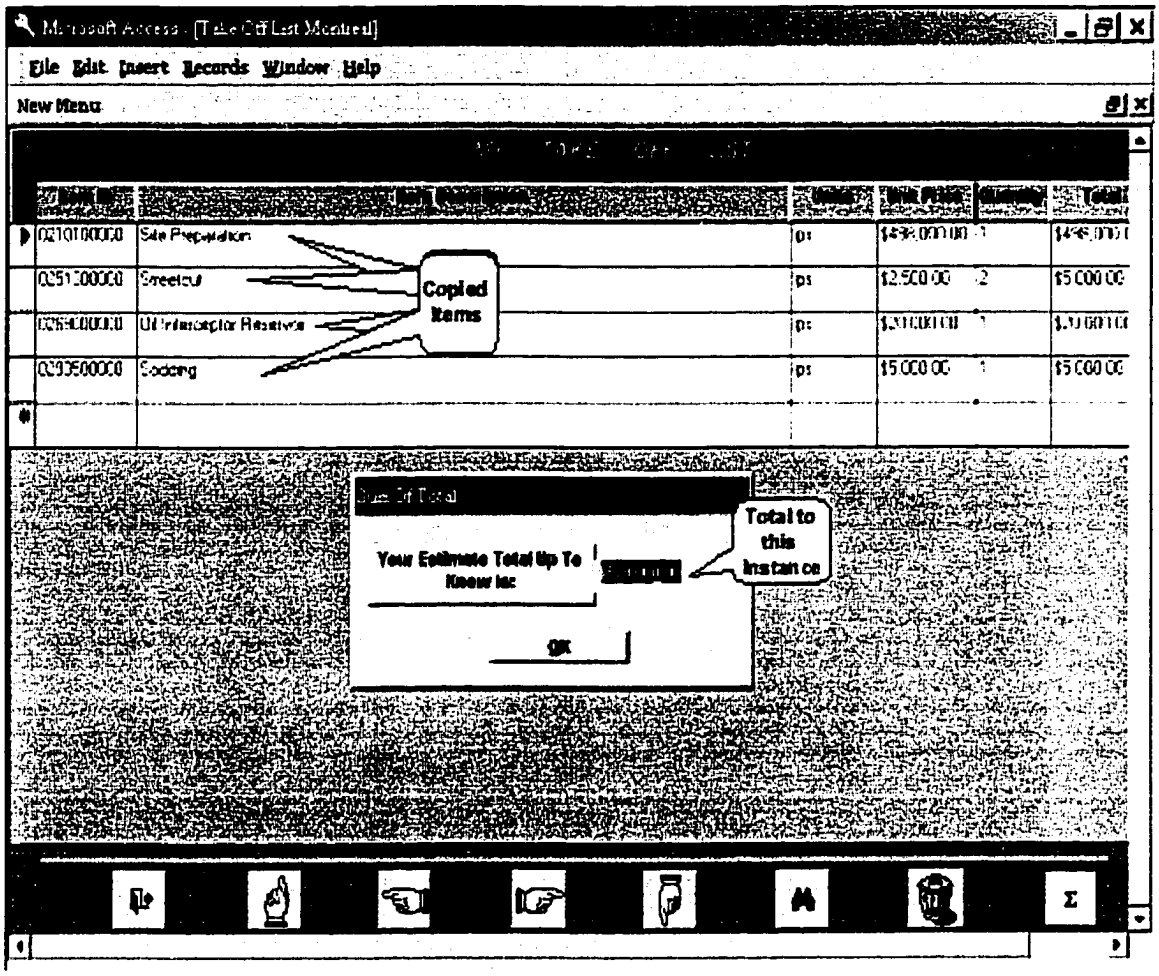


Figure 6.8 List after Copying Site Work's Selected Items

Table 6.2 displays the activity list of this division according to the construction firm. Similar to Division 02, all the missing activities are typed in to the database and assigned a unique number. Figure 6.9 illustrates the Take Off List screen after copying the Concrete's selected items to it and accordingly the total cost at that instance of time. The same process has been carried out for all the other divisions.

Table 6.2 Items of Concrete Division

Item #	Description	Quantity	Unit	Unit $	Total
3.100	Formwork				
	Exterior foundation walls	16,867	Sqft	2.35	39,637.45
	Ext. continuous footings	2214	Sqft	2.35	5,202.90
	Interior foundation walls	2661	Sqft	2.35	6,253.35
	Int. continuous ftgs	368	Sqft	2.35	864.80
	Int. spread footings	1582	Sqft	2.35	3,717.70
	Column piers	674	Sqft	2.35	1,583.90
	Balance bassin walls	1841	Sqft	2.35	4,326.35
	Balance bassin piers	272	Sqft	2.35	639.20
3.151	Install coping anchors	180	Units	5.00	900.00
	Install ground rods	40	Lft	5.00	200.00
	Install angle coping	183	Lft	5.00	915.00
	Conc.column protection-4'H/ 24"dia.	33	Units	250.00	8,250.00
	Concrete curbs	20	Lft	10.00	200.00
	Place concrete for bollards	9	Units	100.00	900.00
	Trench & pit formwork	56	Sqft	2.00	112.00
	S.O.G. stairs	25	Sqft	3.00	75.00
	Loading dck platforms	87	Sqft	4.00	348.00
	Slab depression bulkheads	177	Sqft	10.00	1,770.00
	Form pockets @ stl col bases	129	Units	50.00	6,450.00
3.200	Reinforcement Steel	1	Lps		66,250.00
	w/w/mesh 12x12w5.8x5.8	134392	Sqft	0.20	26,878.40
	w/w/mesh 6x6w6/6	11709	Sqft	0.16	1,873.44
	w/w/mesh 6x6w4/4	3942	Sqft	0.17	670.14
	w/w/mesh stair pans	1200	Sqft	0.16	192.00
3.250	Set & grout base plates (Concrete)	129	Units	15.00	1,935.00
	1/2" asphalt board	1850	Lft	2.00	3,700.00
3.300	Concrete Material				
	Building structure 25 Mpa	562	cu-m	80.00	44,960.00
	Slab on grades 25 Mpa	1228	cu-m	80.00	98,240.00
	Stair pans & bollards 25 Mpa	3	cu-m	91.00	273.00
	Steel deck conc 30 Mpa	66	cu-m	91.00	6,006.00
	Air-entrained	100	cu-m	10.00	1,000.00
	Winter Concrete	1427	cu-m	4.00	5,708.00
3.345	Concrete Floor Finishes				69,850.00
	Place & finish building S.O.G.	60714	Sqft	0.45	27,321.30
	Sawcuts filled	5133	Lft	2.00	10,266.00
	Place & finish balance bassin slab	1384	Sqft	1.00	1,384.00
	Place & finish conc. on deck	5886	Sqft	0.60	3,531.60
	Floor hardener 6.5 kg/sm	57000	Sqft	0.42	23,940.00
	Cure & seal	57000	Sqft	0.12	6,840.00
	Place & finish concrete stair pans	304	Sqft	2.00	608.00
3.420	BETCON Slabs	2088	Sqft	10.00	20,880.00

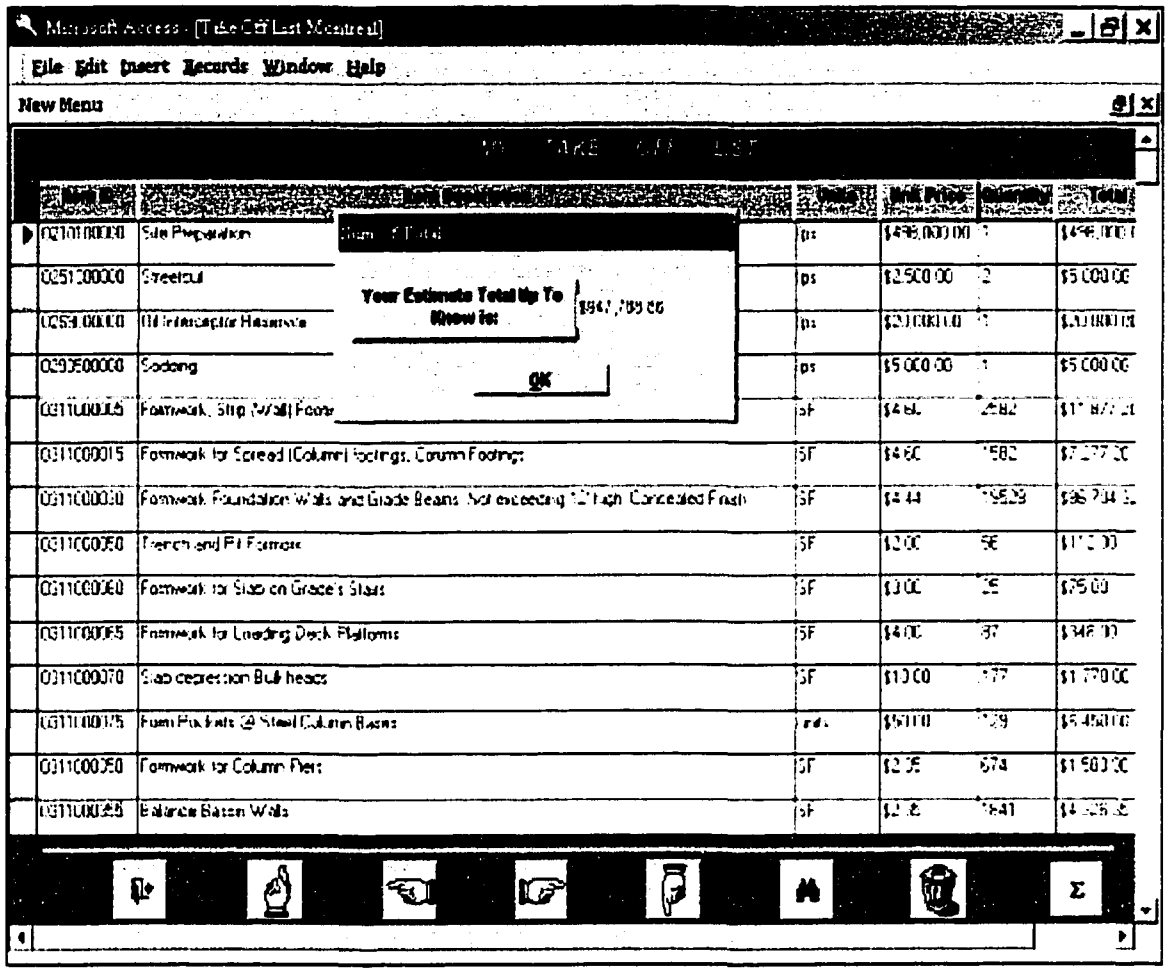


Figure 6.9 List after Copying Concrete's Selected Items

Tables 6.3 to 6.12 exhibit the remaining activities of the project corresponding to each division.

After selecting and copying all the project's activities, the Take off List can be viewed in two different formats as described in chapter 5. Hence, Figures 6.10 illustrates the list as appears after copying all the items to it, in addition the total final direct cost of the project can be viewed. On the other hand, Figure 6.11 shows the second format that is the data sheet view, which allows us to export the list to a Spreadsheet.

Table 6.3 Items of Metal Division

Item #	Description	Quantity	Unit	Unit $	Total
5.120	Structural Steel	68688	sqft		486,100.00
5.210	Steel Joists				
5.311	Steel Deck				
5.500	Metal Fabrication	1	lps	45,000.00	45,000.00

Table 6.4 Items of Wood & Plastics Division

Item #	Description	Quantity	Unit	Unit $	Total
6.100	Rough Carpentry	1	lps		
6.200	Finish Carpentry	1	lps	5,500.00	5,500.00
	Pine window sills w/moulding	204	lft	19.61	4,000.44
6.240	Laminated Plastic				

Table 6.5 Items of Thermal & Moisture Protection Division

Item #	Description	Quantity	Unit	Unit $	Total
7.190	Sheet Vapour Barrier				included
7.212	Board Insulation				0.00
	2" rigid insulation foundations	2305	sqft	0.60	1,383.00
	2" rigid insulation @ Hot Box Rm	1060	sqft	1.20	1,272.00
	1/2" cement board @ Hot Box Rm	1060	sqft	1.50	1,590.00
7.213	Batt & Matt Insulation	488			included
7.216	2" Sprayed urethene insul.	7158	sqft		18,626.00
	3/4" urethane behind Dryvit	4007	sqft		included above
	Urethane @ marquise joists	1	lps		included above
7.466	Architecural Metal Siding				115,000.00
	Sandwich panel w/V.B.	20511	sqft	5.60	
	Single skin	2501	sqft	3.00	
7.472	"Dryvit" Product	4007	sqft	10.00	40,070.00
7.510	Built-Up Bitum.Roofing	60714	sqft		175,950.00
7.620	Metal Flashing & Trim				included above
7.724	Roof Hatches	1	unit	693.00	693.00
7.900	Sealants	1	lps	2,000.00	2,000.00

Table 6.6 Items of Wood and Windows Division

Item #	Description	Quantity	Unit	Unit $	Total
8.100	H.Metal Drs&Frs. 20 gauge metal doors	21	units	150.00	3,150.00
	18 gauge metal insulated doors	7	units	206.00	1,442.00
	KALAMIEN- anit-explosive dr 8x10	1	unit	2,175.00	2,175.00
	16 gauge pressed stl frame/single	56	units	117.00	6,552.00
	16 gauge pressed stl frame/double	2	units	282.00	564.00
	16 gauge pressed stl frame/special	10	units	165.00	1,650.00
8.111	Installation Doors	62	units	75.00	4,650.00
	Install KALAMIEN anti-explosive dr	1	unit	500.00	500.00
8.112	Installation Frames	68	units		
8.210	Solid masonite doors	33	units	115.15	3,800.05
	Bi-fold masonite door	1	unit		
8.331	Rolling Doors: Metal Insulated	7	units		10,300.00
8.450	Impact Doors	1	unit	6,070.00	6,070.00
6.710	Finish Hardware	62	unis		18,775.00
	Aluminium sills	9	units	300.00	2,700.00
8.120	Aluminium Doors & Frames				0.00
	Aluminum entrance doors & frame	4	units		
	Aluminum core	1	unit		
8.800	Metal door lites 6"x 2	7	units	50.00	350.00
	Wood door windows 2'x3'-6"	9	units	100.00	900.00
	Special frame windows	7	units	160.00	1,120.00
8.900	Curtain Wall	1328	sqft		70,000.00
	Windows	389	sqft		
	Vestibule alum.ceiling panel 1/8"	70	sqft		
	Marquise entrance 1/8" aluminum	75	sqft		
	Vestibule glass partitions	242	sqft		

Table 6.7 Items of Finishes Division

Item #	Description	Quantity	Unit	Unit $	Total
9.100	Drywall & Ceilings	1	lps	98,000.00	98,000.00
9.310	Ceramic floor tile	1389	sqft	6.00	8,334.00
	Ceramic wall tile	1338	sqft	6.00	8,028.00
	Ceramic tile base	382	lft	6.00	2,292.00
	Ceramic tile stairs	204	sqft	6.00	1,224.00
9.660	Linoleum flooring	4406	sqft	2.00	8,812.00
	Vinyl base	2379	lft	2.00	4,758.00
9.680	Carpet installation	370	sqyd	18.00	6,660.00
	$26/sqyd supply only allowance	370	sqyd	26.00	9,620.00
	Carpet base	95	lft	5.00	475.00
9.900	Painting	1	lps	16,715.00	16,715.00
9.955	Vinyl Wall Covering	798	sqft	2.00	1,596.00

Table 6.8 Items of Specialties Division

Item #	Description	Quantity	Unit	Unit $	Tota!
10.160	Toilet Partitions	4	units		1,845.00
	Urnal screen	1	unit		
10.800	Toilet & Bath Accesories	1	lps	1,882.00	1,882.00

Table 6.9 Items of Equipment Division

Item #	Description	Quantity	Unit	Unit $	Total
11.160	Loading Dock Equipment	1	lps		2,734.00
11.161	Dock Levellers	4	units		7,405.00

Table 6.10 Items of Furnishings

Item #	Description	Quantity	Unit	Unit $	Total
12.680	Foot Grills	24	sqft		1,076.00

Table 6.11 Items of Mechanical Division

Item #	Description	Quantity	Unit	Unit $	Total
15.250	Thermal Insulation		lps		24,348.00
15.300	Sprinkler System		lps		128,840.00
15.400	Plumbing & Heating		lps		115,250.00
15.500	Ventilation		lps		164,600.00
15.900	Controls		lps		44,300.00

Table 6.12 Items of Electrical Division

Item #	Description	Quantity	Unit	Unit $	Total
16.100	Electrical		lps		334,500.00

It is to be noted that Yardsticks for costing does not include two Divisions, that are division 12 "Furnishings" and Division 13 "Special Construction". Although in this project the "Furnishings" division has been considered for a total of $1,076 that can be neglected for its small value compared to the total direct cost of the

project, also the "Special Construction" division is not considered. Additionally, the " Conveying System" division is skipped (see Appendix E).

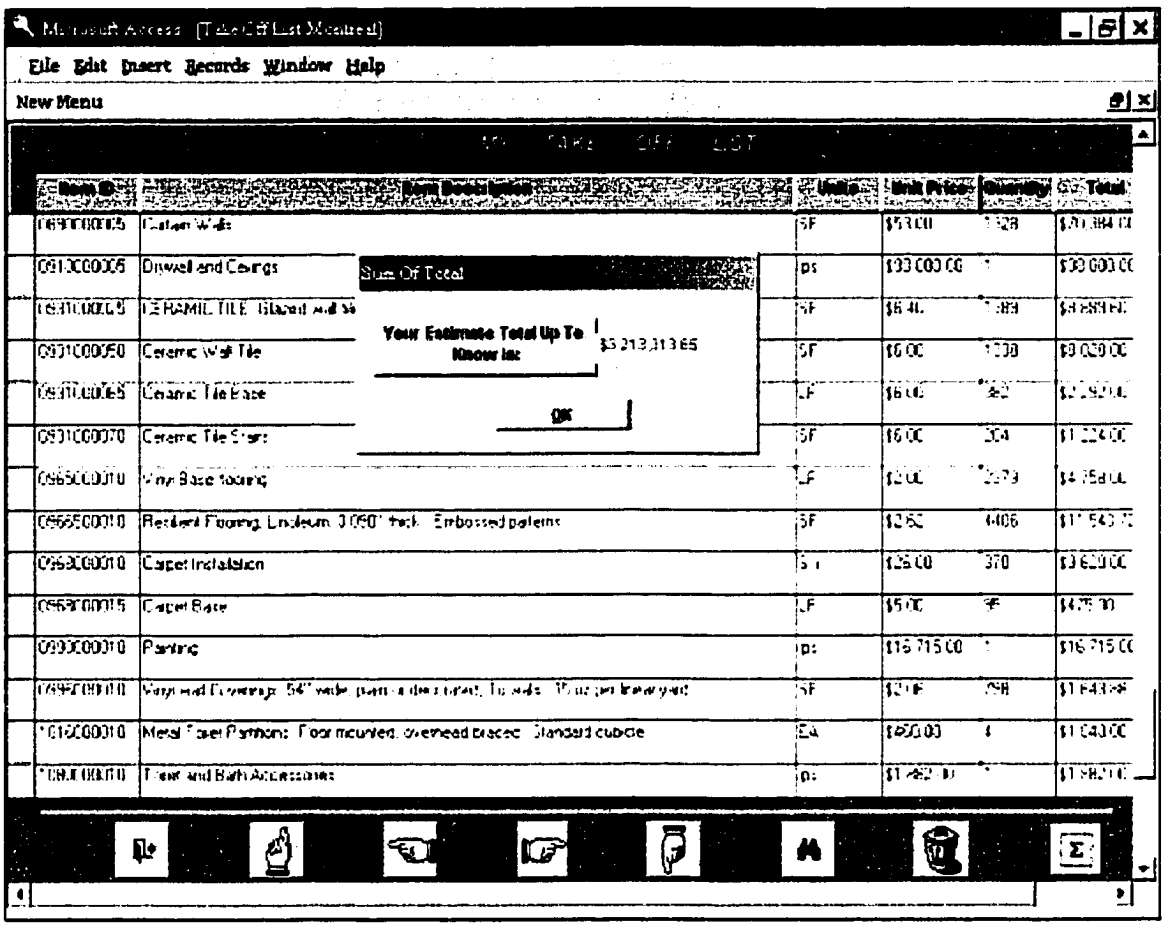
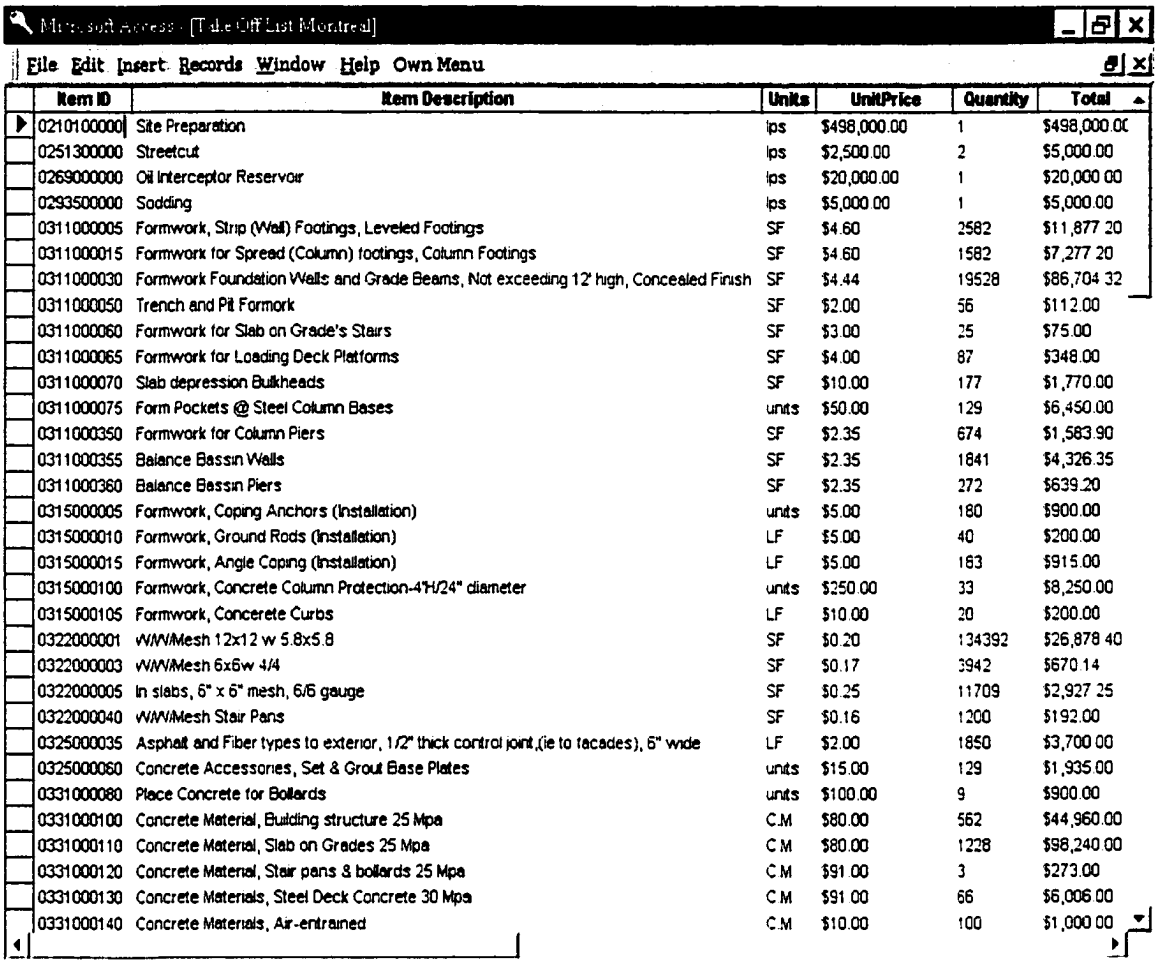


Figure 6.10 Project Final Take Off List

Since the model has an option of exporting the data sheet view table to Microsoft Word, Table 6.13 displays this list after being imported to MS. Word, document.



Item ID	Item Description	Units	UnitPrice	Quantity	Total
0210100000	Site Preparation	lps	$498,000.00	1	$498,000.00
0251300000	Streetcut	lps	$2,500.00	2	$5,000.00
0269000000	Oil Interceptor Reservoir	lps	$20,000.00	1	$20,000.00
0293500000	Sodding	lps	$5,000.00	1	$5,000.00
0311000005	Formwork, Strip (Wall) Footings, Leveled Footings	SF	$4.60	2582	$11,877.20
0311000015	Formwork for Spread (Column) footings, Column Footings	SF	$4.60	1582	$7,277.20
0311000030	Formwork Foundation Walls and Grade Beams, Not exceeding 12' high, Concealed Finish	SF	$4.44	19528	$86,704.32
0311000050	Trench and Pit Formork	SF	$2.00	56	$112.00
0311000060	Formwork for Slab on Grade's Stairs	SF	$3.00	25	$75.00
0311000065	Formwork for Loading Deck Platforms	SF	$4.00	87	$348.00
0311000070	Slab depression Bulkheads	SF	$10.00	177	$1,770.00
0311000075	Form Pockets @ Steel Column Bases	units	$50.00	129	$6,450.00
0311000350	Formwork for Column Piers	SF	$2.35	674	$1,583.90
0311000355	Balance Bassin Walls	SF	$2.35	1841	$4,326.35
0311000360	Balance Bassin Piers	SF	$2.35	272	$639.20
0315000005	Formwork, Coping Anchors (Installation)	units	$5.00	180	$900.00
0315000010	Formwork, Ground Rods (Installation)	LF	$5.00	40	$200.00
0315000015	Formwork, Angle Coping (Installation)	LF	$5.00	183	$915.00
0315000100	Formwork, Concrete Column Protection-4'H/24" diameter	units	$250.00	33	$8,250.00
0315000105	Formwork, Concerete Curbs	LF	$10.00	20	$200.00
0322000001	WWMesh 12x12 w 5.8x5.8	SF	$0.20	134392	$26,878.40
0322000003	WWMesh 6x6w 4/4	SF	$0.17	3942	$670.14
0322000005	In slabs, 6" x 6" mesh, 6/6 gauge	SF	$0.25	11709	$2,927.25
0322000040	WWMesh Stair Pans	SF	$0.16	1200	$192.00
0325000035	Asphalt and Fiber types to exterior, 1/2" thick control joint,(ie to facades), 6" wide	LF	$2.00	1850	$3,700.00
0325000060	Concrete Accessories, Set & Grout Base Plates	units	$15.00	129	$1,935.00
0331000080	Place Concrete for Bollards	units	$100.00	9	$900.00
0331000100	Concrete Material, Building structure 25 Mpa	C.M	$80.00	562	$44,960.00
0331000110	Concrete Material, Slab on Grades 25 Mpa	C.M	$80.00	1228	$98,240.00
0331000120	Concrete Material, Stair pans & bollards 25 Mpa	C.M	$91.00	3	$273.00
0331000130	Concrete Materials, Steel Deck Concrete 30 Mpa	C.M	$91.00	66	$6,006.00
0331000140	Concrete Materials, Air-entrained	C.M	$10.00	100	$1,000.00

Figure 6.11 Project Take Off list in Data Sheet View

Having the entire project work items selected and arranged in the list, the next step for us is to select the values of the General Conditions. Since this is a conceptual estimate, and the model does not include detailed items for the general conditions division, the indirect cost is going to be considered as a percentage of the total direct cost. Although this consideration conflicts with what Assaf, Budshait and Atiyah (1999) recommend for calculating the overhead project costs.

Table 6.13 The Exported Taking Off List in MS Word

	Item Description	Units	UnitPrice	Quanti	Total
0210100000	te Preparation	lps	$498,000.00	1	$498,000.00
0251300000	Streetcut	lps	$2,500.00	2	$5,000.00
0269000000	Oil Interceptor Reservoir	lps	$20,000.00	1	$20,000.00
0293500000	Sodding	lps	$5,000.00	1	$5,000.00
0311000005	Formwork, Strip (Wall) Footings, Leveled Footings	SF	$4.60	2582	$11,877.20
0311000015	Formwork for Spread (Column) footings, Column Footings	SF	$4.60	1582	$7,277.20
0311000030	Formwork Foundation Walls and Grade Beams, Not exceeding 12' high, Concealed Finish	SF	$4.44	19528	$86,704.32
0311000050	Trench and Pit Formork	SF	$2.00	56	$112.00
0311000060	Formwork for Slab on Grade's Stairs	SF	$3.00	25	$75.00
0311000065	Formwork for Loading Deck Platforms	SF	$4.00	87	$348.00
0311000070	Slab depression Bulkheads	SF	$10.00	177	$1,770.00
0311000075	Form Pockets @ Steel Column Bases	units	$50.00	129	$6,450.00
0311000350	Formwork for Column Piers	SF	$2.35	674	$1,583.90
0311000355	Balance Bassin Walls	SF	$2.35	1841	$4,326.35
0311000360	Balance Bassin Piers	SF	$2.35	272	$639.20
0315000005	Formwork, Coping Anchors (Installation)	units	$5.00	180	$900.00
0315000010	Formwork, Ground Rods (Installation)	LF	$5.00	40	$200.00
0315000015	Formwork, Angle Coping (Installation)	LF	$5.00	183	$915.00
0315000100	Formwork, Concrete Column Protection-4'H/24" diameter	units	$250.00	33	$8,250.00
0315000105	Formwork, Concerete Curbs	LF	$10.00	20	$200.00
0322000001	W/W/Mesh 12x12 w 5.8x5.8	SF	$0.20	13439	$26,878.40
0322000003	W/W/Mesh 6x6w 4/4	SF	$0.17	3942	$670.14
0322000005	In slabs, 6" x 6" mesh, 6/6 gauge	SF	$0.25	11709	$2,927.25
0322000040	W/W/Mesh Stair Pans	SF	$0.16	1200	$192.00
0325000035	Asphalt and Fiber types to exterior, 1/2" thick control joint,(ie to facades), 6" wide	LF	$2.00	1850	$3,700.00
0325000060	Concrete Accessories, Set & Grout Base Plates	units	$15.00	129	$1,935.00
0331000080	Place Concrete for Bollards	units	$100.00	9	$900.00
0331000100	Concrete Material, Building structure 25 Mpa	C.M	$80.00	562	$44,960.00
0331000110	Concrete Material, Slab on Grades 25 Mpa	C.M	$80.00	1228	$98,240.00
0331000120	Concrete Material, Stair pans & bollards 25 Mpa	C.M	$91.00	3	$273.00
0331000130	Concrete Materials, Steel Deck Concrete 30 Mpa	C.M	$91.00	66	$6,006.00
0331000140	Concrete Materials, Air-entrained	C.M	$10.00	100	$1,000.00
0331000150	Winter Concrete	C.M	$4.00	1427	$5,708.00
0334500100	Place and Finish Building Slab on Grade	SF	$0.45	60714	$27,321.30
0334500110	Sawcuts Filled	LF	$2.00	5133	$10,266.00
0334500120	Place and Finish Balance Bassin Slab	SF	$1.00	1384	$1,384.00
0334500130	Place and Finish Concrete on Deck	SF	$0.60	5886	$3,531.60
0334500140	Floor Hardener 6.5 kg/sm	SF	$0.42	57000	$23,940.00
0334500150	Cure and Seal	SF	$0.12	57000	$6,840.00
0334500160	Place and Finish Concrete Stair Pans	SF	$2.00	304	$608.00
0342000010	BETCON Slabs	SF	$10.00	2088	$20,880.00
0421000001	Winter Conditions, Exterior Walls	SF	$1.50	14316	$21,474.00
0421000002	Winter Conditions, Interior Walls	SF	$1.50	13908	$20,862.00
0422000005	Interior Concrete Blocks	SF	$6.00	13908	$83,448.00
0422000020	Plain (lightweight) concrete blocks, Backup, 8" (Exterior Walls)	SF	$6.80	7158	$48,674.40
0422000070	Rigid Insulation Cavity Extrior Walls, 2"	SF	$2.00	7158	$14,316.00
0422000105	Architectural split faced concrete blocks, Freestanding jointed and pointed, 4" Split Block Façade	SF	$6.50	7158	$46,527.00
0512000300	Structural Steel, including Steel Joists and Steel Deck	SF	$7.10	68688	$487,684.80

0550000000	METAL FABRICATIONS	lps	$45,000.00	1	$45,000.00
0610000010	Finish Carpentry	lps	$5,500.00	1	$5,500.00
0642000070	Pine Window Sills w/moulding	LF	$19.61	204	$4,000.44
0721200010	Board Insulation, 2" rigid insulation foundations	SF	$0.60	2305	$1,383.00
0721200015	Board Insulation, 2" rigid insulation @Hot Box Rm	SF	$1.20	1060	$1,272.00
0721200020	Board Insulation, 1/2" Cement board @Hot Box Rm	SF	$1.50	1060	$1,590.00
0721600010	2" Sprayed urethene insulation	SF	$2.60	7158	$18,610.80
0746600010	Architectural Metal Siding, Sandwich panel w/V.B.	SF	$5.60	20511	$114,861.60
0746600050	Aechitectural Metal Siding, Single skin	SF	$3.00	2501	$7,503.00
0747200010	"Dryvit" Product	SF	$10.00	4007	$40,070.00
0751000000	BUILT-UP BITUMINOUS ROOFING	SF	$2.90	60714	$176,070.60
0772400010	Roof Hatches	unit	$693.00	1	$693.00
0790000010	Sealants	lps	$2,000.00	1	$2,000.00
0810000010	20 gauge metal doors	units	$150.00	21	$3,150.00
0810000015	18 gauge metal insulated doors	units	$206.00	7	$1,442.00
0810000020	KALAMIEN-anti-explosive door 8x10	unit	$2,175.00	1	$2,175.00
0810000025	16 gauge pressed steel frame/single	units	$117.00	56	$6,552.00
0810000030	16 gauge pressed steel frame/double	units	$282.00	2	$564.00
0810000035	16 gauge pressed steel frame/special	units	$165.00	10	$1,650.00
0811100010	Installation Doors	units	$75.00	62	$4,650.00
0811100020	Install KALAMIEN anti-explosive door	unit	$500.00	1	$500.00
0821000002	Solid masonite doors	units	$115.15	33	$3,799.95
0833100005	Rolling Doors: Metal Insulated	unit	$1,472.00	7	$10,304.00
0845000010	Impact Doors	unit	$6,070.00	1	$6,070.00
0871000000	Finish Hardware	unit	$303.00	62	$18,786.00
0871000002	Aluminium Sills	unit	$300.00	9	$2,700.00
0880000010	Metal Door Lites 6"x2	unit	$50.00	7	$350.00
0880000020	Wood Door Windows 2'x3'-6"	unit	$100.00	9	$900.00
0880000030	Special frame windows	unit	$160.00	7	$1,120.00
0890000005	Curtain Walls	SF	$53.00	1328	$70,384.00
0910000005	Drywall and Ceilings	lps	$98,000.00	1	$98,000.00
0931000025	CERAMIC TILE, Glazed wall tile 1/4" thick, Thinset : 6" x 6"	SF	$6.40	1389	$8,889.60
0931000050	Ceramic Wall Tile	SF	$6.00	1338	$8,028.00
0931000065	Ceramic Tile Base	LF	$6.00	382	$2,292.00
0931000070	Ceramic Tile Stairs	SF	$6.00	204	$1,224.00
0965000010	Vinyl Base flooring	LF	$2.00	2379	$4,758.00
0966500010	Resilient Flooring, Linoleum, 0.090" thick : Embossed patterns	SF	$2.62	4406	$11,543.72
0968000010	Carpet Installation	S.Y	$26.00	370	$9,620.00
0968000015	Carpet Base	LF	$5.00	95	$475.00
0990000010	Painting	lps	$16,715.00	1	$16,715.00
0996000010	Vinyl wall Coverings, 54" wide, plain or decorated, To walls : 15 oz per linear yard	SF	$2.06	798	$1,643.88
1016000010	Metal Toilet Partitions, Floor mounted, overhead braced : Standard cubicle	EA	$460.00	4	$1,840.00
1080000010	Toilet and Bath Accessories	lps	$1,882.00	1	$1,882.00
1116000000	LOADING DOCK EQUIPMENT	lps	$2,734.00	1	$2,734.00
1116100005	Dock Levellers	unit	$1,851.00	4	$7,404.00
1400000000	Conveying System		$0.00	1	$0.00
1525000010	Thermal Insulation	lps	$24,348.00	1	$24,348.00
1533000005	Sprinkler System	lps	$128,840.00	1	$128,840.00
1540000010	Plumbing and Heating	lps	$115,250.00	1	$115,250.00
1550000010	Ventilation	lps	$164,600.00	1	$164,600.00
1590000010	Controls	lps	$44,300.00	1	$44,300.00
1610000010	Electrical subcontract	lps	$334,500.00	1	$334,500.00

The percentage chosen to cover the overhead is 6% of the total direct cost. Additionally, the construction firm considers a percentage of 3% to cover its profit. As well a percentage of 1% of the total direct cost is considered to cover the contingency. To cover Taxes a percentage of 15% is applied to the sum of the total direct cost, profit, contingency and overhead. Chapter 5 explained in detail the model calculation process of the "General Conditions" division. Therefore, Figures 6.12 to 6.14 picture the steps of entering the General Conditions percentages.

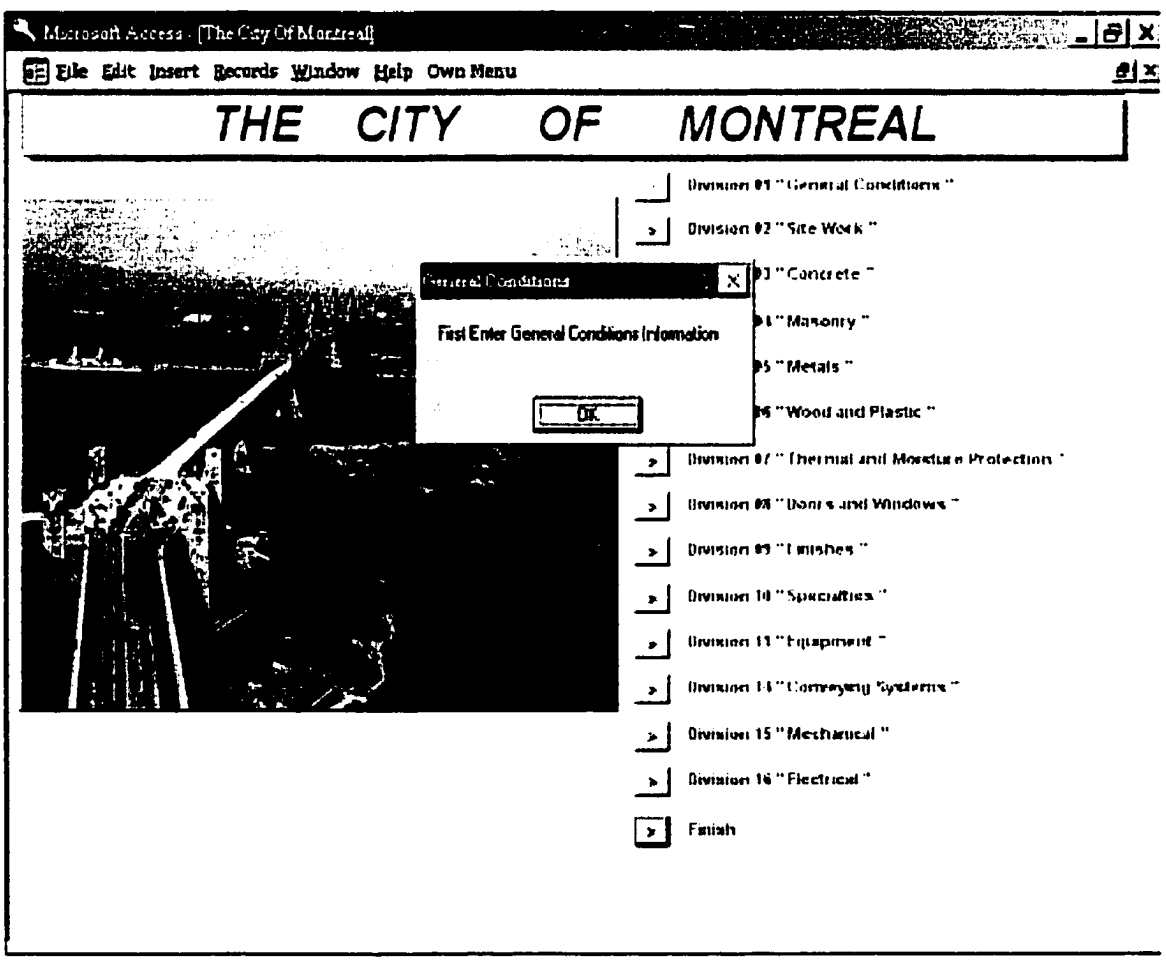


Figure 6.12 Message to Enter General Conditions Information

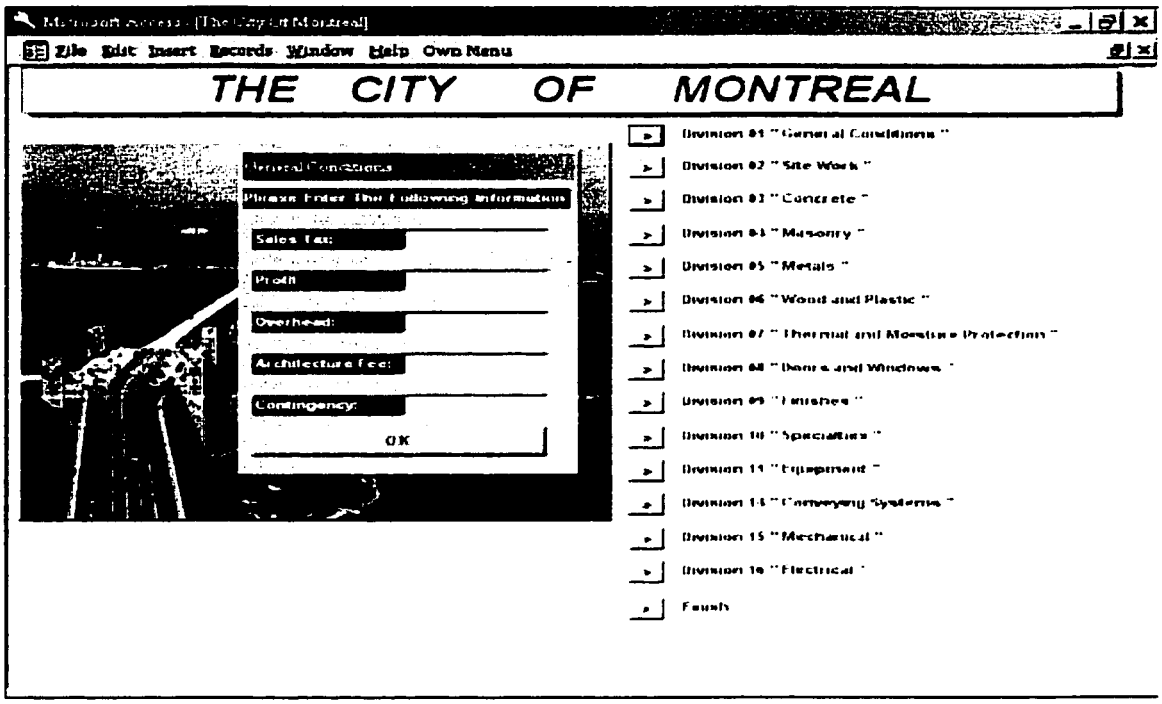


Figure 6.13 General Conditions Form Before Entering The Percentage

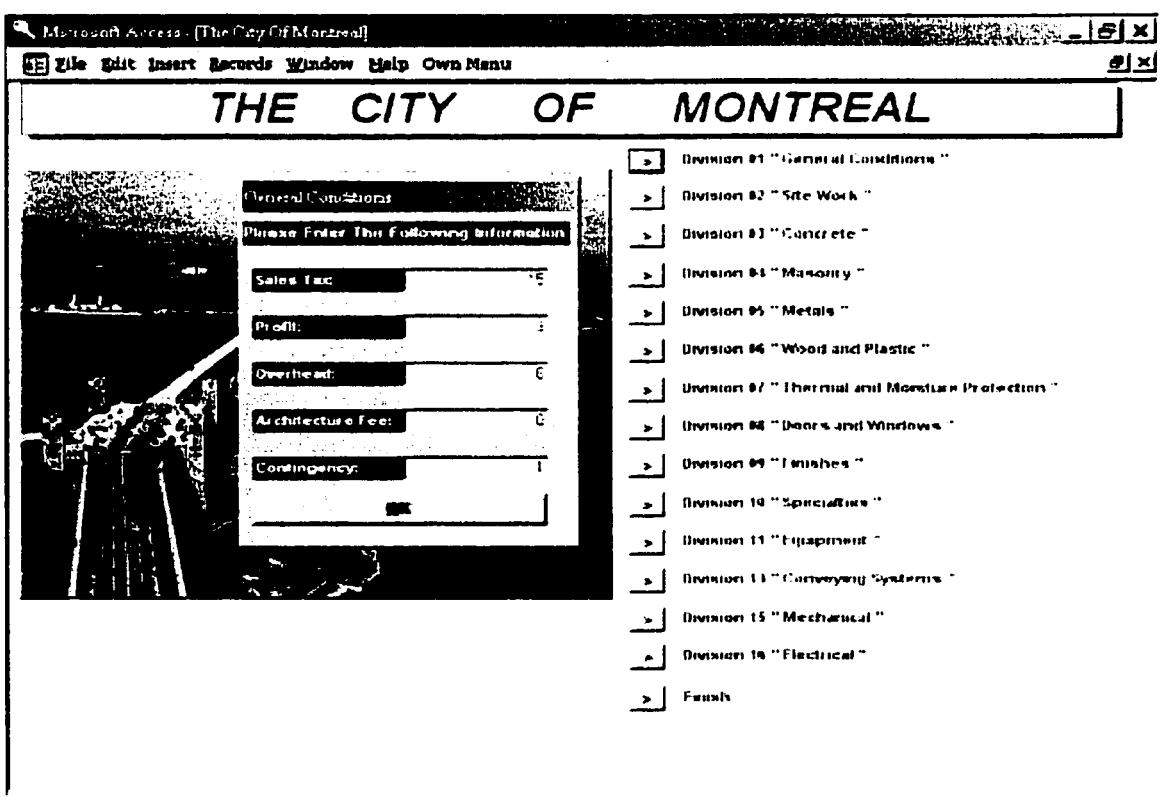


Figure 6.14 General Conditions Form After Entering the Percentage

Immediately after keying in the percentage in their suitable position in the "General Condition" form, the model allows us to continue by enabling the "OK" button. As soon as we hit that button, the model prompts us to choose the format of the report that we like to prepare. As mentioned in chapter 5, the model provides us with three different types of reports and a complete take off list by division format to choose from. We are going to prepare all the four formats one after the other. Figures 6.15 to 6.17 show the three types of reports consecutively. On the other hand Figures 6.18 to 6.22 show the complete take off list by division format for the project that the model generated after selecting the required items.

Original Copies of the output documents that the model provides the user with are included in Appendix E.

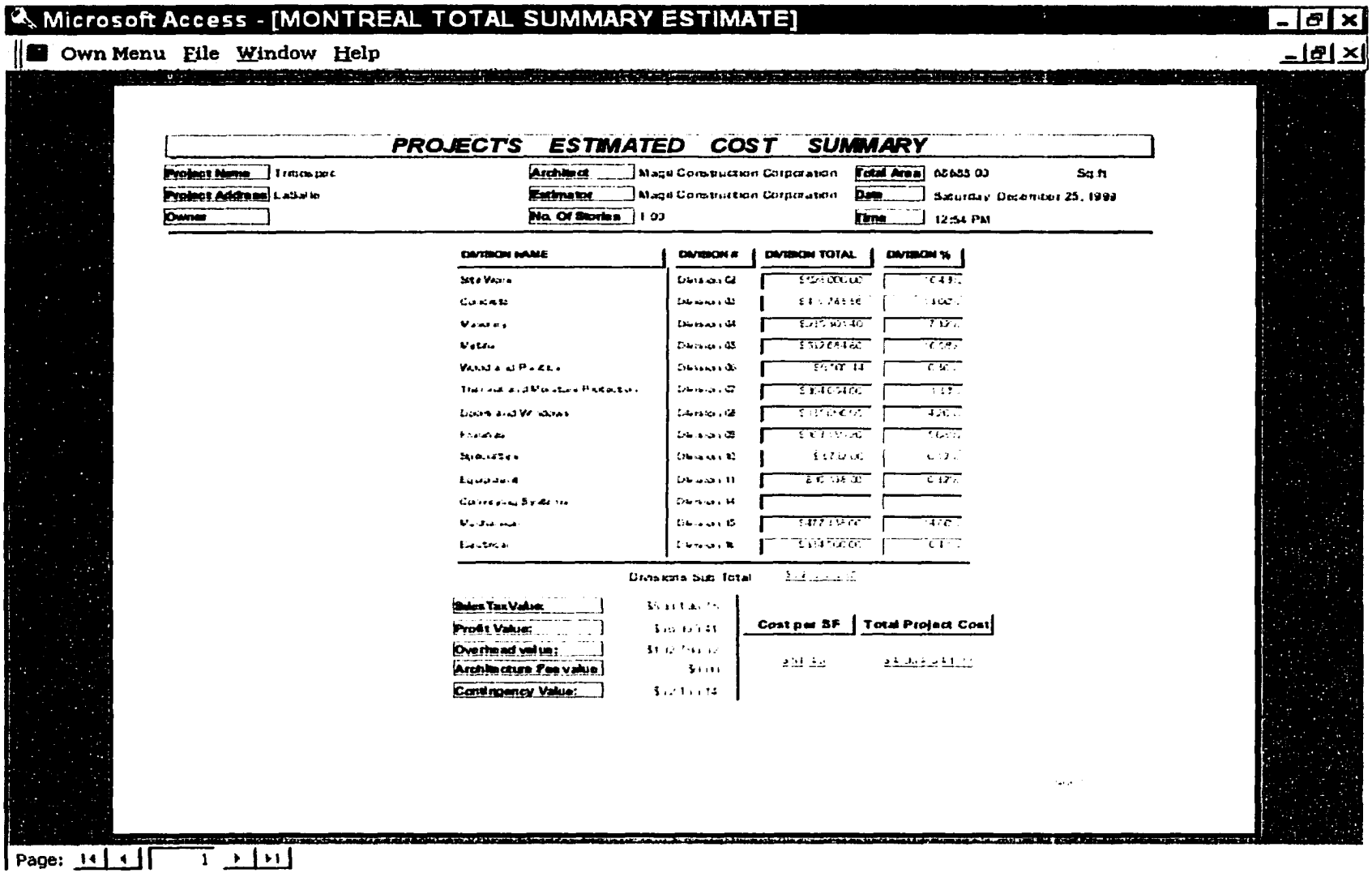


Figure 6.15 Completed Final Report.

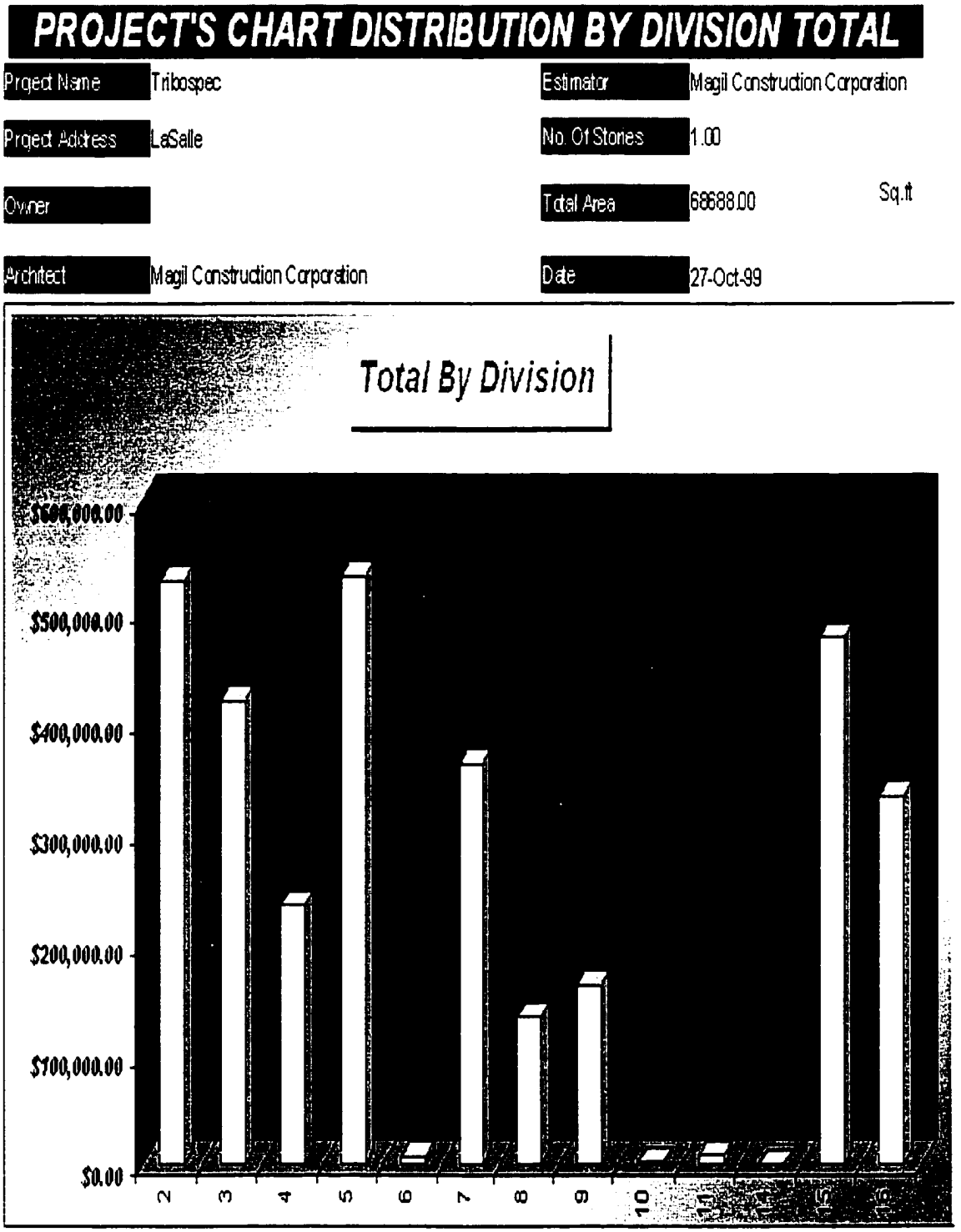


Figure 6.16 Column Bar Chart (Histogram) Report

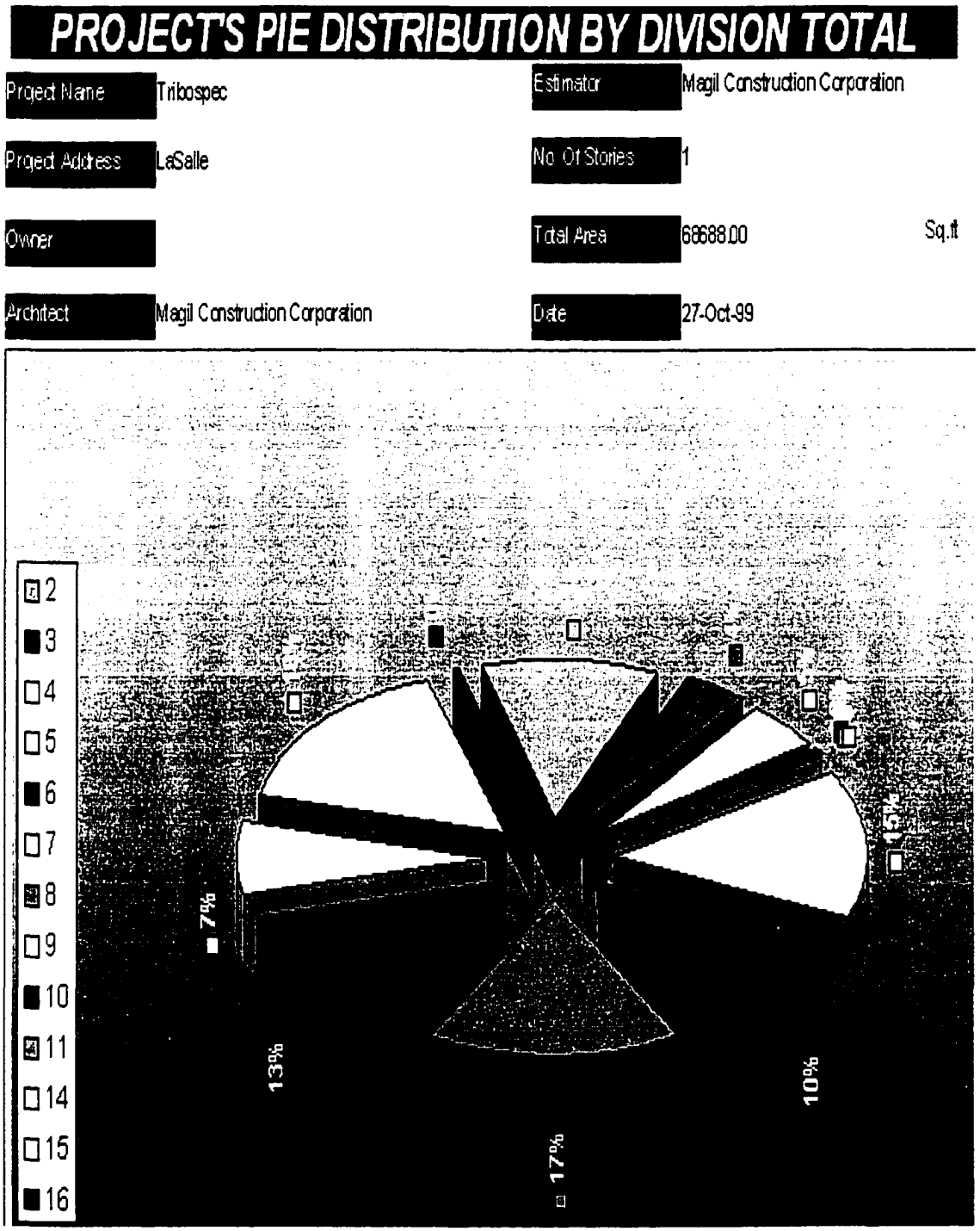
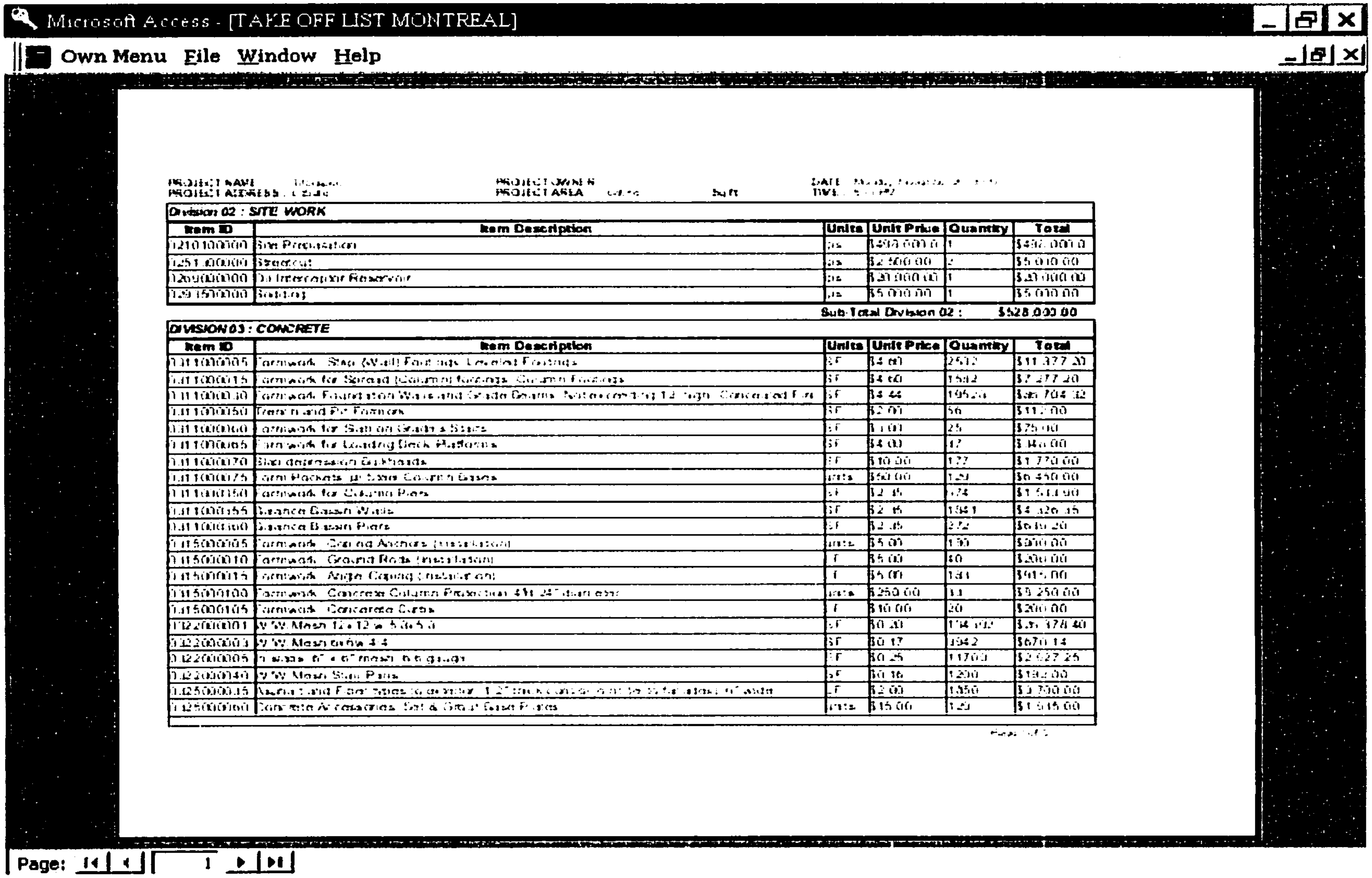


Figure 6.17 Pie Chart Report



Item ID	Item Description	Units	Unit Price	Quantity	Total
Division 02 : SITE WORK					
0210100000	Site Preparation	ls	[illegible]	1	[illegible]
0251.000000	[illegible]	ls	$2,500.00	2	$5,000.00
0269000000	Oil Interceptor Reservoir	ls	$20,000.00	1	$20,000.00
0291500000	Sodding	ls	$5,000.00	1	$5,000.00
		Sub-Total Division 02 :			$528,000.00

Item ID	Item Description	Units	Unit Price	Quantity	Total
DIVISION 03 : CONCRETE					
0311000005	Formwork - Strip (Wall) Footings, Leveled Footings	SF	$4.60	2512	$11,377.20
0311000015	Formwork for Spread (Column) footings, Column Footings	SF	$4.60	1582	$7,277.20
0311000030	Formwork Foundation Walls and Grade Beams, Not exceeding 12' high, Concealed Fin	SF	$4.44	19520	[illegible]
0311000050	Trench and Pit Forming	SF	$2.00	56	$112.00
0311000060	Formwork for Slab on Grade & Stairs	SF	$3.00	25	$75.00
0311000065	Formwork for Loading Dock Platforms	SF	$4.00	47	[illegible]
0311000070	Slab depression Bulkheads	SF	$10.00	177	$1,770.00
0311000075	Form Pockets at Steel Column Bases	units	$50.00	129	$6,450.00
0311000150	Formwork for Column Piers	SF	$2.45	624	[illegible]
0311000155	[illegible] Basin Walls	SF	$2.45	1941	$4,[illegible]
0311000160	[illegible] Basin Piers	SF	$2.45	272	[illegible]
0315000005	Formwork - Ground Anchors (Installation)	units	$5.00	130	[illegible]
0315000010	Formwork - Ground Rods (Installation)	LF	$5.00	40	$200.00
0315000015	Formwork - Angle Coping (Installation)	LF	$5.00	[illegible]	[illegible]
0315000100	Formwork - Concrete Column Protection [illegible]	units	$250.00	[illegible]	$[illegible],250.00
0315000105	Formwork - Concrete Curbs	LF	$10.00	20	$200.00
0322000001	W.W. Mesh 12 x 12 [illegible]	SF	$0.20	[illegible]	[illegible]
0322000003	W.W. Mesh 6x6 4-4	SF	$0.17	3942	$670.14
0322000005	[illegible] 6" x 6" mesh, 6-6 gauge	SF	$0.25	11700	$2,927.25
0322000040	W.W. Mesh Slab Pans	SF	$0.16	1200	$192.00
0325000015	[illegible]	LF	$2.00	1850	$3,700.00
0325000060	Concrete Accessories, Set & Grout Base Plates	units	$15.00	[illegible]	$1,[illegible]15.00

Figure 6.18 Complete Take off List by Division (1 of 5).

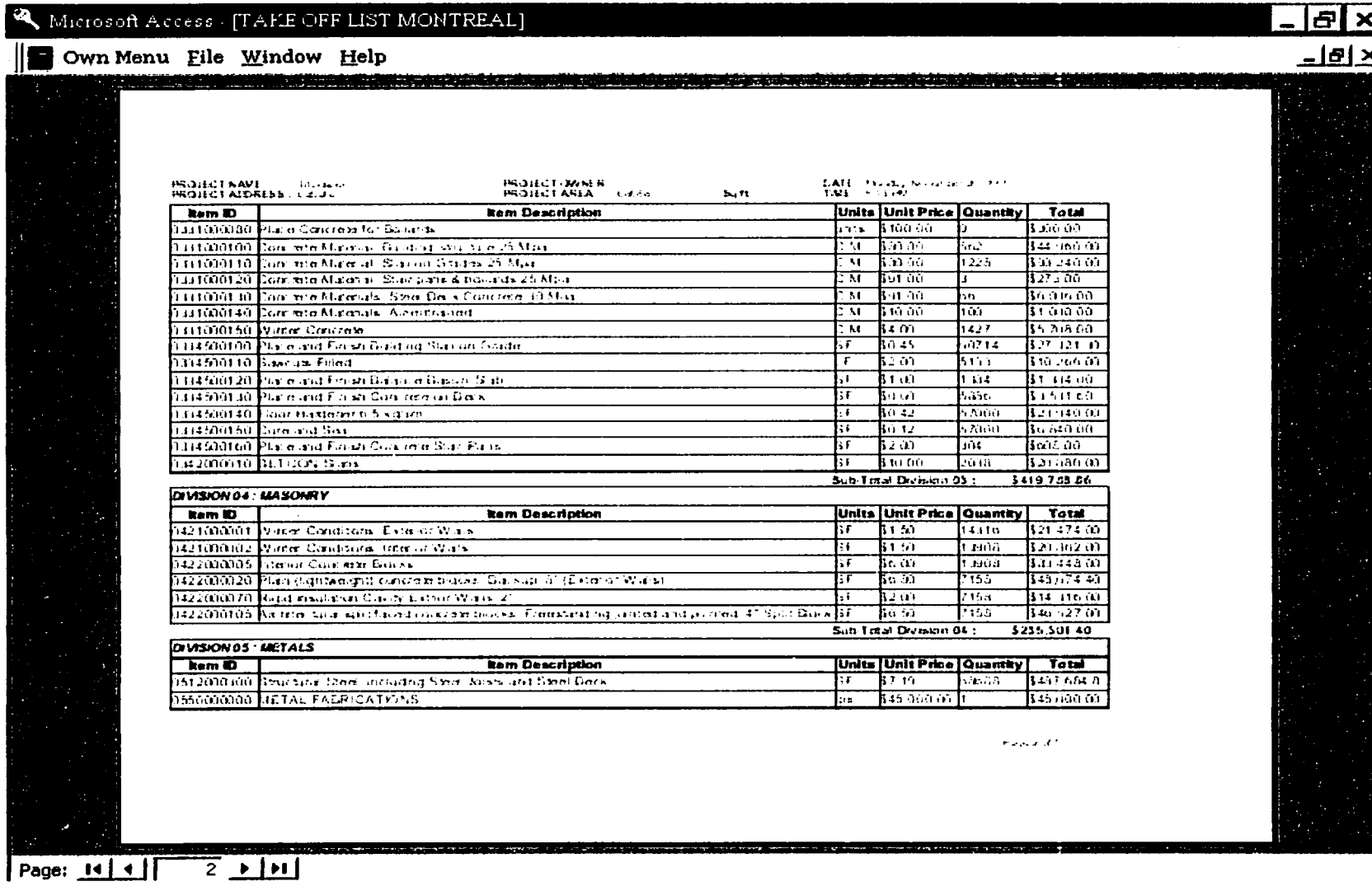


Figure 6.19 Complete Take off List by Division (2 of 5).

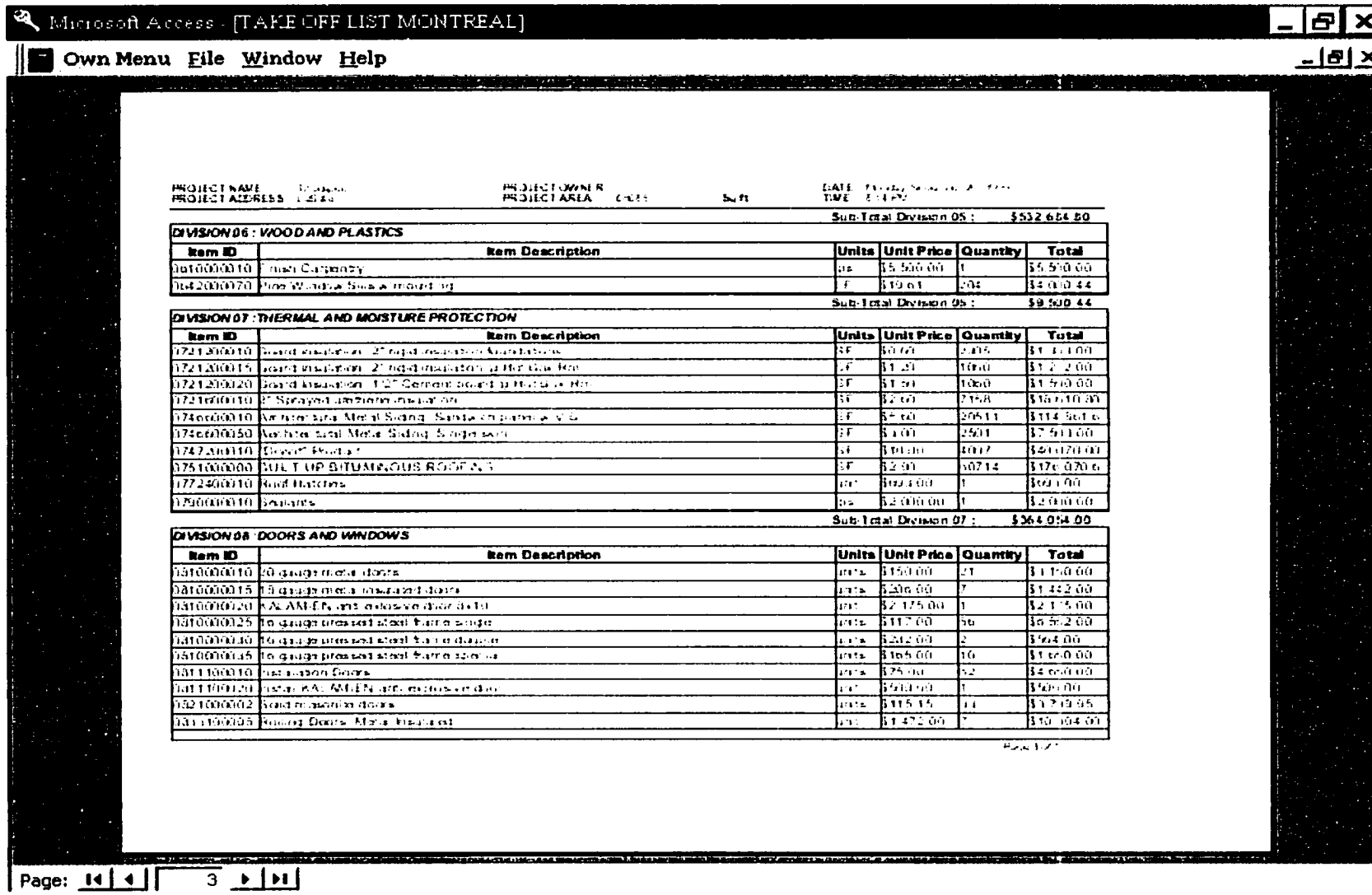


Figure 6.20 Complete Take off List by Division (3 of 5).

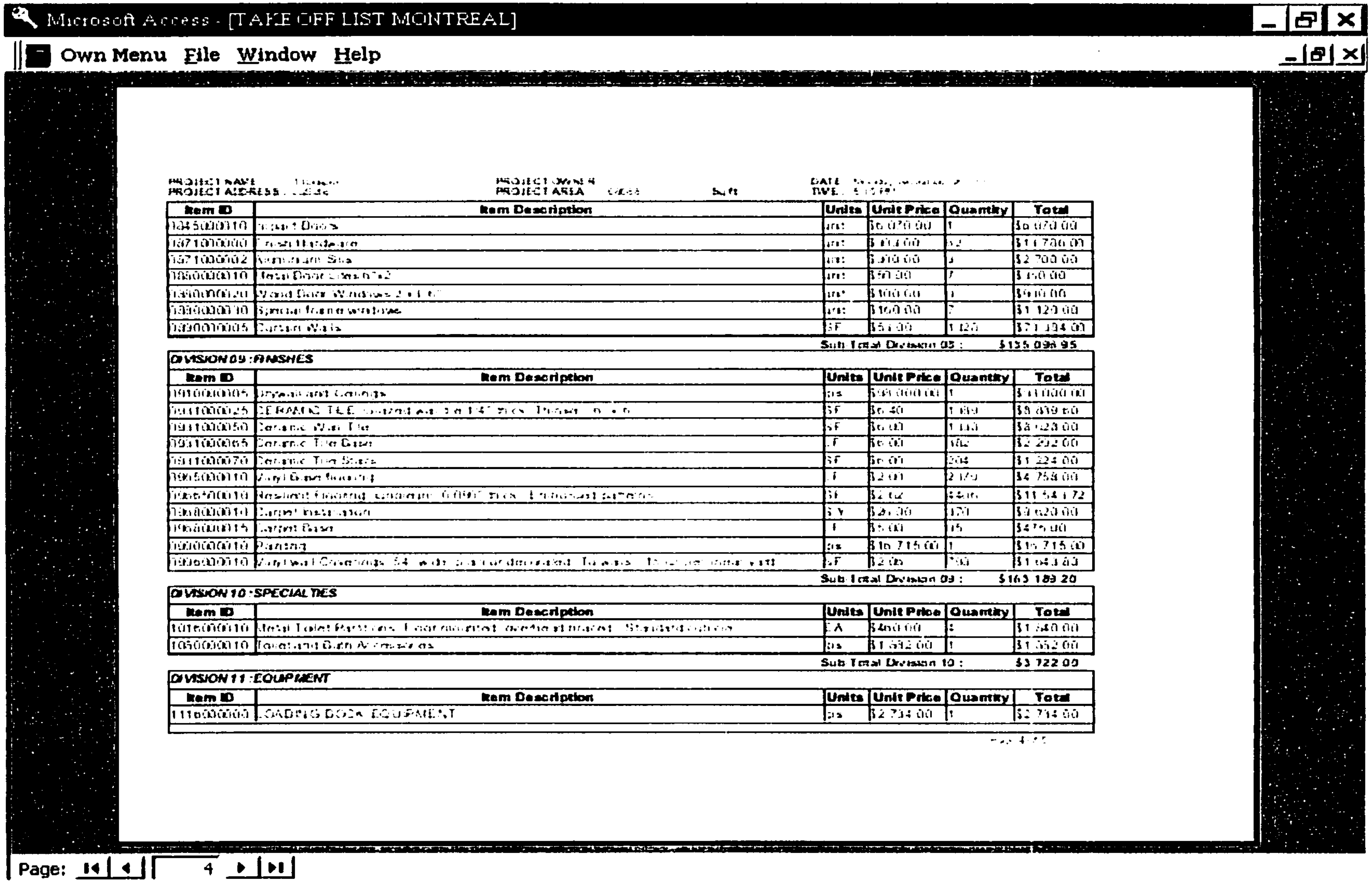
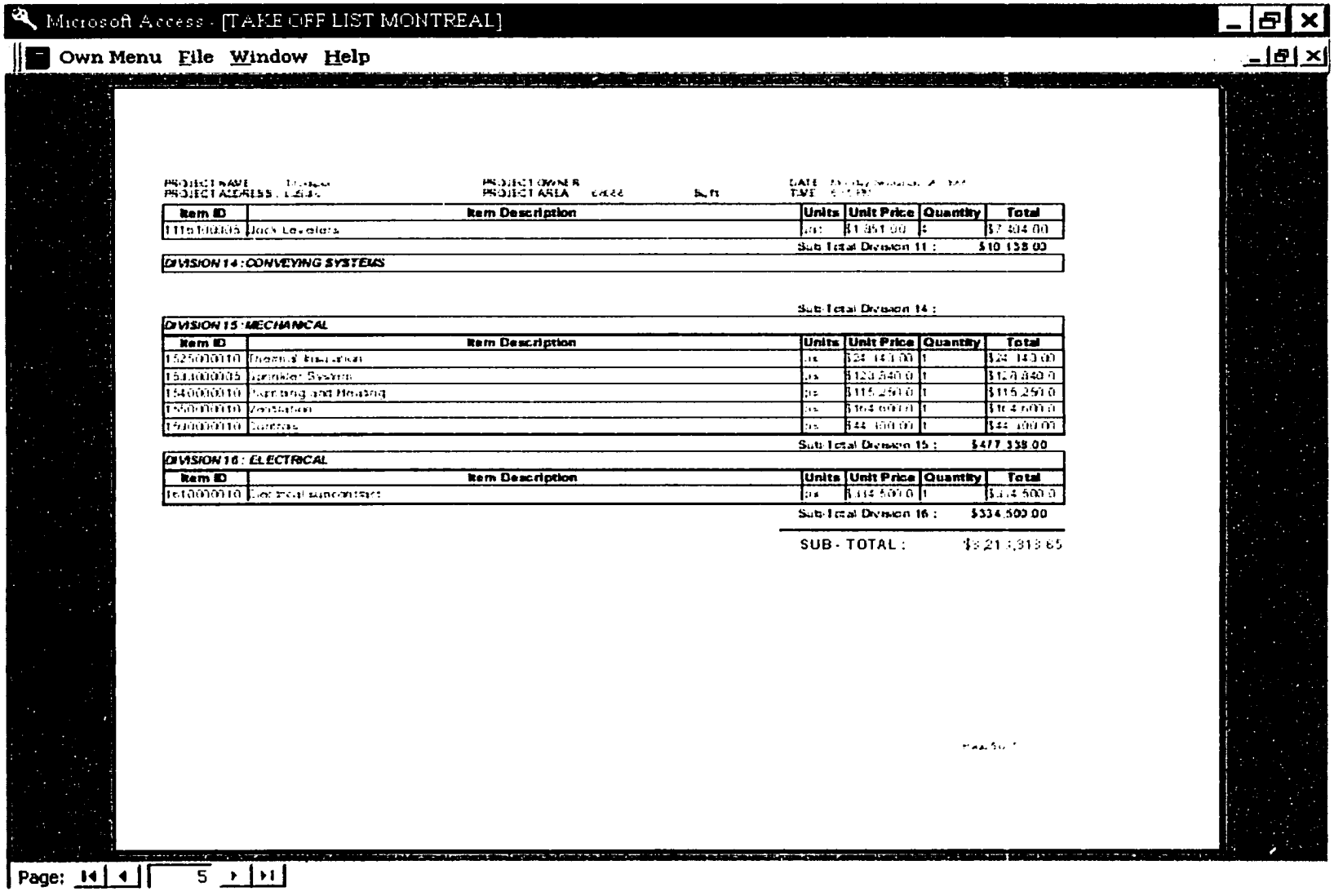


Figure 6.21 Complete Take off List by Division (4 of 5).



Item ID	Item Description	Units	Unit Price	Quantity	Total
11[illegible]005	Dock Levelers	[illegible]	$1,851.00	4	$7,404.00
			Sub Total Division 11 :		$10,158.00

DIVISION 14 : CONVEYING SYSTEMS

Sub Total Division 14 :

DIVISION 15 : MECHANICAL

Item ID	Item Description	Units	Unit Price	Quantity	Total
1525000110	[illegible]	[illegible]	$24,143.00	1	$24,143.00
1530000105	Sprinkler System	[illegible]	$120,840.00	1	$120,840.00
1540000110	Plumbing and Heating	[illegible]	$115,256.00	1	$115,256.00
1550000110	Ventilation	[illegible]	$[illegible]	1	$[illegible]
1590000110	Controls	[illegible]	$44,100.00	1	$44,100.00
			Sub Total Division 15 :		$477,339.00

DIVISION 16 : ELECTRICAL

Item ID	Item Description	Units	Unit Price	Quantity	Total
1610000110	Electrical subcontract	[illegible]	$334,500.00	1	$334,500.00
			Sub Total Division 16 :		$334,500.00

SUB - TOTAL : $[illegible]

Figure 6.22 Complete Take off List by Division (5 of 5).

6.3 Parametric Estimate Application

Assuming the drawings and information on the actual project are not available and only it is an initiated idea to construct a "warehouse with offices". In this case for fast, simple, and approximate estimate of the project construction costs we choose to generate a parametric estimate, which can be carried out by clicking on the "Parametric Estimate" shown in Figure 6.1. Once this option is selected the model asks for the unit type, in our case we click the "Imperial". By doing so we are transferred to a screen similar to the one shown in Figure 5.41 in chapter 5. First we view the list of projects that are provided in the database and select the most similar project to the current. Therefore, hitting on the "Preview Projects" button transfers us to a screen alike to the one shown in Figure 5.42. The work breakdown structure of the project has to be selected in order to proceed. Thus "By Masterformat" is clicked and instantly a screen similar to that shown in Figure 5.40 is presented in order to select the city where the suggested project is to be constructed. Our choice is Montreal, hence the model opens the screen pictured in Figure 6.23, where the search of an identical project can be executed. The search resulted in finding a warehouse project as Figure 6.24 illustrates, the information provided by the database for the warehouse project is clearly classified and the cost of the entire project, per square foot, and the cost of each division separately are provided.

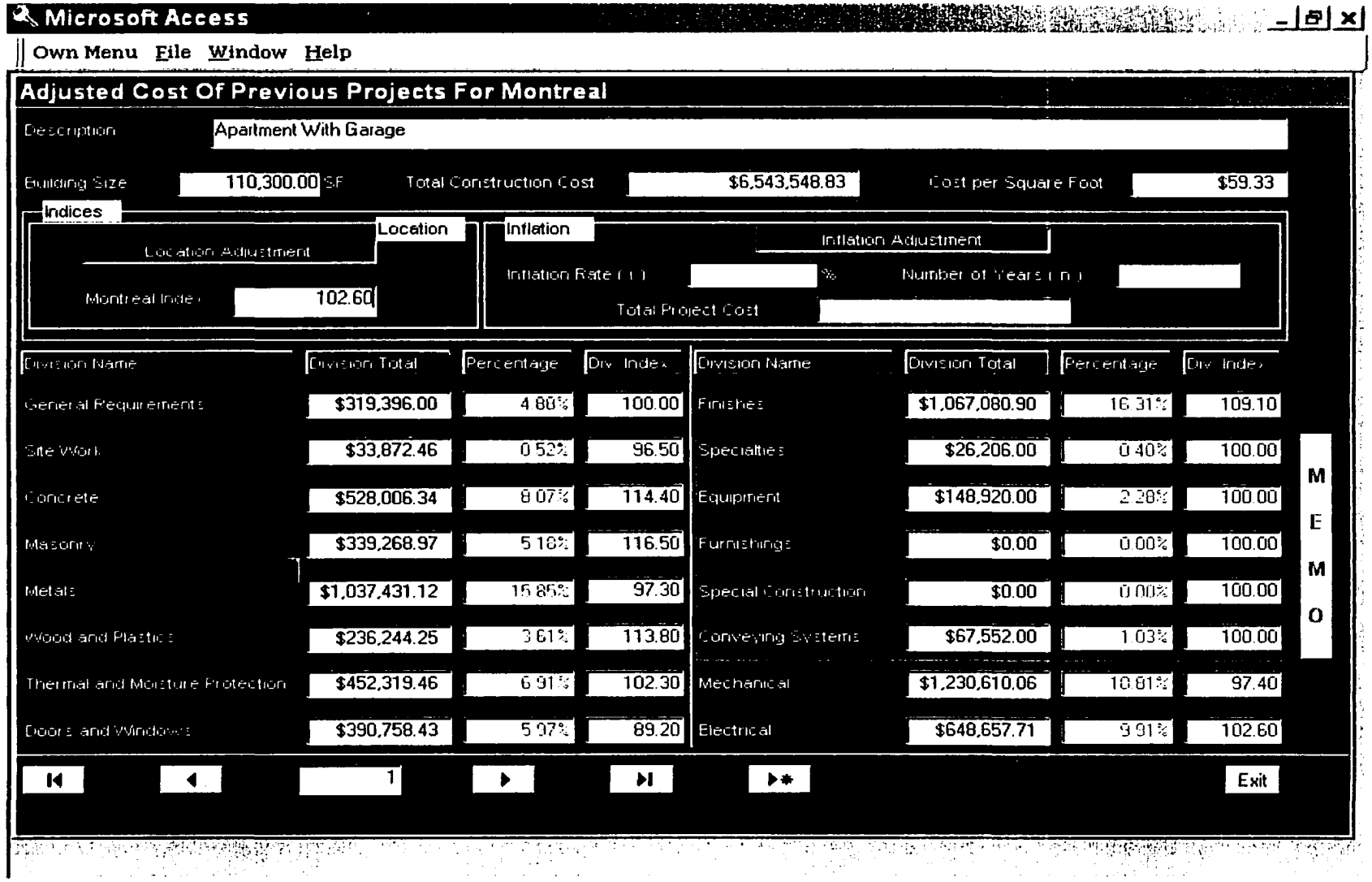


Figure 6.23 First Project in the Database List.

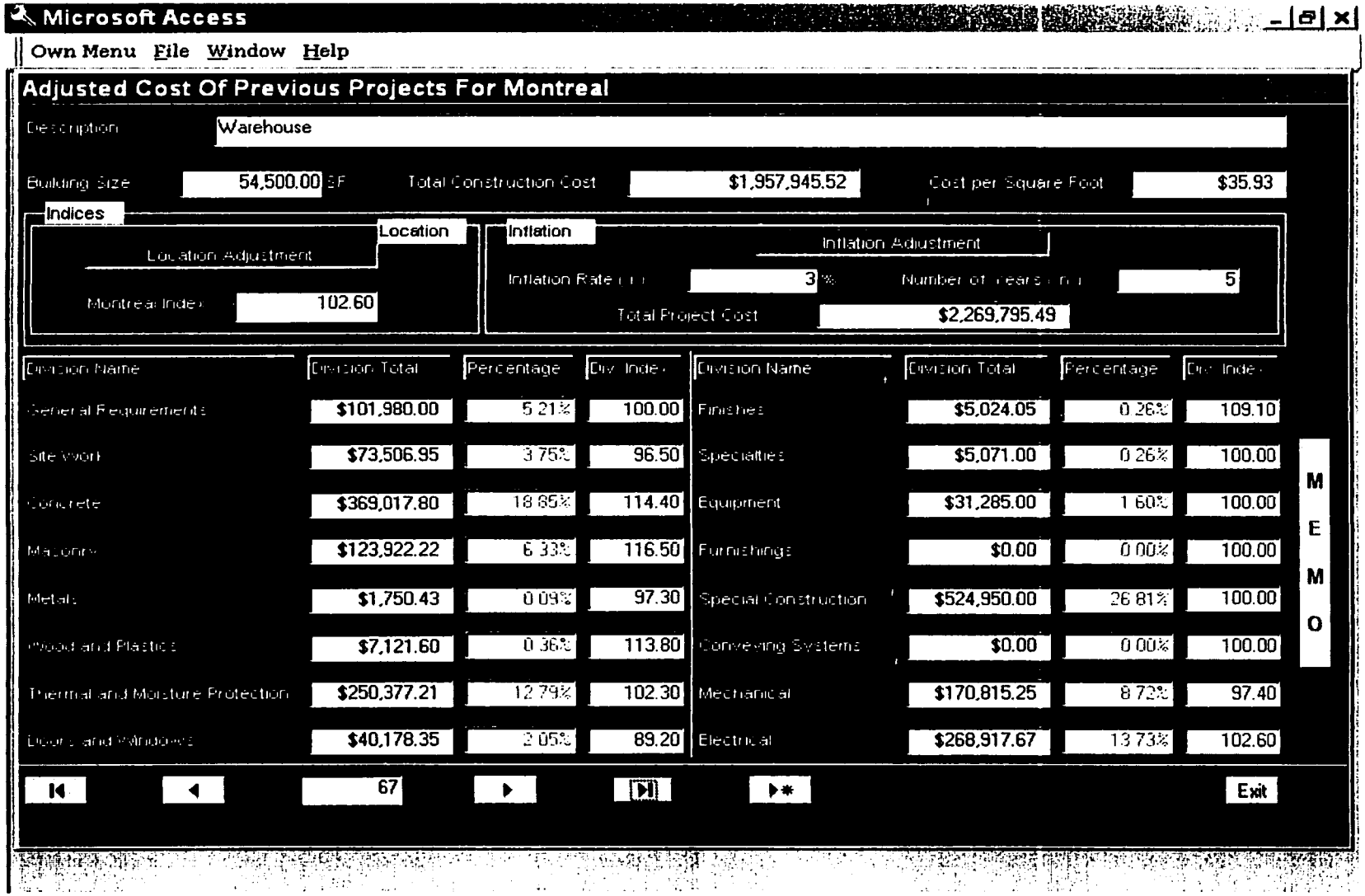


Figure 6.24 Similar Warehouse Project.

It is to be noted that there are differences between the description and the area (Building size) of the available in the database and the actual project. For instance, the actual project is a warehouse with offices with an area of 68,688 ft^2, while the provided one is a warehouse with an area of 54,500 ft^2.

These differences demand some adjustments according to inflation since the costs are based on 1994, and for the size. The model can do the first adjustment by entering the corresponding values, while the second has to be done manually. Considering an inflation rate of 3% and the number of years to be five the calculated adjusted cost due to inflation outfitted by the model is $ 2,269,759.49 as shown in Figure 6.24. This adjusted value is for the total construction cost of the project. Dividing the total adjusted project cost by the area provides the cost per square foot, which is $ 41.65.

The size adjustment can be accomplished by using for instance the size modifier table and graph supplied by R. S. Means as illustrated in Figure 6.25.

The level of accuracy of this type of estimates compared to the preliminary is low, but it can provide an approximation of the costs. Moreover considering the required adjustments could lead to an acceptable value. Own historical data and experience are the factors that govern the accuracy of such estimates.

Similarly, if the project work breakdown structure is based on the Uniformat, then the choice has to be "By Elements" and the same procedures are to be executed.

R171-100 Square Foot Project Size Modifier

One factor that affects the S.F. cost of a particular building is the size. In general, for buildings built to the same specifications in the same locality, the larger building will have the lower S.F. cost. This is due mainly to the decreasing contribution of the exterior walls plus the economy of scale usually achievable in larger buildings. The Area Conversion Scale shown below will give a factor to convert costs for the typical size building to an adjusted cost for the particular project.

Example: Determine the cost per S.F. for a 100,000 S.F. Mid rise apartment building.

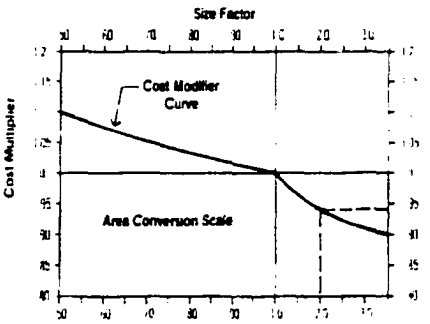
$$\frac{\text{Proposed building area} \quad 100{,}000 \text{ S.F.}}{\text{Typical size from below} \quad 50{,}000 \text{ S.F.}} = 2.00$$

Enter Area Conversion scale at 2.0, intersect curve, read horizontally the appropriate cost multiplier of .94. Size adjusted cost becomes .94 x $66.10 = $62.10 based on national average costs.

Note: For Size Factors less than .50, the Cost Multiplier is 1.1. For Size Factors greater than 3.5, the Cost Multiplier is .90.

The Square Foot Base Size lists the median costs, most typical project size in our accumulated data and the range in size of the projects.

The Size Factor for your project is determined by dividing your project area in S.F. by the typical project size for the particular Building Type. With this factor, enter the Area Conversion Scale at the appropriate Size Factor and determine the appropriate cost multiplier for your building size.



Square Foot Base Size									
Building Type	Median Cost per S.F.	Typical Size Gross S.F.	Typical Range Gross S.F.		Building Type	Median Cost per S.F.	Typical Size Gross S.F.	Typical Range Gross S.F.	
Apartments Low Rise	$ 52.60	21,000	9,700.00	37,200	Jails	$161.00	13,700	7,500	28,000
Apartments Mid Rise	66.40	50,000	32,000	100,000	Libraries	94.70	12,000	7,000	31,000
Apartments High Rise	76.20	310,000	100,000	650,000	Medical Clinics	80.60	7,200	4,200	15,700
Auditoriums	87.95	25,000	7,600	39,000	Medical Offices	85.10	6,000	4,000	15,000
Auto Sales	54.40	20,000	10,800	28,600	Motels	65.20	27,000	15,600	51,000
Banks	116.00	4,200	2,500	7,500	Nursing Homes	87.50	23,000	15,000	37,000
Churches	79.45	9,000	5,300	13,200	Offices Low Rise	71.00	8,600	4,700	19,000
Clubs Country	79.20	6,500	4,500	15,000	Offices Mid Rise	74.55	52,000	31,300	83,100
Clubs Social	77.05	10,000	6,000	13,500	Offices High Rise	84.50	260,000	151,000	466,000
Clubs YMCA	79.40	28,300	12,800	39,400	Police Stations	119.00	10,500	4,000	19,000
Colleges (Class)	104.00	50,000	23,500	98,500	Post Offices	87.95	12,400	6,800	30,000
Colleges (Science Lab)	151.00	45,600	16,600	80,000	Power Plants	673.00	7,500	1,000	20,000
College (Student Union)	116.00	33,400	16,000	85,000	Religious Education	72.85	9,000	6,000	12,000
Community Center	82.80	9,400	5,300	16,700	Research	124.00	19,000	6,300	45,300
Court Houses	112.00	32,400	17,800	106,000	Restaurants	107.00	4,400	2,800	6,300
Dept. Stores	49.15	90,000	44,000	122,000	Retail Stores	52.25	7,200	4,000	17,600
Dormitories Low Rise	84.85	24,500	13,400	40,000	Schools, Elementary	76.10	41,000	24,500	55,000
Dormitories Mid Rise	110.00	55,600	36,100	90,000	Schools Jr. High	77.50	92,000	52,000	119,000
Factories	47.65	26,400	12,900	50,000	Schools Sr. High	77.50	101,000	50,500	175,000
Fire Stations	83.15	5,800	4,000	8,700	Schools Vocational	77.20	37,000	20,500	82,000
Fraternity Houses	81.80	12,500	8,200	14,800	Sports Arenas	64.70	15,000	5,000	40,000
Funeral Homes	91.45	7,800	4,500	11,000	Supermarkets	52.45	20,000	12,000	30,000
Garages Commercial	58.10	9,300	5,000	13,600	Swimming Pools	121.00	13,000	7,800	22,000
Garages Municipal	74.30	8,300	4,500	12,600	Telephone Exchange	141.00	4,500	1,200	10,600
Garages Parking	30.45	163,000	76,400	225,300	Theaters	77.60	10,500	8,600	17,500
Gymnasiums	76.85	19,200	11,600	41,000	Town Halls	85.35	10,600	4,600	23,400
Hospitals	145.00	55,000	27,200	125,000	Warehouses	35.15	25,000	8,000	72,000
House (Elderly)	71.95	37,000	21,000	66,000	Warehouse & Office	40.60	25,000	8,000	72,000
Housing (Public)	66.60	36,000	14,400	74,400					
Ice Rinks	74.75	29,000	27,200	33,600					

Case 2:

The project has a total site area of 62,458 ft2 and a construction building area of 160,000 ft^2. A preliminary estimate is going to be performed according to the drawings provided by the Architect. Since the construction firm has prepared an approximate quantities take off, therefore the same ones are going to be used in building the take off list and accordingly calculating the total construction costs. Appendix E comports the actual take off list.

Figures 6.26 to 6.28 show the generated take off list by the system, while Figures 6.29 to 6.31 show the three types of reports that the system can provide. With the notice that the total direct construction cost of the project provided by the system is $16,899,922.66 excluding the Furnishings Division, while the total direct cost calculated by the construction firm is $16,498,000 excluding Furnishings. Therefore a difference of $401,922 (+2.4%) more is resulted by using the system. As mentioned earlier the cost data provided in the database includes material, installation, transportation and subcontract profit. For the indirect costs, the firm did not consider a value to the sales tax nor for the contingency, so if we assume a profit of 3%, an overhead of 6% and an Architecture fee of 1% the total indirect cost will be $1,689,992. The preliminary estimated cost of constructing the project of case 2 provided by the system is $18,589,915 (excluding Furnishings) compared with $18,528,000 (including Furnishings) that has been computed by the construction firm. Consequently, the system does provide reliable and acceptable results depending on the availability and types of costs data used.

PROJECT NAME: [illegible] PROJECT OWNER : [illegible] DATE : [illegible]
PROJECT ADDRESS : [illegible] PROJECT AREA : [illegible] Sq Ft TIME : [illegible]

Division 02 : SITE WORK

Item ID	Item Description	Units	Unit Price	Quantity	Total
1206000000	Building Demolition	SF	$0.65	124840	$81,146.00
1215000010	Shoring and Underpinning	SF	$2.22	124840	$277,144.80
1220000000	Earthwork	SF	$5.00	124840	$624,104.00
1250000010	Pavers and Curbs	SF	$0.42	206543	$87,030.06
1260000010	Site Services	SF	$0.11	124840	$13,732.40
1270000010	Foundation Drains	SF	$0.19	124840	$23,719.60
1280000010	Site Improvements	SF	$0.10	206543	$20,654.30
1290000010	Landscaping and Irrigation	SF	$0.50	206543	$103,271.50

Sub-Total Division 02 : $1,307,662.66

DIVISION 03 : CONCRETE

Item ID	Item Description	Units	Unit Price	Quantity	Total
1320000010	Concrete Reinforcement	SF	$5.10	284540	$1,452,654.00
1330000010	Cast-in-Place Concrete	SF	$16.00	284540	$4,552,640.00

Sub-Total Division 03 : $6,005,294.00

DIVISION 04 : MASONRY

Item ID	Item Description	Units	Unit Price	Quantity	Total
1421000375	Face brick wall, 4" Giant clay brick 15-5/8" x 3-5/8" x 7-5/8", Veneer	SF	$5.65	284540	$1,608,241.00
1440000010	Exterior Stones	SF	$0.62	93603	$58,033.86

Sub-Total Division 04 : $1,666,274.86

DIVISION 05 : METALS

Item ID	Item Description	Units	Unit Price	Quantity	Total
1550000010	Metals Fabrications	SF	$1.00	284540	$284,540.00

Sub-Total Division 05 : $284,540.00

DIVISION 06 : WOOD AND PLASTICS

Item ID	Item Description	Units	Unit Price	Quantity	Total
1610000005	Rough Carpentry	SF	$0.43	160000	$68,800.00
1620000010	Finish Carpentry	SF	$0.59	76197	$44,956.23

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Figure 6.26 Take off List Generated by the System for Case 2 (1 of 3)

PROJECT NAME: University Marketplace | PROJECT OWNER : University of British Columbia | DATE : Sunday, January 16, 2000
PROJECT ADDRESS : Vancouver, B.C. | PROJECT AREA : 100000 Sq.ft | TIME : 1:36 PM

Sub-Total Division 06 : $113,756.23

DIVISION 07 : THERMAL AND MOISTURE PROTECTION

Item ID	Item Description	Units	Unit Price	Quantity	Total
0710000005	Waterproofing	SF	$0.39	124840	$48,687.60
0716000015	Dampproofing	SF	$0.06	124840	$7,490.40
0725000010	Sprayed fireproofing 2 hour fire rating, Structural steel members : Columns, large (meas	SF	$0.84	208643	$175,260.12
0727000005	Firestopping	SF	$0.10	284840	$28,484.00
0740000010	Performed Roofing and Siding	SF	$0.36	76197	$27,430.92
0750000010	Membrane Roofing and Flashing	SF	$2.90	160000	$464,000.00
0757000010	Traffic Coatings	SF	$1.15	124840	$143,566.00
0770000010	Roof Specialties and Accessories	ps	$1,000.00	1	$1,000.00
0790000010	Sealants	SF	$0.09	284840	$25,635.60

Sub-Total Division 07 : $921,554.64

DIVISION 08 : DOORS AND WINDOWS

Item ID	Item Description	Units	Unit Price	Quantity	Total
0810000005	Metals Doors and Frames	SF	$0.10	284840	$28,484.00
0820000005	Wood Doors and Frames	SF	$2.60	76197	$198,112.20
0830000005	Special Doors	SF	$0.07	208643	$14,605.01
0850000005	Metal Windows	SF	$5.04	76197	$384,032.88
0870000010	Hardware	SF	$0.29	284840	$82,033.92
0880000005	Glazing	SF	$0.05	284840	$14,242.00
0880000007	Glazed Aluminium Railing	SF	$0.35	76197	$26,668.95
0890000005	Curtain Walls	SF	$5.01	83803	$419,853.03

Sub-Total Division 08 : $1,168,031.99

DIVISION 09 : FINISHES

Item ID	Item Description	Units	Unit Price	Quantity	Total
0925000005	Steel Stud and Drywall	SF	$4.15	284840	$1,182,086.00
0930000010	Tile	SF	$1.42	76197	$108,199.74
0958000005	Carpet	SF	$1.60	76197	$121,915.20
0990000010	Painting	SF	$0.63	284840	$179,449.20

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Figure 6.27 Take off List Generated by the System for Case 2 (2 of 3)

PROJECT NAME: University Marketplace | PROJECT OWNER : University of British Columbia | DATE : Sunday, January 16, 2000
PROJECT ADDRESS : Vancouver, B.C. | PROJECT AREA : 100000 Sqft | TIME : 1:36 PM

Sub-Total Division 09 : $1,591,650.14

DIVISION 10 : SPECIALTIES

Item ID	Item Description	Units	Unit Price	Quantity	Total
1040000010	Identifying Devices	SF	$0.13	76197	$9,905.61
1053000010	Awning and Canopies	SF	$0.42	83803	$35,197.26
1055000010	Postal Specialties	SF	$0.05	76197	$3,809.85
1030000010	Toilet and Bath Accessories	SF	$0.17	76197	$12,953.49
1030000015	Closet specialties	SF	$0.09	76197	$6,857.73

Sub-Total Division 10 : $68,723.94

DIVISION 11 : EQUIPMENT

Item ID	Item Description	Units	Unit Price	Quantity	Total
1101400005	Window Washing Equipment	SF	$0.10	76197	$7,619.70
1116000000	LOADING DOCK EQUIPMENT	SF	$0.08	83803	$6,704.24
1145000010	Residential Appliances	SF	$3.88	76197	$295,644.36

Sub-Total Division 11 : $309,968.30

DIVISION 14 : CONVEYING SYSTEMS

Item ID	Item Description	Units	Unit Price	Quantity	Total
1421000030	Geared Passenger Elevator, Centre Opening, 3 floors	PR	$288,900.0	1	$288,900.00

Sub-Total Division 14 : $288,900.00

DIVISION 15 : MECHANICAL

Item ID	Item Description	Units	Unit Price	Quantity	Total
1500000000	Mechanical	ps	$1,909,000	1	$1,909,000.00

Sub-Total Division 15 : $1,909,000.00

DIVISION 16 : ELECTRICAL

Item ID	Item Description	Units	Unit Price	Quantity	Total
1600000000	Electrical	ps	$1,250,000	1	$1,250,000.00

Sub-Total Division 16 : $1,250,000.00

SUB - TOTAL : $16,899,922.66

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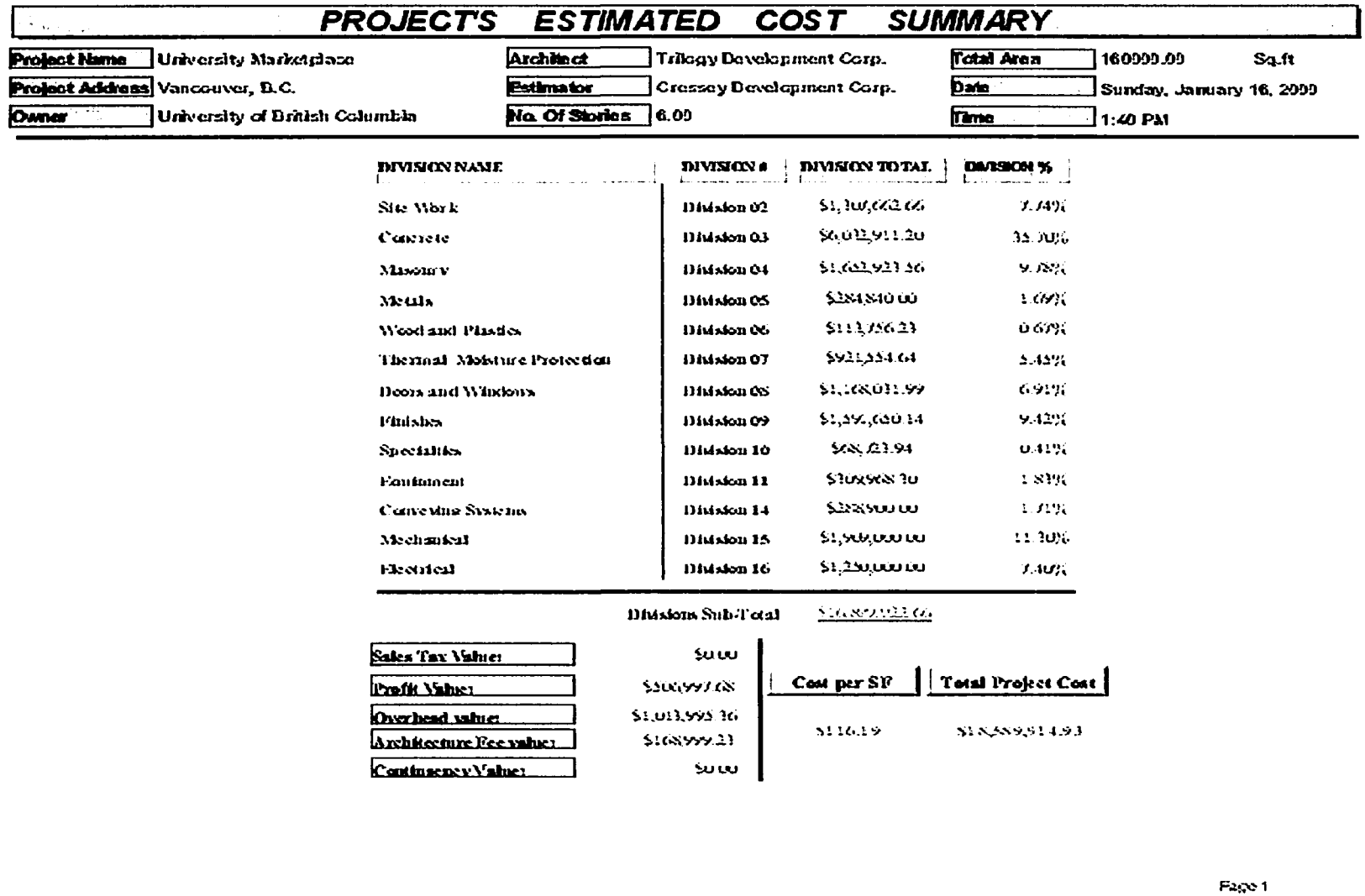
Figure 6.28 Take off List Generated by the System for Case 2 (3 of 3)



PROJECT'S ESTIMATED COST SUMMARY

Project Name	University Marketplace	Architect	Trilogy Development Corp.	Total Area	160000.00 Sq.ft
Project Address	Vancouver, B.C.	Estimator	Cressey Development Corp.	Date	Sunday, January 16, 2000
Owner	University of British Columbia	No. Of Stories	6.00	Time	1:40 PM

DIVISION NAME	DIVISION #	DIVISION TOTAL	DIVISION %
Site Work	Division 02	$1,300,662.66	7.49%
Concrete	Division 03	$6,032,911.20	35.00%
Masonry	Division 04	$1,662,923.56	9.65%
Metals	Division 05	$284,840.00	1.69%
Wood and Plastics	Division 06	$113,756.23	0.67%
Thermal Moisture Protection	Division 07	$921,554.64	5.45%
Doors and Windows	Division 08	$1,168,011.99	6.91%
Finishes	Division 09	$1,596,660.14	9.42%
Specialties	Division 10	$68,623.94	0.41%
Equipment	Division 11	$309,968.30	1.83%
Conveying Systems	Division 14	$288,900.00	1.71%
Mechanical	Division 15	$1,908,000.00	11.30%
Electrical	Division 16	$1,250,000.00	7.40%
	Division Sub-Total	$16,892,933.66	

		Cost per SF	Total Project Cost
Sales Tax Value:	$0.00		
Profit Value:	$506,997.98		
Overhead value:	$1,013,995.96	$116.19	$18,589,514.93
Architecture Fee value:	$168,999.33		
Contingency Value:	$0.00		

Page 1

Figure 6.29 Complete Summary Report for Case 2

PROJECT'S CHART DISTRIBUTION BY DIVISION TOTAL

Project Name	University Marketplace	Estimator	Creasey Development Corp.
Project Address	Vancouver, B.C.	No. Of Stories	3.00
Owner	University of British Columbi	Total Area	62458.00 Sq.ft
Architect	Trilogy Development Corp.	Date	Friday, January 14, 2000

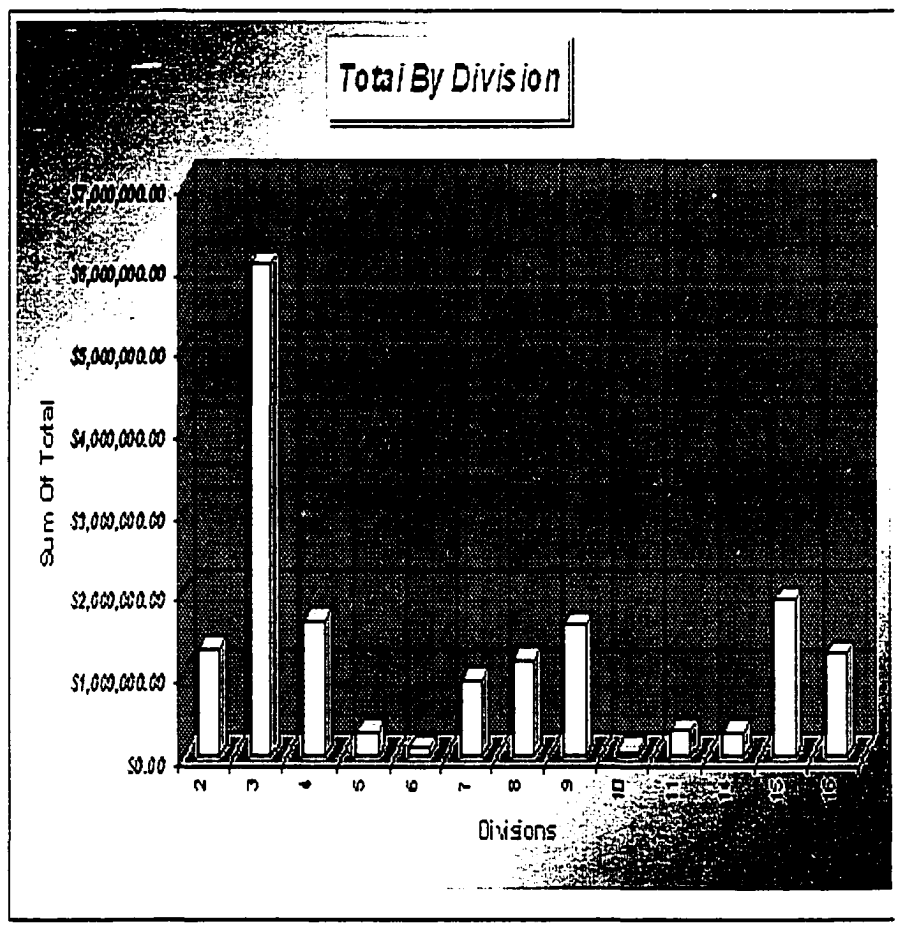


Figure 6.30 Histogram Report of Case 2

PROJECT'S PIE DISTRIBUTION BY DIVISION TOTAL

Project Name	University Marketplace	Estimator	Cressey Development Corp.
Project Address	Vancouver, B.C.	No. Of Stories	6
Owner	University of British Columbia	Total Area	62458.00 Sq.ft
Architect	Trilogy Development Corp.	Date	Friday, January 14, 2000

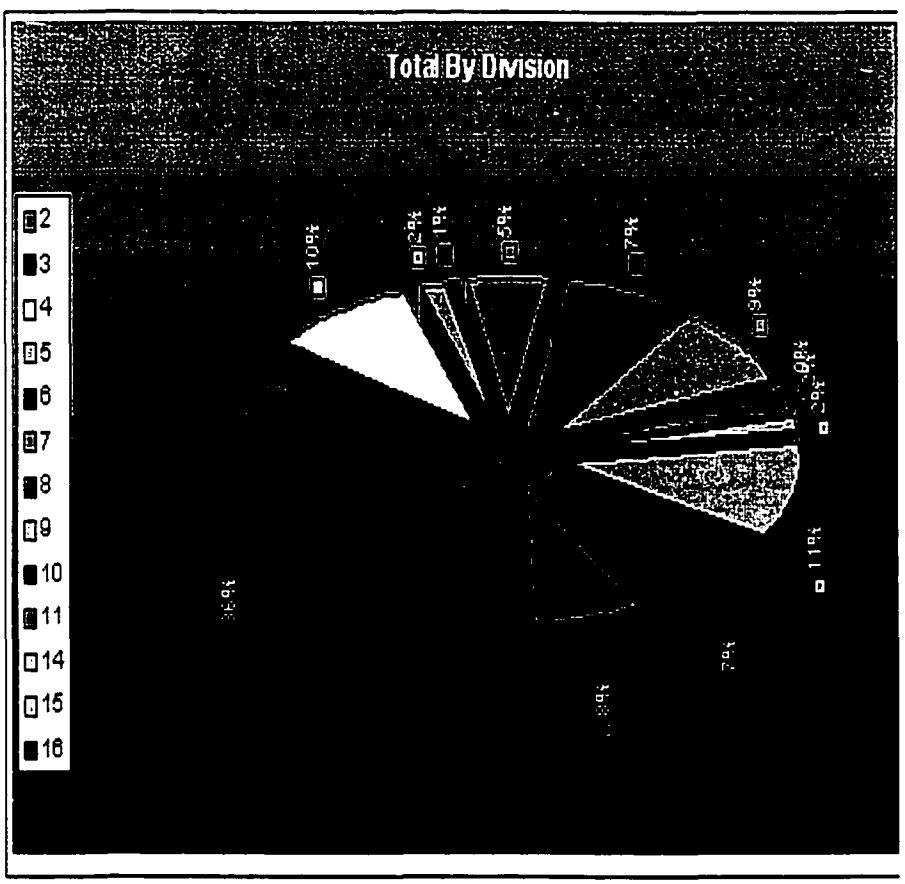


Figure 6.31 Pie Chart Report of Case 2

6.4 Conclusions

The developed computer system "CSC-Estimate" that conceptually estimates the costs of construction for commercial buildings is tested through actual projects. Two types of estimates are established depending on the available information of the project. Based on the model operation, the system has several useful features as follows:

- The system is designed and structured in a manner that allows future expansions and enhancements.
- User friendly, easy to use, efficient, and fast calculations.
- Ability to easy edit, add and modify the available data of all the database.
- Professional output reports that can be used for bidding purposes, and the ability to graphically visualize and print these reports either as pie or histogram chart.
- Exporting the generated estimates to a spreadsheet and a word processing document.

On the other hand, the system does have few limitations that can be improved in future work, including the followings:

- Once the generated preliminary estimates is accomplished, it has to be exported to either a spreadsheet or a word processing in order to be saved for future reference.
- The system cannot be used to prepare detailed estimates hence it would not be used for bidding purposes.

- When preparing parametric estimates the user has to manually perform the calculations necessary to adjust for project size and capacity.
- The user has to manually modify the cities indices supplied whenever new values are published.

CHAPTER 7

CONCLUSION AND FUTURE EXPANSION

7.1 Conclusion

Preparing construction cost estimates is a significant task during the life course of any project. To perform a reliable estimate requires, in addition to the skills and experience of cost engineers and estimators, the consideration of other factors. These include project drawings and specifications in conjunction with the cost data and tools used in preparing an estimate. The unavailability of a computer system that particularly serve the Canadian construction industry by producing estimates for commercial buildings necessitated the development of an efficient system to aid in producing estimate at conceptual stage. The main benefits of this system are its flexibility, simplicity and swift of calculations.

A computer system for conceptual cost estimation that enable owners, engineers and contractors prepare estimates in any of the eight major Canadian cities is developed and bestowed in this thesis. The system comprises imperial parametric estimate module, metric parametric estimate module and preliminary estimate module. The developed system databases have their cost data taken from Hanscomb's yardsticks for costing and possess number of interesting features and advantages, which include the following:

- A sole computer tool that is based on yardsticks for costing the only cost data for the Canadian construction industry.

- The ability to produce parametric and preliminary cost estimates in "imperial" and "metric" units.
- The cost data provided in the database do not have to be adjusted for location since they are based on quotations received from main suppliers in the eight major Canadian cities.
- It incorporates a fast, easy and flexible interface that minimizes the user input and reduces time required for costing the items.
- It consists of databases that contain information on previously executed projects in both "Masterformat" and "Uniformat" to be used for parametric estimates.
- It has a powerful capability to modify and store items' cost data for future use.
- Professional and graphical output reports can be generated fast.

It must be emphasized that the system is only used to prepare conceptual cost estimates for commercial building and all the cost data provided are based on market prices of January 1998 and considered for average rates and average conditions.

7.2 Research Contributions

The contributions of this research reside in the following:

- A unique conceptual cost estimate computer system has been developed that is in particular for the Canadian construction industry.
- An operational database system has been designed and implemented using windows environment and utilizing Microsoft access 97 and visual basic for

applications. This advances the field of MIS (Management Information System) applications in the construction industry, which is known to lack behind other industries in this area. This will aid practitioners in the construction industry to perform conceptual estimates within the short time available to study a project.

The developed system is intended to assist owners, engineers, and estimators in preparing fast, efficient, and reliable conceptual cost estimates. It provides the user with the option of selecting the type of cost data and unit to use. It reduces the time required to build costs list for the project activities so that this reduction can be beneficial for the quantity take off time process. It provides professional output reports that can be used for bidding purposes. It has the option of graphically producing reports, pie or histogram charts. The system includes a structured database, which can be extended, enhanced and modified depending on the user needs.

7.3 Future Research

Despite that this research introduces a functional system as a tool for cost engineers and estimators to use in preparing conceptual cost estimates for the Canadian construction industry, it is a platform that can be potentially enhanced by future works. These may include:

- Detailed cost database models so that the user will be able to prepare all types of estimates in accordance with the different phases of the project.

- Automatic integration between the detailed estimate and scheduling tools allowing the user to schedule the activities according to the crew productivity after generating the estimate.
- Expanding the parametric estimate models so that they can be integrated with a neural network to automatically generate and update cost indices to different cities without using periodical publications.
- Include more project cases in the system parametric database.
- Integration between AutoCAD and the detailed cost estimate databases model to enable the user to automate the quantity take off process directly from the drawings while preparing the estimate.
- Using neural networks or regressions to forecast the cost items of the preliminary cost estimate database model.

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APPENDIX (A)

SAMPLES CODING AND COST DATA OF R. S. MEANS AND YARDSTICKS

How to Use the Unit Price Pages

The following is a detailed explanation of a sample entry in the Unit Price Section. Next to each bold number below is the item being described with appropriate component of the sample entry following in parenthesis. Some prices are listed as bare costs, others as costs that include overhead and profit of the installing contractor. In most cases, if the work is to be subcontracted, the general contractor will need to add an additional markup (R.S. Means suggests using 10%) to the figures in the column "Total Incl. O&P."

Division Number/Title (033/Cost-in-Place Concrete)

Use the Unit Price Section Table of Contents to locate specific items. The sections are classified according to the CSI MasterFormat.

Line Numbers (033 130 0300)

Each unit price line item has been assigned a unique 10-digit code based on the 5-digit CSI MasterFormat classification.

MasterFormat Mediumscope
MasterFormat Division

033 130
033 130 0300

Means Subdivision
Means Major Classification
Means Individual Line Number

Description (CONCRETE IN PLACE, etc.) 5

Each line item is described in detail. Sub-items and additional sizes are indented beneath the appropriate line items. The first line or two after the main item (in boldface) may contain descriptive information that pertains to all line items beneath this boldface listing.

Items which include the symbol **CN** are updated in the Key Material Price Section of *Design Intelligence/The Change Notice* quarterly publication.

Reference Number Information 6

R033-010 You'll see reference numbers shown in bold squares at the beginning of some major classifications. These refer to related items in the Reference Section, visually identified by a vertical gray bar on the edge of pages.

The relation may be: (1) an estimating procedure that should be read before estimating, (2) an alternate pricing method, or (3) technical information.

The "R" designates the Reference Section. The numbers refer to the MasterFormat classification system.

It is strongly recommended that you review all reference numbers that appear within the major classification you are estimating.

Example: The square number above is directing you to refer to the reference number R033-010. This particular reference number shows quantities of concrete as well as forms and reinforcing per S.F. of floor area.

033 | Cast-In-Place Concret[illegible]

033 100 | Structural Concrete				CREW	DAILY OUTPUT	LABOR-HOURS	UNIT	1998 BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P	
126	0010	CONCRETE, READY MIX Regular weight											126
	0020	2000 psi					C.Y.	[illegible]			[illegible]	60	
	3700	[illegible]8 [illegible]b. per bag, add						30			30	33	
	3800	[illegible]. per bag, add						146			146	160	
130	0010	CONCR[illegible]CE Including forms (4 uses), reinforcing	R033-010										130
	0050	[illegible]											
	0300	Beams, 5 kip per L.F., 10' span	R033-[illegible]	C-14A	15.62	12.804	C.Y.	207	340	43	590	820	
	0350	25' span		"	18.55	10.782		179	286	36	501	690	
	0500	Chimney foundations, industrial, [illegible]	R033-[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	0510	Maximum			23.71	4.72[illegible]		140	119	1.56	260.56	[illegible]	
	0700	Columns, square, 12" x 12", [illegible] reinforcing	R033-[illegible]	[illegible]	[illegible]1.96	16.7[illegible]		206	445	56	707	[illegible]	
	0720	Average reinforcing			[illegible]0.13	19.7[illegible]		305	525	66	896	[illegible]	
	[illegible]	[illegible]			9.03	22.1[illegible]		390	590	74	1,054	[illegible]	
	0800	16" x 16", minimum reinforcing			16.22	12.330		176	325	41.50	542.50	765	
	0820	Average reinforcing							[illegible]	53.50	763.50	1,050	

1: HOW TO READ "CURRENT MARKET PRICES" METRIC ON P. 10–IMPERIAL P. 71

This is the Division number and category title. The line tells you whether the page is in metric or imperial.

Capitalized bold-face heading shows main Division category.

This heading in bold-face shows "broadscope" listing.

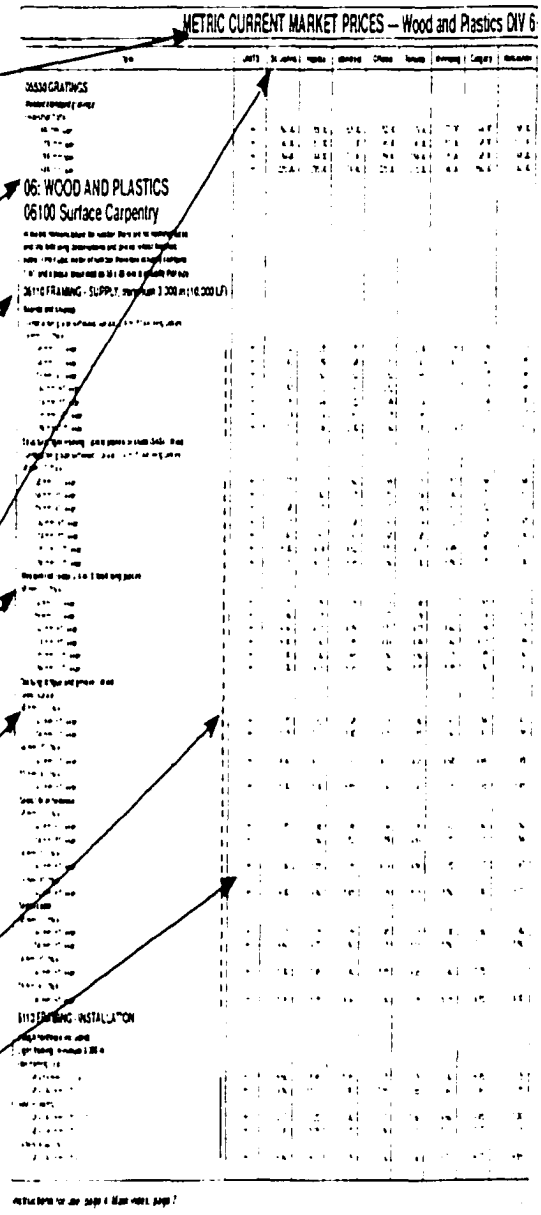
This line contains names of 8 major Canadian cities.

Lower-case bold-face listing of sub-category.

Regular type listings showing "narrowscope" listings.

Dotted line shows supply only, solid line shows installation only.

Column shows metric or imperial unit of measurement.



Prices are shown in dollars and cents if under $1,000; dollars only if over $1,000.

Unit prices are listed separately in **both metric and imperial**, using the Division format.

Prices are based on market prices current January 1998, and include all materials, labour to install, transportation, equipment costs and site overheads and profit for work normally done by subcontractors. Provincial taxes included where applicable, **GST excluded.**

Unit prices are for use in **approximate** construction cost estimating. Prices represent **average** rates for **average** conditions. Many variables influence construction costs at a given location and a given time – the reader must gauge these conditions. The reader must note that prices shown represent normal rather than optimum conditions where lower or higher prices prevail.

Hanscomb recommends obtaining budget quotes from subcontractors and suppliers for specific installations.

Use caution when using unit rates for negotiating change orders.

Item	UNITS	St. Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
Permanent washable type, metal frame:									
2" thick	SF	62.00	59.00	56.00	57.00	56.00	58.00	58.00	61.00
Electronic air cleaner									
Standard residential type	EA	1,510	1,420	1,370	1,380	1,370	1,400	1,410	1,480
Glass fibre, throwaway type									
12"x20"x20"	EA	3.49	3.30	3.18	3.21	3.18	3.24	3.27	3.43
24"x20"x20"	EA	5.65	5.35	5.15	5.20	5.15	5.25	5.30	5.55
15890 DUCT WORK									
Rigid ducts, sheet metal including cleats and normal suspension									
Galvanized steel	LB	5.30	5.10	4.79	4.84	4.79	4.88	4.86	5.15
Aluminum	LB	16.25	15.50	14.60	14.75	14.60	14.90	14.90	15.80
Stainless steel	LB	13.20	12.65	11.90	12.05	11.90	12.15	12.15	12.85
Flexible ducts, aluminum, insulated									
5" dia	LF	5.40	5.65	5.20	5.25	5.20	5.30	5.30	5.65
5" dia	LF	6.10	5.80	5.50	5.55	5.50	5.60	5.60	5.90
6" dia	LF	7.65	7.30	6.90	6.95	6.90	7.05	7.05	7.45
7" dia	LF	8.95	8.55	8.10	8.15	8.10	8.25	8.25	8.75
8" dia	LF	10.05	9.60	9.05	9.10	9.05	9.20	9.20	9.75
9" dia	LF	11.10	10.60	10.00	10.10	10.00	10.20	10.20	10.80
10" dia	LF	12.25	11.70	11.30	11.15	11.00	11.25	11.25	11.90
12" dia	LF	14.05	13.45	12.70	12.80	12.70	12.95	12.95	13.70
14" dia	LF	19.30	18.15	17.10	17.30	17.10	17.45	17.45	18.50
16" dia	LF	23.50	22.50	21.25	21.50	21.25	21.75	21.75	23.00
15940 OUTLETS									
Louvers									
Fresh and exhaust air									
Galvanized steel	SF	38.00	36.25	34.25	34.75	34.25	35.00	35.00	37.00
Aluminum	SF	45.50	43.50	41.00	41.50	41.00	42.00	42.00	44.25

16: ELECTRICAL

16050 Basic Materials and Methods

Material Price Carried At Trade

16110 RACEWAYS INSTALLED COMPLETE

Conduit

Embedded in slab excluding elbows and pull boxes:

Rigid galvanized steel									
1/2"	LF	4.15	3.97	3.63	3.73	3.71	3.73	3.71	4.08
3/4"	LF	4.92	4.70	4.31	4.42	4.40	4.42	4.40	4.84
1"	LF	6.80	6.50	5.95	6.10	6.05	6.10	6.05	6.65
1 1/4"	LF	8.75	8.35	7.65	7.85	7.80	7.85	7.80	8.60
1 1/2"	LF	10.90	10.40	9.55	9.75	9.75	9.75	9.75	10.70
2"	LF	13.80	13.20	12.10	12.40	12.35	12.40	12.35	13.55
E.M.T.									
1/2"	LF	2.57	2.46	2.25	2.31	2.30	2.31	2.30	2.53
3/4"	LF	3.48	3.33	3.05	3.12	3.11	3.12	3.11	3.42
1"	LF	4.70	4.49	4.11	4.22	4.20	4.22	4.20	4.62
1 1/4"	LF	6.80	6.50	5.95	6.10	6.10	6.10	6.10	6.70
1 1/2"	LF	7.80	7.45	6.85	7.00	6.95	7.00	6.95	7.65
2"	LF	9.65	9.40	8.65	8.85	8.80	8.85	8.80	9.70
Rigid pvc									
1/2"	LF	2.64	2.52	2.31	2.37	2.36	2.37	2.36	2.59
3/4"	LF	3.29	3.15	2.88	2.96	2.94	2.96	2.94	3.23
1"	LF	4.29	4.10	3.75	3.85	3.83	3.85	3.83	4.21
1 1/4"	LF	5.45	5.25	4.79	4.91	4.89	4.91	4.89	5.35
1 1/2"	LF	6.55	6.25	5.75	5.90	5.85	5.90	5.85	6.45
2"	LF	8.25	7.85	7.20	7.40	7.35	7.40	7.35	8.10
Surface mounted 8' average high one pull box, one elbow per 100 LF, and supports:									
Rigid galvanized steel									
1/2"	LF	4.79	4.57	4.19	4.29	4.27	4.29	4.27	4.70
3/4"	LF	5.65	5.40	4.95	5.10	5.05	5.10	5.05	5.55
1"	LF	8.25	7.85	7.20	7.40	7.35	7.40	7.35	8.10
1 1/4"	LF	10.80	10.30	9.45	9.70	9.65	9.70	9.65	10.60
1 1/2"	LF	13.45	12.85	11.80	12.10	12.00	12.10	12.00	13.25
2"	LF	16.45	15.75	14.40	14.80	14.70	14.80	14.70	16.15
2 1/2"	LF	28.50	27.25	25.00	25.50	25.50	25.50	25.50	28.00
3"	LF	38.00	36.50	33.25	34.25	34.00	34.25	34.00	37.50
3 1/2"	LF	47.75	45.50	41.75	42.75	42.50	42.75	42.50	46.75
4"	LF	58.00	55.00	50.00	52.00	51.00	52.00	51.00	57.00
5"	LF	112.00	107.00	98.00	100.00	100.00	100.00	100.00	110.00
6"	LF	137.00	131.00	120.00	123.00	123.00	123.00	123.00	135.00
E.M.T.									
1/2"	LF	3.47	3.31	3.03	3.11	3.09	3.11	3.09	3.40
3/4"	LF	4.53	4.33	3.96	4.06	4.04	4.06	4.04	4.45
1"	LF	5.60	5.35	4.91	5.05	5.00	5.05	5.00	5.50
1 1/4"	LF	8.30	7.95	7.30	7.45	7.45	7.45	7.45	8.15

DIV 16 Electrical — IMPERIAL CURRENT MARKET PRICES

Item	UNITS	St. Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
18" wide	LF	43.00	41.00	37.75	38.50	38.50	38.50	38.50	42.25
24" wide	LF	49.75	47.50	43.50	44.75	44.50	44.75	44.50	49.00
Aluminum									
6" wide	LF	41.25	39.50	36.25	37.00	37.00	37.00	37.00	40.50
12" wide	LF	43.25	41.50	38.00	39.00	38.75	39.00	38.75	42.50
18" wide	LF	52.00	50.00	45.75	46.75	46.75	46.75	46.75	51.00
24" wide	LF	60.00	57.00	53.00	54.00	54.00	54.00	54.00	59.00
Wiring channels									
Square section steel									
2 1/2" x 2 1/2"	LF	38.75	37.50	25.00	25.75	25.50	25.75	25.50	28.25
4" x 4"	LF	40.00	38.25	35.00	35.75	35.75	35.75	35.75	39.25
6" x 6"	LF	53.00	51.00	46.50	47.75	47.50	47.75	47.50	52.00
16110 UNDERGROUND SERVICES									
Concrete manholes									
5' x 5' single	EA	3,225	3,050	2,700	3,400	3,775	3,800	3,775	4,150
5' x 10' double	EA	7,800	7,400	6,800	7,000	6,900	7,000	6,900	7,600
Underground duct banks, 4" pvc pipe ducts & fittings including all excavation, concrete and backfilling									
in soft earth with backfill									
1 duct	LF	31.50	30.75	26.50	27.25	27.50	27.25	27.50	30.75
2 ducts	LF	56.00	53.00	46.50	49.75	49.50	49.75	49.50	55.00
3 ducts	LF	63.00	60.00	55.00	56.00	56.00	56.00	56.00	62.00
4 ducts	LF	93.00	89.00	82.00	84.00	83.00	84.00	83.00	92.00
5 ducts	LF	104.00	99.00	91.00	93.00	93.00	93.00	93.00	102.00
6 ducts	LF	109.00	104.00	96.00	98.00	98.00	98.00	98.00	107.00
7 ducts	LF	129.00	123.00	113.00	116.00	115.00	116.00	115.00	127.00
8 ducts	LF	140.00	134.00	122.00	126.00	125.00	125.00	125.00	137.00
9 ducts	LF	158.00	151.00	138.00	142.00	141.00	142.00	141.00	155.00
10 ducts	LF	177.00	170.00	155.00	159.00	158.00	159.00	158.00	174.00
11 ducts	LF	186.00	178.00	163.00	167.00	166.00	167.00	166.00	183.00
12 ducts	LF	196.00	187.00	171.00	175.00	174.00	175.00	174.00	192.00
13 ducts	LF	220.00	210.00	193.00	198.00	197.00	198.00	197.00	216.00
14 ducts	LF	230.00	220.00	200.00	205.00	205.00	205.00	205.00	225.00
15 ducts	LF	246.00	235.00	215.00	220.00	220.00	220.00	220.00	240.00
in soft earth with granular backfill									
1 duct	LF	55.00	52.00	48.00	49.25	49.00	49.25	49.00	54.00
2 ducts	LF	72.00	68.00	63.00	64.00	64.00	64.00	64.00	70.00
3 ducts	LF	82.00	78.00	72.00	74.00	74.00	74.00	74.00	81.00
4 ducts	LF	120.00	115.00	105.00	108.00	107.00	108.00	107.00	118.00
5 ducts	LF	133.00	127.00	116.00	119.00	118.00	119.00	118.00	130.00
6 ducts	LF	142.00	135.00	124.00	127.00	126.00	127.00	126.00	139.00
7 ducts	LF	172.00	164.00	151.00	154.00	154.00	154.00	154.00	169.00
8 ducts	LF	185.00	176.00	162.00	166.00	165.00	166.00	165.00	181.00
9 ducts	LF	199.00	190.00	174.00	179.00	178.00	179.00	178.00	195.00
10 ducts	LF	220.00	210.00	193.00	198.00	197.00	198.00	197.00	216.00
11 ducts	LF	235.00	225.00	205.00	210.00	210.00	210.00	210.00	230.00
12 ducts	LF	250.00	240.00	220.00	225.00	225.00	225.00	225.00	245.00
13 ducts	LF	265.00	270.00	250.00	255.00	255.00	255.00	255.00	280.00
14 ducts	LF	300.00	285.00	260.00	265.00	265.00	265.00	265.00	290.00
15 ducts	LF	315.00	300.00	275.00	280.00	280.00	280.00	280.00	310.00
in soft rock with granular backfill									
1 duct	LF	69.00	66.00	60.00	62.00	61.00	62.00	61.00	68.00
2 ducts	LF	86.00	82.00	75.00	77.00	77.00	77.00	77.00	84.00
3 ducts	LF	93.00	89.00	82.00	84.00	83.00	84.00	83.00	92.00
4 ducts	LF	149.00	142.00	130.00	133.00	133.00	133.00	133.00	146.00
5 ducts	LF	170.00	163.00	149.00	153.00	152.00	153.00	152.00	167.00
6 ducts	LF	174.00	166.00	152.00	156.00	155.00	156.00	155.00	171.00
7 ducts	LF	200.00	192.00	176.00	180.00	179.00	180.00	179.00	197.00
8 ducts	LF	215.00	205.00	190.00	195.00	194.00	195.00	194.00	215.00
9 ducts	LF	240.00	230.00	210.00	215.00	215.00	215.00	215.00	235.00
10 ducts	LF	270.00	260.00	240.00	245.00	245.00	245.00	245.00	270.00
11 ducts	LF	280.00	270.00	245.00	250.00	250.00	250.00	250.00	275.00
12 ducts	LF	295.00	280.00	255.00	265.00	260.00	265.00	260.00	290.00
13 ducts	LF	320.00	305.00	280.00	285.00	285.00	285.00	285.00	315.00
14 ducts	LF	330.00	315.00	290.00	300.00	295.00	300.00	295.00	325.00
15 ducts	LF	345.00	330.00	305.00	310.00	310.00	310.00	310.00	340.00
16110/20 FEEDER CIRCUIT									
70-500 A (support and fittings included, exposed installation, copper conductors)									
Rigid galvanized conduit									
70 A, 3 wire	LF	12.30	11.75	10.75	11.35	10.95	11.05	10.95	12.05
70 A, 4 wire	LF	16.05	15.35	14.05	14.40	14.35	14.40	14.35	15.75
105 A, 3 wire	LF	18.10	17.30	15.85	16.25	16.15	16.25	16.15	17.75
105 A, 4 wire	LF	27.75	26.75	19.10	19.60	19.50	19.60	19.50	21.50
155 A, 3 wire	LF	28.75	27.50	25.50	25.75	25.50	25.75	25.50	28.25
155 A, 4 wire	LF	32.50	31.00	28.50	29.00	29.00	29.00	29.00	31.75
210 A, 3 wire	LF	34.25	32.50	29.75	30.75	30.50	30.75	30.50	33.50
210 A, 4 wire	LF	51.00	49.00	44.75	46.00	45.75	46.00	45.75	50.00
100 A, 3 wire	LF	56.00	53.00	48.75	50.00	49.75	50.00	49.75	55.00

Item	UNITS	St. Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
300 A, 4 wire	LF	73.00	70.00	64.00	66.00	66.00	66.00	66.00	72.00
400 A, 3 wire	LF	79.00	75.00	69.00	72.00	72.00	72.00	72.00	77.00
400 A, 4 wire	LF	104.00	99.00	91.00	93.00	93.00	93.00	93.00	102.00
500 A, 3 wire	LF	111.00	106.00	97.00	100.00	99.00	100.00	99.00	109.00
500 A, 4 wire	LF	196.00	188.00	172.00	176.00	175.00	176.00	175.00	193.00
E.M.T. conduit									
70 A, 3 wire	LF	8.55	8.15	7.45	7.65	7.60	7.65	7.60	8.40
70 A, 4 wire	LF	11.45	10.95	10.00	10.25	10.20	10.25	10.20	11.25
105 A, 3 wire	LF	12.35	11.80	10.85	11.10	11.05	11.10	11.05	12.15
105 A, 4 wire	LF	15.80	15.10	13.80	14.15	14.10	14.15	14.10	15.60
155 A, 3 wire	LF	19.10	18.25	16.75	17.15	17.05	17.15	17.05	18.80
155 A, 4 wire	LF	22.75	21.75	20.00	20.50	20.50	20.50	20.50	22.50
210 A, 3 wire	LF	25.25	24.25	22.00	22.75	22.50	22.75	22.50	24.75
210 A, 4 wire	LF	38.00	36.25	33.25	34.00	33.75	34.00	33.75	37.25
300 A, 3 wire	LF	43.25	41.50	38.00	39.00	38.75	39.00	38.75	42.50
300 A, 4 wire	LF	64.00	62.00	57.25	58.50	58.25	58.50	58.25	63.00
405 A, 3 wire	LF	59.00	56.00	52.00	53.00	53.00	53.00	53.00	58.00
405 A, 4 wire	LF	84.00	80.00	74.00	76.00	75.00	76.00	75.00	82.00
500 A, 3 wire	LF	104.00	99.00	91.00	93.00	93.00	93.00	93.00	102.00
16120 CONDUCTORS									
Building wire installed in conduit									
Rw-90 copper									
No. 14	CLF	37.00	35.25	32.50	33.25	33.00	33.25	33.00	36.25
No. 12	CLF	48.50	46.50	42.50	43.50	43.25	43.50	43.25	47.75
No. 10	CLF	66.00	63.00	58.00	59.00	59.00	59.00	59.00	65.00
No. 8	CLF	97.00	92.00	85.00	87.00	86.00	87.00	86.00	95.00
No. 6	CLF	127.00	122.00	111.00	114.00	114.00	114.00	114.00	125.00
No. 4	CLF	146.00	140.00	128.00	131.00	130.00	131.00	130.00	143.00
No. 3	CLF	220.00	215.00	195.00	200.00	199.00	200.00	199.00	220.00
No. 2	CLF	280.00	270.00	245.00	255.00	250.00	255.00	250.00	275.00
No. 1	CLF	320.00	305.00	290.00	290.00	286.00	290.00	286.00	315.00
No. 1/0	CLF	390.00	375.00	340.00	350.00	350.00	350.00	350.00	385.00
No. 2/0	CLF	475.00	455.00	415.00	425.00	425.00	425.00	425.00	465.00
No. 3/0	CLF	560.00	535.00	490.00	505.00	500.00	505.00	500.00	550.00
No. 4/0	CLF	675.00	645.00	590.00	605.00	605.00	605.00	605.00	665.00
250 mcm	CLF	800.00	765.00	700.00	715.00	715.00	715.00	715.00	785.00
300 mcm	CLF	975.00	935.00	850.00	875.00	870.00	875.00	870.00	960.00
350 mcm	CLF	1 040	1 000	915.00	935.00	935.00	935.00	935.00	1 030
400 mcm	CLF	1 150	1 100	1 000	1 030	1 030	1 030	1 020	1 130
500 mcm	CLF	1 360	1 300	1 190	1 220	1 210	1 220	1 210	1 330
600 mcm	CLF	1 660	1 590	1 460	1 490	1 490	1 490	1 490	1 630
750 mcm	CLF	2 050	1 950	1 780	1 830	1 820	1 830	1 820	2 000
1000 mcm	CLF	2 575	2 475	2 250	2 325	2 300	2 325	2 300	2 525
Rw-90 aluminum									
No. 1	CLF	205.00	194.00	178.00	182.00	181.00	182.00	181.00	199.00
No. 1/0	CLF	240.00	230.00	210.00	215.00	214.00	215.00	214.00	240.00
No. 2/0	CLF	280.00	265.00	245.00	250.00	250.00	250.00	250.00	275.00
No. 3/0	CLF	350.00	335.00	310.00	315.00	315.00	315.00	315.00	345.00
No. 4/0	CLF	425.00	405.00	370.00	380.00	380.00	380.00	380.00	415.00
250 mcm	CLF	480.00	460.00	420.00	430.00	430.00	430.00	430.00	475.00
300 mcm	CLF	555.00	530.00	485.00	495.00	495.00	495.00	495.00	545.00
350 mcm	CLF	655.00	625.00	575.00	590.00	585.00	590.00	585.00	645.00
400 mcm	CLF	760.00	725.00	665.00	680.00	680.00	680.00	680.00	745.00
500 mcm	CLF	845.00	805.00	740.00	760.00	755.00	760.00	755.00	830.00
600 mcm	CLF	930.00	890.00	815.00	835.00	830.00	835.00	830.00	915.00
750 mcm	CLF	1 150	1 100	1 010	1 030	1 030	1 030	1 030	1 130
1000 mcm	CLF	1 600	1 520	1 400	1 430	1 420	1 430	1 420	1 570
Cortex, single copper conductor, low tension, 600 V pvc jacket									
No. 1/0	LF	4.93	4.71	4.32	4.43	4.40	4.43	4.40	4.84
No. 2/0	LF	5.35	5.10	4.67	4.79	4.77	4.79	4.77	5.25
No. 3/0	LF	5.75	5.50	5.05	5.15	5.15	5.15	5.15	5.65
No. 4/0	LF	7.00	6.70	6.10	6.30	6.25	6.30	6.25	6.85
250 mcm	LF	6.55	6.30	5.75	5.90	5.85	5.90	5.85	6.45
300 mcm	LF	8.20	7.85	7.15	7.35	7.30	7.35	7.30	8.05
350 mcm	LF	8.90	8.45	8.65	8.90	8.85	8.90	8.85	9.70
400 mcm	LF	10.65	10.20	9.35	9.55	9.55	9.55	9.55	10.50
500 mcm	LF	12.30	11.75	10.75	11.05	10.95	11.05	10.95	12.05
High tension, 5 kV single copper conductor, x-link shielded pvc									
No. 6	LF	3.62	3.46	3.17	3.25	3.23	3.25	3.23	3.55
No. 5	LF	3.86	3.69	3.38	3.46	3.44	3.46	3.44	3.79
No. 4	LF	4.47	4.27	3.91	4.01	3.99	4.01	3.99	4.39
No. 2	LF	5.45	5.20	4.75	4.87	4.85	4.87	4.85	5.35
No. 1	LF	5.85	5.60	5.15	5.25	5.25	5.25	5.25	5.75
No. 1/0	LF	6.80	6.45	5.95	6.10	6.05	6.10	6.05	6.65
No. 2/0	LF	8.10	7.75	7.10	7.30	7.25	7.30	7.25	7.95
No. 3/0	LF	9.45	9.05	8.30	8.50	8.45	8.50	8.45	9.30
No. 4/0	LF	10.90	10.45	9.55	9.80	9.75	9.80	9.75	10.75
250 mcm	LF	11.70	11.15	10.25	10.50	10.45	10.50	10.45	11.50
300 mcm	LF	12.65	12.05	11.05	11.35	11.30	11.35	11.30	12.40

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Item	UNITS	St. Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
50 A receptacles									
Range and dryer type									
4 wire, 120/240 V	EA	87.00	93.00	85.00	87.00	87.00	87.00	87.00	95.00
16400 Service and Distribution									
16440 DISCONNECTS									
Switches, fusible type, without fuses (individual mounting)									
600 V									
30 A 2 poles 2 W	EA	194.00	185.00	170.00	174.00	173.00	174.00	173.00	190.00
30 A 3 poles 3 W	EA	200.00	193.00	176.00	181.00	180.00	181.00	180.00	198.00
30 A 3 poles 4 W	EA	220.00	210.00	191.00	196.00	195.00	196.00	195.00	215.00
60 A 2 poles 2 W	EA	225.00	215.00	196.00	200.00	200.00	200.00	200.00	220.00
60 A 3 poles 3 W	EA	240.00	230.00	210.00	215.00	215.00	215.00	215.00	235.00
60 A 3 poles 4 W	EA	265.00	250.00	230.00	235.00	235.00	235.00	235.00	260.00
100 A 2 poles 2 W	EA	380.00	365.00	335.00	340.00	340.00	340.00	340.00	375.00
100 A 3 poles 3 W	EA	400.00	380.00	350.00	355.00	355.00	355.00	355.00	390.00
100 A 3 poles 4 W	EA	425.00	405.00	370.00	380.00	380.00	380.00	380.00	420.00
200 A 2 poles 2 W	EA	615.00	590.00	540.00	555.00	550.00	555.00	550.00	605.00
200 A 3 poles 3 W	EA	635.00	605.00	555.00	570.00	565.00	570.00	565.00	620.00
200 A 3 poles 4 W	EA	690.00	660.00	605.00	620.00	615.00	620.00	615.00	675.00
400 A 2 poles 2 W	EA	1 490	1 420	1 300	1 340	1 330	1 340	1 330	1 460
400 A 3 poles 3 W	EA	1 530	1 470	1 340	1 380	1 370	1 380	1 370	1 510
400 A 3 poles 4 W	EA	1 660	1 580	1 450	1 490	1 480	1 490	1 480	1 630
600 A 2 poles 2 W	EA	1 980	1 890	1 730	1 780	1 770	1 780	1 770	1 950
600 A 3 poles 3 W	EA	2 025	1 930	1 760	1 810	1 800	1 810	1 800	1 980
600 A 3 poles 4 W	EA	2 150	2 050	1 870	1 920	1 910	1 920	1 910	2 100
800 A 2 poles 2 W	EA	3 525	3 375	3 075	3 175	3 150	3 175	3 150	3 475
800 A 3 poles 3 W	EA	3 525	3 375	3 075	3 175	3 150	3 175	3 150	3 475
800 A 3 poles 4 W	EA	3 825	3 675	3 350	3 450	3 425	3 450	3 425	3 775
1200 A 2 poles 2 W	EA	4 600	4 375	4 025	4 125	4 100	4 125	4 100	4 500
1200 A 3 poles 3 W	EA	4 600	4 375	4 025	4 125	4 100	4 125	4 100	4 500
1200 A 3 poles 4 W	EA	5 100	4 850	4 425	4 550	4 525	4 550	4 525	4 975
Switches, non fusible									
250 or 600 V									
30 A 2 poles 2 W	EA	161.00	154.00	141.00	145.00	144.00	145.00	144.00	158.00
30 A 3 poles 3 W	EA	169.00	162.00	148.00	152.00	151.00	152.00	151.00	166.00
30 A 3 poles 4 W	EA	186.00	178.00	163.00	167.00	166.00	167.00	166.00	183.00
60 A 2 poles 2 W	EA	186.00	178.00	163.00	167.00	166.00	167.00	166.00	183.00
60 A 3 poles 3 W	EA	205.00	196.00	177.00	182.00	181.00	182.00	181.00	199.00
60 A 3 poles 4 W	EA	240.00	230.00	210.00	215.00	215.00	215.00	215.00	235.00
100 A 2 poles 2 W	EA	310.00	295.00	270.00	275.00	275.00	275.00	275.00	305.00
100 A 3 poles 3 W	EA	325.00	310.00	285.00	290.00	290.00	290.00	290.00	320.00
100 A 3 poles 4 W	EA	340.00	325.00	295.00	300.00	300.00	300.00	300.00	335.00
200 A 2 poles 2 W	EA	570.00	540.00	495.00	505.00	505.00	505.00	505.00	555.00
200 A 3 poles 3 W	EA	590.00	565.00	515.00	525.00	525.00	525.00	525.00	580.00
200 A 3 poles 4 W	EA	640.00	610.00	560.00	570.00	570.00	570.00	570.00	630.00
400 A 2 poles 2 W	EA	1 220	1 170	1 070	1 100	1 090	1 100	1 090	1 200
400 A 3 poles 3 W	EA	1 290	1 230	1 130	1 160	1 150	1 160	1 150	1 270
400 A 3 poles 4 W	EA	1 380	1 320	1 210	1 240	1 230	1 240	1 230	1 360
600 A 2 poles 2 W	EA	1 610	1 540	1 410	1 450	1 440	1 450	1 440	1 590
600 A 3 poles 3 W	EA	1 660	1 580	1 450	1 490	1 480	1 490	1 480	1 630
600 A 3 poles 4 W	EA	1 780	1 700	1 560	1 600	1 590	1 600	1 590	1 750
800 A 2 poles 2 W	EA	2 800	2 775	2 550	2 625	2 600	2 625	2 600	2 850
800 A 3 poles 3 W	EA	2 875	2 825	2 600	2 675	2 650	2 675	2 650	2 925
800 A 3 poles 4 W	EA	3 250	3 100	2 850	2 925	2 900	2 925	2 900	3 200
1200 A 2 poles 2 W	EA	3 875	3 700	3 375	3 475	3 450	3 475	3 450	3 800
1200 A 3 poles 3 W	EA	3 875	3 700	3 375	3 475	3 450	3 475	3 450	3 800
1200 A 3 poles 4 W	EA	4 150	3 950	3 625	3 725	3 700	3 725	3 700	4 075
Splitters troughs									
125 A									
3", 3 poles	EA	170.00	162.00	149.00	153.00	152.00	153.00	152.00	167.00
3", 4 poles	EA	220.00	210.00	193.00	198.00	197.00	198.00	197.00	215.00
225 A									
3", 3 poles	EA	240.00	260.00	235.00	240.00	240.00	240.00	240.00	265.00
3", 4 poles	EA	365.00	350.00	320.00	330.00	325.00	330.00	325.00	360.00
400 A									
3", 3 poles	EA	495.00	475.00	435.00	445.00	440.00	445.00	440.00	485.00
3", 4 poles	EA	640.00	615.00	560.00	575.00	575.00	575.00	575.00	630.00
600 A									
3", 3 poles	EA	845.00	835.00	740.00	760.00	755.00	760.00	755.00	830.00
3", 4 poles	EA	1 060	1 010	925.00	950.00	945.00	950.00	945.00	1 040
Splitter boxes									
125 A									
3 poles	EA	160.00	143.00	131.00	134.00	134.00	134.00	134.00	147.00
4 poles	EA	191.00	183.00	167.00	172.00	171.00	172.00	171.00	188.00
225 A									
3 poles	EA	230.00	220.00	200.00	205.00	205.00	205.00	205.00	225.00
4 poles	EA	295.00	285.00	260.00	265.00	265.00	265.00	265.00	290.00

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DIV 15 Mechanical — IMPERIAL CURRENT MARKET PRICES

Item	UNITS	St. Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
Specialties									
Siamese pumper connection									
4" x 2 1/2"	EA	800.00	750.00	720.00	735.00	715.00	730.00	730.00	785.00
Check valve, 4" dia	EA	535.00	500.00	485.00	490.00	480.00	485.00	485.00	525.00
Double gate and check valves, assembly with bronze trimmings									
4" dia	EA	7,400	6,900	6,700	6,800	6,600	6,700	6,700	7,300
15400 Plumbing									
15430 PLUMBING SPECIALTIES									
Fixture chair carriers									
Lavatory	EA	205.00	191.00	184.00	186.00	182.00	187.00	187.00	198.00
Water closet	EA	340.00	315.00	305.00	310.00	300.00	310.00	310.00	330.00
Urinal	EA	175.00	164.00	158.00	160.00	156.00	161.00	161.00	170.00
Wall hydrants non-freeze type 3/4" dia., 12" wall including 15' of connecting pipe									
Exposed	EA	435.00	435.00	420.00	420.00	415.00	415.00	435.00	455.00
Concealed	EA	565.00	530.00	510.00	515.00	505.00	520.00	520.00	550.00
Trap primer including 25' type I, 1/2" copper pressure pipe									
Bronze, 1/2" dia	EA	360.00	340.00	325.00	330.00	320.00	330.00	330.00	350.00
Floor drain including 10' of connecting drainage pipe									
Cast iron body, nickle bronze top									
2"	EA	255.00	240.00	230.00	235.00	230.00	235.00	235.00	250.00
3"	EA	255.00	240.00	230.00	235.00	230.00	235.00	235.00	250.00
4"	EA	290.00	275.00	265.00	265.00	260.00	270.00	270.00	285.00
Funnel type, cast iron body, polished brass top									
2"	EA	360.00	340.00	325.00	330.00	320.00	330.00	330.00	350.00
3"	EA	360.00	340.00	325.00	330.00	320.00	330.00	330.00	350.00
4"	EA	390.00	365.00	350.00	355.00	350.00	360.00	360.00	380.00
Trench grating									
Medium duty galden duct alloy, grate and frame									
6"	LF	89.00	83.00	80.00	81.00	79.00	82.00	82.00	86.00
12"	LF	138.00	130.00	125.00	126.00	124.00	127.00	127.00	135.00
15"	LF	147.00	138.00	133.00	134.00	132.00	135.00	135.00	143.00
Heavy duty galden duct alloy, grate and frame									
12"	LF	154.00	145.00	139.00	141.00	138.00	142.00	142.00	150.00
Extra heavy duty galden duct alloy, grate and frame									
9"	LF	146.00	136.00	131.00	132.00	130.00	134.00	134.00	142.00
15"	LF	260.00	245.00	235.00	240.00	235.00	240.00	240.00	255.00
Roof drains including 10' of connecting drainage pipe									
Cast iron body with underdeck clamp									
2"	EA	320.00	300.00	290.00	290.00	285.00	295.00	295.00	310.00
3"	EA	320.00	300.00	290.00	290.00	285.00	295.00	295.00	310.00
4"	EA	330.00	310.00	300.00	300.00	295.00	305.00	305.00	325.00
6"	EA	440.00	425.00	405.00	410.00	400.00	410.00	410.00	435.00
Cast iron body metal flow with underdeck clamp									
2"	EA	420.00	395.00	380.00	380.00	375.00	385.00	385.00	410.00
3"	EA	420.00	395.00	380.00	380.00	375.00	385.00	385.00	410.00
4"	EA	455.00	425.00	410.00	415.00	405.00	420.00	420.00	440.00
6"	EA	565.00	530.00	510.00	515.00	505.00	520.00	520.00	550.00
Cleanouts									
Galvanized with cut-off caulking ferrule and nickle bronze cover									
2"	EA	179.00	168.00	162.00	163.00	160.00	165.00	165.00	175.00
3"	EA	179.00	168.00	162.00	163.00	160.00	165.00	165.00	175.00
4"	EA	179.00	168.00	162.00	163.00	160.00	165.00	165.00	175.00
6"	EA	280.00	260.00	250.00	255.00	250.00	255.00	255.00	270.00
15440 PLUMBING FIXTURES									
Based on white fixture including plumbing brass and 15' of connecting pipe for each service, carrier not included.									
Non-refrigerated drinking fountains									
Vitreous china									
Wall hung 12" x 13"	EA	1,040	990.00	955.00	965.00	945.00	955.00	970.00	1,020
Semi-recessed									
15" x 26.5"	EA	1,210	1,160	1,110	1,120	1,100	1,120	1,140	1,190
Fibreglass									
Wall hung 14" x 10"	EA	1,000	960.00	925.00	935.00	915.00	930.00	945.00	985.00
Semi-recessed									
16" x 28"	EA	1,130	1,070	1,030	1,040	1,020	1,040	1,060	1,110
Bathtubs									
Cast iron enamelled, recessed									
5' long	EA	2,825	2,700	2,600	2,630	2,580	2,625	2,650	2,775
Steel enamelled, recessed									
5' long	EA	1,860	1,800	1,730	1,750	1,720	1,750	1,760	1,850
Fibreglass, one piece with sidewalls									
5' long	EA	2,625	2,500	2,425	2,450	2,375	2,425	2,450	2,575
Kitchen sinks									
Stainless steel									
Single bowl, 20" x 20" x 7"	EA	475.00	330.00	695.00	495.00	640.00	495.00	475.00	460.00
Double bowl, 20" x 33" x 7"	EA	1,110	1,060	1,020	1,030	1,000	1,030	1,040	1,090

Item	UNITS	St. Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
15850 Air Distribution									
15855 CENTRAL AIR HANDLING UNITS									
Central station modular units, with insulated casing, fans motors and drives, heating and cooling coils, with filters, humidifier and mixing box. Automatic controls not included.									
Low pressure type:									
1 500 cfm	EA	10 500	10,000	9,600	9 700	9 600	9 600	9 900	10,300
3 000 cfm	EA	14 600	13,900	13,300	13,400	13 300	13 600	13,700	14 300
6,000 cfm	EA	19 900	18,900	18,100	18,300	18,100	18 500	18,700	19 600
10 000 cfm	EA	25 300	23,900	23,000	23,200	23,000	23 400	23,700	24 800
Medium pressure type									
15,000 cfm	EA	40 200	38,000	36,600	36 900	36 600	37 300	37 700	39 500
20,000 cfm	EA	52 000	49,200	47 300	47 700	47 300	48 200	48,700	51 100
30 000 cfm	EA	72 500	68,600	65,300	66 600	65 300	67 200	67 300	71 200
Multizone units, pre-assembled unit, with casing, fans, motors and drives, heating and cooling coils, mixing box with filter section, zone damper section, humidifier. Automatic controls are not included.									
Low pressure blow through unit									
3,000 cfm 8 zones	EA	12 600	11,900	11 400	11 500	11 400	11 700	11 800	12 300
6,000 cfm 8 zones	EA	18 500	17 500	16 800	17 000	16 800	17 100	17 300	18 100
Medium pressure blow through unit									
10,000 cfm, 12 zones	EA	25,900	24 500	23 600	23,800	23,600	24 100	24 300	25 500
15,000 cfm, 12 zones	EA	34 200	32 400	31 100	31 400	31,100	31 700	32,000	33,600
15860 FANS									
Vane axial fans, for suspended mounting									
Direct connected tubular belt driven fan class 1									
3,000 cfm	EA	2,400	2 275	2,200	2,200	2 200	2 225	2,250	2 375
5,000 cfm	EA	2 775	2 625	2,525	2,550	2,525	2 575	2 600	2 725
7,000 cfm	EA	3,200	3 025	2,900	2,950	2,900	2 975	3,000	3 150
10 000 cfm	EA	4 175	4 525	4 350	4 400	4 350	4 450	4 475	4 700
15,000 cfm	EA	5,900	5 600	5,400	5,400	5 400	5 500	5 500	5 800
20,000 cfm	EA	8,500	8,000	7,700	7 800	7,700	7 900	8,000	8,300
Propeller fans									
Direct driven through the wall plate type, unit not including exhaust wall shutter									
12" dia., 1,000 cfm	EA	640 00	605 00	580 00	590 00	580 00	595 00	600 00	630 00
16" dia., 2,000 cfm	EA	740 00	700 00	675 00	680 00	675 00	690 00	695 00	730 00
24" dia., 5,000 cfm	EA	920 00	870 00	835 00	845 00	835 00	850 00	860 00	900 00
30" dia., 9,000 cfm	EA	1 030	975 00	930 00	940 00	930 00	950 00	960 00	1 010
36" dia., 15,000 cfm	EA	1 590	1,500	1 440	1 460	1 440	1 470	1 490	1 560
42" dia., 20,000 cfm	EA	2,900	2,725	2 625	2,650	2,625	2 675	2 700	2 825
48" dia., 30,000 cfm	EA	3 975	3,750	3 600	3 650	3 600	3 675	3,725	3 900
54" dia., 40,000 cfm	EA	4 075	3 850	3,700	3,750	3,700	3 775	3,825	4 000
60" dia., 50,000 cfm	EA	5,200	4 875	4 675	4 725	4 675	4 775	4 825	5 100
72" dia., 60 000 cfm	EA	7,300	6 900	6 600	6 700	6 600	6 700	6 800	7 100
Roof exhaust fans, back draft damper, prefabricated curb and speed controller not included:									
Centrifugal, aluminum direct drive									
200 cfm	EA	590 00	555 00	535 00	540 00	535 00	545 00	550 00	580 00
420 cfm	EA	615 00	585 00	560 00	565 00	560 00	575 00	580 00	605 00
630 cfm	EA	665 00	625 00	605 00	610 00	605 00	615 00	620 00	650 00
850 cfm	EA	730 00	690 00	665 00	670 00	665 00	680 00	685 00	715 00
1 480 cfm	EA	1 230	1 170	1 130	1 140	1 130	1 150	1 160	1 210
2,330 cfm	EA	1 550	1 470	1 410	1 430	1 410	1 440	1 450	1 520
Centrifugal, aluminum, belt driven									
630 cfm	EA	1 370	1 300	1 250	1 260	1 250	1 270	1 280	1 350
1 270 cfm	EA	1 400	1 330	1 280	1 290	1 280	1 300	1 320	1 380
1 910 cfm	EA	1 840	1 740	1 670	1 690	1 670	1 700	1 720	1 800
4 240 cfm	EA	2 950	2 775	2 675	2 700	2 675	2 725	2,750	2 900
6,000 cfm	EA	3 400	3 225	3 100	3 125	3 100	3 150	3 175	3 325
9,500 cfm	EA	5,900	5 600	5,400	5,400	5,400	5 500	5,500	5 800
14 400 cfm	EA	6,000	5 700	5 500	5,500	5,500	5,600	5,600	5 900
15885 AIR FILTERS									
Renewable roll, automatic advance, one spare media									
Vertical type									
3' x 5'	EA	4 300	4 075	3,925	3,950	3 925	4 000	4 025	4 225
3' x 6'	EA	4 400	4,150	4 000	4 025	4 000	4 075	4 100	4 300
3' x 8'	EA	4 475	4 225	4 075	4 100	4 075	4 150	4 200	4 400
3' x 10'	EA	4 550	4 300	4 150	4 175	4 150	4 225	4 275	4 475
3' x 12'	EA	4 650	4 400	4 225	4 275	4 225	4 300	4 350	4 550
Horizontal type									
2' x 5'	EA	4 625	4 375	4 200	4 250	4 200	4 275	4 325	4 525
2' x 6'	EA	4 700	4 450	4 275	4 325	4 275	4 350	4 400	4 625
2' x 8'	EA	4 775	4 525	4 350	4 400	4 350	4 450	4 475	4 700
2' x 10'	EA	4 900	4 625	4 450	4 500	4 450	4 550	4 600	4 800
2' x 12'	EA	4 975	4 725	4 525	4 575	4 525	4 625	4 675	4 900

Instructions for use, page 4. Main index, page 7.

APPENDIX (B)

SAMPLES OF DATABASE TABLES

Sample Table of the Electrical Division showing only the Item ID, and the Description for all its' items.

Item ID	Item Description
1605000000	BASIC MATERIALS and METHODS
1611000005	RACEWAYS INSTALLED COMPLETE
1611000010	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid Galvanized steel, 1/2"
1611000015	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid Galvanized steel, 3/4"
1611000020	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid Galvanized steel, 1"
1611000025	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid Galvanized steel, 1 1/4"
1611000030	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid Galvanized steel, 1 1/2"
1611000035	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid Galvanized steel, 2"
1611000040	CONDUIT, Embedded in slab excluding elbows and pull boxes : E. M. T. 1/2"
1611000045	CONDUIT, Embedded in slab excluding elbows and pull boxes : E. M. T. 3/4"
1611000050	CONDUIT, Embedded in slab excluding elbows and pull boxes : E. M. T. 1"
1611000055	CONDUIT, Embedded in slab excluding elbows and pull boxes : E. M. T. 1 1/4"
1611000060	CONDUIT, Embedded in slab excluding elbows and pull boxes : E. M. T. 1 1/2"
1611000065	CONDUIT, Embedded in slab excluding elbows and pull boxes : E. M. T. 2"
1611000070	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid PVC 1/2"
1611000075	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid PVC 3/4"
1611000080	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid PVC 1"
1611000085	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid PVC 1 1/4"
1611000090	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid PVC 1 1/2"
1611000095	CONDUIT, Embedded in slab excluding elbows and pull boxes : Rigid PVC 2"
1611000100	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 1/2"
1611000105	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 3/4"
1611000110	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 1"
1611000115	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 1 1/4"
1611000120	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 1 1/2"
1611000125	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 2"
1611000130	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 2 1/2"
1611000135	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 3"
1611000140	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 3 1/2"
1611000145	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 4"
1611000150	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 5"
1611000155	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid galvanized steel : 6"
1611000160	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 1/2"
1611000165	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 3/4"
1611000170	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 1"
1611000175	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 1 1/4"
1611000180	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 1 1/2"
1611000185	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 2"
1611000190	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 2 1/2"
1611000195	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 3"

Item ID	Item Description
1611000200	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, E. M. T. : 4"
1611000205	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 1/2"
1611000210	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 3/4"
1611000215	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 1"
1611000220	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 1 1/4"
1611000225	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 1 1/2"
1611000230	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 2"
1611000235	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 2 1/2"
1611000240	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 3"
1611000245	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 3 1/2"
1611000250	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid PVC : 4"
1611000255	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 1/2"
1611000260	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 3/4"
1611000265	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 1"
1611000270	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 1 1/4"
1611000275	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum . 1 1/2"
1611000280	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 2"
1611000285	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 2 1/2"
1611000290	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 3"
1611000295	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 3 1/2"
1611000300	CONDUIT, Surface mounted 8' average high, 1 pull box, 1 elbow/100 LF & support, Rigid Aluminum : 4"
1611000305	ELBOWS, Rigid galvanized steel including coupling and support : 1 1/4"
1611000310	ELBOWS, Rigid galvanized steel including coupling and support : 1 1/2"
1611000315	ELBOWS, Rigid galvanized steel including coupling and support : 2"
1611000320	ELBOWS, Rigid galvanized steel including coupling and support : 2 1/2"
1611000325	ELBOWS, Rigid galvanized steel including coupling and support : 3"
1611000330	ELBOWS, Rigid galvanized steel including coupling and support : 3 1/2"
1611000335	ELBOWS, Rigid galvanized steel including coupling and support : 4"
1611000340	ELBOWS, E. M. T. including coupling : 1 1/4"
1611000345	ELBOWS, E. M. T. including coupling : 1 1/2"
1611000350	ELBOWS, E. M. T. including coupling : 2"
1611000355	ELBOWS, E. M. T. including coupling : 2 1/2"
1611000360	ELBOWS, E. M. T. including coupling : 3"
1611000365	ELBOWS, E. M. T. including coupling : 4"
1611000370	ELBOWS, PVC including coupling : 1/2"
1611000375	ELBOWS, PVC including coupling : 3/4"
1611000380	ELBOWS, PVC including coupling : 1"
1611000385	ELBOWS, PVC including coupling : 1 1/4"
1611000390	ELBOWS, PVC including coupling : 1 1/2"
1611000395	ELBOWS, PVC including coupling : 2"
1611000400	ELBOWS, PVC including coupling : 2 1/2"
1611000405	ELBOWS, PVC including coupling : 3"
1611000410	ELBOWS, PVC including coupling : 3 1/2"
1611000415	ELBOWS, PVC including coupling : 4"
1611000420	ELBOWS, Rigid aluminum including coupling and supports : 1 1/4"
1611000425	ELBOWS, Rigid aluminum including coupling and supports : 1 1/2"
1611000430	ELBOWS, Rigid aluminum including coupling and supports : 2"

Item ID	Item Description
1611000440	ELBOWS, Rigid aluminum including coupling and supports : 2 1/2"
1611000445	ELBOWS, Rigid aluminum including coupling and supports : 3"
1611000450	ELBOWS, Rigid aluminum including coupling and supports : 3 1/2"
1611000455	ELBOWS, Rigid aluminum including coupling and supports : 4"
1611000460	Cable tray including fittings and supports, Ventilated type : Galvanized steel, 6" wide
1611000465	Cable tray including fittings and supports, Ventilated type : Galvanized steel, 12" wide
1611000470	Cable tray including fittings and supports, Ventilated type : Galvanized steel, 18" wide
1611000475	Cable tray including fittings and supports, Ventilated type : Galvanized steel, 24" wide
1611000480	Cable tray including fittings and supports, Ventilated type : Aluminum, 6" wide
1611000485	Cable tray including fittings and supports, Ventilated type : Aluminum, 12" wide
1611000490	Cable tray including fittings and supports, Ventilated type : Aluminum, 18" wide
1611000495	Cable tray including fittings and supports, Ventilated type : Aluminum, 24" wide
1611000500	Cable tray including fittings and supports, Ladder type : Galvanized steel, 6" wide
1611000505	Cable tray including fittings and supports, Ladder type : Galvanized steel, 12" wide
1611000510	Cable tray including fittings and supports, Ladder type : Galvanized steel, 18" wide
1611000515	Cable tray including fittings and supports, Ladder type : Galvanized steel, 24" wide
1611000520	Cable tray including fittings and supports, Ladder type : Aluminum, 6" wide
1611000525	Cable tray including fittings and supports, Ladder type : Aluminum, 12" wide
1611000530	Cable tray including fittings and supports, Ladder type : Aluminum, 18" wide
1611000535	Cable tray including fittings and supports, Ladder type : Aluminum, 24" wide
1611000540	Wiring channels, Square section, steel : 2 1/2" x 2 1/2"
1611000545	Wiring channels, Square section, steel : 4" x 4"
1611000550	Wiring channels, Square section, steel : 6" x 6"
1611000600	Underground Services, Concrete manholes, 5' x 5' single
1611000605	Underground Services, Concrete manholes, 5' x 10' double
1611000610	Underground duct banks, 4" pvc pipe ducts & fittings including all excavation, concrete and backfilling
1611000615	In soft earth with backfill : 1 duct
1611000620	In soft earth with backfill : 2 ducts
1611000625	In soft earth with backfill : 3 ducts
1611000630	In soft earth with backfill : 4 ducts
1611000635	In soft earth with backfill : 5 ducts
1611000640	In soft earth with backfill : 6 ducts
1611000645	In soft earth with backfill : 7 ducts
1611000650	In soft earth with backfill : 8 ducts
1611000655	In soft earth with backfill : 9 ducts
1611000660	In soft earth with backfill : 10 ducts
1611000665	In soft earth with backfill : 11 ducts
1611000670	In soft earth with backfill : 12 ducts
1611000675	In soft earth with backfill : 13 ducts
1611000680	In soft earth with backfill : 14 ducts
1611000685	In soft earth with backfill : 15 ducts
1611000690	In soft earth with granular backfill : 1 duct
1611000695	In soft earth with granular backfill : 2 ducts
1611000700	In soft earth with granular backfill : 3 ducts
1611000705	In soft earth with granular backfill : 4 ducts
1611000710	In soft earth with granular backfill : 5 ducts
1611000715	In soft earth with granular backfill : 6 ducts
1611000720	In soft earth with granular backfill : 7 ducts
1611000725	In soft earth with granular backfill : 8 ducts
1611000730	In soft earth with granular backfill : 9 ducts
1611000735	In soft earth with granular backfill : 10 ducts
1611000740	In soft earth with granular backfill : 11 ducts

1611000745	In soft earth with granular backfill : 12 ducts
1611000750	In soft earth with granular backfill : 13 ducts
1611000755	In soft earth with granular backfill : 14 ducts
1611000760	In soft earth with granular backfill : 15 ducts
1611000765	In soft rock with granular backfill : 1 duct
1611000770	In soft rock with granular backfill : 2 ducts
1611000775	In soft rock with granular backfill : 3 ducts
1611000780	In soft rock with granular backfill : 4 ducts
1611000785	In soft rock with granular backfill : 5 ducts
1611000790	In soft rock with granular backfill : 6 ducts
1611000795	In soft rock with granular backfill : 7 ducts
1611000800	In soft rock with granular backfill : 8 ducts
1611000805	In soft rock with granular backfill . 9 ducts

Sample Table of the Electrical Division showing the Item ID, Units, Quantity, and the cost of each unit item according each of the eight major Canadian cities.

Item ID	Units	Quantity	St Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
1605000000										
1611000005										
1611000010	LF	1	$4.15	$3.97	$3.63	$3.73	$3.71	$3.73	$3.71	$4.08
1611000015	LF	1	$4.92	$4.70	$4.31	$4.42	$4.40	$4.42	$4.40	$4.84
1611000020	LF	1	$6.80	$6.50	$5.95	$6.10	$6.05	$6.10	$6.05	$6.65
1611000025	LF	1	$8.75	$8.35	$7.65	$7.85	$7.80	$7.85	$7.80	$8.60
1611000030	LF	1	$10.90	$10.40	$9.55	$9.75	$9.75	$9.75	$9.75	$10.70
1611000035	LF	1	$13.80	$13.20	$12.10	$12.40	$12.35	$12.40	$12.35	$13.55
1611000040	LF	1	$2.57	$2.46	$2.25	$2.31	$2.30	$2.31	$2.30	$2.53
1611000045	LF	1	$3.48	$3.33	$3.05	$3.12	$3.11	$3.12	$3.11	$3.42
1611000050	LF	1	$4.70	$4.49	$4.11	$4.22	$4.20	$4.22	$4.20	$4.62
1611000055	LF	1	$6.80	$6.50	$5.95	$6.10	$6.10	$6.10	$6.10	$6.70
1611000060	LF	1	$7.80	$7.45	$6.85	$7.00	$6.95	$7.00	$6.95	$7.65
1611000065	LF	1	$9.85	$9.40	$8.65	$8.85	$8.80	$8.85	$8.80	$9.70
1611000070	LF	1	$2.64	$2.52	$2.31	$2.37	$2.36	$2.37	$2.36	$2.59
1611000075	LF	1	$3.29	$3.15	$2.88	$2.96	$2.94	$2.96	$2.94	$3.23
1611000080	LF	1	$4.29	$4.10	$3.75	$3.85	$3.83	$3.85	$3.83	$4.21
1611000085	LF	1	$5.45	$5.25	$4.79	$4.91	$4.89	$4.91	$4.89	$5.35
1611000090	LF	1	$6.55	$6.25	$5.75	$5.90	$5.85	$5.90	$5.85	$6.45
1611000095	LF	1	$8.25	$7.85	$7.20	$7.40	$7.35	$7.40	$7.35	$8.10
1611000100	LF	1	$4.79	$4.57	$4.19	$4.29	$4.27	$4.29	$4.27	$4.70
1611000105	LF	1	$5.65	$5.40	$4.95	$5.10	$5.05	$5.10	$5.05	$5.55
1611000110	LF	1	$8.25	$7.85	$7.20	$7.40	$7.35	$7.40	$7.35	$8.10
1611000115	LF	1	$10.80	$10.30	$9.45	$9.70	$9.65	$9.70	$9.65	$10.60
1611000120	LF	1	$13.45	$12.85	$11.80	$12.10	$12.00	$12.10	$12.00	$13.25
1611000125	LF	1	$16.45	$15.75	$14.40	$14.80	$14.70	$14.80	$14.70	$16.15
1611000130	LF	1	$28.50	$27.25	$25.00	$25.50	$25.50	$25.50	$25.50	$28.00
1611000135	LF	1	$38.00	$36.50	$33.25	$34.25	$34.00	$34.25	$34.00	$37.50
1611000140	LF	1	$47.75	$45.50	$41.75	$42.75	$42.50	$42.75	$42.50	$46.75
1611000145	LF	1	$58.00	$55.00	$50.00	$52.00	$51.00	$52.00	$51.00	$57.00

Item ID	Units	Quantity	St Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
1611000150	LF	1	$112.00	$107.00	$98.00	$100.00	$100.00	$100.00	$100.00	$110.00
1611000155	LF	2500	$137.00	$131.00	$120.00	$123.00	$123.00	$123.00	$123.00	$135.00
1611000160	LF	1	$3.47	$3.31	$3.03	$3.11	$3.09	$3.11	$3.09	$3.40
1611000165	LF	1	$4.53	$4.33	$3.96	$4.06	$4.04	$4.06	$4.04	$4.45
1611000170	LF	1	$5.60	$5.35	$4.91	$5.05	$5.00	$5.05	$5.00	$5.50
1611000175	LF	1	$8.30	$7.95	$7.30	$7.45	$7.45	$7.45	$7.45	$8.15
1611000180	LF	1	$9.95	$9.50	$8.70	$8.95	$8.90	$8.95	$8.90	$9.75
1611000185	LF	1	$11.85	$11.30	$10.35	$10.60	$10.55	$10.60	$10.55	$11.60
1611000190	LF	1	$22.25	$21.25	$19.50	$20.00	$19.90	$20.00	$19.90	$22.00
1611000195	LF	1	$28.25	$27.00	$24.50	$25.25	$25.00	$25.25	$25.00	$27.75
1611000200	LF	1	$42.50	$40.75	$37.25	$38.25	$38.00	$38.25	$38.00	$41.75
1611000205	LF	1	$3.57	$3.41	$3.12	$3.20	$3.19	$3.20	$3.19	$3.50
1611000210	LF	1	$4.44	$4.24	$3.89	$3.99	$3.97	$3.99	$3.97	$4.36
1611000215	LF	1	$6.00	$5.75	$5.25	$5.40	$5.35	$5.40	$5.35	$5.90
1611000220	LF	1	$7.65	$7.30	$6.70	$6.85	$6.80	$6.85	$6.80	$7.50
1611000225	LF	1	$8.75	$8.35	$7.65	$7.85	$7.80	$7.85	$7.80	$8.60
1611000230	LF	1	$10.90	$10.40	$9.55	$9.75	$9.75	$9.75	$9.75	$10.70
1611000235	LF	1	$16.10	$15.40	$14.10	$14.45	$14.40	$14.45	$14.40	$15.85
1611000240	LF	1	$19.90	$19.00	$17.40	$17.85	$17.75	$17.85	$17.75	$19.55
1611000245	LF	1	$24.00	$23.00	$21.00	$21.50	$21.50	$21.50	$21.50	$23.50
1611000250	LF	1	$28.75	$27.50	$25.25	$25.75	$25.75	$25.75	$25.75	$28.25
1611000255	LF	1	$5.50	$5.30	$4.83	$4.96	$4.93	$4.96	$4.93	$5.40
1611000260	LF	1	$7.05	$6.70	$6.15	$6.30	$6.30	$6.30	$6.30	$6.90
1611000265	LF	1	$9.45	$9.00	$8.25	$8.45	$8.40	$8.45	$8.40	$9.25
1611000270	LF	1	$12.95	$12.35	$11.35	$11.60	$11.55	$11.60	$11.55	$12.70
1611000275	LF	1	$14.65	$14.00	$12.85	$13.15	$13.10	$13.15	$13.10	$14.40
1611000280	LF	1	$18.85	$18.05	$16.50	$16.85	$16.85	$16.85	$16.85	$18.55
1611000285	LF	1	$29.75	$28.50	$26.00	$26.75	$26.75	$26.75	$26.75	$29.25
1611000290	LF	56	$39.00	$37.25	$34.25	$35.00	$35.00	$35.00	$35.00	$38.50
1611000295	LF	1	$48.75	$46.50	$42.75	$43.75	$43.50	$43.75	$43.50	$47.75
1611000300	LF	1	$64.00	$61.00	$56.00	$58.00	$57.00	$58.00	$57.00	$63.00
1611000305	EA	1	$89.00	$85.00	$78.00	$80.00	$80.00	$80.00	$80.00	$88.00
1611000310	EA	1	$105.00	$101.00	$92.00	$94.00	$94.00	$94.00	$94.00	$103.00
1611000315	EA	1	$137.00	$131.00	$120.00	$123.00	$122.00	$123.00	$122.00	$134.00

Item ID	Units	Quantity	St Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
1611000320	EA	1	$230.00	$220.00	$205.00	$210.00	$205.00	$210.00	$205.00	$230.00
1611000325	EA	1	$305.00	$290.00	$265.00	$275.00	$275.00	$275.00	$275.00	$300.00
1611000330	EA	75	$390.00	$375.00	$340.00	$350.00	$350.00	$350.00	$350.00	$385.00
1611000335	EA	1	$465.00	$445.00	$405.00	$415.00	$415.00	$415.00	$415.00	$455.00
1611000340	EA	1	$47.25	$45.00	$41.25	$42.50	$42.25	$42.50	$42.25	$46.50
1611000345	EA	1	$59.00	$56.00	$51.00	$53.00	$53.00	$53.00	$53.00	$58.00
1611000350	EA	1	$77.00	$73.00	$67.00	$69.00	$69.00	$69.00	$69.00	$76.00
1611000355	EA	1	$129.00	$123.00	$113.00	$116.00	$115.00	$116.00	$115.00	$127.00
1611000360	EA	1	$166.00	$159.00	$146.00	$149.00	$148.00	$149.00	$148.00	$163.00
1611000365	EA	1	$260.00	$250.00	$230.00	$235.00	$230.00	$235.00	$230.00	$255.00
1611000370	EA	1	$10.90	$10.45	$9.55	$9.80	$9.75	$9.80	$9.75	$10.70
1611000375	EA	1	$20.25	$19.35	$17.70	$18.15	$18.10	$18.15	$18.10	$19.90
1611000380	EA	1	$32.75	$31.25	$28.75	$29.50	$29.25	$29.50	$29.25	$32.25
1611000385	EA	1	$45.25	$43.25	$39.50	$40.50	$40.50	$40.50	$40.50	$44.50
1611000390	EA	1	$58.00	$55.00	$50.00	$52.00	$52.00	$52.00	$52.00	$57.00
1611000395	EA	1	$72.00	$69.00	$63.00	$65.00	$65.00	$65.00	$65.00	$71.00
1611000400	EA	1	$97.00	$93.00	$85.00	$87.00	$87.00	$87.00	$87.00	$96.00
1611000405	EA	1	$129.00	$123.00	$113.00	$116.00	$115.00	$116.00	$115.00	$127.00
1611000410	EA	1	$158.00	$151.00	$139.00	$142.00	$141.00	$142.00	$141.00	$156.00
1611000415	EA	1	$184.00	$176.00	$161.00	$165.00	$165.00	$165.00	$165.00	$181.00
1611000420	EA	1	$79.00	$76.00	$69.00	$71.00	$71.00	$71.00	$71.00	$78.00
1611000425	EA	1	$94.00	$90.00	$82.00	$84.00	$84.00	$84.00	$84.00	$92.00
1611000430	EA	1	$131.00	$125.00	$115.00	$118.00	$117.00	$118.00	$117.00	$129.00
1611000440	EA	1	$210.00	$200.00	$184.00	$189.00	$188.00	$189.00	$188.00	$205.00
1611000445	EA	1	$285.00	$270.00	$245.00	$255.00	$255.00	$255.00	$255.00	$280.00
1611000450	EA	1	$385.00	$365.00	$335.00	$345.00	$345.00	$345.00	$345.00	$380.00
1611000455	EA	1	$465.00	$445.00	$405.00	$415.00	$415.00	$415.00	$415.00	$455.00
1611000460	LF	1	$35.25	$33.50	$30.75	$31.50	$31.50	$31.50	$31.50	$34.50
1611000465	LF	1	$38.00	$36.25	$33.25	$34.00	$33.75	$34.00	$33.75	$37.25
1611000470	LF	1	$47.75	$45.75	$41.75	$43.00	$42.75	$43.00	$42.75	$47.00
1611000475	LF	1	$54.00	$52.00	$47.50	$48.75	$48.50	$48.75	$48.50	$53.00
1611000480	LF	1	$42.75	$40.75	$37.25	$38.25	$38.00	$38.25	$38.00	$42.00
1611000485	LF	1	$47.00	$45.00	$41.25	$42.25	$42.00	$42.25	$42.00	$46.25
1611000490	LF	1	$57.00	$55.00	$50.00	$51.00	$51.00	$51.00	$51.00	$56.00

Item ID	Units	Quantity	St Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
1611000495	LF	1	$67.00	$64.00	$59.00	$60.00	$60.00	$60.00	$60.00	$66.00
1611000500	LF	1	$33.00	$31.75	$29.00	$29.75	$29.50	$29.75	$29.50	$32.50
1611000505	LF	1	$35.75	$34.25	$31.25	$32.25	$32.00	$32.25	$32.00	$35.25
1611000510	LF	1	$43.00	$41.00	$37.75	$38.50	$38.50	$38.50	$38.50	$42.25
1611000515	LF	1	$49.75	$47.50	$43.50	$44.75	$44.50	$44.75	$44.50	$49.00
1611000520	LF	1	$41.25	$39.50	$36.25	$37.00	$37.00	$37.00	$37.00	$40.50
1611000525	LF	1	$43.25	$41.50	$38.00	$39.00	$38.75	$39.00	$38.75	$42.50
1611000530	LF	1	$52.00	$50.00	$45.75	$46.75	$46.75	$46.75	$46.75	$51.00
1611000535	LF	1	$60.00	$57.00	$53.00	$54.00	$54.00	$54.00	$54.00	$59.00
1611000540	LF	1	$28.75	$27.50	$25.00	$25.75	$25.50	$25.75	$25.50	$28.25
1611000545	LF	1	$40.00	$38.25	$35.00	$35.75	$35.75	$35.75	$35.75	$39.25
1611000550	LF	1	$53.00	$51.00	$46.50	$47.75	$47.50	$47.75	$47.50	$52.00
1611000600	EA	1	$4,225.00	$4,050.00	$3,700.00	$3,800.00	$3,775.00	$3,800.00	$3,775.00	$4,150.00
1611000605	EA	1	$7,800.00	$7,400.00	$6,800.00	$7,000.00	$6,900.00	$7,000.00	$6,900.00	$7,600.00
1611000610										
1611000615	LF	1	$41.50	$39.75	$36.50	$37.25	$37.00	$37.25	$37.00	$40.75
1611000620	LF	1	$56.00	$53.00	$48.50	$49.75	$49.50	$49.75	$49.50	$55.00
1611000625	LF	1	$63.00	$60.00	$55.00	$56.00	$56.00	$56.00	$56.00	$62.00
1611000630	LF	1	$93.00	$89.00	$82.00	$84.00	$83.00	$84.00	$83.00	$92.00
1611000635	LF	1	$104.00	$99.00	$91.00	$93.00	$93.00	$93.00	$93.00	$102.00
1611000640	LF	1	$109.00	$104.00	$96.00	$98.00	$98.00	$98.00	$98.00	$107.00
1611000645	LF	1	$129.00	$123.00	$113.00	$116.00	$115.00	$116.00	$115.00	$127.00
1611000650	LF	1	$140.00	$134.00	$122.00	$125.00	$125.00	$125.00	$125.00	$137.00
1611000655	LF	1	$158.00	$151.00	$138.00	$142.00	$141.00	$142.00	$141.00	$155.00
1611000660	LF	1	$177.00	$170.00	$155.00	$159.00	$158.00	$159.00	$158.00	$174.00
1611000665	LF	1	$186.00	$178.00	$163.00	$167.00	$166.00	$167.00	$166.00	$183.00
1611000670	LF	1	$195.00	$187.00	$171.00	$175.00	$174.00	$175.00	$174.00	$192.00
1611000675	LF	1	$220.00	$210.00	$193.00	$198.00	$197.00	$198.00	$197.00	$215.00
1611000680	LF	1	$230.00	$220.00	$200.00	$205.00	$205.00	$205.00	$205.00	$225.00
1611000685	LF	1	$245.00	$235.00	$215.00	$220.00	$220.00	$220.00	$220.00	$240.00
1611000690	LF	1	$55.00	$52.00	$48.00	$49.25	$49.00	$49.25	$49.00	$54.00
1611000695	LF	1	$72.00	$68.00	$63.00	$64.00	$64.00	$64.00	$64.00	$70.00
1611000700	LF	1	$82.00	$79.00	$72.00	$74.00	$74.00	$74.00	$74.00	$81.00
1611000705	LF	1	$120.00	$115.00	$105.00	$108.00	$107.00	$108.00	$107.00	$118.00

Item ID	Units	Quantity	St Johns	Halifax	Montreal	Ottawa	Toronto	Winnipeg	Calgary	Vancouver
1611000710	LF	1	$133.00	$127.00	$116.00	$119.00	$118.00	$119.00	$118.00	$130.00
1611000715	LF	1	$142.00	$135.00	$124.00	$127.00	$126.00	$127.00	$126.00	$139.00
1611000720	LF	1	$172.00	$164.00	$151.00	$154.00	$154.00	$154.00	$154.00	$169.00
1611000725	LF	1	$185.00	$176.00	$162.00	$166.00	$165.00	$166.00	$165.00	$181.00
1611000730	LF	1	$199.00	$190.00	$174.00	$179.00	$178.00	$179.00	$178.00	$195.00
1611000735	LF	1	$230.00	$215.00	$199.00	$205.00	$205.00	$205.00	$205.00	$225.00
1611000740	LF	1	$235.00	$225.00	$205.00	$210.00	$210.00	$210.00	$210.00	$230.00
1611000745	LF	1	$250.00	$240.00	$220.00	$225.00	$225.00	$225.00	$225.00	$245.00
1611000750	LF	1	$285.00	$270.00	$250.00	$255.00	$255.00	$255.00	$255.00	$280.00
1611000755	LF	1	$300.00	$285.00	$260.00	$265.00	$265.00	$265.00	$265.00	$290.00
1611000760	LF	1	$315.00	$300.00	$275.00	$280.00	$280.00	$280.00	$280.00	$310.00
1611000765	LF	1	$69.00	$66.00	$60.00	$62.00	$61.00	$62.00	$61.00	$68.00

APPENDIX (C)

SAMPLES OF DATABASE QUERIES

Sample of the Mechanical Division query according to the city of Toronto, it shows the Item ID, Description, Units, Unit Price, Quantity, and Total. It is to be noted that the Total is calculated by the query using the following expression: (Quantity)*(Unit Price) and the prices are based on Yardsticks for costing. Same criteria are used to the other queries.

Item ID	Item Description	Units	Unit Price	Quantity	Total
1506000000	PIPE and PIPE FITTINGS				
1506000005	Copper pressure piping, based on 10' of pipe, including one tee, one 90-degree elbow, one pipe support and solder				
1506000010	Type m : 1/2"	LF	$7.10	1	$7.10
1506000015	Type m : 3/4"	LF	$8.30	1	$8.30
1506000020	Type m : 1"	LF	$10.10	1	$10.10
1506000025	Type m : 1 1/4"	LF	$13.20	1	$13.20
1506000030	Type m : 1 1/2"	LF	$15.30	1	$15.30
1506000035	Type m : 2"	LF	$20.50	1	$20.50
1506000040	Type m : 2 1/2"	LF	$27.25	1	$27.25
1506000045	Type m : 3"	LF	$33.00	1	$33.00
1506000050	Type l : 1/2"	LF	$7.35	1	$7.35
1506000055	Type l : 3/4"	LF	$8.65	1	$8.65
1506000060	Type l : 1"	LF	$10.65	1	$10.65
1506000065	Type l : 1 1/4"	LF	$13.50	1	$13.50
1506000070	Type l : 1 1/2"	LF	$15.70	1	$15.70
1506000075	Type l : 2"	LF	$21.75	1	$21.75
1506000080	Type l : 2 1/2"	LF	$29.50	1	$29.50
1506000085	Type l : 3"	LF	$36.75	1	$36.75
1506000090	Type k : 1/2"	LF	$7.75	1	$7.75
1506000095	Type k : 3/4"	LF	$9.45	1	$9.45
1506000100	Type k : 1"	LF	$11.60	1	$11.60
1506000105	Type k : 1 1/4"	LF	$14.50	1	$14.50
1506000110	Type k : 1 1/2"	LF	$16.95	1	$16.95
1506000115	Type k : 2"	LF	$23.00	1	$23.00
1506000120	Type k : 2 1/2"	LF	$31.00	1	$31.00
1506000125	Type k : 3"	LF	$39.25	1000	$39,250.00
1506000130	Galvanized steel pressure piping, based on 10' of pipe for screwed piping and 20' of pipe for flanged piping.....				
1506000131	..... including tee, one 90-degree elbow, one pipe support, and jointing material				

Item ID	Item Description	Units	Unit Price	Quantity	Total
1506000135	Schedule 40, screwed : 1/2"	LF	$16.40	1	$16.40
1506000140	Schedule 40, screwed : 3/4"	LF	$18.00	1	$18.00
1506000145	Schedule 40, screwed : 1"	LF	$20.25	1	$20.25
1506000150	Schedule 40, screwed : 1 1/4"	LF	$24.25	1	$24.25
1506000155	Schedule 40, screwed : 1 1/2"	LF	$27.50	1	$27.50
1506000160	Schedule 40, screwed : 2"	LF	$33.00	1	$33.00
1506000165	Schedule 40, flanged : 2 1/2"	LF	$59.00	1	$59.00
1506000170	Schedule 40, flanged : 3"	LF	$69.00	1	$69.00
1506000175	Schedule 40, flanged : 3 1/2"	LF	$93.00	1	$93.00
1506000180	Schedule 40, flanged : 4"	LF	$103.00	1	$103.00
1506000185	Schedule 40, flanged : 6"	LF	$166.00	1	$166.00
1506000200	Galvanized steel pressure piping, based on 10' of pipe for screwed piping and 20' of pipe for welded piping.....				
1506000201	..... including tee, one 90-degree elbow, one pipe support, and jointing material				
1506000205	Schedule 40, screwed : 1/2"	LF	$14.80	1	$14.80
1506000210	Schedule 40, screwed : 3/4"	LF	$16.50	1	$16.50
1506000215	Schedule 40, screwed : 1"	LF	$17.75	1	$17.75
1506000220	Schedule 40, screwed : 1 1/4"	LF	$20.25	1	$20.25
1506000225	Schedule 40, screwed : 1 1/2"	LF	$22.50	1	$22.50
1506000230	Schedule 40, screwed : 2"	LF	$26.75	1	$26.75
1506000235	Schedule 40, welded : 2 1/2"	LF	$41.75	1	$41.75
1506000240	Schedule 40, welded : 3"	LF	$51.00	1	$51.00
1506000245	Schedule 40, welded : 3 1/2"	LF	$63.00	1	$63.00
1506000250	Schedule 40, welded : 4"	LF	$70.00	1	$70.00
1506000255	Schedule 40, welded : 6"	LF	$119.00	1	$119.00
1506000260	Schedule 40, welded : 8"	LF	$173.00	550	$95,150.00
1506000265	Copper drainage piping, based on 10' of pipe, including one tee, one 90-degree elbow, one support, and solder				
1506000270	Drainage waste and vent : 1 1/4"	LF	$12.50	1	$12.50
1506000275	Drainage waste and vent : 1 1/2"	LF	$14.55	1	$14.55
1506000280	Drainage waste and vent : 2"	LF	$18.55	1	$18.55
1506000285	Drainage waste and vent : 3"	LF	$27.25	1	$27.25
1506000300	Cast iron drainage piping, based on 100' of pipe, including two y's, four 1/8 bends, and jointing material				
1506000305	Hub and spigot : 3"	LF	$15.20	1	$15.20
1506000310	Hub and spigot : 4"	LF	$19.95	1	$19.95
1506000315	Hub and spigot : 6"	LF	$32.50	1	$32.50

Item ID	Item Description	Units	Unit Price	Quantity	Total
1506000320	Hub and spigot : 8"	LF	$48.25	1	$48.25
1506000325	Hub and spigot : 10"	LF	$71.00	1	$71.00
1506000330	Hub and spigot : 12"	LF	$96.00	1	$96.00
1506000335	Hub and spigot : 15"	LF	$143.00	1	$143.00
1506000340	Mechanical joint : 3"	LF	$12.70	1	$12.70
1506000345	Mechanical joint : 4"	LF	$16.40	1	$16.40
1506000350	Mechanical joint : 6"	LF	$28.50	1	$28.50
1506000355	Mechanical joint : 8"	LF	$46.25	1	$46.25
1506000360	Mechanical joint : 10"	LF	$68.00	1	$68.00
1506000365	Plastic drainage piping, based on 10' of pipe, including one y, one 1/8 bends, two pipe supports, and jointing material				
1506000370	ABS drainage waste and vent : 1 1/4"	LF	$8.15	1	$8.15
1506000375	ABS drainage waste and vent : 1 1/2"	LF	$9.35	1	$9.35
1506000380	ABS drainage waste and vent : 2"	LF	$10.90	1	$10.90
1506000385	ABS drainage waste and vent : 3"	LF	$14.60	1	$14.60
1506000400	Glass drainage piping, based on 10' of pipe, including one y, one 1/8 bends, two pipe supports, and jointing material				
1506000405	Glass pipe : 1 1/2"	LF	$48.25	1	$48.25
1506000410	Glass pipe : 2"	LF	$62.00	1	$62.00
1506000415	Glass pipe : 3"	LF	$86.00	1	$86.00
1506000420	Glass pipe : 4"	LF	$135.00	1	$135.00
1506000425	Glass pipe : 6"	LF	$275.00	1	$275.00
1510000010	Valves and Cocks (manual), Gates valves Bronze 200 psi water or 125 psi steam pressure, screwed or soldered :				
1510000015	1/2"	EA	$45.50	1	$45.50
1510000020	3/4"	EA	$51.00	1	$51.00
1510000025	1"	EA	$60.00	1	$60.00
1510000030	1 1/4"	EA	$78.00	1	$78.00
1510000035	1 1/2"	EA	$96.00	1	$96.00
1510000040	2"	EA	$129.00	1	$129.00
1510000045	Gate valves, l. b. b. m. Outside screw and yoke : 200 psi water or 125 psi steam pressure, flanged :				
1510000050	2 1/2"	EA	$310.00	1	$310.00
1510000055	3"	EA	$370.00	1	$370.00
1510000060	4"	EA	$550.00	1	$550.00
1510000065	6"	EA	$820.00	1	$820.00
1510000070	8"	EA	$1,390.00	1	$1,390.00
1510000075	Globe valves, Bronze 300 psi water or 150 psi steam pressure, screwed or soldered :				

Item ID	Item Description	Units	Unit Price	Quantity	Total
1510000080	1/2"	EA	$61.00	1	$61.00
1510000085	3/4"	EA	$79.00	1	$79.00
1510000090	1"	EA	$104.00	1	$104.00
1510000095	1 1/4"	EA	$135.00	1	$135.00
1510000100	1 1/2"	EA	$163.00	1	$163.00
1510000105	2"	EA	$255.00	1	$255.00
1510000110	Globe valves, l. b. b. m. Outside screw and yoke :200 psi water or 125 psi steam pressure, flanged :				
1510000115	2 1/2"	EA	$505.00	1	$505.00
1510000120	3"	EA	$585.00	1	$585.00

Sample of the Equipment Division query in case the user chooses to enter own cost data. It shows the Item ID, Description, Units, (Installation Price)/Unit, (Material Price)/Unit, Quantity, and Total. The query calculates the Total using the expression: [(Installation Price/Unit)+(Material Price/Unit)] * (Quantity). The same criteria are used for the other queries.

Item ID	Item Description	Units	Mat/Unit	Inst/Unit	Quantity	Total
1101000000	BUILT- IN MAINTENANCE EQUIPMENT				1	
1101400010	Window Washing Equipment, Powered stage equipment 20' long, 2 point suspension, drop not exceeding 300'	EA			1	
1101400020	Window Washing Equipment, Powered stage equipment 20' long, 4 point suspension, drop not exceeding 300'	EA			1	
1101400030	Window Washing Equipment, Tracks, steel	LF			1	
1116000000	LOADING DOCK EQUIPMENT					
1116100010	Dock Levellers, Platform levellers, Mechanical : Size 6' x 6'	EA			1	
1116100020	Dock Levellers, Platform levellers, Mechanical : Size 6' x 8'	EA			1	
1116100030	Dock Levellers, Platform levellers, Hydraulic : Size 6' x 6'	EA			1	
1116100040	Dock Levellers, Platform levellers, Hydraulic : Size 6' x 8'	EA			1	
1116300010	Truck Door Seals, Normal Duty, For docks 8' wide, With fixed head and double neoprene seal : 8' high	EA			1	
1116300020	Truck Door Seals, Normal Duty, For docks 8' wide, With fixed head and double neoprene seal : 10' high	EA			1	
1116300030	Truck Door Seals, Normal Duty, For docks 8' wide, Additional costs : Extra for heavy duty door seals	EA			1	
1116400010	Rail Dock Shelters, Normal Duty, Not exceeding 60" projection, 3 sides : Not exceeding 100 sf	EA			1	
1116400020	Rail Dock Shelters, Normal Duty, Not exceeding 60" projection, 3 sides : Over 100 sf not exceeding 150 sf	EA			1	
1116400030	Rail Dock Shelters, Normal Duty, Not exceeding 60" projection, 4 sides : Not exceeding 100 sf	EA			1	
1116400040	Rail Dock Shelters, Normal Duty, Not exceeding 60" projection, 4 sides : Over 100 sf not exceeding 150 sf	EA			1	
1116500010	Protective Bumpers, 4" projection, horizontal 10" high : 14" wide	EA			1	
1116500020	Protective Bumpers, 4" projection, horizontal 10" high : 20" wide	EA			1	
1116500030	Protective Bumpers, 4" projection, horizontal 10" high : 24" wide	EA			1	
1116500040	Protective Bumpers, 4" projection, vertical 20" high : 11" wide	EA			1	
1116500050	Protective Bumpers, 5 1/2" projection for use with door seals, vertical 20" high : 11" wide	EA			1	
1160000000	LABORATORY EQUIPMENT					
1161000010	Laboratory Furniture, Tables or counters 24" wide, Plastic	LF			1	
1161000020	Laboratory Furniture, Tables or counters 24" wide, Resin impregnated limestone	LF			1	

Item ID	Item Description	Units	Mat/Unit	Inst/Unit	Quantity	Total
1161000030	Laboratory Furniture, Tables or counters 24" wide, Stainless steel	LF			1	
1161000040	Laboratory Furniture, Solid front storage units 7' high, Plastic or wood	LF			1	
1161000050	Laboratory Furniture, Solid front storage units 7' high, Stainless steel	LF			1	
1161000060	Laboratory Furniture, Solid front wall storage units, Plastic or wood	LF			1	
1161000070	Laboratory Furniture, Solid front wall storage units, Stainless steel	LF			1	
1161000080	Laboratory Furniture, Laboratory stools 30" high, Any type	EA			1	
1162000010	Laboratory Equipment, Fume hoods including 5' hood, base cabinet, counter top & basic fittings, Steel cabinet	LF			1	

APPENDIX (D)

LIST OF THE DATABASE HISTORICAL PROJECTS

Multi-Level Parking Garage Above-Ground		
Description:	**700 cars capacity, reinforced concrete frame, Excluding site**	
Total Construction cost	**$8,937,500.00**	
Building Size:	275,000.00	
Cost per SF:	**$32.50**	
Element	**%**	**S.F. Cost**
A1.Substructure	9.14	$2.97
A2.Structure:	58.37	$18.97
A3.Exterior Enclosure:	6.98	$2.27
B1.Partitions and Doors:	0.71	$0.23
B2.Finishes:	3.97	$1.29
B3.Fittings and Equipment:	2.83	$0.92
C1.Mechanical:	6.15	$2.00
C2.Electrical:	4.89	$1.59
Z1. General Requirements and Fee:	6.95	$2.26

Parking Garage Below-Ground		
Description:	**300 cars capacity, reinforced concrete frame, 3 levels, heated,**	
Total Construction cost	**$6,271,320.00**	
Building Size:	132,000.00	
Cost per SF:	**$47.51**	
Element	**%**	**S.F. Cost**
A1.Substructure	26.18	$12.44
A2.Structure:	30.88	$14.67
A3.Exterior Enclosure:	10.63	$5.05
B1.Partitions and Doors:	3.49	$1.66
B2.Finishes:	7.20	$3.42
B3.Fittings and Equipment:	2.38	$1.13
C1.Mechanical:	8.40	$3.99
C2.Electrical:	3.43	$1.63
Z1. General Requirements and Fee:	7.41	$3.52

Light Industrial		
Description:	**10 % adminstration/canteen etc., Excluding Site**	
Total Construction cost	**$2,151,500.00**	
Building Size:	50,000.00	
Cost per SF:	**$43.03**	
Element	%	S.F. Cost
A1.Substructure	8.74	$3.76
A2.Structure:	21.22	$9.13
A3.Exterior Enclosure:	19.24	$8.28
B1.Partitions and Doors:	0.84	$0.36
B2.Finishes:	7.83	$3.37
B3.Fittings and Equipment:	5.65	$2.43
C1.Mechanical:	17.66	$7.60
C2.Electrical:	12.29	$5.29
Z1. General Requirements and Fee:	6.55	$2.82

Warehouse		
Description:	**Bare, lightly serviced, single storey 18 ft eaves, Excluding Site**	
Total Construction cost	**$981,900.00**	
Building Size:	30,000.00	
Cost per SF:	**$32.73**	
Element	%	S.F. Cost
A1.Substructure	6.42	$2.10
A2.Structure:	18.88	$6.18
A3.Exterior Enclosure:	36.39	$11.91
B1.Partitions and Doors:	7.00	$2.29
B2.Finishes:	0.61	$0.20
B3.Fittings and Equipment:	0.00	$0.00
C1.Mechanical:	20.90	$6.84
C2.Electrical:	2.44	$0.80
Z1. General Requirements and Fee:	7.42	$2.43

Public Administration Building		
Description:	**Brick Veneer, includes fittings, Excluding Site**	
Total Construction cost	**$20,467,630.00**	
Building Size:	173,000.00	
Cost per SF:	**$118.31**	
Element	**%**	**S.F. Cost**
A1.Substructure	2.36	$2.79
A2.Structure:	15.89	$18.80
A3.Exterior Enclosure:	14.81	$17.52
B1.Partitions and Doors:	5.86	$6.93
B2.Finishes:	15.42	$18.24
B3.Fittings and Equipment:	4.96	$5.87
C1.Mechanical:	21.93	$25.94
C2.Electrical:	11.38	$13.46
Z1. General Requirements and Fee:	7.40	$8.76

Commercial Office Building		
Description:	**3 storeys, finished open space with access flooring, one level of below**	
Total Construction cost	**$9,412,620.00**	
Building Size:	87,600.00	
Cost per SF:	**$107.45**	
Element	**%**	**S.F. Cost**
A1.Substructure	2.08	$2.23
A2.Structure:	16.23	$17.44
A3.Exterior Enclosure:	14.23	$15.29
B1.Partitions and Doors:	5.04	$5.42
B2.Finishes:	8.38	$9.00
B3.Fittings and Equipment:	5.32	$5.72
C1.Mechanical:	26.43	$28.40
C2.Electrical:	14.87	$15.98
Z1. General Requirements and Fee:	7.41	$7.96

Theatre		
Description:	3,000 seats, includes workshops and stage equipment, Excluding Site	
Total Construction cost	$38,003,840.00	
Building Size:	190,400.00	
Cost per SF:	$199.60	
Element	%	S.F. Cost
A1.Substructure	2.38	$4.75
A2.Structure:	16.40	$32.74
A3.Exterior Enclosure:	14.64	$29.22
B1.Partitions and Doors:	9.29	$18.54
B2.Finishes:	10.90	$21.75
B3.Fittings and Equipment:	11.82	$23.59
C1.Mechanical:	18.06	$36.04
C2.Electrical:	9.11	$18.18
Z1. General Requirements and Fee:	7.40	$14.78

Art Gallery		
Description:	steel framed, metal clad, 3 storeys, Excluding Site	
Total Construction cost	$11,267,700.00	
Building Size:	69,000.00	
Cost per SF:	$163.30	
Element	%	S.F. Cost
A1.Substructure	2.24	$3.66
A2.Structure:	17.22	$28.12
A3.Exterior Enclosure:	21.71	$35.46
B1.Partitions and Doors:	6.00	$9.80
B2.Finishes:	10.86	$17.73
B3.Fittings and Equipment:	5.65	$9.23
C1.Mechanical:	19.30	$31.51
C2.Electrical:	8.76	$14.30
Z1. General Requirements and Fee:	8.25	$13.48

Private Museum		
Description:	3 storeys, excluding Site	
Total Construction cost	$6,982,000.00	
Building Size:	40,000.00	
Cost per SF:	$174.55	
Element	%	S.F. Cost
A1.Substructure	6.16	$10.75
A2.Structure:	12.32	$21.51
A3.Exterior Enclosure:	22.42	$39.13
B1.Partitions and Doors:	5.36	$9.35
B2.Finishes:	7.90	$13.79
B3.Fittings and Equipment:	10.39	$18.14
C1.Mechanical:	17.11	$29.87
C2.Electrical:	10.63	$18.56
Z1. General Requirements and Fee:	7.71	$13.45

Arena/Sports Center		
Description:	1 rink, 1 basketball or tennis, 3 squash or racquet, 1 pool, Excluding	
Total Construction cost	$6,778,800.00	
Building Size:	72,000.00	
Cost per SF:	$94.15	
Element	%	S.F. Cost
A1.Substructure	4.27	$4.02
A2.Structure:	26.99	$25.41
A3.Exterior Enclosure:	12.81	$12.06
B1.Partitions and Doors:	6.89	$6.49
B2.Finishes:	5.75	$5.41
B3.Fittings and Equipment:	5.36	$5.05
C1.Mechanical:	20.36	$19.17
C2.Electrical:	9.30	$8.76
Z1. General Requirements and Fee:	8.25	$7.77

Civic Center		
Description:	800 seats auditorium, concrete structure, stucco and concrete panel	
Total Construction cost	$11,571,906.00	
Building Size:	67,400.00	
Cost per SF:	$171.69	
Element	%	S.F. Cost
A1.Substructure	3.99	$6.85
A2.Structure:	15.02	$25.78
A3.Exterior Enclosure:	17.87	$30.68
B1.Partitions and Doors:	7.33	$12.59
B2.Finishes:	6.65	$11.42
B3.Fittings and Equipment:	8.21	$14.10
C1.Mechanical:	21.68	$37.23
C2.Electrical:	11.67	$20.04
Z1. General Requirements and Fee:	7.57	$12.99

Zoological Building		
Description:	To house animals, Excluding Site	
Total Construction cost	$1,097,900.80	
Building Size:	5,440.00	
Cost per SF:	$201.82	
Element	%	S.F. Cost
A1.Substructure	15.10	$30.48
A2.Structure:	16.09	$32.48
A3.Exterior Enclosure:	16.27	$32.84
B1.Partitions and Doors:	7.98	$16.10
B2.Finishes:	10.27	$20.72
B3.Fittings and Equipment:	7.69	$15.52
C1.Mechanical:	13.86	$27.98
C2.Electrical:	5.33	$10.75
Z1. General Requirements and Fee:	7.41	$14.95

Supermarket		
Description:	Single Storey, Excluding Site	
Total Construction cost	$2,253,900.00	
Building Size:	33,000.00	
Cost per SF:	$68.30	
Element	%	S.F. Cost
A1.Substructure	9.55	$6.52
A2.Structure:	15.02	$10.26
A3.Exterior Enclosure:	11.04	$7.54
B1.Partitions and Doors:	4.92	$3.36
B2.Finishes:	15.18	$10.37
B3.Fittings and Equipment:	5.71	$3.90
C1.Mechanical:	19.46	$13.29
C2.Electrical:	11.70	$7.99
Z1. General Requirements and Fee:	7.41	$5.06

Fire Station		
Description:	1 storey, 6 appliances, Excluding Site	
Total Construction cost	$936,903.00	
Building Size:	8,900.00	
Cost per SF:	$105.27	
Element	%	S.F. Cost
A1.Substructure	7.69	$8.10
A2.Structure:	8.59	$9.04
A3.Exterior Enclosure:	23.70	$24.95
B1.Partitions and Doors:	7.18	$7.56
B2.Finishes:	6.11	$6.43
B3.Fittings and Equipment:	2.65	$2.79
C1.Mechanical:	22.21	$23.38
C2.Electrical:	14.46	$15.22
Z1. General Requirements and Fee:	7.41	$7.80

Psychiatric Hospital		
Description:	**2 storeys, 325 bed, Excluding Site**	
Total Construction cost	**$88,085,000.00**	
Building Size:	500,000.00	
Cost per SF:	**$176.17**	
Element	%	S.F. Cost
A1.Substructure	2.17	$3.82
A2.Structure:	10.38	$18.28
A3.Exterior Enclosure:	14.48	$25.51
B1.Partitions and Doors:	7.24	$12.76
B2.Finishes:	8.45	$14.89
B3.Fittings and Equipment:	11.92	$21.00
C1.Mechanical:	27.65	$48.71
C2.Electrical:	10.55	$18.58
Z1. General Requirements and Fee:	7.17	$12.63

High Rise Hospital		
Description:	**Concrete Frame, precast concrete cladding, 3 levels below grade, 21**	
Total Construction cost	**$159,779,620.00**	
Building Size:	885,500.00	
Cost per SF:	**$180.44**	
Element	%	S.F. Cost
A1.Substructure	2.16	$3.90
A2.Structure:	9.91	$17.89
A3.Exterior Enclosure:	8.01	$14.46
B1.Partitions and Doors:	7.56	$13.64
B2.Finishes:	4.79	$8.64
B3.Fittings and Equipment:	11.90	$21.48
C1.Mechanical:	33.67	$60.76
C2.Electrical:	15.45	$27.87
Z1. General Requirements and Fee:	6.55	$11.81

Health Center (Clinic)		
Description:	**2 storeys, urban, Excluding Site**	
Total Construction cost	**$3,022,000.00**	
Building Size:	25,000.00	
Cost per SF:	**$120.88**	
Element	%	S.F. Cost
A1.Substructure	1.43	$1.73
A2.Structure:	11.90	$14.38
A3.Exterior Enclosure:	10.99	$13.28
B1.Partitions and Doors:	9.81	$11.86
B2.Finishes:	8.90	$10.76
B3.Fittings and Equipment:	10.03	$12.13
C1.Mechanical:	28.62	$34.59
C2.Electrical:	10.92	$13.20
Z1. General Requirements and Fee:	7.40	$8.95

Regional Hospital / Acute Care Facility		
Description:	**2 storey, Excluding Site**	
Total Construction cost	**$27,043,200.00**	
Building Size:	160,000.00	
Cost per SF:	**$169.02**	
Element	%	S.F. Cost
A1.Substructure	1.57	$2.66
A2.Structure:	8.37	$14.15
A3.Exterior Enclosure:	12.82	$21.66
B1.Partitions and Doors:	7.29	$12.32
B2.Finishes:	6.23	$10.53
B3.Fittings and Equipment:	15.55	$26.29
C1.Mechanical:	27.73	$46.87
C2.Electrical:	12.91	$21.82
Z1. General Requirements and Fee:	7.53	$12.72

Senior Citizens Home		
Description:	170 units, 5 storeys, Excluding Site	
Total Construction cost	$15,408,370.00	
Building Size:	148,300.00	
Cost per SF:	$103.90	
Element	%	S.F. Cost
A1.Substructure	3.18	$3.30
A2.Structure:	10.52	$10.93
A3.Exterior Enclosure:	14.85	$15.43
B1.Partitions and Doors:	10.13	$10.52
B2.Finishes:	7.16	$7.44
B3.Fittings and Equipment:	9.45	$9.82
C1.Mechanical:	26.90	$27.95
C2.Electrical:	10.39	$10.80
Z1. General Requirements and Fee:	7.41	$7.70

International Airport Terminal Building		
Description:	3 levels, Excluding Site	
Total Construction cost	$97,987,500.00	
Building Size:	625,000.00	
Cost per SF:	$156.78	
Element	%	S.F. Cost
A1.Substructure	2.23	$3.50
A2.Structure:	14.82	$23.23
A3.Exterior Enclosure:	14.23	$22.31
B1.Partitions and Doors:	3.85	$6.04
B2.Finishes:	8.46	$13.27
B3.Fittings and Equipment:	12.34	$19.35
C1.Mechanical:	25.01	$39.21
C2.Electrical:	11.65	$18.26
Z1. General Requirements and Fee:	7.41	$11.61

Small Airport Terminal Building		
Description:	Steel framed metal clad, single storey, Excluding Site	
Total Construction cost	$5,415,540.00	
Building Size:	39,000.00	
Cost per SF:	$138.86	
Element	%	S.F. Cost
A1.Substructure	5.04	$7.00
A2.Structure:	13.86	$19.24
A3.Exterior Enclosure:	29.41	$40.84
B1.Partitions and Doors:	6.37	$8.84
B2.Finishes:	8.41	$11.68
B3.Fittings and Equipment:	12.65	$17.57
C1.Mechanical:	11.97	$16.62
C2.Electrical:	4.89	$6.79
Z1. General Requirements and Fee:	7.41	$10.29

Shopping Center		
Description:	Excluding Site	
Total Construction cost	$32,725,000.00	
Building Size:	500,000.00	
Cost per SF:	$65.45	
Element	%	S.F. Cost
A1.Substructure	7.47	$4.89
A2.Structure:	14.35	$9.39
A3.Exterior Enclosure:	13.95	$9.13
B1.Partitions and Doors:	0.64	$0.42
B2.Finishes:	1.83	$1.20
B3.Fittings and Equipment:	2.55	$1.67
C1.Mechanical:	35.86	$23.47
C2.Electrical:	15.94	$10.43
Z1. General Requirements and Fee:	7.41	$4.85

Elementary School		
Description:	17 classrooms, single storey, Excluding Site	
Total Construction cost	$5,312,536.60	
Building Size:	56,770.00	
Cost per SF:	$93.58	
Element	%	S.F. Cost
A1.Substructure	1.84	$1.72
A2.Structure:	11.48	$10.74
A3.Exterior Enclosure:	16.44	$15.38
B1.Partitions and Doors:	7.44	$6.96
B2.Finishes:	10.32	$9.66
B3.Fittings and Equipment:	8.79	$8.23
C1.Mechanical:	25.56	$23.92
C2.Electrical:	10.72	$10.03
Z1. General Requirements and Fee:	7.41	$6.93

Secondary / High School		
Description:	2 storeys, Excluding Site	
Total Construction cost	$14,632,500.00	
Building Size:	150,000.00	
Cost per SF:	$97.55	
Element	%	S.F. Cost
A1.Substructure	2.01	$1.96
A2.Structure:	13.40	$13.07
A3.Exterior Enclosure:	13.65	$13.32
B1.Partitions and Doors:	10.44	$10.18
B2.Finishes:	9.37	$9.14
B3.Fittings and Equipment:	8.13	$7.93
C1.Mechanical:	26.01	$25.37
C2.Electrical:	8.99	$8.77
Z1. General Requirements and Fee:	8.01	$7.81

University Lecture Hall Building		
Description:	**5 stories, Excluding Site**	
Total Construction cost	**$8,636,000.00**	
Building Size:	80,000.00	
Cost per SF:	**$107.95**	
Element	%	S.F. Cost
A1.Substructure	3.80	$4.10
A2.Structure:	17.28	$18.65
A3.Exterior Enclosure:	11.64	$12.57
B1.Partitions and Doors:	7.74	$8.35
B2.Finishes:	8.93	$9.64
B3.Fittings and Equipment:	6.66	$7.19
C1.Mechanical:	25.09	$27.09
C2.Electrical:	11.45	$12.36
Z1. General Requirements and Fee:	7.41	$8.00

Laboratory		
Description:	**3 storeys, Excluding Site**	
Total Construction cost	**$16,002,249.00**	
Building Size:	67,700.00	
Cost per SF:	**$236.37**	
Element	%	S.F. Cost
A1.Substructure	1.38	$3.26
A2.Structure:	10.44	$24.68
A3.Exterior Enclosure:	9.32	$22.04
B1.Partitions and Doors:	5.61	$13.25
B2.Finishes:	5.94	$14.03
B3.Fittings and Equipment:	15.89	$37.56
C1.Mechanical:	32.52	$76.86
C2.Electrical:	11.46	$27.08
Z1. General Requirements and Fee:	7.45	$17.61

College Library		
Description:	3 storeys, includes loose shelving and carrels, Excluding Site	
Total Construction cost	$2,942,920.00	
Building Size:	29,500.00	
Cost per SF:	$99.76	
Element	%	S.F. Cost
A1.Substructure	7.08	$7.06
A2.Structure:	19.24	$19.19
A3.Exterior Enclosure:	21.93	$21.88
B1.Partitions and Doors:	3.77	$3.76
B2.Finishes:	5.03	$5.02
B3.Fittings and Equipment:	6.19	$6.18
C1.Mechanical:	13.88	$13.85
C2.Electrical:	13.74	$13.71
Z1. General Requirements and Fee:	9.11	$9.09

Provincial Courthouse		
Description:	33 courtrooms, 7 storeys, concrete framed, limestone curtainwall	
Total Construction cost	$79,923,760.00	
Building Size:	472,000.00	
Cost per SF:	$169.33	
Element	%	S.F. Cost
A1.Substructure	1.58	$2.67
A2.Structure:	8.58	$14.53
A3.Exterior Enclosure:	12.82	$21.70
B1.Partitions and Doors:	7.29	$12.35
B2.Finishes:	6.23	$10.55
B3.Fittings and Equipment:	15.35	$25.99
C1.Mechanical:	27.73	$46.95
C2.Electrical:	12.91	$21.86
Z1. General Requirements and Fee:	7.53	$12.75

Church		
Description:	**1 storey structure with basement, Excluding Site**	
Total Construction cost	**$1,325,716.00**	
Building Size:	11,300.00	
Cost per SF:	**$117.32**	
Element	%	S.F. Cost
A1.Substructure	7.02	$8.23
A2.Structure:	13.42	$15.74
A3.Exterior Enclosure:	19.66	$23.07
B1.Partitions and Doors:	8.48	$9.95
B2.Finishes:	8.56	$10.04
B3.Fittings and Equipment:	8.80	$10.33
C1.Mechanical:	15.68	$18.39
C2.Electrical:	10.27	$12.05
Z1. General Requirements and Fee:	8.10	$9.50

LowRise Apartment		
Description:	**3 storeys, 33 units, Excluding Site**	
Total Construction cost	**$1,910,720.00**	
Building Size:	32,000.00	
Cost per SF:	**$59.71**	
Element	%	S.F. Cost
A1.Substructure	3.08	$1.84
A2.Structure:	19.68	$11.75
A3.Exterior Enclosure:	18.61	$11.11
B1.Partitions and Doors:	10.58	$6.32
B2.Finishes:	9.55	$5.70
B3.Fittings and Equipment:	4.67	$2.79
C1.Mechanical:	17.79	$10.62
C2.Electrical:	9.48	$5.66
Z1. General Requirements and Fee:	6.55	$3.91

High Rise Apartment		
Description:	**25 storeys, 300 units, Excluding Site**	
Total Construction cost	**$24,190,800.00**	
Building Size:	380,000.00	
Cost per SF:	**$63.66**	
Element	%	S.F. Cost
A1.Substructure	1.71	$1.09
A2.Structure:	20.31	$12.93
A3.Exterior Enclosure:	19.68	$12.53
B1.Partitions and Doors:	9.93	$6.32
B2.Finishes:	8.80	$5.60
B3.Fittings and Equipment:	6.38	$4.06
C1.Mechanical:	17.31	$11.02
C2.Electrical:	8.36	$5.32
Z1. General Requirements and Fee:	7.54	$4.80

High-Rise Condominium		
Description:	**140 units on 15 floors with one floor penthouse, one floor mechanical, 2**	
Total Construction cost	**$13,693,500.00**	
Building Size:	150,000.00	
Cost per SF:	**$91.29**	
Element	%	S.F. Cost
A1.Substructure	12.26	$11.19
A2.Structure:	18.21	$16.62
A3.Exterior Enclosure:	14.32	$13.07
B1.Partitions and Doors:	7.39	$6.75
B2.Finishes:	7.69	$7.02
B3.Fittings and Equipment:	9.52	$8.69
C1.Mechanical:	16.67	$15.22
C2.Electrical:	6.46	$5.90
Z1. General Requirements and Fee:	7.48	$6.83

Hotel		
Description:	150 rooms, 3 floors, Excluding Site	
Total Construction cost	$21,075,782.00	
Building Size:	163,100.00	
Cost per SF:	$129.22	
Element	%	S.F. Cost
A1.Substructure	2.70	$3.49
A2.Structure:	16.24	$20.98
A3.Exterior Enclosure:	20.81	$26.89
B1.Partitions and Doors:	6.48	$8.37
B2.Finishes:	8.20	$10.59
B3.Fittings and Equipment:	5.28	$6.82
C1.Mechanical:	21.01	$27.15
C2.Electrical:	11.88	$15.35
Z1. General Requirements and Fee:	7.41	$9.57

High Rise Office Complex		
Description:	30 office floors, 1 concourse level and 3 parking levels, Excluding Site	
Total Construction cost	$124,488,984.00	
Building Size:	1,403,800.00	
Cost per SF:	$88.68	
Element	%	S.F. Cost
A1.Substructure	3.68	$3.26
A2.Structure:	20.14	$17.86
A3.Exterior Enclosure:	16.02	$14.21
B1.Partitions and Doors:	4.72	$4.19
B2.Finishes:	9.26	$8.21
B3.Fittings and Equipment:	9.55	$8.47
C1.Mechanical:	19.88	$17.63
C2.Electrical:	9.33	$8.27
Z1. General Requirements and Fee:	7.41	$6.57

Corporate Office Complex		
Description:	**4 floors with basement offices and mechanical penthouse**	
Total Construction cost	**$15,233,505.00**	
Building Size:	123,900.00	
Cost per SF:	**$122.95**	
Element	%	S.F. Cost
A1.Substructure	1.97	$2.42
A2.Structure:	14.88	$18.30
A3.Exterior Enclosure:	21.30	$26.19
B1.Partitions and Doors:	5.06	$6.22
B2.Finishes:	8.11	$9.97
B3.Fittings and Equipment:	7.30	$8.98
C1.Mechanical:	21.45	$26.37
C2.Electrical:	12.52	$15.39
Z1. General Requirements and Fee:	7.41	$9.11

APPENDIX (E)

COPIES OF THE ACTUAL PROJECTS' DOCUMENTS & REPORTS GENERATED BY THE COMPUTER SYSTEM

Project: Tribospec		**AS PER SPECS**			**Draft :**	**FINAL**	JM__, AG__, CR__
Project No.:		99-62			**Dist :**	MG__, FQ__, CR__, LB__, AB__	
Project Duration: (Mth)		7			**Area :**	68,688 sq.ft	
					Printed :	**2/8/00 10:37 PM**	
		Qty	**Unit**	**Unit $**	**Total**	**Sub-Total**	
	General Conditions						
1.110	Project Manager	3	mth	8,500.00	25,500.00		
1.125	Superintendant	7	mth	8,500.00	59,500.00		
1.135	Carpenter	10	wks	1,200.00	12,000.00		
1.140	Labor	0	wks	1,100.00	0.00		
1.145	Site Clerk	7	mth		0.00		
1.150	Site Secretary	7	mth		0.00		
1.155	Security Officer	7	wks		0.00		
1.158	Site Employees	7	mth		0.00		
1.160	Site Watchman	7	mth				
1.180	Surveyor	1	mth	2,000.00	2,000.00		
1.205	Temporary Office	7	mth	600.00	4,200.00		
1.220	Communication				0.00		
	Number of Phone/Fax Lines	1					
	Cost of Phone Lines	7	mth	100.00	700.00		
	Cellular Phones/Pagers	7	mth	100.00	700.00		
1.222	Fax Machine (rent or buy)	7	mth	100.00	700.00		
1.223	Copy Machine (rent or buy)	7	mth	100.00	700.00		
1.224	Two-Way Radio	1			0.00		
1.225	Courrier Service	4	mth	200.00	800.00		
1.230	Office Supplies Expenses	4	mth	200.00	800.00		
1.231	Office Equipment		mth		0.00		
1.240	Grid Lines & Levels		lps		0.00		
1.300	Security & Protection		lps		0.00		
1.305	Guard Rails & Barricades	1	lps	1,000.00	1,000.00		
1.310	Hand Tools & Equipment	1	lps	500.00	500.00		
1.315	Winter/Weather Protection	4	mth		15,000.00		
	Tarps for concrete slab deck	5886	sqft				
	Tarps for beacon slab joints	2008	sqft				
	Tarps @ ext. wall openings	3000	sqft				
1.320	Temporary Fence		li-ft		n/a	use existing site fence	
1.325	Fire Protection	3	units	100.00	300.00		
1.330	First Aid Equipment	1	lps	200.00	200.00		
1.405	Temporary Water				0.00		
1.410	Temporary Electricity	1	lps	5,000.00	5,000.00		pole connection
1.411	Electricity Consumption	7	mth	500.00	3,500.00		
1.420	Temporary Toilet	7	mth	500.00	3,500.00		
1.425	Temporary Heat	4	mth		50,000.00	50,000.00	
	Heat concrete slab deck	5886	sqft				
	Heat beacon slab joints	2008	sqft				
	Heat conc block partitions	13606	sqft	1.50			
	Heat drywall partitions	1	lps				plug
1.430	Temporary Lighting	4	mth		2,000.00		plug
1.435	Temporary Sign	1	lps	1,500.00	1,500.00		

	1.555	Photographer Fees				0.00		
	1.560	Plans Copies	1	lps	2,000.00	2,000.00		
	1.565	Shop Drawing				0.00		
	1.567	As Built Drawings				0.00		
	1.568	Maintenance Manuals				0.00		
	1.603	Equipment Rental				0.00		
	1.635	Temporary Stairs				0.00		
	1.640	Temporary Partitions				0.00		
	1.641	Temporary Doors & Windows	1	lps	1,000.00	1,000.00		
	1.705	Current Cleanup				0.00		
	1.710	Final Cleanup	68688	sqft		5,000.00		
	1.725	Rent Dumpster	8	unit	300.00	2,400.00		
	1.731	Floor Repairs				0.00		
	1.740	Snow Removal & De-icing				0.00		
		Main Roof	60000	sqft		5,000.00		
		Exterior works	1	lps		2,000.00		
	1.815	Street Cut Permits				0.00		
					Sub-Total Division 1		207,500.00	
		Sitework						
	2.101	Site Preparation	1			498,000.00		Vespo
	2.228	Street Cut Water & Sewer	1					
	2.232	Stonefill/ Bldg. Fndns.	1					
	2.233	Granular Base/Bldg S.O.G.	1					
	2.234	Granular Base/Bldg.Paving	1					
	2.513	Streetcut	2		2,500.00	5,000.00		
	2.515	Paving						
	2.528	Sidewalk & Curbs						
	2.529	Precast Curbs						
	2.580	Painting Lines						
	2.666	Water Line System						
	2.690	Oil Distribution System						
		Oil interceptor reservoir	1	lps	20,000.00	20,000.00	estimate	Ross Barber
	2.700	Sewer						
	2.710	Foundation Drainage				0.00		
	2.830	Fence (Chainlink or Other)				0.00		
	2.935	Sodding	1	lps	5,000.00	5,000.00		
					Sub-Total Division 2		528,000.00	
		Concrete						
	3.100	Formwork					62,225.65	Lampron
		Exterior foundation walls	16,867	sqft	2.35	39,637.45		
		Ext. continuous footings	2214	sqft	2.35	5,202.90		
		Interior foundation walls	2661	sqft	2.35	6,253.35		
		Int. continuous ftgs	368	sqft	2.35	864.80		
		Int. spread footings	1582	sqft	2.35	3,717.70		
		Column piers	674	sqft	2.35	1,583.90		
		Balance bassin walls	1841	sqft	2.35	4,326.35		
		Balance bassin piers	272	sqft	2.35	639.20		
	3.150	Formwork By G.C.				0.00		
		Install coping anchors	180	units	5.00	900.00		

		Install ground rods	40	lft	5.00	200.00		
		Install angle coping	183	lft	5.00	915.00		
		Conc.column protection-4'H/ 24"dia.	33	units	250.00	8,250.00		
		Concrete curbs	20	lft	10.00	200.00		
		Place concrete for bollards	9	units	100.00	900.00		
		Trench & pit formwork	56	sqft	2.00	112.00		
		S.O.G. stairs	25	sqft	3.00	75.00		
		Loading dck platforms	87	sqft	4.00	348.00		
		Slab depression bulkheads	177	sqft	10.00	1,770.00		
		Form pockets @ stl col bases	129	units	50.00	6,450.00		
	3.200	Reinforcement Steel	1	lps		66,250.00		Acier Pacifique
		w/w/mesh 12x12w5.8x5.8	134392	sqft	0.20	included above		
		w/w/mesh 6x6w6/6	11709	sqft	0.16	included above		
		w/w/mesh 6x6w4/4	3942	sqft	0.17	included above		
		w/w/mesh stair pans	1200	sqft	0.16	included above		
	3.250	Concrete Accessories						
		Set & grout base plates	129	units	15.00	1,935.00		
		1/2" asphalt board	1850	lft	2.00	3,700.00		
	3.300	Concrete Material						Demix $50 discount
		Building structure 25 Mpa	562	cu-m	80.00	44,960.00		
		Slab on grades 25 Mpa	1228	cu-m	80.00	98,240.00		
		Stair pans & bollards 25 Mpa	3	cu-m	91.00	273.00		
		Steel deck conc 30 Mpa	66	cu-m	91.00	6,006.00		
		Air-entrained	100	cu-m	10.00	1,000.00		
		Pump-Mix		cu-m		0.00		
		Winter Concrete	1427	cu-m	4.00	5,708.00		
		Summer Concrete		cu-m		0.00		
		Sub-Total - Concrete Material					156,187.00	
	3.345	Concrete Floor Finishes				69,850.00		Expo
		Place & finish building S.O.G.	60714	sqft	0.45	included above		pump included
		Sawcuts filled	5133	lft	2.00	included above		
		Place & finish balance bassin slab	1384	sqft	1.00	included above		
		Place & finish conc. on deck	5886	sqft	0.60	included above		
		Floor hardener 6.5 kg/sm	57000	sqft	0.42	included above		
		Cure & seal	57000	sqft	0.12	included above		
		Place & finish concrete stair pans	304	sqft	2.00	included above		
	3.346	Joint Fill & Misc.				0.00		
	3.420	BETCON Slabs	2088	sqft	10.00	20,880.00		
					Sub-Total Division 3		401,147.65	
		Masonry						
	4.050	Masonry - winter conditions	42542	sqft		189,700.00	189,700.00	Savite
		exterior walls	14316	sqft	1.50	included above		by masonry subtrade
		interior walls	13908	sqft	1.50	included above		by general contractor
		4" split block façade	7158	sqft	6.00	included above		
		8" concrete blocks -ext.wall	7158	sqft	5.00	included above		
		2" Rigid insulation cavity ext.wall	7159	sqft	2.00	included below		
		Vapour barrier ?????	7159	sqft				not specified
	4.220	Interior concrete blocks	13908	sqft	6.00	included above		
					Sub-Total Division 4		189,700.00	

	Metals						
5.120	Structural Steel	68688	sqft		488,100.00		B.K.
5.210	Steel Joists				included above		
5.311	Steel Deck				included above		
5.500	Metal Fabrication	1	lps	45,000.00	45,000.00		Estimate
				Sub-Total Division 5		531,100.00	
	Wood & Plastic						
6.100	Rough Carpentry	1	lps	0.00	0.00		estimate
6.200	Finish Carpentry	1	lps	5,500.00	5,500.00		Samaco
	Pine window sills w/moulding	204	lft	19.61	4,000.44		MDF alternative credit $2000
6.240	Laminated Plastic				included above		
				Sub-Total Division 6		9,500.44	
	Thermal Moist.Protection						
7.190	Sheet Vapour Barrier				included		see drywall; polyethelene film
7.212	Board Insulation				0.00		
	2" rigid insulation foundations	2305	sqft	0.60	1,383.00		
	2" rigid insulation @ Hot Box Rm	1060	sqft	1.20	1,272.00		
	1/2" cement board @ Hot Box Rm	1060	sqft	1.50	1,590.00		
7.213	Batt & Matt Insulation	488			included		see rough carpentry
7.216	2" Sprayed urethene insul.	7158	sqft		18,626.00		Isolation L.M.
	3/4" urethane behind Dryvit	4007	sqft		included above		
	Urethane @ marquise joists	1	lps		included above		
7.466	Architecural Metal Siding				115,000.00		Nobel
	Sandwich panel w/V.B.	20511	sqft	5.60			
	Single skin	2501	sqft	3.00			
7.472	"Dryvit" Product	4007	sqft	10.00	40,070.00	plug	
7.510	Built-Up Bitum.Roofing	60714	sqft		175,950.00		Verdun
7.620	Metal Flashing & Trim				included above		
7.724	Roof Hatches	1	unit	693.00	693.00		Bolar
7.900	Sealants	1	lps	2,000.00	2,000.00		
				Sub-Total Division 7		356,584.00	
	Doors & Windows						
8.100	H.Metal Doors & Frames				0.00	15,533.00	Capsol
	20 gauge metal doors	21	units	150.00	3,150.00		
	18 gauge metal insulated doors	7	units	206.00	1,442.00		
	KALAMIEN- anit-explosive dr 8x10	1	unit	2,175.00	2,175.00		supply only incl hardware
	16 gauge pressed stl frame/single	56	units	117.00	6,552.00		
	16 gauge pressed stl frame/double	2	units	282.00	564.00		
	16 gauge pressed stl frame/special	10	units	165.00	1,650.00		
8.111	Installation Doors	62	units	75.00	4,650.00		
	Install KALAMIEN anti-explosive dr	1	unit	500.00	500.00		
8.112	Installation Frames	68	units		included		see divs 4 & 9
8.210	Solid masonite doors	33	units	115.15	3,800.05		Capsol; qualify specs for solid oak
	Bi-fold masonite door	1	unit		included above		
8.331	Rolling Doors: Metal Insulated	7	units		10,300.00		Multiporte
8.450	Impact Doors	1	unit	6,070.00	6,070.00		Montauban;install MCCL @$500
8.710	Finish Hardware	62	unis		18,775.00		Futura
	Aluminium sills	9	units	300.00	2,700.00		
8.120	Aluminium Doors & Frames				0.00		

		Aluminum entrance doors & frame	4	units		included below		
		Aluminum core	1	unit		included below		
	8.800	Glass & Glazing				included below		
		Metal door lites 6"x 2	7	units	50.00	included below		
		Wood door windows 2'x3'-6"	9	units	100.00	included below		
		Special frame windows	7	units	160.00	included below		
	8.900	Curtain Wall	1328	sqft		70,000.00		
		Windows	389	sqft		included above		
		Vestibule alum.ceiling panel 1/8"	70	sqft		included above		
		Marquise entrance 1/8" aluminum	75	sqft		included above		
		Vestibule glass partitions	242	sqft		included above		
						0.00	70,000.00	
					Sub-Total Division 8		132,328.05	
		Finishes						
	9.100	Drywall & Ceilings	1	lps	98,000.00	98,000.00		I.T.R.
	9.310	Ceramic				19,900.00		B.T. Ceramique
		Ceramic floor tile	1389	sqft	6.00	included above		
		Ceramic wall tile	1338	sqft	6.00	included above		
		Ceramic tile base	382	lft	6.00	included above		
		Ceramic tile stairs	204	sqft	6.00	included above		
	9.680	Resilient Sheet Flooring				30,500.00		Martellino
		Linoleum flooring	4406	sqft	2.00	included above		
		Vinyl base	2379	lft	2.00	included above		
	9.680	Carpet installation	370	sqyd	18.00	included above		
		$26/sqyd supply only allowance	370	sqyd	26.00	included above		
		Carpet base	95	lft	5.00	included above		
	9.900	Painting	1	lps	16,715.00	16,715.00		Eric Painting
	9.955	Vinyl Wall Covering	798	sqft	2.00	included above		
					Sub-Total Division 9		165,115.00	
		Specialties						
	10.160	Toilet Partitions	4	units		1,845.00		Champlain
		Umal screen	1	unit		included above		
	10.800	Toilet & Bath Accesories	1	lps	1,882.00	1,882.00		Champlain
					Sub-Total Division 10		3,727.00	
		Equipement						
	11.160	Loading Dock Equipment	1	lps		2,734.00		Serco
	11.161	Dock Levellers	4	units		7,405.00		Serco
					Sub-Total Division 11		10,139.00	
		Furnishings						
	12.680	Foot Grills	24	sqft		1,076.00		Bolar
					Sub-Total Division 12		1,076.00	
		Special Construction						
					Sub-Total Division 13		0.00	
		Conveying System						
					Sub-Total Division 14		0.00	
		Mechanical						
	15.250	Thermal Insulation				24,348.00		Isolation Bonaventure
	15.300	Sprinkler System				128,840.00		Trepco
	15.400	Plumbing & Heating				115,250.00		Gil-Mar

15.500	Ventilation				164,600.00		Seconair
15.900	Controls				44,300.00		B.B.P. Energie
				Sub-Total Division 15		477,338.00	
	Electrical						
16.100	Electrical				334,500.00		A&Y Pronovost
				Sub-Total Division 16		334,500.00	
	Communications						
				Sub-Total Division 17		0.00	
	Allowances						
				Sub-Total Division 18		0.00	
				Sub-Total	**3,347,755.14**	**+ Taxes**	
	Other Cost						
	Insurance	2.00	/1000		6,696		
	Construction Permit	0.00	/1000		0	n/a	
	Others		lps		0	6,696	
				Sub-Total	**3,354,451**		
	Administration & Profit	3.00	%		100,634		
				Sub-Total	**3,455,084**		
	Performance Bond		/1000		0		separate price
	Labor & Materiel Bond		/1000		0		separate price
				Sub-Total - Bonding		0.00	
				Sub-Total	**3,455,084**		
				GST (7%)	241,856		
				QST (7.5%)	277,271		
				Total	**3,974,211**		

General Condition Summary	
Other cost	$6,696
Bonding	$0
Division . 1	$207,500
Administration & Profit	$100,634
Total	$314,829

AS PER SPECS	**99-62**			
Estimate Summary				
Sub-Total Division 1	314,829.03	9.11%	4.58 /sq ft	Incl Adm, Profit, Bond & Others
Sub-Total Division 2	528,000.00	15.28%	7.69 /sq ft	
Sub-Total Division 3	401,147.65	11.61%	5.84 /sq ft	
Sub-Total Division 4	189,700.00	5.49%	2.76 /sq ft	
Sub-Total Division 5	531,100.00	15.37%	7.73 /sq ft	
Sub-Total Division 6	9,500.44	0.27%	0.14 /sq ft	
Sub-Total Division 7	356,584.00	10.32%	5.19 /sq ft	
Sub-Total Division 8	132,328.05	3.83%	1.93 /sq ft	
Sub-Total Division 9	165,115.00	4.78%	2.40 /sq ft	
Sub-Total Division 10	3,727.00	0.11%	0.05 /sq ft	
Sub-Total Division 11	10,139.00	0.29%	0.15 /sq ft	
Sub-Total Division 12	1,076.00	0.03%	0.02 /sq ft	

Sub-Total Division 13	0.00	0.00%	0.00 /sq.ft	
Sub-Total Division 14	0.00	0.00%	0.00 /sq.ft	
Sub-Total Division 15	477,338.00	13.82%	6.95 /sq.ft	
Sub-Total Division 16	334,500.00	9.68%	4.87 /sq.ft	
Sub-Total Division 17	0.00	0.00%	0.00 /sq.ft	Communication
Sub-Total Division 18	0.00	0.00%	0.00 /sq.ft	Allowance
Sub-Total	3,455,084.17	100.00%	50.30 /sq.ft	
TPS	241,855.89	**TRUE**		
TVQ	277,270.50			
Total	3,974,210.57	TRUE		

PROJECT'S ESTIMATED COST SUMMARY

Project Name	Tribospec	**Architect**	Magil Construction Corp.	**Total Area**	68688.00 Sq.ft
Project Address	LaSalle	**Estimator**	Magil Construction Corp.	**Date**	Tuesday, February 08, 2000
Owner		**No. Of Stories**	1.00	**Time**	7:40 PM

DIVISION NAME	DIVISION #	DIVISION TOTAL	DIVISION %
Site Work	Division 02	$528,000.00	16.43%
Concrete	Division 03	$419,788.86	13.06%
Masonry	Division 04	$235,301.40	7.32%
Metals	Division 05	$532,684.80	16.58%
Wood and Plastics	Division 06	$9,500.44	0.30%
Thermal Moisture Protection	Division 07	$364,054.00	11.33%
Doors and Windows	Division 08	$135,096.95	4.20%
Finishes	Division 09	$163,189.20	5.08%
Specialties	Division 10	$3,722.00	0.12%
Equipment	Division 11	$10,138.00	0.32%
Conveying Systems	Division 14		
Mechanical	Division 15	$477,338.00	14.86%
Electrical	Division 16	$334,500.00	10.41%
	Divisions Sub-Total	$3,213,313.65	

Project Name	Tribospec	**Architect**	Magil Construction Corp.	**Total Area**	68688.00	Sq.ft
Project Address	LaSalle	**Estimator**	Magil Construction Corp.	**Date**	Tuesday, February 08, 2000	
Owner		**No. Of Stories**	1.00	**Time**	7:42 PM	

Sales Tax Value:	$530,196.75
Profit Value:	$96,399.41
Overhead value:	$192,798.82
Architecture Fee value:	$0.00
Contingency Value:	$32,133.14

Cost per SF	Total Project Cost
$51.46	$4,064,841.77

PROJECT NAME: Tribospec **PROJECT OWNER :** **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : LaSalle **PROJECT AREA :** 68688 Sq.ft **TIME :** 8:23 PM

Division 02 : SITE WORK

Item ID	Item Description	Units	Unit Price	Quantity	Total
0210100000	Site Preparation	lps	$498,000.00	1	$498,000.00
0251300000	Streetcut	lps	$2,500.00	2	$5,000.00
0269000000	Oil Interceptor Reservoir	lps	$20,000.00	1	$20,000.00
0293500000	Sodding	lps	$5,000.00	1	$5,000.00

Sub-Total Division 02 : $528,000.00

DIVISION 03 : CONCRETE

Item ID	Item Description	Units	Unit Price	Quantity	Total
0311000005	Formwork, Strip (Wall) Footings, Leveled Footings	SF	$4.60	2582	$11,877.20
0311000015	Formwork for Spread (Column) footings, Column Footings	SF	$4.60	1582	$7,277.20
0311000030	Formwork Foundation Walls and Grade Beams, Not exceeding 12' high, Concealed Finish	SF	$4.44	19528	$86,704.32
0311000050	Trench and Pit Formork	SF	$2.00	56	$112.00
0311000060	Formwork for Slab on Grade's Stairs	SF	$3.00	25	$75.00
0311000065	Formwork for Loading Deck Platforms	SF	$4.00	87	$348.00
0311000070	Slab depression Bulkheads	SF	$10.00	177	$1,770.00
0311000075	Form Pockets @ Steel Column Bases	units	$50.00	129	$6,450.00
0311000350	Formwork for Column Piers	SF	$2.35	674	$1,583.90
0311000355	Balance Bassin Walls	SF	$2.35	1841	$4,326.35
0311000360	Balance Bassin Piers	SF	$2.35	272	$639.20
0315000005	Formwork, Coping Anchors (Installation)	units	$5.00	180	$900.00
0315000010	Formwork, Ground Rods (Installation)	LF	$5.00	40	$200.00
0315000015	Formwork, Angle Coping (Installation)	LF	$5.00	183	$915.00
0315000100	Formwork, Concrete Column Protection-4'H/24" diameter	units	$250.00	33	$8,250.00
0315000105	Formwork, Concerete Curbs	LF	$10.00	20	$200.00
0322000001	W/W/Mesh 12x12 w 5.8x5.8	SF	$0.20	134392	$26,878.40
0322000003	W/W/Mesh 6x6w 4/4	SF	$0.17	3942	$670.14
0322000005	In slabs, 6" x 6" mesh, 6/6 gauge	SF	$0.25	11709	$2,927.25
0322000040	W/W/Mesh Stair Pans	SF	$0.16	1200	$192.00
0325000035	Asphalt and Fiber types to exterior, 1/2" thick control joint,(ie to facades), 6" wide	LF	$2.00	1850	$3,700.00
0325000060	Concrete Accessories, Set & Grout Base Plates	units	$15.00	129	$1,935.00
0331000080	Place Concrete for Bollards	units	$100.00	9	$900.00

PROJECT NAME: Tribospec **PROJECT OWNER :** **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : LaSalle **PROJECT AREA :** 68688 Sq.ft **TIME :** 8:27 PM

Item ID	Item Description	Units	Unit Price	Quantity	Total
0331000100	Concrete Material, Building structure 25 Mpa	C.M	$80.00	562	$44,960.00
0331000110	Concrete Material, Slab on Grades 25 Mpa	C.M	$80.00	1228	$98,240.00
0331000120	Concrete Material, Stair pans & bollards 25 Mpa	C.M	$91.00	3	$273.00
0331000130	Concrete Materials, Steel Deck Concrete 30 Mpa	C.M	$91.00	66	$6,006.00
0331000140	Concrete Materials, Air-entrained	C.M	$10.00	100	$1,000.00
0331000150	Winter Concrete	C.M	$4.00	1427	$5,708.00
0334500100	Place and Finish Building Slab on Grade	SF	$0.45	60714	$27,321.30
0334500110	Sawcuts Filled	LF	$2.00	5133	$10,266.00
0334500120	Place and Finish Balance Bassin Slab	SF	$1.00	1384	$1,384.00
0334500130	Place and Finish Concrete on Deck	SF	$0.60	5886	$3,531.60
0334500140	Floor Hardener 6.5 kg/sm	SF	$0.42	57000	$23,940.00
0334500150	Cure and Seal	SF	$0.12	57000	$6,840.00
0334500160	Place and Finish Concrete Stair Pans	SF	$2.00	304	$608.00
0342000010	BETCON Slabs	SF	$10.00	2088	$20,880.00

Sub-Total Division 03 : $419,788.86

DIVISION 04 : MASONRY

Item ID	Item Description	Units	Unit Price	Quantity	Total
0421000001	Winter Conditions, Exterior Walls	SF	$1.50	14316	$21,474.00
0421000002	Winter Conditions, Interior Walls	SF	$1.50	13908	$20,862.00
0422000005	Interior Concrete Blocks	SF	$6.00	13908	$83,448.00
0422000020	Plain (lightweight) concrete blocks, Backup, 8" (Exterior Walls)	SF	$6.80	7158	$48,674.40
0422000070	Rigid Insulation Cavity Extrior Walls, 2"	SF	$2.00	7158	$14,316.00
0422000105	Architectural split faced concrete blocks, Freestanding jointed and pointed, 4" Split Block Façade	SF	$6.50	7158	$46,527.00

Sub-Total Division 04 : $235,301.40

DIVISION 05 : METALS

Item ID	Item Description	Units	Unit Price	Quantity	Total
0512000300	Structural Steel, including Steel Joists and Steel Deck	SF	$7.10	68688	$487,684.80
0550000000	METAL FABRICATIONS	lps	$45,000.00	1	$45,000.00

Sub-Total Division 05 : $532,684.80

DIVISION 06 : WOOD AND PLASTICS

PROJECT NAME: Tribospec **PROJECT OWNER :** **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : LaSalle **PROJECT AREA :** 68688 **Sq.ft** **TIME :** 7:32 PM

Item ID	Item Description	Units	Unit Price	Quantity	Total
0610000010	Finish Carpentry	lps	$5,500.00	1	$5,500.00
0642000070	Pine Window Sills w/moulding	LF	$19.61	204	$4,000.44

Sub-Total Division 06 : $9,500.44

DIVISION 07 :THERMAL AND MOISTURE PROTECTION

Item ID	Item Description	Units	Unit Price	Quantity	Total
0721200010	Board Insulation, 2" rigid insulation foundations	SF	$0.60	2305	$1,383.00
0721200015	Board Insulation, 2" rigid insulation @Hot Box Rm	SF	$1.20	1060	$1,272.00
0721200020	Board Insulation, 1/2" Cement board @Hot Box Rm	SF	$1.50	1060	$1,590.00
0721600010	2" Sprayed urethene insulation	SF	$2.60	7158	$18,610.80
0746600010	Architectural Metal Siding, Sandwich panel w/V.B.	SF	$5.60	20511	$114,861.60
0746600050	Aechitectural Metal Siding, Single skin	SF	$3.00	2501	$7,503.00
0747200010	"Dryvit" Product	SF	$10.00	4007	$40,070.00
0751000000	BUILT-UP BITUMINOUS ROOFING	SF	$2.90	60714	$176,070.60
0772400010	Roof Hatches	unit	$693.00	1	$693.00
0790000010	Sealants	lps	$2,000.00	1	$2,000.00

Sub-Total Division 07 : $364,054.00

DIVISION 08 :DOORS AND WINDOWS

Item ID	Item Description	Units	Unit Price	Quantity	Total
0810000010	20 gauge metal doors	units	$150.00	21	$3,150.00
0810000015	18 gauge metal insulated doors	units	$206.00	7	$1,442.00
0810000020	KALAMIEN-anti-exdosive door 8x10	unit	$2,175.00	1	$2,175.00
0810000025	16 gauge pressed steel frame/single	units	$117.00	56	$6,552.00
0810000030	16 gauge pressed steel frame/double	units	$282.00	2	$564.00
0810000035	16 gauge pressed steel frame/special	units	$165.00	10	$1,650.00
0811100010	Installation Doors	units	$75.00	62	$4,650.00
0811100020	Install KALAMIEN anti-explosive door	unit	$500.00	1	$500.00
0821000002	Solid masonite doors	units	$115.15	33	$3,799.95
0833100005	Rolling Doors: Metal Insulated	unit	$1,472.00	7	$10,304.00
0845000010	Impact Doors	unit	$6,070.00	1	$6,070.00
0871000000	Finish Hardware	unit	$303.00	62	$18,786.00
0871000002	Aluminium Sills	unit	$300.00	9	$2,700.00

PROJECT NAME: Tribospec **PROJECT OWNER :** **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : LaSalle **PROJECT AREA :** 68688 **Sq.ft** **TIME :** 7:35 PM

Item ID	Item Description	Units	Unit Price	Quantity	Total
0880000010	Metal Door Lites 6"x2	unit	$50.00	7	$350.00
0880000020	Wood Door Windows 2'x3'-6"	unit	$100.00	9	$900.00
0880000030	Special frame windows	unit	$160.00	7	$1,120.00
0890000005	Curtain Walls	SF	$53.00	1328	$70,384.00

Sub-Total Division 08 : $135,096.95

DIVISION 09 :FINISHES

Item ID	Item Description	Units	Unit Price	Quantity	Total
0910000005	Drywall and Ceilings	lps	$98,000.00	1	$98,000.00
0931000025	CERAMIC TILE, Glazed wall tile 1/4" thick, Thinset : 6" x 6"	SF	$6.40	1389	$8,889.60
0931000050	Ceramic Wall Tile	SF	$6.00	1338	$8,028.00
0931000065	Ceramic Tile Base	LF	$6.00	382	$2,292.00
0931000070	Ceramic Tile Stairs	SF	$6.00	204	$1,224.00
0965000010	Vinyl Base flooring	LF	$2.00	2379	$4,758.00
0966500010	Resilient Flooring, Linoleum, 0.090" thick : Embossed patterns	SF	$2.62	4406	$11,543.72
0968000010	Carpet Installation	S.Y	$26.00	370	$9,620.00
0968000015	Carpet Base	LF	$5.00	95	$475.00
0990000010	Painting	lps	$16,715.00	1	$16,715.00
0996000010	Vinyl wall Coverings, 54" wide, plain or decorated, To walls : 15 oz per linear yard	SF	$2.06	798	$1,643.88

Sub-Total Division 09 : $163,189.20

DIVISION 10 :SPECIALTIES

Item ID	Item Description	Units	Unit Price	Quantity	Total
1016000010	Metal Toilet Partitions, Floor mounted, overhead braced : Standard cubicle	EA	$460.00	4	$1,840.00
1080000010	Toilet and Bath Accessories	lps	$1,882.00	1	$1,882.00

Sub-Total Division 10 : $3,722.00

DIVISION 11 :EQUIPMENT

Item ID	Item Description	Units	Unit Price	Quantity	Total
1116000000	LOADING DOCK EQUIPMENT	lps	$2,734.00	1	$2,734.00
1116100005	Dock Levellers	unit	$1,851.00	4	$7,404.00

Sub-Total Division 11 : $10,138.00

DIVISION 14 :CONVEYING SYSTEMS

PROJECT NAME: Tribospec **PROJECT OWNER :** **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : LaSalle **PROJECT AREA :** 68688 **Sq.ft** **TIME :** 7:37 PM

Sub-Total Division 14 :

DIVISION 15 :MECHANICAL

Item ID	Item Description	Units	Unit Price	Quantity	Total
1525000010	Thermal Insulation	lps	$24,348.00	1	$24,348.00
1533000005	Sprinkler System	lps	$128,840.00	1	$128,840.00
1540000010	Plumbing and Heating	lps	$115,250.00	1	$115,250.00
1550000010	Ventilation	lps	$164,600.00	1	$164,600.00
1590000010	Controls	lps	$44,300.00	1	$44,300.00

Sub-Total Division 15 : $477,338.00

DIVISION 16 : ELECTRICAL

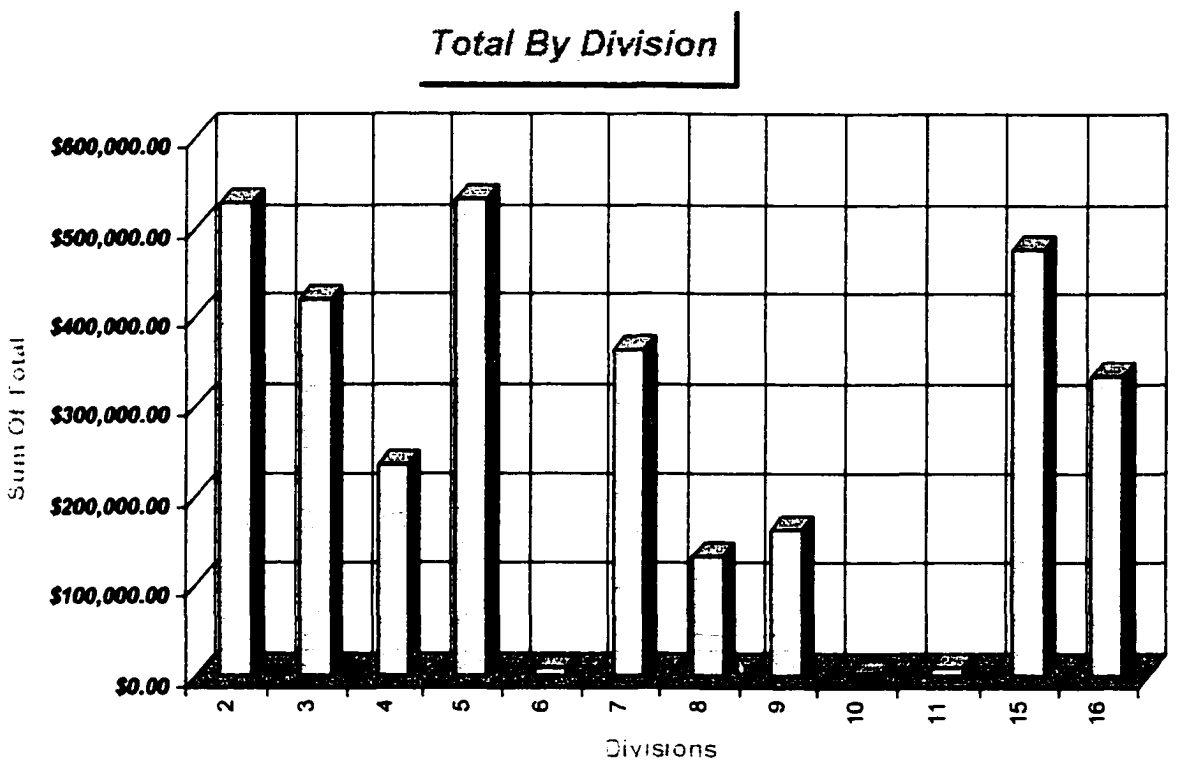
Item ID	Item Description	Units	Unit Price	Quantity	Total
1610000010	Electrical subcontract	lps	$334,500.00	1	$334,500.00

Sub-Total Division 16 : $334,500.00

SUB - TOTAL : $3,213,313.65

PROJECT'S CHART DISTRIBUTION BY DIVISION TOTAL

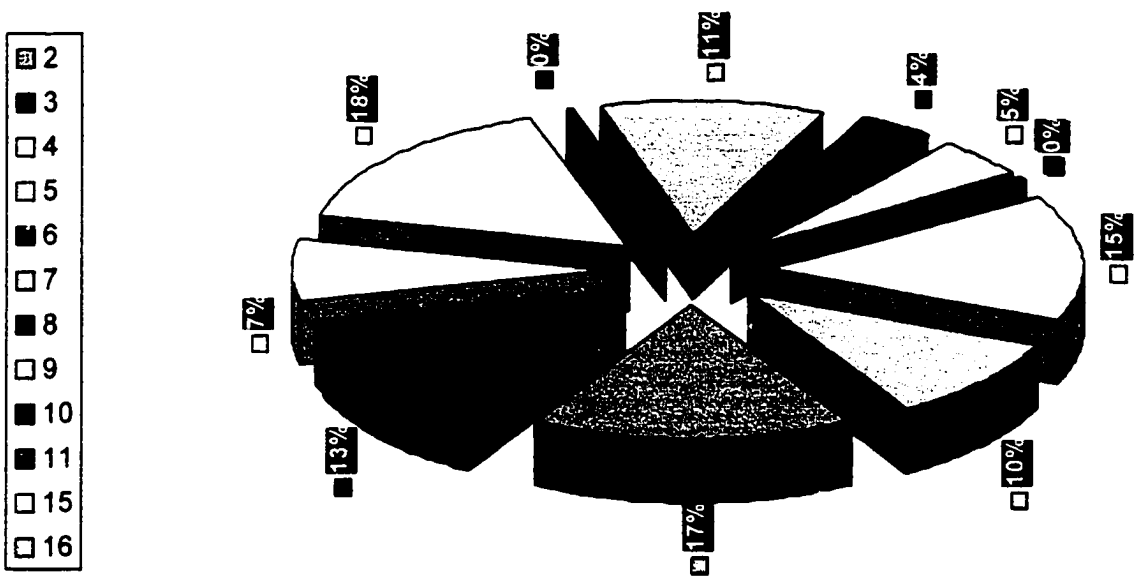
Project Name	Tribospec	**Estimator**	Magil Construction Corporati	
Project Address	LaSalle	**No. Of Stories**	1.00	
Owner		**Total Area**	68688.00	Sq.ft
Architect	Magil Construction Corporati	**Date**	Tuesday, February 08, 2000	



PROJECT'S PIE DISTRIBUTION BY DIVISION TOTAL

Project Name	Tribospec	**Estimator**	Magil Construction Corporation	
Project Address	LaSalle	**No. Of Stories**	1	
Owner		**Total Area**	68688.00	Sq.ft
Architect	Magil Construction Corporation	**Date**	Tuesday, February 08, 2000	

Total By Division



CRESSEY DEVELOPMENT CORPORATION
CONCEPTUAL ESTIMATE BREAKDOWN
University Marketplace
BURNABY, B. C.
TRILOGY Development Corporation

Section	Description	Parkade Total Cost	Area 124,840 Unit Costs	Units 400	Commercial Total Cost	Area 83,603 Unit Costs	Residential Total Cost	Area 76,197 Unit Costs	Units 400	TOTAL Total Cost	GBA 284840 Unit Costs	CBA 160000	Units 104
	Division 1 - General Requirements												
010000	Demolition	344,000	2.76	860	286,000	3.52	537,000	7.00	5,163	1,177,000	4.12	7.32	11,317
010950	Connection Fees (By Owner)												
006000	Bonds and Insurance	7,000	0.08	18	8,000	0.10	13,000	0.17	125	27,000	0.09	0.17	260
	TOTAL DIVISION 1	351,000	2.84	818	294,000	3.62	550,000	7.17	5,288	1,204,000	4.21	7.49	11,577
	Division 2 - Sitework												
020500	Demolition	81,000	0.65	203						81,000	0.28	0.50	771
021500	Shoring and Underpinning	277,000	2.22	693						277,000	0.97	1.72	2,663
022000	Earthwork	698,000	5.80	1,748						698,000	2.45	4.35	6,721
025000	Paving and Curbs	20,000	0.16	50	68,000	0.81				88,000	0.31	0.55	846
026000	Site Services	14,000	0.11	35						1,400	0.05	0.09	135
027000	Foundation Drains	24,000	0.19	60						24,000	0.08	0.15	291
028000	Site Improvements				17,000	0.20	3,000	0.04	29	20,000	0.07	0.12	192
029000	Landscaping & Irrigation				19,000	0.23	87,000	1.13	837	106,000	0.37	0.66	1,010
	TOTAL DIVISION 2	1,114,000	9.13	2,789	104,000	1.24	90,000	1.17	866	1,295,400	4.58	8.14	12,629
	Division 3 - Concrete												
032000	Conrete Reinforcement	577,000	4.62	1,443	337,000	4.00	543,000	7.00	5,221	1,457,000	5.10	9.08	14,010
033000	Cast-in-Place Concrete	1,507,000	12.07	3,768	1,367,000	16.24	1,721,000	22.44	16,548	4,595,000	16.08	28.57	44,183
	TOTAL DIVISION 3	2,084,000	16.69	5,231	1,704,000	20.24	2,264,000	29.44	21,769	6,052,000	21.18	37.65	58,193
	Division 4 - Masonry												
042000	Unit Masonry	50,000	0.40	125	527,000	6.26	655,000	11.15	8,221	1,435,000	5.02	8.91	13,779
044000	Exterior Stone				44,000	0.52				44,000	0.15	0.27	423
	TOTAL DIVISION 4	50,000	0.40	125	571,000	6.78	655,000	11.15	8,221	1,479,000	5.17	9.18	14,202
	Division 5 Metals												
055000	Metal Fabrications	13,000	0.10	33	80,000	0.95	191,000	2.49	1,637	284,000	6.99	1.77	2,731
	TOTAL DIVISION 5	13,000	0.10	33	80,000	0.95	191,000	2.49	1,637	284,000	6.99	1.77	2,731
	Division 6 - Wood & Plastics												
061000	Rough Carpentry				9,000	0.11	59,000	0.77	567	68,000	0.24	0.42	654
062000	Finish Carpentry						45,000	0.69	433	45,000	0.16	0.28	433
	TOTAL DIVISION 6				9,000	0.11	104,000	1.46	1,000	113,000	0.40	0.70	987
	Division 7 - Thermal & Moisture Protection												
071000	Waterproofing	49,000	0.39	123						49,000	0.17	0.30	471
071500	Dampproofing	7,000	0.06	18						7,000	0.02	0.04	67
072150	Sprayed Thermal Insulation	96,000	0.79	245	3,000	0.04				101,000	0.35	0.63	971
072700	Firestopping	3,000	0.02	8	10,000	0.12	16,000	0.21	154	28,000	0.10	0.17	269
074000	Preformed Roofing & Siding				30,000	0.36				30,000	0.11	0.19	288
075000	Membrane Roofing & Flashings				43,000	0.51	421,000	5.49	4,048	464,000	1.62	2.98	4,482
075700	Traffic Coatings	144,000	1.15	360						144,000	0.50	0.90	1,085
077000	Roof Specialties & Accessories						1,000	0.01	10	1,000	0.00	0.01	10
078000	Caulking & Sealants	5,000	0.04	13	10,000	0.12	10,000	0.13	96	25,000	0.09	0.16	240
	TOTAL DIVISION 7	304,000	2.45	767	96,000	1.15	448,000	5.84	4,308	849,000	2.98	5.38	7,883

	Division 8 - Doors & Windows												
081000	Metal Doors & Frames	7,000	0.08	18	5,000	0.08	17,000	0.22	163	29,000	0.10	0.10	279
082000	Wood Doors & Frames						197,000	1.79	1,317	187,000	0.48	0.85	1,317
083000	Special Doors	6,000	0.04	13	10,000	0.12				16,000	0.05	0.09	144
085000	Metal Windows						384,000	5.01	3,692	384,000	1.34	2.99	3,092
087000	Hardware	6,000	0.05	15	4,000	0.05	52,000	0.88	500	62,000	0.22	0.39	596
088000	Glazing	2,000	0.02	5	1,000	0.01	11,000	0.14	106	14,000	0.05	0.09	135
088500	Glazed Aluminium Railing						27,000	0.35	260	27,000	0.09	0.17	260
089000	Curtain Walls				420,000	4.99				420,000	1.47	2.81	4,098
	Total division 8	21,000	0.19	51	440,000	5.25	668,000	8.39	6,058	1,139,000	3.80	7.49	9,941
	Division 9 - Finishes												
092500	Steel Stud and Drywall	16,000	0.12	39	377,000	4.48	771,000	10.05	7,413	1,163,000	4.07	7.23	11,183
093000	Tile						108,000	1.41	1,038	108,000	0.38	0.67	1,038
096800	Carpet						122,000	1.59	1,173	122,000	0.43	0.76	1,173
098000	Painting	56,000	0.45	140	13,000	0.15	110,000	1.43	1,058	179,000	0.63	1.11	1,724
	TOTAL DIVISION 9	72,000	0.57	179	390,000	4.63	1,111,000	14.48	10,682	1,572,000	5.51	9.77	15,118
	Division 10 - Specialties												
105300	Awnings & Canopies				36,000	0.43				36,000	0.13	0.22	346
105500	Postal Specialties						4,000	0.05	38	4,000	0.01	0.02	38
108000	Toilet and Bath Accessories						18,000	0.17	125	13,000	0.05	0.08	125
109000	Closet Specialties						7,000	0.09	67	7,000	0.02	0.04	67
	TOTAL DIVISION 10				36,000	0.43	29,000	0.31	230	60,000	0.21	0.36	576
	Division 11 - Equipment												
110100	Window Washing Equipment						8,000	0.10	72	8,000	0.03	0.05	77
111000	Loading Dock Equipment				7,000	0.08				7,000	0.02	0.04	17
114500	Residential Appliances						289,000	3.86	2,046	296,000	1.04	1.04	2,846
	TOTAL DIVISION 11				7,000	0.08	297,000	3.96	2,118	311,000	1.09	1.13	2,940
150000	Mechanical	287,000	2.30	718	778,000	9.25	844,000	11.00	8,115	1,909,000	868.00	11.87	18,856
	TOTAL DIVISION 15	287,000	2.30	718	778,000	9.25	844,000	11.00	8,115	1,909,000	868.00	11.87	18,856
	Division 16 - Electrical												
160000	Electrical	175,000	1.40	438	337,000	4.00	654,000	8.53	6,288	1,166,000	4.00	7.23	11,212
	TOTAL DIVISION 16	175,000	1.40	438	337,000	4.00	654,000	8.53	6,288	1,166,000	4.00	725.00	11,212
	Division 17 - Management Fee												
170000	Management Fee	134,000	1.07	335	147,000	1.75	258,000	3.36	2,481	540,000	1.89	3.38	5,102
	TOTAL DIVISION 17	134,000	1.07	335	147,000	1.75	258,000	3.36	2,481	540,000	1.89	3.38	5,102
	TOTAL	4,605,000			5,051,000		8,689,000	**TOTAL COST**		**18,537,400**			

PROJECT'S ESTIMATED COST SUMMARY

Project Name	University Marketplace	**Architect**	Trilogy Development Corp.	**Total Area**	160000.00 Sq.ft
Project Address	Vancouver, B.C.	**Estimator**	Cressey Development Corp.	**Date**	Tuesday, February 08, 2000
Owner	University of British Columbia	**No. Of Stories**	6.00	**Time**	7:17 PM

DIVISION NAME	DIVISION #	DIVISION TOTAL	DIVISION %
Site Work	Division 02	$1,307,662.66	7.74%
Concrete	Division 03	$6,032,911.20	35.70%
Masonry	Division 04	$1,652,923.56	9.78%
Metals	Division 05	$284,840.00	1.69%
Wood and Plastics	Division 06	$113,756.23	0.67%
Thermal Moisture Protection	Division 07	$921,554.64	5.45%
Doors and Windows	Division 08	$1,168,031.99	6.91%
Finishes	Division 09	$1,591,650.14	9.42%
Specialties	Division 10	$68,723.94	0.41%
Equipment	Division 11	$309,968.30	1.83%
Conveying Systems	Division 14	$288,900.00	1.71%
Mechanical	Division 15	$1,909,000.00	11.30%
Electrical	Division 16	$1,250,000.00	7.40%
	Divisions Sub-Total	$16,899,922.66	

Project Name	**University Marketplace**	**Architect**	**Trilogy Development Corp.**	**Total Area**	**160000.00 Sq.ft**
Project Address	**Vancouver, B.C.**	**Estimator**	**Cressey Development Corp.**	**Date**	**Tuesday, February 08, 2000**
Owner	**University of British Columbia**	**No. Of Stories**	**6.00**	**Time**	**7:20 PM**

		Cost per SF	Total Project Cost
Sales Tax Value:	$0.00		
Profit Value:	$506,997.68		
Overhead value:	$1,013,995.36		
Architecture Fee value:	$168,999.23	$116.19	$18,589,914.93
Contingency Value:	$0.00		

PROJECT NAME: University Marketplace **PROJECT OWNER :** University of British Columbia **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : Vancouver, B.C. **PROJECT AREA :** 160000 **Sq.ft** **TIME :** 7:03 PM

Division 02 : SITE WORK

Item ID	Item Description	Units	Unit Price	Quantity	Total
0206000000	Building Demolition	SF	$0.65	124840	$81,146.00
0215100010	Shoring and Underpinning	SF	$2.22	124840	$277,144.80
0220000000	Earthwork	SF	$5.60	124840	$699,104.00
0250000010	Paving and Curbs	SF	$0.42	208643	$87,630.06
0260000010	Site Services	SF	$0.11	124840	$13,732.40
027000010	Foundation Drains	SF	$0.19	124840	$23,719.60
0280000010	Site Improvements	SF	$0.10	208643	$20,864.30
0290000010	Landscaping and Irrigation	SF	$0.50	208643	$104,321.50

Sub-Total Division 02 : $1,307,662.66

DIVISION 03 : CONCRETE

Item ID	Item Description	Units	Unit Price	Quantity	Total
0320000010	Concrete Reinforcement	SF	$5.10	284840	$1,452,684.00
0330000010	Cast-in-Place Concrete	SF	$16.08	284840	$4,580,227.20

Sub-Total Division 03 : $6,032,911.20

DIVISION 04 : MASONRY

Item ID	Item Description	Units	Unit Price	Quantity	Total
0421000075	Face brick wall, 4" Giant clay brick 15-5/8" x 3-5/8" x 7-5/8", Veneer	SF	$5.65	284840	$1,609,346.00
0440000010	Exterior Stones	SF	$0.52	83803	$43,577.56

Sub-Total Division 04 : $1,652,923.56

DIVISION 05 : METALS

Item ID	Item Description	Units	Unit Price	Quantity	Total
055000010	Metals Fabrications	SF	$1.00	284840	$284,840.00

Sub-Total Division 05 : $284,840.00

DIVISION 06 : WOOD AND PLASTICS

Item ID	Item Description	Units	Unit Price	Quantity	Total
0610000005	Rough Carpentry	SF	$0.43	160000	$68,800.00
0620000010	Finish Carpentery	SF	$0.59	76197	$44,956.23

Sub-Total Division 06 : $113,756.23

DIVISION 07 :THERMAL AND MOISTURE PROTECTION

PROJECT NAME: University Marketplace **PROJECT OWNER :** University of British Columbia **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : Vancouver, B.C. **PROJECT AREA :** 160000 Sq.ft **TIME :** 7:06 PM

Sub-Total Division 06 : $113,756.23

DIVISION 07 :THERMAL AND MOISTURE PROTECTION

Item ID	Item Description	Units	Unit Price	Quantity	Total
0710000005	Waterproofing	SF	$0.39	124840	$48,687.60
0716000015	Dampproofing	SF	$0.06	124840	$7,490.40
0725000010	Sprayed fireproofing 2 hour fire rating, Structural steel members : Columns, large (measure girth)	SF	$0.84	208643	$175,260.12
0727000005	Firestopping	SF	$0.10	284840	$28,484.00
0740000010	Performed Roofing and Siding	SF	$0.36	76197	$27,430.92
0750000010	Membrane Roofing and Flashing	SF	$2.90	160000	$464,000.00
0757000010	Traffic Coatings	SF	$1.15	124840	$143,566.00
0770000010	Roof Specialties and Accessories	lps	$1,000.00	1	$1,000.00
0790000010	Sealants	SF	$0.09	284840	$25,635.60

Sub-Total Division 07 : $921,554.64

DIVISION 08 :DOORS AND WINDOWS

Item ID	Item Description	Units	Unit Price	Quantity	Total
0810000005	Metals Doors and Frames	SF	$0.10	284840	$28,484.00
0820000005	Wood Doors and Frames	SF	$2.60	76197	$198,112.20
0830000005	Special Doors	SF	$0.07	208643	$14,605.01
0850000005	Metal Windows	SF	$5.04	76197	$384,032.88
0870000010	Hardware	SF	$0.29	284840	$82,033.92
0880000005	Glazing	SF	$0.05	284840	$14,242.00
0880000007	Glazed Aluminium Railing	SF	$0.35	76197	$26,668.95
0890000005	Curtain Walls	SF	$5.01	83803	$419,853.03

Sub-Total Division 08 : $1,168,031.99

DIVISION 09 :FINISHES

Item ID	Item Description	Units	Unit Price	Quantity	Total
0925000005	Steel Stud and Drywall	SF	$4.15	284840	$1,182,086.00
0930000010	Tile	SF	$1.42	76197	$108,199.74
0968000005	Carpet	SF	$1.60	76197	$121,915.20
0990000010	Painting	SF	$0.63	284840	$179,449.20

PROJECT NAME: University Marketplace **PROJECT OWNER :** University of British Columbia **DATE :** Tuesday, February 08, 2000
PROJECT ADDRESS : Vancouver, B.C. **PROJECT AREA :** 160000 Sq.ft **TIME :** 7:08 PM

Sub-Total Division 09 : $1,591,650.14

DIVISION 10 :SPECIALTIES

Item ID	Item Description	Units	Unit Price	Quantity	Total
1040000010	Identifying Devices	SF	$0.13	76197	$9,905.61
1053000010	Awning and Canopies	SF	$0.42	83803	$35,197.26
1055000010	Postal Specialties	SF	$0.05	76197	$3,809.85
1080000010	Toilet and Bath Accessories	SF	$0.17	76197	$12,953.49
1080000015	Closet specialties	SF	$0.09	76197	$6,857.73

Sub-Total Division 10 : $68,723.94

DIVISION 11 ;EQUIPMENT

Item ID	Item Description	Units	Unit Price	Quantity	Total
1101400005	Window Washing Equipment	SF	$0.10	76197	$7,619.70
1116000000	LOADING DOCK EQUIPMENT	SF	$0.08	83803	$6,704.24
1145000010	Residential Appliances	SF	$3.88	76197	$295,644.36

Sub-Total Division 11 : $309,968.30

DIVISION 14 :CONVEYING SYSTEMS

Item ID	Item Description	Units	Unit Price	Quantity	Total
1421000030	Geared Passenger Elevator, Centre biparting, 8 floors	PR	$288,900.00	1	$288,900.00

Sub-Total Division 14 : $288,900.00

DIVISION 15 :MECHANICAL

Item ID	Item Description	Units	Unit Price	Quantity
1500000000	Mechanical	lps	$1,909,000.00	1

Sub-Total Division 15 : $1,909,000.00

DIVISION 16 : ELECTRICAL

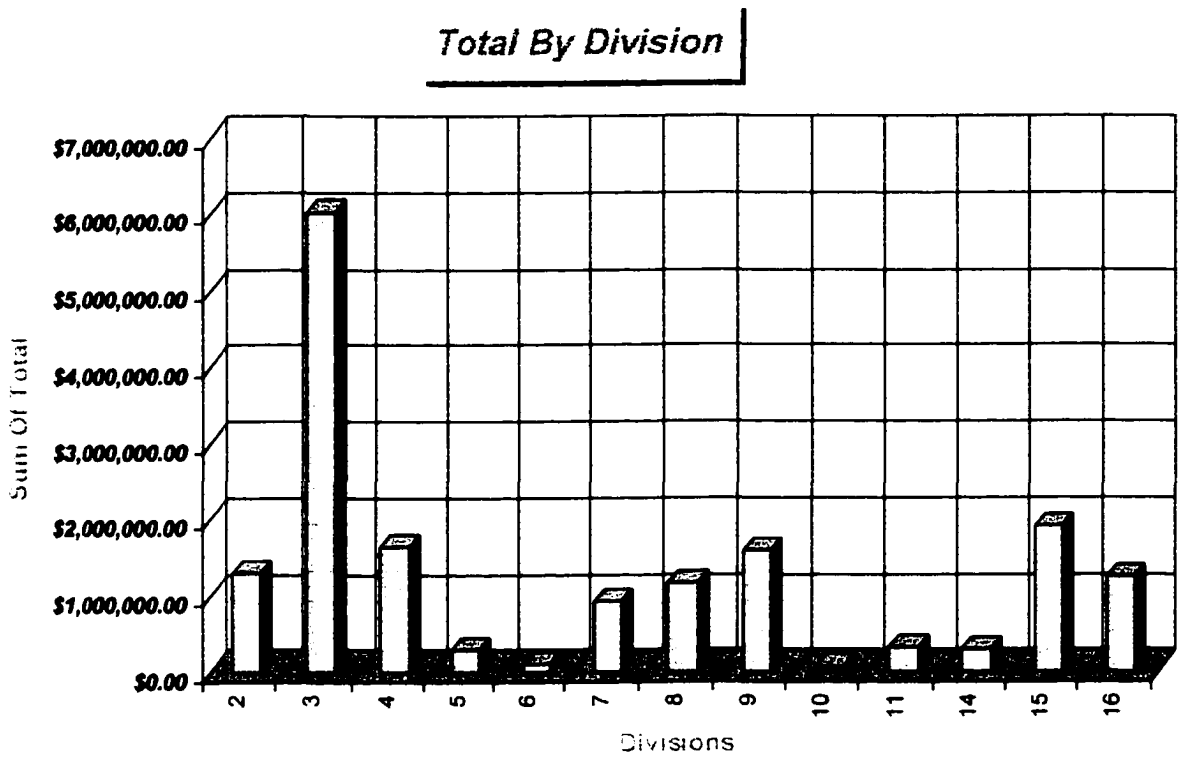
Item ID	Item Description	Units	Unit Price	Quantity	Total
1600000000	Electrical	lps	$1,250,000.00	1	$1,250,000.00

Sub-Total Division 16 : $1,250,000.00

SUB - TOTAL : $16,899,922.66

PROJECT'S CHART DISTRIBUTION BY DIVISION TOTAL

Project Name	University Marketplace	**Estimator**	Cressey Development Corp.	
Project Address	Vancouver, B.C.	**No. Of Stories**	6.00	
Owner	University of British Columbi	**Total Area**	160000.00	Sq.ft
Architect	Trilogy Development Corp.	**Date**	Tuesday, February 08, 2000	



PROJECT'S PIE DISTRIBUTION BY DIVISION TOTAL

Project Name	University Marketplace	**Estimator**	Cressey Development Corp.	
Project Address	Vancouver, B.C.	**No. Of Stories**	6	
Owner	University of British Columbia	**Total Area**	160000.00	Sq.ft
Architect	Trilogy Development Corp.	**Date**	Tuesday, February 08, 2000	

Total By Division